NAVSHIPS 900,705

INSTRUCTION BOOK

for

RADIO, TELEPHONE AND TELEGRAPH TRANSMITTING AND RECEIVING EQUIPMENT

MODELS TCS-14 and TCS-15

AIR KING PRODUCTS CO., INC.
Brooklyn 19, New York

NAVY DEPARTMENT BUREAU OF SHIPS

Contract NXsr 38314
Contract NXsr 48390
Contract NXsr 86279
Contract NXsr 91960
Contract N5sr 8595
Contract N5sr 10539

Approved 7 March 1946

LIST OF EFFECTIVE PAGES

Page Numbers	Change in Effect	Page Numbers	Change in Effect	Page Numbers	Change in Effect
TITLE PAGE	Original	6-1 to 6-2	Original		
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4-1 to 4-7	Original				
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ADDRESS: NAVY DEPARTMENT,
BUREAU OF SHIPS

Section 993-100
REFER TO FILE NO.

NAVY DEPARTMENT
BUREAU OF SHIPS
WASHINGTON 25, D. C.

21 May 1946

To: All Activities concerned with the Installation, Operation and Maintenance of the Subject Equipment.

Subj: Instruction Book for Radio Transmitting Equipment, Navy Models TCS-14/15. (NAVSHIPS 900,705)

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2. When superseded by a later edition, this publication shall be destroyed.

3. Extracts from this publication may be made to facilitate the preparation of other Navy instruction books and handbooks.

4. Copies of this publication may be obtained from the nearest electronics officer.

E. L. COCHRANE
Chief of Bureau

FROM BUREAU OF SHIPS, NAVY DEPARTMENT, WASHINGTON 25, D. C.

RECORD OF CORRECTIONS MADE

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CONTRACTUAL GUARANTEE

The equipment, including all parts and spare parts, except vacuum tubes, batteries, rubber and material normally consumed in operation, is guaranteed for a period of one year from the date of delivery of the equipment to and acceptance by the Government with the understanding that all such items found to be defective as to material, workmanship or manufacture will be repaired or replaced, f.o.b. any point within the continental limits of the United States designated by the Government, without delay and at no expense to the Government; provided that such guarantee will not obligate the Contractor to make repair or replacement of any such defective items unless the defect appears within the aforementioned period and the Contractor is notified thereof in writing within a reasonable time and the defect is not the result of normal expected shelf life deterioration.

To the extent the equipment, including all parts and spare parts, as defined above, is of the Contractor's design or is of a design selected by the Contractor, it is also guaranteed, subject to the foregoing conditions, against defects in design with the understanding that if ten percent (10%) or more of any such said items, but not less than two of any such item, of the total quantity comprising such item furnished under the contract, are found to be defective as to design, such item will be conclusively presumed to be of defective design and subject to one hundred percent (100%) correction or replacement by a suitably redesigned item.

All such defective items will be subject to ultimate return to the Contractor. In view of the fact that normal activities of the Naval Service may result in the use of equipment in such remote portions of the world or under such conditions as to preclude the return of the defective items for repair or replacement without jeopardizing the integrity of Naval communications, the exigencies of the Service, therefore, may necessitate expeditious repair of such items in order to prevent extended interruption of communications. In such cases the return of the defective items for examination by the Contractor prior to repair or replacement will not be mandatory. The report of a responsible authority, including details of the conditions surrounding the failure will be acceptable as a basis for affecting expeditious adjustment under the provisions of this contractual guarantee.

The above one year period will not include any portion of time the equipment fails to perform satisfactorily due to any such defects, and any items repaired or replaced by the Contractor will be guaranteed anew under this provision.

INSTALLATION RECORD

Contract No.	Date of Contract:	Contract No.	Date of Contract:
NXsr 38314	Sept. 23, 1943	NXsr 91960	Mar. 1, 1945
NXsr 48390	Feb. 14, 1944	N5sr 8595	June 27, 1945
NXsr 86279	Dec. 18, 1944	N5sr 10539	July 25, 1945

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

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 67 of the "Bureau of Ships Manual," or superseding instructions.

ORDERING PARTS

All requests or requisitions for replacement material should include the following data:

1. Equipment model designation.
2. Name of part and complete description.
3. Manufacturer's designation.
4. Contractor's drawing and part number.
5. AWS, JAN, or Navy Type Designation.

THE ATTENTION OF OFFICERS AND OPERATING PERSONNEL IS DIRECTED TO CHAPTER 67 OF BUREAU OF SHIPS MANUAL OR SUPERSEDING INSTRUCTIONS ON THE SUBJECT OF RADIO-SAFETY PRECAUTIONS TO BE OBSERVED.

WARNING

THIS EQUIPMENT EMPLOYS VOLTAGES WHICH ARE DANGEROUS AND MAY BE FATAL IF CONTACTED BY OPERATING PERSONNEL. EXTREME CAUTION SHOULD BE EXERCISED WHEN WORKING WITH THE EQUIPMENT.

WHILE EVERY PRACTICABLE SAFETY PRECAUTION HAS BEEN INCORPORATED IN THIS EQUIPMENT, THE FOLLOWING RULES MUST BE STRICTLY OBSERVED:

KEEP AWAY FROM LIVE CIRCUITS

OPERATING PERSONNEL MUST AT ALL TIMES OBSERVE ALL SAFETY REGULATIONS. DO NOT CHANGE TUBES OR MAKE ADJUSTMENTS INSIDE EQUIPMENT WITH HIGH VOLTAGE SUPPLY ON. UNDER CERTAIN CONDITIONS DANGEROUS POTENTIALS MAY EXIST IN CIRCUITS WITH POWER CONTROLS IN THE "OFF" POSITION DUE TO CHARGES RETAINED BY CAPACITORS. TO AVOID CASUALTIES ALWAYS REMOVE POWER AND DISCHARGE AND GROUND CIRCUITS PRIOR TO TOUCHING THEM.

DON'T SERVICE OR ADJUST ALONE

UNDER NO CIRCUMSTANCES SHOULD ANY PERSON REACH WITHIN OR ENTER THE ENCLOSURE FOR THE PURPOSE OF SERVICING OR ADJUSTING THE EQUIPMENT WITHOUT THE IMMEDIATE PRESENCE OR ASSISTANCE OF ANOTHER PERSON CAPABLE OF RENDERING AID.

DON'T TAMPER WITH INTERLOCKS

DO NOT DEPEND UPON DOOR SWITCHES OR INTERLOCKS FOR PROTECTION BUT ALWAYS SHUT DOWN MOTOR GENERATORS OR OTHER POWER EQUIPMENT. UNDER NO CIRCUMSTANCES SHOULD ANY ACCESS GATE, DOOR OR SAFETY INTERLOCK SWITCH BE REMOVED, SHORT CIRCUITED, OR TAMPERED WITH IN ANY WAY, BY OTHER THAN AUTHORIZED MAINTENANCE PERSONNEL, NOR SHOULD RELIANCE BE PLACED UPON THE INTERLOCK SWITCHES FOR REMOVING VOLTAGES FROM THE EQUIPMENT.

RESUSCITATION

AN APPROVED POSTER ILLUSTRATING THE RULES FOR RESUSCITATION BY THE PRONE PRESSURE METHOD SHALL BE PROMINENTLY DISPLAYED IN EACH RADIO, RADAR OR SONAR ENCLOSURE. POSTERS MAY BE OBTAINED UPON REQUEST TO THE BUREAU OF MEDICINE AND SURGERY.

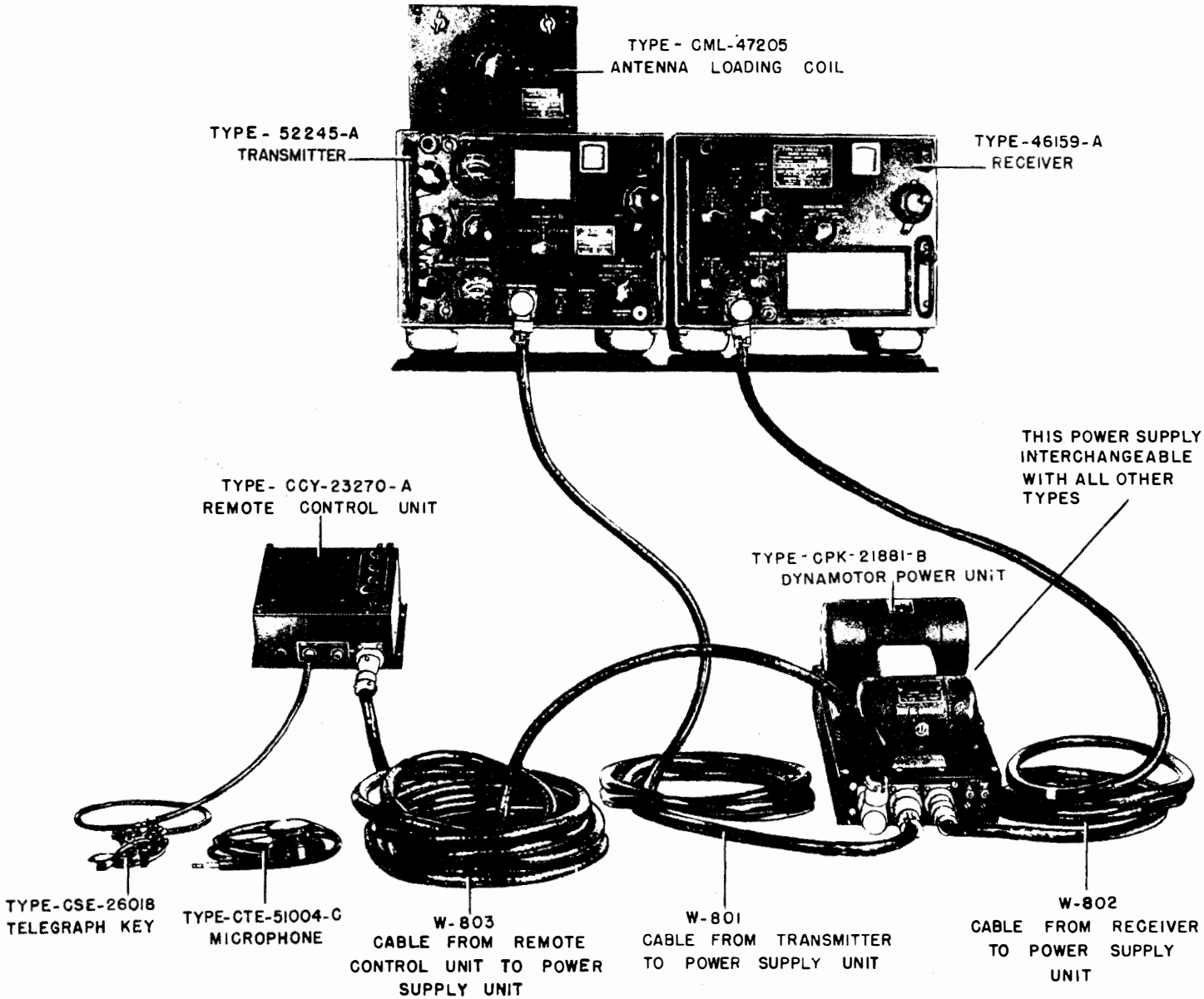


Figure 1-1 Complete TCS Equipment

SECTON I—GENERAL DESCRIPTION

1. MODELS COVERED.

This instruction book covers Navy Models TCS-14 and TCS-15. Five types of power supplies are included and are interchangeable for both TCS equipment models. One power supply only is supplied with each equipment.

2. GENERAL.

The TCS Radio Equipment is a complete radio transmitting and receiving installation. It is designed for use in mobile and portable services: motor boats, motor cars, trucks, ambulances, tanks, and in other services where severe vibration and shock may be encountered.

The parts of each major unit are securely mounted in a cabinet constructed of cold-rolled sheet steel. These cabinets are finished on the inside with dull black lacquer and on the outside with black wrinkle enamel. The front panels are made of zinc sheet with a chemical mat finish. All parts of the cabinet are adequately reinforced to withstand the vibration and shock incident to normal service.

3. TRANSMITTER.

(*See figure 1-2.*)

The Type-52245-A Transmitter employs an oscillator-buffer-final amplifier circuit with provisions for the emission of either CW or voice-amplitude-modulated signals. The frequency range, 1.5 megacycles to 12 mego-

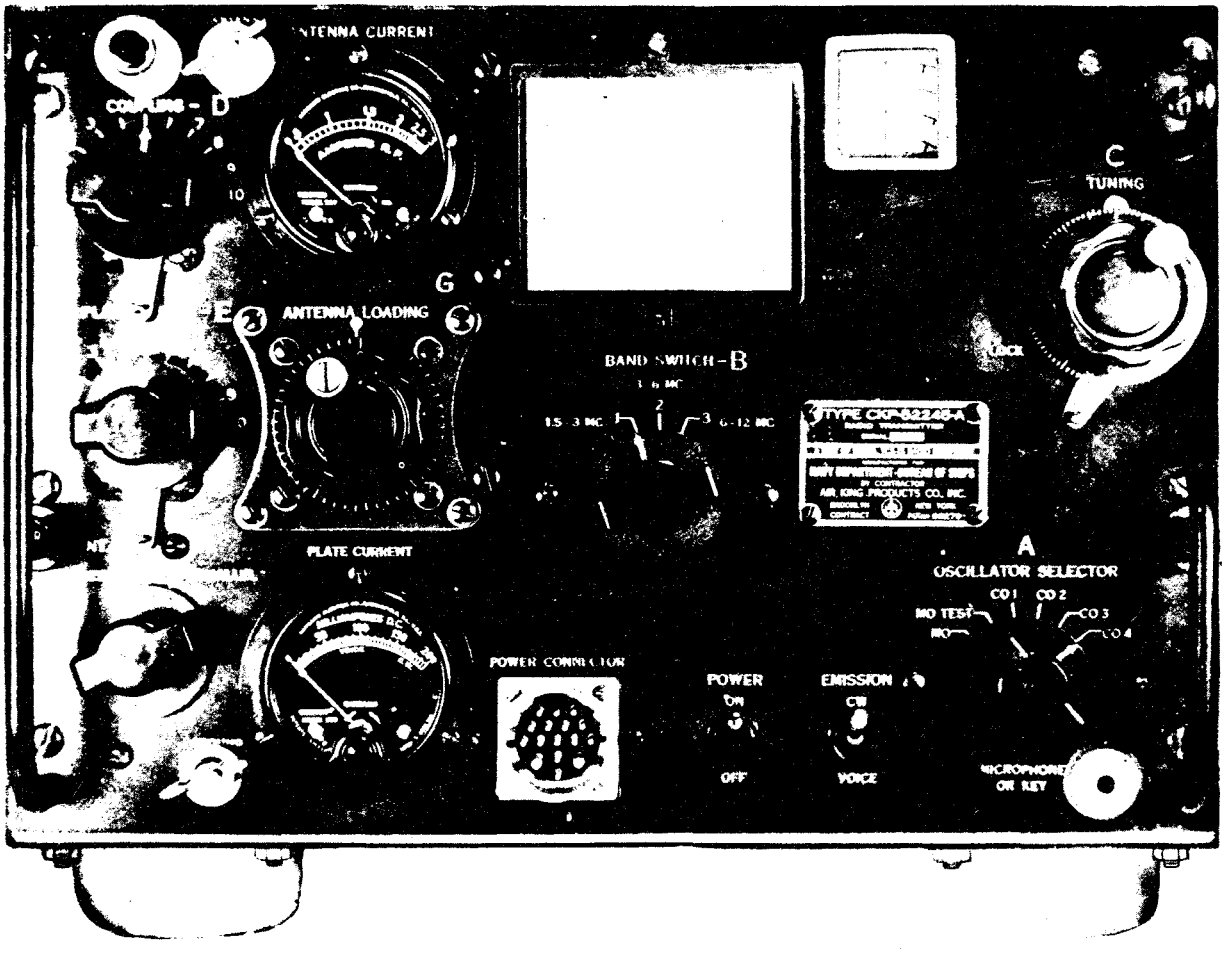


Figure 1-2 Transmitter Type -52245-A. Front Perspective View Showing Cabinet and Shock Mounts

cycles, is covered in three bands.

Band 1: 1.5 Mc to 3 Mc
Band 2: 3 Mc to 6 Mc
Band 3: 6 Mc to 12 Mc

Either master-oscillator-controlled or crystal-controlled operation is available. Continuous coverage of the entire frequency range is provided by the master oscillator. When crystal-controlled operation is desired, any of the four crystals of a set may be selected at will. These crystals, all of which are ground within the range of 1.5 megacycles to 3 megacycles, may be operated on their fundamentals (Band 1) or on their second harmonics (Band 2). When the buffer-amplifier stage is operated as a frequency doubler, second-harmonic output from the crystal-controlled oscillator is frequency-doubled to provide final output in Band 3.

The transmitter is rigidly constructed to give a high degree of frequency stability under the conditions common to the types of services for which the equipment was designed. The frequency variation due to vibration of an amplitude of 1/32 inch in any plane (1/16 inch total excursion) and at a frequency of thirty cycles per second for thirty minutes will not exceed 0.02%; the variation due to changes in line-supply voltage from 10% above to 10% below the normal value will not exceed 0.01%. Increasing the humidity from normal values to 95% humidity will cause a frequency variation which will not exceed 0.10%.

The frequency response of the transmitter is uniform within plus or minus 5 db over the audio range of 300 to 3000 cycles. The audio-frequency distortion is less than 10% rms, measured with 90% modulation at 400 cycles. The residual noise level on the carrier is more than 46 db below the 100% modulation level. The audio system is capable of modulating the carrier at least 90% for voice emission. An audio input of 0.86 volt is required to modulate the carrier 90% at 400 cycles. The audio input circuit is designed to operate from a carbon microphone of approxim tely 100 ohms internal resistance. The carrier may be keyed at speeds up to 30 words per minute without objectionable chirp.

The power output, as measured at the plates of the power-output tubes with normal supply voltage, is 10 watts on voice and 25 watts on CW at all radio frequencies. The actual power delivered to the antenna, however, is dependent upon the type of antenna used. The output network of the unit is designed to operate into a single twenty-foot vertical radiator of the type known as a "whip" antenna. Approximately 60% of the above plate power is obtainable with this antenna.

For the protection of the operating personnel, the transmitter is provided with an interlock switch. When the transmitter unit is removed from its cabinet, the interlock switch opens and all power is removed from the unit.

But note that the interlock switch is by-passed and no protection furnished if switch S602 of the remote-control unit is in the "ON" position.

The transmitter is rigidly constructed to give a high degree of frequency stability under the conditions common to the types of services for which the equipment was designed. The frequency variation due to vibration of an amplitude of 1/16 inch in any plane and at a frequency of thirty cycles per second for thirty minutes will not exceed 0.05%; the variation due to changes in line supply voltage from 10% above to 10% below the normal value will not exceed 0.01%. Increasing the humidity from normal values to 95% humidity will cause a frequency variation which will not exceed 0.10%.

4. RECEIVER.

(*See figure 1-3.*)

The Type -46159-A Receiver employs a sensitive superheterodyne circuit having one stage of r-f amplification and two stages of i-f amplification to give the sensitivity and selectivity that is necessary for operation under conditions experienced in normal service.

The receiver's frequency range is the same as that of the transmitter, 1.5 megacycles to 12 megacycles, in three bands.

Band 1: 1.5 Mc to 3 Mc
Band 2: 3 Mc to 6 Mc
Band 3: 6 Mc to 12 Mc

Master-oscillator-controlled-operation is employed normally, but provision is made for the optional use of crystal control. The latter is satisfactory in Bands 1 and 2, but in Band 3 it results in somewhat reduced sensitivity.

The input circuit of the receiver unit is designed to operate efficiently from the twenty-foot vertical "whip" antenna similar to that used for the transmitter. If desired, the same antenna may be used for both units.

The receiver is of moderate sensitivity and will deliver 6 milliwatts audio power with less than 15 microvolts input on all bands. The two stages i-f amplification provide good selectivity. Receivers contain IF transformers with the following characteristics:

11 Kc wide at 6 db down
18 Kc wide at 20 db down
30 Kc wide at 40 db down

The output circuit of the receiver is designed to work into a 500-ohm load. The maximum output, measured at the output jack with a signal 30% modulated at 400 cycles being fed into the receiver at the ANTENNA terminal, is 1.4 watts. With a gain control set for 1 watt audio output the distortion is less than 5%.

The receiver requires 12 volts a.c. or d.c. at 1.4 amperes for the filaments and 225 volts d.c. at 95 milliamperes for the plates of the tubes.

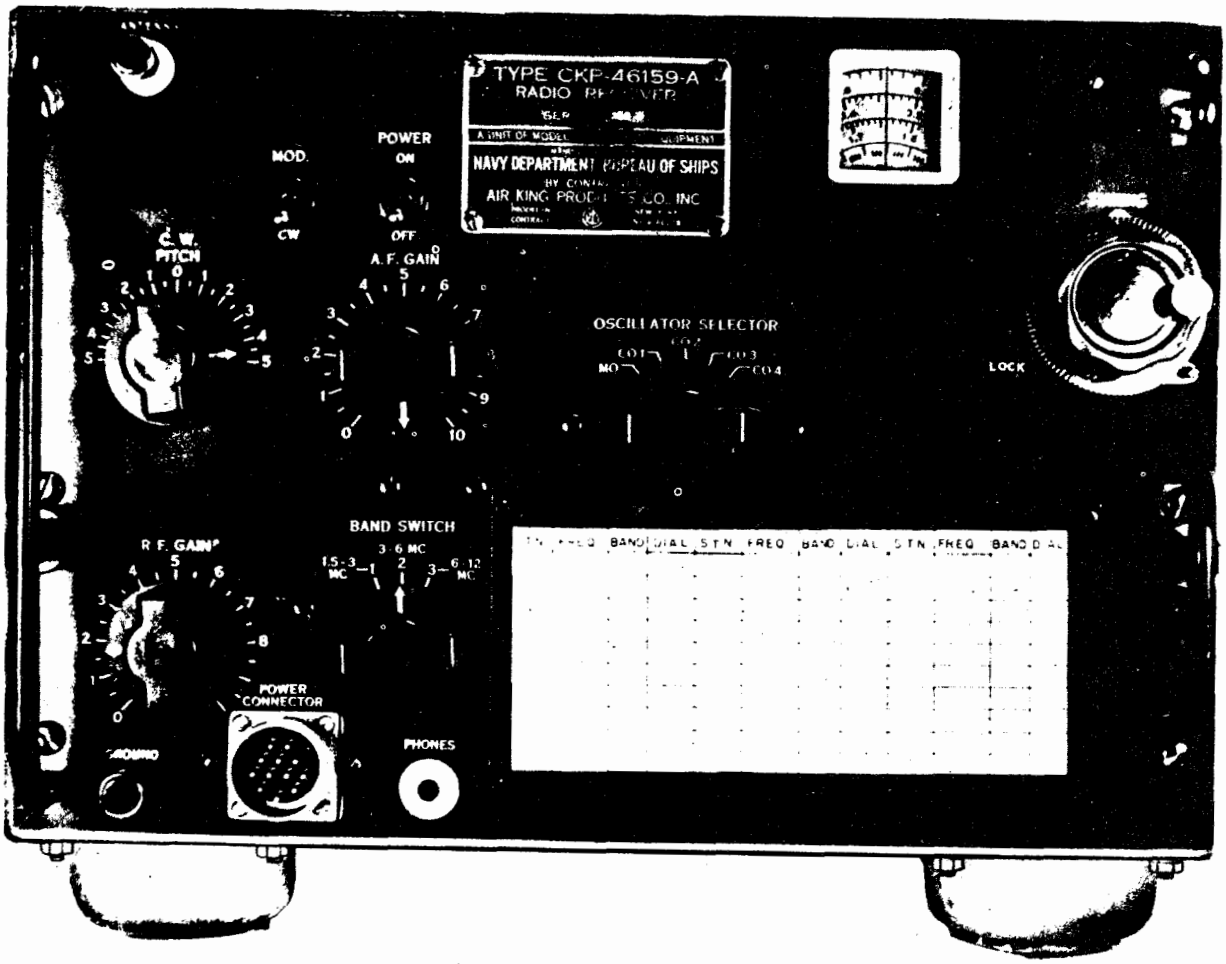


Figure 1-3 Receiver Type -46159-A. Front Perspective View Showing Cabinet and Shock Mounts

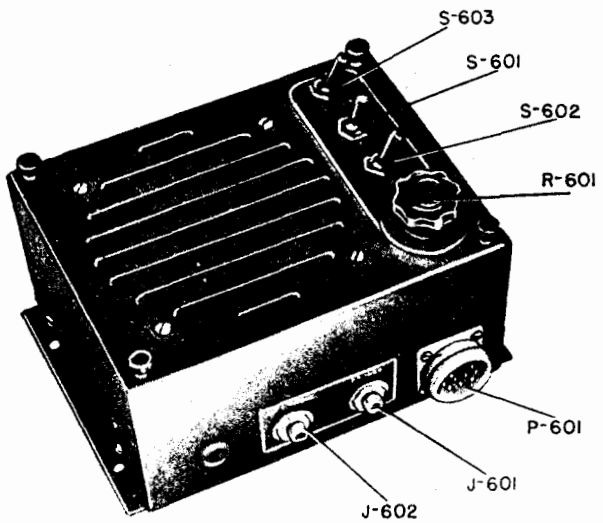


Figure 1-4 Remote Control Unit Type CCI-23270-A. Front Perspective View

5. REMOTE-CONTROL UNIT.

(*See figure 1-4.*)

The Type CCY-23270-A Remote-control Unit contains all the components necessary for power and emission control of the transmitter, and power and audio-input control to the speaker or headphones, from a remote point. The unit contains a loudspeaker that may be used for reception, or, if it is desired to use headphones, the headphones cord plug may be inserted into the PHONES jack. A switch permits the selection of either loudspeaker or phones reception.

6. ANTENNA LOADING COIL.

(*See figure 1-5.*)

The Type CML-47205 Antenna Loading Coil is essential to the satisfactory performance of the transmitter when the latter is used with the recommended twenty-foot vertical "whip" antenna in the frequency range of 1.5 megacycles to 3 megacycles (Band 1). The inductance

of this coil is variable in steps marked from "0" to "6". Step "0" (which is maximum inductance) is for the lower frequencies in this range, and step "5" (minimum inductance) is for the higher frequencies. Step "6" shorts out the loading coil, connecting the transmitter directly to the antenna lead-in.

Two wing nuts are provided to insert the coil in series with the lead-in to the transmitting antenna and a binding post (marked with "G") provides a means for grounding the metal cabinet in which the coil is housed.

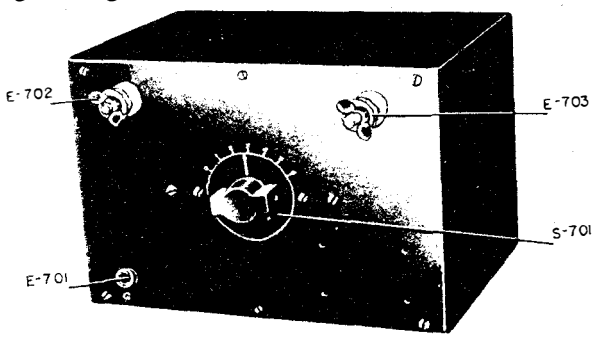


Figure 1-5 Antenna Loading Coil Type CML-47205. Front Perspective View

7. POWER SUPPLIES.

a. The Type CKP-21881-B Power Supply (figure 1-6) consists of a dual dynamotor unit operating from a 12-volt d-c source of power. One dynamotor furnishes 425-volt direct current for the high-voltage stages of the transmitter; the other furnishes 225-volt direct current for the low-voltage stages of the transmitter and for the operation of the receiver. Both circuits employ ripple-filter systems to reduce the ripple voltage to a negligible amount. Transmitter and receiver tube filaments and the relays are supplied from the same source of power as the dynamotors (batteries or other 12-volt d-c source.)

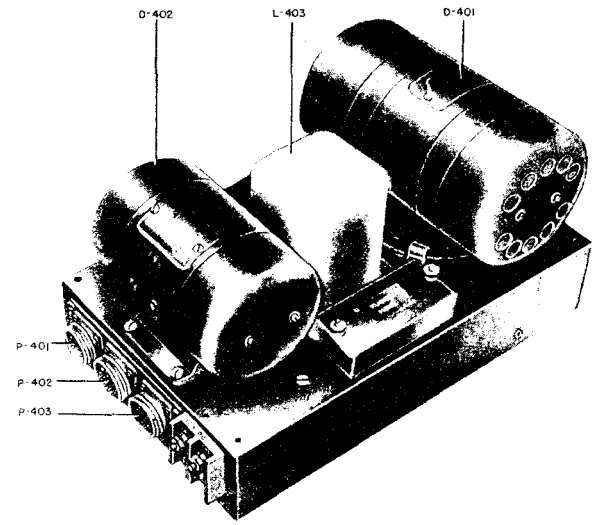


Figure 1-6 Dual Dynamotor Power Unit Type -21881-B. Front Perspective View

b. The Type CKP-20309 Power Unit (figure 1-7) is designed for use with either 115v 50/60 cycle or 230 volts 50/60 cycles a-c simply by changing the position of a toggle switch. This unit utilizes two full wave vacuum tube rectifier systems and a dry disc rectifier to furnish the necessary voltages for operation of the transmitter and receiver.

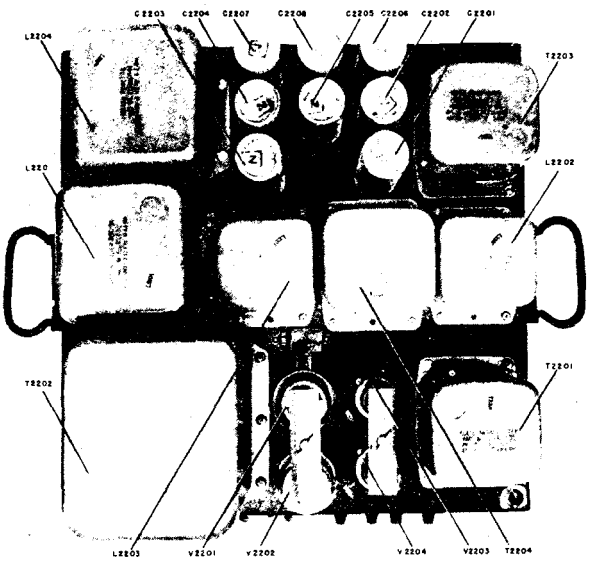


Figure 1-7 Rectifier Power Unit Type -20309. Top View

c. The Type CKP-211330-B Single Machine Dynamotor Power Unit (figure 1-8) consists of a multiple winding dynamotor capable of operating from either a 12v or a 24v d-c source simply by changing the position of a plug located within the unit chassis.

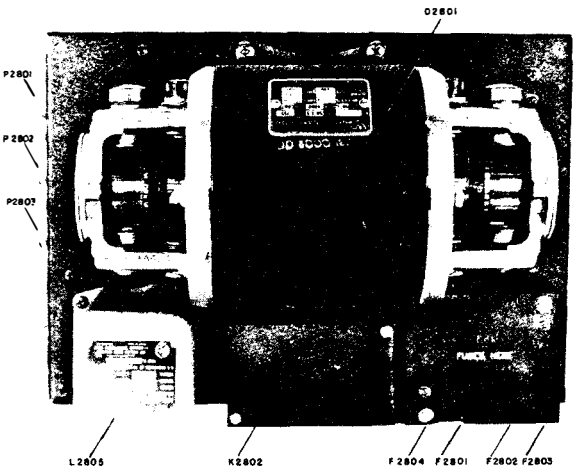


Figure 1-8 Single Dynamotor Power Unit Type -211330-B. Top View

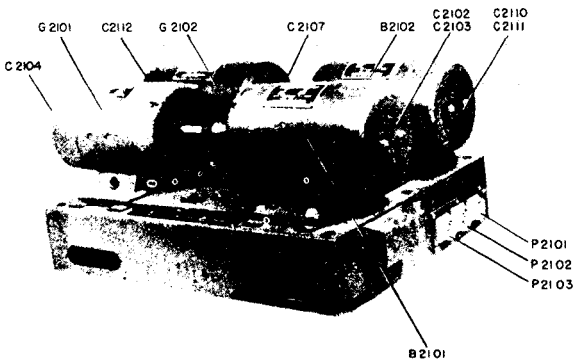


Figure 1-9 Motor Generator Power Unit Type -211100, and -21827-A. Front Perspective View

d. The Type CKP-211100 Power Unit (figure 1-9) utilizes two motors and two generators to supply the voltage necessary for the operation of the transmitter and receiver. It is designed to operate from a 115 volt d.c. power source.

e. The Type CKP-21827-A Power Unit (figure 1-9) utilizes two motors and two generators to supply the voltage necessary for the operation of the transmitter and receiver. It is designed to operate from a 230 volt d.c. power source.

Both motor generator power units may be operated from either 115 or 230 volts by changing the motors. Symbol numbers 2100-2199 apply to Type CKP-211100; symbol numbers 2300-2399 apply to Type CKP-21827-A. Figure 1-9 may be used for both.

8. INTERCONNECTING CABLES.

A complete set of vinylite-covered shielded cables is furnished to interconnect the various units for the complete installation. The transmitter cable consists of eleven conductors and is used between the transmitter and the power-supply unit. It is eleven feet long and is fitted with a shielded 16-terminal female locking-type plug on each end.

The receiver cable consists of seven conductors and is used between the receiver and the power-supply unit. It is ten feet long and is fitted with a shielded 12-terminal female locking-type plug on each end.

The control cable consists of seven conductors and is used between the remote-control and the power-supply units. It is twenty feet long and is fitted with a shielded 9-terminal female locking-type plug on each end.

The plugs at the two ends of each cable are alike, except that one is right-angled and the other straight. Thus each cable may be reversed end-for-end, if desired, for convenience in setting up an installation.

Two #6 Allen-head set screws (four to a cable) hold the cable clamps firmly to the cables. These set screws are covered with glyptal.

9. TELEGRAPH KEY.

The Type CSE-26018 Telegraph Key is the standard hand type equipped with a shorting lever. It has a lacquered brass finish and platinor points. It is accompanied by a cord-and-plug assembly including a 34-inch 2-conductor cord and 3-circuit plug that may be inserted into the MICROPHONE-OR-KEY jack on either the transmitter panel or the remote-control unit.

The red band appearing on the plug or its cord and the red washer of the jack indicates that the circuit employed is the type "A" or "Red" connection. This circuit is shown in figure 2-44.

10. MICROPHONES.

Two Type CTE-51004-C Microphones are supplied with the equipment. Each microphone is of the single-button carbon type and is equipped with a "push-to-talk" switch for the operation of the transmitter relays. Each microphone has an internal resistance of approximately 100 ohms and is accompanied by a cord-and-plug assembly including a 51-inch 3-conductor cord and a 3-circuit plug that may be inserted into the MICROPHONE-OR-KEY jack on either the transmitter panel or the remote-control unit. This microphone is designed for close talking and its frequency characteristics and construction are such as to give excellent articulation on voice while reducing the effects of surrounding noise. The plug and jack circuit is the type "A" or "Red" connection.

11. TOOLS.

A set of two Bristo wrenches (one No. 6 and the other No. 10) is mounted on the inside rear wall of the receiver unit. These wrenches are used for removing or tightening control knobs, etc. A similar set is mounted on the middle partition inside the transmitter unit.

12. CRYSTALS.

As previously indicated, crystals are supplied with some, but not all, equipments. The characteristics of these crystals are as follows:

Temperature coefficient—frequency variations are not to exceed 3 cycles per megacycle per degree Centigrade. Not to exceed 0.01% due to variations of the ambient temperature between 0°C (32°F) and 50°C (122°F).

Humidity—frequency variations not to exceed 0.001% during variations of humidity between 30% and 95%.

Line voltage—frequency variations not to exceed 0.001% during ±10% variations in line voltage.

Accuracy—frequency variations not to exceed ±0.05% of the required frequency when checked at 25°C (77°F) and at normal operating voltages.

13. QUICK REFERENCE DATA.

Nomenclature	Radio Telephone and Telegraph Transmitting and Receiving Equipment. Navy Models TCS-14 and TCS-15
Contract numbers and dates	TCS-14 NXsr 38314 Sept. 23, 1943 NXsr 48390 Feb. 14, 1944 NXsr 86279 Dec. 18, 1944 TCS-15 NXsr 91960 Mar. 1, 1945 N5sr 8595 June 27, 1945 N5sr 10539 July 25, 1945
Contractor	Air King Products Co., Inc., Brooklyn, New York.
Cognizant Naval Inspector	Inspector of Naval Material, New York, New York.
Frequency range	1.5 Mc to 12 Mc.
Type of frequency control	Master oscillator or crystal oscillator.
Type of emission	Voice-modulated or CW.
Nominal carrier output	10 watts on voice-modulated emission. 25 watts on CW emission.

14. TUBE COMPLEMENT.

One set of tubes for the complete equipment sonsists of:

Symbol Designation	Quantity	Type Number	Circuit Function	Unit Type Number
V101	1	12A6	Master Oscillator	-52245
V102	1	12A6	Crystal Oscillator	-52245
V103	1	12A6	Buffer-Doubler	-52245
V104, V105	2	1625	Power Amplifiers	-52245
V106, V107	2	1625	Modulators	-52245
V201	1	12SK7	R-F Amplifier	-46159
V202	1	12SA7	Converter	-46159
V203	1	12A6	Oscillator	-46159
V204	1	12SK7	First I-F Amplifier	-46159
V205	1	12SK7	Second I-F Amplifier	-46159
V206	1	12SQ7	Detector-BFO	-46159
V207	1	12A6	Audio Amplifier	-46159
V2201, V2202	2	5R4GY	H.V. Power Rectifier	-20309
V2203, V2204	2	6X5GT	L.V. Power Rectifier	-20309

15. EQUIPMENT.

a. EQUIPMENT SUPPLIED FOR SINGLE DYNAMOTOR POWER UNIT INSTALLATIONS

Quan. Per Equip.	Name of Unit	Navy Type Designation	Overall Dimensions (Height, Width, Depth)		Volume (Cubic Feet)		Weight (Pounds)	
			Crated	Uncrated	Crated	Uncrated	Crated	Uncrated
1	Radio Transmitter, complete with cabinet, shock mount and tubes	-52245-A	38" x 22" x 52"	11" x 13¾" x 11 13/16"	25	1.033	475	48.0
1	Radio Receiver, complete with cabinet, shock mount and tubes	-46159-A		11 1/16" x 13 13/16" x 11⅞		1.05		38.13
1	Remote Control Unit	-23270-A		4⅜" x 7⅜" x 5¾"		0.108		6.13
1	Loading Coil	-47205		6" x 8½" x 6¾"		0.194		3.75
1	Cable for connecting the receiver and power supply			10' L.				2.88
1	Cable for connecting the remote control unit and power supply			20' L.				5.25
1	Cable for connecting the transmitter and power supply			11' L.				3.13
2	Carbon Microphones with cord and plug assembly	———						ea. .05
1	Telegraph Key with cord and plug assembly	-26018						.05
1	Vertical Mounting Kit							5.0
2	Base plates for use with transmitter and receiver	———		10" x 14 7/16" x ⅝"		.052		10.0
2	Instruction Books			8¾" x 11¼" x ¾"				ea. 1.5
	Equipment Spares							
1	Single Dynamotor Power Unit*	-211330-B		9⅝" x 8 25/32" x 12 15/16"		0.63		35.00
	Power Unit Spares							

* Only one power unit is supplied with each TCS equipment.

Note: Since the equipment covered by this Instruction Book is furnished by several manufacturers, the prefix to Navy Type Designations has been omitted. Prefixes apply as follows:

Equipment built by Air King.....CKP
Equipment built by Cinaudagraph Speakers Inc.....CCY
Equipment built by Meissner Mfg. Co.....CML

b. EQUIPMENT SUPPLIED FOR DUAL DYNAMOTOR POWER UNIT INSTALLATIONS

Quan. Per Equip.	Name of Unit	Navy Type Designation	Overall Dimensions (Height, Width, Depth)		Volume (Cubic Feet)		Weight (Pounds)	
			Crated	Uncrated	Crated	Uncrated	Crated	Uncrated
1	Radio Transmitter, complete with cabinet, shock mount and tubes	-52245-A	50" x 33" x 23"	11" x 13¾" x 11 13/16"	22	1.033	438	48.0
1	Radio Receiver, complete with cabinet, shock mount and tubes	-46159-A		11 1/16" x 13 13/16" x 11 7/8		1.05		38.13
1	Remote Control Unit	-23270-A		4⅜" x 7⅜" x 5¾"		0.108		6.13
1	Loading Coil	-47205		6" x 8½" x 6¾"		0.194		3.75
1	Cable for connecting the receiver and power supply			10' L.				2.88
1	Cable for connecting the remote control unit and power supply			20' L.				5.25
1	Cable for connecting the transmitter and power supply			11' L.				3.13
2	Carbon Microphones with cord and plug assembly	———						ea. .05
1	Telegraph Key with cord and plug assembly	-26018						.05
1	Vertical Mounting Kit							5.0
2	Base plates for use with transmitter and receiver	———		10" x 14 7/16" x ⅜"	———	.052		10.0
2	Instruction Books			8¾" x 11¼" x ¾"				ea. 1.5
	Equipment Spares							
1	Dual Dynamotor Power Unit*	-211881-B		7¼" x 12¾" x 7⅜"		0.408		27.0
	Power Unit Spares			13" x 23" x 16"		2.8		84.0

* Only one power unit is supplied with each TCS equipment.

c. EQUIPMENT SUPPLIED FOR RECTIFIER POWER UNIT INSTALLATIONS

Quan. Per Equip.	Name of Unit	Navy Type Designation	Overall Dimensions (Height, Width, Depth)		Volume (Cubic Feet)		Weight (Pounds)	
			Crated	Uncrated	Crated	Uncrated	Crated	Uncrated
1	Radio Transmitter, complete with cabinet, shock mount and tubes	-52245-A	48" x 35" x 22"	11" x 13¾" x 11 13/16"	24	1.033	353	48.0
1	Radio Receiver, complete with cabinet, shock mount and tubes	-46159-A		11 1/16" x 13 13/16" x 11 7/8		1.05		38.13
1	Remote Control Unit	-23270-A		4⅜" x 7⅜" x 5¾"		0.108		6.13
1	Loading Coil	-47205		6" x 8½" x 6¾"		0.194		3.75
1	Cable for connecting the receiver and power supply			10' L.				2.88
1	Cable for connecting the remote control unit and power supply			20' L.				5.25
1	Cable for connecting the transmitter and power supply			11' L.				3.13
2	Carbon Microphones with cord and plug assembly							ea. .05
1	Telegraph Key with cord and plug assembly	-26018						.05
1	Vertical Mounting Kit							5.0
2	Base plates for use with transmitter and receiver		25"x 23"x 27"	10" x 14 7/16" x ⅝"		.052		10.0
2	Instruction Books			8¾" x 11¼" x ¾"				ea. 1.5
1	Equipment Spares							
	Rectifier Power Unit*	-20309		10⅛" x 17¼" x 16"¼	8	1.698	277	93.0
	Power Unit Spares							

* Only one power unit is supplied with each TCS equipment.

d. EQUIPMENT SUPPLIED FOR MOTOR GENERATOR POWER UNIT INSTALLATIONS

Quan. Per Equip.	Name of Unit	Navy Type Designation	Overall Dimensions (Height, Width, Depth)		Volume (Cubic Feet)		Weight (Pounds)	
			Crated	Uncrated	Crated	Uncrated	Crated	Uncrated
1	Radio Transmitter, complete with cabinet, shock mount and tubes	-52245-A	28½" x 27½" x 22"	11" x 13¾" x 11 13/16"	119.7	1.033	305.0	48.0
1	Radio Receiver, complete with cabinet, shock mount and tubes	-46159-A		11 1/16" x 13 13/16" x 11 7/8		1.05		38.13
1	Remote Control Unit	-23270-A		4⅜" x 7⅜" x 5¾"		0.108		6.13
1	Loading Coil	-47205		6" x 8½" x 6¾"		0.194		3.75
1	Cable for connecting the receiver and power supply			10' L.				2.88
1	Cable for connecting the remote control unit and power supply			20' L.				5.25
1	Cable for connecting the transmitter and power supply			11' L.				3.13
2	Carbon Microphones with cord and plug assembly	———						ea. .05
1	Telegraph Key with cord and plug assembly	-26018						.05
1	Vertical Mounting Kit							5.0
2	Base plates for use with transmitter and receiver	———		10" x 14 7/16" x ⅝"	———	.052		10.0
2	Instruction Books			8¾" x 11¼" x ¾"				ea. 1.5
1	Motor-Generator Power Unit*	-211100 or -21827-A		12⅛" x 16" x 22½"		2.5		115.00
	Power Unit Spares							

* Only one power unit is supplied with each TCS equipment.

SECTION II—THEORY OF OPERATION

1. GENERAL.

The circuits employed in TCS-14 and TCS-15 radio equipment present no novel features that require extensive treatment for the man familiar with basic principles of radio apparatus. But in the application of those circuits to equipment designed for use under severe conditions, on fixed frequencies and for operation from remote control points, several interesting and important circuits have been incorporated to control the functioning of the apparatus.

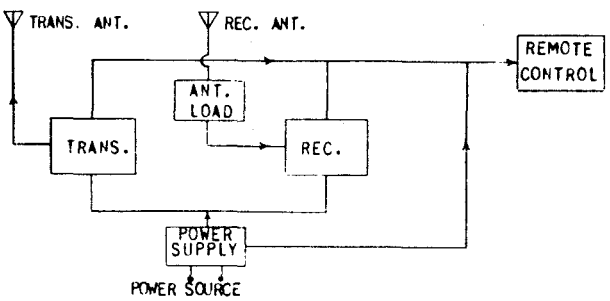


Figure 2-1 Block Diagram of Complete TCS Equipment

2. TRANSMITTER CIRCUITS.

Note

The names of the controls, which are on the panels of the various units, will be shown in capital letters exactly as they appear on the panels. These usually will be followed by circuit symbols for the purpose of further identification. For example: TUNING capacitor C101A.

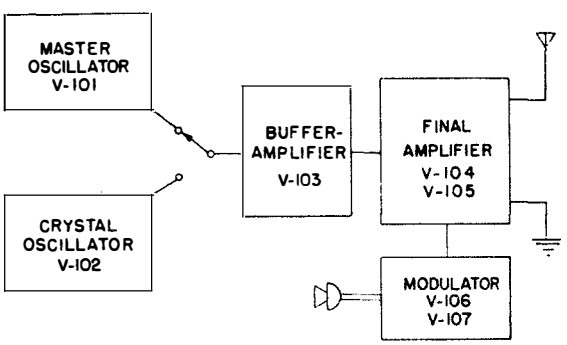


Figure 2-2 Transmitter Type—52245-A. Block Diagram

a. OSCILLATOR. (*See figures 2-5, 2-6, 2-7.*)—The master-oscillator section employs a type 12A6 tube V101 in a Hartley circuit and is continuously tunable from 1.5 Mc to 3 Mc. By adjustment of the TUNING capacitor C101A, output may be obtained on any frequency within this band.

In Band 1 (1.5 Mc to 3 Mc) and Band 2 (3 Mc to 6 Mc) the plate circuit of the master oscillator tube is untuned and the output is capacitively coupled through C106 and C108 to the grid circuit of the buffer-doubler tube V103. In both these bands the output of the oscillator is within the range of 1.5 Mc to 3 Mc. In Band 3 (6 Mc to 12 Mc), however, a tank circuit (see figure 2-3) consisting of L103, C107, and C101B, is switched into the oscillator plate circuit and the oscillator then acts as

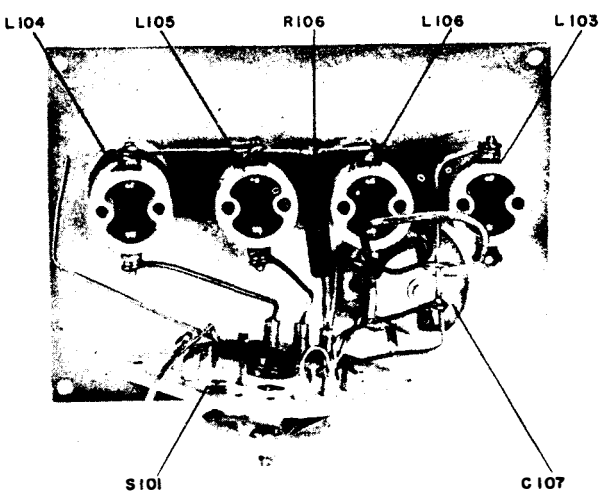


Figure 2-3 Exciter Plate Tank Assembly

a harmonic generator. Thus, output from the oscillator may be obtained in the band of frequencies from 3 Mc to 6 Mc.

The crystal-oscillator section (see figure 2-4) employs a type 12A6 tube V102. When crystal control is selected, the screen voltage is removed from the master oscillator V101 and applied to the crystal oscillator V102. As in the case of the master-oscillator circuit, when the BAND SWITCH S101 is rotated to Band 3 (6 Mc to 12 Mc), the crystal oscillator operates as a harmonic generator, producing an output on the second harmonic frequency of the crystal in use.

b. BUFFER AMPLIFIER. (*See figure 2-5.*)—Tube V103 is a type 12A6 that acts as a buffer amplifier, with or without frequency doubling. The grid circuit is capacitively coupled through C106 and C108 to the plate circuit of the oscillator. Combination grid-leak and cathode bias is employed. When operating in Band 1, V103 acts as a straight amplifier. In Bands 2 and 3, V103 acts as a buffer-doubler. The BAND SWITCH S101A selects the proper inductor, and the plate circuit is tuned to the

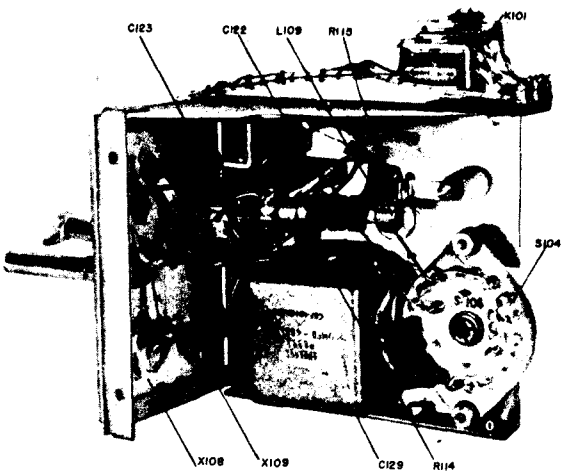


Figure 2-4 Crystal Bracket Assembly, Bottom View

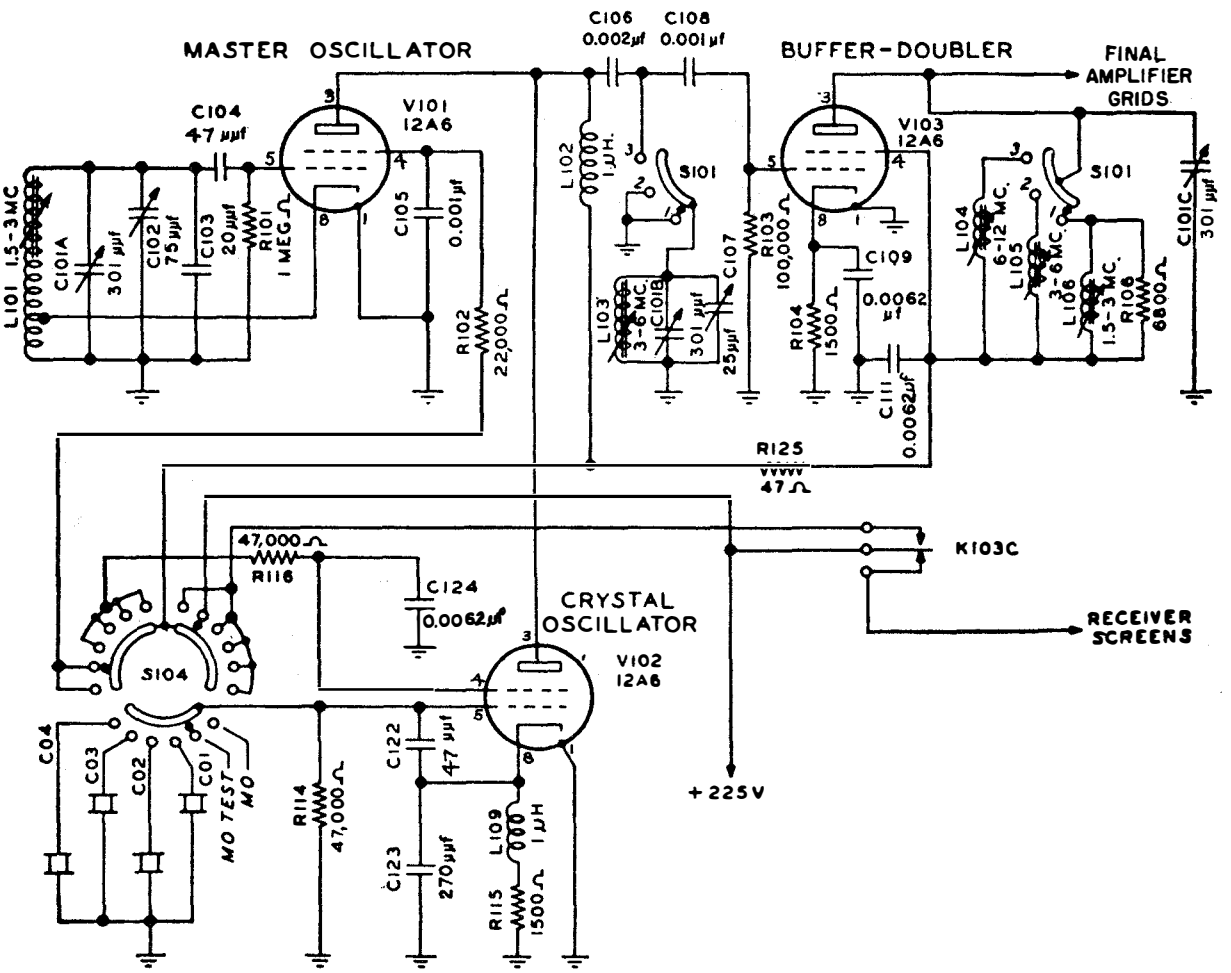


Figure 2-5 Transmitter R-F Exciter Circuit

proper frequency by the adjustment of the TUNING capacitor C101C.

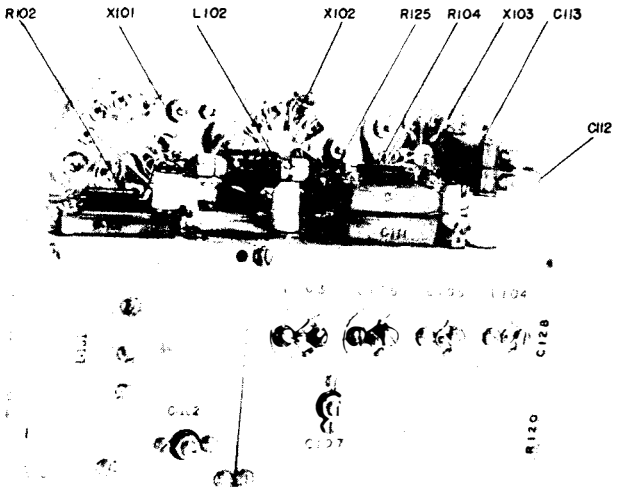


Figure 2-6 Master Oscillator Assembly, Bottom View

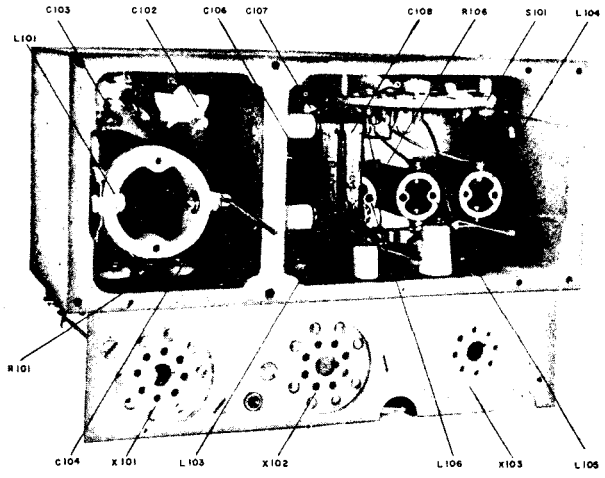


Figure 2-7 Master Oscillator Assembly, Top View

c. FINAL AMPLIFIER. (*See figure* 2-8.)—The final amplifier employs two type 1625 tubes V104 and V105 operating as Class-C amplifiers in a parallel-connected circuit. Grid resistors R107 and R112 supply the necessary bias. Both tubes are used in CW, but only one in VOICE transmission. When the VOICE-CW switch S105 is in the "VOICE" position, only V104 is operative; V105 is disabled by an open filament circuit and a high resistance R113 in its cathode circuit. The output stage operates as a straight amplifier on all frequencies. A direct-current potential of approximately 400 volts is applied to the plates of the tubes. Screen voltage is obtained from the dropping resistors R108, R109, R110, and R111 in the high-voltage circuit.

Full power output to the antenna may be obtained by closing the circuit of the MICROPHONE-OR-KEY jack J101. Voltage is thus applied to the plates of all the tubes in the circuit. When the OSCILLATOR SELECTOR switch S104 is rotated to the "MO TEST" position, voltage is applied to the plates of the oscillator and buffer tubes only without the necessity for closing the circuit of

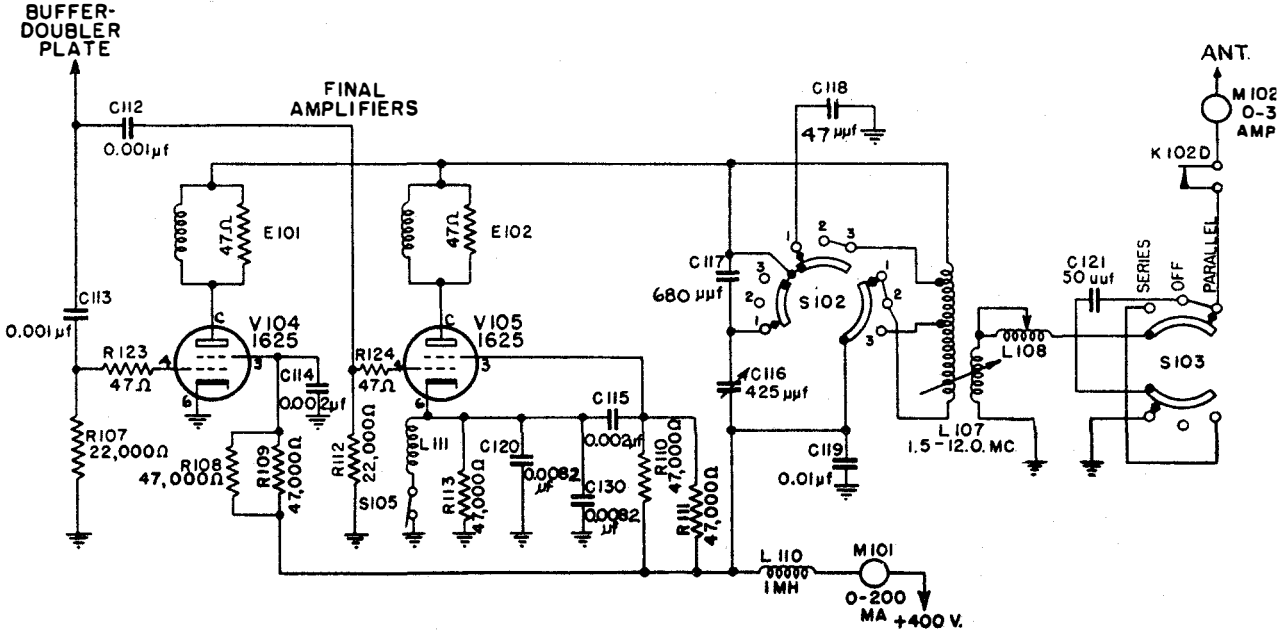


Figure 2-8 Transmitter Final-Amplifier and Antenna-Coupling Circuits

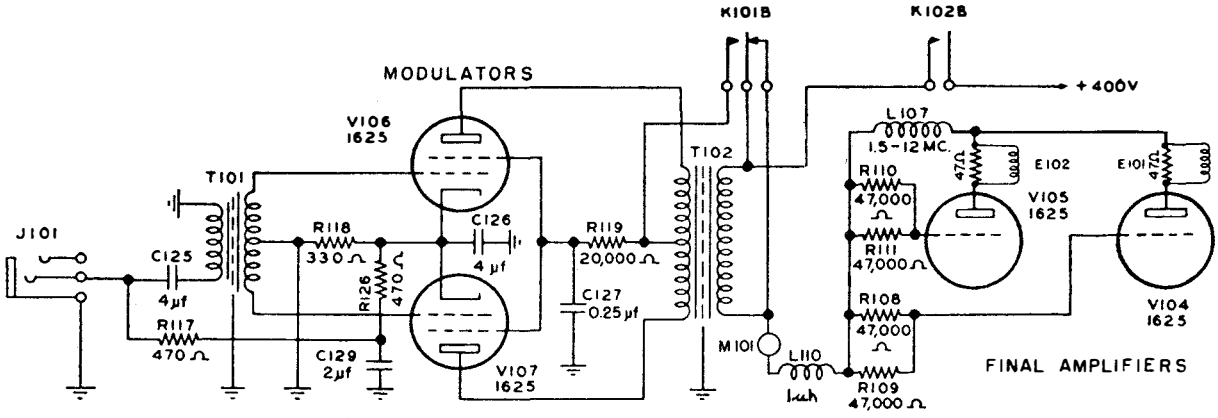


Figure 2-9 Transmitter Modulator Circuit

the MICROPHONE-OR-KEY jack. When so operated, the frequency of the transmitter may be checked.

d. MODULATION SYSTEM. (*See figure 2-9.*)—The modulation system employs two type 1625 tubes V106 and V107 in a push-pull, class-B modulator. The output of a single-button carbon microphone MI-801 is coupled to the grids of the modulator tubes by the input transformer T101. Microphone current is obtained from the cathode circuit of the modulators. Modulator bias is obtained by the use of a cathode resistor R118. Screen voltage is obtained through dropping resistor R119.

When the VOICE-CW switch S105 is placed in the "VOICE" position, the voice relay K101 is actuated, applying filament power to the modulators. When the microphone "push-to-talk" button is pressed, the combined power-and-antenna relay K102 is actuated, applying power to the plates of the modulator tubes. Both the plate and screen of the final amplifier tube V104 are modulated.

e. OUTPUT CIRCUIT. (*See figure 2-8.*)—The output circuit consists of a tank inductor L107. The PLATE TUNING capacitor C116, and the padding capacitors C117 and C118. This combination will tune over the entire frequency range of the transmitter. The taps of the tank inductor and the padding capacitors are so arranged that a favorable L/C ratio is maintained throughout. BAND SWITCH section S102, which is ganged to BAND SWITCH section S101, selects the proper tap and padding capacitor for each band of frequencies.

When the BAND SWITCH is in position 1, the entire inductance of inductor L107 is utilized, padding capacitor C117 is shorted out and padding capacitor C118 is connected in parallel with the capacitor combination, C116 and C119. When the BAND SWITCH is in position 2, a small portion of inductor L107 is shorted out, padding capacitor C118 is removed from the circuit and padding capacitor C117 is connected in series with the variable capacitor C116. When the BAND SWITCH is in position 3, a larger portion of the inductor L107 is shorted out, padding capacitor C118 is removed from the circuit and padding capacitor C117 is connected in series with the variable capacitor C116.

The combination plate-tank inductor and variable coupler L107 regulates the degree of coupling between the final amplifier tank circuit and the antenna. The variable inductor L108 and the antenna-padding capacitor C121 provide a variable means of matching the output circuit of the transmitter to the radiation system. With the ANT. COND. switch S103 in the "OFF" position, C121 is out of the circuit and L108 is connected directly to the antenna; in the "PARALLEL" position, C121 is in parallel with the antenna and ground, while L108 is still connected directly to the antenna; in the "SERIES" position, C121 is connected in series with L108 and the antenna. By selecting the proper combination, a wide range of antenna lengths can be properly matched.

Operation within the frequency range of Band 1 (1.5 Mc to 3 Mc) may be improved by connecting the external ANTENNA LOADING COIL (CML-47205) in series with the antenna lead-in.

f. FILAMENT CIRCUIT. (*See figure 2-40.*)—The filaments of the master oscillator V101, the crystal oscillator V102, the buffer-doubler V103, and the power amplifier V104 are connected in parallel and have filament power applied whenever the POWER switch S107 on the transmitter panel is placed in the "ON" position. The filament of the remaining power amplifier tube V105 is energized when the EMISSION selector switch S105 is placed in the "CW" position. The placing of the EMISSION selector switch in the "VOICE" position energizes the filaments of the modulator tubes V106 and V107 and removes filament power from the power amplifier tube V105.

3. RECEIVER CIRCUITS.

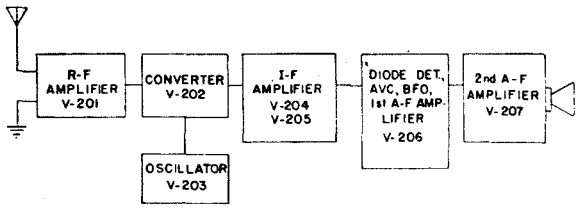


Figure 2-10 Receiver Type—46159-A. Block Diagram

The seven-tube superheterodyne receiver employs a radio-frequency amplifier V201, a converter V202, a separate oscillator V203, two intermediate-frequency amplifiers V204 and V205, a detector-amplifier V206 and an audio output tube V207.

a. R-F AMPLIFIER CIRCUIT. (*See figures 2-11, 2-12.*)—A type 12SK7 triple-grid amplifier tube is employed as the r-f amplifier V201. This r-f amplifier is coupled to the antenna through inductor L201, or L202, or L203, and the fixed capacitor C206. The BAND SWITCH section S208 selects the appropriate inductor to be used with each band of frequencies. The variable capacitor C201C tunes the r-f amplifier circuit and is one section of the three-section variable capacitor that

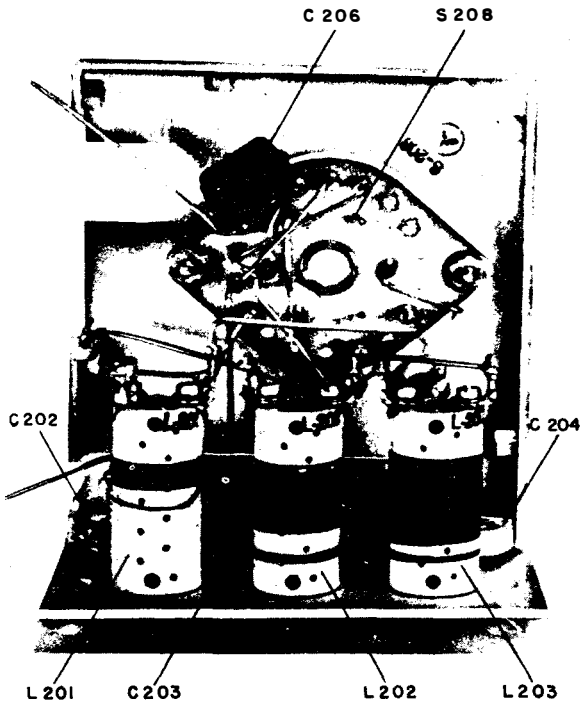


Figure 2-11 RF Assembly, Side View

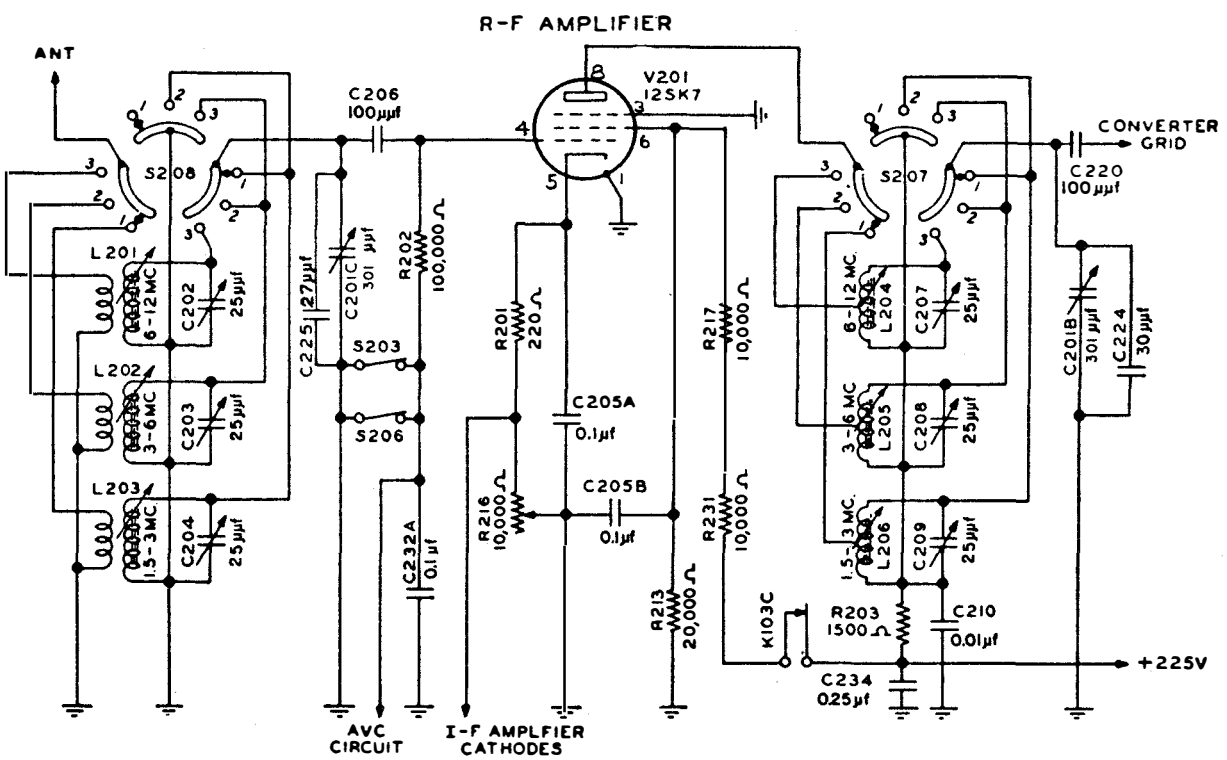


Figure 2-12 Receiver R-F Amplifier Circuit

is rotated by the TUNING control on the front panel of the receiver.

The plate of the r-f amplifier V201 is coupled to the grid of the converter tube V202 through inductor L204, or L205, or L206, and the fixed capacitor C220. The BAND SWITCH section S207 selects the appropriate inductor. Tuning is accomplished by means of the variable capacitor C201B, which is another section of the three-section variable capacitor.

The gain of this stage (as well as the two i-f stages) is controlled by varying the cathode resistance with the R. F. GAIN control R216. Screen voltage is obtained from the 225-volt supply and is dropped through a voltage dividing circuit consisting of R213, R217, and R231. AVC is supplied through resistor R202.

b. CONVERTER. (*See figures 2-13, 2-14.*)—A type 12SA7 pentagrid tube is employed as the converter V202. This tube is excited by a separate oscillator V203 except during periods of crystal-controlled operation. When crystal reception has been selected by the operation of the OSCILLATOR SELECTOR switch S202, a section of V202 operates as the oscillator to self-excite the converter. The full 225 volts are applied to the plate through the primary of the i-f transformer Z201 and screen voltage for the tube is obtained through the dropping resistor R205 in series with the plate-supply voltage. When the transmitter carrier is on, this screen voltage is removed from V202 by the operation of the carrier-control relay K103 in the transmitter. The AVC voltage is applied to the grid of the converter tube through the grid resistor R209.

c. OSCILLATOR. (*See figures 2-14, 2-15.*)—It is probable that the receiver, for most of the time, will be operated continuously tunable over its entire frequency range. For this type of operation the OSCILLATOR SELECTOR switch S202 is rotated to the "MO" position, switching in a type 12A6 beam power tube V203 as a separate oscillator to excite the converter V202.

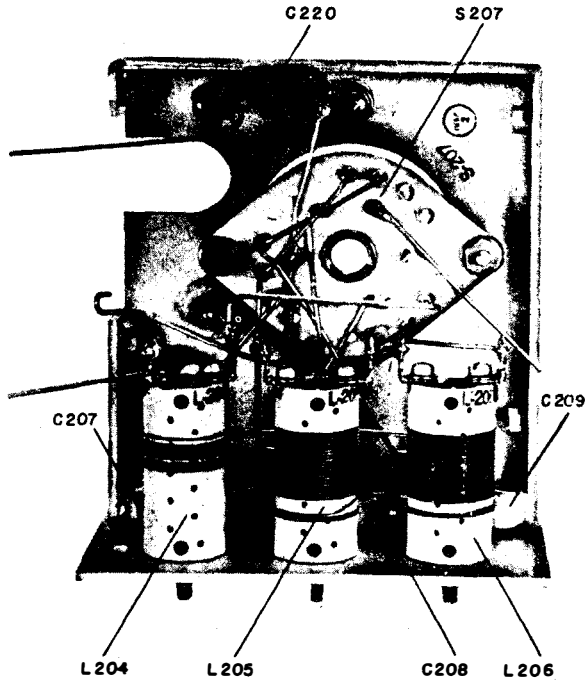


Figure 2-13 Converter Assembly, Side View

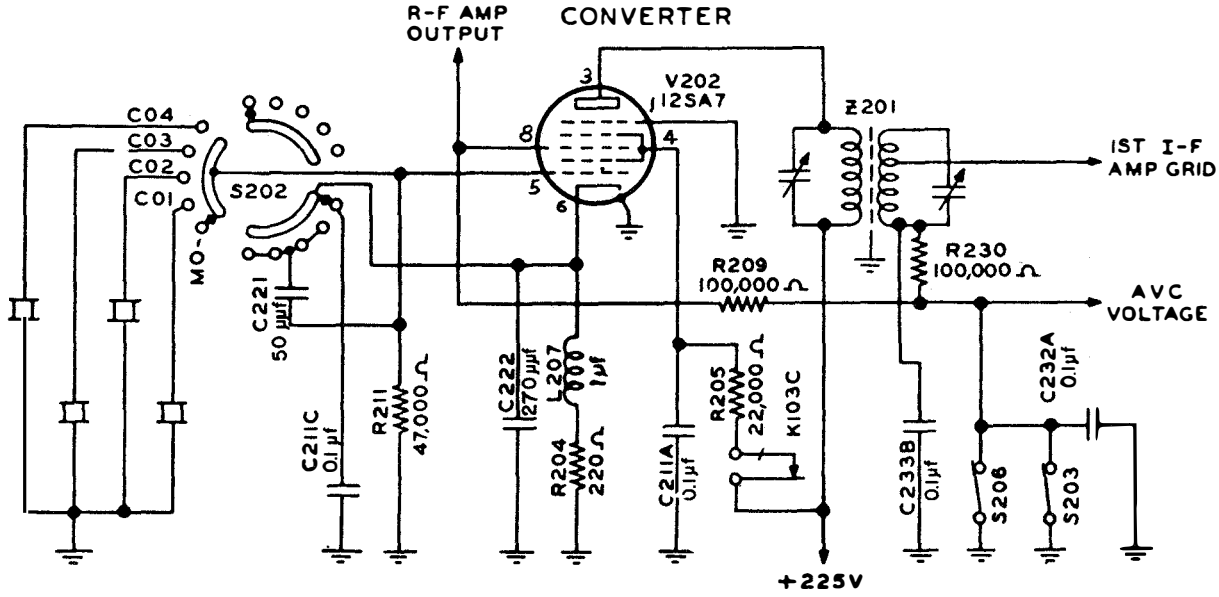


Figure 2-14 Receiver Converter Circuit

The BAND SWITCH control operates selector switch S201 which selects the proper grid coil for this oscillator. Variable capacitor C201A, still another section of the three-section variable capacitor described above, tunes the oscillator to a frequency 455 Kc (the intermediate-frequency employed here) lower than the frequncy of the signal that is being received.

However, provision is made for optional crystal-controlled operation, and in that case the triode section of V202 serves as the high-frequency oscillator, while V203 is disabled by the removal of its plate and screen power. Four positions of the OSCILLATOR SELECTOR switch S202 (C01, C02, C03 and C04), are provided for crystal-controlled operation. The crystals themselves may be ground within the range of 1.5 Mc to 3 Mc or they may be ground to higher frequencies if desired. They may be operated on the fundamental, the second harmonic, or—if necessary—the fourth harmonic, and in all cases their operating frequency should be 455 Kc above or below the desired reception frequency.

d. I-F AMPLIFIER CIRCUIT. (*See figures 2-18, 2-19, 2-20, 2-21.*)—Two type 12SK7 triple-grid amplifier tubes are utilized as intermediate-frequency amplifiers. The output of the converter tube V202 is fed into the grid of the first intermediate-frequency amplifier tube V204 through the interstage transformer Z201. The plate of the first i-f amplifier tube V204 is coupled to the grid of the second i-f amplifier tube V205 by the second interstage transformer Z202. The plate of the second i-f amplifier tube is coupled through the third i-f transformer to the diode detector of the 12SQ7.

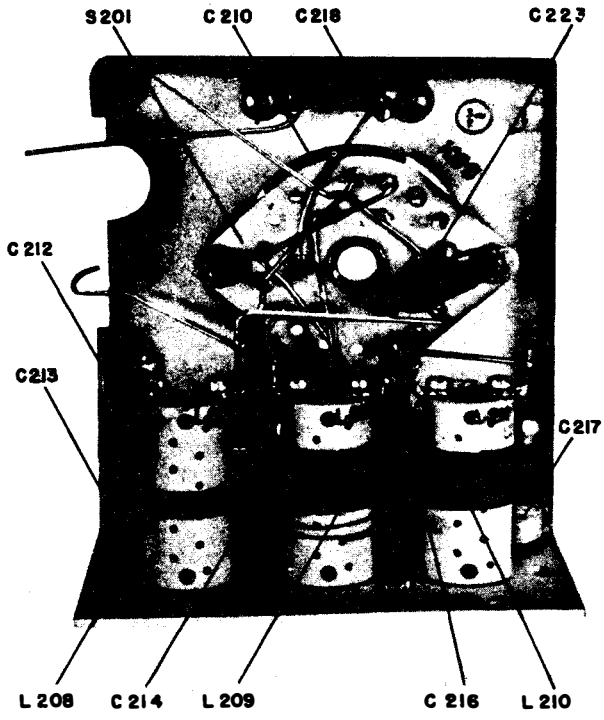


Figure 2-15 Oscillator Assembly, Side View

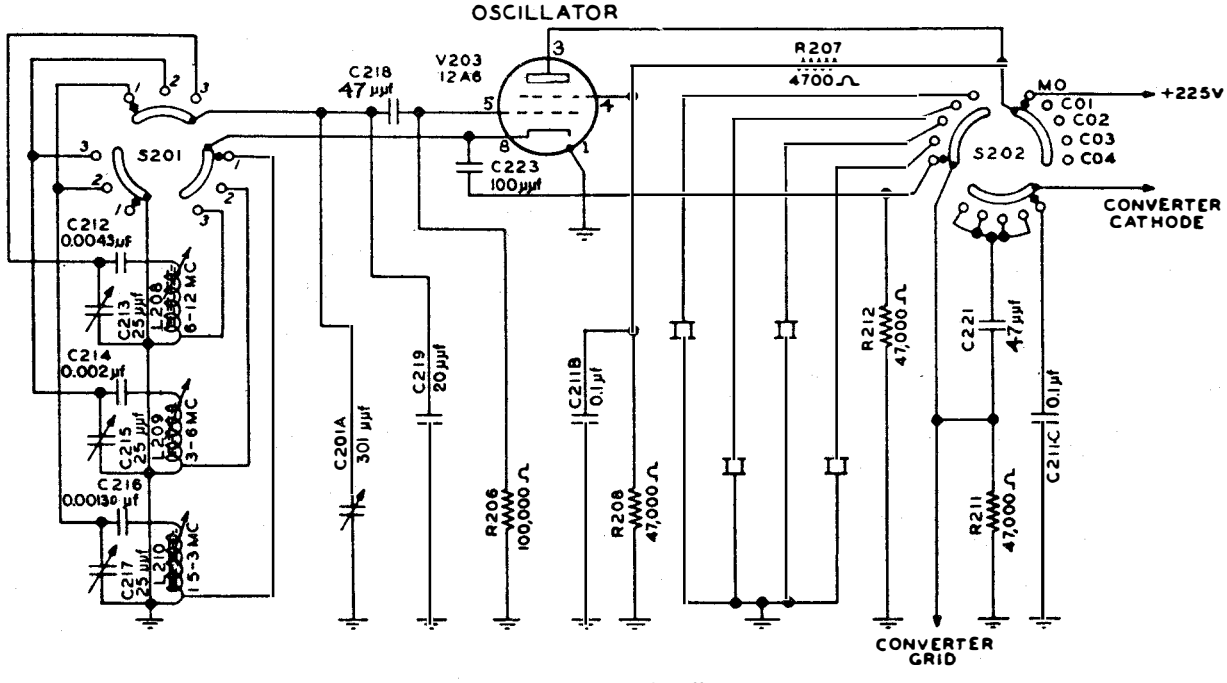


Figure 2-16 Receiver Oscillator Circuit

As is the case with the r-f amplifier V201, the gain of both i-f stages is controlled by varying the cathode resistances with the R. F. GAIN control R216. Screen voltage is obtained by connecting dropping resistors in series with the 225-volt supply. When the transmitter carrier is turned on, screen voltage is removed from the first i-f amplifier tube V204 by the operation of relay K103 in the transmitter. AVC voltage is supplied to the grid of only the first i-f amplifier V204 through resistor R230.

e. DETECTOR-BFO. (*See figures 2-17, 2-22.*)—A duplex-diode high-mu triode type 12SQ7 is employed as a combination detector and beat-frequency oscillator V206. The diode plates of this tube are connected together and coupled to the output of the second i-f amplifier by the transformer Z203.

The triode section of V206 operates as a beat-frequency oscillator. When CW reception is selected by the operation of the MOD.-CW switch S203, the impedance of the grid circuit is changed by connecting capacitor C229 across the grid resistor R221. Thus the circuit made up of cathode, grid and triode plates is made to oscillate by the feedback coupling transformer Z204. The output of the oscillator beats with the incoming signal to give an audible beat note that is fed to the grid of the audio amplifier V207. The frequency of the beat note may be varied over a small range by the operation of the CW PITCH control located on the receiver panel. This control operates the trimmer capacitor incorporated in the transformer Z204. Plate voltage for V206 is supplied from the 225-volt supply through resistor R222 and the secondary of transformer Z204.

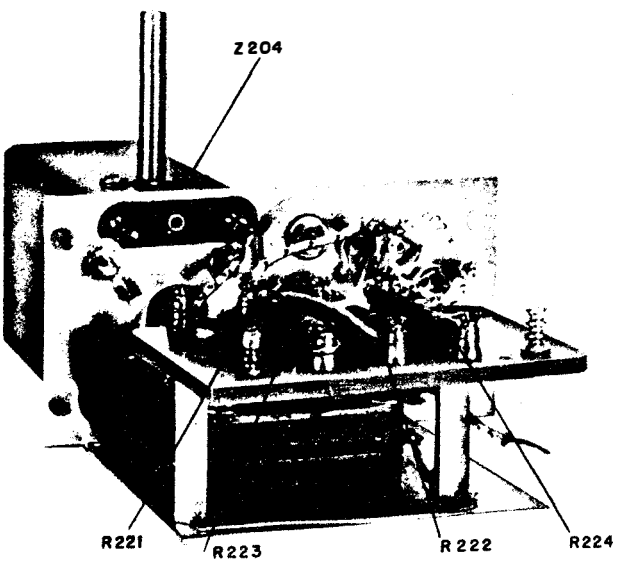


Figure 2-17 BFO Assembly, Bottom View

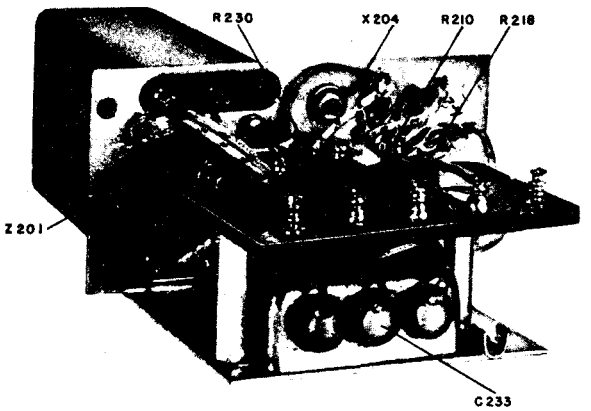


Figure 2-18 First I-F Assembly

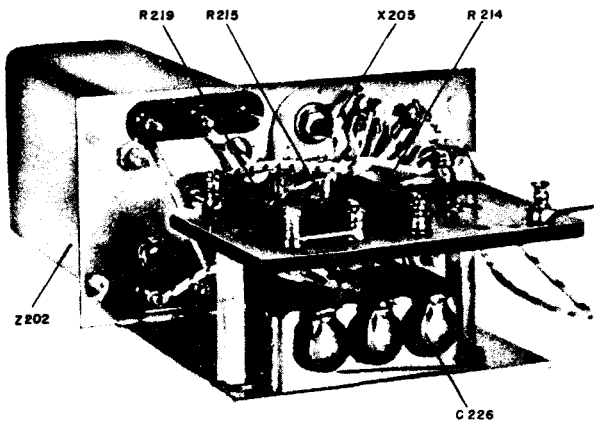


Figure 2-19 Second I-F Assembly

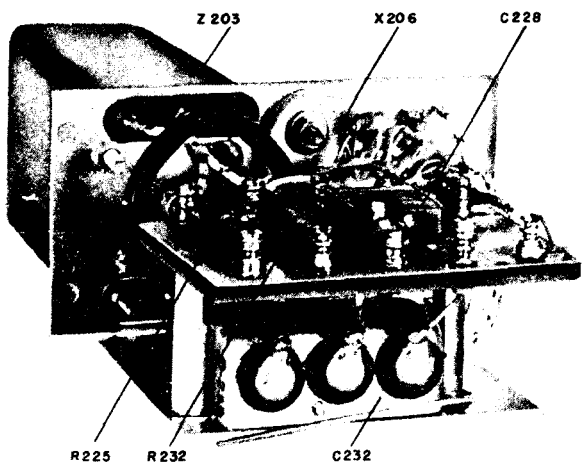


Figure 2-20 Third I-F Assembly

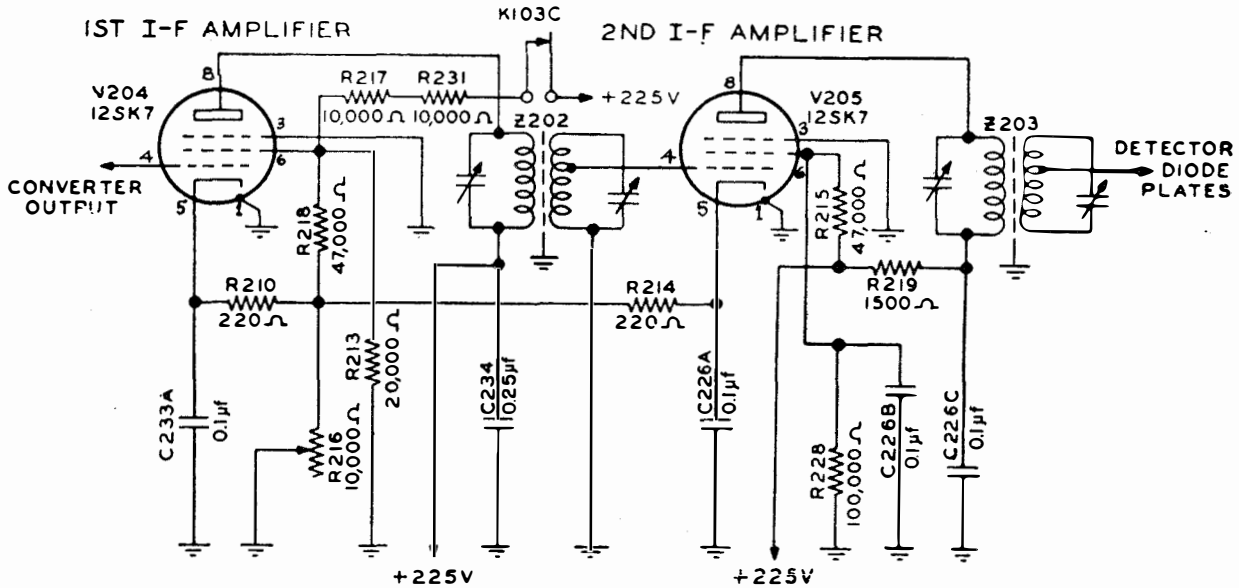


Figure 2-21 Receiver I-F Amplifier Circuit

f. AVC CIRCUIT. (*See figure 2-23.*)—The AVC voltage is applied to the grids of three tubes in the receiver, the r-f amplifier V201, the converter V202, and the first i-f amplifier V204. A portion of the negative voltage that is developed across the load resistors R225, R220 and R226 of the detector is utilized to control the output of the receiver. The filter consisting of resistor R227 and capacitor C232A filters out the audio component of the voltage that is applied to the grids. A combination of series and shunt feed is employed. The r-f amplifier and the converter tubes are shunt fed through resistors R202 and R209 and the i-f amplifier is series fed through resistor R230 and the secondary of the i-f transformer Z201.

During periods of CW reception, the AVC action is grounded out by grounding the lower ends of the grid resistors R202, R209 and R230 by operation of the MOD.-CW switch S203, or by the operation of switch S206. This latter switch, which operates in conjunction with the R. F. GAIN control R216, is opened when the

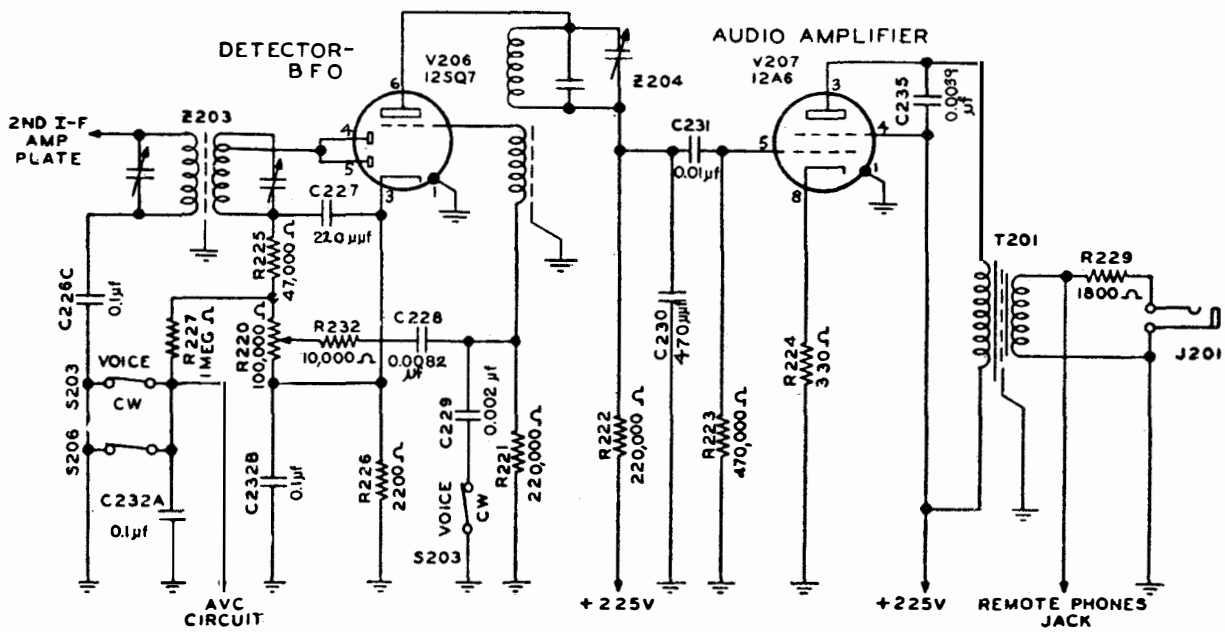


Figure 2-22 Receiver Detector—BFO and A-F Amplifier Circuits

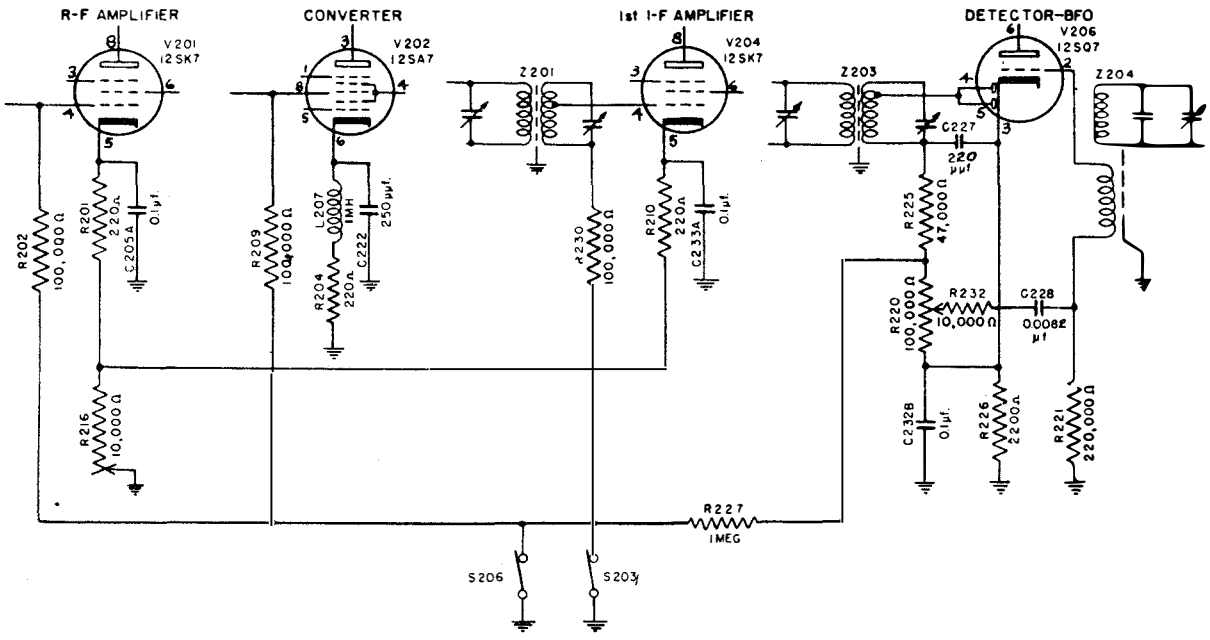


Fig. 2-23 Receiver Automatic-Volume-Control Circuit.

R. F. GAIN control is rotated to its maximum clockwise position. The AVC is now operative. When CW reception is desired, the R. F. GAIN control is advanced only partially, closing switch S206 and rendering the AVC action inoperative.

g. AUDIO AMPLIFIER. (*See figure 2-22.*)—In addition to acting as a detector, BFO and AVC tube, V206 also serves as the first a-f amplifier. The output of the diode-detector section is amplified in the triode audio-amplifier section of V206 and is resistance-coupled to the audio output tube V207, a type 12A6 beam power tube. Audio output is controlled by the A. F. GAIN control R220 which controls the input from the diode section of V206 to the grid of the triode section of the same tube. The output of V207 is coupled to PHONES jack J201 through the output transformer T201. Dropping resistor R229 is in the secondary circuit of this transformer to match the output to the headphones.

When the transmitter is operated, the receiver is disabled by removing the screen voltage from the r-f amplifier V201, the converter V202, and the first i-f amplifier V204 by shorting out the secondary of the audio output transformer T201 and by grounding the ANTENNA terminal. These disabling actions are accomplished by the operation of relay K103 in the transmitter, which is actuated when the MICROPHONE-OR-KEY circuit is closed.

4. ANTENNA.

(*See fig. 2-24.*)

Either a single antenna or seperate antennas may be used for transmission and reception. If a single antenna is to be used, this antenna should be connected to the ANTENNA post E105 of the transmitter and a wire jumper should be run between the RECEIVER post E107 of the transmitter and the ANTENNA post E201 of the receiver. No jumper is necessary if separate antennas are used.

The output network of the transmitter and the input circuit of the receiver are designed to satisfactorily match a twenty-foot vertical antenna of the type known as the "whip" or "fishpole" antenna. However, if the transmitter is to be operated in the frequency range 1.5 Mc to 3 Mc, it is desirable to connect the Type CML-47205 Antenna Loading Coil Unit in series with the antenna to permit a better matching of the transmitter output network to the vertical radiator. This inductor is then a part of the antenna coupling network and should be mounted as close to the transmitter as possible to keep r-f losses down to a minimum.

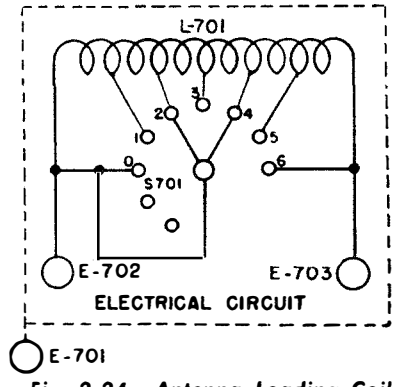


Fig. 2-24 Antenna Loading Coil Schematic Diagram

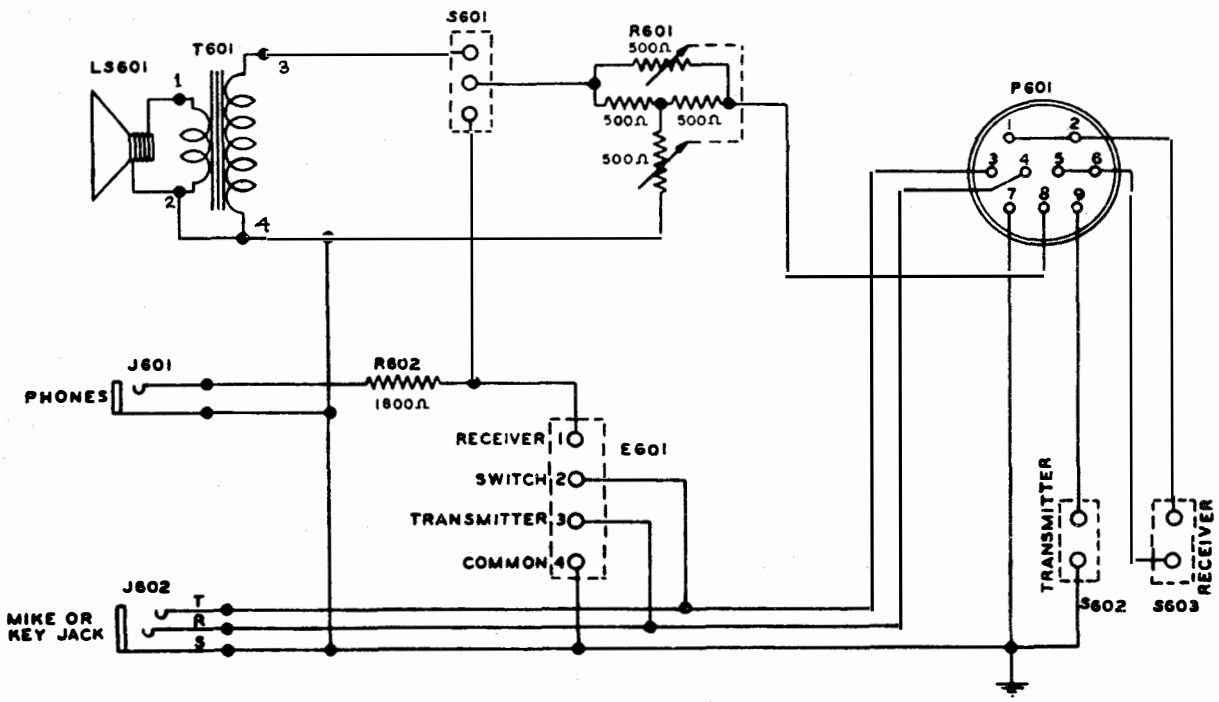


Fig. 2-25 Remote-Control Unit Type CCY-23270-A—Schematic Diagram

5. REMOTE-CONTROL CIRCUITS.

(See figures 2-25, 2-26.)

The Type CCY-23270-A Remote-Control Unit enables the TCS equipment to be operated from a remote point (up to twenty feet—the length of the cable connecting the remote-control and power-supply units). The remote-control unit contains the switches and controls necessary for the operation of both the transmitter and the receiver.

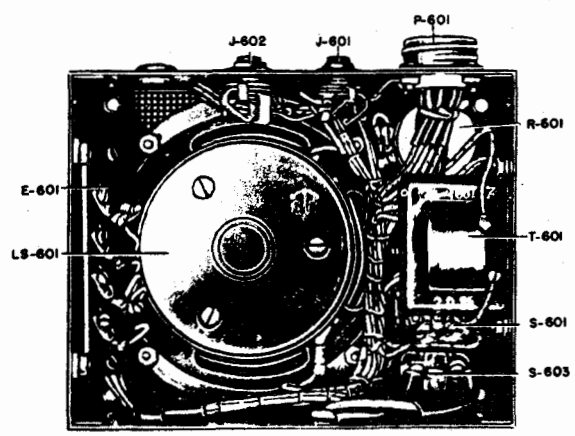


Fig. 2-26 Remote Control Unit Open Bottom Vew

TRANSMITTER ON-OFF switch S602 and RECEIVER ON-OFF switch S603, located on the panel of the remote-control unit, perform the same functions as the POWER switches S107 and S205 in the transmitter and receiver units respectively. The MICROPHONE jack J602 is connected in parallel with the MICROPHONE-OR-KEY jack J101 in the transmitter unit and permits the control of the transmitter carrier from the remote position. Reception may be had either over the permanent-magnet speaker contained in the remote-control unit or headphones which may be plugged into the PHONES jack J601. SPEAKER-PHONES switch S601 permits the selection of either loudspeaker or headphones reception. The audio input to the speaker or phones is controlled by the VOLUME CONTROL R601, in the remote-control unit.

6. HAND SET CONNECTIONS.

Although a hand set is not supplied with TCS equipment, provisions are made for its use through a terminal strip located within the remote-control unit (*see figures 2-25 and 2-26*). If the four knurled knobs are loosened, the bottom mounting plate may be removed, exposing this four-terminal strip. The circuit of a suitable hand set is shown in figure 2-27 with the leads numbered to correspond with the engraving on the terminal strip in the remote-control unit. Like numbered leads and terminals should be connected together.

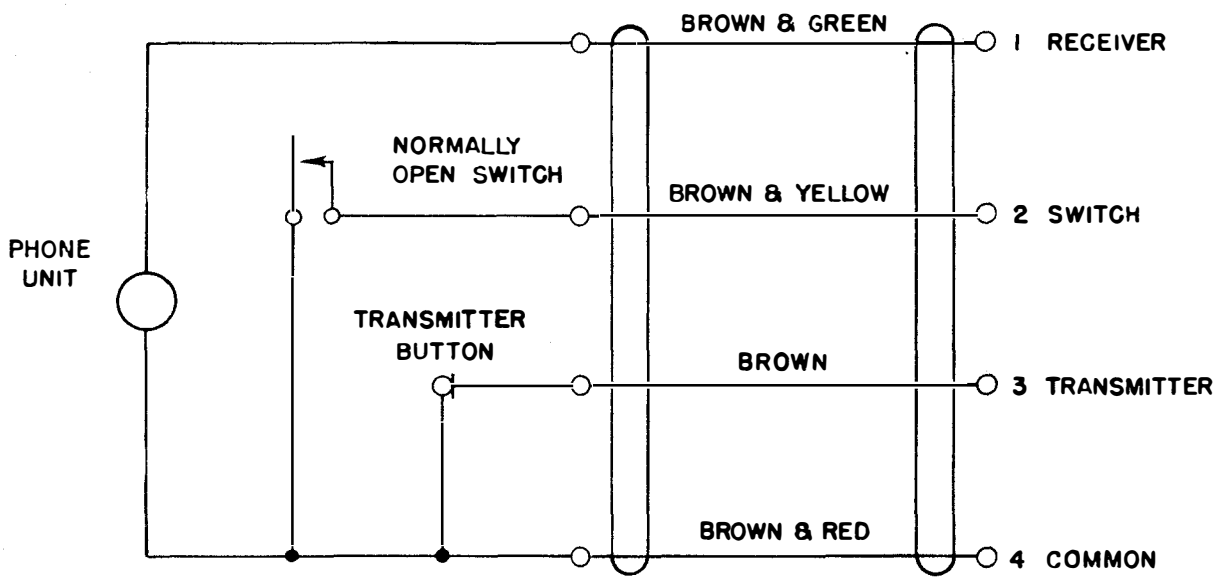


Figure 2-27 Handset Schematic Diagram

7. POWER-CONTROL CIRCUITS.

POWER switch S205, on the receiver panel, is the primary power control switch of the TCS equipment. When this switch is placed in the "ON" position, filament power is applied to the receiver tubes and primary power is applied to the low-voltage section of the power unit. This, in turn, applies plate and screen power to all tubes in the receiver unit.

After POWER switch S205 has been placed in "ON" position, placing POWER switch S107 on the transmitter panel in the "ON" position will apply filament power to the tubes in the transmitter and operate the relay in the power unit that will apply primary power to the high-voltage section of the power unit.

If the OSCILLATOR SELECTOR switch S104 on the transmitter panel now is placed in the "MO TEST" position, plate and screen power will be applied to the oscillator and buffer tubes. A frequency check now may be made on the transmitter. If the OSCILLATOR SELECTOR switch is in any position other than the "MO TEST" position, it is necessary to operate the "push-to-talk" button on the microphone or the telegraph key to close the carrier-control circuit through MICROPHONE-OR-KEY jack J101 before high voltage will be applied to any tube in the transmitter. The operating of the "push-to-talk" button on the microphone or the closing of the telegraph key completes the circuit necessary for the operation of relays K102 and K103 in the transmitter. If the EMISSION selector switch S105 on the transmitter panel is placed in the "VOICE" position, relay K101 is energized and when operated, completes the circuit from the modulator tube plates and screens to the carrier-control relay so that when the circuit through J101 is completed, plate power is applied to the modulator tubes V106 and V107.

8. POWER SUPPLY CIRCUITS.

a. The Type -21881-B Power Supply (*see figures 2-28, 2-29, 2-30, 2-31*) operating from a 12-volt direct-current source, contains two dynamotors, D401 which furnishes the 425-volt direct current for the high-voltage stages of the transmitter and D402 which supplies the 225-volt direct current for the low-voltage stages of the transmitter and for the operation of the receiver. Both the input and output circuits of the dynamotors are filtered to reduce the interference caused by brush arcing and to reduce the ripple components of the output. Relay K401,

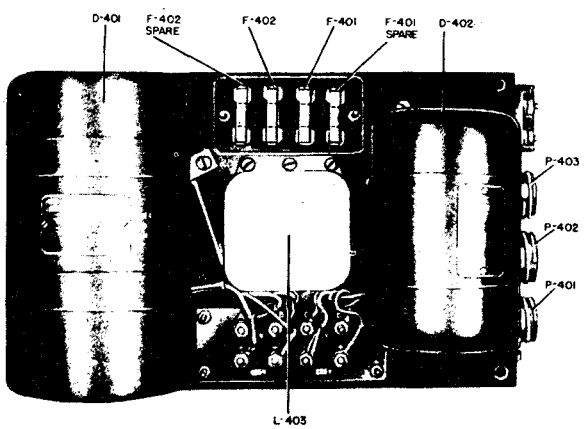


Fig. 2-28 Type -21881-B Dynamotor Power Supply Top View

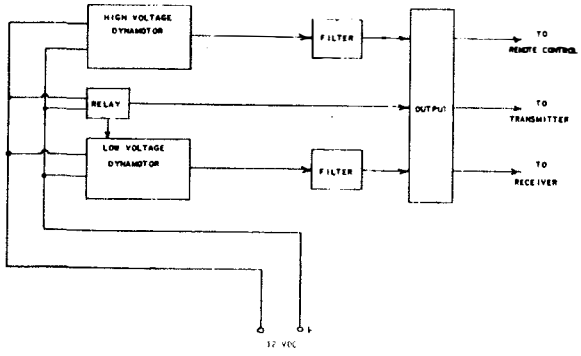


Fig. 2-29 Type -21881-B Dual Dynamotor Power Supply—Block Diagram

operated by closing the POWER switch S107 on the transmitter panel, controls the filament voltages to the receiver and transmitter and the voltage that is applied to the motor section of the high-voltage dynamotor D401. A spark-suppressing circuit consisting of R402 and capacitor C412 is connected across the contacts of relay K401.

Two 0.0047μf mica capacitors (C402 and C403) are part of the D401 high-voltage dynamotor and are accessible when the end bells of this dynamotor are removed. Similarly, two 0.0047μf mica capacitors (C409 and C410) are part of the D402 low-voltage dynamotor and may be reached by removing the end bells of that machine.

A 30-ampere 25-volt fuse F402 is inserted in the input to dynamotor D401 and a 15-ampere 25-volt fuse F401 protects the input to dynamotor D402. These fuses, and a spare of each type, are located on the power-unit chassis.

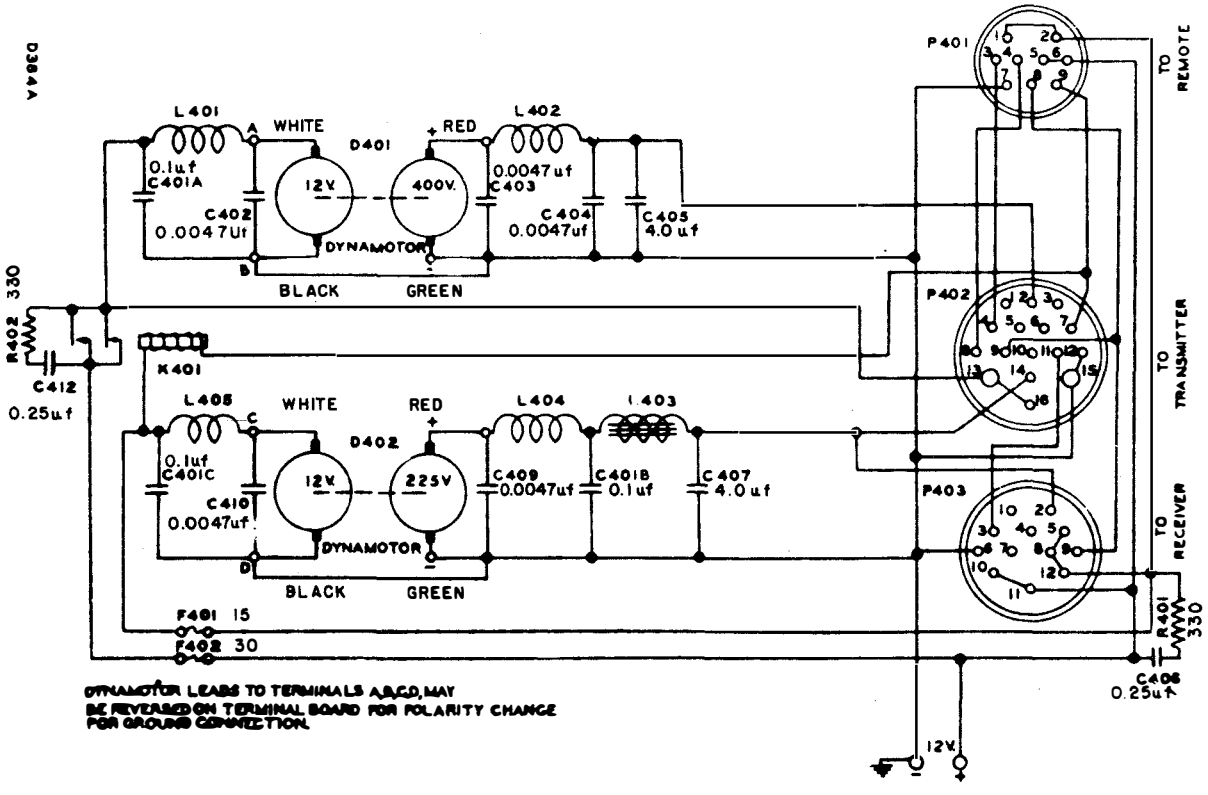


Fig. 2-30 Type -21881-B Dual Dynamotor Power Supply—Schematic Diagram

IMPORTANT: As supplied, the negative lead from the power source must be connected to the terminal of the power-supply unit which is marked with "GND" (ground). If it should become necessary to ground the positive lead of the power source, provision for doing this is afforded by the terminal strip on the chassis of the power-supply unit. When changing the polarity of the power input to the power-supply unit, it must be remembered that the input connections to both dynamotors must be changed.

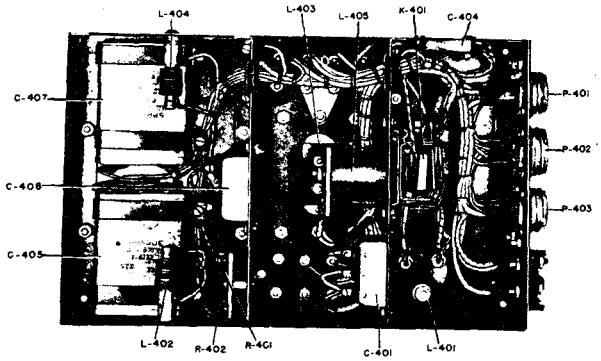


Fig. 2-31 Type -21881-B Dual Dynamotor Power Supply—Bottom Open View

b. The Type -20309 Power Unit (figures 2-32, 2-33, 2-34, 2-35) is designed for operation from either a 115-volt or a 230-volt 60 cycle A-C power source. Dual input voltage operation is accomplished by means of tapped transformer primaries. A toggle switch, S2201, is employed to select the proper primary taps for the line voltage used.

It employs two full-wave rectifier systems to supply 225 volts and 400 volts for application to the plates and screens of the tubes in the transmitter and receiver. Filament power is supplied by the step-down transformer, T2203. A second winding on transformer, T2203, is connected to a dry disc rectifier, CR2201. The disc rectifier supplies the d-c voltage necessary for the operation of the relays in the transmitter and relay K2201 in the power unit. The low voltage section of the power unit employs two Type 6X5GT high vacuum full-wave rectifiers with the plates connected in parallel and the filaments connected in series. Relay K2201 is energized by the operation of the POWER switch, S207, in the transmitter. The high voltage section of the power unit employs two Type 5U4G or two Type 5R4GY high-vacuum full-wave rectifier tubes. The plates of these tubes are connected in parallel across the secondary of the high voltage transformer, T2202. Filament Power necessary for the operation of the high voltage rectifiers, V2201 and V2202, is supplied by transformer, T2204. The

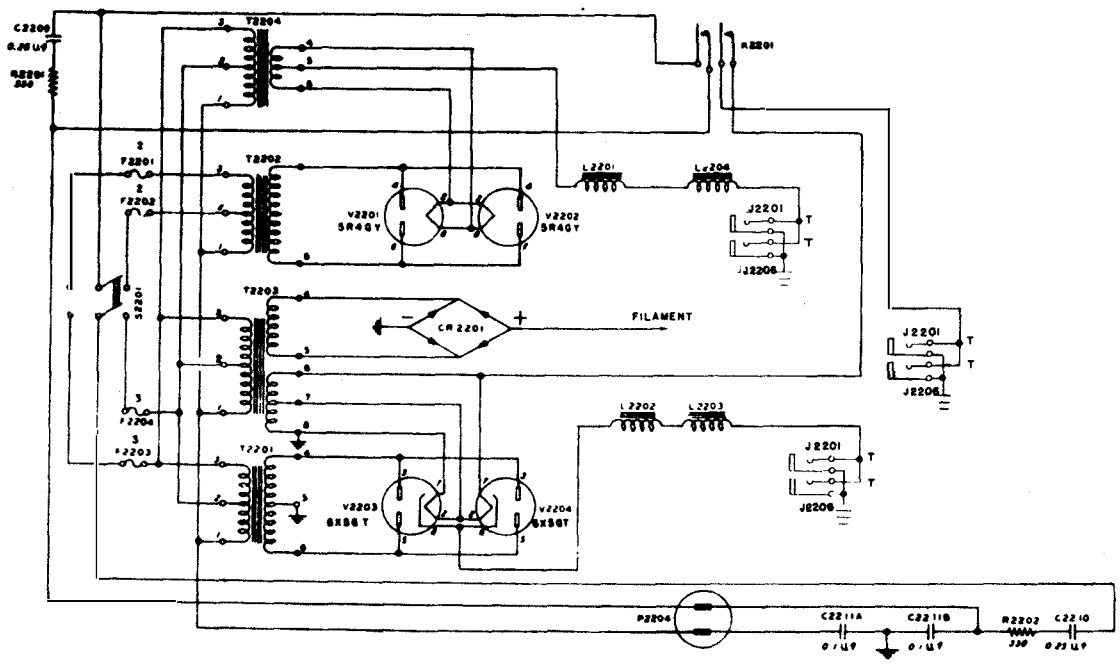


Fig. 2-32 Type -20309 Rectifier Power Supply—Schematic Diagram

operation of relay K2201 closes the primary circuit of the high voltage transformer, T2202, and energizes filament circuits of the transmitter and receiver. The output voltages of both sections of the power unit are adequately filtered to reduce the ripple voltage to a negligible value, and each supply is equipped with a bleeder resistor to discharge the filter capacitors when the unit is turned off. A fuse in the primary of each section of the power unit protects rectifiers and transformers from damage due to overload. Separate fuses are used for 115-volt and for 230-volt operation. It is important that only fuses of the correct values be used. Do not allow the 115-volt and the 230-volt fuses to become interchanged.

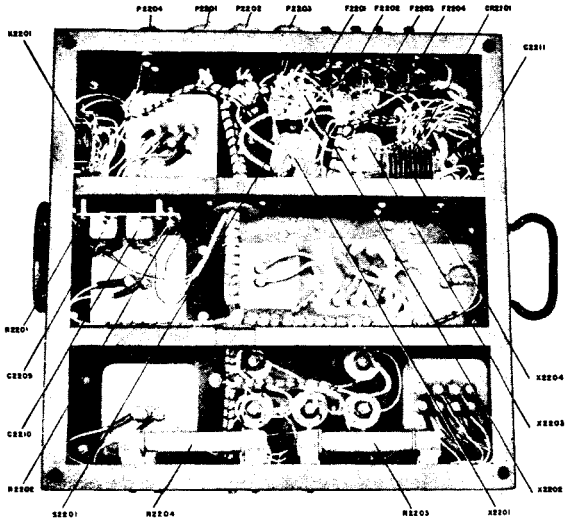


Fig. 2-33 Type -20309 Rectifier Power Supply Bottom Open View

c. The Type -211330-B Power Unit (see figures 2-36, 2-37, 2-38, 2-39) is designed for operation with Model TCS Series Radio Equipment where a 12- or 24-volt D.C. source of power is available. The unit furnishes filament and plate power for both the receiver and transmitter of the Model TCS equipment.

This power unit employs a multiple winding dynamotor mounted on a heavy sheet metal chassis along with various filter units, connectors and relays necessary for operation. Since the same input terminals are used for both 12- and 24-volt input a reversible Voltage Plug, P2805, is incorporated to arrange the input circuits for either 12 or 24 volts simply by changing the position of the plug. The right-hand input terminal is the ground terminal. Either positive ground or negative ground can be used by plugging Polarity Plug P2804 into socket J2801 to correspond to the ground polarity employed. Both the voltage plug and the polarity plug are located within the unit and are made accessible by removing the bottom cover from the chassis.

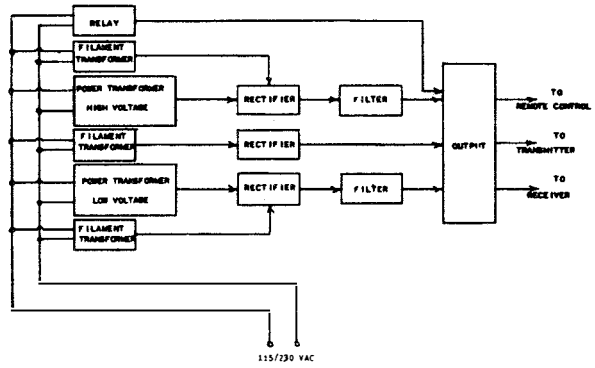


Fig. 2-34 Type -20309 Rectifier Power Supply Block Diagram

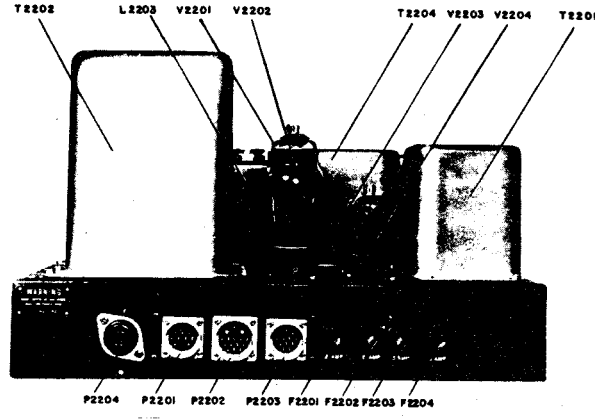


Fig. 2-35 Type -20309 Rectifier Power Supply End View

WARNING

The position of the voltage and polarity plugs should be correct for the power source employed. The plugs are correct when the stampings read on the sides of the plugs correspond to the characteristics of the power source when the plugs are viewed from the open bottom of the power unit.

The input to the dynamotor is controlled by relay K2801 which operates when the Model TCS receiver is turned on. An additional relay, K2802, operates to apply filament and plate power to the transmitter. POWER switch is operated to the ON position.

The dynamotor has two input windings which are used in parallel on 12-volt input and in series on 24-volt input. Output from the dynamotor is delivered by two windings connected in series. The high voltage (440 v) is taken from both windings in series while the low voltage (225 v) is taken from one winding.

The input and output circuits are filtered to minimize output of noise and ripple voltages. A Spark filter is connected across the contacts of relay K2801.

Overload protection is accomplished by fuses in both the input circuits and the output circuits. The input fuse, F2804, is 40 amp for 12-volt operation and 20 amp for 24-volt operation. It is important that the correct fuse is installed before power is applied to the input terminals. The fuses are located under the cover marked FUSES on the top of the chassis. Turn to the parts list for information regarding size and value of the fuses used in this equipment.

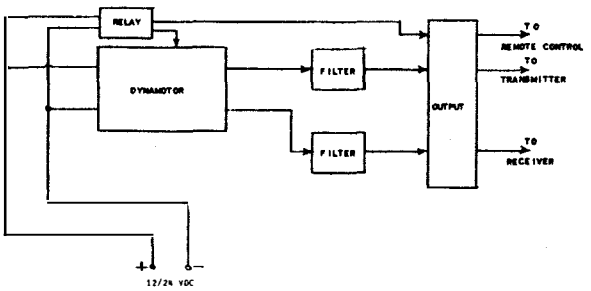


Fig. 2-36 Type -211330-B Single Dynamotor Power Supply—Block Diagram

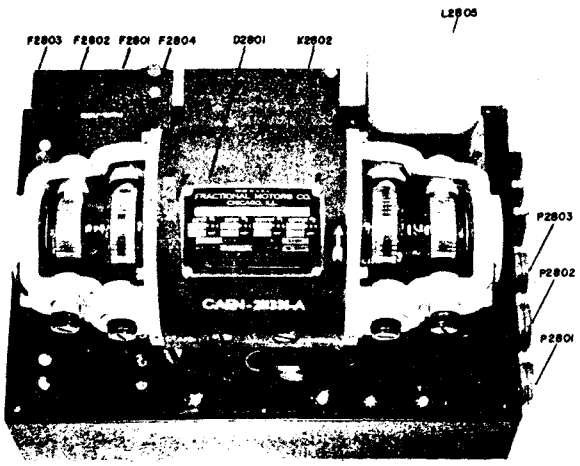


Fig. 2-37 Type -211330-B Single Dynamotor Power Supply—Top View

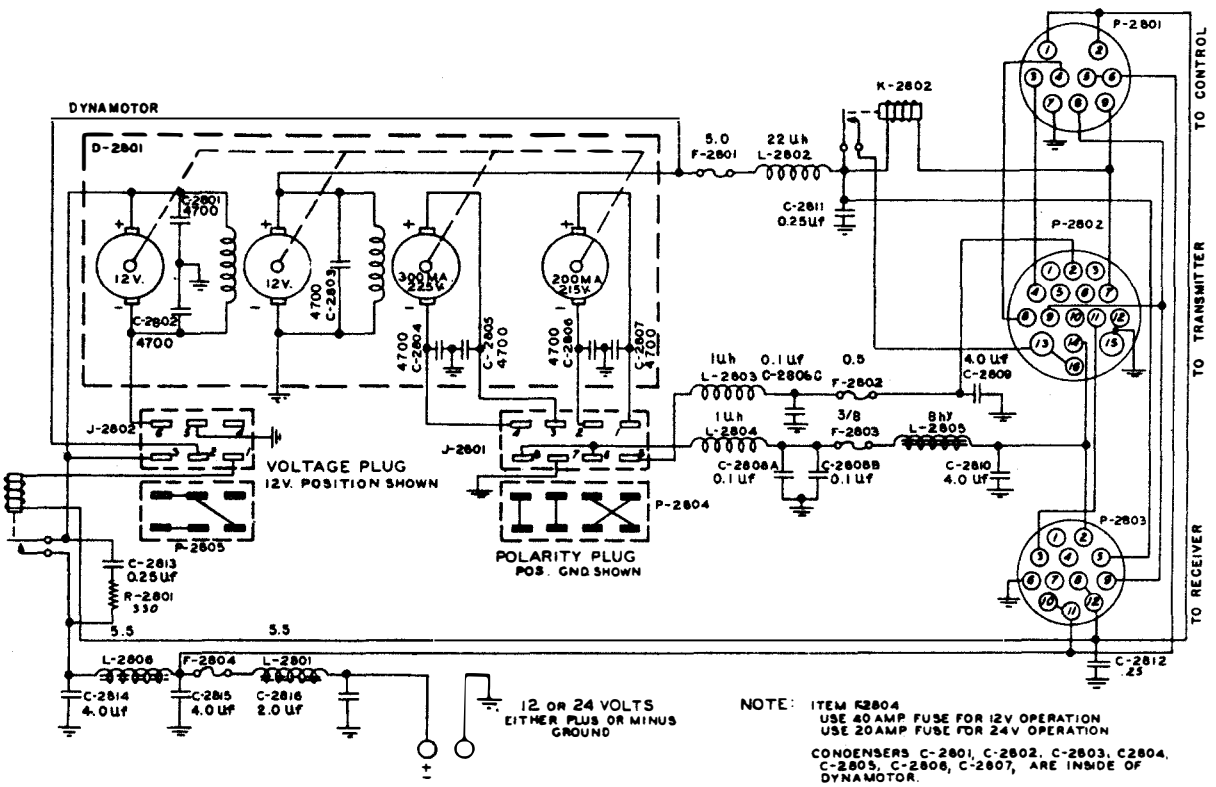


Fig. 2-38 Type -211330-B Single Dynamotor Power Supply—Schematic Diagram

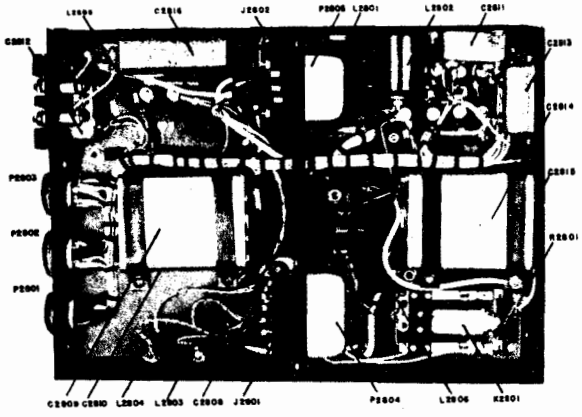


Fig. 2-39 Type -211330-B Single Dynamotor Power Supply—Bottom Open View

d. The Types -21827-A and -211100 (see figures 2-40, 2-41, 2-42, 2-43) Power Units employ two motors and two generators to supply the voltages necessary for the operation of the transmitter and receiver. The basic power input for these motor generators is the same for both types. Type 21827-A operates from a 230 volt dc source, and Type -211100 operates from a 115 volt dc source.

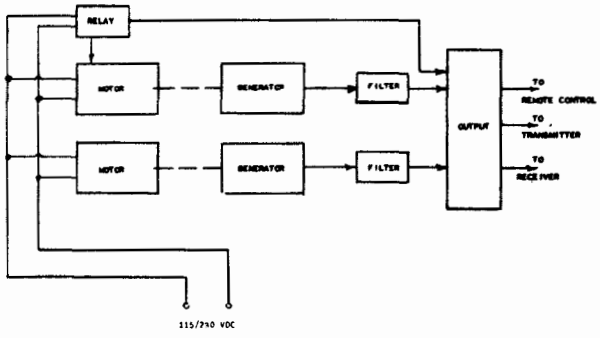


Fig. 2-40 Types -211100 and -21827-A Motor-generator Power Supply—Block Diagram

NOTE:
1. ITEMS C2302, C2303, C2310 & C2311 ARE A PART OF AND PURCHASED WITH THE MOTORS B2301 & B2302
2. ITEM C2304 IS PURCHASED WITH AND IS A PART OF GENERATOR G2301
3. ITEMS C2307 & C2312 ARE A PART OF AND PURCHASED WITH C2302

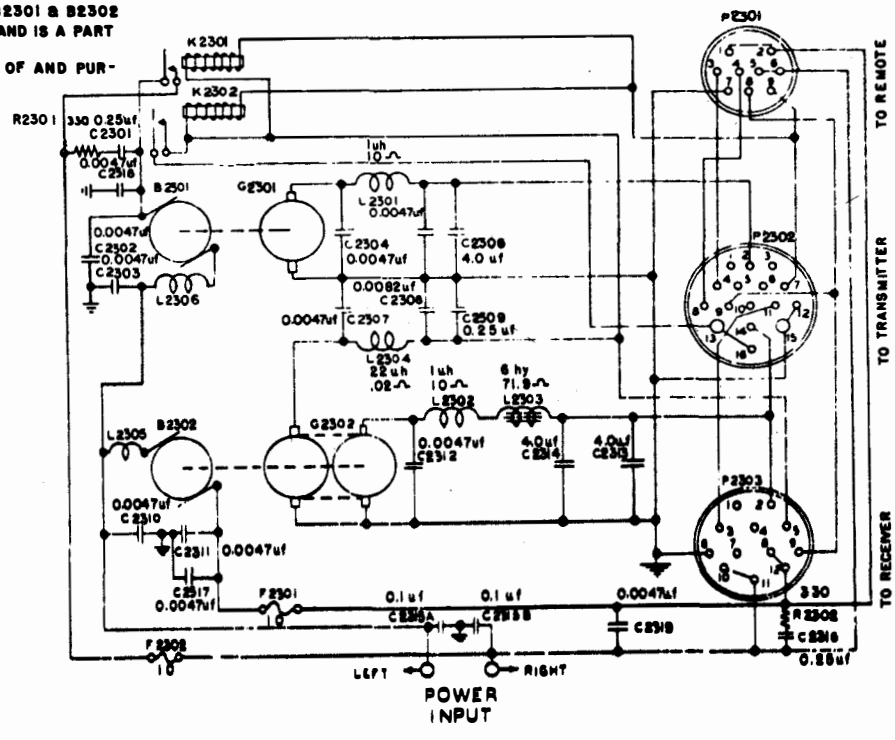


Fig. 2-41 Type -21827-A Motor Generator Power Supply—Schematic Diagram

NOTE:
1. ITEMS C2302, C2303, C2310 & C2311 ARE A PART OF AND PURCHASED WITH THE MOTORS B2301 & B2302
2. ITEM C2304 IS PURCHASED WITH AND IS A PART OF GENERATOR B2301
3. ITEMS C2307 & C2312 ARE A PART OF AND PURCHASED WITH B2302

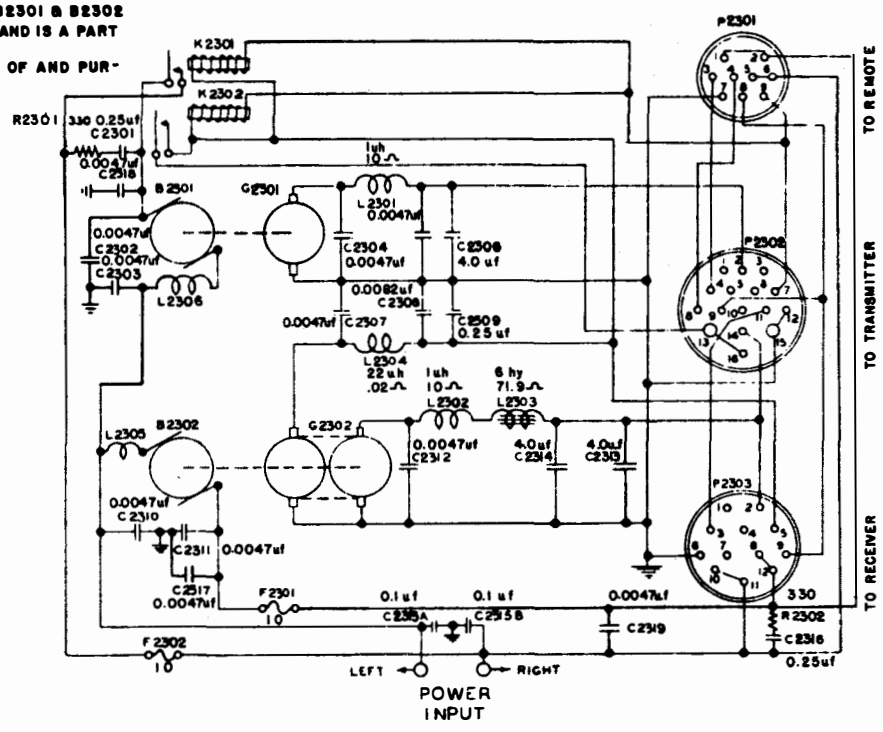


Fig. 2-42 Type -211100 Motor Generator Power Supply—Schematic Diagram

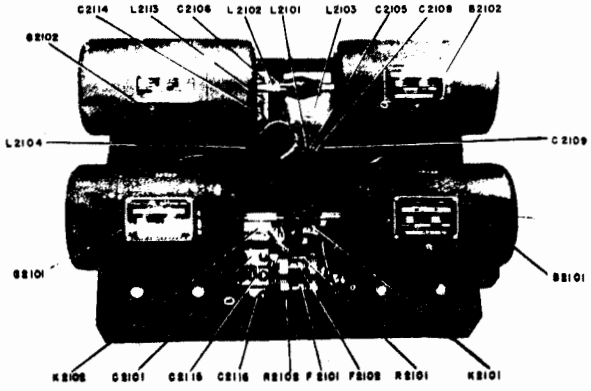


Fig. 2-43 Motor Generator Power Supply
Type -211100—Symbol Nos. 2100-2199
Type -21827-A—Symbol Nos. 2300-2399

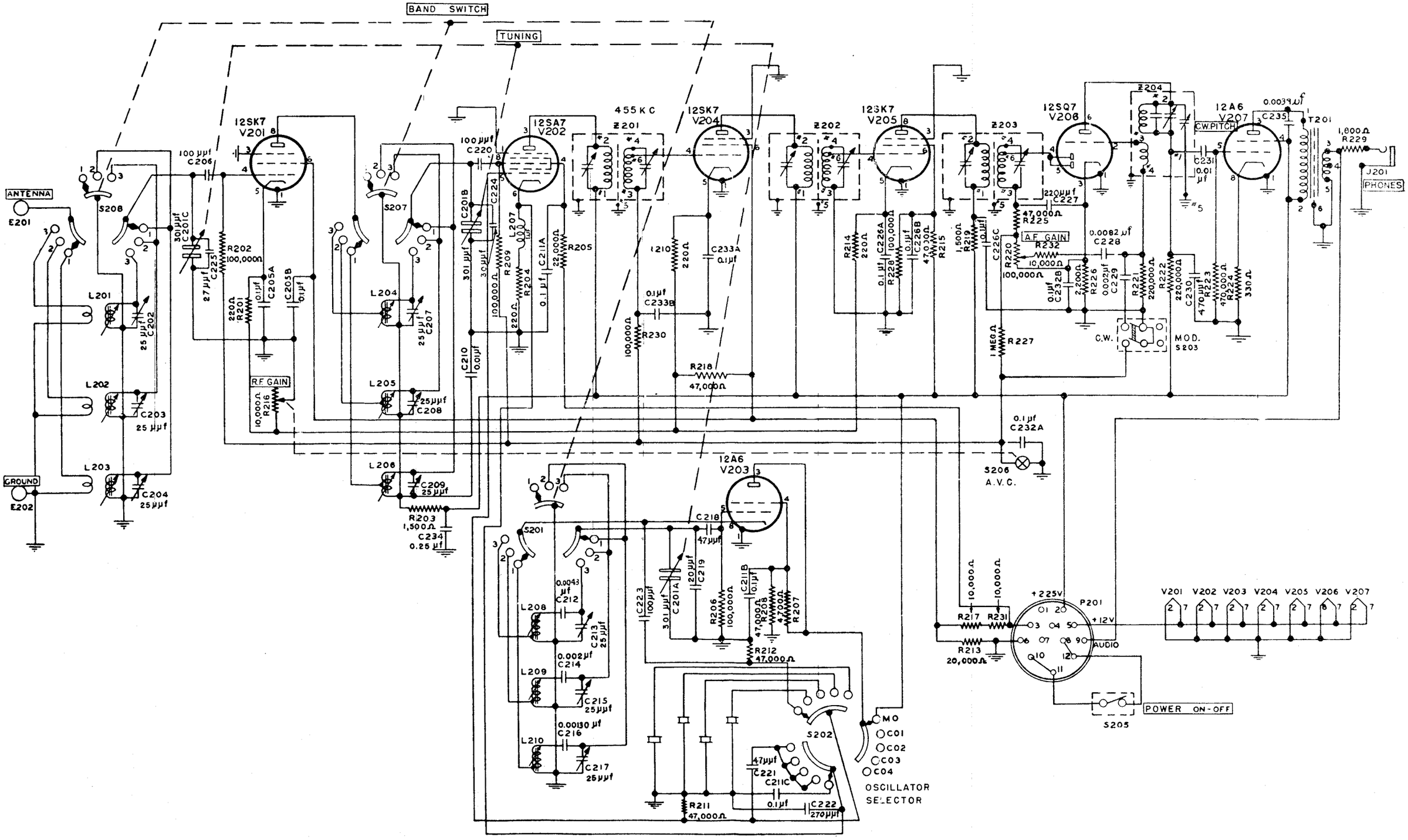


Fig. 2-44 Receiver Type -46159-A—Schematic Diagram

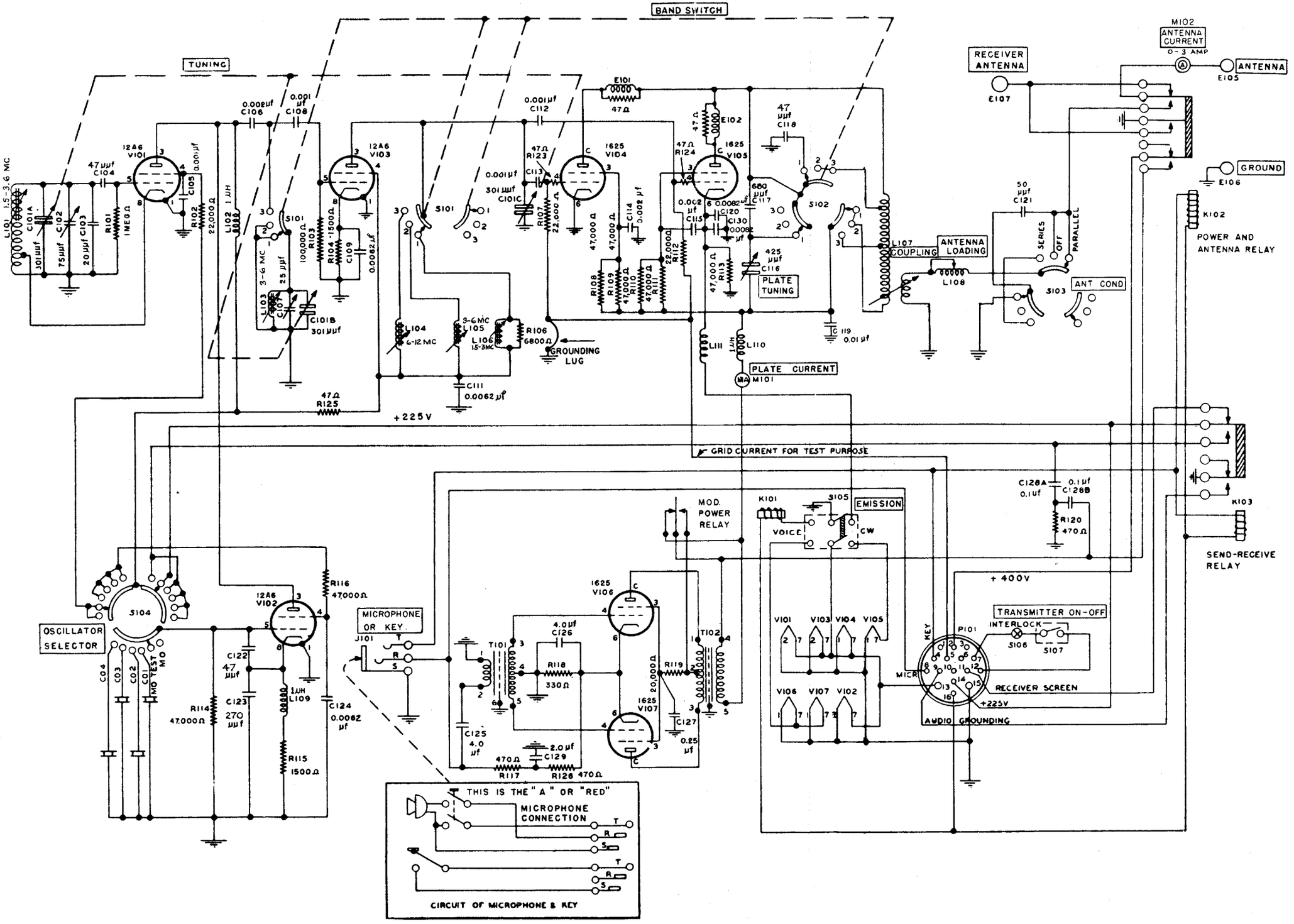


Fig. 2-45 Transmitter Type -52245-A—Schematic Diagram

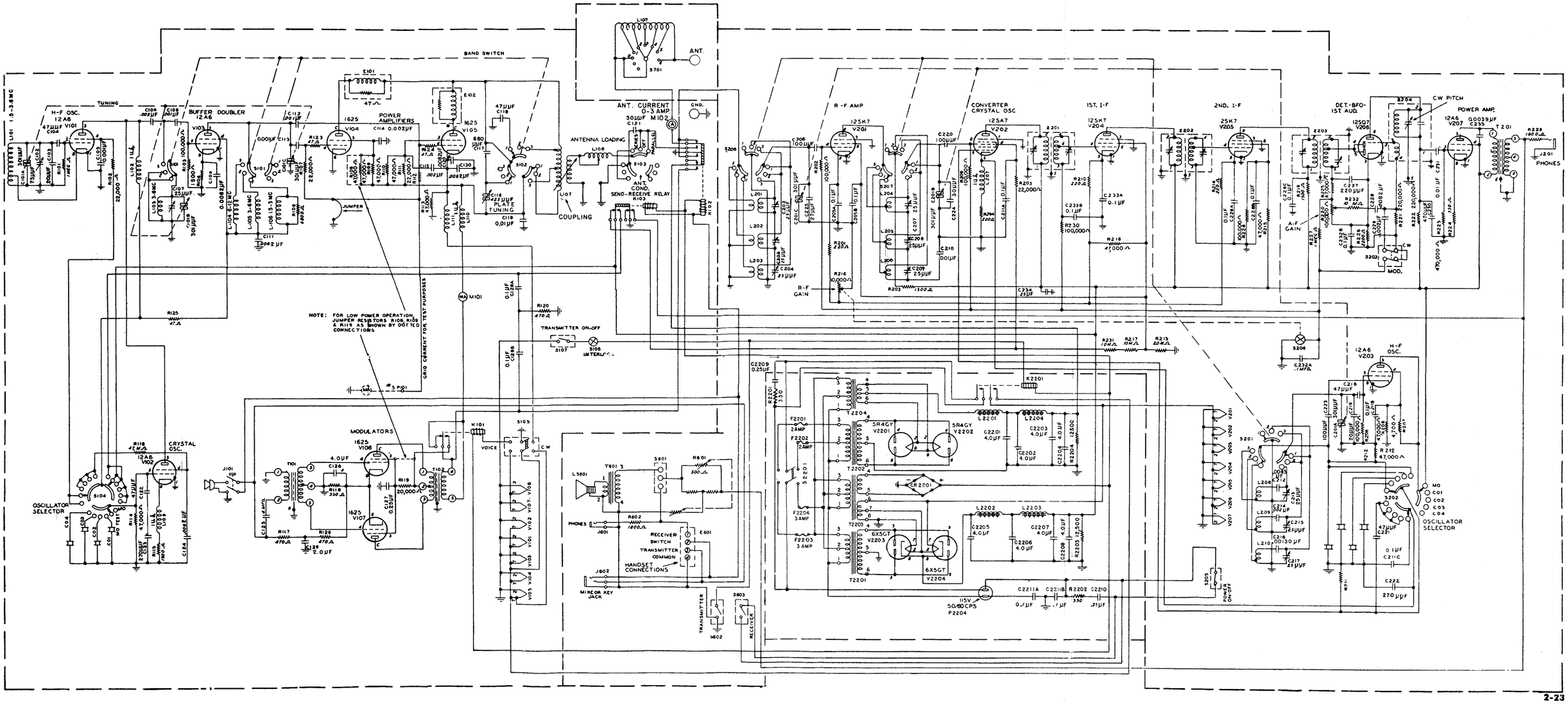


Fig. 2-46 Typical Complete Schematic Diagram of TCS Equipment, Type -20309 Power Unit Shown

SECTION III—INSTALLATION AND INITIAL ADJUSTMENTS

1. UNCRATING.

Open the packing cases carefully. When the crates are marked with arrows to indicate the upright position, remove the crate covers only and carefully lift out the units. Search all packing material for small packages. Remove the wrappings and blow or lightly brush away the packing dust and shavings. Inspect each unit for shipment damage and if apparent damage is found, file a claim immediately with the shipping agency. If a claim for damage is to be filed, the original packing case and packing material must be preserved.

2. INSTALLATION.

a. TRANSMITTER.

Manipulate all controls such as switches, dials, etc., to be sure that they operate properly. Loosen the two knurled lock nuts which hold the two knobs bearing double-headed arrows and which are located at the sides of the front panel. Rotate these knobs to release the cabinet clamps and remove the transmitter unit from its cabinet. Inspect all components visually for evidence of possible damage and tighten all screws or bolts that may have become loosened in shipment.

WARNING

DO NOT DISTURB THE ADJUSTMENT OF THE CAPACITANCE AND INDUCTANCE TRIMMERS.

These trimmers are shown in figure 3-2 as C102, C107, L101, L103, L104, L105 and L106. Disturbing any of these adjustments may easily render the unit inoperative, after which laboratory facilities will be required for realignment.

If the tubes are in place, make sure that they are undamaged and that each tube is pressed down firmly in its proper socket. If tubes are not in place, insert them, referring to figure 3-1 for the location of the sockets. Be sure that the plate lead connectors on the Type 1625 tubes are placed firmly on the plate caps. Fasten each tube clamp securely.

The four three-prong sockets in the right rear corner of the chassis are for the "plug-in" crystal holders (supplied with some, but not all, TCS equipments).

The transmitter unit should not be replaced in the cabinet until the cabinet has been mounted as described below.

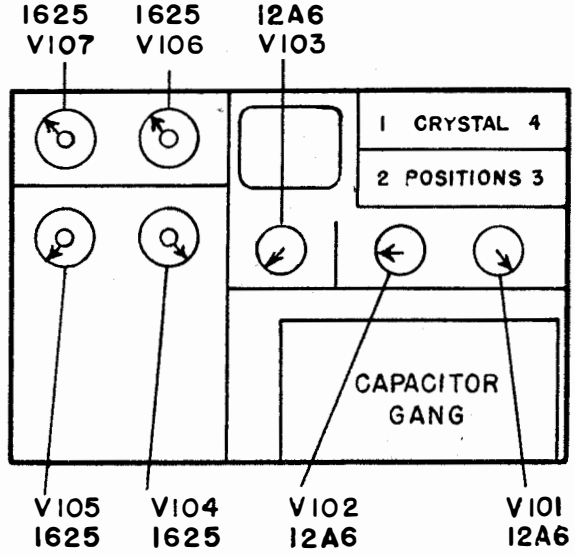


Figure 3-1 Transmitter Tube Layout.

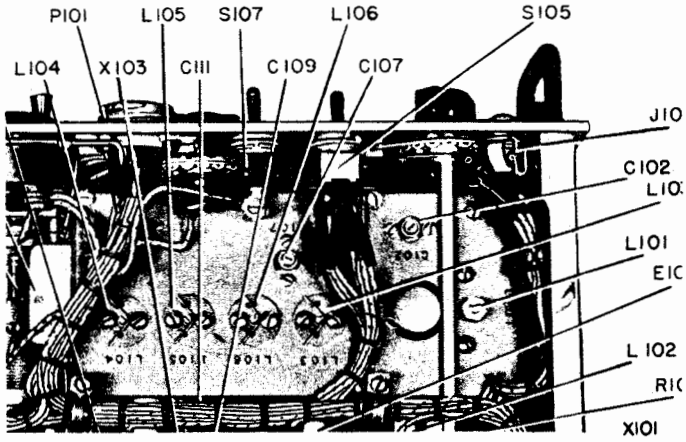


Figure 3-2 Partial View of Transmitter (Bottom open)

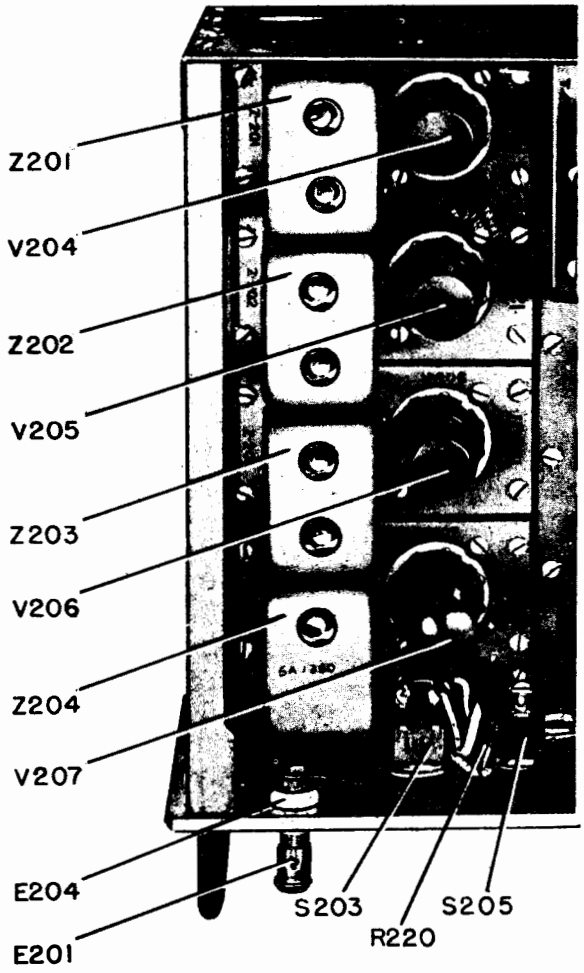


Figure 3-3 Partial View of Receiver (Bottom open)

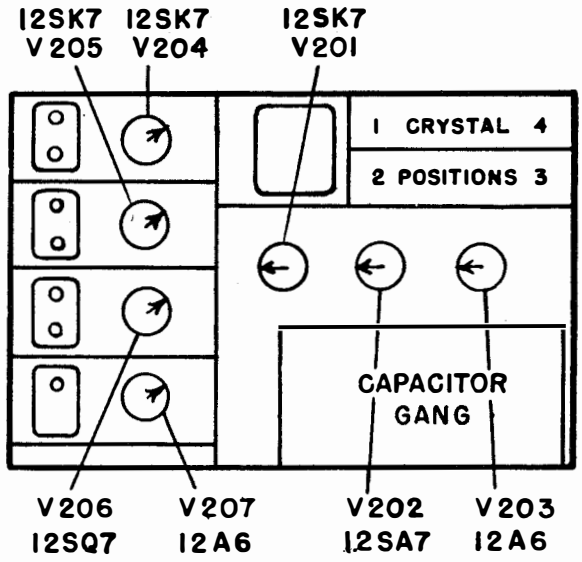


Figure 3-5 Receiver Tube Layout

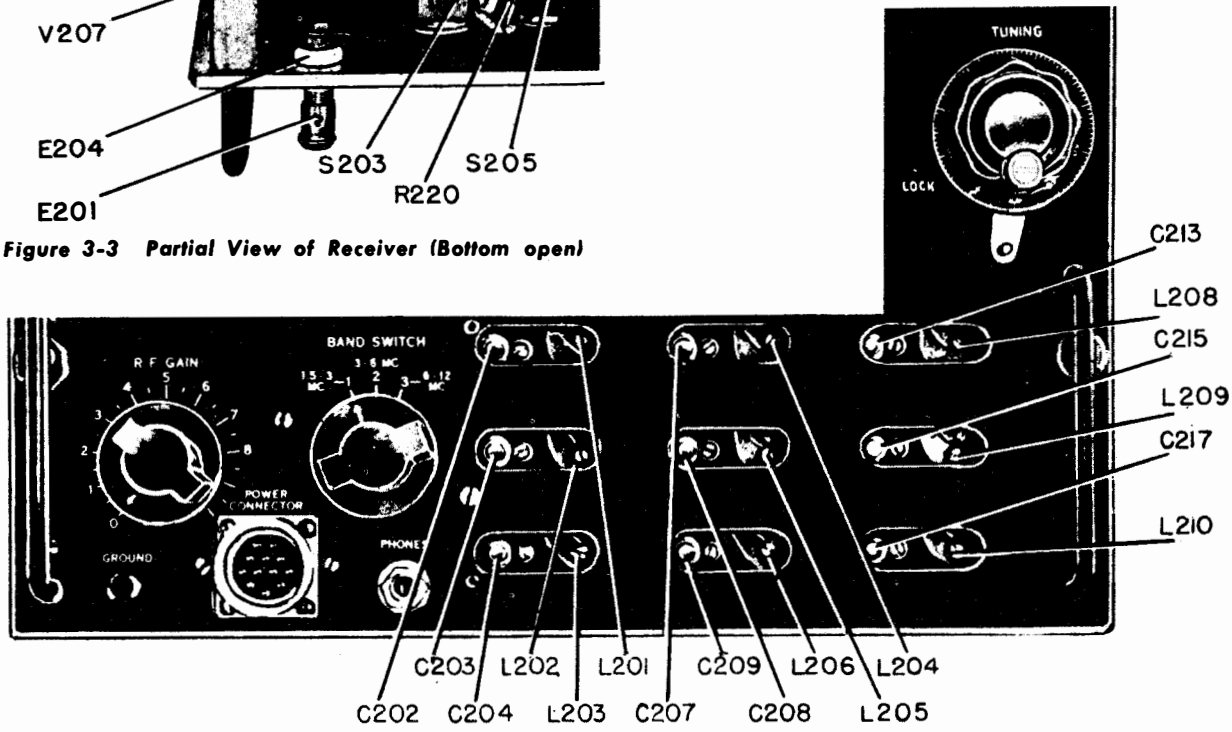


Figure 3-4 Partial View of Receiver Front Panel With Chart Removed Showing Trimmers

b. RECEIVER.

Manipulate all controls to be sure that they operate properly. Remove the receiver from its cabinet in the same manner as the transmitter was removed from its cabinet. Inspect all components visually for evidence of possible damage and tighten all screws or bolts that may have become loosened in shipment.

WARNING

DO NOT DISTURB THE ADJUSTMENT OF THE CAPACITANCE AND INDUCTANCE TRIMMERS.

These trimmers are shown in figure 3-4 as C202, C203, C204, C207, C208, C209, C213, C215, C217, L201, L202, L203, L204, L205, L206, L208, L209, and L210. The two trimmers at the top of each of the i-f transformers Z201, Z202 and Z203 and the one at the top of the BFO transformer Z204 (*see figure* 3-3), should not be disturbed either. As in the case with the transmitter, disturbing any of these adjustments may render the unit inoperative.

Examine the tubes for defects and be sure that each one is pressed down firmly in its proper socket. If the tubes are not in place, insert them, referring to figure 3-5 for the location of the sockets. Fasten each tube clamp securely.

The four three-prong sockets located in the right rear corner of the chassis are for the "plug-in" crystal holders (not supplied with the TCS equipment).

Do not replace the receiver in its cabinet until the cabinet has been mounted as described below.

3. MOUNTING OF UNITS.

a. TRANSMITTER AND RECEIVER.

Two types of installation are possible with the TCS equipment. The transmitter and receiver units may be mounted end-to-end or one above the other, whichever type of installation may be best accommodated in the space available. (*Refer to figures* 3-6 *and* 3-7.)

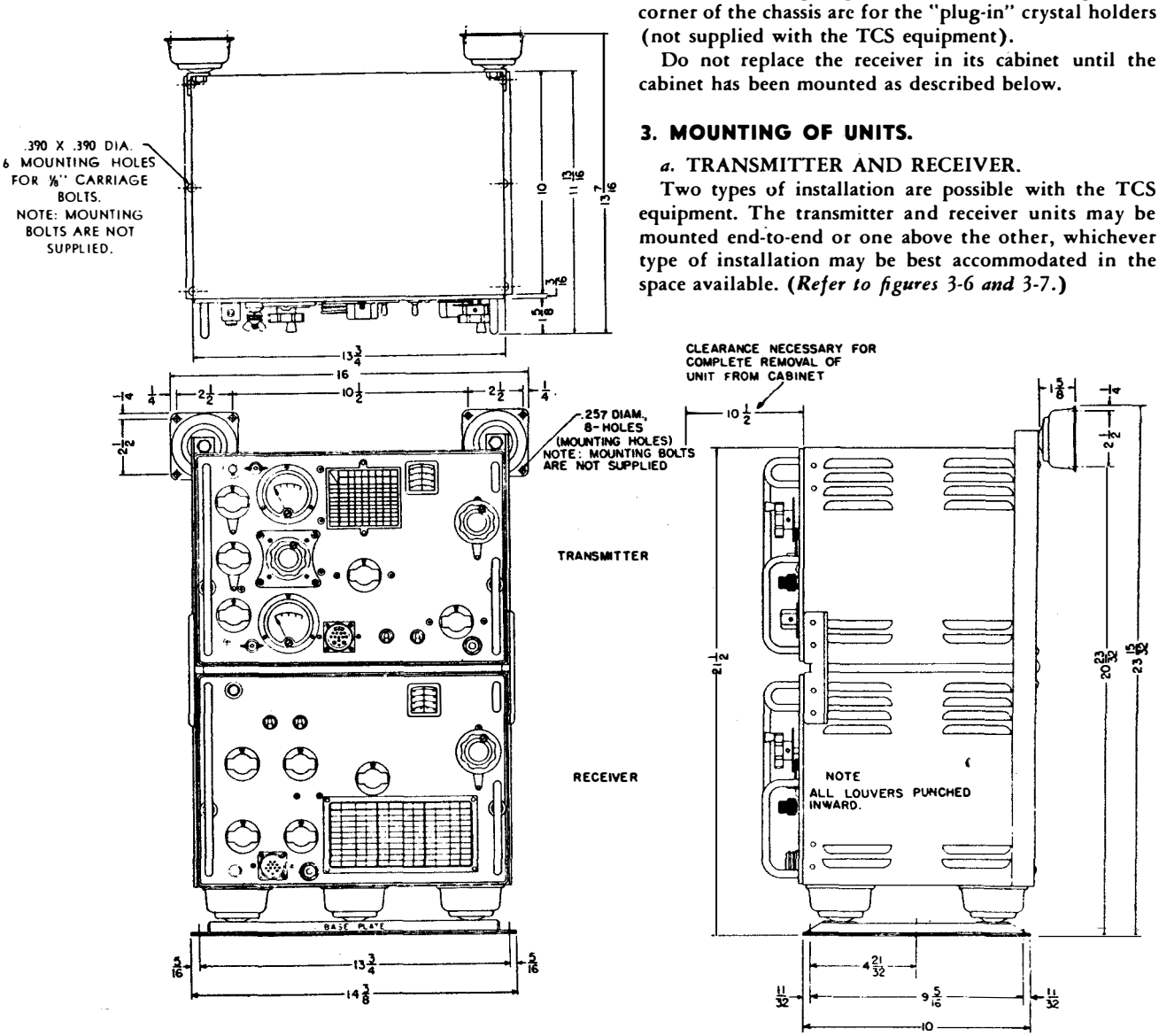
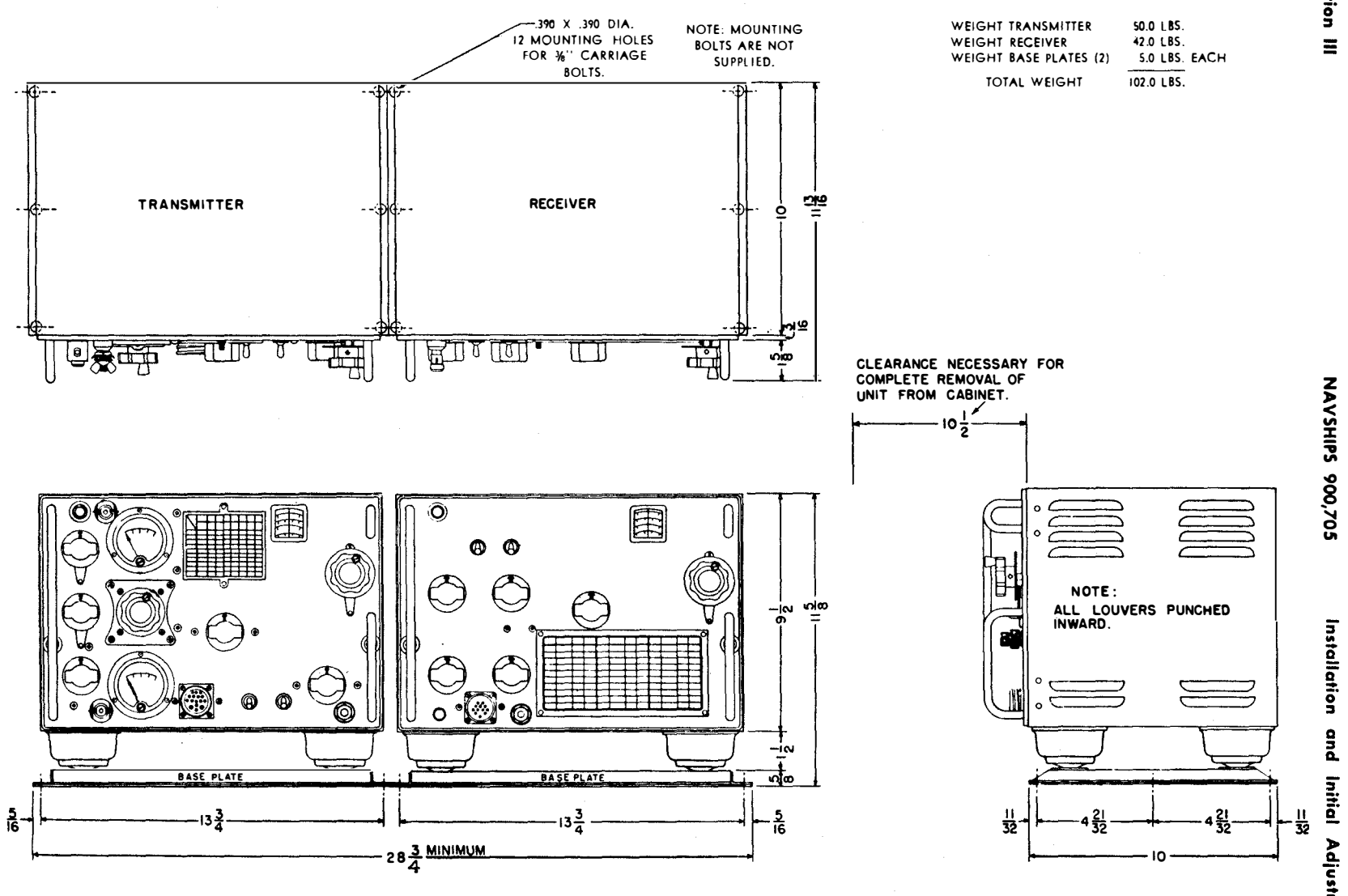


Figure 3-6 Transmitter and Receiver Units. Vertical Mounting.



WEIGHT TRANSMITTER	50.0 LBS.
WEIGHT RECEIVER	42.0 LBS.
WEIGHT BASE PLATES (2)	5.0 LBS. EACH
TOTAL WEIGHT	102.0 LBS.

Figure 3-7 Transmitter and Receiver Units. Horizontal Mounting.

Note

It is recommended that wherever possible the horizontal type of installation be used.

Angle irons, mounting brackets and base plates are supplied with each equipment for mounting the cabinets in either position. Shock mounts are supplied with both the transmitter and receiver cabinets. Due to the varied service conditions under which the TCS equipment may be called upon to operate, it has been considered impracticable to furnish shock mounts that will provide optimum performance under all conditions. Stiff shock mounts are furnished with this equipment to protect it from damage due to shock vibrations of steep wave front, such as might be encountered in transit or during gunfire.

When the transmitter and receiver are mounted horizontally the actual installation will require a space 28-3/4" wide by 11-5/8" high by 11-13/16" deep. The vertical installation requires a space 14-3/8" wide by 23-15/32" high by 13-7/16" deep. However, enough additional space should be allowed for the free circulation of air about the cabinets.

Note

When installing any of the units which are attached to the interconnecting cables, a minimum clearance of 6-1/2" should be allowed between the edge of the chassis nearest the connected plugs and any other object which may interfere with the cable. Sharp bends in the cable tend to weaken the vinylite covering and the metal shielding and may eventually damage the wires within the cable.

(1) HORIZONTAL MOUNTING.

(*a*) Place the two base plates end-to-end and flat side down on the table or other mounting surface.

(*b*) Mark the six mounting holes for each base plate (three at each end) on the mounting surface and drill holes in this surface to accommodate the 3/8" bolts needed to fasten down the plates. (These bolts are not supplied with the TCS equipment.)

(*c*) Fasten both cabinets to the base plates as follows:

1. Place the cabinet on a table with the shock mounts facing up.

2. Place the base plate, flat side up, over the shock mounts and line up the holes in the base plate with those running through the shock mounts.

3. Insert the 3/8"—24 x 1-3/4" hexagonal-head cap screw from the flat side of the base plate down through the shock mount and through the flat washer held captive between the shock mount and cabinet.

4. From inside the cabinet place a lock washer over the end of the cap screw and screw on the 3/8"—24 nut. Repeat for the other three shock mounts and fasten the base plate to the other cabinet in similar manner.

(*d*) Place the cabinets with the attached base plates right side up on the mounting surface and bolt the base plates down through the holes previously drilled.

(2) VERTICAL MOUNTING.

When mounted in this position, the transmitter should be the upper unit.

(*a*) Remove the four shock mounts from the transmitter cabinet.

(*b*) Fasten two or these four shock mounts to the front and rear centers of the bottom of the receiver cabinet, making six shock mounts for that cabinet.

(*c*) Fasten its base plate to the receiver cabinet as previously described, using six hexagonal-head cap screws.

(*d*) Bolt the two long angle brackets to the rear edges of both cabinets using eight 10—24 x 3/8" button-head machine screws into the four threaded inserts which are mounted in the back of each cabinet. Be sure to use lock washers with each screw.

(*e*) Fasten the front edges of the two cabinets together by means of the two five-inch straps supplied. Each of these straps contains four holes tapped for an 8—32 machine screw. Working from the inside of the cabinets and using lock washers and the 8—32 x 1/4" machine screws supplied, fasten these straps to the cabinets so that the 3/8" center tab of each strap rests between the top and bottom cabinets.

(*f*) Bolt the two remaining shock mounts to the holes in the tops of the two long angle brackets. Use 3/8"—24 x 1-3/4" hexagonal-head cap screws, lock washers and 3/8"—24 nuts. The heads of these cap screws should rest inside the shock mounts and these latter should be mounted so that they may be screwed to a back board or wall thus supporting the entire installa-

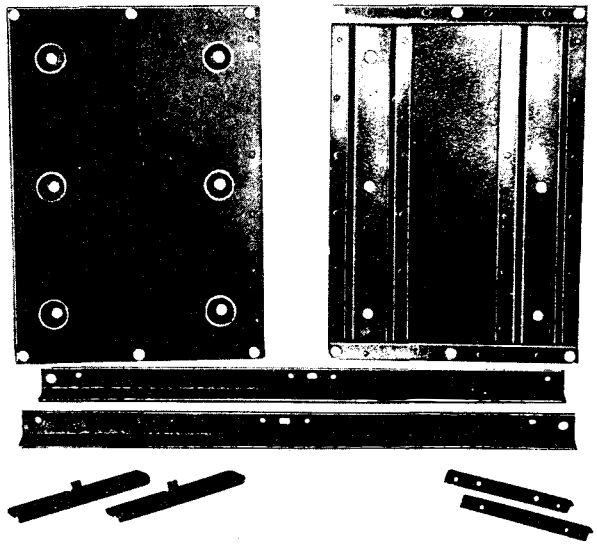


Figure 3-8 Base Plates and Mounting Hardware.

tion. When mounting any of these shock mounts, be careful to include the 1-¾" diameter flat washer that belongs there.

(*g*) Place the entire installation on the mounting surface and adjust so that the two upper shock mounts will fit up against the back board or wall. Fasten these shock mounts to this back board or wall and bolt the base plate down to the mounting surface with six ⅜" bolts.

After the transmitter and receiver cabinets have been installed, replace the units in their respective cabinets. Make sure that each unit goes all the way into its cabinet. Rotate the two knobs bearing double-headed arrows on each unit until the cabinet clamps catch hold (the arrows then are in a horizontal position) and screw down the knurled lock nuts. These cabinet clamps hold the panels to the cabinet and, in the case of the transmitter, insure that the power-interlock switch S106 is held securely in the closed position. The receiver has no power-interlock switch.

b. POWER-SUPPLY UNITS.

(1) The Dynamotor Power Units have been provided with shock mounts to reduce the effects of the vibration. Figures 3-9 and 3-10 show the overall and mounting dimensions of the units. The base plates must be removed from the chassis for mounting. Bolts should be inserted from the inside of the shock mounts and tightened firmly before the units are fastened to the base plates. The units may be changed or removed for servicing without disturbing the base plates by removing the screws that hold the chassis to the base plates.

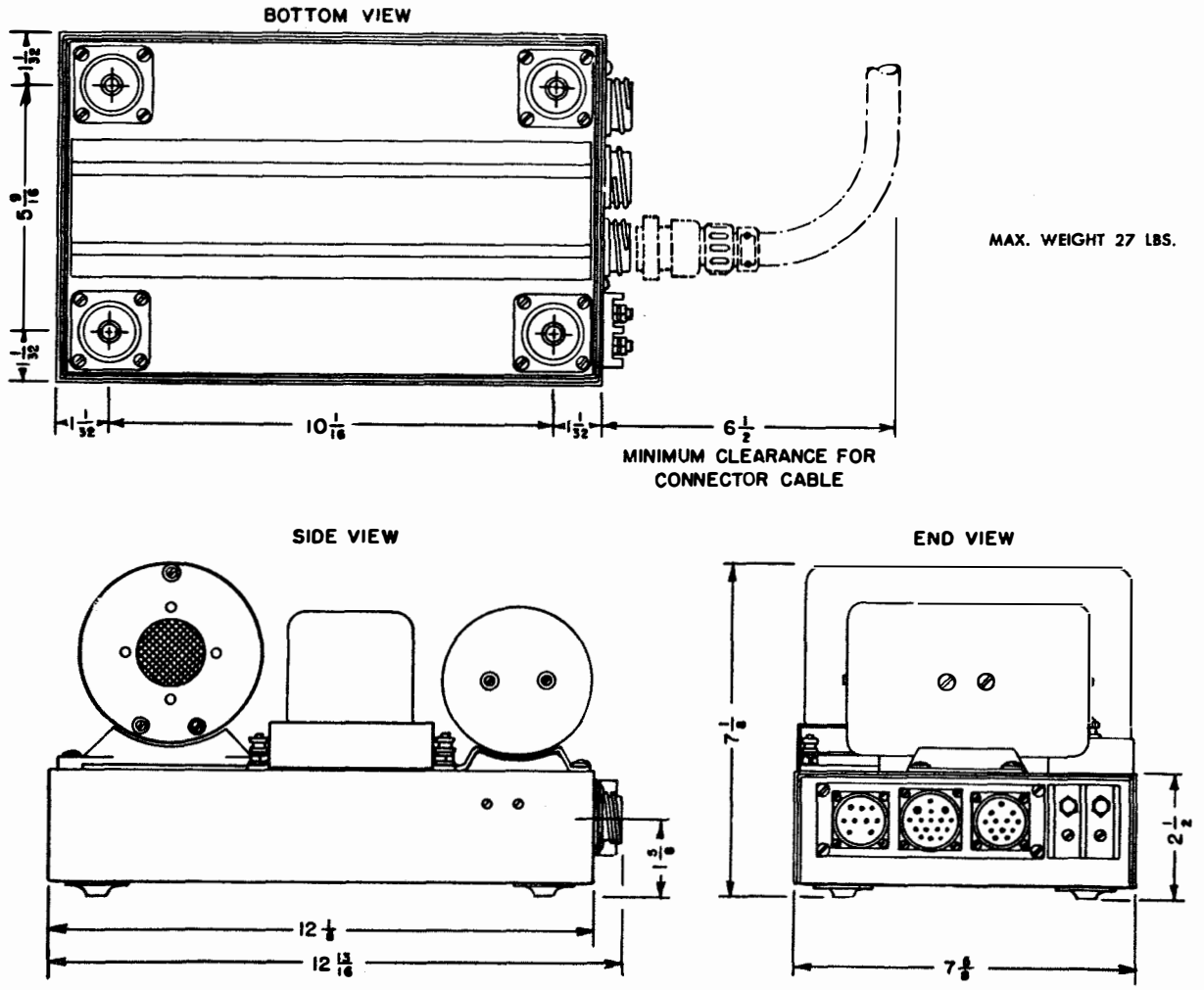


Figure 3-9 Type -21881-B Dual Dynamotor Power Unit Installation Diagram

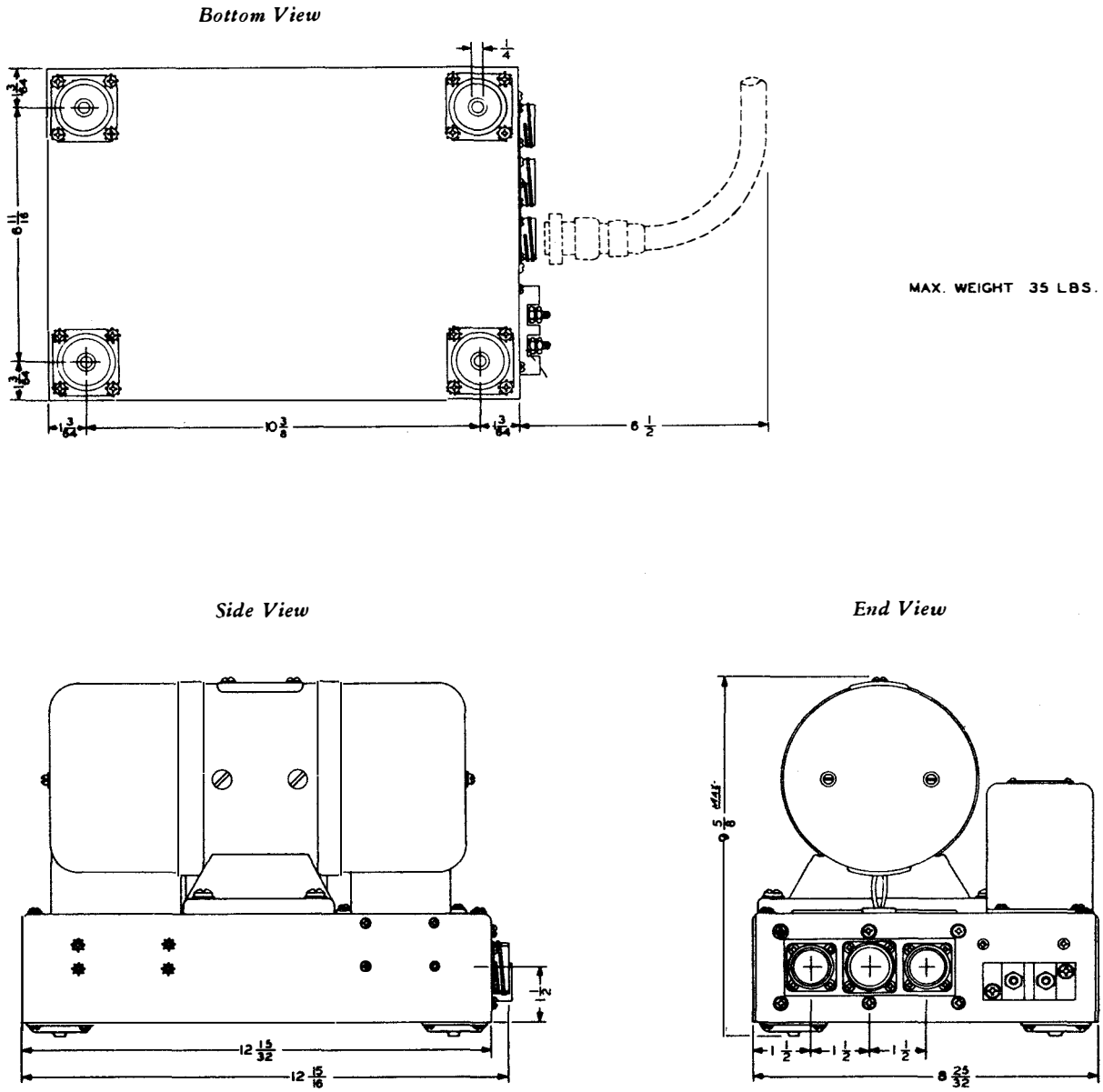
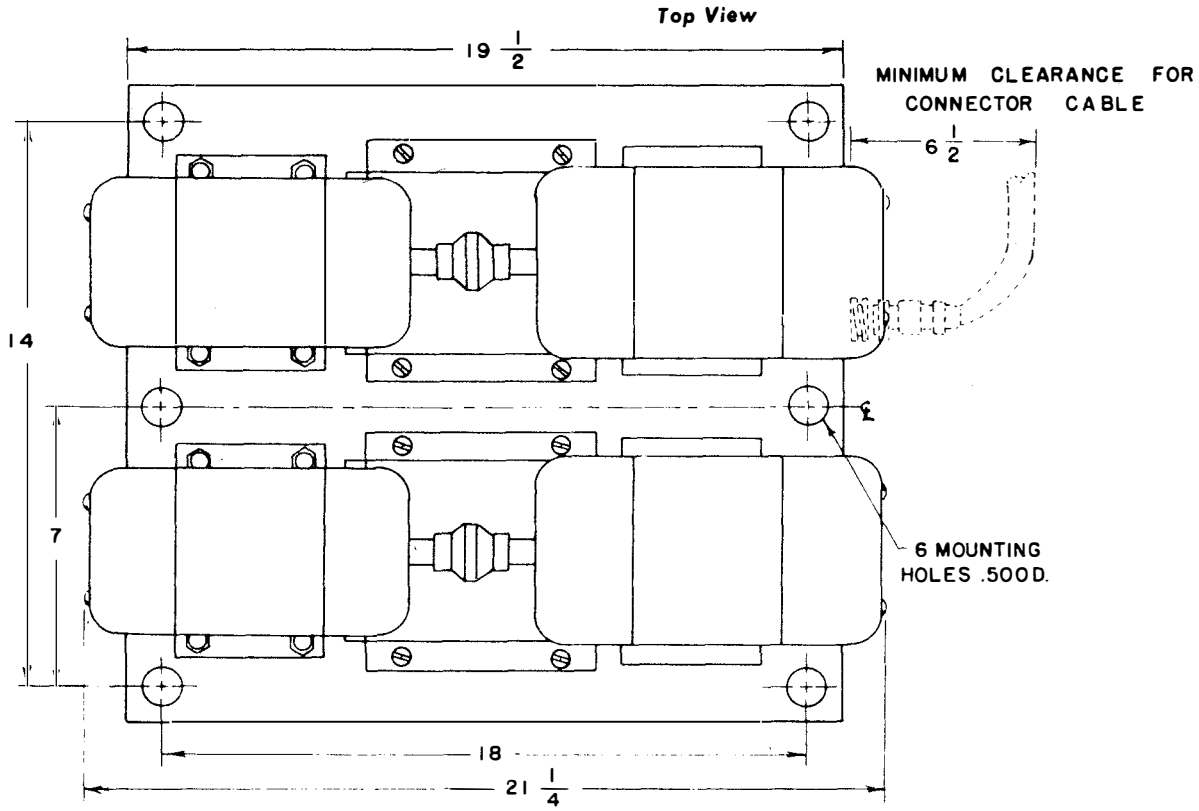


Figure 3-10 Type -211330-B Single Dynamotor Power Unit Installation Diagram

(2) MOTOR GENERATOR POWER UNITS.— The Types -211100 and -21827-A Power Units are mounted on identical bases, and therefore require identical mounting facilities. Figure 3-11 shows the mounting dimensions of the unit. Bolts 3/8" in diameter should be used to secure the unit. This unit is rather heavy and considerable care should be exercised in the selecting of the mounting position so that the table or bench is firm enough to withstand the vibration caused by the rotating machines.

(3) RECTIFIER POWER UNIT. — The Type -20309 Power Unit requires a space 16 1/4" by 17 1/4" by 10 1/8" high for mounting. Refer to Figure 3-12. The unit should be secured in position with four 3/8" bolts.



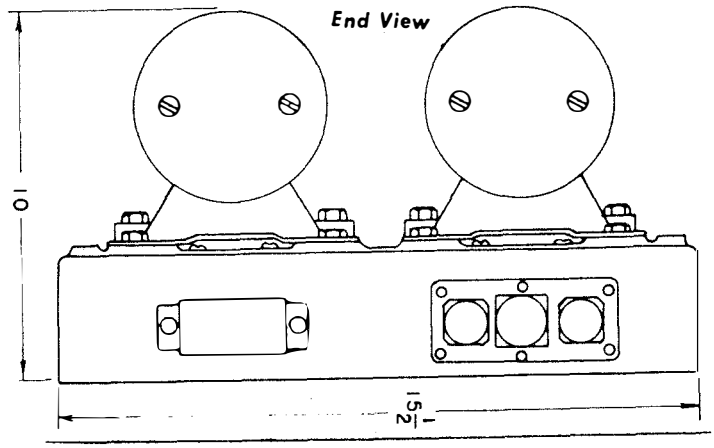


Figure 3-11 Type -211100 and -21827-A Motor Generator Power Units Installation Diagram.

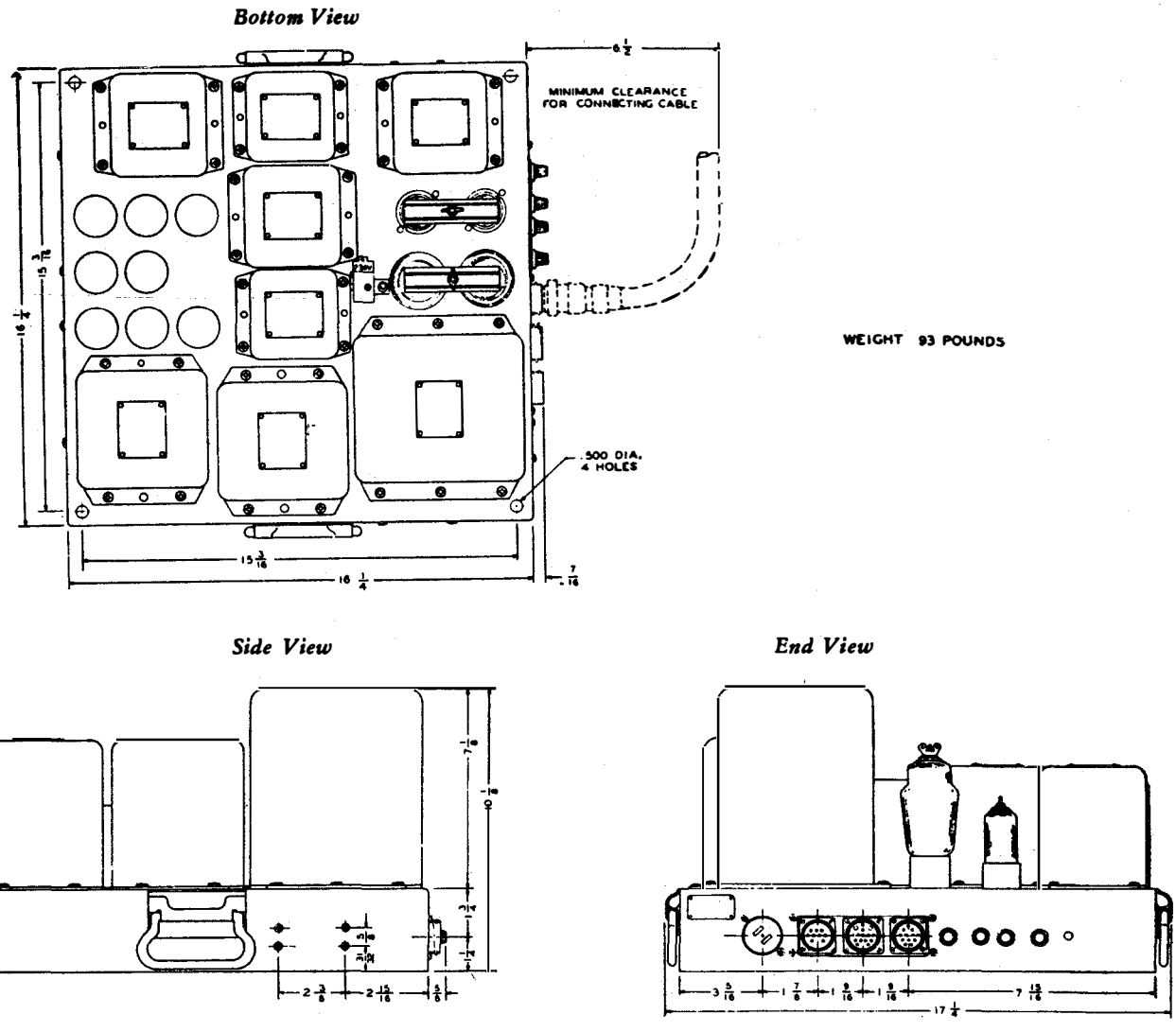


Figure 3-12 Type -20309 Rectifier Power Unit Installation Diagram

c. HAND SET.

Although a hand set is not supplied with TCS equipment, provisions are made for its use through a terminal strip located within the remote-control unit (*see figures 2-25 and 2-26*). If the four knurled knobs are loosened, the bottom mounting plate may be removed, exposing this four-terminal strip. The circuit of a suitable hand set is shown in figure 3-8 with the leads numbered to correspond with the engraving on the terminal strip in the remote-control unit. Like numbered leads and terminals should be connected together. A hole in the chassis of the remote-control unit is provided to admit the hand set cord.

d. REMOTE-CONTROL UNIT.

Remove the remote-control unit from its packing material. Manipulate all controls and switches to check for any damage that may have been caused in shipment. Tighten all screws that may have become loosened.

This unit may be mounted in any position within twenty feet (the length of the control cable) of the power-supply unit. It should be mounted in a position such that the output from the speaker is directed toward the operator and also within easy reach so that he may control the transmitter and receiver power and the audio input to the speaker and phones. Mounting flanges are provided so that the unit may be mounted using four 1/8 bolts. (*Refer to figure 3-13.*) As in the case when mounting all other units, a minimum clearance of 6-1/2" should be allowed between the edge of the chassis nearest the connector plug and any other object which may interfere with the connecting cable.

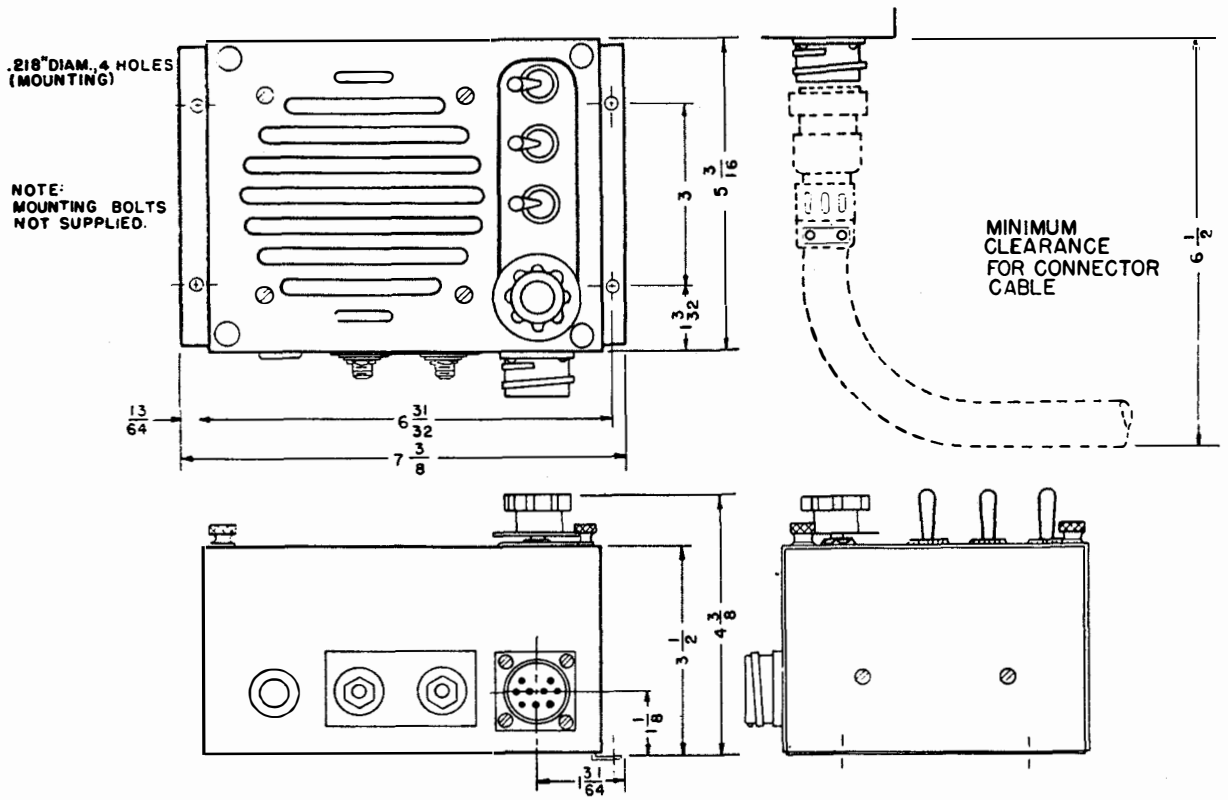


Figure 3-13 Remote-Control Unit Installation Layout

e. ANTENNA LOADING COIL.

The antenna loading coil need not be mounted within reach of the operator but should be mounted in a position so that the control knob may be operated during adjustment of the transmitter. Fig. 3-14 and 3-15 show outline and mounting dimensions of the unit.

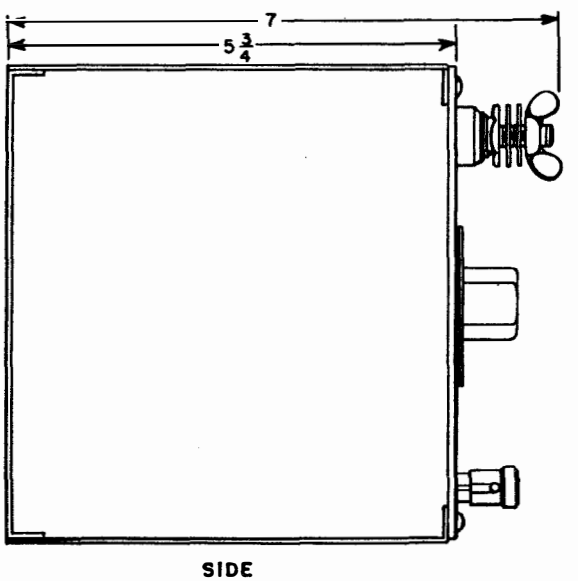


Figure 3-14 Antenna Loading Coil (Side View)

4. CONNECTIONS.

When all the units have been mounted, the installation may be completed by making the power, inter-unit, antenna and ground connections. (*See figure 1-1.*)

a. POWER CONNECTIONS.

The connections from the power source to the power unit should be made with heavy wires or a cable. The size of wire required will be dependent on the type of power unit that is to be used. When using the Dual Dynamotor Power Unit, wire rated at least 20 amperes should be used. Under normal conditions this supply will draw approximately 17 amperes. Correspondingly smaller wire may be used with the other types of power units. The approximate current drawn from the power source by each type of unit may be calculated from data that may be found in the table showing the power input requirements of the power units in Section 7 of this book. Carefully tighten the terminal nuts so that a good

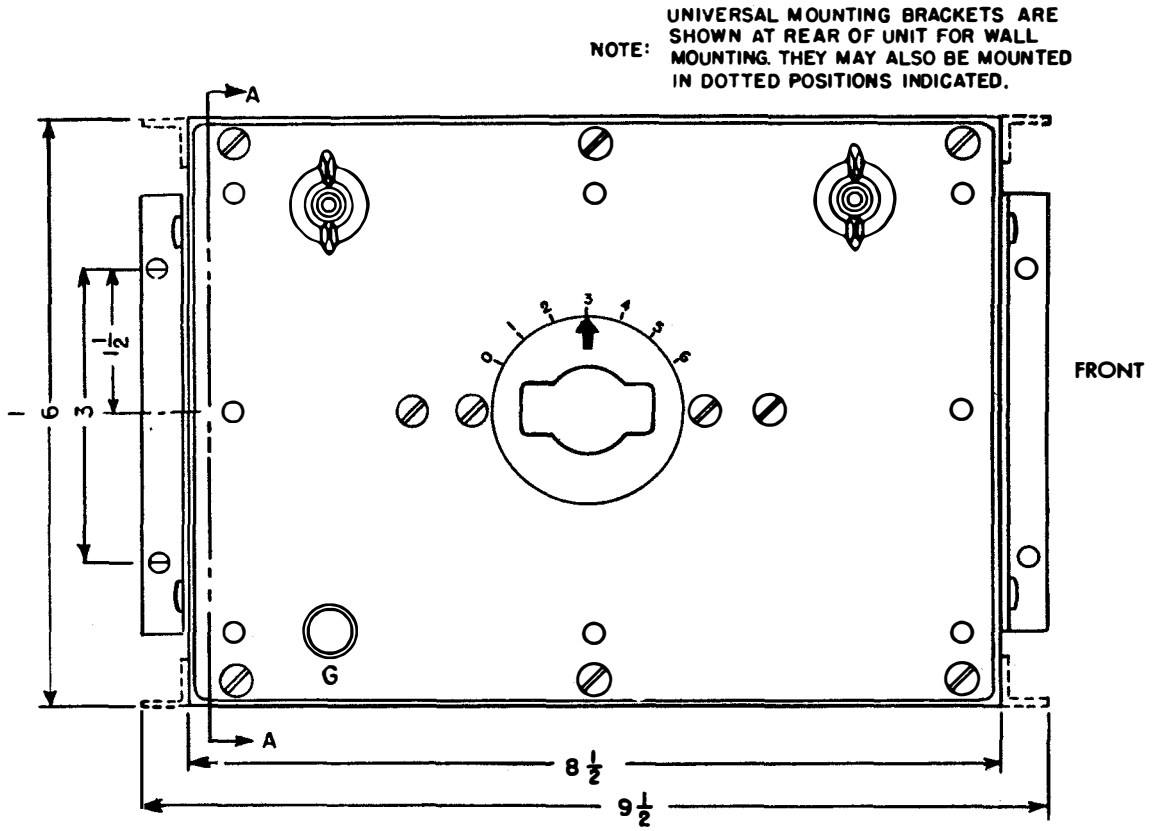


Figure 3-15 Antenna Loading Coil Unit Installation Diagram.

connection is made between the power input cable and the unit input terminal.

CAUTION

The Type -21881-B Power Unit has been designed so that by changing connections on a terminal board on the top of the chassis either the negative or the positive lead from the power source may be connected to the GND terminal. As supplied, the terminal board connections are such that negative lead from the power source should be connected to the GND terminal. If it is desired to connect a positive power source lead to the GND terminal, remove the cover plate from the terminal board and reverse the connections to terminals A and B and reverse the connections to terminals C and D. It must be remembered that the input connections to both dynamotors must be reversed if the polarity of the power source is to be changed. The schematic diagram of this Power Unit is shown on Figure 2-30 and should be referred to when changing power source polarity. When the motor generator power unit is being used either polarity of input power connections may be used.

The Single Machine Dynamotor Power Unit may be connected to operate with either the negative or the positive power lead grounded by removing the bottom plate of the power unit and placing the POLARITY PLUG P2804 into the socket J2801 so that the stamping on plug P2804, as read from the bottom of the chassis, corresponds to the grounded polarity.

Since this power unit has been designed for either 12 or 24 volt plug d-c operation, it is important that VOLTAGE PLUG P2805 be inserted into socket J2802 so that the stamping on the plug, as read from the bottom of the unit, is the same as the input voltage used. This plug, P2805, is located by taking the bottom plate off the unit.

b. INTER-UNIT CONNECTIONS.

IMPORTANT

Before connecting any cables, care should be taken that POWER switch S107 of the trans-

mitter, POWER switch S205 of the receiver and both TRANSMITTER ON-OFF switch S602 and RECEIVER ON-OFF switch S-603 of the remote-control unit are all in the "OFF" positions.

Insert one end of the transmitter power cable (sixteen-prong plugs) into the POWER CONNECTOR receptacle P101 on the transmitter panel and the other end into the sixteen-prong plug receptacle on the power-supply unit. The lock nuts holding this and all other cables to the panels should be tightenetd carefully and the safety locking wires inserted through the small holes in the lock nuts.

Note

The plugs at the two ends of this and the other interconnecting cables are alike, except that one is right-angled and the other straight, so that each cable may be reversed, if desired, for convenience in setting up the inter-connected equipment.

Insert one end of the receiver power cable (twelve-prong plugs) into the POWER CONNECTOR receptacle P201 on the receiver panel and the other end into the twelve-prong plug receptacle on the power-supply unit.

Insert one end of the control cable (nine-prong plugs) into the plug receptacle P601 on the remote-control unit and the other end into the nine-prong plug receptacle on the power-supply unit.

c. ANTENNA CONNECTIONS.

Either a single antenna or separate antennas may be used for transmission and reception. If a single antenna is to be used, this antenna should be connected to the ANTENNA post E105 of the transmitter and a wire jumper should be run between the RECEIVER post E107 of the transmiter and the ANTENNA post E201 of the receiver. No jumper is necessary if separate antennas are used.

The output network of the transmitter and the input circuit of the receiver are designed to satisfactorily match a twenty-foot vertical antenna of the type known as the "whip" or "fishpole" antenna. However, if the transmitter is to be operated in the frequency range 1.5 Mc to 3 Mc, it is desirable to connect the Type CML-47205 Antenna Loading Coil Unit in series with the antenna to permit a better matching of the transmitter output network to the vertical radiator. This inductor is then a part of the antenna coupling network and should be mounted as close to the transmitter as possible to keep r-f losses down to a minimum. It is recommended that bare wire supported on ceramic insulators be used wherever practicable for antenna connections.

d. GROUND CONNECTIONS.

A good ground connection is an important part of the radiation system and should be given careful consideration. When used in mobile service, the GROUND terminals of the transmitter, receiver, and antenna loading coil unit should be connected to the frame of the vehicle in which the installation is being made. If the equipment is operated as a "fixed" station, a good earth ground should be used.

Careful consideration should be given to the length of the leads to the transmitter and receiver ANTENNA and GROUND terminals to permit the free movement of the units on the shock mounts. It is also necessary to allow enough slack in the leads so that the vibration encountered in service will not pull the leads from the terminal posts on the transmitter and receiver.

5. INSTRUCTIONS FOR DISASSEMBLY.

The TCS-14 and TCS-15 equipment employs the subassembly type of construction. The following chart indicates method of separating or reconnecting the various sections.

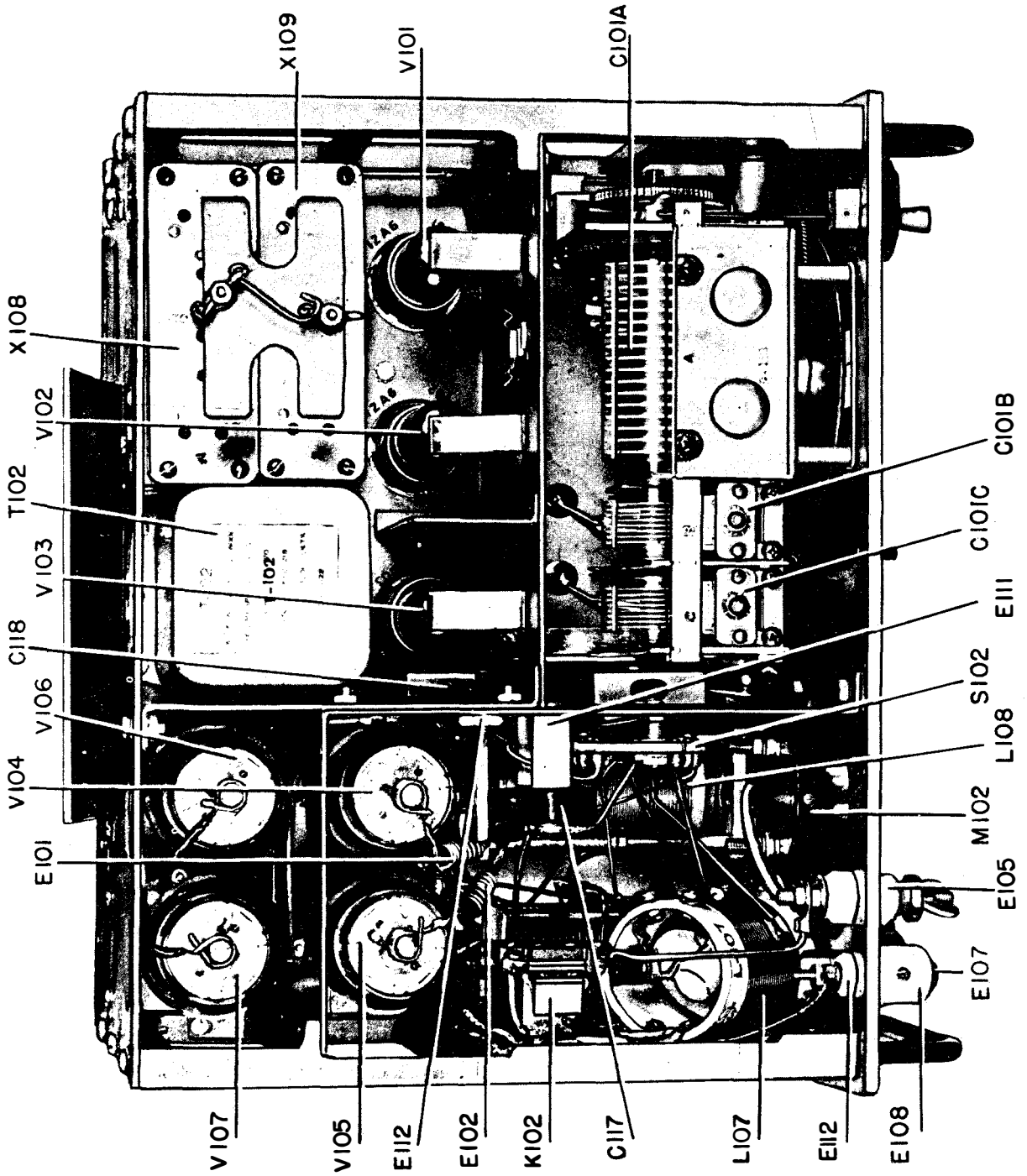


Figure 3-16 Transmitter Type CKP-52245-A, Open Top View

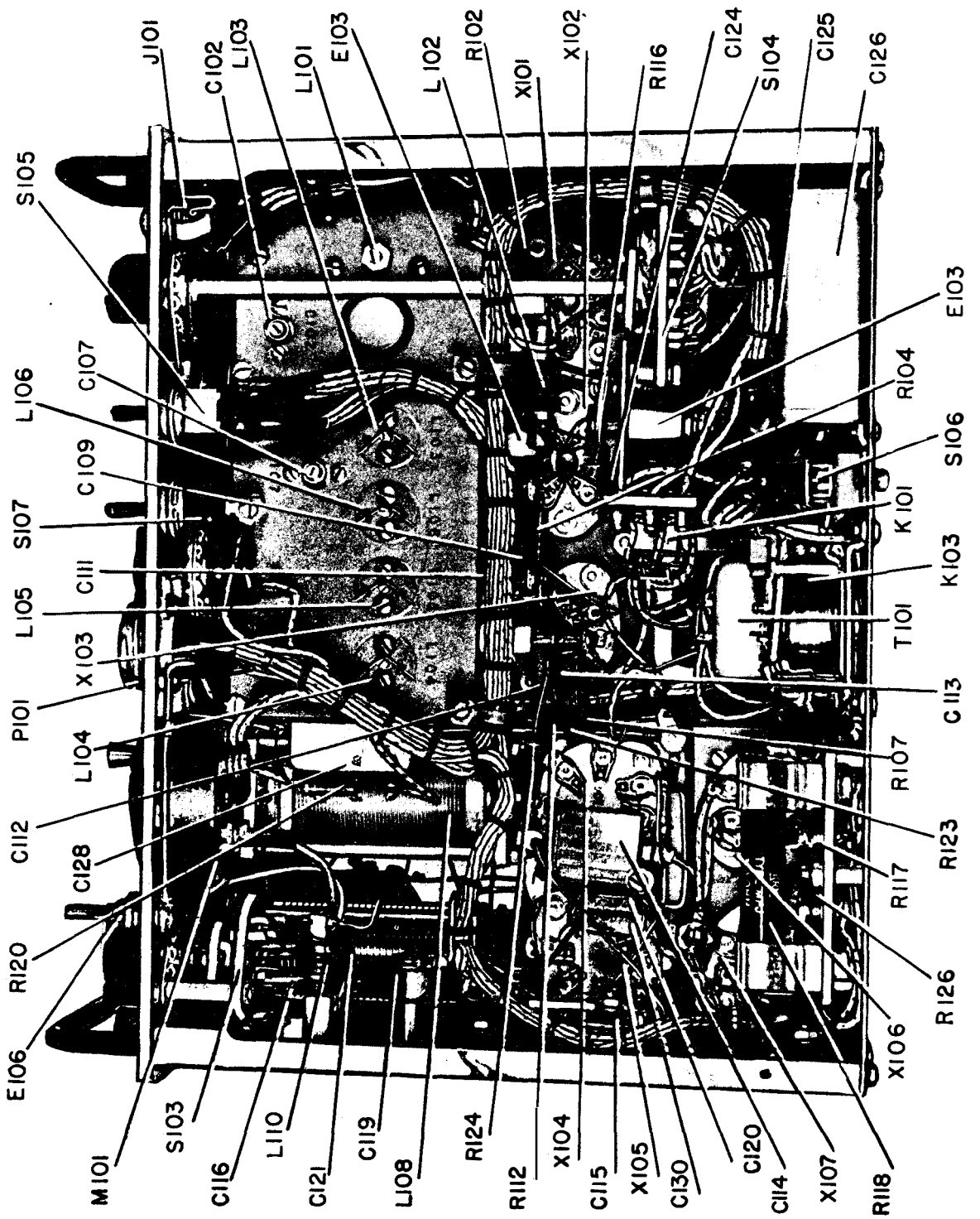


Figure 3-17 Transmitter Type CKP-52245-A, Open Bottom View

TABLE 3-1
DISASSEMBLY PROCEDURE
TRANSMITTER

Assembly	Parts Included	Instructions for Assembly Removal
Back Plate Fig. 3-16, 3-17	C-125, C-126, C-127, C-129, T-101, T-102	Removal of the back plate simplifies much of the service work on the transmitter: It gives immediate access to the parts mounted directly on the back panel and it also fully exposes many other transmitter parts. To remove the back plate, take out the following screws: the 4 on each edge that bolt the plate to the end castings, the 2 that fit into the crystal bracket, the 2 (screwing into stake-nuts) that are near the center of the plate, the 3 that bolt the plate to the vertical modulator-compartment shield, and the one bolting the modulator chassis to the left-end casting. The modulator tube chassis is left bolted to the back plate and no other screws need be taken out. The back plate can now be lifted away from the transmitter frame as far as the connecting wires permit. Some additional clearance may be gained by cutting some of the cable ties.
Front Panel Fig. 3-18	S-101 Detent, S-101 Rotor	Removal of the front panel is necessary only for replacement of the S-101 detent and rotor.
Crystal Bracket Fig. 3-19	C-122, C-123, C-124, C-129, K-101, L-109, R-114, R-115, R-116, S-104, X-108, X-109	Removal of the back plate (see above) gives access to all crystal-bracket parts. When its mounting screws are taken out, the back plate can be pulled away from the crystal bracket. If it becomes necessary to remove the crystal bracket entirely: First, take off the back plate; then take out the 2 screws fitted into the right-end casting, remove the connecting wires, take off the knob of S-104, and slide out the S-104 shaft. The crystal bracket now can be slid out the bottom of the transmitter.
Variable Capacitor Fig. 3-20	C-101A, C-101B, C-101C	To remove the variable-capacitor assembly: Take off the "TUNING" knob and the dial lock (unscrew the dial-lock handle counterclockwise). Reaching through a hole in the right-end casting with a #6 Bristo wrench, loosen the set screws in the shaft extension and remove the shaft extension. Unsolder the 3 wires to the exciter and the braided ground wire. Take out one mounting screw from the right-end casting and 2 from the mounting-foot fitted into the top plate of the exciter. The variable capacitor now can be lifted out the top of the transmitter. In unsoldering the 3 wires going from the variable-capacitor sections to the exciter, it is helpful to remove the three tubes, V-101, V-102, and V-103, and to pass the soldering iron through the large slots in the shield between these tubes and the variable capacitor.

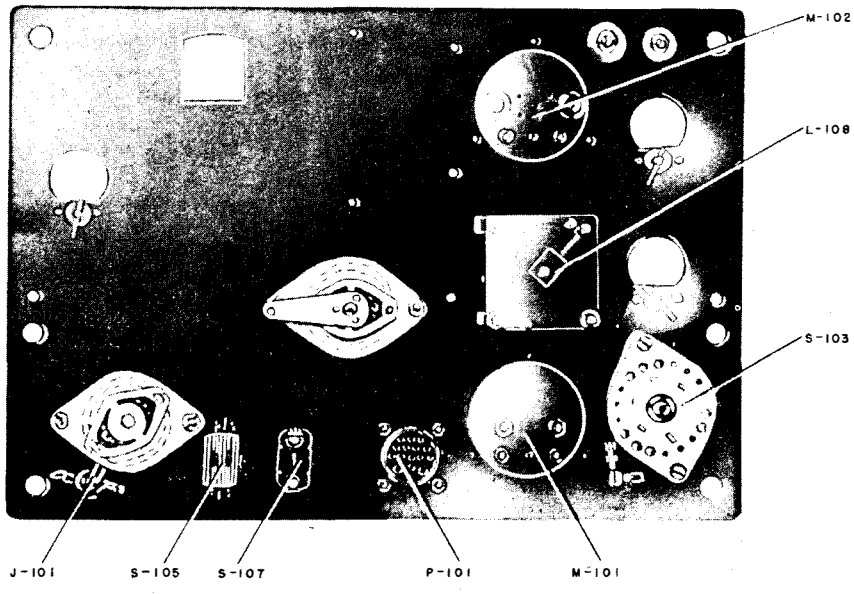


Figure 3-18 Transmitter Front Panel, Inside View

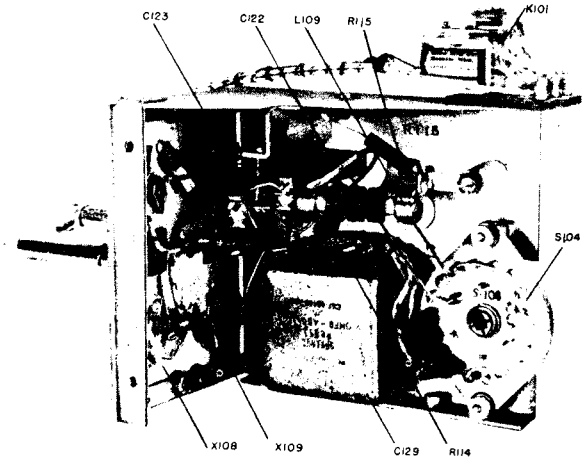


Figure 3-19 Crystal Bracket Assembly

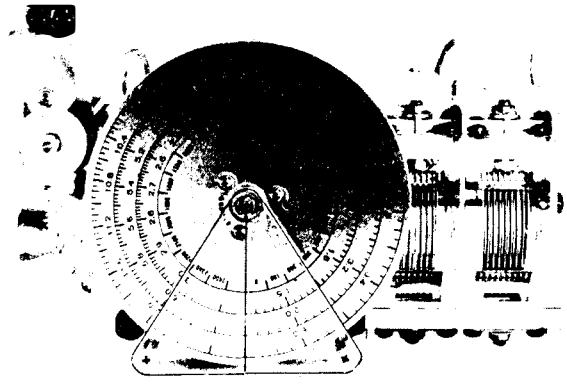


Figure 3-20 Ganged Variable Capacitor Assembly

TRANSMITTER (Continued)

Assembly	Parts Included	Instructions for Assembly Removal
Exciter Figs. 3-21, 3-22, 3-23	C-102, C-103, C-104, C-105, C-106, C-107, C-108, C-109, C-111, C-112, C-113, L-101, L-102, L-103, L-104, L-105, L-106, R-101, R-102, R-103, R-104, R-106, R-125, S-101, X-101, X-102, X-103	Removal of the exciter is not advisable unless the part sought for replacement is otherwise inaccessible. External parts can be replaced by loosening or removing the transmitter back plate and the crystal bracket (refer to the preceding page). Internal parts can be replaced by removing the variable capacitor C-101, Fig. 3-20 (refer to page 3-14), or the bottom plate of the exciter, Fig. 3-21. To remove this bottom plate, take off the knob of S-104, slide out the shaft of S-104, and take out all bottom-plate machine screws. To remove the top plate, take out all its machine screws. If it is necessary to remove the exciter assembly itself, the procedure is as follows: Remove the right-end casting by taking out the back-plate screws, front-panel handles, cabinet locks, and the screws holding the exciter and the crystal bracket. Take out the 2 screws in the top bracket next to V-102 and V-103. Take out the 4 screws in the left end of the exciter, 2 of which hold C-128. Take off the knobs of S-101 and S-104 and slide out the shafts of these switches. Remove the cable clamps and the connecting wires. Disconnect three buss wires from the variable capacitor C-101. The exciter assembly now can be removed from the right end of the transmitter.
Final Amplifier Plate Inductance Fig. 3-24	L-107	Before removing L-107, take off its "COUPLING" dial and dial lock (the latter is removed by taking out the mounting screws and turning the lever counterclockwise). The coil then can be unbolted from the left-end casting, its connecting wires clipped, and the coil brought out through the casting. (Note: It is recommended that the connecting wires be clipped and replaced rather than unsoldered while the coil is still in the transmitter.)
Antenna Loading Coil Figs. 3-16, 3-17	L-108	To remove L-108: Take out the 4 mounting screws bolting the bakelite escutcheon to the front panel, take out one screw in the rear bracket, and unsolder the connecting wires. The whole unit then can be brought out through the front panel.
Plate-Tuning Capacitor Figs. 3 and 24	C-116	To remove C-116, L-108 must first be removed as directed above. Then take off the dial lock of C-116 by taking out its mounting screws and turning the lever counterclockwise. Take out the bolts securing C-116 to the left-end casting and unsolder the connecting wires. C-116 then can be brought out through the mounting hole for L-108.

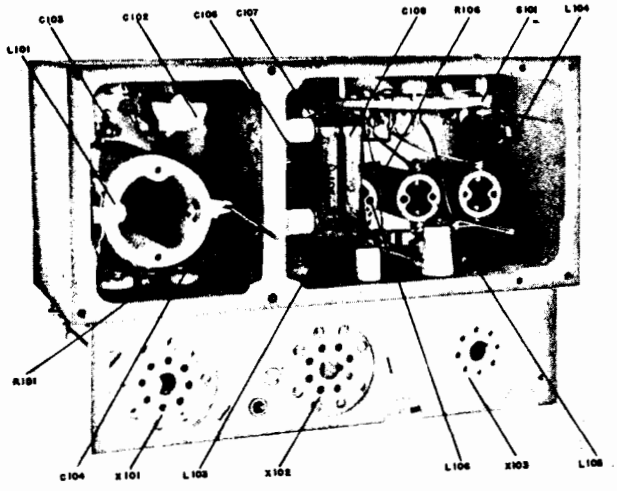


Figure 3-21 Transmitter Exciter Assembly, Top View

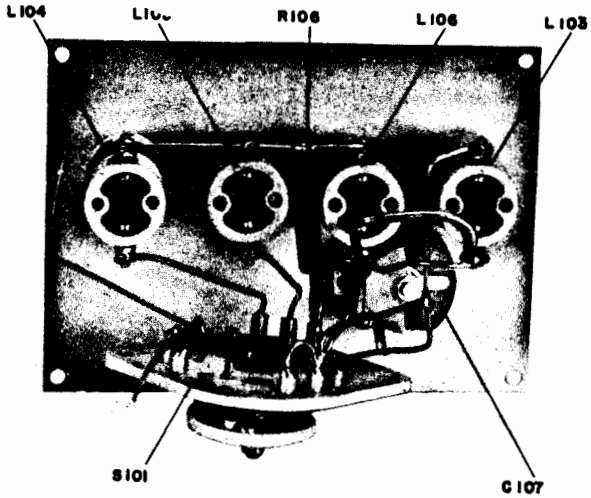


Figure 3-23 Transmitter Exciter Plate Tank Assembly, Top View

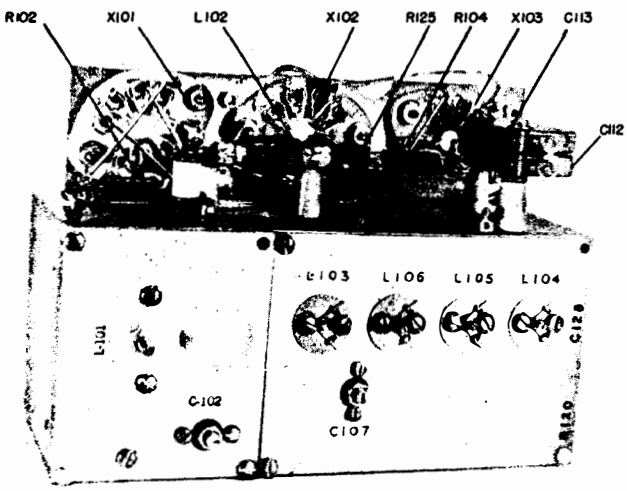


Figure 3-22 Transmitter Exciter Assembly, Bottom View

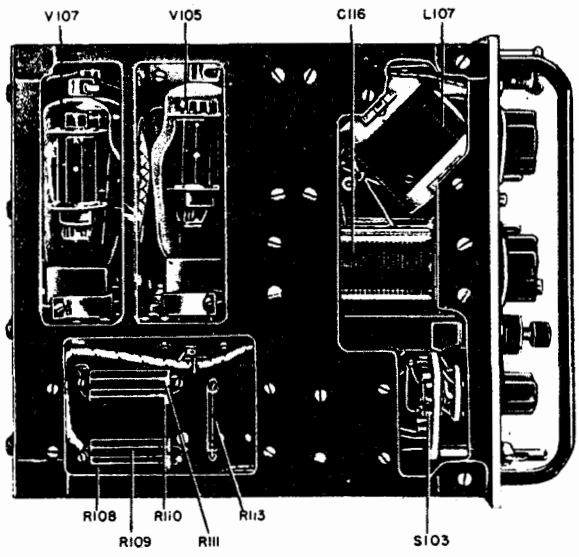


Figure 3-24 Transmitter Unit, Left Side Open View

RECEIVER

Assembly	Parts Included	Instructions for Assembly Removal
R-F, Converter, and H-F Oscillator Assemblies Figs. 3-25, 3-26, 3-27	C-202, C-203, C-204, C-206, C-207, C-208, C-209, C-210, C-212, C-213, C-214, C-215, C-216, C-217, C-218, C-220, C-223, L-201, L-202, L-203, L-204, L-205, L-206, L-208, L-209, L-210, S-201, S-207, S-208	These three units are exposed for servicing by the removal of a bottom plate secured by 11 screws, and most service work on them can be done without removing the units themselves. However, if it is found necessary to remove them, the procedure is as follows: Loosen the set screw in the gear end of the band-switch shaft (S-201, S-207, S-208), press the shaft out of the switch sections and through the hole in the right-end casting. The section of the switch shaft going through the front panel may be removed by taking off its knob and pulling the shaft section out through the detent bushing. Remove the front panel to gain access to the screws bolting the oscillator section to the right-end casting. Take out 6 screws on top and 3 along the front end of the r-f chassis. The units now are free except for their connecting wires, which must be removed carefully so as not to damage any component parts.
R-F Chassis Figs. 3-28, 3-29	C-205, C-211, C-219, C-221, C-222, C-224, C-225, L-207, R-201, R-202, R-203, R-204, R-205, R-206, R-207, R-208, R-209, R-211, R-212, R-213, S-202, T-201, X-201, X-202, X-203, X-208, X-209	All parts on the r-f chassis are made easily available for replacement by taking off the receiver back plate and loosening the large resistor board. In taking off the back plate, remove all the screws except those holding the Bristo wrenches. Before attempting to loosen the resistor board, C-234 should be taken off and pulled away from the board. Then the 4 mounting screws holding the resistor board can be taken out. The connecting leads are flexible enough so that the resistor board can be turned, giving access to the parts on the lower side.

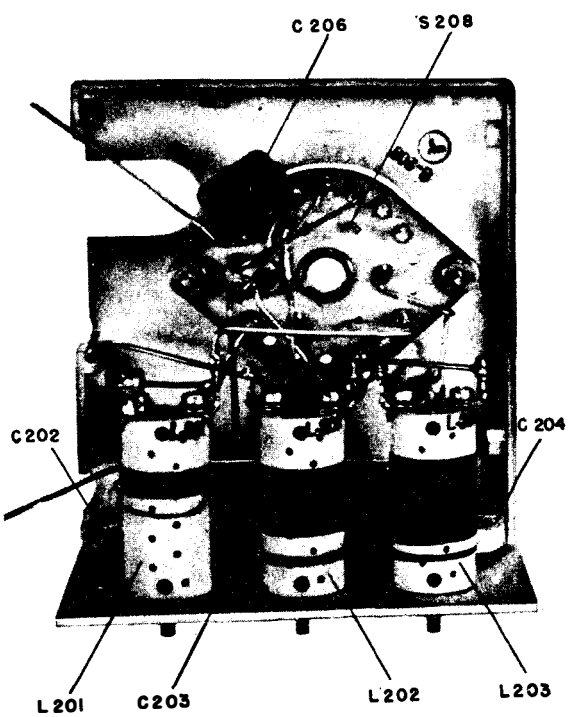


Figure 3-25 Receiver R-F Assembly, Side View

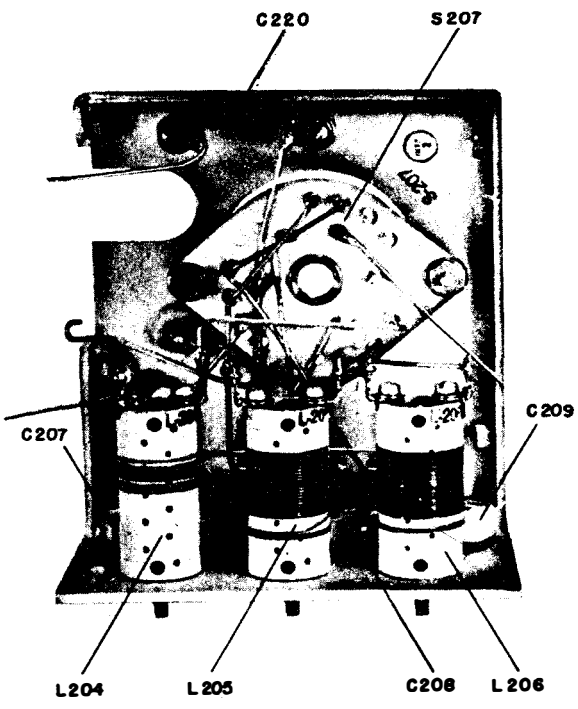


Figure 3-26 Receiver Converter Assembly, Side View

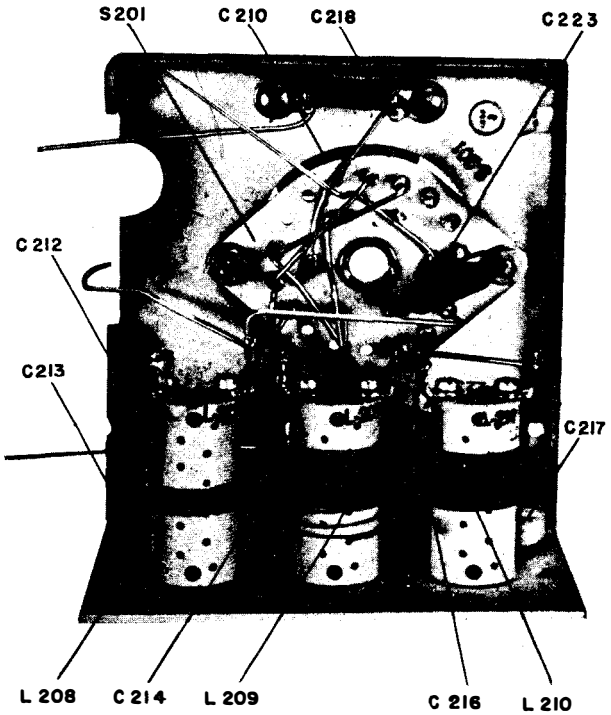


Figure 3-27 Receiver Oscillator Assembly, Side View

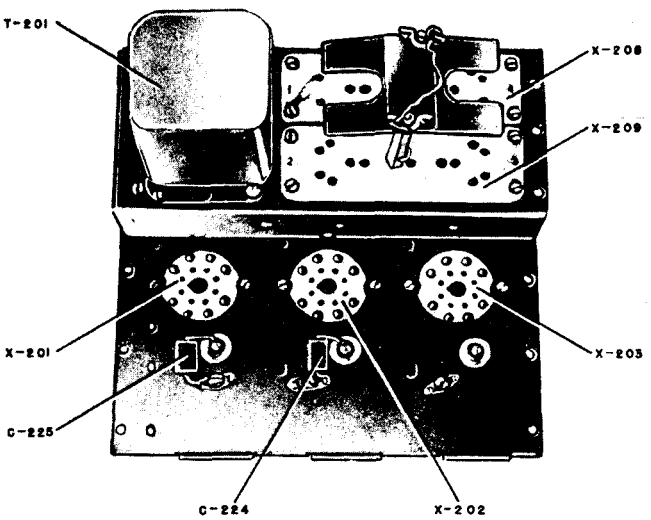


Figure 3-28 Receiver R-F Chassis, Top View

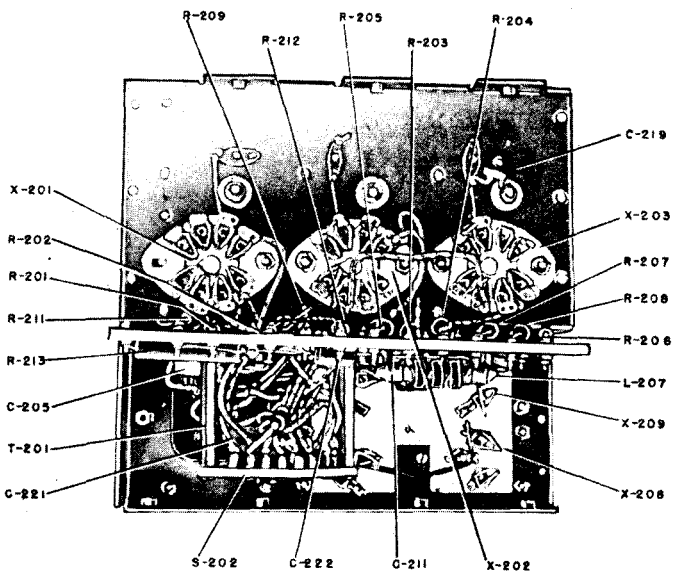


Figure 3-29 Receiver R-F Chassis, Bottom View

RECEIVER (Continued)

Assembly	Parts Included	Instructions for Assembly Removal
I-F and B-F-O Assemblies Figs. 3-30, 3-31, 3-32, 3-33	C-226, C-227, C-288, C-229, C-231, C-232, C-233, C-235, R-210, R-214, R-215, R-218, R-219, R-221, R-222, R-223, R-224, R-225, R-226, R-228, R-230, R-232, X-204, X-205, X-206, X-207, Z-201, Z-202, Z-203, Z-204.	Most of the parts in these assemblies are serviceable without major disassembly. To remove the i-f assemblies, disconnect the connecting wires and take out 4 mounting screws on the top of each assembly plate. The interconnecting wires between the different stages must be removed and pulled through the plates. To repair the b-f-o transformer Z-204: Take off the nuts from the studs holding the shield-can to the chassis, reach through the two holes provided in the front panel with a small screwdriver, take out the trimmer-capacitor mounting screws, and pull off the shield-can.
R-F Gain Control Fig. 3-34	R-216	The removal of R-216 involves gaining enough room behind it so that it may be taken off the rear of the front panel. This is done by taking out the 4 b-f-o assembly mounting screws and tipping back the b-f-o assembly. It is not necessary to remove the CW PITCH knob or any b-f-o unit connections. When replacing R-216, align its positioning pin with the hole in the panel.
Variable Capacitor Fig. 320	C-201A, C-201B, C-201C	The variable capacitor C-201 may be removed as follows: Take off the "TUNING" knob and the dial lock (unscrew the dial-lock handle counterclockwise). Reach through the hole in the right-end casting with a #6 Bristo wrench, loosen the set screws in the shaft extension, and remove the shaft extension. Unsolder the connecting wires, take out one mounting screw from the right-end casting and two from the mounting-foot fitted into the r-f chassis. Lift the variable capacitor out the top of the receiver.

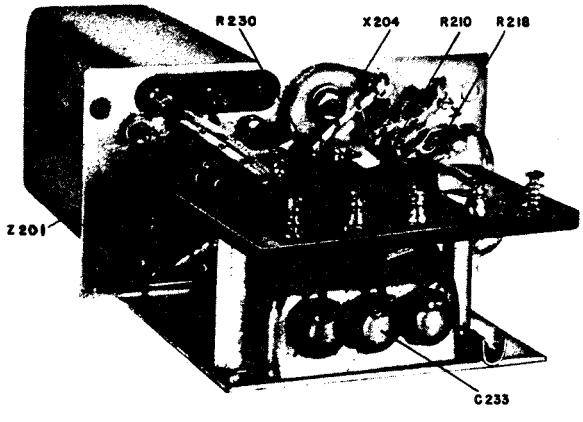


Figure 3-30 Receiver 1st I-F Assembly, Bottom View

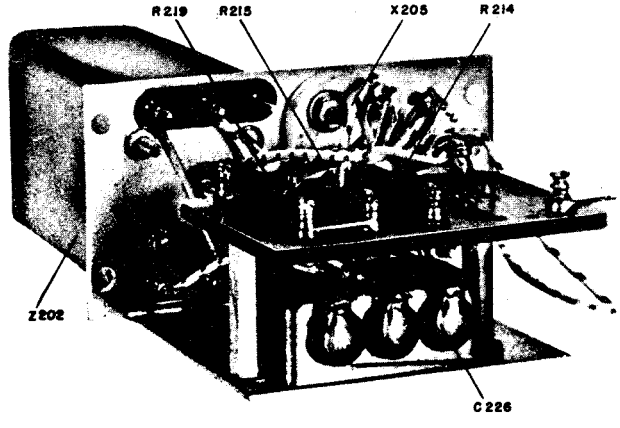


Figure 3-31 Receiver 2nd I-F Assembly, Bottom View

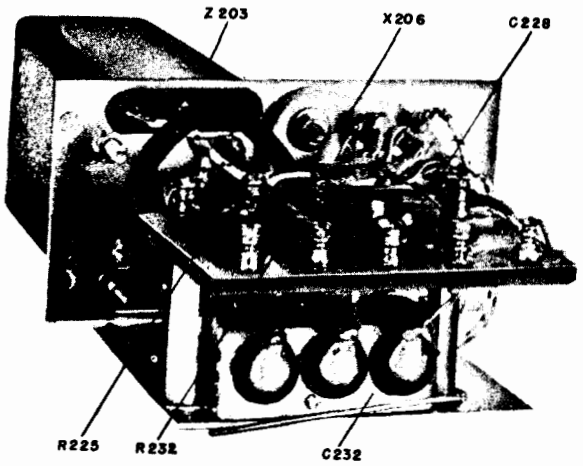


Figure 3-32 Receiver 3rd I-F Assembly, Bottom View

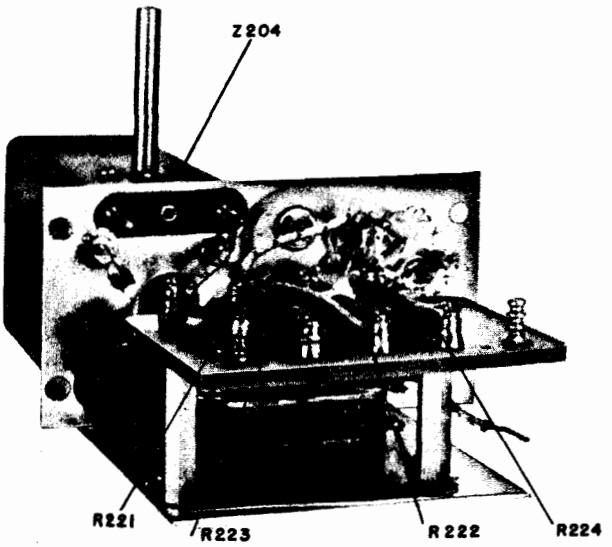


Figure 3-33 Receiver B-F-O Assembly, Bottom View

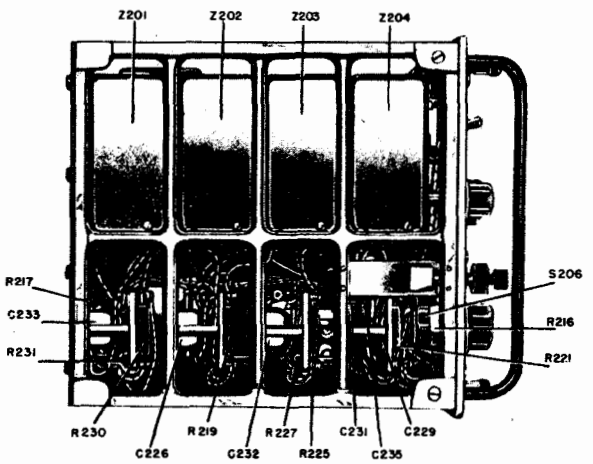


Figure 3-34 Receiver Unit, Left End Open View

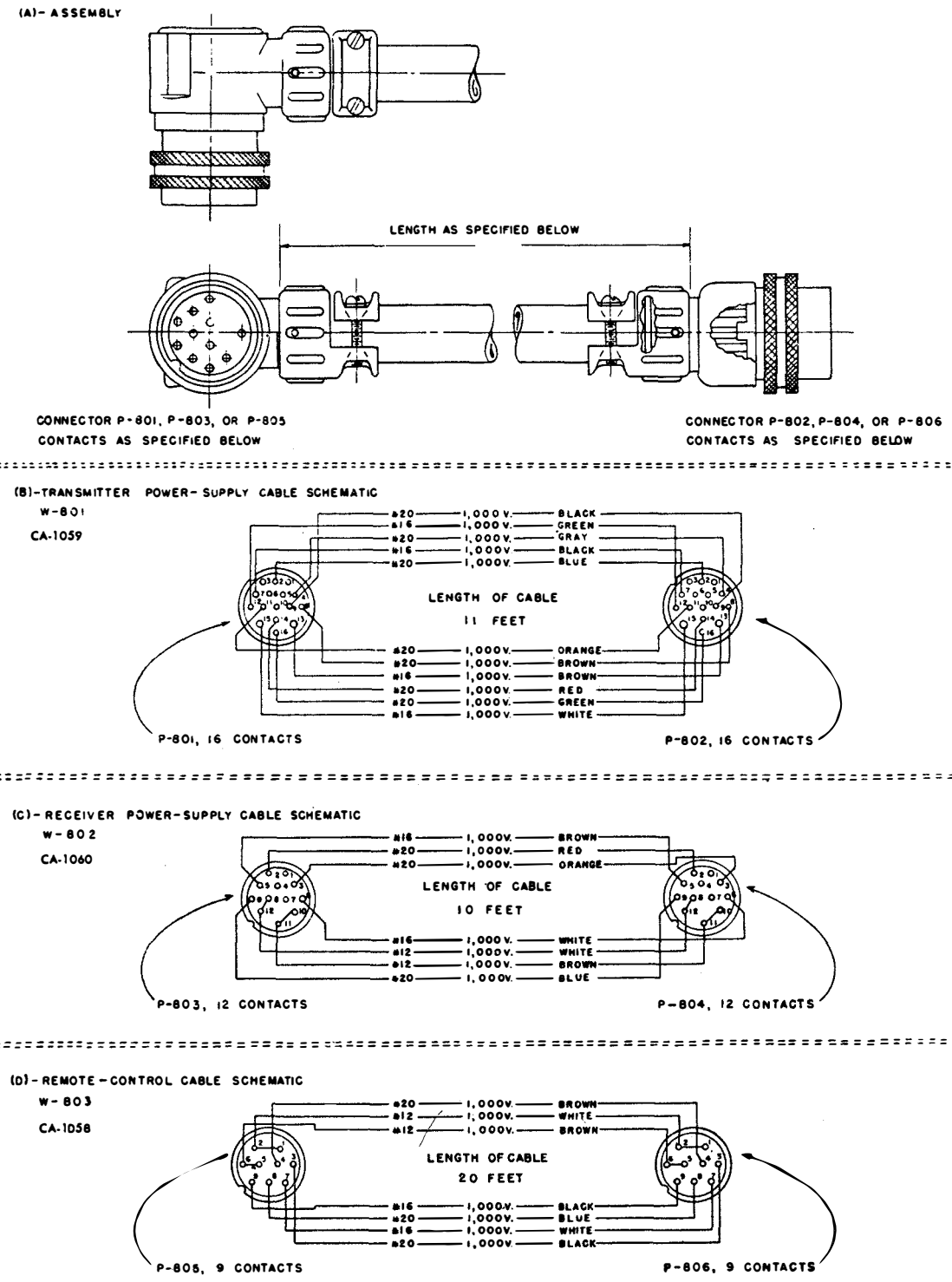


Figure 3-35 Interconnecting Cables. Schematics and Assembly.

6. INITIAL ADJUSTMENTS.

WARNING

OPERATION OF THIS EQUIPMENT INVOLVES THE USE OF HIGH VOLTAGES WHICH ARE DANGEROUS TO LIFE. OPERATING PERSONNEL SHOULD AT ALL TIMES OBSERVE ALL SAFETY PRECAUTIONS. SEE PAGE ix.

DO NOT CHANGE TUBES OR MAKE ADJUSTMENTS INSIDE EQUIPMENT WITH HIGH VOLTAGE SUPPLY ON. DO NOT DEPEND ON DOOR SWITCHES OR INTERLOCKS FOR PROTECTION BUT ALWAYS SHUT DOWN MOTOR GENERATORS OR OTHER POWER EQUIPMENT AND OPEN THE MAIN SWITCH IN THE SUPPLY LINE TO THE EQUIPMENT.
WHILE TRANSMITTER IS IN OPERATION, CARE SHOULD BE TAKEN TO AVOID ANY CONTACT WITH THE ANTENNA OR THE ANTENNA POST E105, SINCE SUCH CONTACT MAY RESULT IN SERIOUS R-F BURNS.

After the complete equipment has been uncrated and installed, the following checks should be made before proceeding with any adjustments for actual operation:

a. Be sure to check the type number of the power unit against the Table of Units (Table 8-2) to determine what source of primary power is necessary for the operation of the unit involved. If the wrong voltage is applied to the input terminals, the unit may be damaged to the extent that it will be necessary to replace components which may involve considerable labor and delay.

b. Be sure that the POWER switches (S107 and S205) on both the transmitter and receiver panels are in the "OFF" position. If the remote-control unit is in use, be sure that the RECEIVER switch S603 in that unit, too, is in the "OFF" position.

c. Be sure that the cabinet clamps on both sides of the transmitter and receiver panels are secure. This is especially important for the transmitter with its power-interlock switch S106.

d. Check the installation of the power cable between the transmitter and the power-supply unit and the power cable between the receiver and the power-supply unit. If the remote-control unit is used, check the installation of its power cable to the power-supply unit. Tighten all cable connector nuts.

e. Check the connection of the power-supply unit to the batteries or other source of power.

f. Check the ANTENNA and GROUND connections to the transmitter and receiver units.

g. Check the fuses in the power supply unit, making sure that good fuses of the proper rating are in place. Each of the power units has been provided with two sets of fuses, one to protect the low voltage section of the power unit and the other to protect the high voltage section of the power unit and the other to protect the high voltage section of the power unit.

Before attempting to operate the equipment the fuses should be removed from the receptacles and checked against the ratings given in Table 5-2. Only fuses of correct ratings should be used.

7. OPERATIONAL CHECK.

After initial adjustments have been made, the following test procedure should be made which will reveal any damage that might affect the operation of the equipment.

a. Connect a dummy load consisting of 100 uuf in series with a non-inductive resistance of 13.6 ohms between the ANTENNA and GROUND terminals of the transmitter.

NOTE

If tests are made near 1500 kc increase the capacity to 300 uuf.

b. Connect an antenna of approximately the same length as the "whip" to the ANTENNA terminal on the receiver and a good ground to the GROUND terminal.

c. Using the cables that have been supplied with the equipment, make the inter-unit connections between the transmitter receiver, power unit and remote control.

d. Connect the power unit to the power source using heavy leads or cable.

e. Operate the POWER switches that are located on the transmitter and receiver front panels, to the ON positions.

f. Insert the microphone cord plug into the MICROPHONE OR KEY jack on the transmitter panel and the earphones cord plug into the PHONES jack on the receiver panel.

g. Operate the EMISSION selector switch on the transmitter panel to the CW position.

h. Operate the push-to-talk button on the microphone and immediately rotate the PLATE TUNING control until the PLATE CURRENT meter indicates a sharp dip in plate current. Tune for exact minimum plate current.

i. Check the operation of the transmitter, receiver, power unit and control, by using both the panel controls and the controls located on the remote control unit to perform the functions necessary for the transmission and reception of both modulated and CW signals.

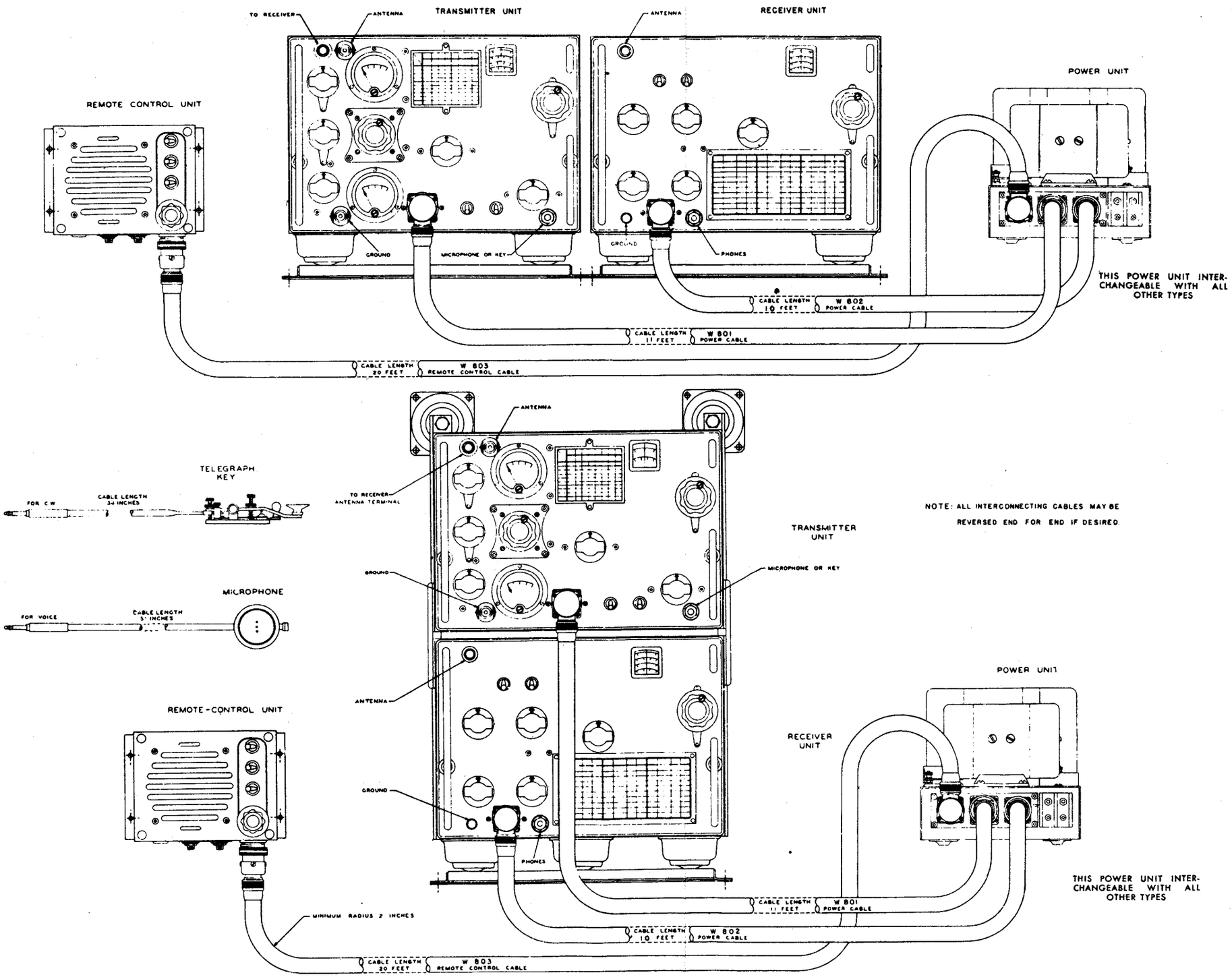


Figure 3-36 General View of TCS Equipment with Interconnecting Cables

SECTION IV — OPERATION

WARNING

OPERATION OF THIS EQUIPMENT INVOLVES THE USE OF HIGH VOLTAGES WHICH ARE DANGEROUS TO LIFE. OPERATING PERSONNEL SHOULD AT ALL TIMES OBSERVE ALL SAFETY PRECAUTIONS. SEE PAGE ix.

DO NOT CHANGE TUBES OR MAKE ADJUSTMENTS INSIDE EQUIPMENT WITH HIGH VOLTAGE SUPPLY ON. DO NOT DEPEND ON DOOR SWITCHES OR INTERLOCKS FOR PROTECTION BUT ALWAYS SHUT DOWN MOTOR GENERATORS OR OTHER POWER EQUIPMENT AND OPEN THE MAIN SWITCH IN THE SUPPLY LINE TO THE EQUIPMENT.

1. ROUTINE OPERATION.

In the following paragraphs the routine operating procedure is outlined in brief form:

a. CW OR VOICE OPERATION—PANEL CONTROL. (See figures 4-1 and 4-2.)

(1) Select the desired type of oscillator control for both transmitter and receiver with the OSCILLATOR SELECTOR switches S104 and S202 ("MO" or choice of four "CO" positions).

(2) Place the EMISSION switches S105 and S203 on the transmitter and receiver in the positions corresponding to the type of emission and reception desired: "VOICE" (or "MOD.") or "CW."

(3) Adjust the BAND SWITCHES and the TUNING controls C101 and C201 to the desired frequency.

(4) Plug the microphone or the telegraph key into the MICROPHONE-OR-KEY jack J101 on the transmitter panel.

(5) Plug the headphones into the PHONES jack J201 on the receiver panel.

(6) Place the transmitter and receiver POWER switches S107 and S205 in the "ON" position.

(7) Allow about a half-minute for the tube filaments to heat up. Then close the telegraph key (or press the microphone "push-to-talk" button) and adjust the transmitter PLATE TUNING and ANTENNA LOADING controls as described under "TRANSMITTER OPERATION." As noted there, the Type CML-47205 Antenna Loading Coil must also be used if the transmitter is to operate within the frequency range of Band 1 (1.5 Mc to 3 Mc). *Note carefully the warning against overheating the tubes and frequency-doubling in the final amplifier of the transmitter.*

After the above adjustments have been made, the complete equipment is ready for operation.

(8) To shut down the transmitter and receiver, merely place POWER switches S107 and S205 in the "OFF" position.

b. CW OR VOICE OPERATION—REMOTE CONTROL.

Before the equipment can be controlled from the remote position, all tuning and coupling adjustments must be made with the transmitter and receiver panel controls as described above.

(1) After these adjustments have been made and the equipment is ready for operation, place both panel POWER switches S107 and S205 in the "OFF" position.

(2) Remove the microphone or the telegraph key from the MICROPHONE-OR-KEY jack J101 on the transmitter panel and insert it into the MICROPHONE jack J602 on the remote-control unit.

(3) If headphones are to be used, plug them into the PHONES jack J601 on the remote-control unit, and place the SPEAKER-PHONES switch S601, on the same unit, to the "PHONES" position.

(4) For speaker operation, the SPEAKER-PHONES switch S601 should be placed in the "SPEAKER" position.

(5) Place the TRANSMITTER ON-OFF and RECEIVER ON-OFF switches S602 and S603, on the remote-control unit, in the "ON" position. After a wait of about a half minute (for the tube filaments to heat up) the transmitter and receiver are ready for remote-control operation. The receiver audio output may be adjusted with the VOLUME CONTROL R601 on the remote-control unit.

(6) To shut down the transmitter and receiver, merely place the TRANSMITTER ON-OFF and RECEIVER ON-OFF switches S602 and S603 in the "OFF" position.

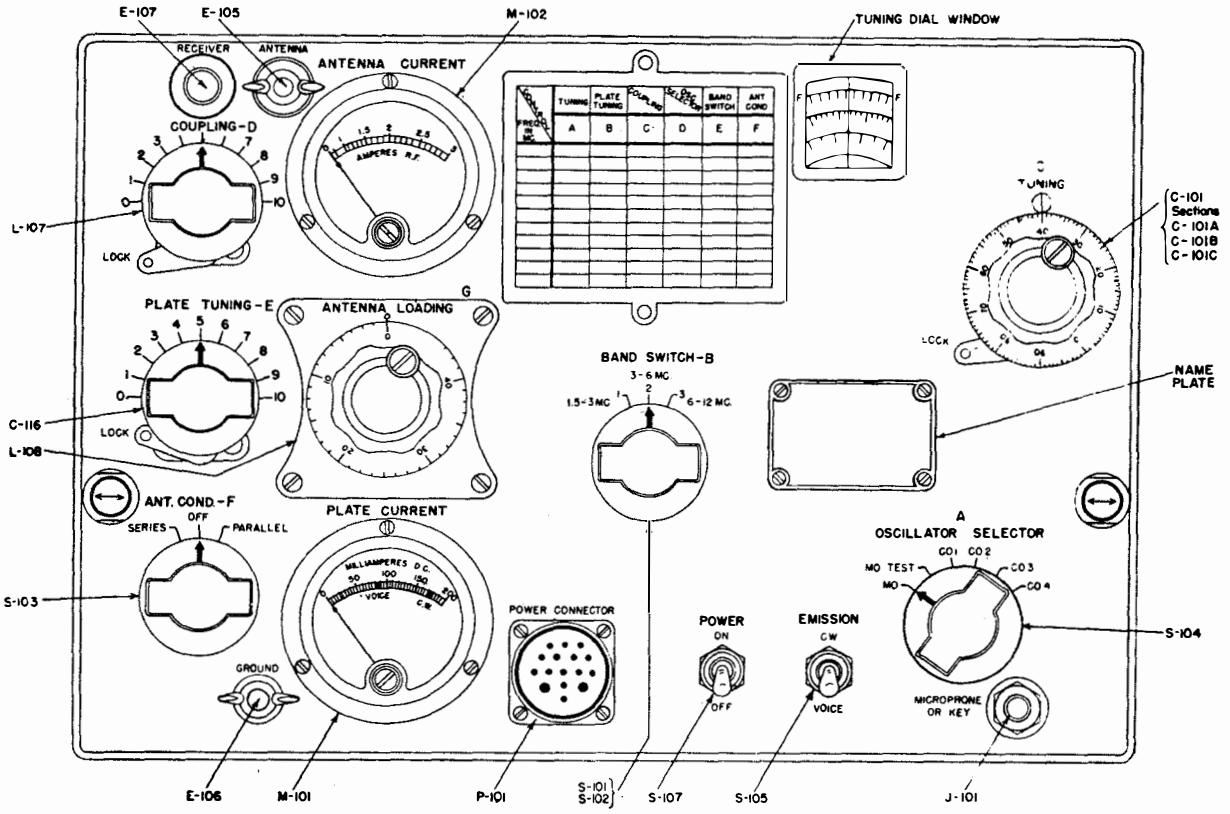


Figure 4-1 Transmitter Front Panel.

2. TRANSMITTER OPERATION.

After the preliminary adjustments have been made a number of choices confront the operator. He must decide:

1—whether the transmitter is to be master-oscillator or crystal-oscillator controlled,

2—whether the emission is to be CW or voice-modulated,

3—the frequency at which the transmitter is to be operated.

a. MASTER OSCILLATOR OR CRYSTAL OSCILLATOR.

IMPORTANT

The crystal-oscillator tube V102 should be in its proper socket at all times, regardless whether the transmitter is self-excited or crystal-excited, so that its capacitance will be present to maintain the alignment of the 3-gang tuning capacitor C101 of the transmitter.

If master-oscillator operation is desired, the OSCILLATOR SELECTOR switch S104 is rotated to the "MO" position. If, however, the transmitter is to be crystal-oscillator controlled, any one of four different crystals may be selected by rotating the OSCILLATOR SELECTOR switch to "CO 1", "CO 2", "CO 3", or "CO 4".

b. CW OR VOICE-MODULATION. — Having decided upon the type of excitation, the operator now must choose the type of emission to be used. If CW emission is selected, the telegraph key is plugged into the MICROPHONE-OR-KEY jack J101, and the EMISSION switch S105 is placed in the "CW" position. If voice-modulated emission is desired, the microphone is plugged into the MICROPHONE-OR-KEY jack in place of the telegraph key and the EMISSION switch is placed in the "VOICE" position.

c. SELECTING THE FREQUENCY. — The BAND SWITCH S101 and S102 should be set on the band that includes the desired transmission frequency. If master-oscillator operation is to be used, the TUNING control C101 is adjusted to the desired frequency as indicated by the dial calibration appearing in the window slightly above and to the left of the TUNING control.

Note

Four sets of dial readings appear in the window

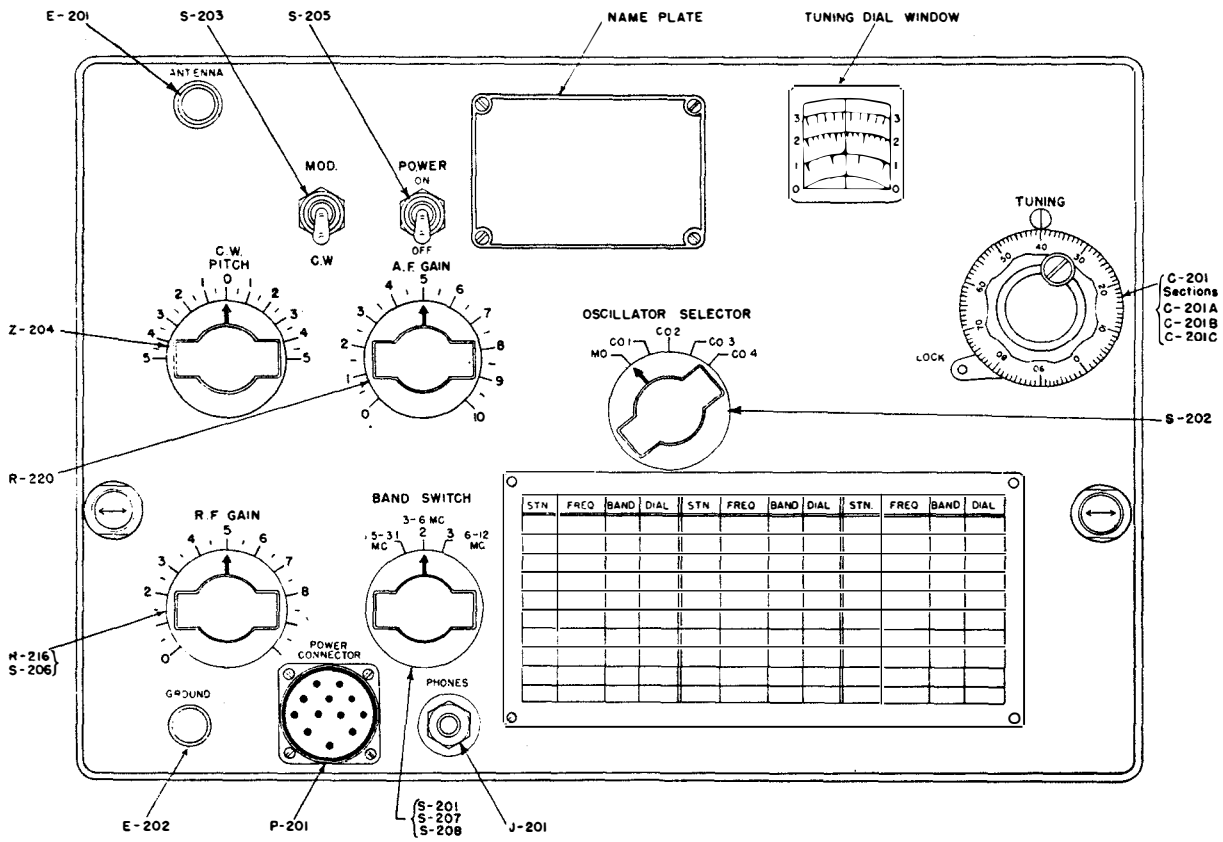


Figure 4-2 Receiver Front Panel.

to the left of the TUNING control. The topmost reading indicates frequencies lying in Band 3 (6 Mc to 12 Mc) and is identified by the numbers "3" engraved on the escutcheon around the window. The next lower set of readings refer to frequencies lying in Band 2 (3 Mc to 6 Mc) and is indicated by the numbers "2" engraved on the escutcheon. The numbers "1" refer to the reading indicating frequencies lying in Band 1 (1.5 Mc to 3 Mc). The bottom set of readings (indicated by numbers "0") are arbitrary units referring to the amount of rotation of the TUNING capacitor C101.

All the above refers also to the readings in the tuning dial window of the receiver unit. (See fig. 4-2).

If the output of the transmitter must be exactly on a specified frequency, it is advisable to use a frequency monitor or other means of checking the frequency. To conduct this test, the OSCILLATOR SELECTOR switch S104 should be rotated to the "MO TEST" position and the power applied as hereinafter described. With switch S104 in this position, only the oscillator and buffer stages are operative, thus providing a reduced-power output for the purpose of the frequency test.

Any necessary frequency change may be made by adjusting the TUNING control C101. When the oscillator has been tuned to the desired frequency the TUNING control should be locked in position. This is done by moving the lever under the TUNING dial in a clockwise direction towards the word "LOCK" engraved on the panel. (All the locking devices on the transmitter and receiver panels operate in the same way.) The OSCILLATOR SELECTOR switch should then be turned back to the "MO" position.

If the transmitter is to be crystal-controlled, the frequency of the output will depend upon the natural frequency of the crystal selected. Thus, operation in Band 1 will be at the fundamental frequency of the crystal, operation in Band 2 will be at the second harmonic frequency, while operation in Band 3 will be at the fourth harmonic frequency.

d. TUNING THE FINAL AMPLIFIER.—The transmission frequency being set, the operator may now proceed to tune the final amplifier. The panel controls should be set as follows:

PLATE TUNING	at "0"
COUPLING	at "0"
ANTENNA LOADING	at "0"
ANT. COND.	at "OFF"

Both POWER switch S107 on the transmitter panel and POWER switch S205 on the receiver panel should be placed in the "ON" position. Power is thus applied to the oscillator and buffers stages.

When CW emission has been selected, closing the telegraph key causes high voltage to be applied to the plate circuit of the final amplifier tubes V104 and V105. If the EMISSION selector switch is in the "VOICE" position, pressing the "push-to-talk" button on the microphone applies high voltage to the plate circuit of final-amplifier tube V104 (final-amplifier tube V105 is disabled) and the plate circuit of the modulator tubes V106 and V107.

WARNING

Great care must be exercised to prevent damage to the final-amplifier tubes due to over-heating in out-of-resonance operation while tuning up. The rated plate currents are as follows:

VOICE	80 to 90 milliamperes
CW	170 to 180 milliamperes

These ratings are indicated by red bands on the scale of the PLATE CURRENT meter M101. Should the pointer go beyond these bands, it indicates that the transmitter is out of resonance and that the final-amplifier tubes are being overheated. Since these tubes may be damaged by prolonged overheating, the transmitter must be brought to a resonant condition as quickly as possible.

Resonance is obtained by rotating the PLATE TUNING capacitor C116 until the PLATE CURRENT, as indicated on M101, dips sharply. Tune for the exact minimum PLATE CURRENT meter reading.

In crystal-controlled operation the tuning of the oscillator and buffer stages is rather broad, but in all cases the PLATE TUNING control should be adjusted to give a minimum PLATE CURRENT reading, indicating resonance.

CAUTION

Care should be exercised, while making PLATE TUNING adjustments, to avoid doubling the frequency in the final-amplifier circuit. This stage is designed for operation only as a straight amplifier. It is often possible to obtain PLATE CURRENT dips with two different settings of the PLATE TUNING control C116, but only the lower dial setting which results in a pronounced dip of the PLATE CURRENT meter is correct. In general, the higher the frequency of the transmitter output, the greater the dial reading of the PLATE TUNING and ANTENNA LOADING controls. The other dip indicates that the final amplifier is acting as a frequency-doubler; this is undesirable because it loses the advantage of a favorable L/C ratio. All frequency multiplying should be done in the oscillator and buffer stages by selecting the correct position of the BAND SWITCH.

From this point, the tuning will be dependent on the operating frequency and the type of antenna used. The following paragraphs outline the procedure for transmitter adjustments when the recommended "short" (twenty-foot) vertical radiator is employed. It should be noted that if the antenna is appreciably longer than twenty feet, operation at the high-frequency end of the frequency range (Band 3) is not possible. The antenna then must be shortened. On the other hand, if the antenna is considerably less than twenty feet long, operation at the low-frequency end of the frequency range (Band 1) may be impossible, even with the use of the external LOADING COIL as described below. The obvious remedy is to lengthen the antenna.

e. COUPLING THE FINAL AMPLIFIER TO ANTENNA.—When coupling the final amplifier tank circuit to the antenna, the operator should keep a continuous watch upon the PLATE CURRENT meter M101 and the ANTENNA CURRENT meter M102. Care should be taken that the plate current does not exceed the rated values (as indicated by the red bands on the scale of M101). The object of this operation is to obtain as large an antenna current as possible at the rated plate current.

The antenna COUPLING control L107 should be set at the "10" position. Then the ANTENNA LOADING control L108 should be rotated slowly in a clockwise direction until the ANTENNA CURRENT meter attains its maximum reading. At this point the antenna COUPLING control should be set at the "9" position and the ANTENNA LOADING control should be rotated back and forth several degrees to see if a further rise in antenna current may be obtained. Then set the antenna COUPLING control in the "8" position and repeat as before. Continue this procedure until the largest antenna current (at the rated plate current) is obtained.

If it is found impossible to load the transmitter to the rated plate current through adjustments of the antenna COUPLING and ANTENNA LOADING controls, as directed above, the ANT. COND. switch S103 should be rotated from the "OFF" to the "SERIES" position, and the loading procedure attempted again. (The "SERIES" setting of S103 is likely to be required only in operation at the high-frequency end of the transmitter's range.)

Note

The "PARALLEL" setting of the ANT. COND. switch S103 should not be necessary when the Type CML-47205 Antenna Loading Coil is available for properly loading the transmitter to the rated plate current in operation on Band 1 with the recommended "short" antenna. If the antenna loading coil should not be available for operation on Band 1 with the recommend-

ed "short" antenna, good operation may be unobtainable. In this case, the "PARALLEL" setting of the ANT. COND. switch should be used. If improvement is still needed, try a longer antenna.

For operation within the frequency range of 1.5 Mc to 3 Mc (Band 1) with the recommended "short" vertical radiator, it is necessary to use the Type CML-47205 Antenna Loading Coil, connected in series with the antenna lead-in. This is a separate major unit and is distinct from the ANTENNA LOADING control L108, which is provided on the transmitter panel. Remove the antenna lead-in from the ANTENNA post E105 on the front panel of the transmitter; connect it to one of the terminal posts, with wing-nuts, on the front panel of the antenna loading coil; and connect a "jumper" wire from the other terminal post of the antenna loading coil to the transmitter ANTENNA post E105. Another "jumper" wire should be connected from the GROUND post E703, marked "G", on the front panel of the antenna loading coil to the GROUND post E106 on the transmitter front panel.

The inductance of the Type CML-47205 Antenna Loading Coil can be varied in steps from "0" (its maximum inductance) to "6" (coil shorted), as determined by the setting of the tap switch S701 on the loading coil panel. These steps are designed so that it is possible to obtain continuously variable loading through the combination of this antenna loading coil and the internal loading coil L108.

Note

In making loading adjustments, whenever the Type CML-47205 Antenna Loading Coil and the transmitter internal loading coil L108 are used in conjunction, the most effective combination of the two is with the lowest-numbered possible setting (maximum inductance) of S701 on the Type CML-47205 coil and the highest-numbered possible setting (minimum inductance) of the ANTENNA LOADING control L108 on the transmitter front panel.

The above paragraphs give a general outline of the tuning and loading adjustments. The procedure itself may be varied slightly, but the operator always should keep in mind the fact that the desired objective is the greatest ANTENNA CURRENT reading with the rated PLATE CURRENT.

To aid the operator, Table 4-1 is presented. *It should be kept in mind that this table is merely a broad approximation of the settings which the operator will encounter in tuning his transmitter since variations exist between different transmitters, especially if different size antennas are used.* The recommended twenty-foot antenna was used for this table.

f. CHANGING EXCITATION DURING OPERATION.—It may become necessary for the operator to change from crystal-oscillator to master-oscillator operation (or vice versa) while the transmitter is in operation. To accomplish this the OSCILLATOR SELECTOR switch S104 should be rotated to the desired position. If no change in frequency is contemplated, no tuning adjustment is necessary, except to compensate for a very slight detuning which sometimes occurs as the change-over is made. It should be remembered, however, that crystal-oscillator operation is restricted to the fundamental and harmonic frequencies of the crystal employed.

In making these changes, as well as all other changes made while the transmitter is in operation, high voltage must be kept off the plates of the tubes. Care must be taken to keep the telegraph key in an open position and the "push-to-talk" button on the microphone must not be pressed.

g. CHANGING EMISSION DURING OPERATION.—In changing from voice-modulated to CW operation, the operator should remove the microphone plug from the MICROPHONE-OR-KEY jack J101 and place EMISSION switch S105 in the "CW" position. After an interval of about a half-minute (time for final-amplifier tube V105 to heat up) the telegraph key should be plugged into jack J101. When the key is pressed, the plate current, as indicated on the PLATE CURRENT meter M101, should not exceed 180 milliamperes. If the current rises beyond this value, the transmitter is out of resonance and should be brought back *at once* by adjusting the PLATE TUNING capacitor C116 for the maximun current dip. Coupling between the final amplifier and the antenna now should be adjusted (as described above) to obtain the greatest ANTENNA CURRENT reading at the rated PLATE CURRENT.

To change from CW to voice-modulated operation, the operator should remove the telegraph key from the MICROPHONE-OR-KEY jack. *The antenna COUPLING control L107 should be turned back to the "0" position. Failure to do so may result in damage to the tubes.*

The EMISSION switch S105 should now be placed in the "VOICE" position and after an interval of about a half-minute (time for the modulator tubes V106 and V107 to heat up), the microphone is plugged into jack J101. When the "push-to-talk" button of the microphone is pressed, the PLATE CURRENT should not exceed 90 milliamperes. A current rise beyond this value indicates an out-of-resonance condition and should be corrected *immediately*. The coupling between the final amplifier and the antenna should now be adjusted for maximum efficiency.

h. CHANGING FREQUENCY DURING OPERATION.—Should the occasion arise where a change of frequency is desirable during the operation of the transmitter, COUPLING control L107, ANTENNA LOADING control L108 and PLATE TUNING control C116 should be set at "0" and the operator should proceed to retune the transmitter and couple it to the antenna, just as he did at the outset. Precautions against over-heating the tubes and frequency-doubling in the final amplifier should be observed.

TABLE 4-1
APPROXIMATE CONTROL SETTINGS

Control Freq. Mc	Osc. Sel. A	Band Switch B	Tuning C	Coupling D	Plate Tuning E	Ant. Cond. F	Ant. Load. G	Ext. Load Coil H
1.5	MO	1	1.5	6 to 8.5	0.8 to 1.5	OFF	7.5	2
2.25	MO	1	2.25	6 to 7.5	7.3 to 7.8	OFF	5	6
3.0	MO	1	3.0	6 to 7	9 to 9.5	OFF	20	6
3.0	MO	2	3.0	6 to 7	0.8 to 1.2	OFF	20	6
4.5	MO	2	4.5	6 to 7	8	OFF	33	6
6.0	MO	2	6.0	5.5 to 6.5	9 to 9.5	OFF	39	6
6.0	MO	3	6.0	4 to 5	0.5 to 1	OFF	39	6
9.0	MO	3	9.0	4 to 5	7.5 to 8	SERIES	35	6
12.0	MO	3	12.0	3 to 4	9 to 9.8	SERIES	41.5	6

i. TO SHUT DOWN THE TRANSMITTER.—To shut down the transmitter, POWER switch S107 should be placed in the "OFF" position. This removes filament power from the transmitter tubes. (It should be remembered that both POWER switch S107 on the transmitter panel and POWER switch S205 on the receiver panel must be in the "ON" position before the transmitter is made operative again.)

3. RECEIVER OPERATION.

After the preliminary adjustments have been made, a number of choices confront the operator. He must decide:

1—whether the receiver is to be continuously tunable or crystal controlled,

2—whether CW or voice-modulated signals are to be received,

3—the frequency of the signal to be received.

a. CONTINUOUSLY TUNABLE OR CRYSTAL CONTROLLED.—To operate the receiver continuously tunable over its entire frequency range, the OSCILLATOR SELECTOR switch S202 should be rotated to the "MO" position. Although it is probable that the receiver will, for most of the time, be used in this manner, provision is made, nevertheless, for the optional use of crystal-controlled operation. This latter is possible on all three frequency bands, but it may be employed on Band 3 (6 Mc to 12 Mc) only at the cost of reduced sensitivity.

Rotating the OSCILLATOR SELECTOR switch S202 to the "CO 1", "CO 2", "CO 3" or "CO 4" position selects any one of four crystals (not supplied with the receiver unit of the TCS equipment). These crystals should be ground for frequencies within the range of 1.5 Mc to 3 Mc. Allowance should be made so that the fundamental or harmonic frequency to be used is either higher or lower than the desired reception frequency by the amount of the intermediate frequency, 455 Kc. The second and fourth harmonic frequencies of the crystals may be used, but operation with the fourth harmonic will result in reduced sensitivity.

b. CW OR VOICE-MODULATED RECEPTION.—For CW reception the Mod.-CW switch S203 should be placed in the "CW" position and the R.F. GAIN control R216 should be partially advanced. (Until the R.F. GAIN control is advanced to its maximum clockwise position and a click is heard, the automatic volume control is inoperative.) The A.F. GAIN control R220 should be placed in the fully advanced position and adjustments of sensitivity and audio output should then be made with the R.F. GAIN control R216 only.

Heterodyning is caused by feeding back energy from the plate to the grid circuit of the detector-amplifier tube V206 and the pitch of the audible note so produced may be varied by adjustment of the CW PITCH control Z204.

For voice-modulated reception the MOD.-CW switch S203 should be placed in the "MOD." position. The R.F. GAIN control R216 should be advanced to its maximum clockwise position until a click is heard indicating that the automatic volume control has been placed in operation through the action of the AVC switch S206. The audio output now may be controlled by the A.F. GAIN control R220.

c. TUNING THE RECEIVER.—Headphones should be plugged into the PHONES jack J201 and plate and filament power applied to the receiver by placing the POWER switch S205 in the "ON" position. (It may be recalled that this POWER switch must be in the "ON" position before the transmitter can become operative. Thus, placing the transmitter in an operative condition also makes the receiver operative.)

The BAND SWITCH S201, S207 and S208 may now be rotated to the band in which reception is desired. The TUNING control C201 should be adjusted until the desired frequency is indicated by the dial calibration appearing in the window slightly above and to the left of the TUNING control. If the OSCILLATOR SELECTOR switch S202 is in the "MO" position, any frequency lying in the band may be selected. If the receiver is crystal-controlled, only frequencies that are the fundamental or harmonics of the natural frequency of the crystal in use may be selected.

d. TO SHUT DOWN THE RECEIVER.—To shut down the receiver, POWER switch S205 should be placed in the "OFF" position. This removes plate and filament power from the receiver tubes.

4. REMOTE-CONTROL OPERATION.

The transmitter and receiver both may be operated by remote control at distances up to twenty feet by means of Type CCY-23270-A Remote-Control Unit. (*See figure 4-3*)

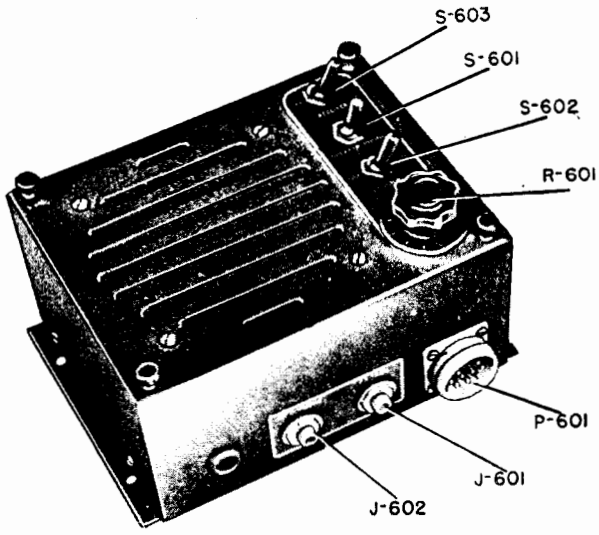


Figure 4-3 Remote Control Unit.

All emission, tuning and coupling adjustments should be made at the transmitter panel, as previously described, and all tuning and loading controls should be locked in place. POWER switch S107 should be placed in the "OFF" position and the microphone or key (as the case may be) removed from the MICROPHONE-OR-KEY jack J101 on the transmitter panel and plugged into the MICROPHONE jack J602 of the remote-control unit. The TRANSMITTER ON-OFF switch S602 in the remote-control unit then should be placed in the "ON" position and, after about a half minute (time for the tubes to heat up), the transmitter may be operated from the remote-control unit.

For remote-control operation of the receiver, all adjustments should be made on the receiver panel, as previously described, and TUNING control C201 should be locked in place. POWER switch S205 on the receiver panel should be placed in the "OFF" position and the RECEIVER ON-OFF switch S603 of the remote-control unit should be placed in the "ON" position. The SPEAKER-PHONES switch S601 should be placed in the "SPEAKER" position, operating speaker LS601 of the remote-control unit. If the receiver has been set for voice-modulated reception, VOLUME CONTROL R601 of the remote-control unit should be fully advanced and the A.F. GAIN control R220 on the receiver panel should be adjusted to give more than enough speaker output for intelligible reception. VOLUME CONTROL R601 then can be used to regulate the output of the speaker. If the operator desires to use headphones rather than the speaker, the headphones may be removed from PHONES jack J201 on the receiver panel and inserted into PHONES jack J601 of the remote-control unit. The SPEAKER-PHONES switch S601 then should be placed in the "PHONES" position.

To shut down the station, both TRANSMITTER-ON-OFF switch S602 and RECEIVER ON-OFF switch S603 should be placed in the "OFF" position.

5. USE OF A BATTERY CHARGER.

If a battery charger is employed, it is desirable to stop the charger while the radio equipment is in use. The battery-charging process results in an excessive terminal voltage across the batteries. This abnormal voltage, when applied to the radio equipment, places an overload on the power-supply unit, receiver, and transmitter, and it may shorten the life of the tubes and other component parts.

Battery chargers often produce acoustic and electrical noise, which may interfere with the use of the receiver. This is an additional reason for charging the batteries only when the radio equipment itself is not in use.

6. ALIGNMENT.

The transmitter and receiver units have been properly aligned at the factory and should not require readjustment unless the unit has been damaged or tampered with. If the equipment fails to function properly, realignment should be tried only as a last resort and then only if the misalignment seriously impairs the operating performance of the units. The alignment procedure outlined in Section 7 must be followed in detail and it is recommended that only experienced personnel be allowed to make these adjustments.

SECTION V
OPERATOR'S MAINTENANCE

WARNING

OPERATION OF THIS EQUIPMENT INVOLVES THE USE OF HIGH VOLTAGES WHICH ARE DANGEROUS TO LIFE. OPERATING PERSONNEL SHOULD AT ALL TIMES OBSERVE ALL SAFETY PRECAUTIONS. SEE PAGE ix.

WHEN TRANSMITTER IS IN OPERATION, CARE SHOULD BE TAKEN TO AVOID CONTACT WITH THE ANTENNA OR THE ANTENNA POST E105, SINCE SUCH CONTACT MAY RESULT IN SERIOUS R-F BURNS.

1. GENERAL MAINTENANCE.

This radio equipment is constructed of materials considered to be the best obtainable for the purpose, and has been carefully inspected and adjusted at the factory. However, certain parts of the equipment require a nominal amount of attention in order to maintain the most efficient and dependable operation.

To assure dependable service, periodical inspection and operational checks of the equipment should be made. The following chart gives suggestions for inspection and operational checks to be made at the beginning of each watch.

TABLE 5-1—ROUTINE CHECK.

What to Check	How to Check	Precautions
1. Antenna and ground connections and the wire that connects the transmitter RECEIVER ANTENNA terminal to the ANTENNA terminal on the receiver.	Be sure that spring connector terminals are making good contact with the wires and that none of the wires have been weakened or broken by vibration.	Poor connections will prevent equipment from operating satisfactorily.
2. Cable Connectors.	Be sure that cable plug connector locking rings are tight.	Loose connections cause intermittent operation.
3. Toggle Switches.	Flip on and off.	Dynamotors or motor-generators must start if used on D.C. Rectifiers must light if used on A.C.
4. Knobs.	Try for free turning.	In extreme temperature knobs and shafts may freeze.
5. Meters.	Turn Coupling and Plate Tuning knobs.	Meter needles should move up.
6. Band Switches.	Rotate switches.	There should be free operation.
7. Battery or other power source.	Check for tight connections.	Corroded or loose connections will prevent equipment from operating.
8. Relay contacts in Transmitter and Power Unit.	Check for alignment, pitting and corrosion.	If contacts require cleaning, a burnishing tool should be used. Never use sandpaper or emery cloth.

2. EMERGENCY MAINTENANCE.

a. VACUUM TUBE OPERATION.—In order to obtain satisfactory tube life the following precautions must be taken:

(1) Operate all tube filaments within ± 5% of rated voltage.

(2) Do not exceed rated plate current in any of the tubes during normal operation of the equipment.

(3) When tuning, do not exceed rated plate current except for periods of short duration.

Failure to observe the above precautions may result in the destruction of tubes.

b. VACUUM TUBE FAILURE.—Should tube failure occur when no spares are available, the installation may be kept in operation by taking advantage of the fact that similar types of tubes are used in different portions of the circuits.

In the transmitter, the master oscillator V101, the crystal oscillator V102 and the buffer-amplifier V103 all employ type 12A6 tubes. Since only one oscillator tube functions at any one time, should one of them fail, the other may be interchanged. (It should be noted that removing either of the oscillator tubes will affect the calibration of the dial.)

Should the buffer-amplifier V103 fail, it may be replaced by either of the two oscillator tubes. Even if two

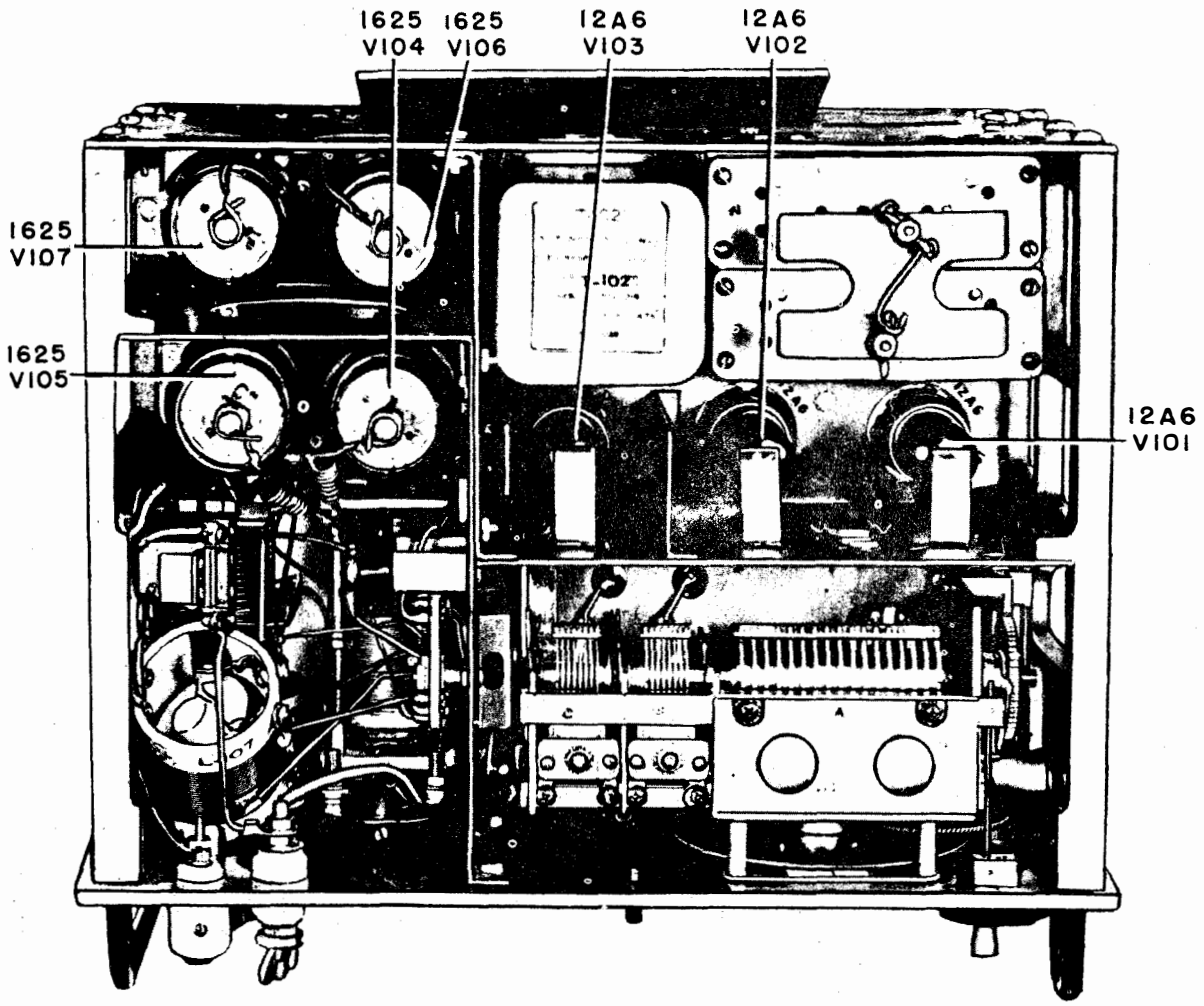


Figure 5-1 Open Top View of Transmitter.

or three of these tubes should fail simultaneously, the transmitter still may be made to function by substituting oscillator V203 and a-f amplifier V207 of the receiver. Of course, the receiver will not function unless V207 is replaced, but V203 need not be replaced if the receiver may be operated by crystal control.

In the transmitter the final amplifiers V104 and V105 and the modulators V106 and V107 all employ type 1625 tubes. When CW emission is desired, only tubes V104 and V105 function. If either or both of these tubes fail, they may be replaced by the modulator tubes V106 and V107. When VOICE emission is selected, V105 is made inoperative. It then can be used to replace any of the other three tubes. (See figures 5-1 and 5-2 for vacuum tube location.)

c. POWER UNIT FAILURE.—If the output voltage of the dynamotors drop to zero, the fuses and brushes should be inspected. If these are in good condition the only solution is to replace the dynamotors or the complete power-supply unit. However, the voltage may drop as a result of a partial breakdown of the armature and it may be possible to operate the equipment with reduced output.

3. FUSES.

Fuses may be replaced by spares which are located near those supplied in the equipment. For fuse location, see figures 5-3, 5-4, 5-5, 5-6 and table 5-2.

WARNING

Never replace a fuse with one of higher rating unless continued operation of the equipment is more important than probable damage. If a fuse burns out immediately after replacement, do not replace it a second time until the cause of trouble has been corrected.

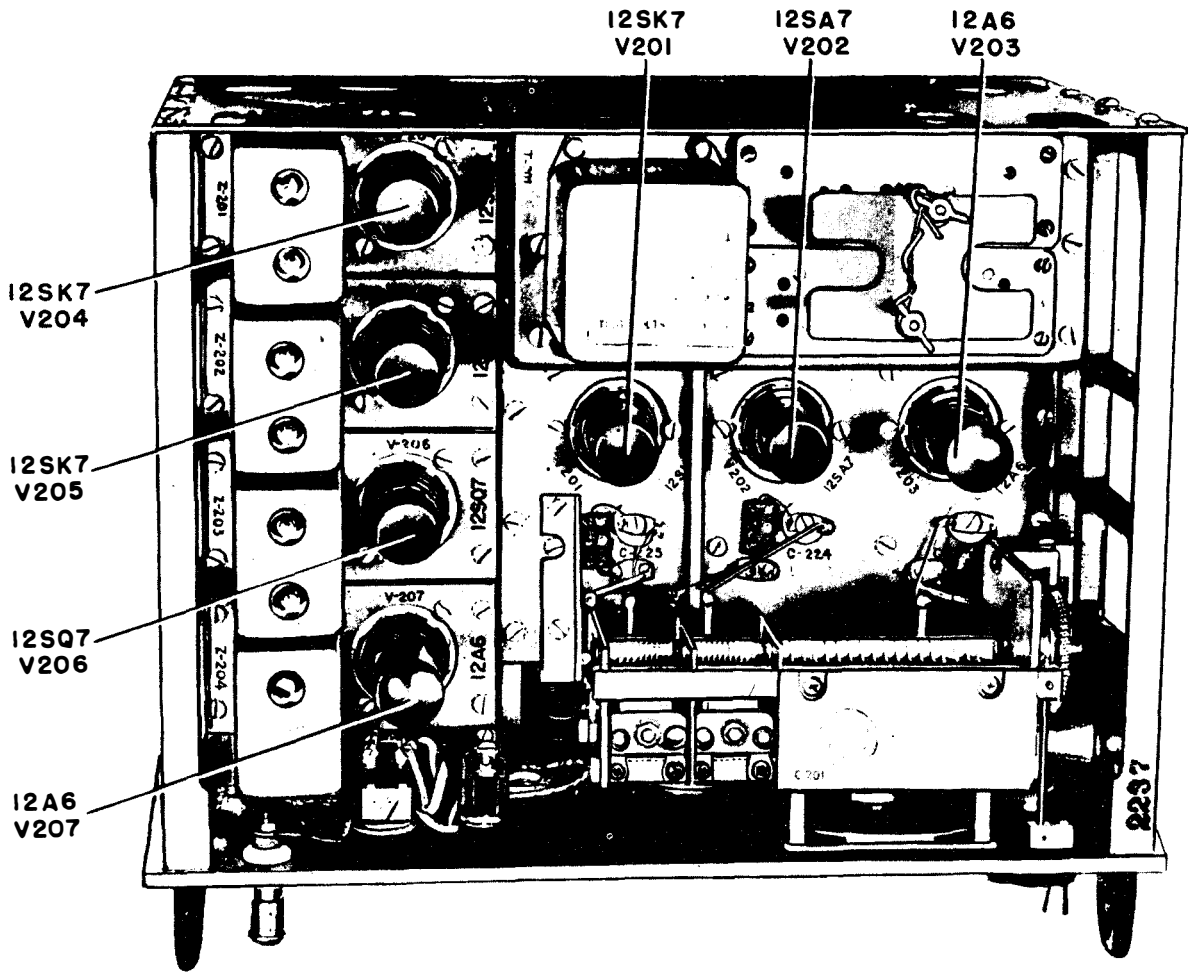


Figure 5-2 Open Top View of Receiver

TABLE 5-2—FUSE LOCATIONS

Fuse and Value	Location	Function
F-401, 15 amps	Fuse box at top of -211881-B Power Unit	L. V. Dynamotor Pri.
F-402, 30 amps	Fuse box at top of -211881-B Power Unit	H. V. Dynamotor Pri.
F-2101, 10 amps	Inside cover at top of -211100 Power Unit	B-2101 Primary Fuse
F-2102, 10 amps	Inside cover at top of -211100 Power Unit	B-2102 Primary Fuse
F-2201, 2 amps	End panel of -20309 Power Unit, adjacent to plugs	H. V. Primary Fuse
F-2202, 2 amps.	End panel of -20309 Power Unit, adjacent to plugs	H. V. Primary Fuse
F-2203, 3 amps	End panel of -20309 Power Unit, adjacent to plugs	L. V. Primary Fuse
F-2204, 3 amps	End panel of -20309 Power Unit, adjacent to plugs	L. V. Primary Fuse
F-2301, 10 amps	Inside cover at top of -21827-A Power Unit	B-2301 Primary Fuse
F-2302, 10 amps	Inside cover at top of -21827-A Power Unit	B-2302 Primary Fuse
F-2801, 5 amps	Fuse box at top of -211330-B Power Unit	Filament Fuse
F-2802, 0.5 amp	Fuse box at top of -211330-B Power Unit	H. V. Fuse
F-2803, 3/8 amp	Fuse box at top of -211330-B Power Unit	L. V. Fuse
F-2804, 20 amps	Fuse box at top of -211330-B Power Unit	Primary Fuse for 24 volt operation
F-2804, 40 amps	Fuse box at top of -211330-B Power Unit	Primary Fuse for 12 volt operation

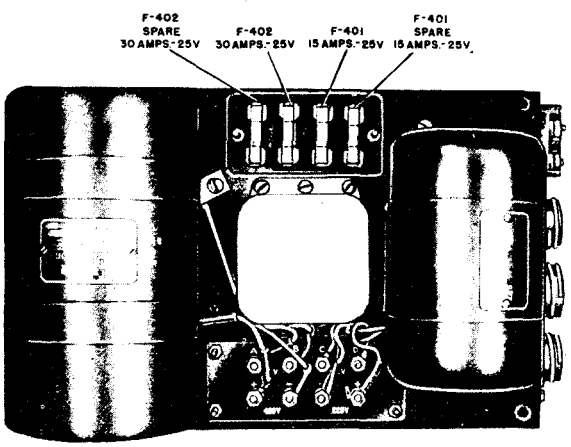


Figure 5-3 Dual Dynamotor Power Supply.

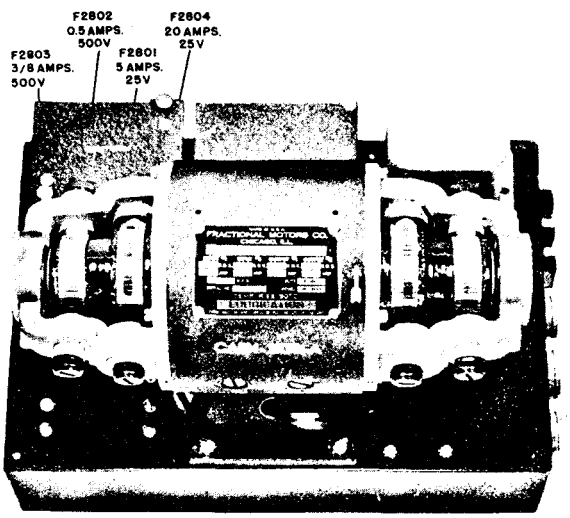


Figure 5-4 Single Dynamotor Power Supply.

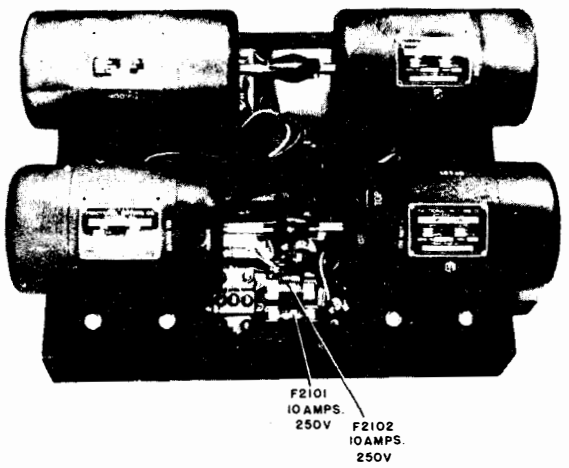


Figure 5-5 Motor-Generator Power Supply.

Note

For 21827-A Motor Generator Power supply F2301, F2302 have same value.

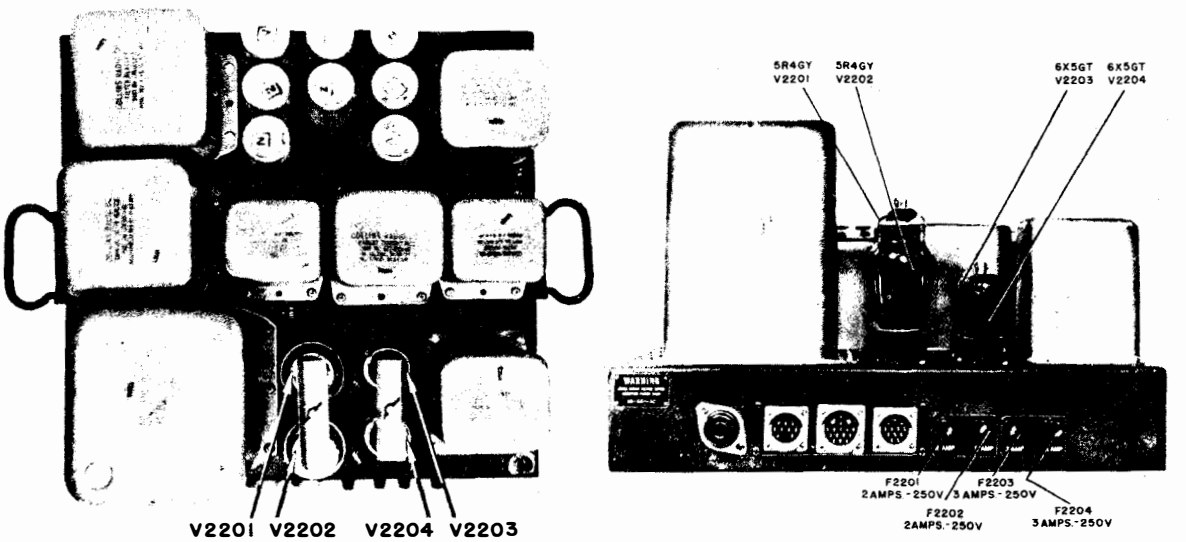


Figure 5-6 Rectifier Power Supply.

SECTION VI

PREVENTIVE MAINTENANCE

1. GENERAL.

To prevent failure of the equipment and to maintain peak performance, a definite schedule of inspection and operational check should be followed. Table 6-1 gives suggestions for checks to be made at the beginning of each watch.

Also see page 6-2 for items to be checked periodically to prevent failure of the equipment.

THE ATTENTION OF MAINTENANCE PERSONNEL IS INVITED TO THE REQUIREMENTS OF CHAPTER 67 (OR 68) OF THE "BUREAU OF SHIPS MANUAL," OF THE LATEST ISSUE.

2. LUBRICATION.

The equipment described in this instruction book is lubricated for life and no further lubrication will be required.

TABLE 6-1 ROUTINE CHECK.

What to Check	How to Check	Precautions
1. Antenna and ground connections and the wire that connects the transmitter RECEIVER ANTENNA terminal to the ANTENNA terminal on the receiver.	Be sure that spring connector terminals are making good contact with the wires and that none of the wires have been weakened or broken by vibration.	Poor connections will prevent equipment from operating satisfactorily.
2. Cable Connectors.	Be sure that cable plug connector locking rings are tight.	Loose connections cause intermittent operation.
3. Toggle Switches.	Flip on and off.	Dynamotors or motor-generators must start if used on D.C. Rectifiers must light if used on A.C.
4. Knobs.	Try for free turning.	In extreme temperature knobs and shafts may freeze.
5. Meters.	Turn Coupling and Plate Tuning knobs.	Meter needles should move up.
6. Band Switches.	Rotate switches.	There should be free operation.
7. Battery or other power source.	Check for tight connections.	Corroded or loose connections will prevent equipment from operating.
8. Relay contacts in Transmitter and Power Unit.	Check for alignment, pitting and corrosion.	If contacts require cleaning, a burnishing tool should be used. Never use sandpaper or emery cloth.

3. PERIODIC CHECKS.

a. Carefully check all connecting cables for breaks (especially at the junctions of the cables and the plug connectors). Be sure that the cable plug connector locking rings are tight and fastened with safety wires, and see that the Allen-head set screws of the cable clamps are tight.

b. Blow or lightly brush dust from the equipment periodically. It is particularly important to prevent the accumulation of dust around the transmitter dials and tuning capacitors.

c. Tubes in the TCS equipment may require replacement from time to time. It will generally be possible to determine if a tube is defective by noting the improved performance of the unit when a new tube is substituted. Be sure that the tube clamps hold the tubes securely in their sockets.

d. If equipment is run continuously, or for any length of time, even if only in a stand-by position, both transmitter and receiver should be checked hourly for frequency drift caused by changes in temperature. This can be accomplished by contacting a known reference point (another station) and returning both the transmitter and receiver until best results are obtained from both.

4. EMERGENCY MAINTENANCE.

a. VACUUM TUBE OPERATION.—In order to obtain satisfactory tube life the following precautions must be taken:

(1) Operate all tube filaments within ± 5% of rated voltage.

(2) Do not exceed rated plate current in any of the tubes during normal operation of the equipment.

(3) When tuning, do not exceed rated plate current except for periods of short duration.

Failure to observe the above precautions may result in the destruction of tubes.

b. VACUUM TUBE FAILURE.—Should tube failure occur when no spares are available, the installation may be kept in operation by taking advantage of the fact that similar types of tubes are used in different portions of the circuits.

In the transmitter, the master oscillator V101, the crystal oscillator V102 and the buffer-amplifier V103 all employ type 12A6 tubes. Since only one oscillator tube functions at any one time, should one of them fail, the other may be interchanged. (It should be noted that removing either of the oscillator tubes will affect the calibration of the dial.)

Should the buffer-amplifier V103 fail, it may be replaced by either of the two oscillator tubes. Even if two or three of these tubes should fail simultaneously, the transmitter still may be made to function by substituting oscillator V203 and a-f amplifier V207 of the receiver. Of course, the receiver will not function unless V207 is replaced, but V203 need not be replaced if the receiver may be operated by crystal control.

In the transmitter the final amplifiers V104 and V105 and the modulators V106 and V107 all employ type 1625 tubes. When CW emission is desired, only tubes V104 and V105 function. If either or both of these tubes fail, they may be replaced by the modulator tubes V106 and V107. When VOICE emission is selected, V105 is made inoperative. It then can be used to replace any of the other three tubes. (See figures 6-1 and 6-2 for vacuum tube location.)

c. POWER UNIT FAILURE.—If the output voltage of the dynamotors drop to zero, the fuses and brushes should be inspected. If these are in good condition the only solution is to replace the dynamotors or the complete power-supply unit. However, the voltage may drop as a result of a partial breakdown of the armature and it may be possible to operate the equipment with reduced output.

d. SWITCHES.—Switches on the TCS equipment may present two main sources of trouble—the rotor springs may lose their tension and the contact points may oxidize or corrode. While these difficulties are comparatively easy to overcome, careless operation in making these repairs may lead to more serious troubles.

Careful note should be taken of the relative positions of the component parts of the switches before disassembly so that they may be reassembled properly. The operator should not tamper with the detent mechanism.

Never try to adjust the tension of the rotor springs without removing the rotor assembly from the rest of the switch. To do this, press the thumb against the rotor and turn the switch until the C washer drops out. The rotor may then be removed. To adjust the tension of the springs, place the center sleeve of the rotor on a flat surface (contacts facing down). The springs may then be adjusted so that the outer contacts are 3/16 inch and the inner contacts 1/4 inch from the flat surface. Rotating a pencil eraser over the contact surfaces usually will remove any oxide. If the corrosion is too great for this treatment, or if the contacts are pitted, they may be filed lightly.

Do not attempt to remove the center sleeve of the rotor from its ceramic disk. Make sure that the C washer is replaced on the rotor before final reassembly of all switches.

BAND SWITCH S201-S207-S208 has a double set of contacts on one section of the rotor. In assembly, care must be taken that this section of the rotor goes to that section of the stator that has four contacts.

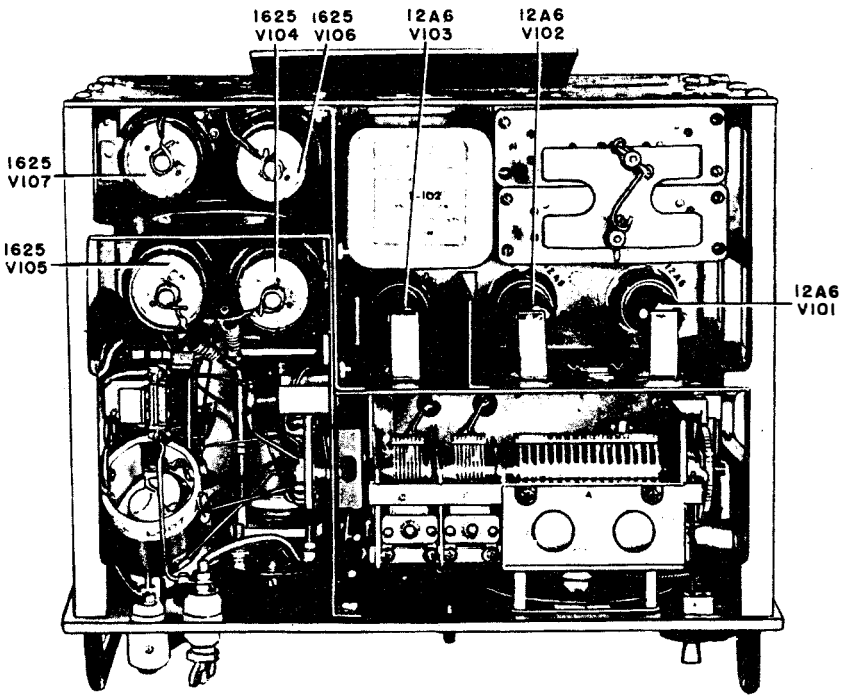


Figure 6-1 Open Top View of Transmitter

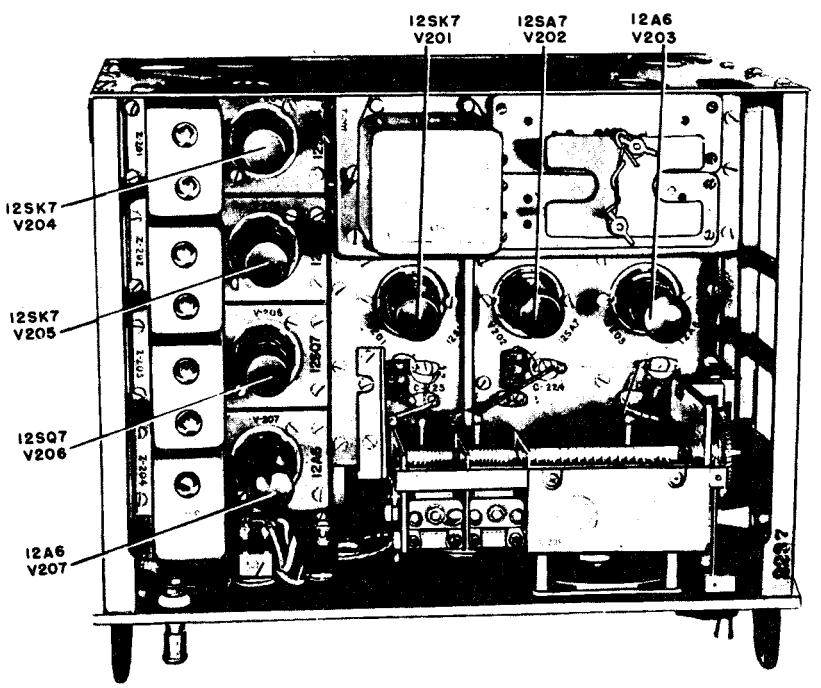


Figure 6-2 Open Top View of Receiver

FAILURE REPORTS

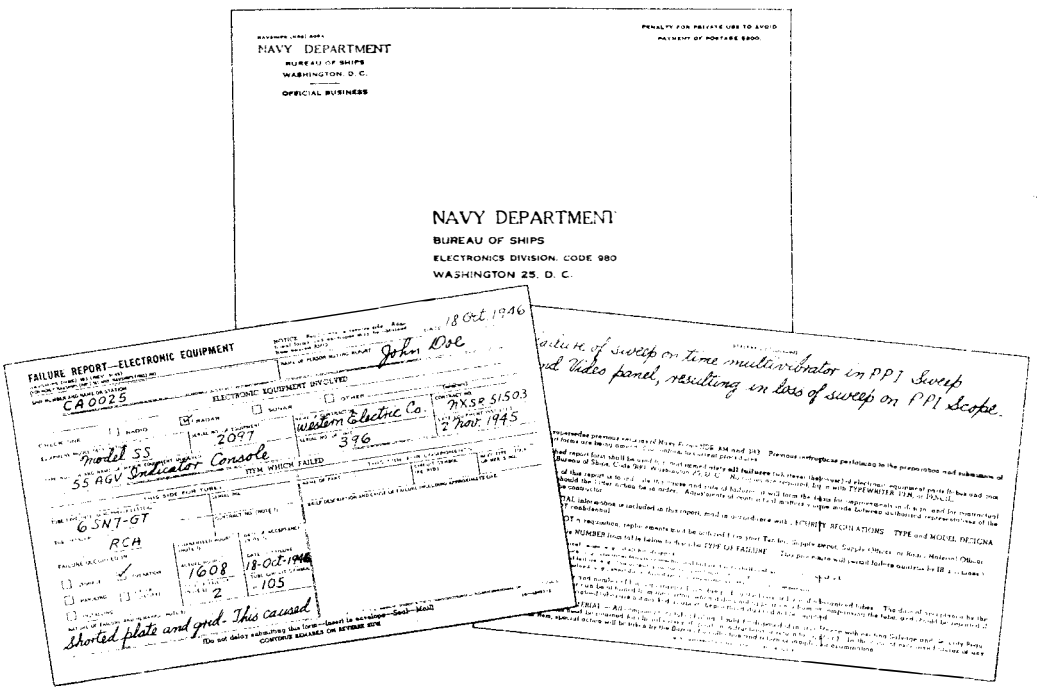
A FAILURE REPORT must be filled out for the failure of any part of the equipment whether caused by defective or worn parts, improper operation, or external influences. It should be made on Failure Report, form NBS-383, which has been designed to simplify this requirement. The card must be filled out and forwarded to BUSHIPS in the franked envelope which is provided. Full instructions are to be found on each card.

Use great care in filling the card out to make certain it carries adequate information. For example, under "Circuit Symbol" use the proper circuit identification taken from the schematic drawings, such as T-803, in the case of a transformer, or R-207, for a resistor. Do not substitute brevity for clarity. Use the back of the card to completely describe the cause of failure and attach an extra piece of paper if necessary.

The purpose of this report is to inform BUSHIPS of the cause and rate of failures. The information is used by the Bureau in the design of future equipment and in the maintenance of adequate supplies to keep the present equipment going. The cards you send in, together with those from hundreds of other ships, furnish a store of information permitting the Bureau to keep in touch with the performance of the equipment of your ship and all other ships of the Navy.

This report is not a requisition. You must request the replacement of parts through your Officer-in-Charge in the usual manner.

Make certain you have a supply of Failure Report cards and envelopes on board. They may be obtained from any Electronics Officer.



Sample Failure Report Cards Properly Filled In

SECTION VII
CORRECTIVE MAINTENANCE

1. LOCATION OF FAULTS.

a. GENERAL.—In case of trouble, look for the simple causes first. Analyze and isolate the difficulty before attempting to remove or dismantle any part of the equipment. A few moments of thought and study of the complete schematic circuit diagram, Fig. 7-36, together with a tabulation of the various possible causes of failure, may save hours of haphazard labor. Radio equipments are often damaged by needless assembly and removal of parts, when the real cause of trouble is merely a broken lead or a faulty connection.

b. DEFECTIVE TUBES.—The most common cause of improper operation of radio equipment is tube failure. A complete set of tested tubes of the same type as specified should be kept on hand at all times. If faulty operation of the transmitter is observed and tube failure suspected, each tube may be checked by replacing the tube with a tube known to be in good condition. Open heaters or tubes of low emission will cause screen voltage readings to be higher than normal and bias voltages to be low or completely absent.

c. OVERLOAD.—If an open fuse is found it is an indication of an overload. The overload may be caused by a defective capacitor, defective tubes or a high voltage arc. A direct short is most readily found by means of a continuity check. The d-c resistance of the various circuits may be checked in order to locate the fault.

d. CORROSION.—Defective tubes causing an overload in power circuits may usually be located by inspection. It will be found that excessive heating or sputtering within the tube is a good indication of a fault in the tube circuit. High voltage arcs may be caused by bent condenser plates, corrosion or dust. One of the greatest sources of trouble in equipment located in a salt atmosphere is corrosion. Corrosion resulting from salt spray or salt laden atmosphere may cause failure of the equipment for no apparent reason. In general it will be found that contacts such as tap switches, tube prongs, cable plug connectors and relay contacts are most affected by corrosion. When it is necessary to operate equipment in localities subject to such corrosive atmosphere, inspection of wiping contacts, cable plugs, relay contacts, etc., should be made more frequently in order to keep the equipment in good condition.

In event the relay contacts of the various relays become dirty or corroded, erratic operation or complete failure of operation will result. Since many of the contacts are made of soft silver, a burnishing tool rather than a file or sandpaper should be used in cleaning the contacts. The contact leaves should not require adjusting unless they have become damaged. Adjustment of contact leaves should be attempted only by trained personnel and with adequate tools designed for the purpose. Failure of the normally closed contacts of voice CW relay K101 in the CW position will allow the P.A. plate current to flow through the modulation transformer secondary winding. This results in a lower than normal output from the transformer on CW. If cleaning the contacts does not remedy the situation, the pressure of the contact leaf can be increased by bending the contact leaf slightly towards the normally closed contact. Only the amount of tension necessary for vibration proof operation should be applied since too much pressure may cause the normally open Voice Contacts to become faulty in operation.

e. CAPACITORS.—Shorted or leaky filter and by-pass capacitors cause a reduction in voltage in the associated circuits. Open filter or by-pass capacitors cause instability, loss of signal level, increase in noise level, and, in some instances, a reduction in voltage in the circuit. Leaky coupling capacitors may cause distortion or excessive tube heating.

f. RESISTORS.—Defective resistors may cause a reduction in voltage in the circuit, a blocked grid, or objectionable hum. A resistor that heats excessively may indicate a shorted by-pass capacitor, in which case it is likely that the resistor will be damaged and will also require replacement.

g. LOADING COIL.—It is possible for the loading coil L108 to become erratic in operation in dust laden air. This coil can be cleaned by brushing with a straight motion parallel with the wire using a rather stiff brush moistened with carbon tetrachloride. A toothbrush can be used in an emergency—do not use anything that would scratch the wire.

h. SWITCHES.—Switches on the TCS equipment may present two main sources of trouble—the rotor springs may lose their tension and the contact points may oxidize or corrode. While these difficulties are comparatively easy to overcome, careless operation in making these repairs may lead to more serious troubles.

Careful note should be taken of the relative positions of the component parts of the switches before disassembly so that they may be reassembled properly. The operator should not tamper with the detent mechanism.

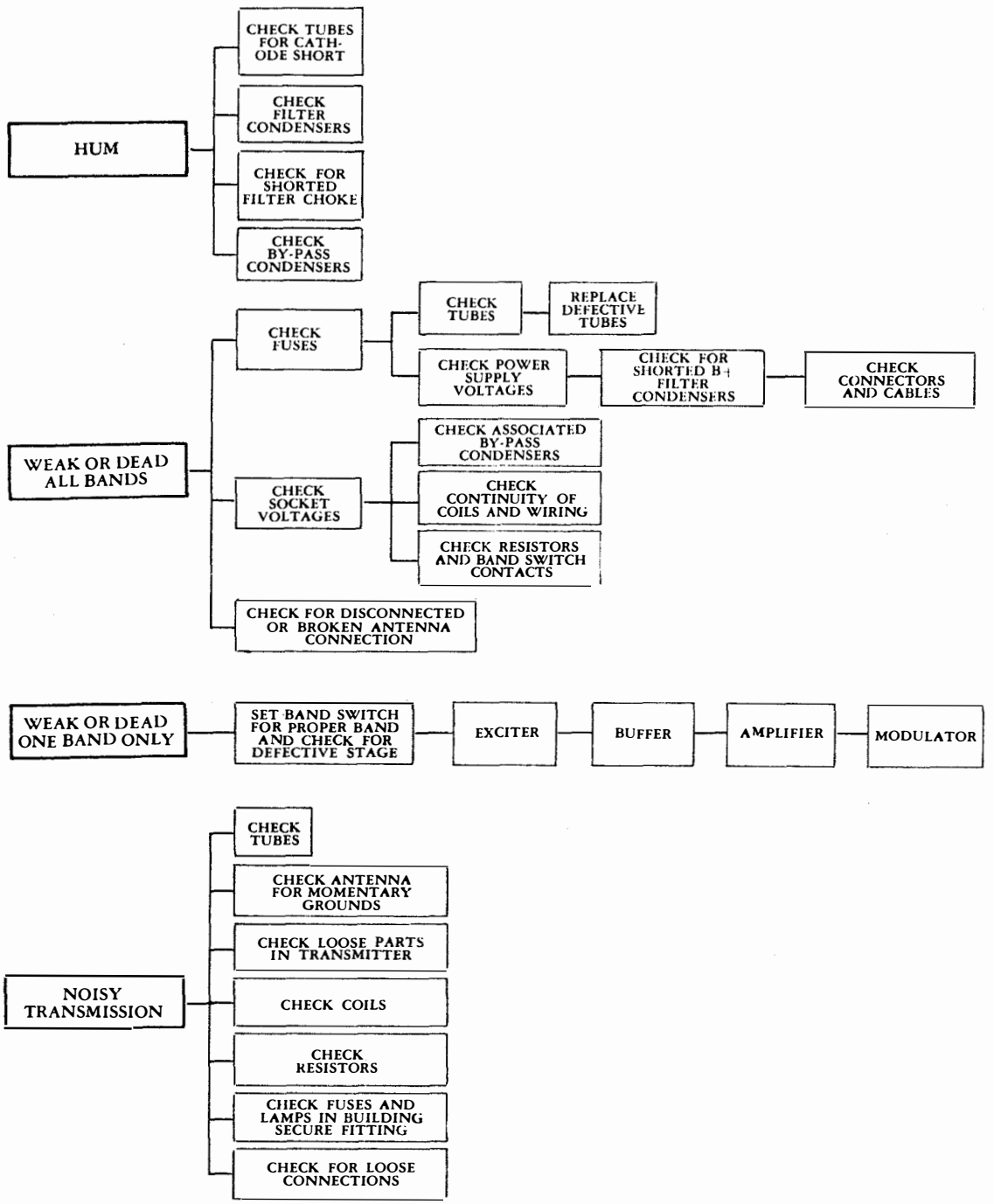


Figure 7-1 Trouble Shooting Chart—Transmitter Only.

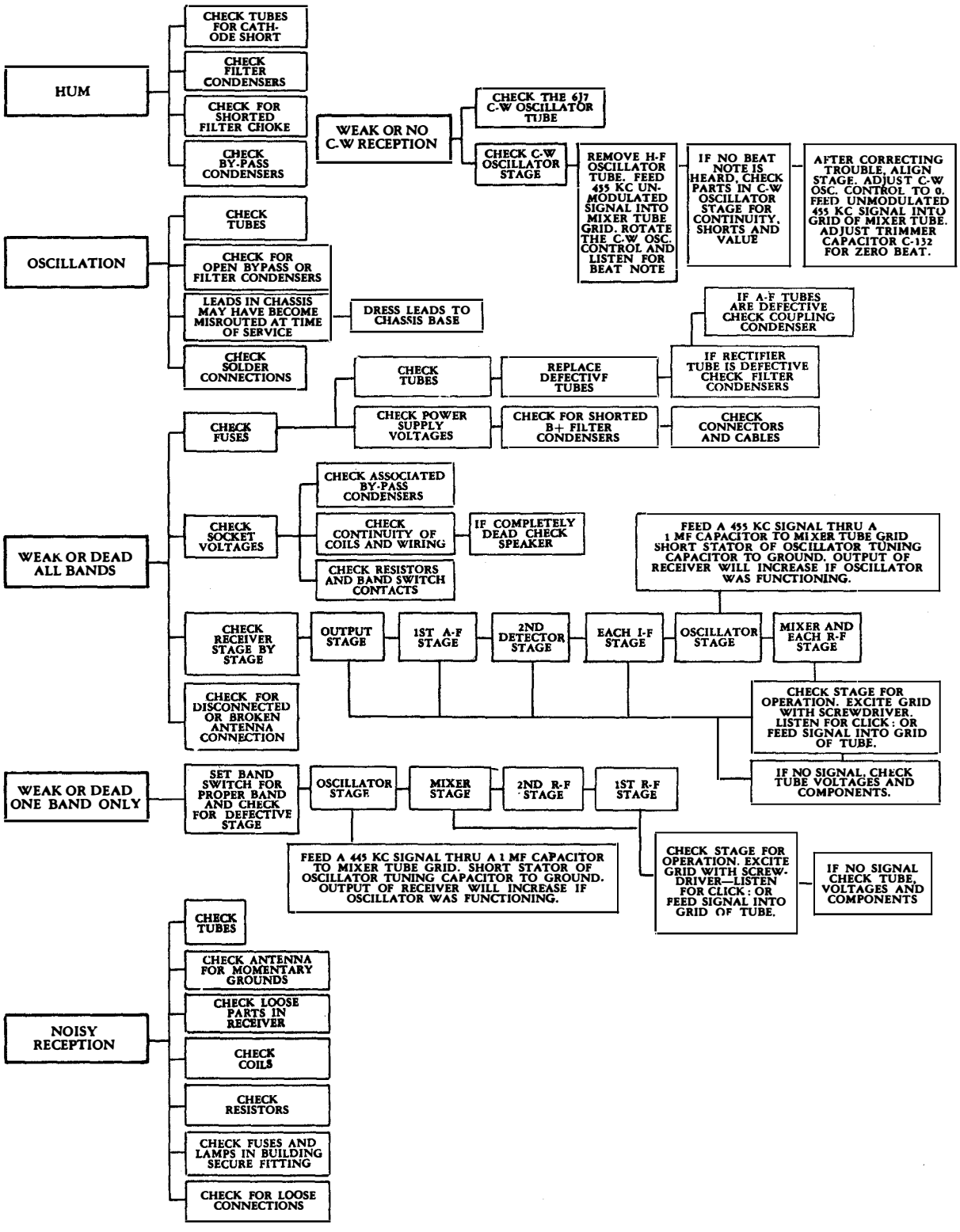


Figure 7-2 Trouble Shooting Chart—Receiver Only.

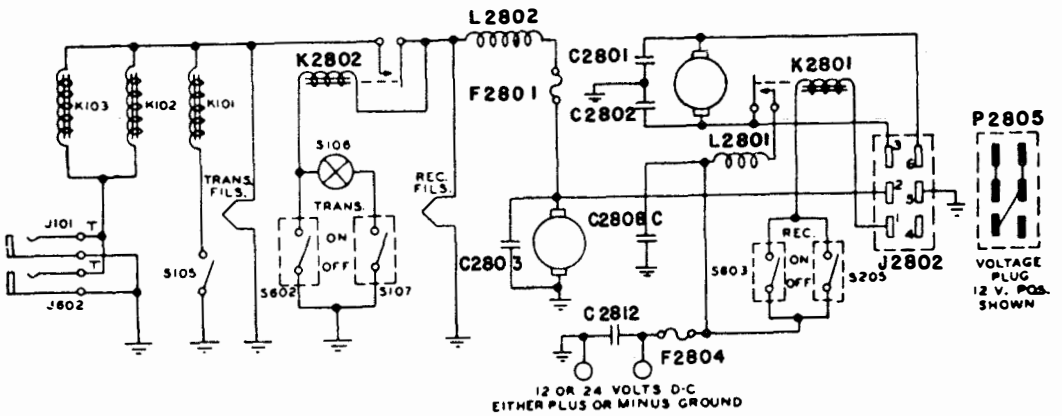


Figure 7-3 TCS Primary Power Circuits using the Single Dynamotor Power Unit.

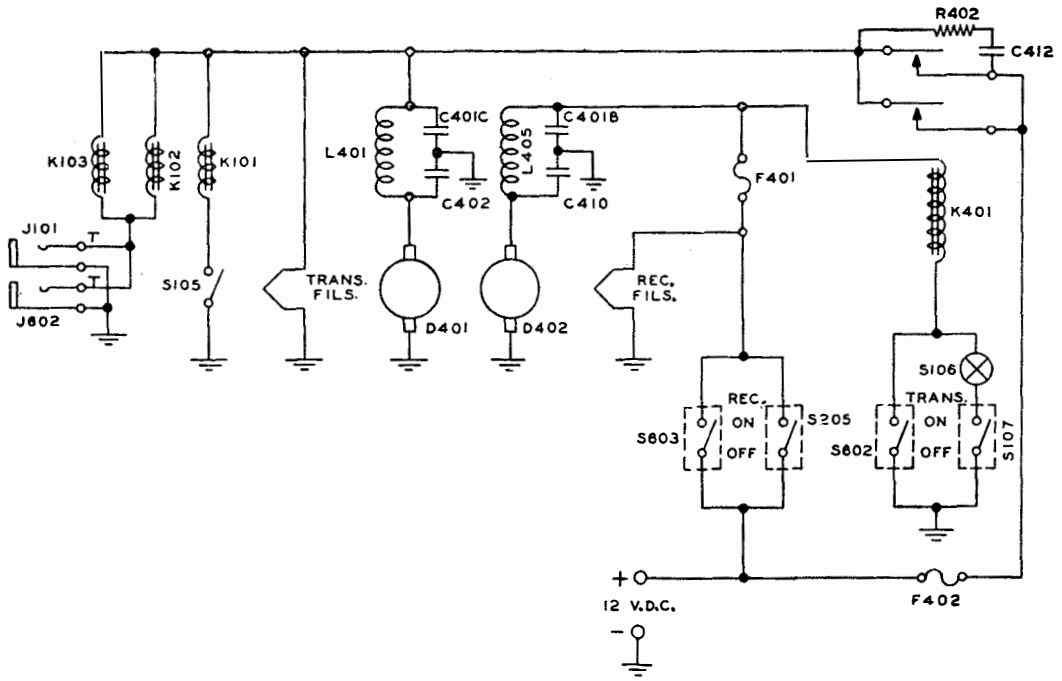


Figure 7-4 TCS Primary Power Circuits using the Dual Dynamotor Power Unit.

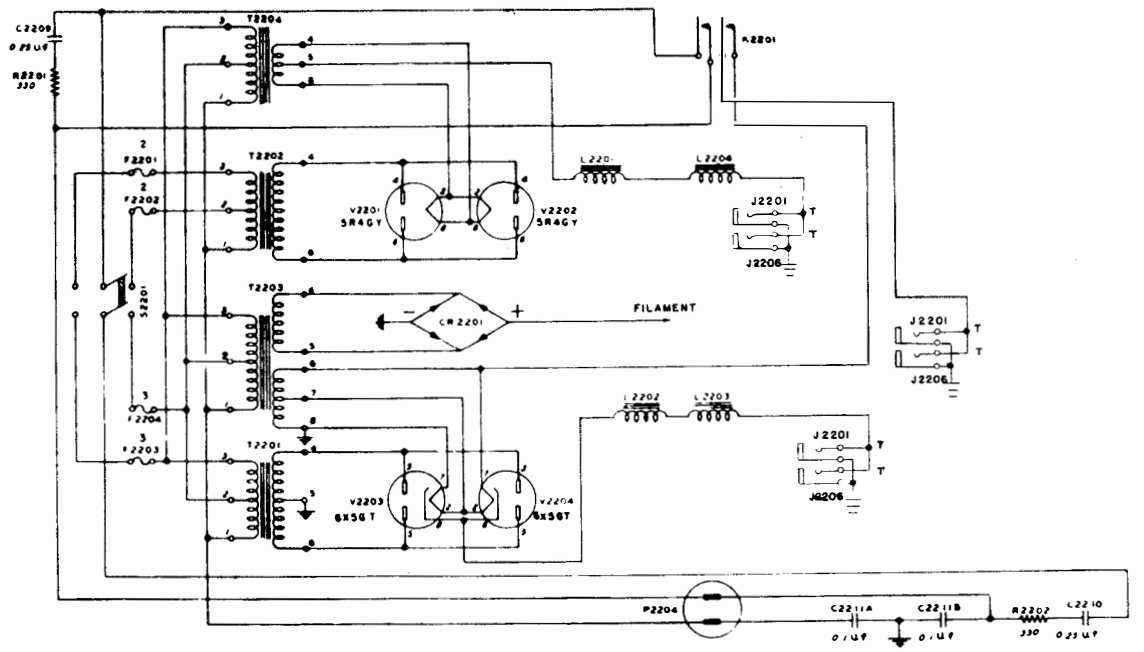


Figure 7-5 TCS Primary Power Circuits using the Rectifier Power Unit.

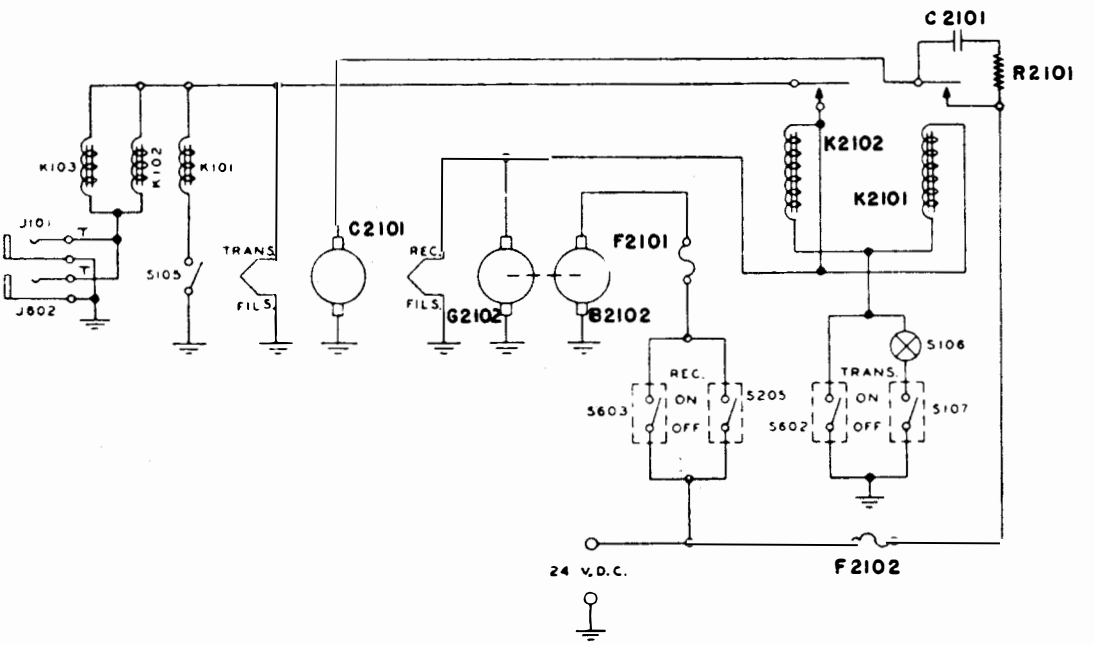


Figure 7-6 TCS Primary Power Circuits using the Motor-Generator Power Unit.

2. TUBE DATA.

WARNING

In order to obtain satisfactory tube life the following precautions must be taken:

(1) Operate all tube filaments within ±5% of rated voltage.

(2) Do not exceed rated plate current in any of the tubes during normal operation of equipment.

(3) When tuning, do not exceed rated plate current except for periods of short duration.

Failure to observe the above precautions may result in the destruction of tubes.

Failure to observe the above precautions may result in the destruction of tubes.

Note

ALL TUBES SUPPLIED WITH THE EQUIPMENT OR AS SPARES ON THE EQUIPMENT CONTRACT SHALL BE USED IN THE EQUIPMENT PRIOR TO EMPLOYMENT OF TUBES FROM GENERAL STOCK.

a. GENERAL.

Weak signals are the usual symptom of worn-out vacuum tubes and under most conditions it is usually the best policy to suspect them as the most probable source of trouble. All radio equipment is subject to a gradual decrease in performance through the aging of vacuum tubes. Due to the gradual nature of this condition it is difficult to recognize and it will usually be found necessary to advance the volume control from time to time. It is good practice to check all of the tubes at periodic intervals and replace those which fall below the minimum limits of transconductance or emission indicated in the tabulation of "Tube Characteristics". After tubes have been tested, paste a sticker on the glass bearing the date of test and either transconductance or the emission current as determined.

With the antenna lead from transmitter disconnected from the receiver and all of the frequency-determining circuits tuned to resonance, advance the "VOLUME CONTROL" to maximum. A relatively high and steady noise level should be heard in the phones. With all the controls adjusted as above, reduce the "VOLUME CONTROL" to "O". A barely audible hum, previously inaudible over the tube noise, should be heard. During the above tests, the "NOISE SUPPRESSOR" control must be heard in its "OFF" position if set is so equipped. Failure of this test indicates that the receiver is inoperative and the tubes should be changed before looking farther for the trouble.

Note

A LOSS IN SENSITIVITY OR POWER DOES NOT NECESSARILY INDICATE THAT TROUBLES OTHER THAN WORN-OUT TUBES DO NOT EXIST, BUT UNDER ANY CONDITION THE TUBES SHOULD BE CHECKED BEFORE DISTURBING ANY OF THE INTERNAL RECEIVER ADJUSTMENTS.

b. TUBE CHARACTERISTICS.

Tube Type	Description	Filament Voltage V	Filament Current A	Plate Voltage V	Grid Bias V	Screen Voltage V	Plate Current MA	Screen Current MA	AC Plate Resistance Ohms	TRANSCONDUCTANCE UMHOS		EMISSION	
										Normal	Min.	Is MA	E V
12A6	Beam Power Amplifier	12.6	0.15	250 max.	−12.5	250 max.	30-32	3.5-5.5	70,000	3000	2200	50	30
12SA7	Pentagrid Converter	12.6	0.15	300 max.	0 min.	100 max.	3.3-3.5	8.5	0.5-1.0 meg.	450	425	70	30
12SK7	Triple-grid Super control amplifier	12.6	0.15	300 max.	−1 / −3	100	9.2-13	2.6-4.0	.8-.12 meg.	2000	1600	65	30
12SQ7	Duplex-diode High-Mu Triode	12.6	0.15	300 max.	−1 / −2	X	0.4 0.9	X	110,000 91,000	1100	900	.8	10
1625	Transmitting Beam Power Amplifier	12.6	0.45	600	25	300	100 240	5 10	X	6000	5100	300	50
6X5GT/G	Full Wave High Vacuum Rectifier	6.3	0.6	1250	X	X	210	X	6000	X	X	140	0-50
5R4GY	Full Wave High Vacuum Rectifier	5.0	2.0	850	X	X	700	X	X	X	X	325	0-75

If no signals are receivable or if the sensitivity is still poor after changing all of the vacuum tubes, check the voltages at the various tube sockets. Prior to making the measurements, the equipment should be operated at nominal voltage with all tubes in sockets for a warm-up period of at least ten minutes. Refer to tabulation entitled "Tube Socket Voltages" for the normal values.

The voltages at the various socket terminals should conform to within ±15% (approximately) to those shown in the "Tube Socket Voltages" table, measured with the receiver in normal operative condition with antenna disconnected. Due to the change in load when one tube is removed, the voltages measured at the tube sockets are somewhat higher than the corresponding values shown in the tabulation of "Tube Operating Voltages and Currents."

If the voltage at any terminal fails to check with value indicated in tables in this secton it is an indication of a faulty connection, circuit components or a short circuit which should be located and remedied. If the voltages are correct, test the audio amplifier by touching the grid of the first audio amplifier tube with the finger. If an equal or loud hum is heard in the headphones, the audio amplifier is operating satisfactorily. If no result is obtained by touching the grid, check the audio amplifier circuits for open or faulty connections.

c. TRANSMITTER AND RECEIVER RESISTANCE MEASUREMENTS.

Tube	Pin No.							
	1	2	3	4	5	6	7	8
V101 (12A6)	0	0	∞	∞	1 meg.	∞	1	0
V102 (12A6)	0	0	∞	∞	50,000	∞	1	1,500
V103 (12A6)	0	0	∞	∞	100,000	∞	1	1,500
V104 (1625)	1	∞	∞	20,000	0	0	0	—
V105 (1625)	4.3	∞	∞	20,000	∞	43,000	0	—
V106 (1625)	0	∞	∞	3,000	∞	330	1	—
V107 (1625)	0	∞	∞	2,600	∞	330	1	—
V201 (12SK7)	0	0	0	1.2 meg.	200	13,000	1.5	38,000
V202 (12SA7)	0	0	40,000	50,000	23,500	230	1.5	1.2 meg.
V203 (12A6)	0	0	38,000	33,000	100,000	∞	1.5	0
V204 (12SK7)	0	0	0	1.2 meg.	220	12,000	1.5	37,000
V205 (12SK7)	0	0	0	3.5	220	47,000	1.5	37,000
V206 (12SQ7)	0	220,000	2,200	140,000	140,000	250,000	1.5	0
V207 (12A6)	0	0	38,000	35,000	470,000	∞	1.5	330

Conditions: All tubes in sockets; cables disconnected.
Transmitter: Band 1; VOICE; POWER off; MO.
Receiver: Band 1; MOD.; AVC on; MO.

d. TRANSMITTER SOCKET VOLTAGES.

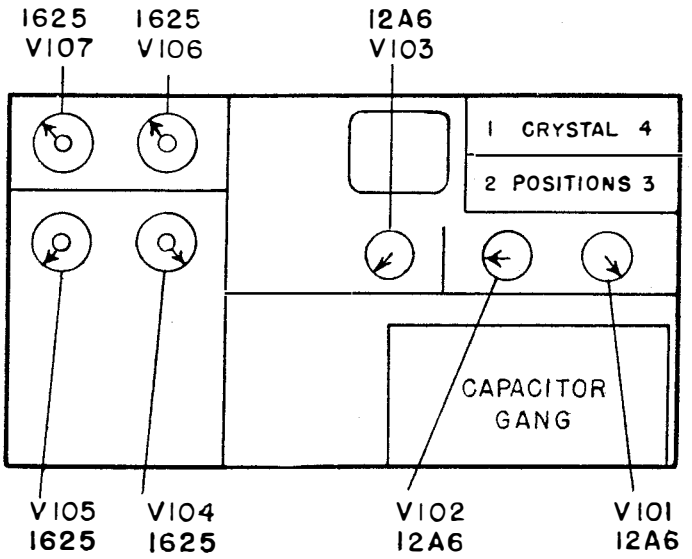


Figure 7-7 Transmitter Tube Layout.

TYPICAL TRANSMITTER OPERATING VOLTAGES AND CURRENTS.

Tube	Type of Emission	Filament Voltage	Plate Voltage		Screen Voltage		Grid Voltage		Grid Current		Cathode Voltage		Cathode Current	
			1.5 Mc	12.0 Mc	1.5 Mc	12.0 Mc	1.5 Mc	12.0 Mc	1.5 Mc	12.0 Mc	1.5 Mc	12.0 Mc	1.5 Mc	12.0 Mc
V101	CW	12.6	218	218	190	185	29	65			0	0		
(12A6)	VOICE	12.6	218	218	190	185	29	65			0	0		
V102	CW	12.6	218	218	163	163	36	42			21	22	17	18
(12A6)	VOICE	12.6	218	218	163	163	36	42			21	22	17	18
V103	CW	12.6	218	218	218	218	36	28			22	25	16	24
(12A6)	VOICE	12.6	218	218	218	218	36	28			22	25	16	24
V104	CW	12.6	448	448	250	265	38	40	1.8	1.7	0	0	87	87
(1625)	VOICE	12.6	430	430	245	255	41	47	2.0	1.6	0	0	85	85
V105	CW	12.6	448	448	250	265	39	40	1.8	1.7	0	0	87	87
(1625)	VOICE	12.6	430	430	410	410	41	47	0	0	0	0	0	0
V106	CW	0	0	0	0	0	0	0			0	0	0	0
(1625)	VOICE	12.6	445	445	355	355	0	0			29	29	100	100
V107	CW	0	0	0	0	0	0	0			0	0	0	0
(1625)	VOICE	12.6	445	445	355	355	0	0			29	29	100	100

NOTE: All voltage measurements were made between tube prongs and ground, and with the final amplifier loaded to rated input. A vacuum-tube voltmeter was used for all voltage measurements.

e. RECEIVER SOCKET VOLTAGES.

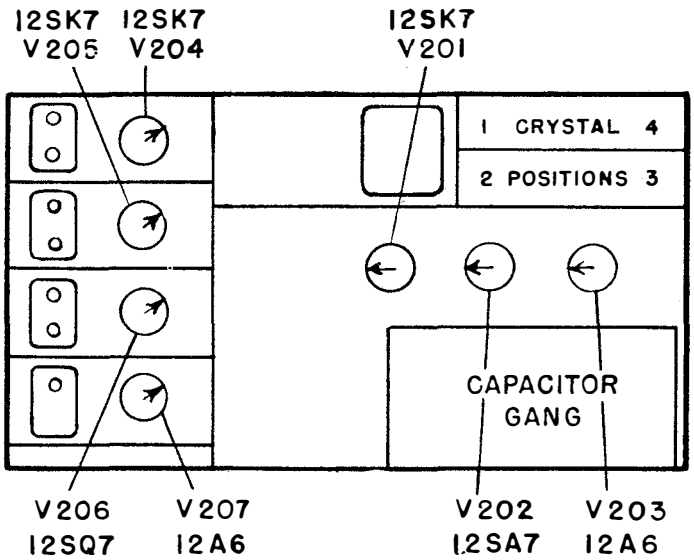


Figure 7-8 Receiver Tube Layout

TYPICAL RECEIVER OPERATING VOLTAGES.

Tube	Filament Voltage	Plate Voltage		Screen Voltage		Control Grid Voltage		Suppressor Grid Voltage		Cathode Voltage	
		1.5 Mc	12.0 Mc	1.5 Mc	12.0 Mc	1.5 Mc	12.0 Mc	1.5 Mc	12.0 Mc	1.5 Mc	12.0 Mc
V201 (12SK7)	12.6	215	215	59	59	—	—	0	0	1.75	1.75
V202 (12SA7)	12.6	225	225	79	79	—	—	0	0	2.0	2.0
V203 (12A6)	12.6	225	225	200	200	−34	−37	—	—	—	—
V204 (12SK7)	12.6	225	225	60	60	—	—	0	0	1.6	1.6
V205 (12SK7)	12.6	210	210	84	84	—	—	0	0	2.15	2.15
V206 (12SQ7)	12.6	130	130	—	—	—	—	—	—	1.0	1.0
V207 (12A6)	12.6	210	210	225	225	—	—	—	—	9.8	9.8

NOTE: All measurements were made with a vacuum-tube voltmeter between tube prongs and ground. The R.F. GAIN and A.F. GAIN controls were set for maximum gain, the AVC was off and the MOD.-CW switch was in the "MOD." position.

3. TYPICAL TRANSMITTER PERFORMANCE DATA.

a. TRANSMITTER POWER INPUT REQUIREMENTS.

Emission	Filament Power		Plate Power	
	Volts	Amps.	Volts	Amps.
CW	12.0	1.6	220 440	0.030 0.186
VOICE	12.0	2.1	220 440	0.029 0.188

b. TRANSMITTER POWER OUTPUT.

Band	Frequency	CW Emission		Voice Emission	
		450V	400V	450V	400V
		watts	watts	watts	watts
1	1.5 Mc	32.5	24.0	15.0	12.0
1	3.0 Mc	30.0	24.0	14.0	11.0
2	3.0 Mc	28.5	23.5	13.0	10.5
2	6.0 Mc	33.5	28.5	16.0	12.5
3	6.0 Mc	30.0	25.5	11.0	9.5
3	12.0 Mc	32.0	25.5	14.0	11.0

NOTE: The above power measurements were made using a dummy load consisting of 300 $\mu\mu$f in series with 13 ohms of non-inductive resistance on 1.5 Mc and 100 $\mu\mu$f in series with 13 ohms of non-inductive resistance on all other frequencies.

These readings represent the actual power delivered to the antenna as measured with an external meter. All readings taken at MO.

c. TRANSMITTER AUDIO-FREQUENCY DATA.

(1) AUDIO-FREQUENCY RESPONSE.

Frequency	90% Mod.
200 cps	+1 db
300 cps	+1 bd
400 cps	+1 db
1000 cps	0.00 db
2000 cps	−2 db
3000 cps	−4 db
5000 cps	−7 db

(2) AUDIO INPUT.—0.80 volt for 90% modulation.

(3) AUDIO DISTORTION.—8.5% rms at 400 cps and with 90% modulation.

(4) NOISE LEVEL.—53 db below the 100% modulation level with input at 1000 cps.

a. RECEIVER POWER INPUT PEQUIREMENTS.

Emission	Filament Power		Plate Power	
	Volts	Amps.	Volts	Amps.
CW	12.0	1.15	225	.096
MOD.	12.0	1.15	225	.095

4. TYPICAL RECEIVER PERFORMANCE DATA.

Note

Except as otherwise stated, all the following receiver data tables were obtained with the A.F. GAIN control R220 and the R.F. GAIN control R216 in their maximum clockwise positions and the AVC off. Placing the MOD.-CW switch S203 in the "CW" position automatically grounds out the AVC, but when switch S203 is in the "MOD." position, this grounding is accomplished by turning the R.F. GAIN control R216 back slightly from its maximum clockwise position until a click is heard. This indicates that switch S206 has been closed and the AVC grounded out.

a. RECEIVER POWER INPUT REQUIREMENTS.

Emission	Filament Power		Plate Power	
	Volts	Amps.	Volts	Amps.
CW	12.0	1.15	225	.096
MOD.	12.0	1.15	225	.095

b. RECEIVER AUDIO-FREQUENCY DATA. (1) OVERALL FREQUENCY RESPONSE.

Frequency	1000 Cps Sig. 30% Mod.	Frequency	1000 Cps Sig. 30% Mod.
200 cps	−1.3 db	2000 cps	−1.8 db
300 cps	−0.3 db	2500 cps	−2.8 db
500 cps	+0.5 db	3000 cps	−4.5 db
1000 cps	0.0 db	4000 cps	−8.0 db
1500 cps	−0.8 db		

(2) SENSITIVITY.

Band 1			Band 2			Band 3		
Freq. (Mc)	CW Input (μv)	VOICE Input (μv)	Freq. (Mc)	CW Input (μv)	VOICE Input (μv)	Freq. (Mc)	CW Input (μv)	VOICE Input (μv)
1.5	4.6	9.7	3.0	2.7	5.6	6.0	1.8	3.9
1.9	2.4	5.3	3.8	1.4	3.0	7.5	1.3	2.8
2.3	2.0	4.5	4.5	1.0	1.5	9.0	1.0	1.9
2.6	1.7	3.8	5.2	0.8	1.5	10.5	0.8	1.7
3.0	1.0	2.2	6.0	0.5	0.7	12.0	0.5	1.1

NOTE: The above measurements were made with the OSCILLATOR SELECTOR switch S202 in the "MO" position and with a 6-milliwatt output to a 500-ohm load.

(3) SELECTIVITY.

Ratio	Band Width
2	6.12 Kc
10	11.30 Kc
100	19.00 Kc
1000	29.58 Kc
10,000	45.00 Kc

NOTE: The above measurements were taken with the receiver tuned to 1.5 Mc, the MOD.-CW switch in the "MOD." position, and the OSCILLATOR SELECTOR at "MO"

(4) IMAGE RATIO.

Band 1		Band 2		Band 3	
Freq. (Mc)	Ratio (db)	Freq. (Mc)	Ratio (db)	Freq. (Mc)	Ratio (db)
1.5	66.6	3.0	65.5	6.0	51.4
2.3	59.0	4.5	58.0	9.0	44.4
3.0	55.9	6.0	52.0	12.0	28.0

(5) AVC CHARACTERISTICS.

Freq. (Mc)	Input (μv)	Output (db)	Input (μv)	Output (db)	Change (db)	Tolerance (db)
2.3	100,000	+20	1,000	+14.3	—5.7	—6.0
4.5	100,000	+20	1,000	+15.2	—4.8	—6.0
9.0	100,000	+20	1,000	+15.0	—5.0	—6.0

NOTE: The audio input is 30% modulated at 400 cps. The A.F. GAIN control is set for +20 db output with 100,000 μv input.

(6) DISTORTION AND POWER OUTPUT.

Power Output		Distortion
db	Watts	
—19.2	0.500	6.0%
—22.4	1.000	7.0%
—24.0	1.500	8.0%

NOTE: The audio input is 30% modulated at 400 cps.

5. RESISTANCE MEASUREMENTS FROM CABLE CONNECTOR PLUG TERMINALS TO GROUND.

Pin No.	Transmitter Conn. P101.	Receiver Conn. P201	Remote-Control Unit Conn. P601
1	∞	∞	∞
2	∞	39,000	∞
3	∞	34,000	∞
4	75	∞	∞
5	0	2	∞
6	∞	0	∞
7	∞	∞	0
8	1270	∞	Min. 25 R601 Max. 500

Pin No.	Transmitter Conn. P101	Receiver Conn. P201	Remote-Control Unit Conn. P601
9	∞	78	∞
10	∞	∞	....
11	∞	∞	....
12	∞	∞	....
13	1.4	....	....
14	∞	....	....
15	0	....	....
16	53	....	....

Conditions: Tubes in sockets; all POWER switches in "OFF" positions.
Transmitter: MO; VOICE; Band 1.
Receiver: MO; MOD.; Band 1; AVC on.

6. TYPICAL TCS POWER INPUT REQUIREMENTS.

Power Unit by Navy Type Number	-20309	-211330	-2111330	-211100	-21827-A	-21881-B
Input Voltage	115/230v-ac	12/24 dc	12/24 dc	115v dc	230v dc	12v dc
Conditions						
CW—Key open—Receiver ON	150w	108w	359w	288w	275w	108w
CW—Key closed—Receiver ON	234w	485w	414w	391w	385w	185w
VOICE—Key open—Receiver ON	150w	110w	352w	288w	275w	110w
VOICE—90% Modulation—Receiver ON	243w	205w	445w	205w	385w	205w
Transmitter OFF Receiver ON	89w	58w	175w	58w	140w	58w

7. WINDING DATA FOR CHOKES REACTORS AND TRANSFORMERS.

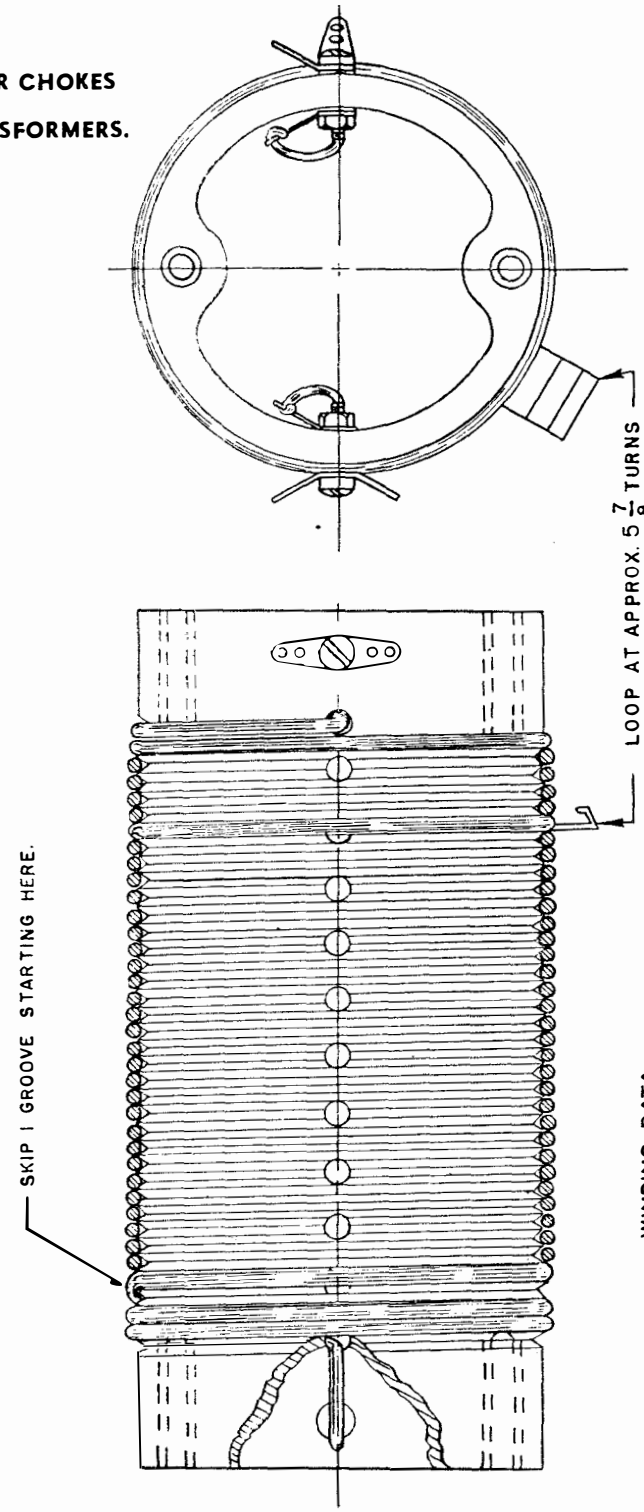
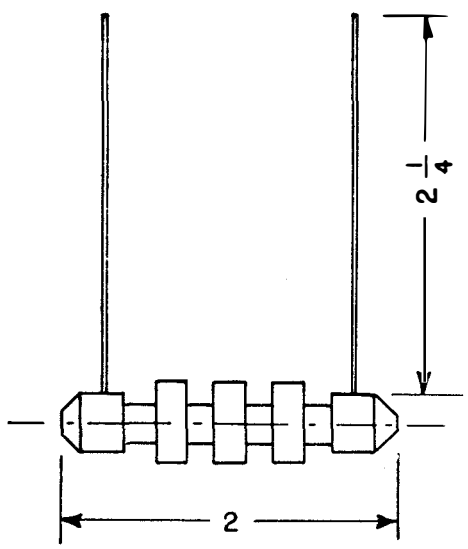


Figure 7-9 Transmitter Master-Oscillator Grid Inductor (L101).

WINDING DATA

WIRE	GAUGE	PART NO.	APPROX NO OF TURNS	TYPE OF WINDING	L.	DIST. C	Q	FREQ.	CAP.
DOUBLE ENAMEL	18	W 1 1016	41 1/2	SINGLE LAYER			240 220	3900 1950	51 214



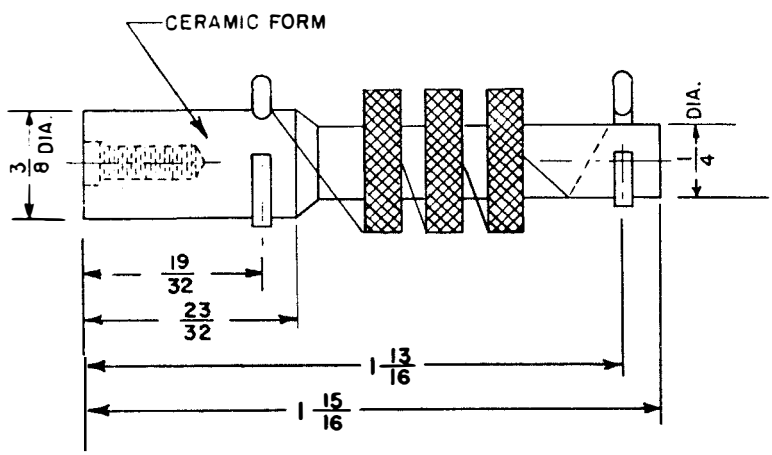
INDUCTANCE: 1 MH.
MAX. CURRENT: 300 MA.
D.C. RESISTANCE: 10 OHMS

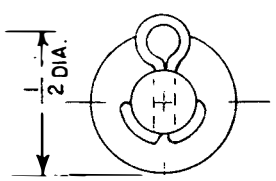
NO. OF SECTIONS: 3
IMPREGNATION: LOW LOSS
INDUCTANCE LIMITS: ±10%

HIGH FREQUENCY RADIO FREQUENCY CHOICE MULTIPLE-PI, DUO-LATERAL WOUND ON CERAMIC FORM. WIRE LEAD TERMINALS FROM MOULDED END CAPS.

190 TURNS No. 32
SSE PER PI

Figure 7-10 Radio-Frequency Choke Coil (L102, L109, L207, L2101, L2102, L2301, L2302).



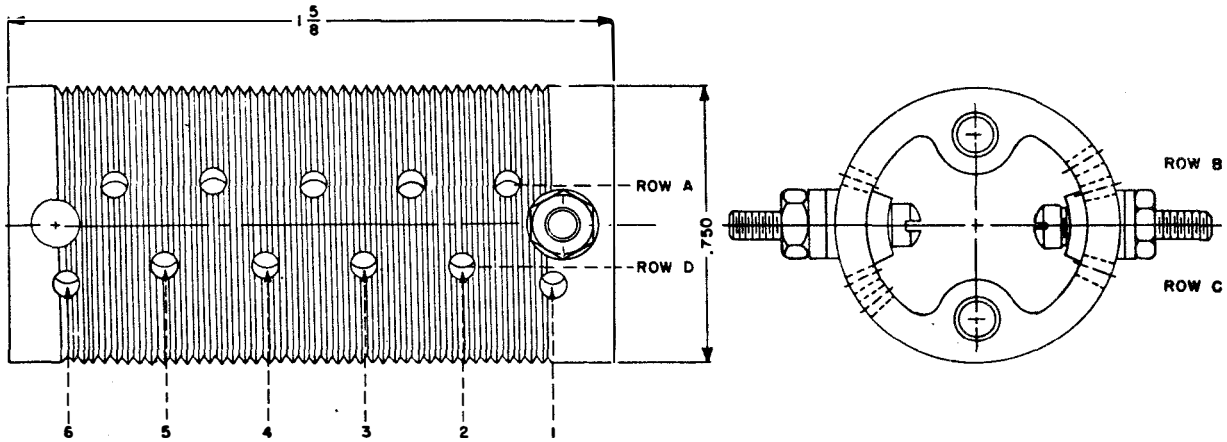


INDUCTANCE: 1. MH.
MAX. CURRENT: 300 MA.
D.C.RESISTANCE: 10 OHMS
DIST'D. CAPACITY: 1.5 μμf. MAX.
NO. OF SECTIONS: 3
IMPREGNATION: LOW LOSS
INDUCTANCE: ±10%
MULTIPLE PI DUO LATERAL WOUND.

190 TURNS No. 32
SSE PER PI

Figure 7-11

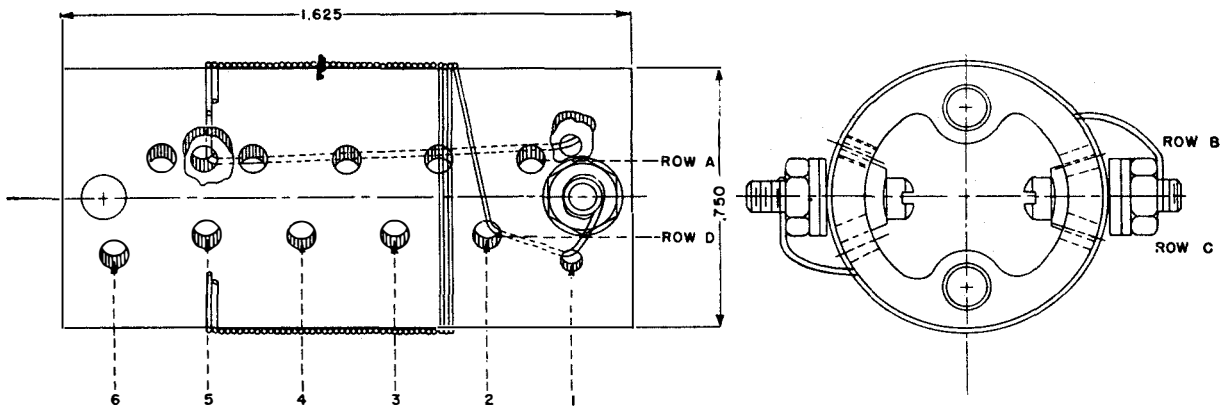
Final-Amplifier Plate Choke Coil (L110).
High-Voltage Noise Filter Inductor (L402).
Low-Voltage Noise Filter Inductor (L404).
Filament Noise Filter Reactor (L2803).
Low-Voltage Noise Filter Reactor (L2804).



WINDING DATA

Coil	Wire	Gauge	Part No.	Approx. No. of Turns	Type of Winding	Row A	Row B	Row C	Row D	L	Dist C	Q	Freq.	Cap.	Remarks
L103	Enam. Copper	28	WI-1015	23-1/2	Single Layer		Stop Hole 5		Start Hole 2	7.45 µh	2.16 µµf	119 169	3.0 Mc 6.0 Mc	136 µµf	
L104	Enam. Copper	28	WI-1015	9-1/2	Single Layer			Stop Hole 4	Start Hole 3	1.92 µh	1.33 µµf	104 148	6.0 Mc 12.0 Mc	138 µµf	At 6-1/8 turns skip 2 grooves for one turn only, then at 7-1/8 turns skip alternate grooves for remaining 3-1/2 turns
L105	Enam. Copper	28	WI-1015	24-1/2	Single Layer		Stop Hole 5		Start Hole 2	7.85 µh	1.66 µµf	115 169	3.0 Mc 6.0 Mc	131 µµf	

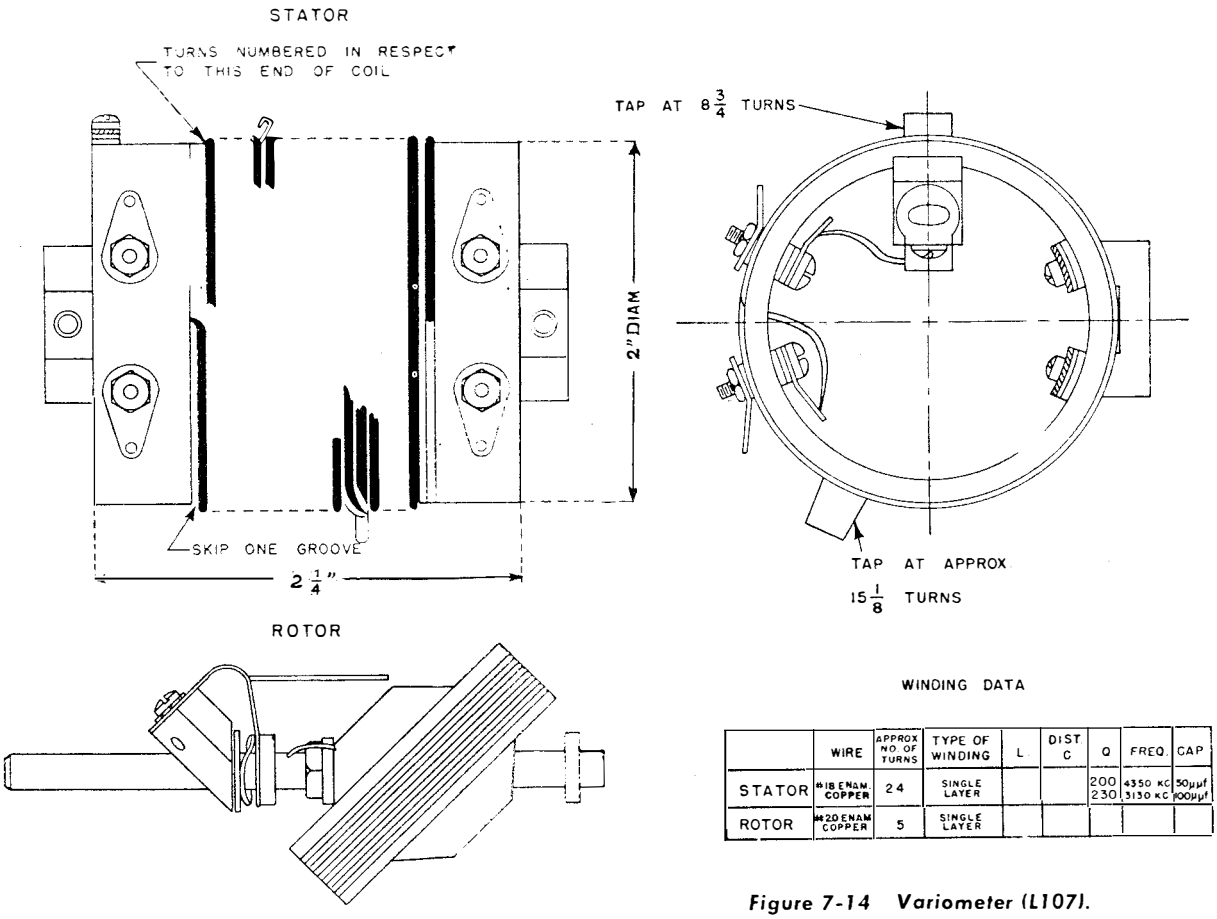
Figure 7-12 Transmitter Oscillator Plate Inductor 3.0-6.0 Mc (L103). Transmitter Doubler Plate Inductor 6.0-12.0 Mc (L1041). Transmitter Buffer Plate Inductor 3.0-6.0 Mc (L105).



WINDING DATA

WIRE	GAUGE	PART NO.	APPROX. NO. OF TURNS	TYPE OF WINDING	ROW A	ROW B	ROW C	ROW D	L	DIST. C	Q	FREQ.	CAP.
ENAMELED COPPER	28	WI-1015	47	SINGLE LAYER		STOP HOLE 5		START HOLE 2	33.0 µH.	2.0 MMF.	91 113	1.5 MC 3.0 MC	91 MMF.

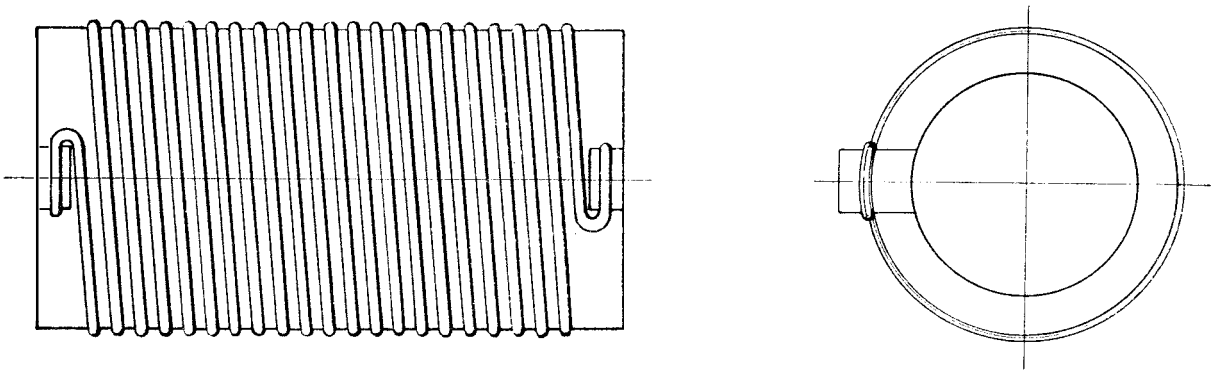
Figure 7-13 Transmitter Buffer Plate Inductor 1.5-3.0 Mc (L106).



WINDING DATA

	WIRE	APPROX NO. OF TURNS	TYPE OF WINDING	L	DIST. C	Q	FREQ.	CAP
STATOR	#18 ENAM. COPPER	24	SINGLE LAYER			200 230	4350 KC 3130 KC	50 μμf 100 μμf
ROTOR	#20 ENAM. COPPER	5	SINGLE LAYER					

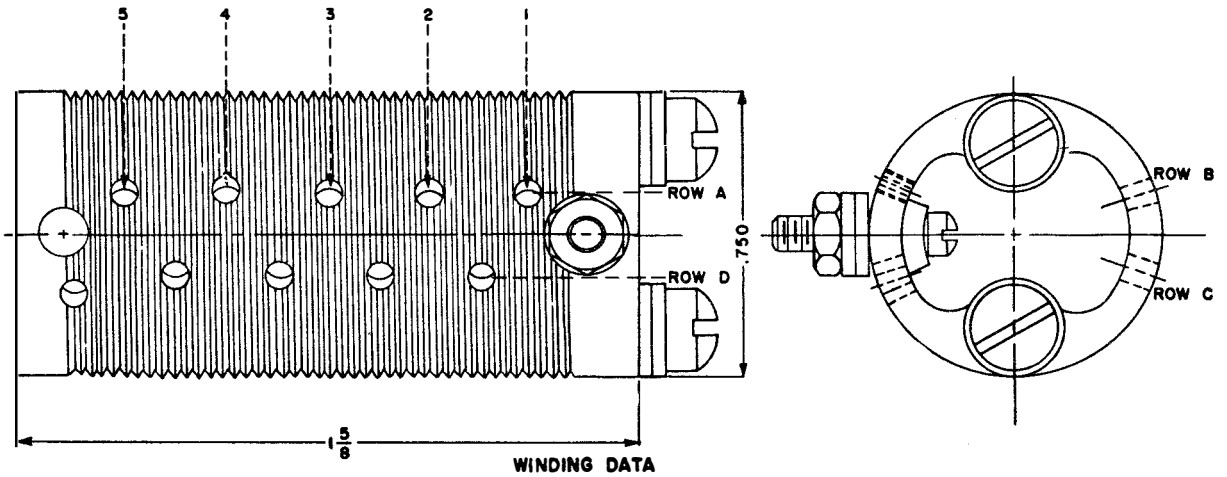
Figure 7-14 Variometer (L107).



WINDING DATA

WIRE	GAUGE	PART NO.	APPROX NO. OF TURNS	TYPE OF WINDING	L	DIST. C	Q	FREQ.	CAP
BARE TINNED COPPER	18	WI-5009	45	SINGLE LAYER					

Figure 7-15
Antenna-Loading Inductor (L108).

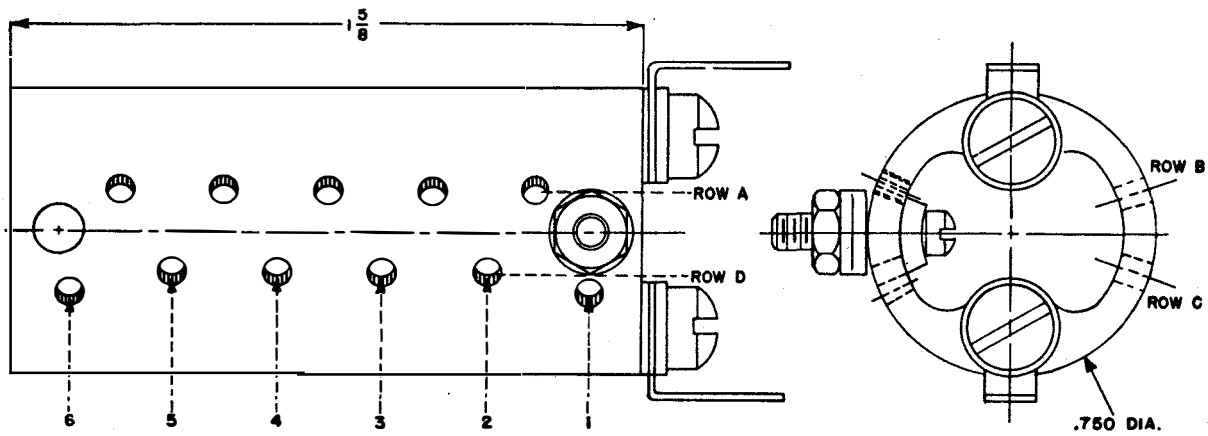


WINDING DATA

Coil	Wire	Gauge	Part No.	Approx. No. of Turns	Type of Winding	Row A	Row B	Row C	Row D	L	Dist. C	Q	Freq.	Cap.
L201	Enam. Copper	28	WI-1015	8-1/2	Single layer			Stop Hole 3	Start Hole 2	1.86 µh at 1000 cps		102 144	6.0 Mc 12.0 Mc	389 95
	D.S.C. Enam. Copper	32	WI-1027	2-1/2	Inter-wound			Stop Hole 2	Start Hole 2					
L202	Enam. Copper	28	WI-1015	23	Single Layer				Start Hole 2 Stop Hole 5	7.34 µh at 1000 cps		117 165	3.0 Mc 6.0 Mc	385 93.5
	D.S.C. Enam. Copper	32	WI-1027	2-1/2	Inter-wound			Stop Hole 2	Start Hole 2					
L204	Enam. Copper	28	WI-1015	9 Tap at 2nd Turn	Single Layer	Tapped Hole 2 Stop Hole 3			Start Hole 2	1.85 µh at 1000 cps		97 137	6.0 Mc 12.0 Mc	380 92.5
L205	Enam. copper	28	WI-1015	24 Tap at 6th Turn	Single Layer	Start Hole 1 Tap Hole 2 Stop Hole 4				7.84 µh at 1000 cps		117 165	3.0 Mc 6.0 Mc	370 90
L208	Enam. copper	28	WI-1015	8 Tap at 2nd Turn	Single Layer	Tap at Hole 3 Stop Hole 4			Start Hole 3	1.65 µh at 1000 cps		96 134	6.0 Mc 12.0 Mc	451.4 110.6
L209	Enam. Copper	28	WI-1015	21 Tap at 4th Turn	Single Layer	Tap at Hole 2 Stop Hole 4			Start Hole 2	6.44 µh at 1000 cps		119 160	3.0 Mc 6.0 Mc	443 108.4

Figure 7-16

Receiver Antenna Inductor 6.0-12.0 Mc (L201).
Receiver Antenna Inductor 3.0-6.0 Mc (L202).
Receiver Converter Inductor 6.0-12.0 Mc (L204).
Receiver Converter Inductor 3.0-6.0 Mc (L205).
Receiver Oscillator Inductor 6.0-12.0 Mc (L208).
Receiver Oscillator Inductor 3.0-6.0 Mc (L209).

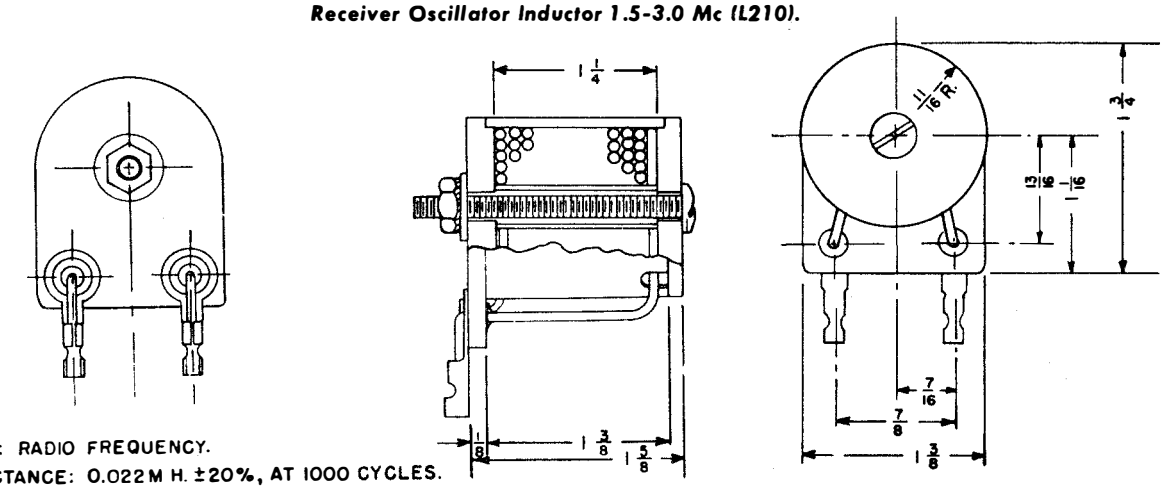


WINDING DATA

Coil	Wire	Gauge	Part No.	Approx No. of Turns	Type of Winding	Row A	Row B	Row C	Row D	L	Dist C	Q	Freq	Cap.
L203	Enam Copper	28	WI-1015	47	Single Layer				Start Hole 2 Stop Hole 5	30.7 µh at 1000 cps		92 116	1.5 Mc 3.0 Mc	385 94.5
	Dbl. Silk Enam Copper	32	WI-1027	5-1/2	Inter-wound			Stop Hole 2	Start Hole 2					
L206	Enam Copper	28	WI-1015	46 Tap at 8th Turn	Single Layer	Tap Hole 2 Stop Hole 4			Start Hole 2	31.3 µh at 1000 cps		93 117	1.5 Mc 3.0 Mc	370 90
L210	Enam Copper	28	WI-1015	36 Tap at 8th Turn	Single Layer	Tap Hole 2 Stop Hole 4			Start Hole 2	22.3 µh at 1000 cps		92 110	1.5 Mc 3.0 Mc	454 129

Figure 7-17

Receiver Antenna Inductor 1.5-3.0 Mc (L203). Receiver Converter Inductor 1.5-3.0 Mc (L206). Receiver Oscillator Inductor 1.5-3.0 Mc (L210).



TYPE: RADIO FREQUENCY.
INDUCTANCE: 0.022 M H. ±20%, AT 1000 CYCLES.
D. C. RESISTANCE: 0.020 OHMS ±20%.
WIRE SIZE: # 12 ENAMELED COPPER.
NUMBER OF TURNS: 55
WINDING: PIE WOUND

Figure 7-18

Noise Filter for Primary of High-Voltage Dynamotor (L401). Noise Filter for Primary of Low-Voltage Dynamotor (L405). Filament Voltage Filter Inductor (L2104, L2304). Filament Noise Filter Reactor (L2802).

NOTE: TOTAL 58 TURNS - LEAVE 2 GROOVES VACANT BETWEEN 13 T AND 9 T COIL AND 1 GROOVE VACANT BETWEEN EACH OF THE OTHER COILS. START WINDING 3rd GROOVE FROM EACH END.

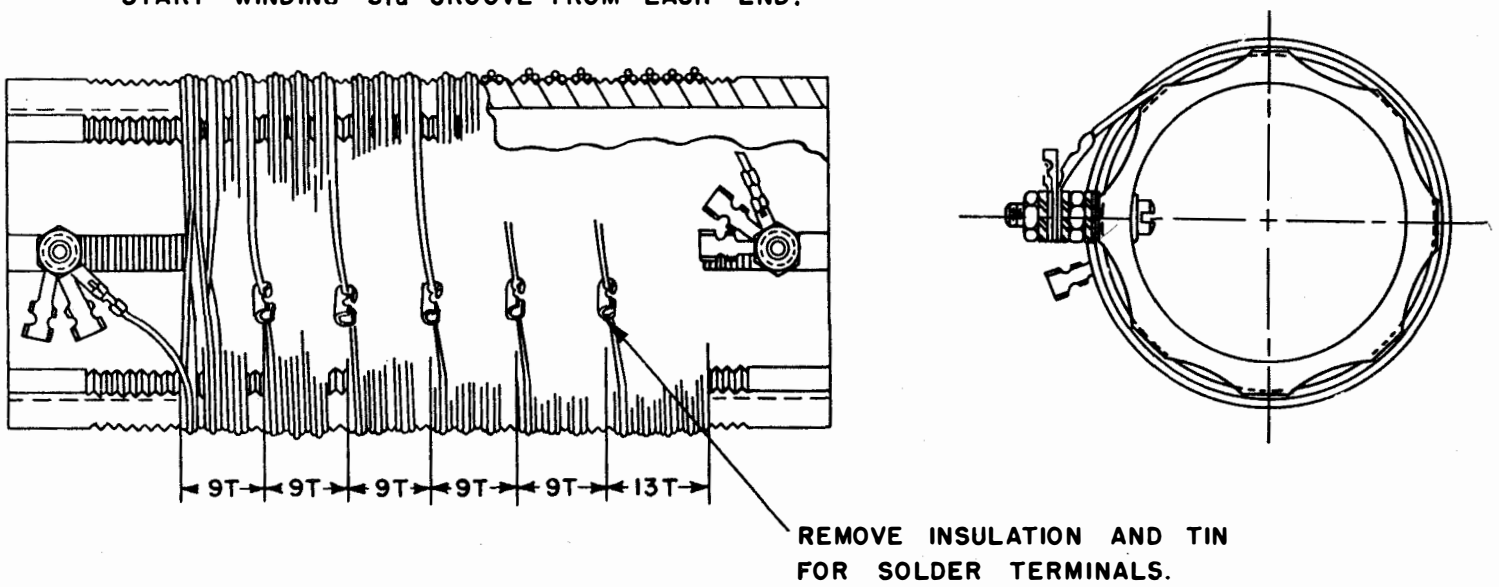
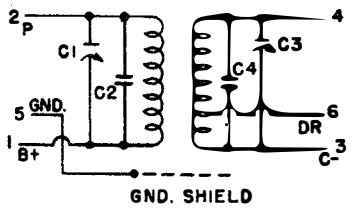


Figure 7-19 Antenna Loading Coil Inductor (L701).



TYPE : INTERSTAGE

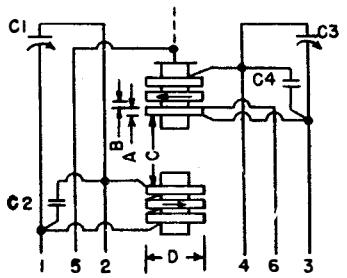
FREQUENCY : 455 Kc

NARROW BAND TRANSFORMER

This transformer appears in receivers of the following types and serial numbers:
Type CKP-46159-A; all sets bearing serial numbers up to No. 299.
Type CIH-46159-A; all sets bearing serial numbers up to No. 3199.

WIDE BAND TRANSFORMER

This transformer appears in receivers of the following types and serial numbers:
Type CKP-46159-A: all sets bearing serial numbers higher than No. 300.
Type CIH-46159-A; all sets bearing serial numbers higher than No. 3200.



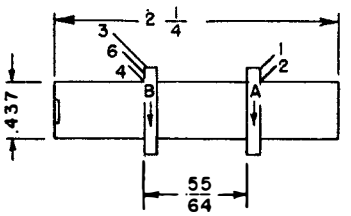
APPROX. DIM.

A - 3/32

B - 1/16

C - 27/32

D - 13/16



WDG.	TURNS	WIRE	CAM	GEARS	L/1000 cps (μh)	Q/455Kc
A	271	36SNE	.125"	34-23	1200±40	57±4
B	256+36	36SNE	.125"	34-23	1400±45	57±4
MUTUAL: 42±3						

DATA

C1	-	48 MMFD. EFF.
C2	-	50 MMFD. SILVER MICA
C3	-	48 MMFD. EFF.
C4	-	50 MMFD. SILVER MICA

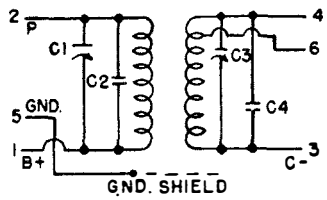
D.C. RESIST. IN OHMS

1-2	11 OHMS	D.C.
3-4	11 "	"
3-6	3 "	"

DATA

C1	-	5-55 MMFD
C2	-	50 MMFD ±3% SILVER MICA
C3	-	5-55 MMFD
C4	-	50 MMFD ±3% SILVER MICA

Figure 7-20 I-F Transformer, Interstage (Z201, Z202).



TYPE : DIODE

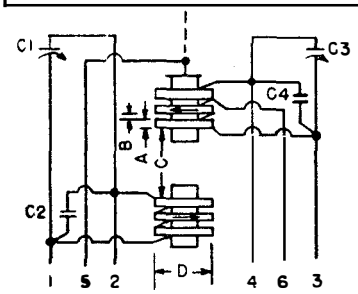
FREQUENCY : 455 Kc

NARROW BAND TRANSFORMER

This transformer appears in receivers of the following types and serial numbers:
Type CKP-46159-A; all sets bearing serial numbers up to No. 299.
Type CIH-46159-A; all sets bearing serial numbers up to No. 3199.

WIDE BAND TRANSFORMER

This transformer appears in receivers of the following types and serial numbers:
Type CKP-46159-A; all sets bearing serial numbers higher than No. 300.
Type CIH-46159-A; all sets bearing serial numbers higher than No. 3200.



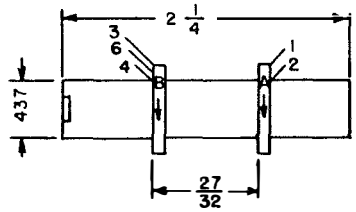
APPROX. DIM.

A - 3/32

B - 1/16

C - 27/32

D - 13/16



WDG	TURNS	WIRE	CAM	GEARS	L/1000 cps (mh)	Q/455Kc
A	271	36SNE	.125"	34-23	1200±40	57±4
B	136+156	36SNE	.125"	34-23	1400±45	57±4
MUTUAL: 45±3						

DATA

C1	-	48 MMFD. EFF.
C2	-	50 MMFD. SILVER MICA
C3	-	48 MMFD. EFF.
C4	-	50 MMFD. SILVER MICA

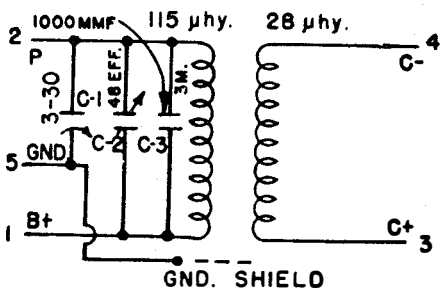
D.C. RESIST. IN OHMS

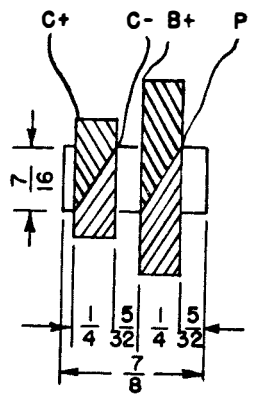
1-2	11 OHMS	D.C.
3-4	11 "	"
3-6	7.3 "	"

DATA

C1	-	5-55 MMFD
C2	-	50 MMFD ±3% SILVER MICA
C3	-	5-55 MMFD
C4	-	50 MMFD ±3% SILVER MICA

Figure 7-21 I-F Transformer, Diode (Z203).





#7-40 LITZ

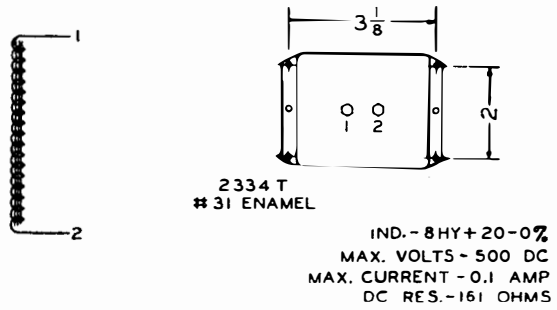
COILS WOUND IN SAME DIRECTION.

TYPE : B. F. O.

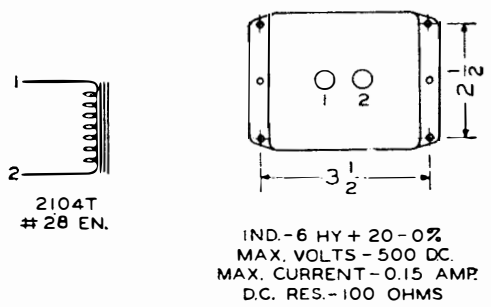
FREQUENCY : 455 Kc

DATA		
C1	-	3-30 MMFD
C2	-	48 MMFD EFF.
C3	-	1000 MMFD SILVER MICA
D.C. RESIST. IN OHMS		
1-2	-	2.6 OHMS
3-4	-	2.0 OHMS

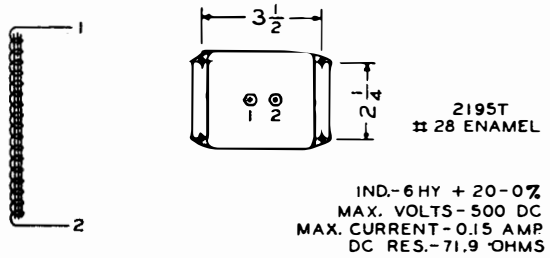
Figure 7-22 B.F.O. Transformer (Z204).



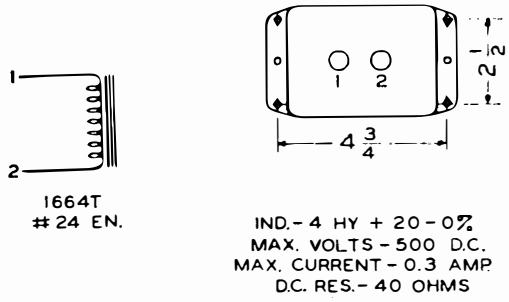
LV Ripple-Filter Reactor L403



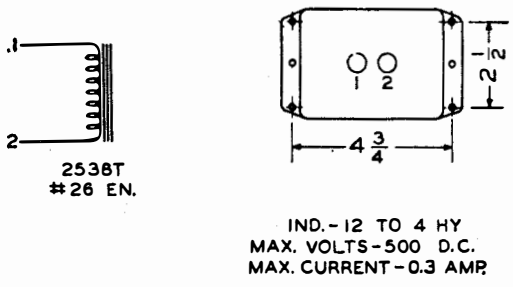
LV Input Filter Reactor L2202, L2203



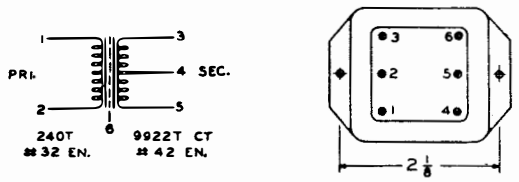
LV Filter Reactor L2103, L2303



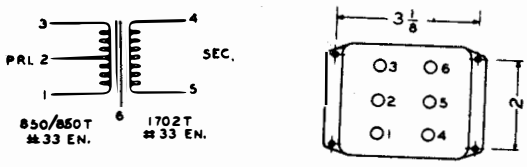
HV Output Filter Reactor L2204



HV Input Filter Reactor L2201

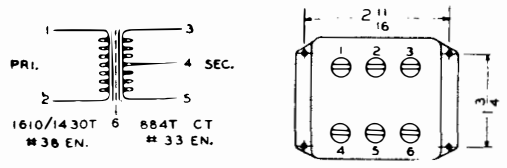


Microphone Transformer T101

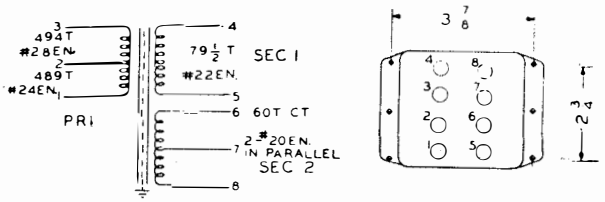


Modulation Transformer T102

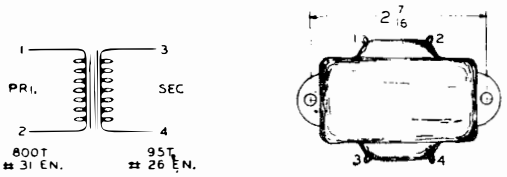
Figure 7-23 Additional Reactors and Transformers



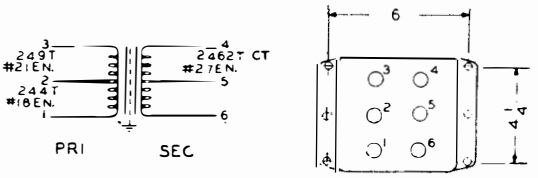
Output Transformer T201



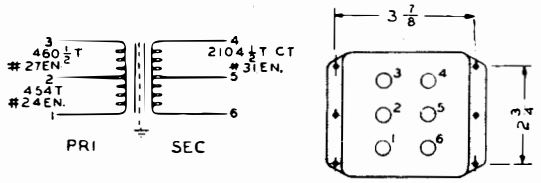
Fil. and Relay Power Trans. T2203



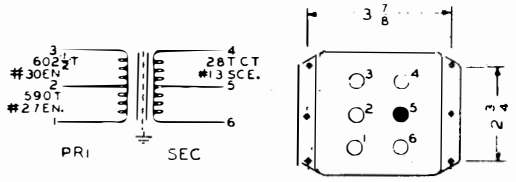
Speaker Transformer T601



HV Plate Power Transformer T2202



LV Plate Power Transformer T2201

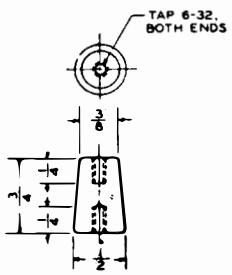


HV Rect Fil. Power Trans. T2204

Figure 7-23 Additional Reactors and Transformers (Cont'd)

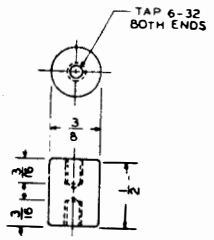
8. CERAMIC INSULATORS.

E-103



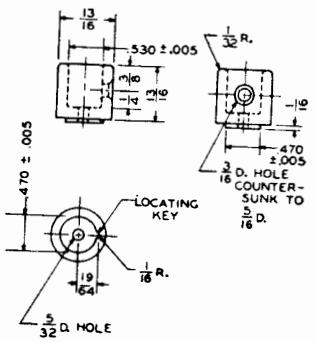
Navy Type No. 61503
Material: Porcelain

E-104
E-203



Navy Type No. 61415
Material: Low Loss Ceramic

E-108



Material: Low Loss Ceramic

9. ALIGNMENT.

The transmitter and receiver units have been properly aligned at the factory and should not require readjustment unless the unit has been damaged or tampered with. If the equipment fails to function properly, realignment should be tried only as a last resort and then only if the misalignment seriously impairs the operating performance of the units. The alignment procedure must be followed in detail and it is recommended that only experienced personnel be allowed to make these adjustments.

10. TRANSMITTER ALIGNMENT.

Improper alignment of the transmitter is indicated by a low power output, by distortion of the signal and by inaccurate dial calibration, especially at the high frequency end of each band.

If realignment becomes necessary, there is needed an accurate frequency meter, a low-range direct-current milliammeter (0-10 ma), and suitable screwdrivers, wrenches, etc. The master-oscillator section of the transmitter is used in aligning and the procedure is as follows:

a. Shut off all power by placing switches S107, S205 and S603 in the "OFF" positions.

b. Disconnect the power cable from the transmitter and remove this unit from its cabinet.

c. Place the transmitter on a flat surface with the front panel facing upward. In this position the interlock switch S106 is held in the closed position, making it possible to apply plate power to the tubes. Reconnect the power cable.

d. Place EMISSION switch S105 in the "CW" position. Either the "VOICE" or "CW" position may be used, but the latter is preferable because it causes both power amplifier tubes to operate and thus results in a grid current large enough to give a good indication of proper circuit alignment.

e. Set the OSCILLATOR SELECTOR switch S104 in the "MO" position.

f. Rotate BAND SWITCH S101-S102 to position 1 (1.5 to 3 Mc) and rotate the TUNING control C101 until the dial indicates 3.0 Mc.

g. Take out the screw that holds the grounding lug connecting the final-amplifier grid resistors R107 and R112 to the chassis, detach this lug from the chassis-grounding post, and insert the direct-current milliammeter between the junction of the resistors and the chassis. (see figure 7-24)

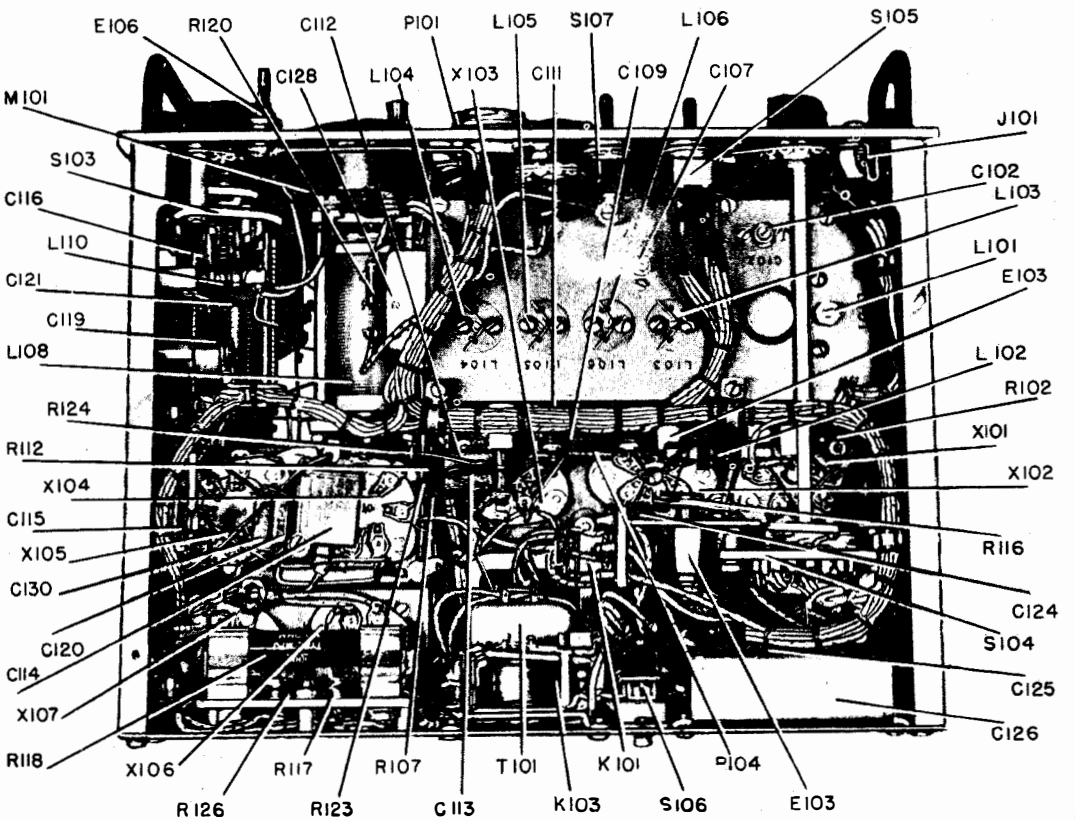


Figure 7-24 Open Bottom View of Transmitter

b. Place switches S107 and S205 in the "ON" position and, inserting the key plug into J101, close the shorting switch on the key. (If switch S105 has been placed in the "VOICE" position, insert the microphone plug and hold down the "press-to-talk" button.)

i. While checking the frequency of the output with the frequency meter, adjust the trimmer capacitor C102, until the oscillator frequency is exactly 3.0 Mc.

WARNING

When tightening the holding nut of C102, be careful that it does not touch the sides of the metal housing. This also applies to the holding nut of C107.

j. Rotate the TUNING control C101 until the dial indicates 1.5 Mc and adjust the inductance trimmer within inductor L101, until the frequency of the oscillator output is exactly 1.5 Mc. (*Refer to figure 7-24 for the location of the capacitance and inductance trimmers.*)

k. Repeat steps *i* and *j* until no further adjustment of the inductance or capacitance is required.

The above procedure completes the alignment of the oscillator grid circuit and no further adjustment of these trimmers should be necessary.

l. Rotate the TUNING control to 1.5 Mc (if it is not already there) and adjust the trimmer within inductor L106 for maximum final-amplifier grid current, as indicated on the direct-current milliammeter.

m. Rotate the BAND SWITCH to position 2 (3 to 6 Mc).

n. Rotate the TUNING control to 3.0 Mc and adjust the inductance trimmer in L105 for maximum final-amplifier grid current.

o. Rotate the BAND SWITCH to position 3 (6 to 12 Mc) and rotate the TUNING control to 12.0 Mc.

p. Adjust the capacitance trimmer C107 for maximum final-amplifier grid current.

q. Rotate the TUNING control to 6.0 Mc and adjust the trimmers within inductors L103 and L104 for maximum final-amplifier grid current.

r. Repeat steps *o*, *p* and *q* until no further adjustment of the trimmers will increase the final-amplifier grid current.

The above procedure completes the alignment of the transmitter but before the meter is removed from the final-amplifier grid circuit, a careful check should be made of the excitation on all bands. The meter reading for CW operation should be between 3.0 ma and 5.0 ma and should be nearly uniform over the entire band. (For VOICE operation, the values will be about half as much.) Any variations should be in the form of a smooth curve as the TUNING control is rotated over the range of any one band. If any sharp dips are noticed, the alignment procedure should be repeated.

After realignment, the power should be shut off, the direct-current milliammeter removed, and the grounding lug to which the final-amplifier grid resistors R107 and R112 are soldered should be firmly screwed back in its original chassis-ground position. The transmitter then may be replaced in its cabinet.

11. RECEIVER ALIGNMENT.

Like the transmitter, the receiver should not be realigned until all other trouble-shooting methods have been tried and even then only if the misalignment seriously impairs the operation of the set. A serious misalignment may manifest itself by a loss of sensitivity, low power output and excessive distortion. (It should be kept in mind, however, that a defective tube may show these same symptoms.)

In case realignment is definitely required, there is needed a good signal generator covering the frequency range from 450 Kc to 12,000 Kc, an audio-output meter that will present a 500-ohm load to the receiver output, and suitable screwdrivers, wrenches, etc.

a. INTERMEDIATE-FREQUENCY ALIGNMENT.

Most cases of misalignment occur in the intermediate-frequency transformers (Z201, Z202 and Z203) and these should be realigned first.

(1) Remove power from the receiver by placing POWER switch S205 in the "OFF" position. Disconnect the power cable from the receiver.

(2) Remove the receiver from its cabinet and place upright on the work bench. Reconnect the power cable.

(3) Connect the audio-output meter to the receiver-output circuit by attaching one lead of the meter to terminal 9 of the POWER CONNECTOR P201 and the other lead to ground.

(4) Place the MOD.-CW switch S203 in the "MOD." position.

(5) Turn off the automatic volume control by a slight counter-clockwise rotation of the R.F. GAIN control R216 from its maximum clockwise position. Rotate this control only until a click is heard (indicating the throwing of the AVC switch S206) and leave the control in this position. Fully advance the A.F. GAIN control R220.

(6) Connect the signal-generator output across the control grid of the converter tube V202 (Terminal No. 8 of X202) and ground. No dummy antenna should be used. Set the signal generator to feed a 455-Kc signal, 30% modulated at 400 cycles, into the converter tube.

(7) Place POWER switch S205 in the "ON" position and adjust all i-f transformer trimmers for maximum output as indicated by the audio-output meter (*refer to figure 7-25*).

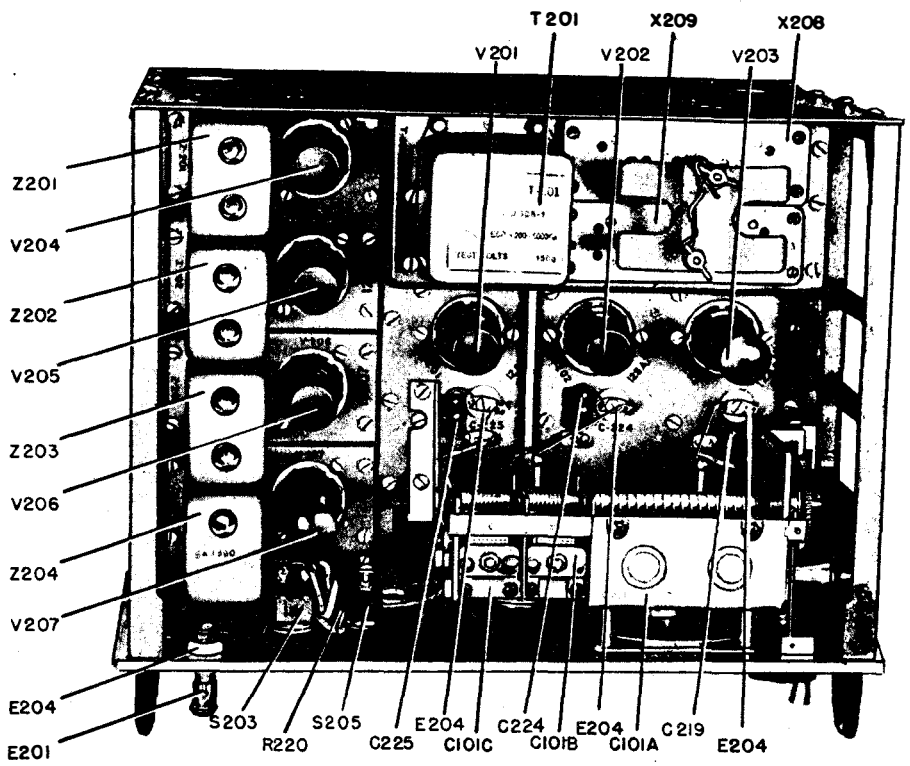


Figure 7-25 Open Top View of Receiver

WARNING

The trimmer of Z204 (BFO) and the primary trimmers of Z201, Z202 and Z203 are "hot," that is, connected to the high-voltage lead. Any adjustment of these trimmers should be made with an insulated screwdriver to avoid receiving an unpleasant shock and care should be taken to avoid grounding them.

While the above procedure usually will be sufficient to align the i-f transformers, a more serious misalignment may require that each i-f stage be aligned separately. This may be accomplished as follows:

(8) Connect the output of the signal generator directly to the grid of the second i-f amplifier tube V205 (Terminal No. 4 of X205) and adjust the trimmers of i-f transformer Z203 until the audio-output meter reads a maximum.

(9) Connect the output of the signal generator directly to the grid of the first i-f amplifier tube V204 (Terminal No. 4 of X204) and adjust the trimmers of i-f transformers Z202 for maximum output.

(10) Connect the output of the signal generator to the control grid of the converter tube V202 (Terminal No. 8 of X202) and adjust the trimmers of i-f transformer Z201 for maximum output.

(11) With the output of the signal generator still on the control grid of V202 readjust the trimmers of Z202 and Z203 for maximum output.

b. RADIO-FREQUENCY ALIGNMENT.

It is possible that even after the intermediate-frequency transformers have been aligned, the receiver may still fail to function properly. This would tend to indicate that the radio-frequency stage requires realignment. If skilled personnel and adequate equipment is available, an overall sensitivity test might be made to check the radio-frequency stage.

The equipment required is a signal generator whose output can be calibrated in microvolts, a means of measuring the receiver output in milliwatts and a dummy antenna consisting of a 10-ohm non-inductive resistor in series with a 100-micro-microfarad capacitor. Connect the dummy antenna between the output lead of the signal generator and the receiver ANTENNA terminal E201. Various r-f signals (30% modulated at 400 cps) within the frequency range of the equipment should be fed into the receiver, and the receiver itself should be accurately tuned to each such signal. For an audio output of 6 milliwatts, the signal input should be less than 15 microvolts at all frequencies within the range of the equipment. If more than this signal input is required to give a 6-milliwatt output, the sensitivity of the receiver should be considered unsatisfactory and realignment of the radio-frequency stage indicated.

(1) Repeat steps (1) to (5) inclusive of the intermediate-frequency alignment procedure and place the OSCILLATOR SELECTOR switch S202 in the "MO" position.

(2) Connect the dummy antenna specified (10-ohm non-inductive resistor in series with the 100-micro-microfarad capacitor) between output lead of the signal generator and receiver ANTENNA terminal E201.

(3) Remove the tuning chart from the front panel of the receiver, exposing nine slots in the panel that give access to the trimmers requiring readjustment. Loosen the capacitance-trimmer lock nuts on C202, C203, C204, C207, C208, C209, C213, C215, and C217. (*See figure 7-26.*)

(4) Place POWER switch S205 in the "ON" position.

WARNING

Capacitance trimmers C207, C208 and C209 are "hot", that is, connected to the high-voltage lead. Any adjustments of these trimmers should be made with a screwdriver constructed of bakelite, fibre, wood, or any other suitable insulating material to avoid unpleasant shock and to prevent grounding to the front panel.

(5) Set BAND SWITCH S201 at position "1" and adjust the receiver TUNING control C201 to 1.5 Mc. Set the signal generator for an output on 1.5 Mc and adjust the inductance trimmers within inductors L203, L206 and L210 for a maximum reading on the audio-output meter.

(6) Rotate the TUNING control until the dial indicates 3.0 Mc and adjust the signal generator to give output on 3.0 Mc. Adjust the capacitance trimmers C204, C209 and C217 for maximum output.

(7) Repeat steps (5) and (6) until no further adjustment of these trimmers will increase the output.

(8) Set the BAND SWITCH at position "2" and adjust the TUNING control until the dial indicates 3.0 Mc. Set the signal generator for an output on 3.0 Mc and adjust the inductance trimmers within inductors L202, L205 and L209 for maximum output.

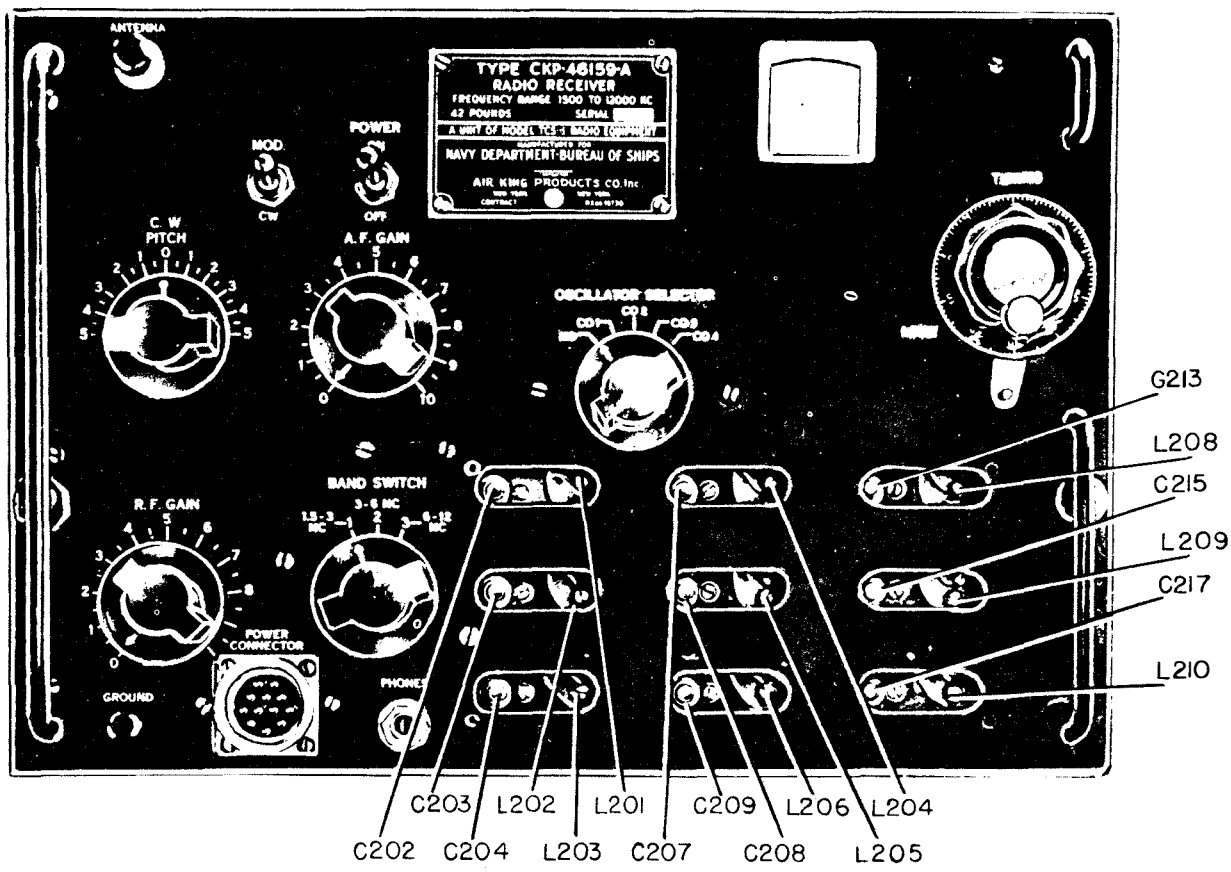


Figure 7-26 Receiver Front Panel with Chart Removed Showing Trimmers

(9) Rotate the TUNING control to 6.0 Mc and adjust the signal generator for output on 6.0 Mc. Adjust the capacitance trimmers C203, C208 and C215 for maximum output.

(10) Repeat steps (8) and (9) until no further adjustment of the trimmers will increase the output.

(11) Rotate the BAND SWITCH to position "3" and adjust the TUNING control to 6.0 Mc. Set the signal generator for 6.0 Mc and adjust the inductance trimmers within inductors L201, L204 and L208 for maximum output.

(12) Rotate the TUNING control to 12.0 Mc and adjust the signal generator for 12.0 Mc. Adjust the trimming capacitors C202, C207 and C213 for maximum output.

(13) Repeat steps (11) and (12) until no further adjustment of the trimmers will increase the output.

(14) When all trimming adjustments have been completed, rotate the TUNING control to the midpoint of each band and check the calibration and sensitivity of the receiver. If the sensitivity is low or the calibration is too much in error, the alignment procedure should be repeated.

(15) When proper alignment has been obtained and with a signal being fed into the receiver, the capacitance trimmer lock nuts should be tightened with the trimmers in the positions that give maximum output. The trimmer screws should be held securely while the lock nuts are tightened. Replace the tuning chart.

c. BFO ALIGNMENT.

In CW reception, if it is impossible to adjust the beat-frequency oscillator to produce an audible signal of variable pitch, this stage should be realigned as follows:

(1) Loosen the adjusting-screw lock nut on the capacitance trimmer of the beat-frequency oscillator coil Z204 (*refer to figure 7-25*).

CAUTION

This trimmer is "hot" and insulated tools should be used.

(2) Set the CW PITCH control to "0". (If the CW PITCH knob is removed, a red line will be seen on the end of the shaft. This line, when vertical, indicates that the BFO trimmer capacitor is at half-mesh, and should correspond to the "0" position.)

(3) Set the MOD.-CW switch in the "MOD." position and tune the receiver to the exact frequency of any modulated r-f signal, within the equipment's range, fed into it from the signal generator through the dummy antenna specified above.

(4) Switch off the modulation on the signal from the signal generator and set the receiver MOD.-CW switch in the "CW" position.

(5) Without retuning the receiver, adjust the capacitance trimmer of Z204 for "zero beat" (zero audio output as indicated by the output meter).

(6) Screw down the lock nut on the Z204 trimmer.

As a check on the realignment of the beat-frequency oscillator, rotate the CW PITCH control in both directions from zero. The pitch of the beat note should increase as the control is rotated in either direction from "0" toward "5".

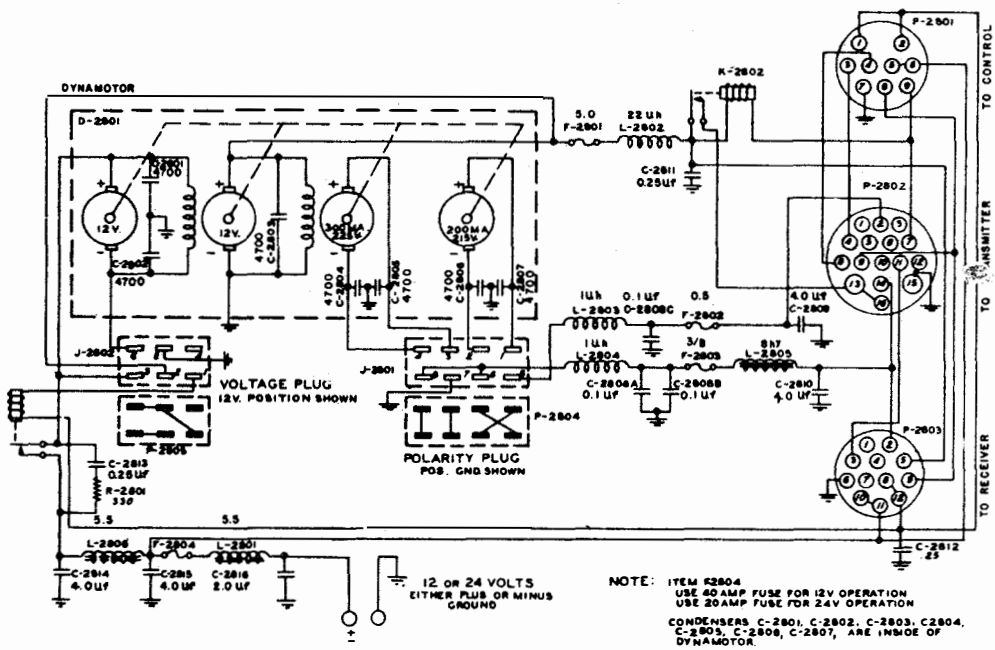


Fig. 7-27 Type -211330-B Single Dynamotor Power Supply—Schematic Diagram

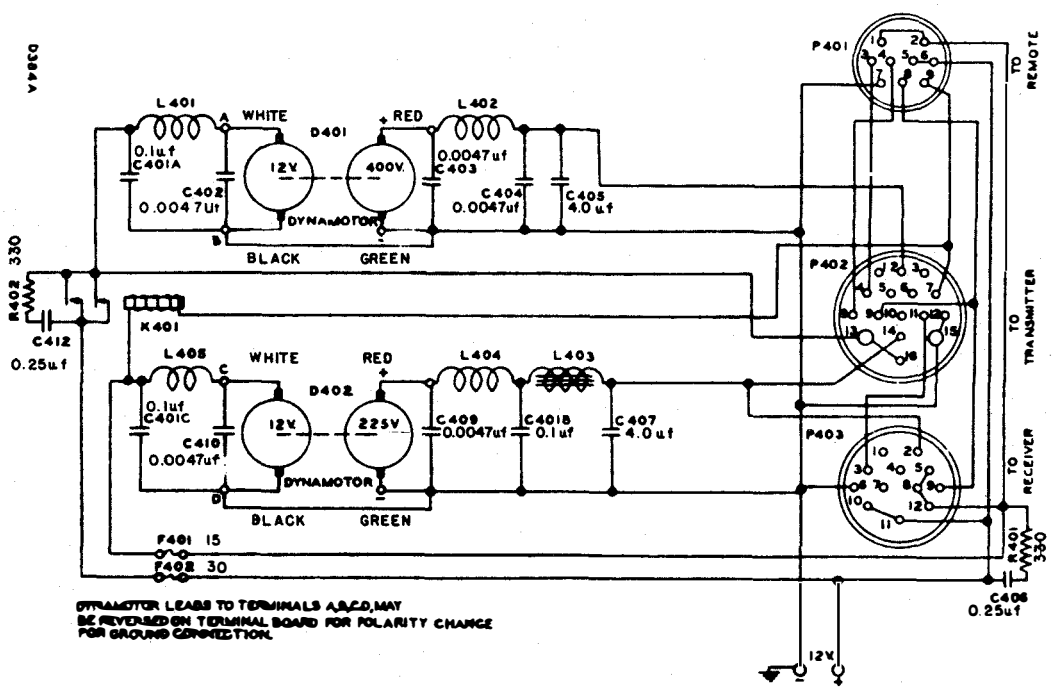


Fig. 7-28 Type -21881-B Dual Dynamotor Power Supply—Schematic Diagram

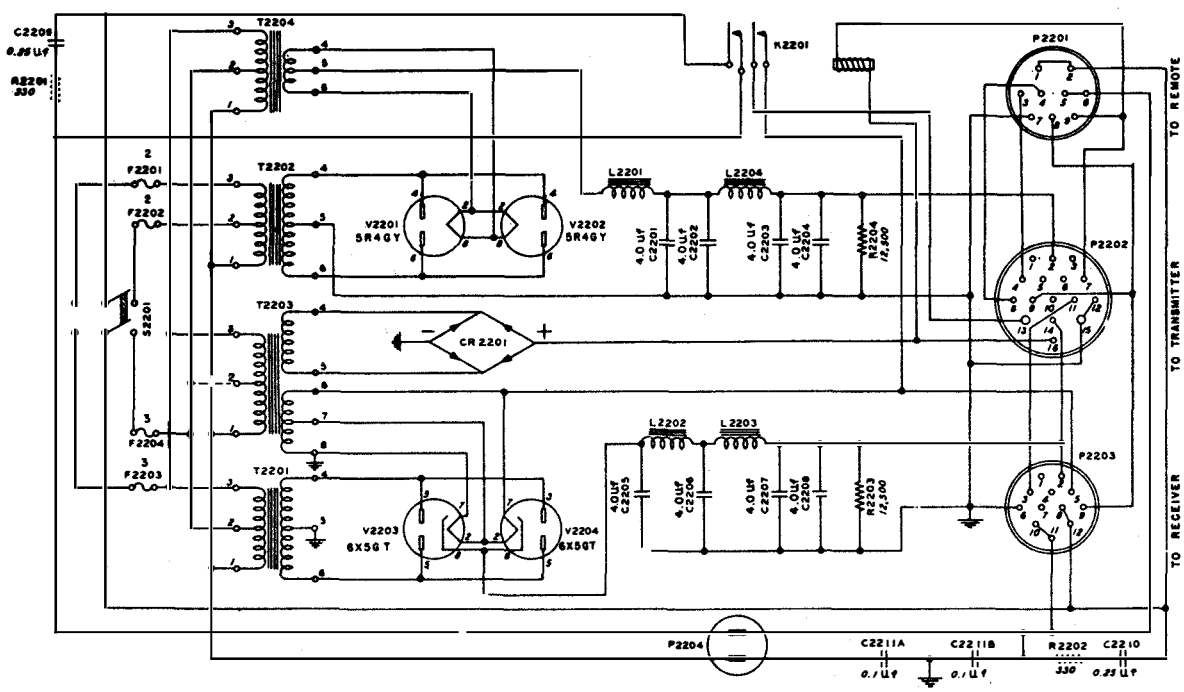
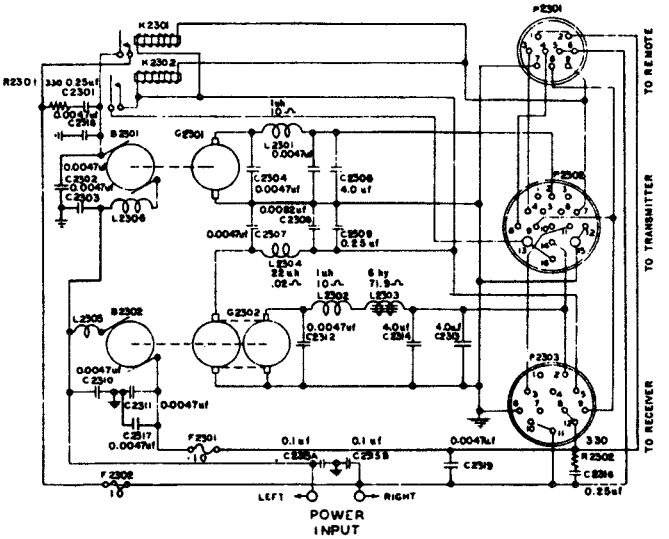


Fig. 7-29 Type -20309 Rectifier Power Supply—Schematic Diagram



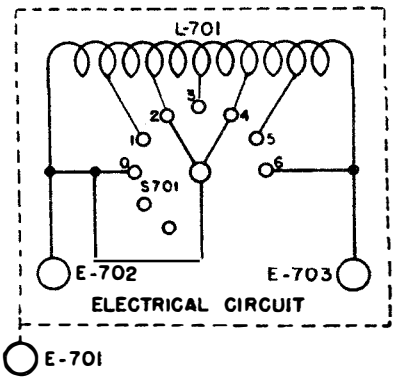


Fig. 7-31 Antenna Loading Coil—Schematic Diagram

Fig. 7-30 Type -211100 or -21827-A Motor Generator Power Supply
Type -211100—Symbol Nos. 2100-2199
Type -21827-A—Symbol Nos. 2300-2399

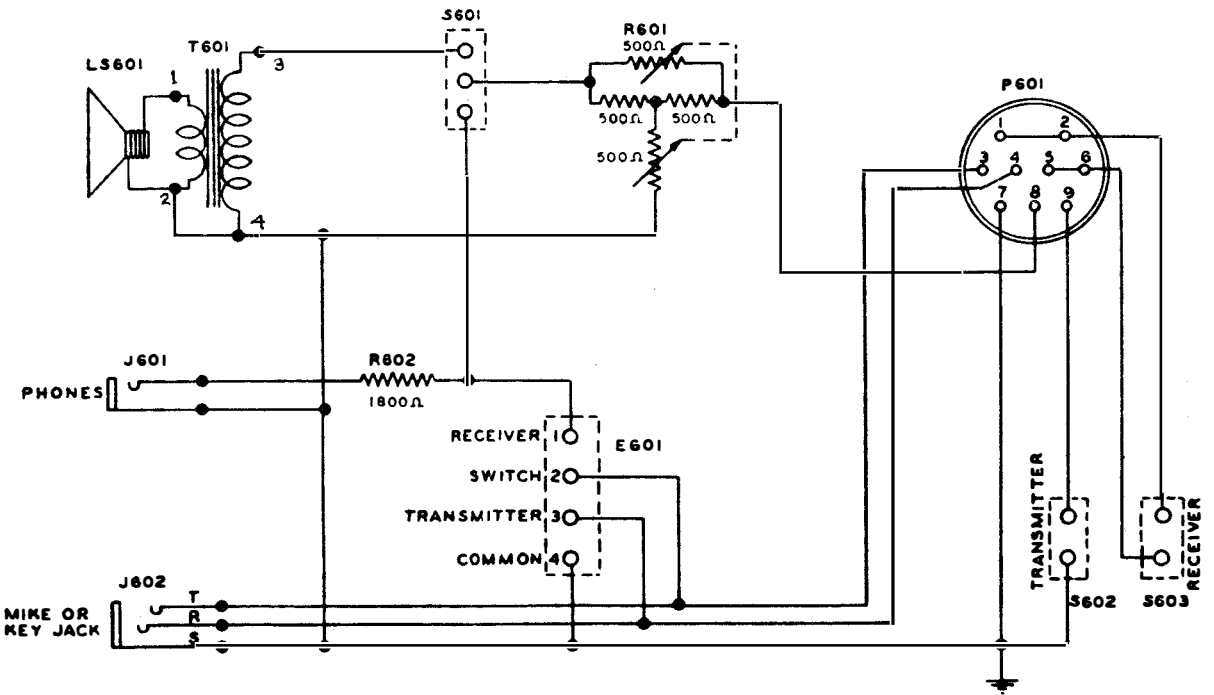
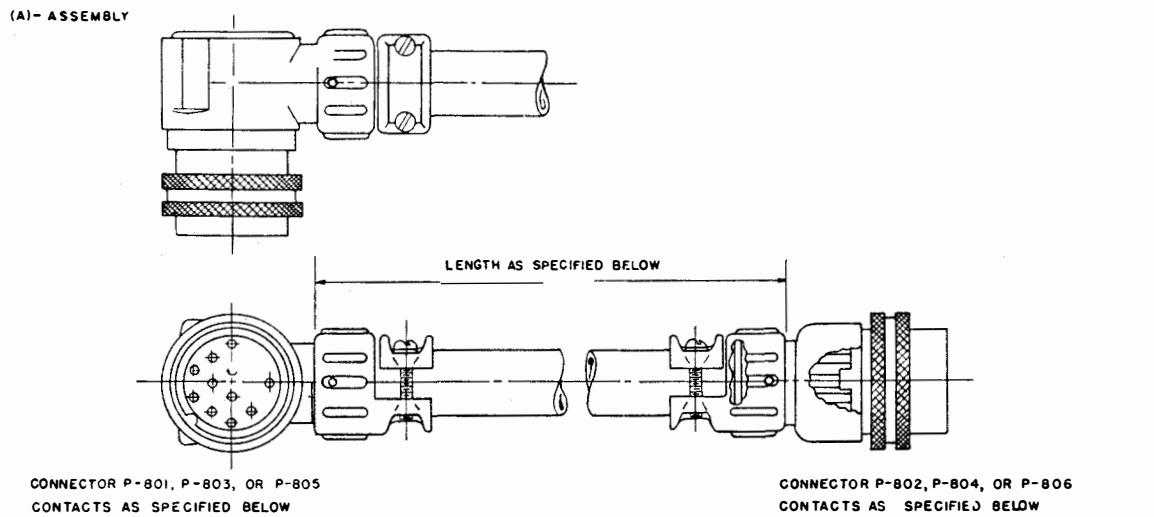
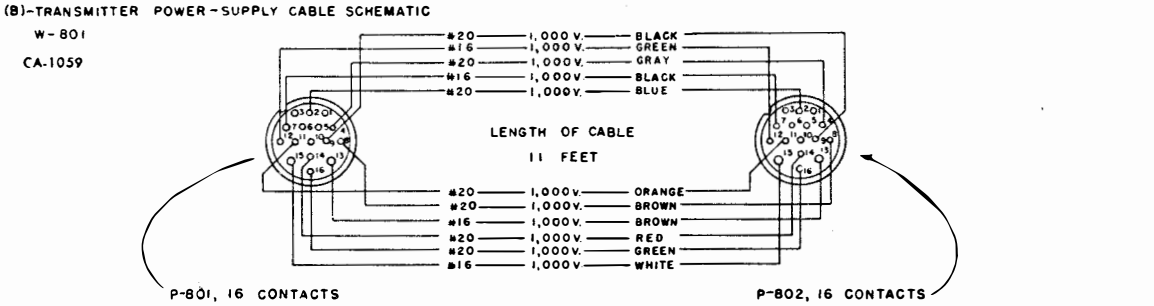
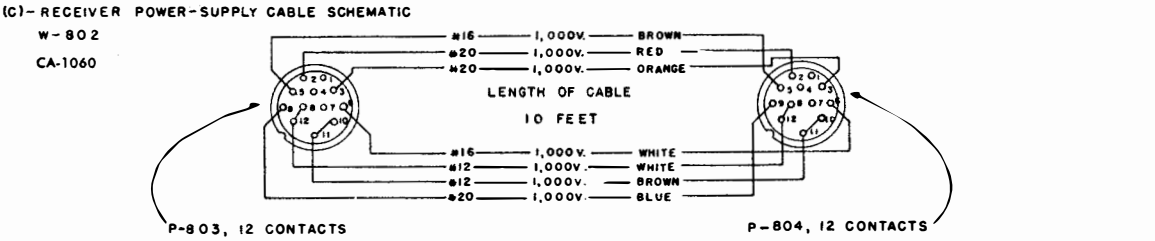


Fig. 7-32 Remote-Control Unit Type CCY-23270-A—-Schematic Diagram







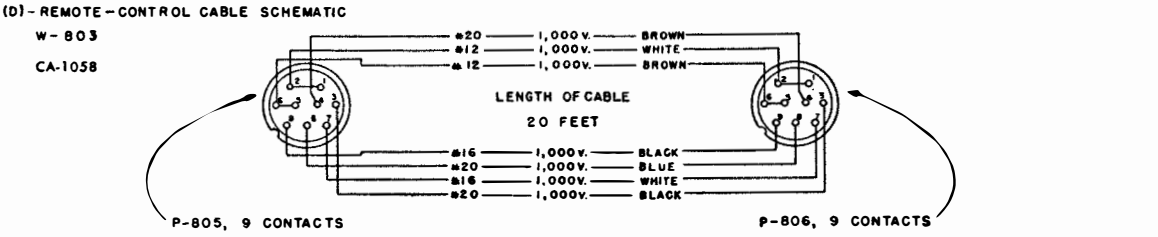


Fig. 7-33 General View of TCS Equipment with Interconnecting Cables

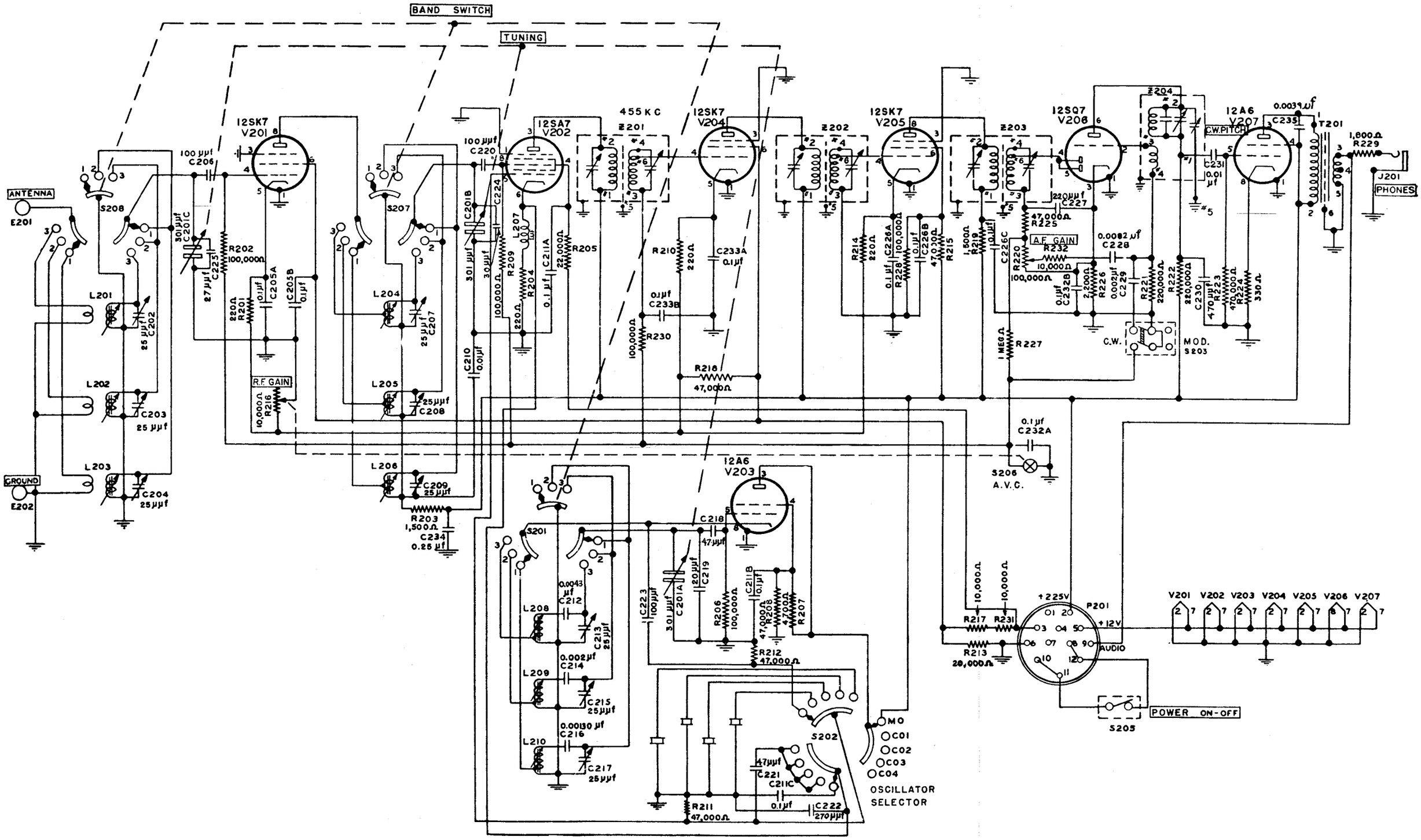


Fig. 7-34 Receiver Type -46159-A, Schematic Diagram

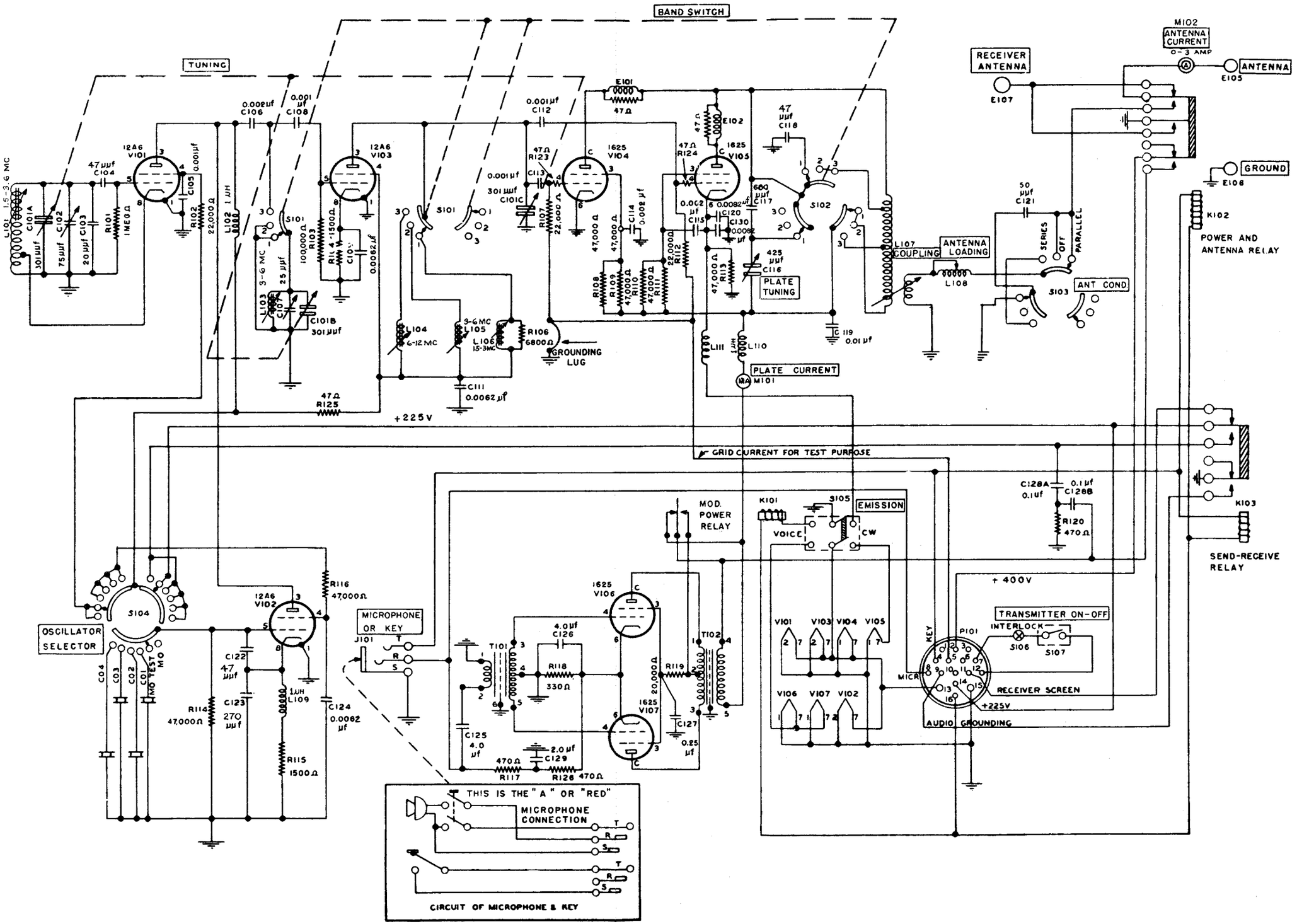


Fig. 7-35 Transmitter Type -52245-A, Schematic Diagram

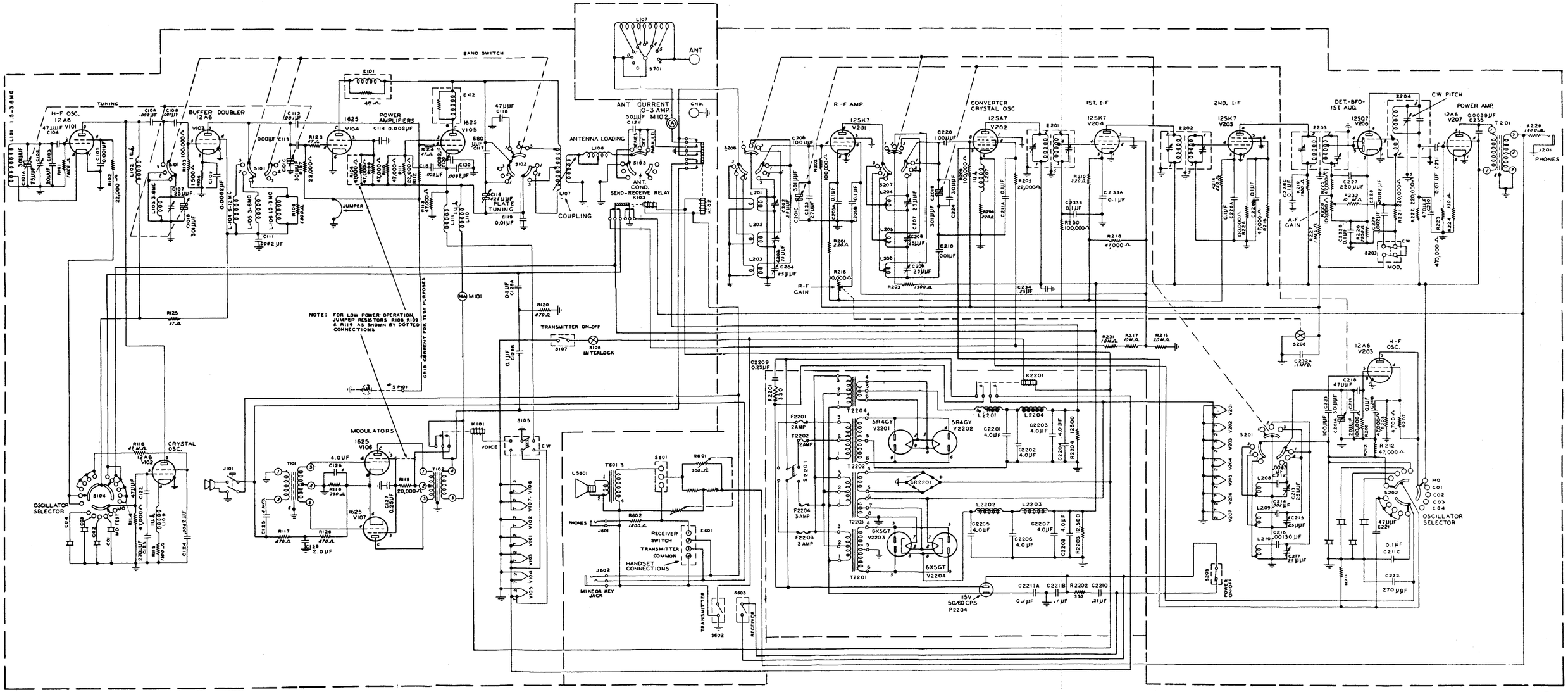


Fig. 7-36 Typical Complete Schematic Diagram of TCS Equipment

SECTION VIII
PARTS AND SPARE PARTS

TABLE 8-1—LIST OF MAJOR UNITS FOR NAVY MODEL TCS RADIO EQUIPMENT.

Navy Type Designation	Name of Unit	Symbol Group
CKP-52245-A	Radio Transmitter (including cabinet with shock mounts)	101 to 199
CKP-46159-A	Radio Receiver (including cabinet with shock mounts)	201 to 299
....	Not Used	301 to 399
CKP-21881-B	Dual Dynamotor Power-Supply Assembly	401 to 499
....	Not Used	1501 to 599
CCY-23270-A	Remote-Control Unit	601 to 699
CML-47205	Antenna Loading Coil	701 to 799
....	Accessories	801 to 899
CKP-211100	Motor Generator Power Supply	2100 to 2199
CKP-20309	Power Supply ac 115/230	2200 to 2299
CKP-21827-A	Motor Generator Power Supply	2300 to 2399
CKP-211330-B	Single Dynamotor Power Supply	2800 to 2899

NOTE: Only one power unit is supplied with each TCS equipment.

TABLE 8-1a—LIST OF CONTRACTS.

NXsr 38314	NXsr 48390	NXsr 86279	NXsr 91960	N5sr 8595	N5sr 10539
-52245-A	-52245-A	-52245-A	-20309	-20309	-21827-A
-46159-A	-46159-A	-46159-A	-211100		
-23270-A	-23270-A	-23270-A			
-47205	-47205	-47205			
-21881-B	-21881-B	-211330-B			
		-20309			

NOTE: For name of unit supplied on each contract see table 8-1.

1. PRELIMINARY NOTES TO PARTS AND SPARE PARTS LIST.

Table 8-2 is a list of parts and spare parts of the complete TCS-14 and TCS-15 equipment. All components are grouped according to major units and listed in order of symbol numbers within each major unit. Thus, all capacitors in the major unit are together, all resistors together, etc.

Column 7 lists Air King and Collins drawing and part numbers. Inasmuch as other models in the TCS Series have been and are being manufactured by the Collins Radio Company, Cedar Rapids, Iowa, the Collins number has been included here for reference purposes only.

Column 8 lists all symbol designations involved. This group of symbol designations will appear next to the key component—first time a component appears in parts list.

Columns 9-14 list the total quantity for each equipment next to the key component.

Equipment spare parts are listed by Box numbers and Quantity next to the key component. For items that are the same as key components, only the box number is listed. If there are no equipment spare parts a zero appears in the proper space.

Tender and stock spare parts columns show quantity next to key components. If there are no tender or stock spares for the particular part a zero appears in the proper space. Items that are the same as key components have blank spaces in the quantity columns.

Where a JAN type designation for a part appears in Table 8-2, the electrical rating or tolerance may differ slightly from the rating on the corresponding part in the equipment shipped. The actual parts may be replaced with items having the ratings shown in the list, or by items of the spare parts bearing corresponding symbol designations. These deviations are occasioned by the changeover from the old standards to current Joint Army-Navy (JAN) standards.

TABLE 8-2

COMBINED PARTS AND SPARE PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODELS TCS-14 AND TCS-15 EQUIPMENT

PARTS								QUANTITY PER EQUIPMENT						SPARE PARTS																	
														EQUIPMENT SPARES												TENDER SPARES		STOCK SPARES	
														TCS-14		TCS-15				20309		211100		21827A					
														12 VDC		12/24 VDC		Less Power Supply		115/230 VAC		115 VDC		230 VDC					
SYMBOL DESIGNATION	NAME OF PART AND DESCRIPTION	FUNCTION	A.W.S., JAN. AND NAVY TYPE DESIGNATION	NAVY STOCK NO.	(MFR.) AND MFRS. DESIG-NATION	AIR KING (COLLINS) DRAWING AND PART NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	TCS-14 12 VDC	TCS-15 12/24 VDC	TCS-15 Less Power Supply	20309 115/230 VAC	211100 115 VDC	21827-A 230 VDC	Box	Quan.	Box	Quan.	Box	Quan.	Box	Quan.	Box	Quan.	Box	Quan.	TCS-15 12/24 VDC Quan.	TCS-15 Less Power Sup. Quan.	TCS-14 12 VDC Quan.	TCS-15 12/24 VDC Quan.
TRANSMITTER: NAVY TYPE CKP-52245-A							CAPACITORS																						
C-101	CAPACITOR, variable; triple section, max. per section - 301.5 μμf. Misc. sec. section - no more than 28.5 μμf. Min. cap. of RF & Antenna sections - no more than 13.5 μμf.	C-101A, C-101B, C-101C	482970		(236P) 723-360A	SA-1433-2 (894D)	C-101	1	1	1	0	0	0		0		0		0		0		0		0	0	0	0	0
C-101A	301 μμf Section of C-101	V-101 Grid tuning																											
C-101B	301 μμf Section of C-101	V-101 Plate tuning																											
C-101C	301 μμf Section of C-101	V-103 Plate tuning																											
C-102	CAPACITOR, midget variable: air dielectric 6.1 to 76.1 μμf. 1000 V test	V-101 Grid trimmer			(86A)	CO-798 (922N53)	C-102	1	1	1	0	0	0		0	2	1	6	1		0		0		0	1	1	0	1
C-102	CAPACITOR, midget variable: air dielectric 4.5 to 75 μμf, 600 WV	V-101 Grid trimmer			(482114) 8548H APC	CO-798 (922N42)																							
C-103	CAPACITOR, fixed: Ceramic 20 μμf ± 2 1/2% 500 WV temperature coef-ficient - 0.00075% JAN spec JAN-C-20	Temperature comp.	CC30B120GG		(25C) Class D	CO-945 (913N420M7.5	C-103, C-219	2	2	2	0	0	0	6	1	3	1	9	1		0		0		0	2	2	2	2
C-104	CAPACITOR, fixed: Silvered mica 0.000047 μf ± 20% 500 WV JAN spec JAN-C-5.	V-101 Grid cap.	CM20C470M		(215E)	CO-790 (912N450A)	C-104	1	1	1	0	0	0	6	1	3	1	9	1		0		0		0	1	1	1	1
C-105	CAPACITOR, fixed: Mica, 0.001 μf ± 20% 2500 WV JAN spec. JAN-C-5,	V-101 Screen bypass	CM45A102M		(234M)	CO-762 (915N210E)	C-105, C-108, C-112, C-113	4	4	4	0	0	0	4	1	1	1	8	1		0		0		0	3	3	4	4
C-106	CAPACITOR, fixed: Mica, 0.002 μf ± 20% 1200 WV JAN spec. JAN-C-5	V-101 Plate coupling	CM45A202M		(234M)	CO-763 (915N220E)	C-106, C-114, C-115	3	3	3	0	0	0	4	1	1	1	8	1		0		0		0	2	2	3	3
C-107	CAPACITOR, midget variable: air dielectric 3.5 to 28 μμf, 600 WV	V-101 Plate trimmer	482113		(534M) APC-25-6	CO-799 (922N37A)	C-107, C-202, C-203, C-204, C-207, C-208, C-209, C-213, C-215, C-217	10	10	10	0	0	0		0	2	1	6	1		0		0		0	10	10	0	10
Δ C-107	CAPACITOR, midget variable: air dielectric 8.5 to 28 μμf, 600 WV	V-101 Plate trimmer	483437		(86A) CO-H-799D	CO-799																							
C-108	Same as C-105	V-103 Grid coupling																											
C-109	CAPACITOR, fixed: Mica 0.0062 μf ± 20% 1200 WV JAN spec. JAN-C-5	V-103 Cathode bypass	CM50A622M		(234M)	CO-803 (915N260E)	C-109, C-111, C-124, C-403, C-404, C-2105, C-2306	5	3	3	0	1	1	6	2	3	1	9	1		0	3	1	3	1	2	2	5	3
C-110		Not used																											
C-111	Same as C-109	V-103 Plate blocking																											
C-112	Same as C-105	V-105 Grid coupling																											
C-113	Same as C-105	V-104 Grid coupling																											
C-114	Same as C-106	V-104 Screen bypass																											
C-115	Same as C-106	V-105 Screen bypass																											
C-116	CAPACITOR, midget variable: 20 to 425 μμf 600 WV air dielectric	Plate tuning	481849		(236P) 80114	CO-797	C-116	1	1	1	0	0	0		0	2	1	6	1		0		0		0	1	1	0	1
C-117	CAPACITOR, fixed: Mica, 0.00068 μf ± 20% 2500 WV, JAN spec. JAN-C-5	Series final tank	CM55A681M		(66S) A-50	CO-1006 (950N350A)	C-117	1	1	1	0	0	0	6	1	3	1	9	1		0		0		0	1	1	1	1
C-118	CAPACITOR, fixed: Mica 0.000047 μf ± 20%, 2500 WV JAN spec. JAN-C-5	Shunt final tank	CM55A470M		(66S)	CO-766 (950N460A)	C-118	1	1	1	0	0	0	4	1	1	1	8	1		0		0		0	1	1	1	1

Δ may be used for replacement.

CAPACITORS (Cont'd)

C-119	CAPACITOR, fixed: Mica 0.01 μf ± 20% 2500 WV, JAN spec. JAN-C-5	Final plate blocking	CM61A103M		(66S)	CO-767 (9Z5N110A)	C-119	1	1	1	0	0	0	4	1	1	1	8	1		0		0		0	1	1	1	1
C-120	CAPACITOR, fixed: Mica 0.0082 μf ± 10% 300 WV JAN spec. JAN-C-5	V-106 Cathode bypass	CM55A822K		(215E)	CO-787 (9C9N280CA)	C-120, C-130, C-228, C-2108, C-2308	3	3	3	0	1	1	6	1	3	1	9	1		0	3	1	3	1	2	2	3	3
C-121	CAPACITOR, silvered Ceramic, 50 μμf ± 10%, 2500 WV at 2.0 MC 1000 WV at 16 MC	Padding capacitor	481690-10		(25C)	CO-885 (913N450C)	C-121	1	1	1	0	0	0	6	1	2	1	6	1		0		0		0	1	1	1	1
C-122	CAPACITOR, fixed: Mica 0.000047 μf ± 20%, 2500 WV, JAN spec. JAN-C-5	V-102 Grid Capacitor	CM45A470M		(234M)	CO-602 (910N450E)	C-122	1	1	1	0	0	0	6	1	3	1	9	1		0		0		0	1	1	1	1
C-123	CAPACITOR, fixed: Mica, 0.00027 μf ± 10%, 2500 WV, JAN spec. JAN-C-5	V-102 Cathode bypass	CM45A271K		(234M)	CO-771 (910N325E)	C-123	1	1	1	0	0	0	4	1	1	1	8	1		0		0		0	1	1	1	1
C-124	Same as C-109	V-102 Screen bypass																													
C-125	CAPACITOR, fixed: Paper, 4.0 μf ± 20%, 600 WV, oil filled	Mike coupling	481849-20		(66S)	CO-772 (93CN8)	C-125, C-126, C-406, C-407, C-2106, C-2113, C-2114, C-2306, C-2313, C-2314, C-2809, C-2810, C-2814, C-2815	4	6	2	0	3	3	4	2	1	3	8	1		0	3	2	3	2	9	3	10	15
C-126	Same as C-125	Mod. Cathode bypass																													
C-127	CAPACITOR, fixed: Paper, 0.25 μf + 20% - 10%, 600 WV, JAN spec. JAN-C-25	Mod. screen bypass	CP51B1EF254V		(234M)	CO-773 (956NS05W)	C-127, C-234, C-406, C-412, C-2101, C-2109, C-2116, C-2209, C-2210, C-2301, C-2309, C-2316, C-2A11	4	5	2	2	3	3	4	2	1	3	9	1	2	1	3	2	3	2	8	3	10	13
C-128	CAPACITOR, fixed: Paper; 2 section 0.1 μf + 20% - 10%, 600 WV JAN spec. JAN-C-25	C-128A, C-128B	CP51B4EF104V		(66S)	CO-808 (956ND01W)	C-128	1	1	1	0	0	0	6	1	3	1	9	1		0		0		0	2	2	3	3
C-128A	Part of C-128	Spark depressor																													
C-128B	Part of C-128	Spark depressor																													
C-129	CAPACITOR, fixed: Foil paper 2.0 μf + 20% - 10% 400 WV, AWS spec. C75.16 - 1944	Mike Current filter	CP50b1AE206MK		(66S)	CO-775 (954NS4Y)	C-129	1	1	1	0	0	0	4	1	1	1	9			0		0		0	2	2	3	3
C-130	Same as C-120	V-106 Cathode bypass																													

MISCELLANEOUS ELECTRICAL PARTS

E-101	RESISTOR, 47 ohm ± 20% 1 W. shunted by 8-turn coil	V-104 Plate parasitic sup.			(202A) SA-1549	SA-1549 (704A)	E-101, E-102	2	2	2	0	0	0	11	1	7	1	1	1		0		0		0	1	1	1	1
E-102	Same as E-101	V-106 Plate parasitic sup.																													
E-103	STANDOFF, ceramic 3/4" lg. overall	Conical Standoff	61503		(25C)	MP-1079 (19CNSW7)	E-103	1	1	1	0	0	0	11	5	6	5	1	5		0		0		0	9	9	20	18
E-104	STANDOFF, ceramic 3/8" diam. x 1/2" lg. overall	Cylindrical standoff	61415		(25C)	MP-1078 (19CNSL5)	E-104, E-205	2	2	2	0	0	0	11	4	6	5	1	5		0		0		0	9	9	16	18
E-105	FRONT PANEL assembly: Stud, wing nut, lockwasher, washers and ceramic bushing	Trans. antenna post			(202A) Part of SA-1516	Part of SA-1516	E-105	1	1	1	0	0	0		0		0		0		0		0		0	0	0	12	0
E-106	FRONT PANEL assembly: Lockwashers, washers, 1/4"-28 nut and wing nut, 1/4 - 28 x 1-1/2 B.H.M.S.	Trans. ground post			(202A) B-1	SA-1518 (372N13)	E-106, E-201, E-202	3	3	3	0	0	0		0		0		0		0		0		0	0	0	0	0
E-107	BINDING POST, push type, black bakelite	Receiver, ant. post assy.			(521**)	TE-1001	E-107	24	24	24	0	0	0		0	7	2	1	2		0		0		0	6	6	0	10
E-107A	BUSHING, ceramic	Antenna connection	61152		(25C)	MP-1075	E-107, E-703	24	24	24	0	0	0		0	6	12	1	12		0		0		0	24	24	48	48
E-108	POST, Barrier-binding	Antenna connection			(25C)	MP-1077	E-108	1	1	1	0	0	0	11	1	6	1	1	1		0		0		0	1	1	2	2
E-111	STANDOFF, 1/2" x 1"	Cylindrical standoff	61170		(25C)	MP-1081	E-111	1	1	1	0	0	0	11	1	6	1	1	1		0		0		0	2	2	4	4
	CLAMP, tube	Used on X-101, X-102, X-103				SA-1398		3	3	3	0	0	0		0	7	1	1	1		0		0		0	1	1	0	2
	CLAMP, assembly #2 for tube	Used on P.A. Bracket				SA-1546		1	1	1	0	0	0		0	7	1	1	1		0		0		0	1	1	0	1
	CLAMP, assembly #1 for tube	Used on P.A. Bracket				SA-1547		1	1	1	0	0	0		0	7	1	1	1		0		0		0	1	1	0	1
	CRANK, assembly, switch	Used on P.A. Bracket				SA-1370		1	1	1	0	0	0		0		0		0		0		0		0	1	1	0	1
*	COUPLER, shaft cond.	Extension shaft. 1 on rec. 1 on trans.				SM-1280		2	2	2	0	0	0		0		0		0		0		0		0	1	1	0	2
	COUPLER, shaft diaph.	Assy. lock plate for var. 10 coupler				SA-1521		1	1	1	0	0	0		0		0		0		0		0		0	1	1	0	1

* *Used on transmitter and receiver. Not shown under receiver miscellaneous electrical parts.*

TABLE 8-2

COMBINED PARTS AND SPARE PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODELS TCS-14 AND TCS-15 EQUIPMENT

PARTS								QUANTITY PER EQUIPMENT						SPARE PARTS																	
														EQUIPMENT SPARES												TENDER SPARES		STOCK SPARES			
														TCS-14		TCS-15				20309		211100		21827A							
														12 VDC		12/24 VDC		Less Power Supply		115/230 VAC		115 VDC		230 VDC							
SYMBOL DESIGNATION	NAME OF PART AND DESCRIPTION	FUNCTION	A.W.S., JAN. AND NAVY TYPE DESIGNATION	NAVY STOCK NO.	(MFR.) AND MFRS. DESIG-NATION	AIR KING (COLLINS) DRAWING AND PART NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	TCS-14 12 VDC	TCS-15 12/24 VDC	TCS-15 Less Power Supply	-20309 115/230 VAC	-211100 115 VDC	-21827-A 230 VDC	Box	Quan.	Box	Quan.	Box	Quan.	Box	Quan.	Box	Quan.	Box	Quan.	TCS-15 12/24 VDC Quan.	TCS-15 Less Power Supp Quan.	TCS-14 12 VDC Quan.	TCS-15 12/24 VDC Quan.
							MISCELLANEOUS ELECTRICAL PARTS (Cont'd)																										
	DETENT & ARM assy, 3 pos.	Used on front panel				SA-1373		1	1	1	0	0	0		0		0		0		0		0		0	1	1	0	1		
*	DETENT assy, switch, 3 pos.	Trans. front panel - 1 Rec. front panel - 1				SA-1535		2	2	2	0	0	0		0		0		0		0		0		0	1	1	0	2		
	DETENT assembly. 6 pos.	Used on front panel				SA-1536		1	1	1	0	0	0		0		0		0		0		0		0	1	1	0	1		
*	KNOB, Bar assembly 3/8" I.D.	Used on: Trans - 4 and Rec - 2			(503M)	SA-1525		6	6	6	0	0	0		0		0		0		0		0		0	3	7	7	6		
*	KNOB, Bar assembly 1/1" I.D.	Used on: Trans - 1. Rec - 3			(503M)	SA-1526		4	4	4	0	0	0		0		0		0		0		0		0	2	2	4	4		
*	NUT, draw	Trans. front panel - 2 Rec. front panel - 2			(505E)	NT-463		4	4	4	0	0	0		0		0		0		0		0		0	0	0	4	4		
*	NUT, indicator	Trans. front panel - 2 Rec. front panel - 2			(505E)	NT-464		4	4	4	0	0	0		0		0		0		0		0		0	0	0	4	4		
	NUT, wing 1/4-28	Used on front panel			(10P)	NT-466		1	1	1	0	0	0		0		0		0		0		0		0	0	0	4	4		
*	NUT, wing #6-32	For crystal brackets Rec. - 2, trans. - 2			(501M)	NT-469		4	4	4	0	0	0		0		0		0		0		0		0	0	0	4	4		
*	SCREW, set #10 - 32 x 3/8 Bristol cup pt.	Used on bar knobs, Trans. - 5, Rec. - 5			(206B)	SC-539		10	10	10	0	0	0		0		0		0		0		0		0	0	0	4	4		
*	SCREW, set, #6-32 x 1/8 Bristol Cup pt.	Used on indicator nut, variable cond. & ext. shaft on variable cond. Trans. - 6, Rec. - 6			(206B)	SC-584		12	12	12	0	0	0		0		0		0		0		0		0	0	0	26	26		
*	SCREW, set #10-32 x 3/16 Bristol Cup pt.	Used on bar knobs, Trans - 5, Rec. - 5			(206B)	SC-586		10	10	10	0	0	0		0		0		0		0		0		0	0	0	22	22		
*	SCREW, 10-32 x 1/4 Bristol hd cup pt.	Used on Trans. & Rec.			(206B)	SC-635		1	1	1	0	0	0		0		0		0		0		0		0	0	0	2	2		
	SHAFT EXT. assembly P.T. Cond.	Used on C-116				SA-1770		1	1	1	0	0	0		0		0		0		0		0		0	1	1	0	1		
*	SHOCK MOUNT	Used on: Rec. cabinet - 4 Trans. cabinet - 4			(506H)	PI-1001		8	8	8	0	0	0	10	2	7	2	5	2		0		0		0	0	8	16	8		
	SPRING, min. working length 1/8"	Used on lock for loading coil				SP-1021		1	1	1	0	0	0		0	7	2	1	2		0		0		0	4	4	0	10		
*	SPRING, tension	Trans. 4 used on exciter casting Rec. 9 used on R.F. section				SP-1022		13	13	13	0	0	0		0	7	13	1	13		0		0		0	26	26	0	65		
	WASHER, C	On detent assy. & switch assy.			(25C)	WA-1014		3	0	0	0	0	0		0		0		0		0		0		0	0	0	14	0		
	GRID, clip				(05N)	PI-1025		4	0	0	0	0	0		0		0	0	0	0	0		0		0	0	0	1	0		

Used on transmitter and receiver. Not shown under receiver miscellaneous electrical parts.

JACKS																													
J-101	JACK, telephone: 3 circuit, for plug with 3/16 dia. barrel. 1 1/32 lg x 1" wd.	Key and mike jack	49909		(235N) PI-1023	PI-1023 (35-N110)	J-101, J-602	2	2	2	0	0	0	10	1	6	1	1	1		0		0		0	2	2	4	4
RELAYS																													
K-101	RELAY, general purpose: SPDT normally closed, lg 1 1/2" x 1 1/8" wd x 1 5/32" h'overall. 12 VDC Coil, 75 ohms ± 10%	Modulator power relay			(506A) R-25	RL-1001	K-101	1	1	1	0	0	0	5	1	6	1	6	1		0		0		0	2	2	3	3
K-102	RELAY, general purpose: DPDT, SPST aux. normally open, 2 7/8" lg x 1 13/16" wd x 1 9/16" h'overall 12 VDC coil 40 ohms	Antenna relay	29220		(508A) R-22	RL-1002 (410000300)	K-102, K-103, K-401, K-2101, K-2201, K-2301, K-2801, K-2802	3	4	2	1	1	1	5	2	6	2	6	1	2	1	1	1	1	1	5	3	8	10
K-103	Same as K-102	Send-receive relay																											
INDUCTORS																													
L-101	OSCILLATOR COIL assembly, 1.5 to 3 Megacycles	V-101 Grid inductor			(515N)	SA-1454 (321D-1)	L-101	1	1	1	0	0	0		0		0		0		0		0		0	1	1	1	1
L-102	CHOKE, 3 Sect., 1 mh ± 10%, 300 MA max: 10 ohms	V-101 Plate choke	47896		(05N) R-300	PI-1009 (240N57)	L-102, L-109, L-207, L-2101, L-2102, L-2301, L-2302	3	3	3	0	2	2	10	1	7	3	1	1		0	2	2	2	2	6	6	9	9
L-103	COIL, 3-6 Megacycles	V-101 Plate tank ind.			(515N)	SA-1450 (790D)	L-103	1	1	1	0	0	0		0		0		0		0		0		0	1	1	1	1
L-104	COIL, assembly, 6-12 Megacycles	V-103 Plate tank ind.			(515N)	SA-1453 (792D)	L-104	1	1	1	0	0	0		0		0		0		0		0		0	1	1	1	1
L-105	OSCILLATOR COIL assembly 3-6 Megacycles	V-103 Plate tank ind.			(515N)	SA-1451 (791D)	L-105	1	1	1	0	0	0		0		0		0		0		0		0	1	1	1	1
L-106	BUFFER COIL assembly, 1.5-3 Megacycles	V-103 Plate tank ind.			(515N)	SA-1452 (793D)	L-106	1	1	1	0	0	0		0		0		0		0		0		0	1	1	1	1
L-107	VARIO-COUPLER assembly, 1.5-12 Megacycles	P.A. Plate inductance			(246S)	SA-1564 (568D-2)	L-107	1	1	1	0	0	0		0		0		0		0		0		0	1	1	1	1
L-108	VARIABLE INDUCTOR COIL assembly	Antenna loading coil			(245S) SA-1520	SA-1520	L-108	1	1	1	0	0	0		0		0		0		0		0		0	1	1	1	1
L-109	Same as L-102	V-102 Cathode choke																											
L-110	CHOKE 1 mh ± 10% 300 MA Max: 10 ohms.	P.A. Plate Choke	47895		(05N) R-300U	PI-1008 (240580000)	L-110, L-402, L-404, L-2803, L-2804	3	3	1	0	0	0	10	2	7	3	1	1		0		0		0	6	2	9	9
L-111	CHOKE, 15 turns of K-90 wirewound on outside of cable	Cathode choke			(202A)	CA-1078AK	L-111	1	1	1	0	0	0		0		0		0		0		0		0	0	0	0	0
METERS																													
M-101	MILLIAMMETER DC, 0-200 ma; round black bakelite flush mtg. case; 2 11/16" diam. flange x 15/16" d. body. "Voice" centered at 85 ma; "CW" centered at 175 ma	P.A. Plate ma			(40G)	ME-1001 (458N0710D)	M-101	1	1	1	0	0	0		0		0		0		0		0		0	0	1	1	1
M-102	THERMOAMMETER AC, 0-3 amp. RF; 0.1 amp per division: round black bakelite flush mtg. case: 2 11/16" diam. flange x 15/16" d. body.	Antenna ammeter			(40G) 8DW44	ME-1002	M-102	1	1	1	0	0	0		0		0		0		0		0		0	0	1	1	1
PLUG CONNECTORS																													
P-101	CONNECTOR, male contact: 16 contacts, wall mounting	Transmitter to power supply	49893		(10C) SK-C16-32S	RC-1020 (371306000)	P-101, P-402, P-2102, P-2202, P-2302, P-2802	2	2	1	1	1	1	11	2	8	1	6	1	3	1	3	1	3	1	2	1	4	4
RESISTORS																													
R-101	RESISTOR, fixed: Composition: 1 megohm, ±5%, 1 W JAN spec. JAN-R-11.	V-101 Grid resistor	RC30BE105J		(243S)	RE-938 (729NG1MEG)	R-101, R-227	2	2	2	0	0	0	1	1	3	1	8	1		0		0		0	6	6	5	10
R-102	RESISTOR, fixed: Composition: 22000 ohms, ±20% 1 W JAN spec. JAN-R-11	V-101 Screen dropping	RC30BE223M		(243S) (BTI-Navy)	RE-933 (729NG22M)	R-102, R-107, R-112	3	3	3	0	0	0	1	2	3	2	8	2		0		0		0	9	9	8	15

TABLE 8-2

COMBINED PARTS AND SPARE PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODELS TCS-14 AND TCS-15 EQUIPMENT

PARTS														SPARE PARTS																	
								QUANTITY PER EQUIPMENT						EQUIPMENT SPARES												TENDER SPARES		STOCK SPARES	
														TCS-14		TCS-15				20309		211100		21827A							
														12 VDC		12/24 VDC		Less Power Supply		115/230 VAC		115 VDC		230 VDC							
SYMBOL DESIGNATION	NAME OF PART AND DESCRIPTION	FUNCTION	A.W.S., JAN. AND NAVY TYPE DESIGNATION	NAVY STOCK NO.	(MFR.) AND MFRS. DESIGNATION	AIR KING (COLLINS) DRAWING AND PART NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	TCS-14 12 VDC	TCS-15 12/24 VDC	TCS-15 Less Power Supply	20309 115/230 VAC	211100 115 VDC	21827A 230 VDC	Box	Quan.	Box	Quan.	Box	Quan.	Box	Quan.	Box	Quan.	Box	Quan.	TCS-15 12/24 VDC Quan.	TCS-15 Less Power Sup. Quan.	TCS-14 12 VDC Quan.	TCS-15 12/24 VDC Quan.
RESISTORS (Cont'd)																															
R-103	RESISTOR, fixed: Composition; 100000 ohms, ±20% 1 W JAN spec. JAN-R-11	V-103 Grid resistor	RC30BE104M		(2436) BTI-Navy	RE-935 (729NG100M)	R-103, R-202, R-206, R-209, R-228, R-230	6	6	6	0	0	0	1	3	3	3	8	3		0		0		0	18	18	15	30
R-104	RESISTOR, fixed: Composition; 1500 ohms ±20% 1 W JAN spec. JAN-R-11	V-103 Cathode resistor	RC30BE152M		(2438)	RE-929 (729NG1500)	R-104, R-115, R-203, R-219	4	4	4	0	0	0	1	2	3	2	8	2		0		0		0	12	12	10	20
R-106	RESISTOR, fixed: Composition; 6800 ohms ±20% 1 W JAN spec. JAN-R-11	V-103 Plank loading	RC30BE682M		(2438)	RE-931 (729NG6800)	R-106	1	1	1	0	0	0	1	1	3	1	8	1		0		0		0	3	3	3	5
R-107	Same as R-102	V-104 Grid resistor																													
R-108	RESISTOR, fixed: Composition; 47000 ohms ±5% 2 W JAN spec. JAN-R-11	V-104 Screen dropping	RC40BE473J		(28J)	RE-943 (729NH47M)	R-108, R-109, R-110, R-111, R-208	5	5	5	0	0	0	1	3	3	3	8	3		0		0		0	15	15	13	25
R-109	Same as R-108	V-104 Screen dropping																													
R-110	Same as R-108	V-105 Screen dropping																													
R-111	Same as R-108	V-105 Screen dropping																													
R-112	Same as R-102	V-105 Grid resistor																													
R-113	RESISTOR, fixed: Composition; 47000 ohms ±20% 1 W JAN spec. JAN-R-11	V-105 Cathode resistor	RC30BE473M		(517N)	RE-934 (729NG47M)	R-113, R-114, R-116, R-211, R-212, R-215, R-218, R-225	8	8	8	0	0	0	1	4	3	4	8	4		0		0		0	24	24	20	40
R-114	Same as R-113	V-102 Grid resistor												1		3		8													
R-115	Same as R-104	V-102 Grid resistor												1		3		8													
R-116	Same as R-113	V-102 Screen dropping												1		3		8													
R-117	RESISTOR, fixed: Composition; 470 ohms ±20% 1 W JAN spec. JAN-R-11	Limiting resistor	RC30BE471M		(2438) BTI-Navy	RE-928 (729NG470)	R-117, R-120, R-126	3	3	3	0	0	0	1	2	3	2	8	2		0		0		0	9	9	8	15
R-118	RESISTOR, fixed: Composition; 330 ohms ±20% 5 W JAN, spec. JAN-R-11	Mod. cathode resisto.	RC75BE331M		(28J) MPJ	RE-944 (730NA330F)	R-118	1	1	1	0	0	0	1	1	3	1	8	1		0		0		0	3	3	5	5
R-119	RESISTOR, fixed: Composition; 20000 ohms ±5% 5 W JAN spec. JAN-R-11	Mod. screen resistor	RC76BE203J		(28J) MPJ	RE-945 (730NA20MF)	R-119	1	1	1	0	0	0	1	1	3	1	8	1		0		0		0	3	3	5	5
R-120	Same as R-117	Spark suppressor																													
R-123	RESISTOR, fixed: Composition; 47 ohms ±20% 1 W JAN spec. JAN-R-11	V-104 Grid parasitic	RC30BE470M		(2433) SI-1	RE-925 (729N047)	R-123, R-124, R-125	1	1	1	0	0	0	1	2	3	2	8	2		0		0		0	9	9	8	15
R-124	Same as R-123	V-105 Grid parasitic																													
R-125	Same as R-123	V-103 Screen resistor																													
R-126	Same as R-117	Limiting resistor																													
SWITCHES																															
S-101	SWITCH assembly 3 positions	Band switch			(25C) SA-1555	SA-1555 (178C-4)	S-101, S-102, S-103	3	3	3	0	0	0		0	9	1	4	1		0		0		0	2	2	3	3

Original

						SWITCHES (Cont'd)																											
S-101A	ROTOR assembly #1 (for S-101 and S-104)	Part of S-101			(25C) SA-1562	SA-1562 (316B-7)	S-101-A, S-104-A	2	2	2	0	0	0	11	3	9	1	4	1		0		0		0	2	2	3	3
S-102	Same as S-101	PA Plate inductor switch																													
S-103	Same as S-101	Antenna switch assy.																													
S-104	Switch, 6 positions	Crystal osc. control			(25C) SA-1578	SA-1578 (178C-4)	S-104	1	1	1	0	0	0		0	9	1	4	1		0		0		0	1	1	1	1
S-104A	Same as S-101A	Part of S-104																													
S-105	SWITCH DPDT. lever toggle; 1 amp. 250 V or 3 amp. 125V.	Voice CW switch	24003		(98C)	SW-1010 (266N103)	S-105, S-203, S-601	3	3	3	0	0	0	5	1	9	1	4	1		0		0		0	2	2	3	3
S-106	SWITCH, pushbutton, normally open; 3 amp 250 V	Interlock switch	24607		(98C) 7190	SW-1016	S-106	1	1	1	0	0	0	5	1	9	1	4	1		0		0		0	1	1	1	1
S-107	SWITCH, SPST, lever-toggle; 25 amp. 15 to 125V.	Transmitter off-on switch	24118		(98C) 6801K3	SW-1011	S-107, S-205, S-602, S-603	4	4	4	0	0	0	5	1	9	1	4	1		0		0		0	2	2	4	4
						TRANSFORMERS																									
T-101	TRANSFORMER, Primary: 75 ohm; sec: 125000 ohms, CT; 0.02 W. 150-5000 Cps.	Microphone Trans.	301087		(244S) 8004-C	TR-1020 (677N213)	T-101	1	1	1	0	0	0	2	1	11	1	3	1		0		0		0	2	2	3	3
T-102	TRANSFORMER, Primary: 3000 ohms, CT sec; 6000 ohms: 20 W., 200-5000 cps.	Modulation Trans.	301089		(244S)	TR-1022	T-102	1	1	1	0	0	0	3	1	11	1	3	1		0		0		0	2	2	3	3
						TUBES																									
V-101	TUBE, Beam power amplifier JAN-spec. JAN-1-A	Master oscillator	12A6		(524K) 12A6	TU-1024	V-101, V-102, V-103 V-203, V-207	5	5	5	0	0	0	7	10	13	10	7	10		0		0		0	15	15	0	0
V-102	Same as V-10.	Crystal oscillator																													
V-103	Same as V-101	Buffer-doubler																													
V-104	TUBE, Beam power pentode JAN spec. JAN-1-A	Power amplifier	1625		(525S) 1625	TU-1025	V-104, V-105, V-106, V-107	4	4	4	0	0	0	7	8	13	8	7	8		0		0		0	12	12	0	0
V-105	Same as V-104	Power amplifier																													
V-106	Same as V-104	Modulator																													
V-107	Same as V-104	Modulator																													
						SOCKETS																									
X-101	SOCKET, tube: std octal; ceramic	For V-101	49367		(235N) 228	SO-1012 (220N581)	X-101, X-102, X-103, X-201, X-202, X-203, X-204, X-205, X-206, X-207, X-2201, X-2202, X-2203, X-2204	10	10	10	4	0	0	5	5	12	5	5	5	3	2		0		0	5	5	10	10
X-102	Same as X-101	For V-102																													
X-103	Same as X-101	For V-103																													
X-104	SOCKET, Tube 7-pin ceramic	For V-104	49366		(235N) 227	SO-1013 (220N573)	X-104, X-105, X-106, X-107	4	4	4	0	0	0	5	2	12	2	5	2		0		0		0	2	2	4	4
X-105	Same as X-104	For V-105																													
X-106	Same as X-104	For V-106																													
X-107	Same as X-104	For V-107																													
X-108	SOCKET, Tube: dual, 3-pin ceramic	For crystals 1, 4	49911		(235N) SA-1577	SA-1577	X-108, X-109, X-208, X-209	4	4	4	0	0	0	11	2	12	2	5	2		0		0		0	2	2	4	4
X-109	Same as X-108	For crystals, 2, 3																													
RECEIVER: NAVY TYPE CKP-46159-A						**CAPACITORS**																									
C-201	CAPACITOR, variable; triple-section	C-201A, C-201B, C-201C	482971		(236P) 7233-50A	SA-1750-2 (716D)	C-201	1	1	1	0	0	0		0		0		0		0		0		0	0	0	0	0
C-201A	Section of C-201, 28.5 μμf min. to 301 μμf max.	Osc. tuning																													

TABLE 8-2

COMBINED PARTS AND SPARE PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODELS TCS-14 AND TCS-15 EQUIPMENT

PARTS															SPARE PARTS																					
								QUANTITY PER EQUIPMENT							EQUIPMENT SPARES																TENDER SPARES		STOCK SPARES	
															TCS-14		TCS-15				20309		211100		21827A											
															12 VDC		12/24 VDC		Less Power Supply		115/230 VAC		115 VDC		230 VDC											
SYMBOL DESIGNATION	NAME OF PART AND DESCRIPTION	FUNCTION	A.W.S., JAN. AND NAVY TYPE DESIGNATION	NAVY STOCK NO.	(MFR.) AND MFRS. DESIG-NATION	AIR KING (COLLINS) DRAWING AND PART NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	TCS-14 12 VDC	TCS-15 12/24 VDC	TCS-15 Less Power Supply	20309 115/230 VAC	211100 115 VDC	21827-A 230 VDC		Box	Quan.	Box	Quan.	Box	Quan.	Box	Quan.	Box	Quan.	Box	Quan.	TCS-14 12/24 VDC	TCS-15 12/24 VDC	TCS-15 Less Power Sup.	TCS-14 12 VDC	TCS-15 12/24 VDC
							CAPACITORS (Cont'd)																														
C-201B	Section of C-201, 13.5 μμf min. to 301.5 μμf max.	Converter tuning																																	
C-201C	Section of C-201, 13.5μμf min. to 301.5 μμf max.	R-F-Tuning																																	
C-202	Same as C-107	R-F Trimmer, Band 3	483437																																
C-203	Same as C-202	R-F Trimmer, Band 2																																	
C-204	Same as C-202	R-F Trimmer, Band 1																																	
C-205	CAPACITOR, fixed: Foil paper, dual-section 0.1 μf +20% -10% 400 WV JAN spec. JAN-C-25	C-205A and C-205B	CP51B4EF104V		(66S) P-9451	CO-776 (954401640)	C-205, C-2115, C-2315	1	1	1	0	1	1		6	1	2	1	9	1		0	3	1	3	1	2	2	3	3
C-205A	Section of C-205	V-201 Cathode bypass																																	
C-205B	Se tion of C-205	V-201 Screen bypass																																	
C-206	CAPACITOR, fixed: Silvered mica, 100 μμf ±20%, 500 WV JAN spec. JAN-C-5	V-201 Grid coupling	CM20C101M		(215E) MOSW	CO-769 (912N310A)	C-206, C-220, C-223	3	3	3	0	0	0		4	1	1	1	8	1		0		0		0	2	2	3	3
C-207	Same as C-202	Conv. trimmer, Band 3																																	
C-208	Same as C-202	Conv. trimmer, Band 2																																	
C-209	Same as C-202	Conv. trimmer, Band 1																																	
C-210	CAPACITOR, fixed: Mica, 0.01 μf ±20% 600 WV JAN spec. JAN-C-5	Plate supply bypass	CM45A103M		(234M)	CO-778 (910N110C)	C-210, C-231	2	2	2	0	0	0		6	1	2	1	9	1		0		0		0	2	2	2	2
C-211	CAPACITOR fixed: Foil paper, tripie-section, 0.1 μf +20% -10% 400 WV JAN spec. JAN-C-25	C-211A, C-211B, C-211C	CP50B5EE104V		(66S) P-9454	CO-804 (954NT01Y)	C-211, C-226	2	2	2	0	0	0		6	1	3	1	9	1		0		0		0	3	3	5	5
C-211A	Section of C-211	V-202 Screen bypass																																	
C-211B	Section of C-211	V-203 Screen bypass																																	
C-211C	Section of C-211	V-202 Cathode bypass																																	
C-212	CAPACITOR, fixed: Silvered mica, 0.0043 μf ±2%, 500 WV JAN spec. JAN-C-5	Series padding	CM35D432J		(215E) MWSW	CO-780 (912N240A)	C-212	1	1	1	0	0	0		6	1	3	1	9	1		0		0		0	1	1	1	1
C-213	Same as C-202	Osc. trimmer, band 3																																	
C-214	CAPACITOR, fixed: Silvered mica, 0.002 μf ±5% 500 WV JAN spec. JAN-C-5	Series padding cap.	CM35D202J		(215E)	CO-781 (912N220A)	C-214, C-229	2	2	2	0	0	0		6	1	3	1	9	1		0		0		0	2	2	2	2
C-215	Same as C-202	Osc. trimmer Band 2																																	
C-216	CAPACITOR, fixed: Silvered mica, 0.00130 μf ±5% 500 WV JAN spec. JAN-C-5	Series padding cap.	CM35D132J		(215E) MWSW	CO-782 (914N2125A)	C-216	1	1	1	0	0	0		6	1	3	1	9	1		0		0		0	1	1	1	1
C-217	Same as C-202	Osc. trimmer, Band 1																																	

CAPACITORS (Cont'd)

C-218	CAPACITOR, fixed: Silvered mica, 0.000047 ±20% 500 WV JAN spec. JAN-C-5	V-203 Grid coupling	CM20C470M		(215E) MOSW	CO-770 (912N450C)	C-218, C-221	2	2	2	0	0	0	4	1	1	1	8	1		0		•		0	2	2	2	2
C-219	Same as C-103	Osc. tuning padding	CC30SL200G																															
C-220	Same as C-206	V-202 Grid coupling																																
C-221	Same as C-218	V-202 Grid feedback																																
C-222	CAPACITOR, fixed: Silvered mica, 0.00027 µf ±10% 500 WV JAN spec. JAN-C-5	V-202 Grid feedback	CM20A271K		(215E) MOSW	CO-783 912N325C)	C-222	1	1	1	0	0	0	6	1	3	1	9	1		0		0		0	1	1	1	1
C-223	Same as C-206	Osc. coupling cap.																																
C-224	CAPACITOR, fixed: Silvered mica, 30 µµf ±20% 500 WV JAN spec. JAN-C-5	Converter tuning pad.	CM20A300M		(215E) MOSW	CO-784 (912N430C)	C-224	1	1	1	0	0	0	6	1	3	1	9	1		0		0		0	1	1	1	1
C-225	CAPACITOR, fixed: Silvered mica, 0.000027 µf ±5% 500 WV JAN spec JAN-C-5	R-F Tuning padding	CM20C270J		(215E)	CO-1016 (912N240C)	C-225	1	1	1	0	0	0	6	1	3	1	9	1		0		0		0	1	1	1	1
C-226	Same as C-211	C-226A, C-226B, C-226C																																
C-226A	Section of C-226	V-205 Cathode bypass																																
C-226B	Section of C-226	V-205 Screen bypass																																
C-226C	Section of C-226	V-205 Plate decoupling																																
C-227	CAPACITOR, fixed: Silvered mica, 220 µµf ±20% 500 WV JAN spec. JAN-C-5	V-206 Diode feedback	CM20A221M		(215E)	CO-786 (912N320A)	C-227	1	1	1	0	0	0	6	1	3	1	9	1		0		0		0	1	1	1	1
C-228	Same as C-120	V-206 Audio coupling	CM35A822K																															
C-229	Same as C-214	V-206 Grid bypass																																
C-230	CAPACITOR, fixed: Silvered mica, 0.00047 µf ±20% 500 WV JAN spec. JAN-C-5	V-206 Plate bypass	CM35A471M		(215E)	CO-761 (912N350A)	C-230	1	1	1	0	0	0	4	1	1	1	8	1		0		0		0	1	1	1	1
C-231	Same as C-210	V-207 Audio coupling																																
C-232	CAPACITOR, fixed: Foil paper, dual section, 0.1 µf ±20% 400 WV JAN spec. JAN-C-25	C-232A and C-232B	CP50B4EF104V (481465-20)		(66G)	CO-774 (954ND01Y)	C-232, C-233	2	2	2	0	0	0	4	1	1	1	9	1		0		0		0	3	3	5	5
C-232A	Section of C-232	AVC bypass																																
C-232B	Section of C-232	V-206 Cathode bypass																																
C-233	Same as C-232	C-233A and C-233B																																
C-233A	Section of C-233	V-204 Cathode bypass																																
C-233B	Section of C-233	V-204 Grid bypass																																
C-234	Same as C-127	Plate supply filter	CP51B1EF254V		(234M)	CO-773 (956N505W)																												
C-235	CAPACITOR, fixed: Mica, 0.0039 µf ±10% 1700 WV JAN spec. JAN-C-5	V-207 Plate bypass	CM45A392K		(66G) MIL-C-240	CO-789 (925N240C)	C-235	1	1	1	0	0	0	6	1	3	1	9	1		0		0		0	1	1	1	1

MISCELLANEOUS ELECTRICAL PARTS

E-201	Same as E-103	Rec. antenna post																																
E-202	Same as E-201	Rec. ground post																																

TABLE 8-2

COMBINED PARTS AND SPARE PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODELS TCS-14 AND TCS-15 EQUIPMENT

PARTS								QUANTITY PER EQUIPMENT						SPARE PARTS															
														EQUIPMENT SPARES										TENDER SPARES		STOCK SPARES	
														TCS-14	TCS-15					20309		211100		21827A					
														12 VDC	12/24 VDC		Less Power Supply		115/230 VAC		115 VDC		230 VDC		TCS-15 12/24 VDC	TCS-15 Less Power Supp.	TCS-14 12 VDC	TCS-15 12/24 VDC
SYMBOL DESIGNATION	NAME OF PART AND DESCRIPTION	FUNCTION	A.W.S., JAN. AND NAVY TYPE DESIGNATION	NAVY STOCK NO.	(MFR.) AND MFRS. DESIG-NATION	AIR KING (COLLINS) DRAWING AND PART NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	TCS-14 12 VDC	TCS-15 12/24 VDC	TCS-15 Less Power Supply	20309 115/230 VAC	211100 115 VDC	21827-A 230 VDC	Box	Quan.	Box	Quan.	Box	Quan.	Box	Quan.	Box	Quan.	Box	Quan.	Quan.	Quan.	Quan.	Quan.
		MISCELLANEOUS ELECTRICAL PARTS (Cont'd)																											
E-203	Same as E-104	Cylindrical standoff	61415																										
	TUNING ROD assembly	Used on RF unit				SA-2707		1	1	1	0	0	0		C	10	1	2	1		0		0		0	2	2	0	2
	DETENT assembly, 5 pos.	Used on front panel				SA-1607		1	1	1	0	0	0		0		0		0		0		0		0	1	1	0	2
	SCREW, #6 - 32 - 1/4 Bristol hd oval pt.	Used on shaft hand switch, 4 7/8" lg.			(208B)	SC-619		1	1	1	0	0	0		0		0		0		0		0		0	0	0	2	2
	MITRE GEAR, assembly	RF section				SA-1374		1	1	1	0	0	0		0		0		0		0		0		0	1	1	0	1
		HARDWARE																											
H-201	#6 WRENCH bristo	Wrench			(208B) PI-1026	PI-1026 (24N973)	H-201	1	1	1	0	0	0	10	1	6	1	1	1		0		0		0	1	1	2	2
H-202	#10 WRENCH bristo	Wrench			(208B) PI-1024	PI-1024 (24N971)	H-202	1	1	1	0	0	0	10	1	6	1	1	1		0		0		0	1	1	2	2
	#8 WRENCH allen head	Wrench			WR-1005-AK	WR-1005-AK		1	0	0	0	0	0	8	1		0		0		0		0		0	0	0	0	0
	#6 WRENCH allen head	Wrench			WR-1006-AK	WR-1006-AK		1	0	0	0	0	0	8	1		0		0		0		0		0	0	0	0	0
	TOOL I. F. aligning	Alignment			SA-2707-AK	SA-2707-AK		1	0	0	0	0	0	10	1		0		0		0		0		0	0	0	0	0
		JACKS																											
J-201	JACK, 2 circuit, midget	Phone jack	49986		(23SN) JK-44A	PI-1022	J-201, J-601	2	2	2	0	0	0	10	1	6	1	1	1		0		0		0	2	2	4	4
J-201	JACK, 2 circuit, midget	Phone jack	490258		(10T) TC-60	PI-1022 (558N101)																							
		INDUCTORS																											
L-201	COIL, 6.0 to 12.0 megacycles	RF Coil, Band 3			(515N)	SA-1459 (806D)	L-201	1	1	1	0	0	0		0		0		0		0		0		0	1	1	1	1
L-202	COIL, 3.0 to 6.0 megacycles	RF Coil Band 2			(515N)	SA-1460 (798D)	L-202	1	1	1	0	0	0		0		0		0		0		0		0	1	1	1	1
L-203	COIL, 1.5 to 3.0 megacycles	RF Coil Band 1			(515N)	SA-1458 (805D)	L-203	1	1	1	0	0	0		0		0		0		0		0		0	1	1	1	1
L-204	COIL, 6.0 to 12.0 megacycles	Converter coil, Band 3			(515N)	SA-1455 (801D)	L-204	1	1	1	0	0	0		0		0		0		0		0		0	1	1	1	1
L-205	COIL, 3.0 to 6.0 megacycles	Converter coil, Band 2			(515N)	SA-1457 (799D)	L-205	1	1	1	0	0	0		0		0		0		0		0		0	1	1	1	1
L-206	COIL, 1.5 to 3.0 megacycles	Converter coil, Band 1			(515N)	SA-1461 (803D)	L-206	1	1	1	0	0	0		0		0		0		0		0		0	1	1	1	1
L-207	Same as L-102	V-202 Cathode RF choke	47896																										
L-208	COIL, 6.0 to 12.0 megacycles	Osc. coil, Band 3			(515N)	SA-1462	L-208	1	1	1	0	0	0		0		0		0		0		0		0	1	1	1	1

May be used for replacement

INDUCTORS (Cont'd)																													
L-209	COIL, 3.0 to 6.0 megacycles	Osc. coil, Band 2			(515M)	SA-1463 (804D)	L-209	1	1	1	0	0	0		0		0		0		0		0		0	1	1	1	1
L-210	COIL, 1.5 to 3.0 megacycles	Osc. coil, Band 1			(515N)	SA-1456 (802D)	L-210	1	1	1	0	0	0		0		0		0		0		0		0	1	1	1	1
PLUG CONNECTORS																													
P-201	CONNECTOR, male contact: 12 contacts wall mounting	Receiver to power supply	49899		(10C) GK-12-328	RC-1021 (371204000)	P-201, P-403, P-2103, P-2203, P-2303, P-2803	2	2	1	1	1	1	11	2	8	1	6	1	3	1	3	1	3	1	2	1	4	4
RESISTORS																													
R-201	RESISTOR, fixed: Insulated wire-wound, 220 ohms ±10% 1 W	V-201 Cathode	637ʻ5-221		(28J) BW1-NAVY	RE-926 (708N220)	R-201, R-204, R-210, R-214	4	4	4	0	0	0	1	2	3	2	8	2		0		0		0	12	12	10	20
R-202	Same as R-103	V-201 Grid	RC30BE104M																										
R-203	Same as R-104	V-201 Plate dropping	RC30BE152M																										
R-204	Same as R-201	V-202 Cathode																											
R-205	RESISTOR, fixed: Composition; 22000 ohms ± 20% 2 W JAN spec. JAN-R-11	V-202 Screen resistor	RC40BE223M		(28J) BT2-NAVY	RE-942 (729NH22M)	R-205	1	1	1	0	0	0	1	1	3	1	8	1		0		0		0	3	3	3	5
R-206	Same as R-202	V-203 Grid												1		3		8											
R-207	RESISTOR, fixed: Composition; 4700 ohms ± 20% 2 W JAN spec. JAN-R-11	V-203 Screen	RC40BE472M		(28J)	RE-939 (729NH4700)	R-207	1	1	1	0	0	0	1	1	3	1	8	1		0		0		0	3	3	3	5
R-208	Same as R-108	V-203 Voltage dividing	RC40BE473J																										
R-209	Same as R-202	V-202 Grid																											
R-210	Same as R-201	V-204 Cathode																											
R-211	Same as R-113	V-202 Control Grid	RC30BE473M																										
R-212	Same as R-211	V-202 Injector Grid																											
R-213	RESISTOR, fixed: Composition 20000 ohms ± 5% 2 W JAN spec. JAN-R-11	V-201 and V-204 screen voltage dividing	RC40BE203J		(28J)	RE-941 (729NH20M)	R-213	1	1	1	0	0	0	1	1	3	1	8	1		0		0		0	3	3	3	5
R-214	Same as R-201	V-205 Cathode																											
R-215	Same as R-211	V-205 Screen dropping																											
R-216	POTENTIOMETER, 10000 ohms ± 20% 1 W with spat switch	RF Gain control and AVC switch	631556-20		(28J)	PT-1000 (380NE10MS)	R-216	1	1	1	0	0	0	1	1	3	1	8	1		0		0		0	3	3	5	5
R-217	RESISTOR, fixed: Composition, 10000 ohms ± 20% 2 W JAN spec. JAN-R-11	V-201 and V-204 screen dropping	RC40BE103M		(28J) BT2-NAVY	RE-940 (729NH10M)	R-217, R-231	2	2	2	0	0	0	1	1	3	1	8	1		0		0		0	6	6	5	10
R-218	Same as R-211	Bleeder																											
R-219	Same as R-203	V-205 Plate dropping																											
R-220	POTENTIOMETER, 100000 ohms ± 20% 1 W	AF Gain control	631557-20		(28J)	PT-1002 (380N103)	R-220	1	1	1	0	0	0	1	1	3	1	8	1		0		0		0	3	3	5	5
R-221	RESISTOR, fixed: Composition; 220000 ohms, ± 20% 1 W JAN spec. JAN-R-11	V-206 Grid	RC30BE224M		(243S)	RE-936 (729NG220M)	R-221, R-222	2	2	2	0	0	0	1	1	3	1	8	1		0		0		0	8	6	5	10
R-222	Same as R-221	V-206 Plate supply																											
R-223	RESISTOR, fixed: Composition; 470000 ohms ± 20% 1 W JAN spec. JAN-R-11	V-207 Grid	RC30BE474M		(243S)	RE-937 (729NG470M)	R-223	1	1	1	0	0	0	1	1	3	1	8	1		0		0		0	3	3	3	15
R-224	RESISTOR, fixed: Insulated Composition, 330 ohms ± 10% 1 W Jan spec. JAN-R-11	V-207 Cathode	RC31BE331K (63288-331)		(28J)	RE-927 (708N330N)	R-224, R-401, R-402, R-2101, R-2102, R-2201, R-2202, R-2301, R-2302, R-2801	3	2	1	2	2	2	1	2	3	1	8	1	3	1	2	1	2	1	6	3	8	10

TABLE 8-2

COMBINED PARTS AND SPARE PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODELS TCS-14 AND TCS-15 EQUIPMENT

PARTS															SPARE PARTS																	
								QUANTITY PER EQUIPMENT							EQUIPMENT SPARES												TENDER SPARES		STOCK SPARES	
															TCS-14		TCS-15				20309		211100		21827A							
															12 VDC		12/24 VDC		Less Power Supply		115/230 VAC		115 VDC		230 VDC							
SYMBOL DESIGNATION	NAME OF PART AND DESCRIPTION	FUNCTION	A.W.S., JAN. AND NAVY TYPE DESIGNATION	NAVY STOCK NO.	(MFR.) AND MFRS. DESIG-NATION	AIR KING (COLLINS) DRAWING AND PART NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	TCS-14 12 VDC	12/24 V.	TCS-15 Less Power Supply	20309 115/230 VAC	211100 115 VDC	21827-A -230 VDC		Box	Quan.	Box	Quan.	Box	Quan.	Box	Quan.	Box	Quan.	Box	Quan.	TCS-15 12/24 VDC Quan.	TCS-15 Less Power Sup. Quan.	TCS-14 12 VDC Quan.	TCS-15 12/24 VDC Qu an.
RESISTORS (Cont'd)																																
R-225	Same as R-211	Diode load																														
R-226	RESISTOR, fixed: Composition; 2200 ohms ± 20% 1 W JAN spec. JAN-R-11	V-206 Cathode	RC30BE222M		(2438)	RE-930 (729NG2200)	R-226	1	1	1	0	0	0		1	1	3	1	8	1		0		0		0	3	3	3	5
R-227	Same as R-101	AVC Feedback	RC30BE105J																													
R-228	Same as R-202	V-205 Screen voltage Dividing																														
R-229	RESISTOR, fixed: Composition; 1800 ohms, ±10% 1 W JAN spec. JAN-R-11	Limiting	RC31BE182K		(2438)	RE-946 (729NG1800)	R-229, R-602	2	2	2	0	0	0		1	1	3	1	8	1		0		0		0	6	6	5	10
R-230	Same as R-202	V-204 Grid																														
R-231	Same as R-217	V-201 and V-204 screen dropping																														
R-232	RESISTOR, fixed: Composition; 10000 ohms ±20% 1 W JAN spec. JAN-R-11	Limiting	RC30BE103M		(2438)	RE-932 (729NG10M)	R-232	1	1	1	0	0	0		1	1	3	1	8	1		0		0		0	3	3	3	5
SWITCHES																																
S-201	SWITCH, 3 positions, 9 contacts	Oscillator band switch			(25C) SA-1630	SA-1630 (178C)	S-201, S-207, S-208	3	3	3	0	0	0			0	9	1	4	1		0		0		0	2	2	3	3
S-201A	Rotor assembly #2	Part of S-201			(25C) SA-1429	SA-1429 (551B-3)	S-201-A	1	1	1	0	0	0		11	2	9	1	4	1		0		0		0	2	2	2	3
S-202	SWITCH, 5 positions, 15 contacts	Osc. Selector switch			(25C) SA-1627)	SA-1627 (178C-4)	S-202	1	1	1	0	0	0			0	9	1	4	1		0		0		0	1	1	1	1
S-203	Same as S-105	MOD-CW Switch	24003																													
S-204		Not used																														
S-205	Same as S-107	Power switch	24118-A																													
S-206	Part of R-216	AVC Switch															0		0		0		0		0	0	0	0	0
S-207	Same as S-201	Converter band switch																														
S-208	Same as S-201	RF Amp Band switch																														
TRANSFORMERS																																
T-201	TRANSFORMER: Primary, 7500 ohms, sec; 500 ohms CT. 2.5 W., 200-5000 cps.	Output transformer	501088		(2448)	TR-1021	T-201	1	1	1	0	0	0		3	1	11	1	3	1		0		0		0	2	2	3	3
TUBES																																
V-201	TUBE: Triple grid amplifier JAN spec. JAN-1-A	RF Amplifier	12SK7		(524K) 12SK7	TU-1037	V-201, V-204, V-205	3	3	3	0	0	0		7	6	13	6	7	6		0		0		0	9	9	0	0

TUBES (Cont'd)																																		
V-202	TUBE: Pentagrid converter JAN spec. JAN-1-A	Converter	12SA7		(524K) 12SA7	TU-1026	V-202	1	1	1	0	0	0	7	2	13	2	7	2		0		0		0	3	3	0	0
V-203	Same as V-101	R-F Oscillator	12A6																															
V-204	Same as V-201	1st 1-F amplifier																																
V-205	Same as V-201	2nd 1-F amplifier																																
V-206	TUBE: Duplex diode triode JAN spec. JAN-1-A	Detector-amplifier	12SQ7		(524K) 12SQ7	TU-1027	V-206	1	1	1	0	0	0	7	2	13	2	7	2		0		0		0	3	3	0	0
V-207	Same as V-203	Audio amplifier																																
SOCKETS																																		
X-201	Same as X-101	For V-201	49367																															
X-202	Same as X-201	For V-202																																
X-203	Same as X-201	For V-203																																
X-204	Same as X-201	For V-204																																
X-205	Same as X-201	For V-205																																
X-206	Same as X-201	For V-206																																
X-207	Same as X-201	For V-207																																
X-208	Same as X-108	For crystals 1, 4	49911																															
X-209	Same as X-208	For crystals, 2, 3																																
IF TRANSFORMERS																																		
Z-201	TRANSFORMER, interstage, 455 KC ±10%	1st IF	471273		(242S) SA-2612-AAK	SA-2612AAK	Z-201, Z-202, Z-208	3	3	3	0	0	0	2	2	10	3	2	3		0		0		0	6	6	9	9
Z-202	Same as Z-201	2nd IF																																
Z-203	TRANSFORMER, diode output, 455 KC ±10%	3rd IF	471273		(242S) SA-2612-AAK)	SA-2612AAK																												
Z-204	TRANSFORMER, 455 KC 1F	Beat osc. coil assy	471280		(242S) SA-1380)	SA-1380	Z-204	1	1	1	0	0	0	2	1	10	1	2	1		0		0		0	2	2	3	3
REMOTE CONTROL: NAVY TYPE CCY-23270-A						**MISCELLANEOUS ELECTRICAL PARTS**																												
E-601	TERMINAL STRIP: 4 Contacts, bakelite	Handset terminal bd.			(210C) SA-1443	SA-1443 (2230A)	E-601	1	1	1	0	0	0		0		0		0		0		0		0	0	0	0	0
	KNOB assembly	For R-601			(504A)	SA-1637		1	1	1	0	0	0		0		0		C		0		0		0	1	1	1	1
JACKS																																		
J-601	Same as J-201	Phone jack	49986																															
J-602	Same as J-101	Key & mike jack	49909																															
LOUDSPEAKERS																																		
LS-601	LOUDSPEAKER, permanent magnet 5" cone, 6 ohm voice coil	Loudspeaker	49437		(210C) PI-1003)	PI-1003 271N220	LS-601	1	1	1	0	0	0		0		0		0		0		0		0	0	0	0	0
PLUG CONNECTORS																																		
P-601	CONNECTOR, male contact: 9 Contacts, wall mounting	Power supply to remote	49896		(10C) GK-9-32S	RC-1019 (371N211)	P-401, P-601, P-2101, P-2201, P-2301, P-2601	2	2	1	1	1	1	11	2	8	1	6	1	3	1	3	1	3	1	2	1	4	4

TABLE 8-2

COMBINED PARTS AND SPARE PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODELS TCS-14 AND TCS-15 EQUIPMENT

PARTS								QUANTITY PER EQUIPMENT							SPARE PARTS																	
															EQUIPMENT SPARES														TENDER SPARES		STOCK SPARES	
															TCS-14		TCS-15				20309		211100		21827A							
															12 VDC		12/24 VDC		Less Power Supply		115/230 VAC		115 VDC		230 VDC							
SYMBOL DESIGNATION	NAME OF PART AND DESCRIPTION	FUNCTION	A.W.S., JAN. AND NAVY TYPE DESIGNATION	NAVY STOCK NO.	(MFR.) AND MFRS. DESIG-NATION	AIR KING (COLUNS) DRAWING AND PART NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	TCS-14 12 VDC	TCS-15 12/24 VDC	TCS-15 Less Power Supply	20309 115/230 VAC	211100 115 VDC	21827-A 230 VDC		Box	Quan.	Box	Quan.	Box	Quan.	Box	Quan.	Box	Quan.	Box	Quan.	TCS-14 12/24 VDC Quan.	TCS-15 12/24 VDC Quan.	TCS-15 Less Power Sup. Quan.	TCS-14 12 VDC Quan.	TCS-15 12/24 VDC Quan.
RESISTORS																															
R-601	POTENTIOMETER, bridge T pad 500 ohms ±20%	Rec. vol. control			(533C) 2-35	PT-1001	R-601	1	1	1	0	0	0		1	1	3	1	8	1		0		0		0	3	3		5	5
R-602	Same as R-229	Limiting	RC51BE182K																												
SWITCHES																															
S-601	Same as S-106	Speaker-phones switch	24003																												
S-602	Same as S-107	Transmitter on-off switch	24118-A																												
S-603	Same as S-602	Receiver on-off switch																													
TRANSFORMERS																															
T-601	TRANSFORMER, primary: 500 ohms, sec: 6 ohms, 2 W., 200-5000 cps.	Speaker transformer	302039		(210C) 2D85	TR-1023 (8675705A)	T-601	1	1	1	0	0	0		2	1	11	1	3	1		0		0		0	2	2		3	3
ANTENNA LOADING COIL: NAVY TYPE CML-47205								MISCELLANEOUS ELECTRICAL PARTS																							
E-702	POST, terminal: 3/4" O.D. ceramic	Terminal bushing	61507		(25C) D-647	MP-1076 (190NB123)	E-702	2	2	2	0	0	0		1	0	6	1	1	1		0		0		0	24	2		0	4
E-703	Same as E-107	Ground Post	61152																												
INDUCTORS																															
L-701	COIL, loading 97μ total inductance, tapped at 15,27,44,60, and 76μ	Loading inductor			(233H) SA-1468	SA-1468 (467B-4	L-701	1	1	1	0	0	0			0		0		0		0		0		0	1	1		0	1
MECHANICAL PARTS																															
O-701	SWITCH detent assembly consisting of plate, spring, bearing				(233H) SA-1717	SA- 1717 (1188C-1)	O-701	1	1	1	0	0	0			0		0		0		0		0		0	0	0		0	0
O-702	SHAFT assembly consisting of shaft & taper pin				(202A) SA-1523	SA-1523 (226A-8)	O-702	1	1	1	0	0	0			0		0		0		0		0		0	0	0		0	0
SWITCHES																															
S-701	SWITCH: 0-6 Positions, 9 contacts	Tap switch			(25C) SA-1435	SA-1435 (1194C-1)	S-701	1	1	1	0	0	0			0		0		0		0		0		0	1	1		0	1
HARDWARE																															
H-801	KIT, cabinet mounting	Contains the necessary hardware for mounting the transmitter and receiver cabinets horizontally or vertically (angle brackets, screws, nuts, and washers contained in a cardboard carton)			(202A) MA-1055	MA-1063	H-801	1	1	1	0	0	0			0		0		0		0		0		0	0	0		0	0

HARDWARE (Cont'd)

H-802	CLAMP, cable: die-cast aluminum body, plated brass screws, plated phosphor bronze spring lockwasher	For W-801	AN-3057-8		(204A) AN-3057-8	DC-1015	H-802	1	1	1	0	0	0		0		0		0		0		0		0	0	0	0	0
H-803	Same as H-802	For W-801																											
H-804	Same as H-802	For W-802																											
H-805	Same as H-802	For W-802																											
H-806	Same as H-802	For W-803																											
H-807	Same as H-802	For W-805																											
							MICROPHONES																						
MI-801	MICROPHONE, carbon: Single button type, complete with "push to talk" switch, 51 inch, 3-conductor cord and plug. Navy type-51042 Microphone is included.	Microphone	51004C		(231M)	SA-1396 (2DN406)	MI-801, MI-802	2	2	2	0	0	0		0		0		0		0		0		0	0	0	0	0
MI-802	Same as MI-801	Microphone																											
							PLUG CONNECTORS																						
P-801	CONNECTOR, female contact: Right angle, 16 contacts	Part of W-801	49894		(10C) SK-C16-23-1/2AC	PL-1014 (317N307)	P-801	1	1	1	0	0	0		0		0		0		0		0		0	0	0	0	0
P-802	CONNECTOR, female contact: Straight 16 contacts	Part of W-801	49895		(10C) SK-C16-21-1/2AC	PL-1015 (317N308)	P-802	1	1	1	0	0	0		0		0		0		0		0		0	0	0	0	0
P-803	CONNECTOR, female contact, right angle, 12 contacts	Part of W-802	49900		(10C) SK-12-23-1/2AC	PL-1013 (317N213)	P-803	1	1	1	0	0	0		0		0		0		0		0		0	0	0	0	0
P-804	CONNECTOR, female: Contact straight, 12 terminals	Part of W-802	49901		(10C) SK-12-21-1/2AC	PL-1012 317N212	P-804	1	1	1	0	0	0		0		0		0		0		0		0	0	0	0	0
P-805	CONNECTOR, female contact: right angle, 9 contacts	Part of W-803	49897		(10C) SK-9-23-1/2AC	PL-1017 (317N215)	P-805	1	1	1	0	0	0		0		0		0		0		0		0	0	0	0	0
P-806	CONNECTOR, female contact: Straight, 9 contacts	Part of W-803	49898		(10C) SK-9-21-1/2AC	PL-1016 (317N214)	P-806	1	1	1	0	0	0		0		0		0		0		0		0	0	0	0	0
							SWITCHES (Telegraph Key)																						
S-801	TELEGRAPH KEY: Standard type with shorting lever, brass finish lacquered platinor points	Telegraph key	26018		527S	PI-1002 (274N11)	S-801	1	1	1	0	0	0		0		0		0		0		0		0	0	0	0	0
							INTERCONNECTING CABLES																						
W-801	CABLE, included P-802 and 11 feet of 16 conductor shielded plastic cable	Trans. power cable	62271		(245S)	CA-1059	W-801	1	1	1	0	0	0	9	1	14	1	10	1		0		0		0	1	1	2	2
W-801A	CABLE includes tinned soft copper 4 conductors, 16 gauge, 26 strands #30; 7 conductors 20 gauge, 10 strands, #30; dielectric test 1500 V, 60 cycles, between conductors, and 1000 V between all conductors together to shield and ground	Cable (wire) only			(223G) W-1001	CA-1094		1	1	1	0	0	0		0		0		0		0		0		0	0	0	0	0
W-802	CABLE, includes P-803 and P-804 and 10 feet of 7-conductor shielded plastite cable	Rec. power cable	62272		(245S) CA-1060	CA-1060 (2156A)	W-802	1	1	1	0	0	0	9	1	14	1	10	1		0		0		0	1	1	2	2
W-802A	CABLE, includes tinned soft copper, 2 conductors 12 gauge, 65 strands #30, 2 conductors 16 gauge, 26 strands #30; 3 conductors 20 gauge, 10 strands #30; dielectric test as for W-801A	Cable (wire) only			(223G)	CA-1095	W-802A, W-803A	2	2	2	0	0	0		0		0		0		0		0		0	0	0	0	0
W-803	CABLE, includes P-805 and P-806, and 20 feet of 7-conductor shielded plastite cable	Control cable	62270		(245S) CA-1058	CA-1058 (748A-1)	W-803	1	1	1	0	0	0	9	1	14	1	10	1		0		0		0	1	1	2	2

TABLE 8-2

COMBINED PARTS AND SPARE PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODELS TCS-14 AND TCS-15 EQUIPMENT

PARTS								QUANTITY PER EQUIPMENT						SPARE PARTS															
														EQUIPMENT SPARES										TENDER SPARES		STOCK SPARES	
														TCS-14		TCS-15				20309		211100		21827A					
														12 VDC		12/24 VDC		Less Power Supply		115/230 VAC		115 VDC		230 VDC					
SYMBOL DESIGNATION	NAME OF PART AND DESCRIPTION	FUNCTION	A.W.S., JAN. AND NAVY TYPE DESIGNATION	NAVY STOCK NO.	(MFR.) AND MFRS. DESIG-NATION	AIR KING (COLLINS) DRAWING AND PART NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	TCS-14 12 VDC	TCS-15 12/24 VDC	TCS-15 12/24 VDC Less Power Supply	20309 115/230 VAC	211100 115 VDC	21827A 230 VDC	Box	Quan.	Box	Quan.	Box	Quan.	Box	Quan.	Box	Quan.	Box	Quan.	TCS-15 12/24 VDC Quan.	TCS-15 12/24 VDC Less Power Sup. Quan.	TCS-14 12 VDC Quan.	TCS-15 12/24 VDC Quan.
INTERCONNECTING CABLES (Cont'd)																													
W-803A	Same as W-802A	Cable wire only																											
W-804	CABLE, includes phone plug, 3 circuit phone plug and 34 inches of 2-conductor cord	Key cord and plug	62269		(500A) SA-1390	SA-1390 (426N7)	W-804	1	1	1	0	0	0	11	1	7	1	1	1		0		0		0	1	1	2	2
W-804A	CABLE, includes 2 conductors, 16 strands #30	Cord only			(231M)	CA-1062 (426N7)		1	1	1	0	0	0		0		0		0		0		0		0	0	0	0	0
	CABLE, Co-axial, copper braid 14" length	Coaxial cable			(223G)	CA-1098		0	1	1	0	0	0		0	6	1	1	1		0		0		0	1	1	0	2
POWER SUPPLY: NAVY TYPE CKP-21128I-B							**CAPACITORS**																						
C-401	CAPACITOR, Foil paper triple section 0.1 μf + 20%-10% 600 WV JAN spec. JAN-C-5	C-401A, C-401B, C-401C	CP51B5EF104V		(234M)	CO-779 (956000100)	C-401, C-2808	1	1	0	0	0	0	6	1	2	1		0		0		0		0	2	0	1	3
C-401A	Section of C-401	H-V dynamotor pri. noise-filter																											
C-401B	Section of C-401	L-V dynamotor sec. noise-filter																											
C-401C	Section of C-401	L-V dynamotor pri. noise-filter																											
C-402	CAPACITOR, fixed Mica, 0.0047 μf ± 20%, 500 WV JAN spec. JAN-C-5	H-V dynamotor pri. noise-filter	CM35B472M		(64S) HWBW	CO-764 (909N280CN)	C-402, C-409, C-410, C-2102, C-2103, C-2107, C-2110, C-2111, C-2112, C-2117, C-2118, C-2119, C-2302, C-2303, C-2307, C-2310, C-2311, C-2312, C-2317, C-2318, C-2319	3	0	0	0	9	9	4	1		0		0		0	3	1	3	1	0	0	3	0
C-403	Same as C-402	H-V noise-filter																											
C-404	Same as C-402	H-V noise-filter																											
C-405	Same as C-125	H-V noise-filter	481249-20																										
C-406	Same as C-127	Spark suppressor	CP51B1EF254V																										
C-407	Same as C-405	L-V noise-filter																											
C-408		Not used																											
C-409	Same as C-402	L-V noise-filter																											
C-410	Same as C-402	L-V dynamotor pri. noise-filter																											
C-411		Not used																											
C-412	Same as C-406	Spark suppressor																											
							DYNAMOTORS																						
D-401	DYNAMOTOR: Input: 12 V, 9.9 amp., DC; Output: 400 V 0.18 amp., DC; 4700 rpm	Power supply	211041		(60E) ML-4120-46	DM1000	D-401	1	0	0	0	0	0	8	1		0		0		0		0		0	0	0	3	0
D-402	DYNAMOTOR, Input: 12 V, 3.8 amp. DC Output: 220 V, 0.1 amp. DC; 4400 rpm	Power supply	211042		(200W) 35X030	DM1001 (231N40A)	D-402	1	0	0	0	0	0	8	1		0		0		0		0		0	0	0	3	0

MISCELLANEOUS ELECTRICAL PARTS

D-401A	BRUSH, positive LV	For D-401			(60E)	PI-1011 (234N104)	D-401-A	1	0	0	0	0	0	10	6		0		0		0		0		0	0	0	20	0
D-401B	BRUSH, negative LV	For D-401			(60E)	PI-1010 (234N105)	D-401-B	1	0	0	0	0	0	10	5		0		0		0		0		0	0	0	20	0
D-401C	BRUSH, positive HV	For D-401			(60E)	PI-1065 (234N102)	D-401-C	1	0	0	0	0	0	10	5		0		0		0		0		0	0	0	20	0
D-401D	BRUSH, negative HV	For D-401			(60E)	PI-1013 (234N103)	D-401-D	1	0	0	0	0	0	10	5		0		0		0		0		0	0	0	20	0
D-402A	BRUSH, positive LV	For D-402			(200W)	PI-1016 (234N100A)	D-402-A	1	0	0	0	0	0	10	5		0		0		0		0		0	0	0	20	0
D-402B	BRUSH, negative LV	For D-402			(200W)	PI-1015 (234N101A)	D-402-B	1	0	0	0	0	0	10	5		0		0		0		0		0	0	0	20	0
D-402C	BRUSH, positive HV	For D-402			(200W)	PI-1014 (234N102A)	D-402-C	1	0	0	0	0	0	10	5		0		0		0		0		0	0	0	20	0
D-402D	BRUSH, negative HV	For D-402			(200W)	PI-1012 (234N103A)	D-402-D	1	0	0	0	0	0	10	5		0		0		0		0		0	0	0	20	0
	BRUSH HOLDER LV	For D-401			(60E)	BH-1001		1	0	0	0	0	0	6	2		0		0		0		0		0	0	0	12	0
	BRUSH HOLDER HV	For D-401			(60E)	BH-1002		1	0	0	0	0	0	6	2		0		0		0		0		0	0	0	12	0
	BRUSH HOLDER LV	For D-402 (Right)			(200W)	BH-1003		1	0	0	0	0	0	6	1		0		0		0		0		0	0	0	6	0
	BRUSH HOLDER LV	For D-402 (Left)			(200W)	BH-1004		1	0	0	0	0	0	6	1		0		0		0		0		0	0	0	6	0
	BRUSH HOLDER HV	For D-402 (Right)			(200W)	BH-1005		1	0	0	0	0	0	6	1		0		0		0		0		0	0	0	6	0
	BRUSH HOLDER HV	For D-402 (Left)			(200W)	BH-1006		1	0	0	0	0	0	6	1		0		0		0		0		0	0	0	6	0
	CAP, Brush Holder LV	For D-401			(60E)	BH-1011		1	0	0	0	0	0	6	2		0		0		0		0		0	0	0	6	0
	CAP, Brush Holder HV	For D-401			(60E)	BH-1012		1	0	0	0	0	0	6	2		0		0		0		0		0	0	0	6	0
	CAP, Brush Holder	For D-402			(200W)	BH-1013		2	0	0	0	0	0	6	4		0		0		0		0		0	0	0	12	0
	SHOCK MOUNT	Used on bottom plate			(506H)	PI-1019		4	4	0	0	0	0	10	1	7	1		0		0		0		0	4	0	8	4
FUSES																															
F-401	FUSE, cartridge; 15 amp., 25v., 9/32" x 1 1/4"	L-V dynamotor pri	28033-15		(97B) 4AG	FU-1002 (264N506)	F-401	1	0	0	0	0	0	11	20		0		0		0		0		0	0	0	100	0
F-402	FUSE, cartridge: 30 amp., 25 V, 9/32" x 1 1/4",	H-V dynamotor pri.	28033-30		(97B) 4AG	FU-1001 (264N509)	F-402	1	0	0	0	0	0	11	20		0		0		0		0		0	0	0	100	0
RELAYS																															
K-401	Same as K-102	Motor Control contactor	29220																												
INDUCTORS																															
L-401	CHOKE COIL assembly: 22mh x 20% 0.02 ohms.	H-V dynamotor pri. noise-filter ind.	471006		(233M) SA-1426	SA-1426 (416A-1)	L-401, L-405, L-2104, L-2304, L-2802	2	1	0	0	1	1		0		0		0		0		0	1	0	2	1
L-402	Same as L-110	H-V noise-filter ind.	47895																												
L-403	CHOKE: 8 mh, 0.1 amp., 160 ohms, 120 cps. 2500 TV, 120 cps	L-V ripple-filter reactor	301090		(244S) TR-1024	TR-1024 (678N125A)	L-403	1	0	0	0	0	0	3	1		0		0		0		0		0	0	0	3	0
L-404	Same as L-402	L-V noise filter ind.																													
L-405	Same as L-401	L-V dynamotor pri. noise-filter ind.																													
PLUG CONNECTORS																															
P-401	Same as P-601	Power Supply to Remote Control	49996																												

TABLE 8-2

COMBINED PARTS AND SPARE PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODELS TCS-14 AND TCS-15 EQUIPMENT

SYMBOL DESIGNATION	NAME OF PART AND DESCRIPTION	FUNCTION	A.W.S., JAN. AND NAVY TYPE DESIGNATION	NAVY STOCK NO.	(MFR.) AND MFRS. DESIGNATION	AIR KING (COLLINS) DRAWING AND PART NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	Qty per Equip. TCS-14 12 VDC	Qty per Equip. TCS-15 12/24 VDC	Qty per Equip. TCS-15 Less Power Supply	Qty per Equip. -20309 115/230 VAC	Qty per Equip. -211100 115 VDC	Qty per Equip. -21827-A 230 VDC	Equip. Spares TCS-14 12 VDC Box	Equip. Spares TCS-14 12 VDC Quan.	Equip. Spares TCS-15 12/24 VDC Box	Equip. Spares TCS-15 12/24 VDC Quan.	Equip. Spares TCS-15 Less Power Supply Box	Equip. Spares TCS-15 Less Power Supply Quan.	Equip. Spares 20309 115/230 VAC Box	Equip. Spares 20309 115/230 VAC Quan.	Equip. Spares 211100 115 VDC Box	Equip. Spares 211100 115 VDC Quan.	Equip. Spares 21827A 230 VDC Box	Equip. Spares 21827A 230 VDC Quan.	Tender Spares TCS-15 12/24 VDC Quan.	Tender Spares TCS-15 Less Power Sup. Quan.	Stock Spares TCS-14 12 VDC Quan.	Stock Spares TCS-15 12/24 VDC Quan.
	PLUG CONNECTORS (Cont'd)																												
P-402	Same as P-101	Power Supply to transmitter	49893																										
P-403	Same as P-201	Power Supply to receiver	49899																										
	RESISTORS																												
R-401	Same as R-224	Spark suppressor	RC31BE331K (63288-331)																										
R-402	Same as R-401	Spark suppressor																											
	POWER SUPPLY: NAVY TYPE-211100 — **MOTORS**																												
B-2101	MOTOR, DC: 3/16 h.p. 115 V 3450 rpm	For HV generator	-211224-B		(520F)	MO-13690 (230000100)	B-2101, B-2102	0	0	0	0	2	0		0		0		0		0	6	1		0	0	0	0	0
B-2102	Same as B-2101	For LV generator																											
	CAPACITORS																												
C-2101	Same as C-127	Spark suppressor cap.	CP51B1EF254V																										
C-2102	Same as C-402	Motor Noise Filter Cap.	CM35B472M																										
C-2103	Same as C-2102	Motor Noise Filter Cap.																											
C-2104	CAPACITOR, fixed: mica 0.006 µf ± 20% 1000 TV JAN spec. JAN-C-5	HV Filter Cap.	CM55B602M		(66S)	CO-11425 (910260840)	C-2104, C-2304	0	0	0	0	1	1		0		0		0		0	3	1	3	1	0	0	0	0
C-2105	Same as C-109	HV Filter Cap.	CM50A622M																										
C-2106	Same as C-125	HV Filter Cap.	481249-20																										
C-2107	Same as C-2102	Filament Supply noise-filter cap.																											
C-2108	Same as C-120	Filament Supply noise-filter cap.	CM35A822K																										
C-2109	Same as C-2101	Filament Supply noise-filter cap.																											

CAPACITORS (Cont'd)

C-2110	Same as C-2102	Motor noise filter cap.																														
C-2111	Same as C-2102	Motor noise filter cap.																														
C-2112	Same as C-2102	LV Filter cap.																														
C-2113	Same as C-2106	LV Filter cap.																														
C-2114	Same as C-2106	LV Filter cap.																														
C-2115	Same as C-205	C-2115A, C-2115B	CP5184EF104V																													
C2115A	Section of C-2115	Power Input filter cap																														
C2115B	Section of C-2115	Power Input filter cap.																														
C-2116	Same as C-2101	Spark Suppressor cap.																														
C-2117	Same as C-2102	Motor noise filter cap.																														
C-2118	Same as C-2102	Motor noise filter cap.																														
C-2119	Same as C-2102	Motor noise filter cap.																														
							MISCELLANEOUS ELECTRICAL PARTS																											
	BRUSH, positive LV	For G-2102			(520F) BR-107	BH-11063		0	0	0	0	1	1		0		0		0		0	2	5	2	5	0	0	0	0				
	BRUSH, negative LV	For G-2102			(520F) BR-107	BH-11064		0	0	0	0	1	1		0		0		0		0	2	5	2	5	0	0	0	0				
	BRUSH, positive HV	For G-2101, G-2102			(520F) BR-108	BH-11065		0	0	0	0	2	2		0		0		0		0	2	10	2	10	0	0	0	0				
	BRUSH, negative Hv	For G-2101, G-2102			(520F) BR-108-A	BH-11066		0	0	0	0	2	2		0		0		0		0	2	10	2	10	0	0	0	0				
	BRUSH, negative input	For B-2101, B-2102			(520F) BR-104	BH-11069		0	0	0	0	2	2		0		0		0		0	2	10	2	10	0	0	0	0				
	BRUSH, positive input	For B-2101, B-2102			(520F) BR-104	BH-11070		0	0	0	0	2	2		0		0		0		0	2	10	2	10	0	0	0	0				
	CAP, Brush holder HV	For G-2101, G-2102			(520F) BHC-103	BH-11071		0	0	0	0	4	4		0		0		0		0	2	4	2	4	0	0	0	0				
	CAP, Brush holder LV	For B-2101, B-2102, G-2102			(520F) BHC-101	BH-11072		0	0	0	0	4	4		0		0		0		0	2	6	2	6	0	0	0	0				
	CAP, Brush holder HV	For G-2101, G-2102			(520F) BLT-107	BH-11073		0	0	0	0	4	4		0		0		0		0	2	4	2	4	0	0	0	0				
	CAP, Brush holder LV	For B-2101, B-2102 G-2102			(520F) BLT-104	BH-11074		0	0	0	0	4	4		0		0		0		0	2	6	2	6	0	0	0	0				
	CLIP, Fuse	For 9/16 Ferrule type fuses			(97B)	FC-11611		0	0	0	0	4	4		0		0		0		0	2	1	2	1	0	0	0	0				
							FUSES																									
F-2101	FUSE, cartridge; 10 amp 250 V 9/16" x 2"	B-2101 Primary Fuse	28044-10		(227L)	FU-11624 (264210000)	F-2101, F-2102, F-2301, F-2302	0	0	0	0	2	2		0		0		0		0	2	20	2	20	0	0	0	0				
F-2102	Same as F-2101	B-2102 Primary Fuse																														
							GENERATORS																									
G-2101	GENERATOR, DC: 430 V 0.200 amp. 3450 rpm	HV Generator	-211220-D		(520F)	GN-13700 (231000200)	G-2101, G-2301	0	0	0	0	1	1		0		0		0		0	4	1	4	1	0	0	0	0				
G-2102	GENERATOR, DC: 240 V 0.100 amp., 12.5 V 4.0 amp. 3450 rpm	LV Plate & filament generator	-211219-C		(520F)	GN-13701 (231000100)	G-2102, G-2302	0	0	0	0	1	1		0		0		0		0	5	1	5	1	0	0	0	0				
							RELAYS																									
K-2101	Same as K-102	HV Motor Control Contactor	29220																													

TABLE 8-2

COMBINED PARTS AND SPARE PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODELS TCS-14 AND TCS-15 EQUIPMENT

PARTS								QUANTITY PER EQUIPMENT						SPARE PARTS																	
														EQUIPMENT SPARES												TENDER SPARES		STOCK SPARES			
														TCS-14	TCS-15					20309		211100		21827A							
														12 VDC	12/24 VDC		Less Power Supply			115/230 VAC		115 VDC		230 VDC							
SYMBOL DESIGNATION	NAME OF PART AND DESCRIPTION	FUNCTION	A.W.S., JAN. AND NAVY TYPE DESIGNATION	NAVY STOCK NO.	(MFR.) AND MFRS. DESIG-NATION	AIR KING (COLLINS) DRAWING AND PART NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	TCS-14 12 VDC	TCS-15 12/24 VDC	TCS-15 Less Power Supply	20309 115/230 VAC	211100 115 VDC	21827-A 230 VDC	Box	Quan.	Box	Quan.	Box	Quan.	Box	Quan.	Box	Quan.	Box	Quan.	TCS-15 12/24 VDC Quan.	TCS-15 Less Power Sup. Quan.	TCS-14 12 VDC Quan.	TCS-15 12/24 VDC Quan.		
RELAYS (CONT'D)																															
K-2102	RELAY general purpose 12 VDC coil SPST cont.	Filament voltage control contactor	29898		(528L)	RL-12492 (401110200)	K-2102, K-2302	0	0	0	0	1	1		0		0		0		0	1	1	1	1	0	0	0	0		
INDUCTORS																															
L-2101	Same as L-102	HV Filter inductor	47896																												
L-2102	Same as L-2101	LV Filter inductor																													
L-2103	CHOKE: 6 hy 0.15 amp. 100 ohm 2195t #28 EN	LV Filter reactor	301992		(55C)	CL-11020 (678132100)	L-2103, L-2303	0	0	0	0	1	1		0		0		0		0	1	1	1	1	0	0	0	0		
L-2104	Same as L-401	Fil. Voltage Filter inductor	471006																												
MECHANICAL PARTS																															
O-2101	COUPLING, flexible: 1 1/4" x 2" Cold Rolled Steel	HV Gen.			(529L)	MP-11835 (015306000)	O-2101, O-2102, O-2301, O-2302	0	0	0	0	2	2		0		0		0		0	2	1	2	1	0	0	0	0		
O-2102	Same as O-2101	LV Gen.																													
PLUG CONNECTORS																															
P-2101	Same as P-601	Power supply to remote control	49896																												
P-2102	Same as P-101	Power supply to transmitter	49893																												
P-2103	Same as P-201	Power supply to receiver	49899																												
RESISTORS																															
R-2101	Same as R-224	Spark Suppressor res.	RC31BE331K 63288-331																												
R-2102	Same as R-2101	Spark Suppressor res.																													
POWER SUPPLY: NAVY TYPE -20309							**CAPACITORS**																								
C-2201	CAPACITOR, Paper: 4 μf ± 20% 600WV	High voltage filter capacitor	481054-20		(75C) TL-8040	CO-11420 (930340000)	C-2201, C-2202, C-2203, C-2204, C-2205, C-2206, C-2207, C-2208	0	0	0	8	0	0		0		0		0	2	4		0		0	0	0	0	0		
C-2202	Same as C-2201	High voltage filter capacitor																													
C-2203	Same as C-2201	High voltage filter capacitor																													
C-2204	Same as C-220	High voltage filter capacitor																													

CAPACITORS (Cont'd)

C-2205	Same as C-2201	Low voltage filter capacitor																													
C-2206	Same as C-2201	Low voltage filter capacitor																													
C-2207	Same as C-2201	Low voltage filter capacitor																													
C-2208	Same as C-2201	Low voltage filter capacitor																													
C-2209	Same as C-127	Transient filter capacitor	CP51B1EF254V																												
C-2210	Same as C-2209	Transient filter capacitor																													
C-2211	CAPACITOR, paper: Dual Section 0.1 uf + 20% -10% 600 WV Jan spec. JAN-C-25	C-2211A and C-2211B	CP51B4EF104V		(66S)	CO-11421 (954401640)	C-2211	0	0	0	1	0	0		0		0		0	2	1		0		0	0	0	0	0	
C2211A	Section of C-2211	Line filter																													
C2211B	Section of C-2211	Line filter																													
DRY DISC RECTIFIERS																															
CR2201	RECTIFIER, dry disc, 12V DC 1.2 amp	Relay power rectifier	20399		(514B)	RF-13645 (353270000)	CR-2201	0	0	0	1	0	0		0		0		0	3	1		0		0	0	0	0	0	
MISCELLANEOUS ELECTRICAL PARTS																															
E-2201	POST, bakelite for 1-1/4" x 1/4" fuse	Receptacle for F-2201			(78L) 1075A	FH-13635 (265203000)	E-2201, E-2202, E-2203, E-2204	0	0	0	4	0	0		0		0		0	2	1		0		0	0	0	0	0	
E-2202	Same as E-2201	Receptacle for F-2202																													
E-2203	Same as E-2201	Receptacle for F-2203																													
E-2204	Same as E-2201	Receptacle for F-2204																													
	CLAMP, tube	Tube hold down				MS-11860		0	0	0	2	0	0		0		0		0	3	1		0		0	0	0	0	0	
	CLIP, fuse	Clip for ferrule type resistor, R-2203 & R-2204			(531S)	FC-1001 (265804000)		0	0	0	2	0	0		0		0		0	3	2		0		0	0	0	0	0	
	MOUNTING BLOCK	Ceramic resistor mounting R-2203 and R-2204			(532A)	MP-11806 (193100000)		0	0	0	2	0	0		0		0		0	3	2		0		0	0	0	0	0	
FUSES																															
F-2201	FUSE, cartridge: 2 Amp. 250V 1-1/4" x 1/4"	HV Primary fuse	28032-2		(78L) 1042	FU-11614 (264407000)	F-2201, F-2202	0	0	0	2	0	0		0		0		0	2	20		0		0	0	0	0	0	
F-2202	Same as F-2201	HV Primary fuse																													
F-2203	FUSE, cartridge: 3 Amp 250V 1-1/4" x 1/4"	LV Primary fuse	28032-3		(78L) 1043	FU-11615 (264408000)	F-2203, F-2204	0	0	0	2	0	0		0		0		0	2	20		0		0	0	0	0	0	
F-2204	Same as F-2203	LV Primary fuse																													
RELAYS																															
K-2201	Same as K-102	Power control relay	29220																												
INDUCTORS & REACTORS																															
L-2201	COIL: 4-12 HY 0.035-0.300 Amp 2538 turns #24 en	HV Input filter reactor	301990		(55C) 8690	CL-11010 (678000900)	L-2201	0	0	0	1	0	0		0		0		0	1	1		0		0	0	0	0	0	
L-2202	COIL: 6 Hy 0.150 amp 2104 turns #28 en	LV Input filter reactor	301991		(55C) 8499-C	CL-11012 (678000700)	L-2202, L-2203	0	0	0	2	0	0		0		0		0	6	2		0		0	0	0	0	0	
L-2203	Same as L-2202	LV Output filter reactor																													

TABLE 8-2

COMBINED PARTS AND SPARE PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODELS TCS-14 AND TCS-15 EQUIPMENT

PARTS															SPARE PARTS																					
								QUANTITY PER EQUIPMENT							EQUIPMENT SPARES														TENDER SPARES				STOCK SPARES			
															TCS-14		TCS-15				20309		211100		21827A											
															12 VDC		12/24 VDC		Less Power Supply		115/230 VAC		115 VDC		230 VDC											
SYMBOL DESIGNATION	NAME OF PART AND DESCRIPTION	FUNCTION	A.W.S., JAN. AND NAVY TYPE DESIGNATION	NAVY STOCK NO.	(MFR.) AND MFRS. DESIG-NATION	AIR KING (COLLINS) DRAWING AND PART NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	TCS-14 12 VDC	TCS-15 12/24 VDC	TCS-15 Less Power Supply	-20309 115/230 VAC	-211100 115 VDC	-21827A 230 VDC		Box	Quan.	Box	Quan.	Box	Quan.	Box	Quan.	Box	Quan.	Box	Quan.	Box	Quan.	TCS-15 12/24 VDC Quan.	TCS-15 Less Power Sup. Quan.	TCS-14 12 VDC Quan.	TCS-15 12/24 VDC Quan.
INDUCTORS & REACTORS (Cont'd)																																			
L-2204	COIL: 4 Hy 0.300 amp 40 ohm 1664 turns #24 en	HV Output filter reactor	701994		(55C) 6517-D	CL-11011 (678000600)	L-2204	0	0	0	1	0	0			0		0		0	1	1		0		0	0	0	0	0	0	0					
PLUG CONNECTORS																																			
P-2201	Same as P-601	Power supply to remote control	49896																																
P-2202	Same as P-101	Power supply to transmitter	49893																																
P-2203	Same as P-201	Power supply to receiver	49899																																
P-2204	CONNECTOR, male contact: 2 conductor AC	AC Line input receptacle	49844		(40G) GE-2711	RC-12475 (368370000)	P-2204	0	0	0	1	0	0			0		0		0	3	1		0		0	0	0	0	0	0	0					
	CONNECTOR, female contacts. 2 conductor AC	AC Line input plug	49903		(40G)	RC-12476 (368000200)		0	0	0	1	0	0			0		0		0	3	1		0		0	0	0	0	0	0	0					
RESISTORS																																			
R-2201	Same as R-224	Transient filter resistor	RC31BE331K 63288-331																																
R-2202	Same as R-2201	Transient filter resistor																																	
R-2203	RESISTOR, fixed: ferrule type, wire-wound 12500 ohms ± 20% 40W	LV bleeder resistor	631022-F20		(5:9H)	RE-124500 (733141000)	R-2203, R-2204	0	0	0	2	0	0			0		0		0	3	1		0		0	0	0	0	0	0	0					
R-2204	Same as R-2203	HV bleeder resistor																																	
SWITCHES																																			
S-2201	SWITCH, DPDT Lever toggle	Primary voltage	24003		(52SC)	SW-13350 (266000200)	S-2201	0	0	0	1	0	0			0		0		0	3	1		0		0	0	0	0	0	0	0					
TRANSFORMER																																			
T-2201	TRANSFORMER, Primary: 115, 230 V 57.5 VA 460 1/2T #27 en. & 454T #24 en. sec: 500V CT. 0.106 amp. 2104 1/2T C.T. #31 en.	LV Plate Power trans.	302073		(55C) 8678	TR-11003 (672000300)	T-2201	0	0	0	1	0	0			0		0		0	6	1		0		0	0	0	0	0	0	0					
T-2202	TRANSFORMER, Pri: 115, 230 V 185VA 249T #21 en. #244T #18 en sec: 1100 v. ct. 0.212 amp 246ZT CT #27 en.	HV Plate Power trans.	302074		(55C) 8679	TR-11002 (672000400)	T-2202	0	0	0	1	0	0			0		0		0	6	1		0		0	0	0	0	0	0	0					
T-2203	TRANSFORMER, Pri: 115, 230 V 494 T #28 en & 469T #24 en sec: #1 16.6 V 1.25 amp 79 1/2T #22 en sec #2 12.6 V 3.5 amp 60T6-180 en., C.T. at ground potential.	Fil. and relay power	302075		(55C) 8681	TR-11000 (672000500)	T-2203	0	0	0	1	0	0			0		0		0	1	1		0		0	0	0	0	0	0	0					

TRANSFORMER (Cont'd)

T-2204	TRANSFORMER, Pri: 115, 230 V 30 VA 402 1/2T #30 an & 60T #27 on sec: 6V 6 amp ct 28t #13BCE	HV rectifier filament Power transformer	308076		(55C) 8680	TR-11001 (272000600)	T-2204	0	0	0	1	0	0		0		0		0		6	1		0		0	0	0	0	0									

TUBES

V-2201	TUBE, full wave high vacuum rectifier JAN spec. JAN-1-A	HV rectifier	5R4GY		(526R) 5R4GY	TU-13511	V-2201, V-2202	0	0	0	2	0	0		0		0		0		4 & 5	4		0		0	0	0	0	0									
V-2202	Same as V-2201	HV rectifier																																				
V-2203	TUBE, full wave high vacuum rectifier JAN spec. JAN-1-A	LV rectifier	6X5GT		(519N) 6X5GT	TU-13510	V-2203, V-2204	0	0	0	2	0	0		0		0		0		4 & 5	4		0		0	0	0	0	0									
V-2204	Same as V-2203	LV rectifier																																				

SOCKETS

X-2201	Same as X-101	For V-2201	49367																																			
X-2202	Same as X-2201	For V-2202																	5		3																		
X-2203	Same as X-2201	For V-2203																	5		3																		
X-2204	Same as X-2201	For V-2204																	5		3																		

POWER SUPPLY: NAVY TYPE - 21827-A **MOTORS**

B-2301	MOTOR: 5/16 h.p. 220 VDC 3450 rpm 1.25 amps.	For HV generator	211223-B		(520F)	MO-13691 (270000300)	B-2301, B-2302	0	0	0	0	0	2		0		0		0		0		0		6	1	0	0	0	0									
B-2302	Same as B-2301	For LV generator																							6														

CAPACITORS

C-2301	Same as C-127	Spark Suppressor cap.	CP51B1EF254V																																			
C-2302	Same as C-402	Motor Noise filter cap.	CM35B472M																																			
C-2303	Same as C-2302	Motor Noise filter cap.																																				
C-2304	Same as C-2104	HV Filter cap.	CM55B602M																																			
C-2305	Same as C-109	HV Filter cap.	CM60A622M																																			
C-2306	Same as C-125	HV Filter cap.	481349-20																																			
C-2307	Same as C-2302	Filament Supply noise filter cap.																																				
C-2308	Same as C-120	Filament Supply noise filter cap.	CM35A822K																																			
C-2309	Same as C-2301	Filament Supply noise filter cap.																																				
C-2310	Same as C-2302	Motor noise filter cap.																																				
C-2311	Same as C-2302	Motor noise filter cap.																																				
C-2312	Same as C-2302	LV Filter cap.																																				
C-2313	Same as C-2306	LV Filter cap.																																				
C-2314	Same as C-2306	LV Filter cap.																																				

TABLE 8-2

COMBINED PARTS AND SPARE PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODELS TCS-14 AND TCS-15 EQUIPMENT

PARTS															SPARE PARTS																			
								QUANTITY PER EQUIPMENT							EQUIPMENT SPARES														TENDER SPARES				STOCK SPARES	
															TCS-14		TCS-15				20309		211100		21827A									
															12 VDC		12/24 VDC		Less Power Supply		115/230 VAC		115 VDC		230 VDC									
SYMBOL DESIGNATION	NAME OF PART AND DESCRIPTION	FUNCTION	A.W.S., JAN. AND NAVY TYPE DESIGNATION	NAVY STOCK NO.	(MFR.) AND MFRS. DESIG-NATION	AIR KING (COLLINS) DRAWING AND PART NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	TCS-14 12 VDC	TCS-15 12/24 VDC	TCS-15 Less Power Supply	-20309 115/230 VAC	-211100 115 VDC	-21827-A 230 VDC		Box	Quan.	Box	Quan.	Box	Quan.	Box	Quan.	Box	Quan.	Box	Quan.	TCS-15 12/24 VDC Quan.	TCS-15 Less Power Sup. Quan.	TCS-14 12 VDC Quan.	TCS-15 12/24 VDC Quan.
CAPACITORS (Cont'd)																																		
C-2315	Same as C-205	C-2315A, C-2315B	CP51B4EF104V																															
C2315A	Section of C-2315	Power Input filter cap.																																
C2315B	Section of C-2315	Power Input filter cap.																																
C-2316	Same as C-2301	Spark Suppressor cap.																																
C-2317	Same as C-2302	Motor Noise filter cap.																																
C-2318	Same as C-2302	Motor noise filter cap.																																
C-2319	Same as C-2302	Motor noise filter cap.																																
MISCELLANEOUS ELECTRICAL PARTS																																		
	BRUSH, positive LV	For G-2302. For Spare Parts data see page B-19																																
	BRUSH, negative LV	For G-2302. For Spare Parts data see page B-19																																
	BRUSH, positive HV	For G-2301, G-2302. For Spare Parts data see page B-19																																
	BRUSH, negative HV	For G-2301, G-2302. For Spare Parts data see page B-19																																
	BRUSH, negative input	For B-2301, B-2302. For Spare Parts data see page B-19																																
	BRUSH, positive input	For B-2301, B-2302. For Spare Parts data see page B-19																																
	CAP, Brush holder HV	For G-2301, G-2302. For Spare Parts data see page B-19																																
	CAP, Brush holder LV	For B-2301, B-2302, G-2302 For Spare Parts data see page B-19																																
	CAP, Brush holder HV	For G-2301, G-2302. For Spare Parts data see page B-19																																
	CAP, Brush holder LV	For B-2301, B-2302, G-2302 For Spare Parts data see page B-19																																
	CLIP, Fuse	For 9/16 Ferrule type fuses																																

FUSES																													
F-2301	Same as F2101	B-2301 Primary fuse	28044-10																										
F-2302	Same as F-2301	B-2302 Primary fuse																											
GENERATORS																													
G-2301	Same as G2101	HV generator	-211220-D																										
G-2302	Same as G-2102	LV Plate & filament generator	-211219-C																										
RELAYS																													
K-2301	Same as K-102	HV Motor control contactor	29220																										
K-2302	Same as K-2102	Filament voltage control contactor																											
INDUCTORS																													
L-2301	Same as L-102	HV Filter inductor	47896																										
L-2302	Same as L-2301	LV Filter inductor																											
L-2303	Same as L-2103	LV Filter inductor	301992																										
L-2304	Same as L-2104	Fil. voltage filter inductor																											
MECHANICAL PARTS																													
O-2301	Same as O-2101	HV Gen.																											
O-2302	Same as O-2301	LV Gen.																											
PLUG CONNECTORS																													
P-2301	Same as P-601	Power supply to Remote control	49896																										
P-2302	Same as P-101	Power Supply to transmitter	49893																										
P-2303	Same as P-201	Power supply to receiver	49899																										
RESISTORS																													
R-2301	Same as R-224	Spark suppressor res.	RC31BE331K 63288-331																										
R-2302	Same as R-2301																												
POWER SUPPLY: NAVY TYPE -211330-B																													
CAPACITORS																													
C-2801	CAPACITOR, fixed: mica 0.0047 µf ± 20% 500WV JAN spec. JAN-C-5	Primary noise filter capacitor	CM35A472M		(2155)	CO-11422 (909260354)	C-2801, C-2802, C-2803, C-2804, C-2805, C-2806, C-2807	0	7	0	0	0	0		0	3	2		0		0		0		0	4	0	0	6
C-2802	Same as C-2801	Primary noise filter capacitor																											
C-2803	Same as C-2801	Primary noise filter capacitor																											

TABLE 8-2

COMBINED PARTS AND SPARE PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODELS TCS-14 AND TCS-15 EQUIPMENT

PARTS								QUANTITY PER EQUIPMENT						SPARE PARTS															
														EQUIPMENT SPARES										TENDER SPARES		STOCK SPARES	
														TCS-14		TCS-15				20309		211100		21827A					
														12 VDC		12/24 VDC		Less Power Supply		115/230 VAC		115 VDC		230 VDC					
SYMBOL DESIGNATION	NAME OF PART AND DESCRIPTION	FUNCTION	A.W.S., JAN. AND NAVY TYPE DESIGNATION	NAVY STOCK NO.	(MFR.) AND MFRS. DESIG-NATION	AIR KING (COLLINS) DRAWING AND PART NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	TCS-14 12 VDC	TCS-15 12/24 VDC	TCS-15 Less Power Supply	-20309 115/230 VAC	-211100 115 VDC	-21827-A 230 VDC	Box	Quan.	Box	Quan.	Box	Quan.	Box	Quan.	Box	Quan.	Box	Quan.	TCS-15 12/24 VDC Quan.	TCS-15 Less Power Sup. Quan.	TCS-14 12 VDC Quan.	TCS-15 12/24 VDC Quan.
CAPACITORS (Cont'd)																													
C-2804	Same as C-2801	Sec. noise filter																											
C-2805	Same as C-2801	Sec. noise filter																											
C-2806	Same as C-2801	Sec. noise filter																											
C-2807	Same as C-2801	Sec. noise filter																											
C-2808	Same as C-401	C-408A, C-408B, C-408C	CP51B6EF104V		(234M)	CO-779 (958000100)																							
C2808A	Part of C-2808	LV noise filter capacitor																											
C2808B	Part of C-2808	LV noise filter capacitor																											
C2808C	Part of C-2808	HV noise filter capacitor																											
C-2809	Same as C-125	HV ripple filter capacitor	481249-20																										
C-2810	Same as C-2809	LV ripple filter capacitor																											
C-2811	Same as C-127	Filter Capacitor	CP51B1EF254V																										
C-2812	Same as C-2811	Line filter capacitor																											
C-2813	Same as C-2811	Transient filter capacitor																											
C-2814	Same as C-2809	Input line filter capacitor																											
C-2815	Same as C-2809	Input line filter capacitor																											
C-2816	CAPACITOR, fixed paper 2 μf ± 10% 600 WV	Input line filter			(68S)	CO-11423 (930782400)	C-2816	0	1	0	0	0	0		0	3	1		0		0		0		0	2	0	0	3
DYNAMOTORS																													
D-2801	DYNAMOTOR: Input: 12/24 V DC at 23/11.5 amps. Output: 12/225/440 V DC		211331-A		(520F)	DA-11545 (2310009900)	D-2801	0	1	0	0	0	0		0	13	1		0		0		0		0	2	0	0	3
MISCELLANEOUS ELECTRICAL PARTS																													
	BRUSH pos. input	For D-2801			(520F)	BH-11055		0	1	0	0	0	0		0	4	10		0		0		0		0	20	0	0	40
	BRUSH Neg. input	For D-2801			(520F)	BH-11056		0	1	0	0	0	0		0	4	10		0		0		0		0	20	0	0	40
	BRUSH pos. HV	For D-2801			(520F)	BH-11057		0	1	0	0	0	0		0	4	10		0		0		0		0	20	0	0	40
	BRUSH neg. HV	FOR D-2801			(520F)	BH-11058		0	1	0	0	0	0		0	4	10		0		0		0		0	20	0	0	40

MISCELLANEOUS ELECTRICAL PARTS (Cont'd)

	BRUSH holder LV	For D-2801			(520F)	BH-11059		0	1	0	0	0	0		0	4	4		0		0		0		0	16	0	0	24
	BRUSH holder HV	For D-2801			(520F)	BH-11060		0	1	0	0	0	0		0	4	4		0		0		0		0	16	0	0	24
	CAP HV brush holder	For D-2801			(520F)	BH-11061		0	1	0	0	0	0		0	4	4		0		0		0		0	16	0	0	24
	CAP LV brush holder	For D-2801			(520F)	BH-11062		0	1	0	0	0	0		0	4	4		0		0		0		0	16	0	0	24
	SHOCK MOUNT	Used on bottom plate. For Spare Parts data see Shock mount page 8-17.																												
						FUSES																								
F-2801	FUSE: 5 amp 25V 1-1/2" x 13/32"	Filament fuse	28038-5		(227L)	FU-11621 (284604000)	F-2801	0	1	0	0	0	0		0	5	20		0		0		0		0	40	0	0	100
F-2802	FUSE: 0.5 amp 500V 1-1/4" x 1/4"	HV Fuse	28038-1/2		(227L)	FU-11619 (284403000	F-2802	0	1	0	0	0	0		0	5	20		0		0		0		0	40	0	0	100
F-2803	FUSE: 3/8 amp 500V 1-1/4" x 1/4"	LV Fuse	28038-3/8		(227L)	FU-11618 (284402100)	F-2803	0	1	0	0	0	0		0	5	40		0		0		0		0	80	0	0	200
F-2804	FUSE: 20 amp 25V 1-1/2" x 13/32"	Primary fuse for 24V operation	28038-20		(227L)	FU-11622 (284607000)	F-2804	0	1	0	0	0	0		0	5	20		0		0		0		0	40	0	0	100
F-2804	FUSE: 40 amp 25V 1-1/2" x 13/32"	Primary fuse for 12V operation	28038-40		(227L)	FU-11620 (28460900)	F-2804	0	1	0	0	0	0		0	5	20		0		0		0		0	40	0	0	100
						JACKS																								
J-2801	RECEPTACLE: 8 Terminal wall mounting	Receptacle for polarity plug	49905		(10C) DP33	RC-12943 (370200200	J-2801	0	1	0	0	0	0		0	8	1		0		0		0		0	1	0	0	2
J-2802	RECEPTACLE: 6 Terminal wall mounting	Receptacle for voltage plug	49907		(10C) DP33	RC-12491 (370200100)	J-2802	0	1	0	0	0	0		0	8	1		0		0		0		0	1	0	0	2
						RELAYS																								
K-2801	Same as K-102	Motor control contactor	29220																											
K-2802	Same as K-2801	Filament control contactor																												
						INDUCTORS																								
L-2801	CHOKE: 5.5 mh, Iron core	Primary noise filter reactor	47893		(246S)	CL-11018 (24000100)	L-2801, L-2806	0	2	0	0	0	0		0		0		0		0		0		0	1	0	0	1
L-2802	Same as L-401	Filament noise filter reactor	471006																											
L-2803	Same as L-110	Filament noise filter reactor	47895																											
L-2804	Same as L-2803	LV Noise filter reactor																												
L-2805	CHOKE: 8 Hy 0.10 amp 160 ohm	LV Ripple filter reactor	301090		(55C) 6508 A, 6508C	CL-10000 (578125100)	L-2805	0	1	0	0	0	0		0	12	1		0		0		0		0	2	0	0	3
L-2806	Same as L-2801	Primary noise filter reactor																												
						PLUG CONNECTORS																								
P-2801	Same as P-601	Power Supply to Remote control	49898																											
P-2802	Same as P-101	Power supply to transmitter	49893																											
P-2803	Same as P-201	Power supply to receiver	49899																											
P-2804	PLUG, connector: 8 Terminal	Polarity plug	49904		(10C) DP34	RC-12492 (370200400)	P-2804	0	1	0	0	0	0		0	8	1		0		0		0		0	1	0	0	2
P-2805	PLUG, connector: 6 Terminal	Voltage plug	49906		(10C) DP34	RC-12490 (370200300)	P-2805	0	1	0	0	0	0		0	8	1		0		0		0		0	1	0	0	2
						RESISTORS																								
R-2801	Same as R-224	Transient filter resistor	RC31BE331K 63288-331		(28J)	RE-9Z7 (708N330N)																								

TABLE 8-3—CROSS REFERENCE PARTS LIST.

JAN, AWS Type Designation	Key Component	JAN, AWS Type Designation	Key Component	Navy Type Designation	Key Component	Navy Type Designation	Key Component
5R4GY	V-2201	RC30BE224M	R-221	20399	CR-2201	61488	E-111
6X5GT	V-2203	RC30BE470M	R-123	22022	M-102	61503	E-103
12A6	V-101	RC30BE471M	R-117	22410	M-101	61507	E-702
12SA7	V-202	RC30BE473M	R-113	24003	S-105	62269	W-804
12SK7	V-201	RC30BE474M	R-223	24118	S-107	62270	W-803
12SQ7	V-206	RC30BE682M	R-106	24607	S-106	62271	W-801
1625	V-104	RC31BE182K	R-229	26018	S-801	62272	W-802
AN3057-8	H-802	RC31BE331K	R-224	28032½	F-2802	63288-331	R-224
CC30SL200G	C-103	RC40BE103M	R-217	28032-⅜	F-2803	63703-221	R-201
CM20C101M	C-206	RC40BE203J	R-213	28032-2	F-2201	211219B	G-2102
CM20A221M	C-227	RC40BE223M	R-205	28032-3	F-2203	211220-C	G-2101
CM20C270J	C-225	RC40BE472M	R-207	28033-15	F-401	211223A	B-2301
CM20A271K	C-222	RC40BE473J	R-108	28033-30	F-402	211224	B-2101
CM20A300M	C-224	RC75BE331M	R-118	28038-5	F-2801	211331-A	D-2801
CM20C470M	C-104	RC76BE203J	R-119	28038-20	F-2804	221041	D-401
CM35D132J	C-216			28038-40	F-2804	221042	D-402
CM35D202J	C-214			28044-10	F-2101	301087	T-101
CM35D432J	C-212			29220	K-102	301088	T-201
CM35A471M	C-230			29808	K-2102	301089	T-102
CM35A472M	C-2801			47893	L-2801	301090	L-403
CM35B472M	C-402			47895	L-110	301990	L-2201
CM35A822K	C-120			47896	L-102	301991	L-2202
CM45A102M	C-105			49366	X-104	301992	L-2103
CM45A103M	C-210			49367	X-101	301994	L-2204
CM45A202M	C-106			49437	LS-601	302039	T-601
CM45A271K	C-123			49844	P-2204	302073	T-2201
CM45A392K	C-235			49893	P-101	302074	T-2202
CM45A470M	C-122			49894	P-801	302075	T-2203
CM50A622M	C-109			49895	P-802	302076	T-2204
CM55A470M	C-118			49896	P-601	471006	L-401
CM55B602M	C-2104			49897	P-805	471273	Z-201
CM55A681M	C-117			49898	P-806	471280	Z-204
CM61A103M	C-119			49899	P-201	481054-20	C-2201
CP50B1AE205MK	C-129			49900	P-803	481249-20	C-125
CP50B4EE104V	C-232			49901	P-804	481465-20	C-232
CP50B5EE104V	C-211			49903	P-2204	481690-10	C-121
CP51B4EE104V	C-205			49904	P-2804	482115	C-116
CP51B4EF104V	C-128			49905	J-2801	482970	C-101
CP51B5EF104V	C-401			49906	P-285	482971	C-201
CP51B1EF254V	C-127			49907	J-2802	482988	C-102
RC30BE103M	R-232			49909	J-101	483437	C-107
RC30BE104M	R-103			4991	X-108	631022-C	R-2203
RC30BE105J	R-101			49986	J-201	631556-20	R-216
RC30BE152M	R-104			51004C	M1-801	631557-20	R-220
RC30BE222M	R-226			61152	E-107	633875-20	R-601
RC30BE223M	R-102			61415	E-104		

TABLE 8-4

a. RESISTOR COLOR CODE.

The Standard AWS Color Code is used to indicate the resistance of the small resistors used in the equipment. The colors and corresponding numbers are listed below:

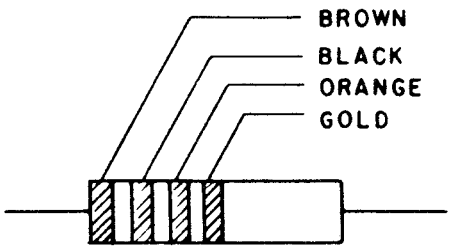
0—Black	5—Green
1—Brown	6—Blue
2—Red	7—Violet
3—Orange	8—Gray
4—Yellow	9—White

The resistors are marked with three colored "bands" near one end. All resistance values are in ohms. The color sequence begins with the color nearest the end of the resistor. The first "band" indicates the first digit of the sequence, the second "band" the second digit and the third "band" the number of zeros following the second digit.

Tolerance values for the resistors are designated by the fourth "band" on the resistor body, using the following colors to indicate the percentage of tolerance:

1%—Brown	6%—Blue
2%—Red	7%—Violet
3%—Orange	8%—Gray
4%—Yellow	9%—White
5%—Green or Gold	10%—Silver
	20%—No color

For example, the resistor shown below has a resistance of 10,000 ohms and a tolerance of ±5%, as indicated by the sequence of colors: brown (1), black (0), orange (3), and gold (5%).



b. CAPACITOR COLOR CODE.

The Standard AWS Color Code is used to indicate the capacitance in microfarads of some of the midget mica capacitors used in the equipment. The colors and corresponding numbers are listed below:

0—Black	5—Green
1—Brown	6—Blue
2—Red	7—Violet
3—Orange	8—Gray
4—Yellow	9—White

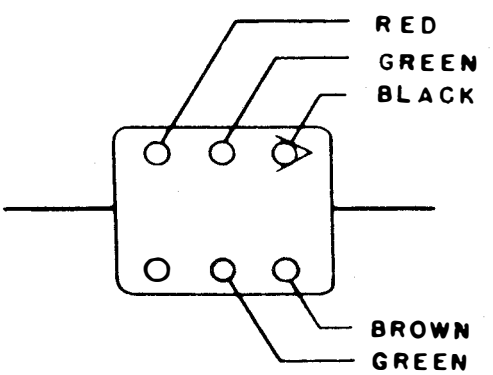
Tolerances are indicated by a single color as follows:

1%—Brown	6%—Blue
2%—Red	7%—Violet
3%—Orange	8%—Gray
4%—Yellow	9%—White
5%—Green or Gold	10%—Silver
	20%—No color

The capacitors are marked with six dots arranged in two horizontal rows of three dots each. The upper three dots (marked with an arrow to indicate the proper sequence) are colored to indicate three digits of the capacitance, and the lower right-hand dot is colored to indicate the number of zeros following the third digit. All capacitance values are in microfarads ($\mu\mu f$).

The middle dot in the lower row is colored to indicate the tolerance in per cent. The left-hand dot of the lower row, if colored, shows the characteristic.

For example, the capacitor shown below has a capacitance of 2500 $\mu\mu f$ (0.0025 μf). The color sequence along the upper row is red (2), green (5), and black (0). The right-hand dot on the lower row is brown (1), indicating the number of zeros following the third digit. The tolerance is ±5%, indictated by the green (5%) coloring of the middle dot in the lower row.



c. STANDARD CABLE WIRE CODE.

Letters refer to wire size and type

Numerals refer to RMA Color Code*

Wire Code	Color	Construction & Ratings
G93	White—Orange Tracer	No. 18 A.W.G. Shielded 7 strands 0.0159 tinned copper 1000 volts Cellulose acetate butyrate tape Felted asbestos, flame-proofed, glass braid
J9 J90 J91 J95 J96	White White—Black Tracer White—Brown Tracer White—Green Tracer White—Blue Tracer	No. 16 A.W.G. 26 strands 0.010 tinned copper 1000 volts Cellulose acetate butyrate tape Felted asbestos, flame-proofed, glass braid
K9 K90 K91 K92 K93 K94 K95 K96 K924 K925	White White—Black Tracer White—Brown Tracer White—Red Tracer White—Orange Tracer White—Yellow Tracer White—Green Tracer White—Blue Tracer White—Red & Yellow Tracers White—Red & Green Tracers	No. 20 A.W.G. 7 strands 0.0126 tinned copper 1000 volts Cellulose acetate butyrate tape Felted asbestos, flame-proofed, glass braid
L92 L96	White—Red Tracer White—Blue Tracer	No. 20 A.W.G. 7 strands 0.0126 tinned copper 3000 volts Cellulose acetate butyrate tape Felted asbestos, flame-proofed, glass braid
P9 P91	White White—Brown Tracer	No. 12 A.W.G. 61 strands 0.010 tinned copper 1000 volts Cellulose acetate butyrate tape Felted asbestos, flame-proofed, glass braid

* *Note on Color Designations:* Numbers represent colors in the same ways as on resistors and capacitors (see next page); thus 2 = red, 9 = white, etc.

TABLE 8-5—LIST OF MANUFACTURERS.

Code Desig.	Navy Type Prefix	Name and Address
05N	CNA	National Company, Inc. 61 Sherman Street Malden, Massachusetts
10C	CED	Cannon Electrical Devel. Co. 3209 Humboldt Street Los Angeles, California
10P	—	Pheoll Mfg. 80 Walker Street New York, New York
10T	CTE	Telephonics Corp. 350 West 31st Street New York, New York
25C	CBN	Centralab, Inc. 900 East Keefe Avenue Milwaukee, Wisconsin
28J	CIR	International Resistance Co. 401 North Broad Street Philadelphia, Pennsylvania
40G	CG	General Electric Company Schenectady, New York
55C	CTR	Chicago Transformer Corp. 3501 Addison Street Chicago, Illinois
60E	CEK	Eicor, Inc. 1501 West Congress Street Chicago, Illinois
64C	COL	Collins Radio Co. Cedar Rapids, Iowa
66S	CSF	Sprague Specialties Company North Adams, Massachusetts
75C	CD	Cornell-Dubillier Electric Corp. 1000 Hamilton Blvd., South South Plainfield, New Jersey
78L	CLF	Littelfuse Laboratories 4765 Ravenswood Avenue Chicago, Illinois
86A	CAIM	American Steel Package Co. Squire Avenue Defiance, Ohio
96C	CAE	Cutler-Hammer 1333 West St. Paul Avenue Milwaukee, Wisconsin
97B	CFA	Bussmann Mfg. Company 2538 West University Street St. Louis, Missouri
200W	CWO	Webster Products 3825 Armitage Avenue Chicago, Illinois
202A	CKP	Air King Products Company, Inc. 1523 Sixty-Third Street Brooklyn, New York
204A	CPH	American Phenolic Corp. 1250 West Van Buren Street Chicago, Illinois
208B	CTB	The Bristol Company 117 Bristol Road Waterbury, Connecticut
210C	CCY	Cinaudagraph Speakers, Inc. 3911 South Michigan Blvd. Chicago, Illinois
215E	CMF	Electro Motive Mfg. Co., Inc. South Park & John Streets Willimantic, Connecticut
223G	—	Graybar Electric Company, Inc. 420 Lexington Avenue New York, New York
227L	—	L & B Electric Company 5206 New Utrecht Avenue Brooklyn, New York
231M	CMX	The Magnavox Company 2131 Pueter Road Fort Wayne, Indiana
233M	CML	Meissner Manufacturing Company 7th & Belmont Street Mt. Carmel, Illinois
234M	CMR	Micamold Radio Corporation 1087 Flushing Avenue Brooklyn, New York
235N	CNZ	National Fabricated Products Co. 2650 West Belden Avenue Chicago, Illinois
236P	COC	Oak Manufacturing Company 1200 North Clybourne Avenue Chicago, Illinois

TABLE 8-5—LIST OF MANUFACTURERS (Cont'd)

Code Desig.	Navy Type Prefix	Name and Address
242S	CFW	F. W. Sickles Company P. O. Box 920 Springfield, Massachusetts
243S	CSA	Stackpole Carbon Company 1942 Tannery Street St. Mary's, Pennsylvania
244S	CADF	Standard Transformer Corp. 1500 North Halsted Street Chicago, Illinois
245S		Standard Winding Corporation Newburgh, New York
246S	CACY	Stanwyck Winding Company Gardnertown Road Newburgh, New York
500A	—	Alfred Hale Rubber Co. North Quincy, Massachusetts
501M	—	Miltre Specialty 815 Broadway Brooklyn, New York
503M	—	Midwest Moulding Co. 333 North Whipple Street Chicago, Illinois
504A	—	Adolph Friedman Co. 220 East 23rd Street New York, New York
505E	—	Emco Radio 78 Reade Street New York, New York
506H	—	Henrite Products Corp. Ironton, Ohio
508A	CAOX	Automatic Elec. Mfg. Co. Mankato, Minnesota
513S	CWS	Stewart Warner Co. 1826 Diversey Parkway Chicago, Illinois
514B	CABR	Benwood Linze Co. 1811 Locust St. St. Louis, Missouri
515N	—	National Screw Machine Works Co. 52 Clifford Street Newark, N. J.
517N	CNO	Noblitt Sparks Industries, Inc. Columbus, Ohio
518H	CAEK	Hanovia Chemical & Mfg. Co. 233 New Jersey Railroad Avenue Newark, New Jersey
519N	CNU	National Union Radio Corp. 57 State Street Newark, New Jersey
520F	CAEN	Fractional Motors Co. 1501 North Halsted Street Chicago, Illinois
521M	—	M & S Sales Co. 10 East 3rd Street Mt. Vernon, New York
523C	—	Crescent Electric Co. Waterloo, Iowa
524K	CKR	Kenrad Tube & Lamp Corp. Owensboro, Kentucky
525S	CHS	Sylvania Electric Emporium, Pennsylvania
526R	CRC	RCA Mfg. Co. Harrison, New Jersey
527S	CSE	Signal Electric Co. 1939 Troon Street Menominee, Mich.
528L	CLR	Leach Relay 5915 Avalon Blvd. Los Angeles, Calif.
529L	—	Lord Manufacturing Co. Erie, Penn.
530E	CER	Erie Resistor Corp. 644 West 12th St. Erie, Penn.
531S	—	H. B. Sherman 30 Rockefeller Plaza New York City
532A	—	Akron Porcelain Akron 14, Ohio
533C	CTC	Chicago Telephone Supply Co. Elkhart, Ind.
534H	CHC	Hammarlund Mfg. Co. 450 W. 34 Street New York, New York