NAVSHIPS 900, 425

[redacted]
"UNCLASSIFIED"

INSTRUCTION BOOK

for

RADIO FREQUENCY SIGNAL GENERATOR EQUIPMENT NAVY MODEL LP-5

FEDERAL MANUFACTURING & ENGINEERING CORPORATION
199 STEUBEN STREET, BROOKLYN, N. Y.

NAVY DEPARTMENT BUREAU OF SHIPS

Contracts NXsr—40979
NXsr—62309
"NObsr-39320"

Approved 25 JANUARY 1945
"Change 1 : 17 February 1948"

LIST OF PEN AND INK CORRECTIONS TO BE MADE IN NAVSHIPS 900, 425

1. On Cover and Title Page..... Add "NObsr-39320" to list of contracts.
   Add "Change 1: 17 February 1948" beneath approval date.
   Delete the word "RESTRICTED" and substitute the word "UNCLASSIFIED."

2. On page i.................. Add under SECTION V. MAINTENANCE the following:
   8 Winding Data 5-13
   Add under SECTION VI. PARTS AND SPARE PARTS the following:
   6 Addendum to Parts List.. 6-0

3. On page ii................. Add at bottom the following:
   "7-15 Schematic Wiring Diagram of the LP-5 Signal Generator Equipment
   7-17; 7-18

4. On page iii and page 1-2, paragraph 2*a* (2)......... Add "NObsr-39320" under Contract Number.
   Add "June 26, 1947" under Dates of Contracts.

5. On page 1-1............... Change in table headed EQUIPMENT SUPPLIED the fifth item in the last column reading "8 oz" to "27 oz".

6. On page 5-10.............. In line 7 change "50%" to read "5%."

7. On pages 6-2 to 6-20....... Add new Navy Type Numbers procured since former contracts as follows:

PART I—SIGNAL GENERATOR UNIT

Symbol Desig.	Navy Type Number	Symbol Desig.	Navy Type Number	Symbol Desig.	Navy Type Number
E-109	CFD-61656	L-147	CFD-472206	R-139	CAG-636854-Q
L-102	CNA-47122	L-150	CFD-472207	S-105	CFD-241323
L-106	CFD-472208	P-101	UG-424/U	S-106	CFD-241322
L-108	CJA-472209	P-103	CJC-491828	S-107	CFD-636855
L-109	CFD-472203	R-106	CAG-635631-R	T-101	CFD-304512
L-141	CFD-472198	R-113	CFD-636848	W-101	CFD-62409
L-142	CFD-472199	R-114, R-115	CAG-636856	W-102	CG-506/U
L-143	CFD-472200			W-103	CG-505/U
L-144	CFD-472201	R-129	CAG-636853	X-101	CAXD-491827
L-145	CFD-472204	R-130	CAG-635649	X-102	CAXD-491825
L-146	CFD-472205	R-131	CAG-635651	X-104	CAXD-491826

PART II—RECTIFIER POWER UNIT

F-201	CFA-28112-2R5	J-202	CG-491831	R-201	CAG-635648
J-201	CJC-491648-A	L-201	CFD-304511	T-201	CFD-304510
		P-201	CG-491830		

PART III—DUMMY ANTENNA UNIT

L-301................CFD-472202

ADDRESS NAVY DEPARTMENT
BUREAU OF SHIPS

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

REFER TO FILE No.

Section 993-100

17 February 1948

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

Subj: Instruction Book for Radio Frequency Signal Generator Navy Model LP-5 (NAVSHIPS 900,425).

1. NAVSHIPS 900,425 is the instruction book for the subject equipment and is in effect upon receipt.

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. All requests for NAVSHIPS publications should be directed to the nearest District Publications and Printing Office. When changes or revised books are distributed, notice will be included in the applicable maintenance bulletin and the ELECTRON Magazine.

E. W. MILLS
Chief of Bureau

FROM BUREAU OF SHIPS

LIST OF EFFECTIVE PAGES

PAGE NUMBERS	CHANGE IN EFFECT	PAGE NUMBERS	CHANGE IN EFFECT
Title Page	Original	4-1 to 4-9	Original
A	Original	5-0 to 5-12	Original
B	Change 1	5-13 to 5-15	Change 1
C	Change 1	6-0	Change 1
i to v	Original	6-1 to 6-22	Original
1-0 to 1-2	Original	7-1 to 7-16	Original
2-1	Original	7-17, 7-18	Change 1
3-0 to 3-6	Original		

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CONTRACTUAL GUARANTEE

The Contractor guarantees that at the time of delivery thereof the articles provided for under this contract, with the exception of vacuum tubes, will be free from any defects in material or workmanship and will conform to the requirements of this contract. Notice of any such defect or nonconformance shall be given by the Government to the Contractor within one year of the delivery of the defective or nonconforming article.

INSTALLATION RECORD

Contract Number { NXsr—40979, NXsr—62309, "NObsr-39320"

Dates of Contracts { Dec. 14, 1943, May 25, 1944, "June 26, 1947"

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 on this page 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. Navy stock number or, when ordering from an Army supply depot, the Army stock number.
2. Name of part.

If the Navy stock number has not been assigned, the requisitions should specify the following:

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.

DESTRUCTION OF
ABANDONED MATERIEL IN THE COMBAT ZONE

In case it should become necessary to prevent the capture of this equipment and when ordered to do so, DESTROY IT SO THAT NO PART OF IT CAN BE SALVAGED, RECOGNIZED, OR USED BY THE ENEMY. BURN ALL PAPERS AND BOOKS.

Means:

1. Explosives, when provided.
2. Hammers, axes, sledges, machetes, or whatever heavy object is readily available.
3. Burning by means of incendiaries such as gasoline, oil, paper, or wood.
4. Grenades and shots from available firearms.
5. Burying all debris or disposing of it in streams or other bodies of water, where possible and when time permits.

Procedure:

1. Obliterate all identifying marks. Destroy nameplates and circuit labels.
2. Demolish all panels, castings, switch and instrument boards.
3. Destroy all controls, switches, relays, connections, and meters.
4. Rip out all wiring and cut interconnections of electrical equipment. Smash gas, oil, and water-cooling systems in gas-engine generators, etc.
5. Smash every electrical or mechanical part, whether rotating, moving, or fixed.
6. Break up all operating instruments such as keys, phones, microphones, etc.
7. Destroy all classes of carrying cases, straps, containers, etc.
8. Bury or scatter all debris.

DESTROY EVERYTHING!

HIGH VOLTAGE 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.

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.

SAFETY NOTICES

While every practicable safety precaution has been incorporated in this equipment, the following rules should be strictly observed:

1. 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.

2. DON'T SERVICE OR ADJUST ALONE. Under no circumstance 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.

3. 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.

4. 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.

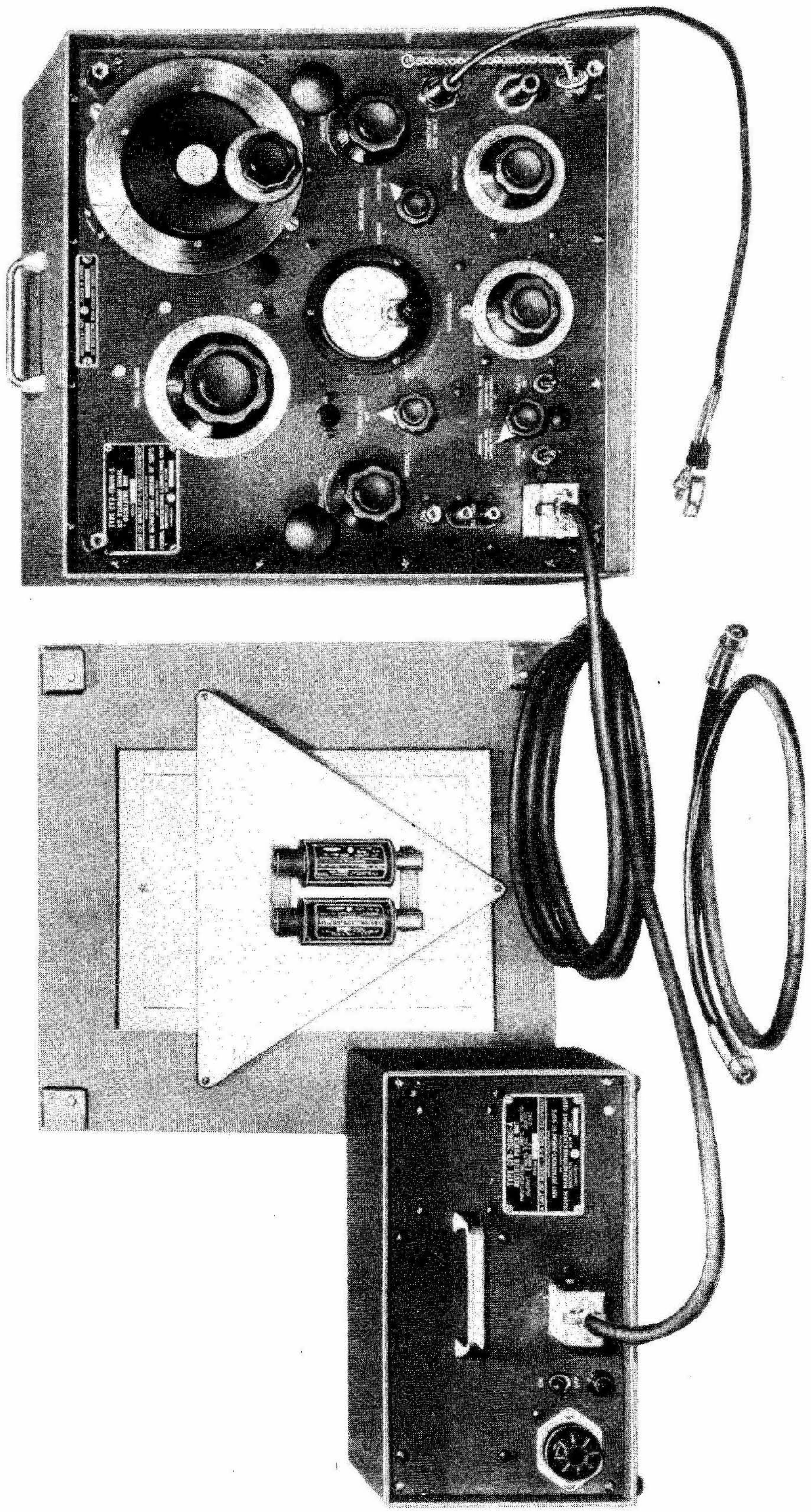


Figure 1-1—General View of the Model LP-5 Radio Frequency Signal Generator Equipment

CAUTION

This is a precision instrument. **These instructions should be read and studied in their entirety with great care before attempting to assemble or operate this equipment, in order that the very best performance and usefulness may be obtained and damage to the instrument avoided.**

SECTION I

GENERAL DESCRIPTION

1. GENERAL.

a. The Model LP-5 Radio Frequency Signal Generator Equipment is a device for producing radio-frequency oscillations, either modulated or unmodulated, covering frequencies from 9.5 to 30,000 kilocycles and so arranged and shielded that a continuously variable calibrated output voltage is obtainable across its output leads from 0.5 microvolts to 0.1 volt. An extended range from 30,000 to 50,000 kilocycles is also provided. It is designed and intended primarily for use in the testing, servicing, and alignment of all types of radio receiving equipments.

b. The equipment is designed for operation principally on 115 volts, 60 cycles, single phase alternating current, but may also be operated from batteries. (See Sec. III, Par. 3.)

c. The complete equipment consists of four major units, namely:

(1) Signal Generator Unit (Type CFD-60006-A)
(2) Rectifier Power Unit (Type CFD-20080-A)
(3) Dummy Antenna Unit (Type CFD-66017)
(4) 10:1 Attenuator Unit (Type CFD-63710)

with necessary cables and cords as listed in the Table below.

d. The Signal Generator Unit is provided with a protective cover on the inside face of which are mounted the Dummy Antenna Unit and the 10:1 Attenuator Unit. These two units are held in place by clips and thus may be easily removed. Space for the Instruction Book is provided behind these units. The Interconnecting Cable (W-101), Output Test Cord (W-102), Patch Cord (W-103), and Concentric Plug (P-101) are stowed on the Signal Generator Unit panel. (See Sec. II, Par. 1.)

e. The Signal Generator Unit weighs 55 pounds. The Rectifier Power Unit weighs 20 pounds. Both units are fitted with a carrying handle.

EQUIPMENT SUPPLIED

Quantity	*Numerical Series of Reference Symbols*	*Name of Unit*	*Navy Type Designation*	*Overall Dimensions Inches*						*Volume Cubic Feet*		*Weight*	
				Crated			*Uncrated*						
				Height	Width	Depth	Height	Width	Depth	*Crated*	*Uncrated*	*Crated*	*Uncrated*
1	101-199	Signal Generator Unit	CFD-60006-A				17	15	11½				55 lbs
1	201-299	Rectifier Power Unit	CFD-20080-A				7	12	6				20 lbs
1	301-399	Dummy Antenna Unit	CFD-66017				4½	1⅜	1⅜				5 oz
1	401-499	10:1 Attenuator Unit	CFD-63710				4½	1⅜	1⅜				5 oz
1	W-101	Interconnecting Cable	—										"27 oz" ~~8 oz~~
1	W-102	Output Test Cord	—										2 oz
1	W-103	Patch Cord	—										8 oz
1	P-101	Concentric Plug	—										1 oz
1	P-201	Power Input Plug	—										1 oz
1 Complete Assembly of Above Units (Crated)		LP-5 Radio-Frequency Signal Generator Equipment		31	24	19				8.2 cu. ft.		169 lbs	

2. QUICK REFERENCE DATA.

a. The following information, given for quick reference purposes, contains pertinent data applicable to the LP-5 Radio Frequency Signal Generator Equipment.

(1) Name and Designation of All Equipment Involved: See Table, Par. 1.

(2) Contract Numbers and Dates:
NXsr—40979—Dec. 14, 1943.
NXsr—62309—May 25, 1944.
"NObsr-39820" "June 26, 1947"

(3) Contractor: Federal Manufacturing and Engineering Corp., 199 Steuben St., Brooklyn, N. Y.

(4) Cognizant Naval Inspector: INM, New York.

(5) Rated Frequency: 9.5 to 50,000 kilocycles. Accuracy ±1% 9.5 to 30,000 kilocycles ±5% 30,000 to 50,000 kilocycles .

(6) Output Voltage: 0.5 microvolts to 0.1 volt (continuously variable). 1 volt fixed also available.

(7) Internal Modulation Frequency: 1000 cycle per second ±10%.

(8) External Modulation Frequency: 0 to 15,000 cycles per second.

(9) Modulation Range: 0 to 50 per cent.

(10) Power Supply:
A.C. Operation—115 volts ±10%, 60 cycles ±2 cycles.
Battery Operation—200 volts, 40 milliamperes—"B" Supply; 6 volts, 1.7 amperes —"A" Supply.

(11) Power Consumption: A.C. Operation—55 watts (maximum).

(12) Number of Packages in Complete Shipment: 1 case.

(13) Total Cubic Contents: 8.2 cu. ft.

(14) Total Weight: 169 lb.

(15) Vacuum Tube Complement: See Table, Par. 4.

3. DETAILED DESCRIPTION.

a. The rated frequency range is 9.5 to 30,000 kilocycles. This range is covered by eight steps which can be chosen by a band-change switch on the front of the panel. Within each band the frequency is varied by means of a straight-line logarithmic condenser. Percentage frequency change, therefore, is proportional to tuning condenser dial rotation. The dial is direct-reading in frequency over the entire range and can be set with an accuracy better than one per cent. The highest frequency band is provided to extend the working frequency range to 50,000 kilocycles. Although the equipment does not perform as well over this highest frequency band, the available output is adequate to conduct receiver tests. The method of making a readjustment of the frequency calibration for any range is explained in Section V, CHART 4.

b. The output is continuously variable from 0.5 microvolt to 0.1 volt and is determined by the setting of two attenuator dials and the reading of a vacuum-tube voltmeter. In addition to this variable output a constant output of one volt can be obtained directly across the carrier vacuum tube voltmeter.

c. The output may be obtained either unmodulated or modulated. Modulation is adjustable between 0 and 50 per cent. An internal source for modulation of 1,000 cycles per second is provided. Provision is also made for the use of external modulation.

d. The equipment is designed primarily for A.C. operation, but for applications where alternating current is not available batteries may be substituted for the Rectifier Power Unit. (See Sec. III, Par. 3.) The power requirements are as follows:

For A.C. Operation

115 volts ±10 per cent.
60 cycles ±2 cycles.
55 watts.

For Battery Operation

200 volts, 40 millamperes—"B" Supply.
6.0 volts, 1.7 amperes—"A" Supply.

4. VACUUM TUBE COMPLEMENT.

a. The vacuum tubes used in the various units are listed below, the Number Required, Tube Type, Symbol Designation, Function and Location being shown for each.

VACUUM TUBE COMPLEMENT

Number Required	*Tube Type*	*Symbol Desig.*	*Function*	*Location*
1	76	V-101	Carrier (R-F) Oscillator	Signal Generator Unit
1	89	V-102	Separator	Signal Generator Unit
1	76	V-105*	Modulation (A-F) Oscillator	Signal Generator Unit
1	84	V-104	Modulation V-T Voltmeter	Signal Generator Unit
1	955	V-103	Carrier V-T Voltmeter	Signal Generator Unit
1	84	V-201**	Rectifier	Power Unit

* Same as V-101 ** Same as V-104

5. ADDITIONAL MATERIAL REQUIRED FOR BATTERY OPERATION.

a. The following material is required for battery operation:

(1) Mating Jack Receptacle for Battery Operation (See Sec. III, Par. 3*d*).

SECTION II

INSTALLATION AND ADJUSTMENT

1. UNPACKING.

a. Unpack the equipment as carefully as possible to avoid damage. Vacuum tubes are shipped in place.

b. The Model LP-5 Radio Frequency Signal Generator Equipment is packed by the contractor in a single wooden crate, each individual major unit of the equipment being first enclosed in a special cushioned carton. This carton contains the following:

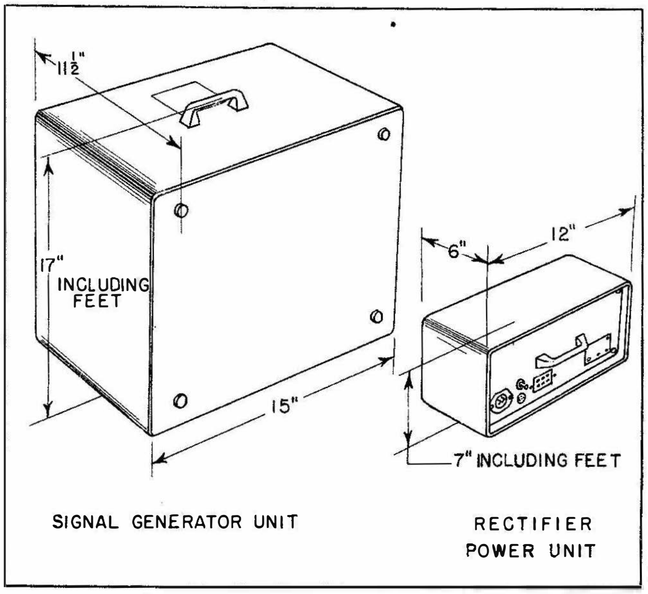


Figure 2-1—Dimensions of the Unpacked LP-5 Radio Frequency Signal Generator Equipment

(1) Signal Generator Unit (Type CFD-60006-A) with which is packed:

1—Dummy Antenna Unit (Type CFD-66017)
1—10:1 Attenuator Unit (Type CFD-63710)
1—Instruction Book
1—Interconnecting Cable (W-101)
1—Output Test Cord (W-102)
1—Patch Cord (W-103)
1—Concentric Plug (P-101)

(2) Rectifier Power Unit (Type CFD-20080-A). with which is packed:

1—Power Input Plug (P-201)

c. The Dummy Antenna Unit, the 10:1 Attenuator Unit, and Instruction Book will be found on the inside of the panel cover of the Signal Generator Unit. There are no loose small parts.

d. The Interconnecting Cable (W-101), Output Test Cord (W-102), Patch Cord (W-103), and Concentric Plug (P-101) are packed on the Signal Generator panel. The method employed is shown by Figure 7-12.

e. The Power Input Plug (P-201) will be found on the panel of the Rectifier Power Unit.

f. Dimensions of each major unit of the equipment when unpacked are given in Figure 2-1.

2. INSTALLATION.

a. The above equipment is intended to be operated with both of the panels in the vertical position. Both major units are fitted with rubber supporting feet for protecting the finish of the surface on which they rest. The rubber feet also serve to insulate the cabinets from a grounded deck; but for all ordinary purposes no precautions need be taken to maintain this isolation, and either or both units can make contact with grounded metal (a bulkhead, for instance) without interfering with either the power or radio-frequency circuits.

b. The connections necessary to place the equipment in operation are as follows:

(1) The Interconnecting Cable (W-101) should be plugged into the Rectifier Power Unit and attached to the Signal Generator Unit. (See Figure 1-1.)

(2) The CARRIER control on the Signal Generator Unit panel (E-115, Fig. 7-13) should be turned to the full counterclockwise position

(3) Connection to the 115-volt, 60 cycle mains should be made from the receptacle in the lower left hand corner of the Rectifier Power Unit.

c. For battery operation see Sec. III, Par. 3.

3. ADJUSTMENTS.

a. Normally the Model LP-5 Radio Frequency Signal Generator Equipment will require no internal adjustments.

SECTION III

OPERATION

1. GENERAL.

a. To be thoroughly familiar with the method of operating the Model LP-5 Radio Frequency Signal Generator Equipment it is essential that both Section III—OPERATION, and Section IV—THEORY OF OPERATION, be read and studied. The essential details of operation, however, and certain precautions to be taken by the operator are covered below under the following headings and paragraphs.

(1) Power Circuits—A.C. Operation...Par 2
(2) Power Circuits—Battery Operation. Par 3
(3) Adjusting Carrier Frequency.......Par 4
(4) Adjusting Output Voltage.........Par 5
(5) Internal Modulation ....Par 6
(6) External Modulation ....Par 7
(7) General Instructions for Use......Par 8

NOTE

All references to Symbol Designations given in parenthesis in this Section III—thus (S-101) etc.—apply to Figure 7-13, unless other Section numbers are given with the Symbol Designation. All words in roman capital letters in the text—thus: CARRIER, etc.—refer to markings on the panels of the Signal Generator Unit and Rectifier Power Unit as shown by Figure 7-13.

2. POWER CIRCUITS—A.C. OPERATION.

a. The CARRIER control knob (E-115) should always be turned to its full counterclockwise position before turning the POWER switch (S-101) to the ON position.

b. Instructions were given in Section II for preparing the equipment for operation from the 115-volt A.C. mains using the Rectifier Power Unit. The plate and filament power is controlled by three switches, one in the Rectifier Power Unit (S-201) and two in the Signal Generator Unit (S-101 and S-102). Throwing both POWER switches to ON will apply line voltage to the primary of the power transformer, which will be indicated by the lighting of the two pilot lamps (E-121 and E-202). Heater voltage becomes available at the Signal Generator immediately. Plate voltage is applied as soon as the Rectifier Tube has reached operating temperature and when the PLATE switch (S-102) is turned to ON. It will be noted that all tubes, including the rectifier, are of the indirectly heated type; accordingly, an appreciable time is required for the equipment to become operative after being turned on. (For stability reasons at least 15 minutes warm up period should be allowed.)

c. The PLATE switch (S-102) is provided on the panel of the Signal Generator Unit for controlling the voltage applied to the plate circuit. This switch permits the interruption of oscillations during receiver testing without allowing the heaters of the tubes to cool. When using the equipment it is recommended that the heaters be energized continuously (that is POWER switches ON), making all ON and OFF control of the equipment by the application and removal of plate potential by use of the PLATE switch (S-102).

NOTE

With no plate potentials applied to the Signal Generator Unit, but with the vacuum-tube cathodes heated, the Carrier V-T Voltmeter (M-101) will be deflected a few divisions to the right. This is entirely normal.

3. POWER CIRCUITS—BATTERY OPERATION.

a. The CARRIER control knob (E-115) should always be turned to its full counterclockwise position before turning the POWER switch (S-101) to the ON position.

b. The Signal Generator Unit can be operated from batteries with very little noticeable difference in performance provided three precautions are observed.

(1) Connect the batteries to the Mating Jack Receptacle as outlined in Par. *c* and Par. *d* below.

(2) Keep the batteries as far from the Signal Generator and receiver under test as the Interconnecting Cable will permit.

(3) Do not use the batteries supplying the Signal Generator for operating the receiver under test.

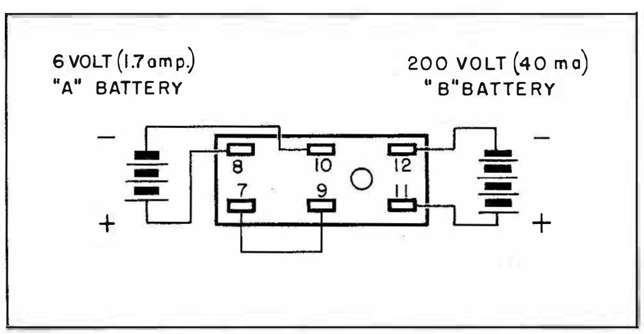


Figure 3-1—Battery Connections to Mating Jack Receptacle as Viewed from Batteries

c. The Signal Generator Unit requires 200 volts of plate battery and 6 volts of filament battery. The latter is conveniently obtained from a 6-volt lead-acid storage battery. There must be no common external connection between the plate and filament batteries.

d. Battery connections should be made to a Mating Jack Receptacle (not supplied, see Sec. I, Par. 5) following the connection as given by Figure 3-1 which are as follows:

(1) Connect terminal No. 7 to terminal No. 9.

(2) Connect terminal No. 8 to A+

(3) Connect terminal No. 10 to A—

(4) Connect terminal No. 11 to B+

(5) Connect terminal No. 12 to B—

Terminal No. 10 (and hence A—) is the grounded terminal. Terminal numbers are embossed inside the plug as shown in Figure 3-1.

e. When the batteries have been connected as indicated in Par. *d* above, and the Mating Jack Receptacle connected to the plug end of the Interconnecting Cable (W-101), the operation of the equipment is in every way like that for A.C. operation. The POWER switch (S-101) controls both "A" and "B" batteries.

CAUTION

The PLATE switch (S-102) when in the OFF position interrupts oscillations as outlined in Par. 2c above, *but it does not eliminate battery drain since the switch substitutes a dummy load of 5,000 ohms for the normal plate load.*

4. ADJUSTING CARRIER FREQUENCY.

a. Always turn back the CARRIER control knob (E-115) in a counterclockwise direction when the frequency of the Signal Generator Unit is to be changed, and be sure the METER READS switch (E-118) is set to the CARRIER position. In addition, when using carrier frequencies below 300 kilocycles, set the lower Modulation switch (E-117) to the NORMAL position. These precautions are necessary to prevent overloading of the Oscillator Tube. At 50 kilocycles, for instance, the Signal Generator will deliver the proper voltage and cause the Meter (M-101) to deflect to the "SET-CARRIER" mark with about 30 volts plate voltage applied by the CARRIER potentiometer. With the CARRIER control knob (E-115) turned all the way over in a clockwise direction the plate voltage will be 200 volts, and the tube will be overloaded and damaged if run for a considerable time. This condition will be noticed immediately by the fact that the Carrier Meter is deflected off scale.

b. The desired frequency is set by selecting the proper coil with the FREQ. RANGE switch (E-113) and turning the direct-reading Frequency Tuning Dial (N-107) so that the desired frequency is indicated. The Frequency Tuning Dial carries three direct-reading frequency scales and one non-direct reading scale as follows:

(1) The first scale marked "ACE" is used when the FREQ. RANGE switch is set at A, C, or E.

(2) The second scale marked "BDF" is used when the FREQ. RANGE switch is set at B, D, or F.

[Direct readings are made by use of the triangular transparent indicator (E-124) at the *upper left* of the dial.]

(3) The third scale marked G is used when the FREQ. RANGE switch is set at G.

[Direct readings are made by the use of the disc indicator (E-123) at the *lower left* of the dial.]

(4) The fourth scale (0-300 divisions), is used when the FREQ. RANGE switch is set at H. This scale is *not direct reading,* but the frequency calibration may be found by reading this division scale (which covers an arc of 180 degrees on the outside of the dial) and then using the frequency calibration curve given in Figure 3-5. The calibration is accurate to within 5 per cent.

[Readings are made by the use of the disc indicator (E-122) at the *upper right* of the dial.]

c. Larger scales with more detailed calibration than the ones etched on the dial, are given by the charts of Figures 3-2, 3-3, 3-4 for the A, B, C, D, E, F and G settings of the FREQ. RANGE switch. The printed scale is given in terms of the 0-300 divisions scale on the dial. [Readings are made by the use of the disc indicator (E-122) at the *upper right* of the dial.] The printed scales consists of three groups:

(1) The A, C and E Bands (Fig. 3-2).

(2) The B, D and F Bands (Fig. 3-3).

(3) The G Band (Fig. 3-4).

Each group is in reality one long scale broken up into three short sections for convenience. On the upper side of the scale is plotted "FREQUENCY" and immediately below it the number of scale "DIVISIONS" as read from the Frequency Tuning Dial (N-107). The proper location of the decimal point and the "units" for the frequency scale can be obtained by inspection from the setting of the FREQ. RANGE switch. The scales chosen are of sufficient size to permit of reading either "FREQUENCY" or "DIVISIONS" to within one part in 1,500. The calibration is accurate to within one per cent.

d. Since the tuning condenser is of the straight-line logarithmic type, percentage frequency change is proportional to tuning condenser rotation. Small percentage changes in frequency can be set and read directly on the Vernier Dial (N-108). This dial has 125 uniform divisions. Each small division corresponds to a 0.1 per cent change in frequency. This uniform law of frequency change does not apply, however, at the extreme ends of the tuning ranges, that is, from 0-25 and from 275-300 divisions of the Frequency Tuning Dial (N-107).

5. ADJUSTING OUTPUT VOLTAGE.

a. After making sure that the CARRIER control (E-115) is in the counterclockwise position; the METER READS switch (E-118) in the CARRIER position; the MODULATION switch (E-119) at OFF; and the lower Modulation switch (E-117) in the NORMAL position, then set the POWER switches (S-101 and

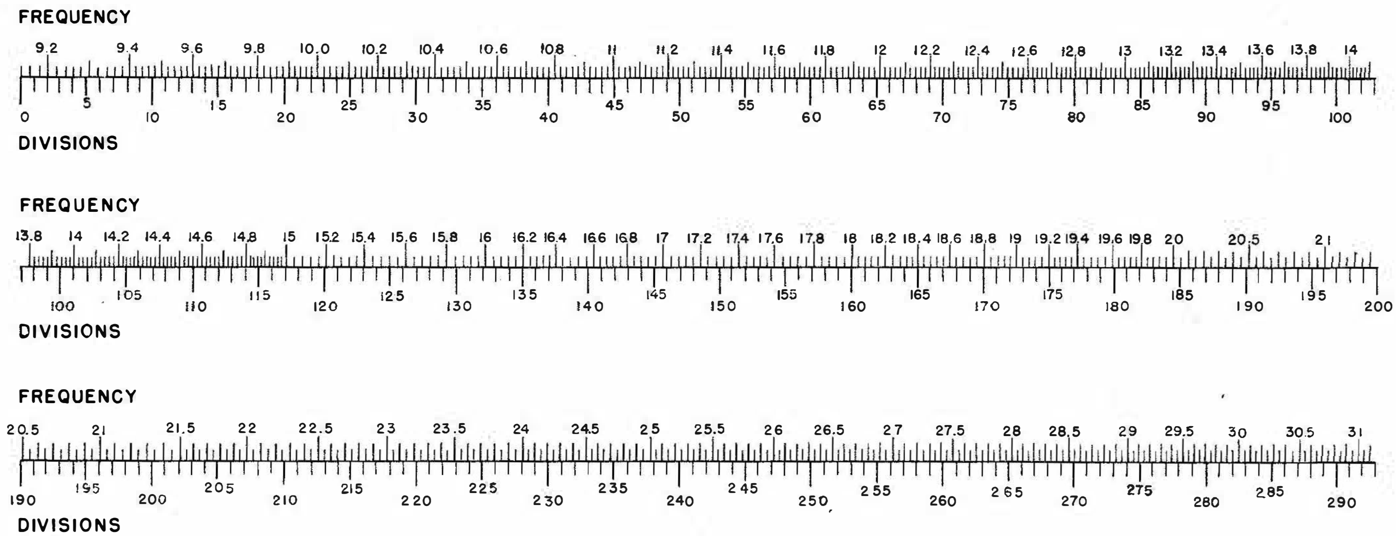


Figure 3-2—Frequency Calibration Scales for Bands A, C and E

(Band A: 9.2—31 kc Band C: 92-310 kc Band E: 0.92—3.10 Mc)

[Accurate to within 1%. Read "DIVISIONS" opposite disc. indicator (E-122) at upper right of main dial]

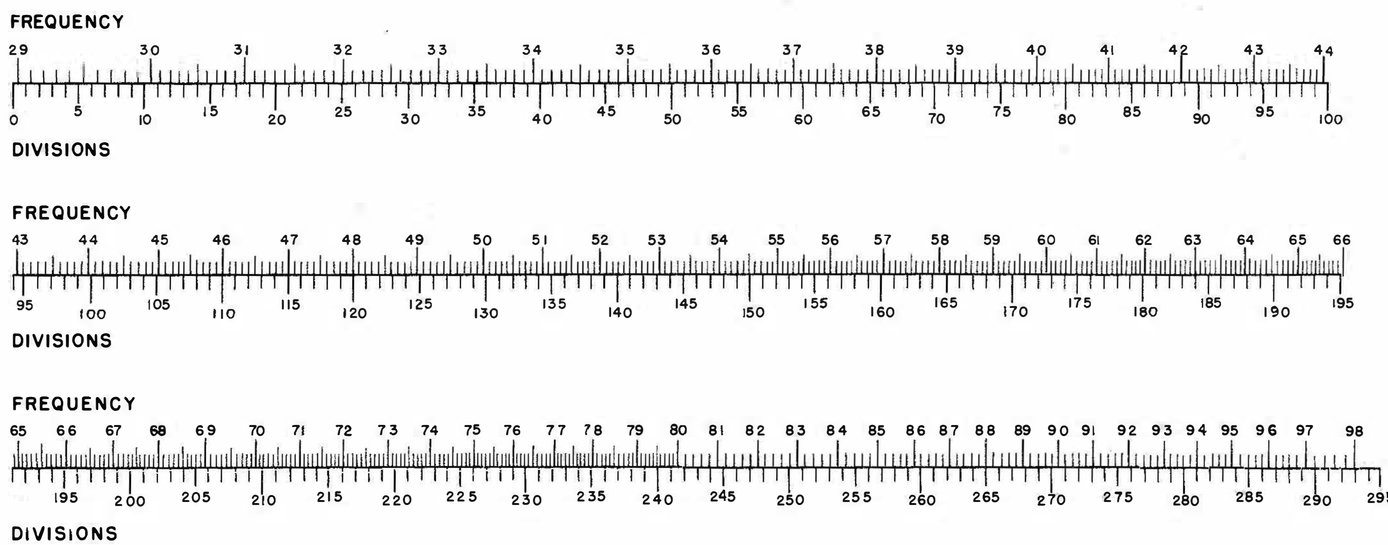


Figure 3-3—Frequency Calibration Scales for Bands B, D and F

(Band B: 29—98 kc Band D: 290—980 kc Band F: 2.9—9.8 Mc)

[Accurate to within 1%. Read "DIVISIONS" opposite disc. indicator (E-122) at upper right of main dial]

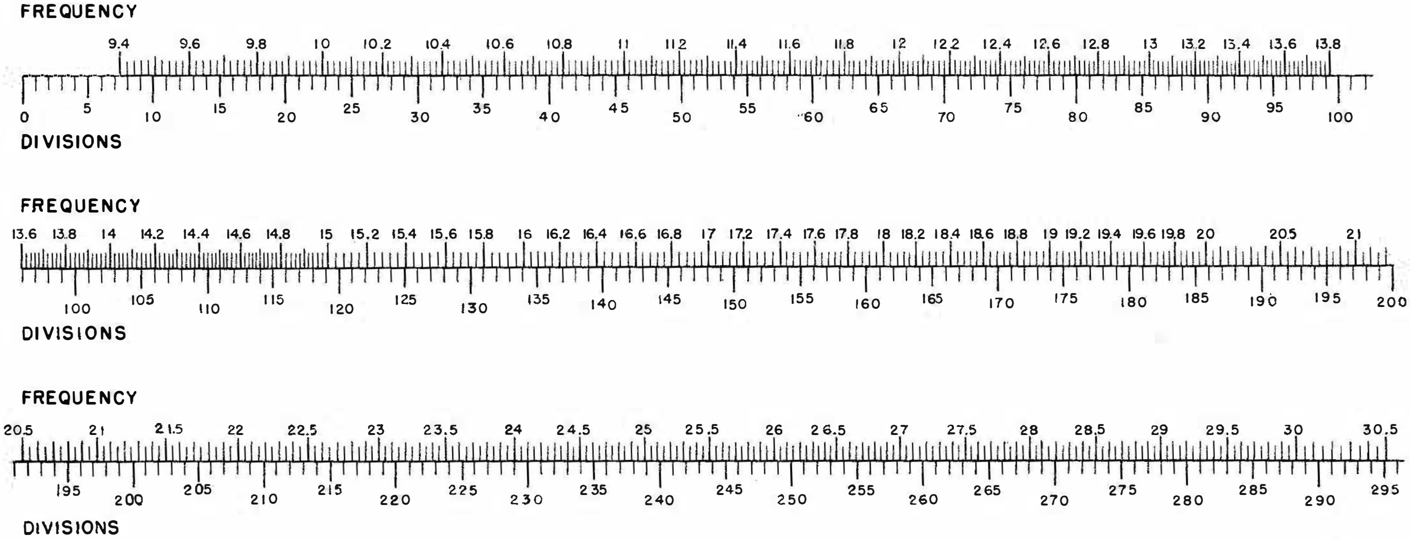


Figure 3-4—Frequency Calibration Scales for Band G

(Band G: 9.2——30.5 Mc)

[*Accurate to within 1%. Read "DIVISIONS" opposite disc. indicator (E-122) at upper right of main dial*]

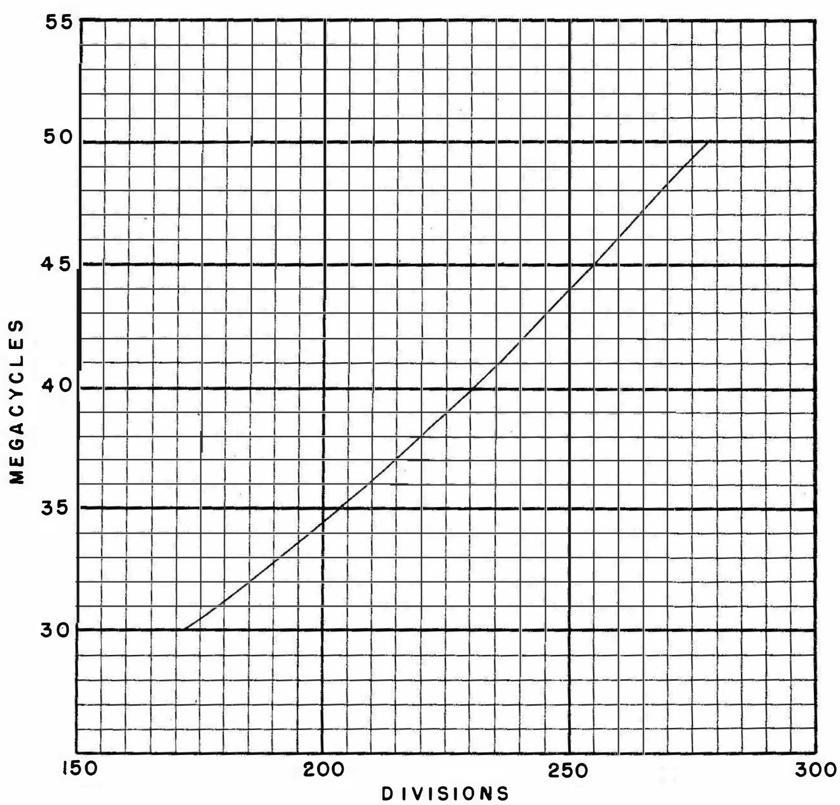


Figure 3-5—Frequency Calibration Curve for Band H

[*Accurate to about 5%. Read "DIVISIONS" opposite disc. indicator (E-122) at upper right of main dial*]

S-201) for the ON position. The pilot lights will indicate immediately. After the tubes heat up turn the PLATE switch (S-102) to ON and the equipment will be in operating condition. Allow a 15 minute period for the tubes to heat up to a stabilized temperature condition.

b. Advance the CARRIER control (E-115) in a clockwise direction until the Meter (M-101) is on the "SET CARRIER" mark. The output voltage of the CONSTANT ONE-VOLT Output Jack (J-103) is then one volt, and the output voltage of the Lower Output Jack (J-102) can be read directly from the MICROVOLTS dial (N-109) and MULTIPLIER (E-114) settings.

c. To avoid leakage, the snap-button cap (H-106) provided with the equipment must be in place covering the Frequency Modulation Jack (J-101) between the FREQ. RANGE switch (E-113) and the Frequency Tuning Dial (N-107). Likewise the snap-button cap (H-102) must be in place at the adjustment for the Carrier V-T Voltmeter (R-129).

d. When the Lower Output Jack (J-102) of the Signal Generator Unit is used, the upper CONSTANT ONE-VOLT Output Jack (J-103) must also be covered by the cap supplied (H-107).

6. INTERNAL MODULATION.

a. For internal 1,000-cycle modulation, set the MODULATION switch (E-119) to INTERNAL and the METER READS switch (E-118) to MODULATION. Adjust the MODULATION control knob (E-116) until the Meter (M-101) reads the desired percentage modulation.

7. EXTERNAL MODULATION.

a. Set the upper MODULATION switch (E-119) to EXT. Set the lower Modulation switch (E-117) to EXTERNAL MOD. if the carrier frequency is greater than 300 kilocycles; and to NORMAL if the carrier frequency is less than 300 kilocycles. In the NORMAL position of this switch (E-117) the modulation frequency must be 1,000 cycles or less. The equipment is not suited for modulation frequencies in excess of 1,000 cycles at carrier frequencies below 300 kilocycles. Connect an external audio-frequency source to the EXT. MOD. terminals (E-111). Adjust for desired percentage modulation by means of the MODULATION control knob (E-116).

b. For modulation frequencies between 30 and 15,000 cycles per second the input impedance at the EXT. MOD. terminals (E-111) is 4,000 ohms. Approximately 4 to 5 volts (r.m.s) is required for 30 per cent modulation. The modulation circuit is well filtered for radio frequencies. At carrier frequencies above 300 kilocycles no special precaution need be taken to prevent pickup from the leads connecting to the EXT. MOD. terminals (E-111).

c. As is pointed out in the discussion of the Separator circuit in Sec. IV, Par. 4 *d*, carrier frequencies below 300 kilocycles should not be used with the lower Modulation switch (E-117) in the EXTERNAL MOD. position. If this switch is in the NORMAL position, carrier frequencies down to 9.5 kilocycles may be produced, but the external modulation frequency should be limited to values below 1,000 cycles. Modulation frequencies in excess of 1,000 cycles must not be used with the lower Modulation switch (E-117) in the NORMAL position since the output of the Signal Generator Unit would contain a relatively large amount of modulation frequency in addition to the modulated carrier voltage. The Table below indicates the proper position of the lower Modulation switch (E-117) for different modulation and carrier frequency conditions.

POSITION OF LOWER MODULATION SWITCH (E-117) FOR DIFFERENT MODULATION AND CARRIER FREQUENCY CONDITIONS

Switch Position	*Modulation Frequency Cycles*	*Carrier Frequency Kilocycles*
NORMAL	0-1000	9.5-50,000
EXTERNAL MOD.	0-15,000	300-50,000

8. GENERAL INSTRUCTIONS FOR USE.

a. DETAILS. For additional details of the proper technique involved in the testing, aligning and servicing of radio receiving equipments by the use of Signal Generators (or Radio-Frequency Oscillators similar to the Model LP-5 Signal Generator Equipment) reference should be made to the instruction books covering the receivers in question, the Standards on Radio Receivers of the Institute of Radio Engineers, or the published literature. However, due to the fact that most commercially published test procedure is concerned with broadcast receivers, where the test values and parameters differ somewhat from those standardized for Naval equipments, certain details of the Naval standard values and methods are included herein. In addition, certain general precautions and procedure which should be observed in the use of the Model LP-5 Signal Generator Equipment to permit best results to be obtained and to preclude damage to the instrument are included.

b. COUPLING TO RECEIVER.—In coupling the Model LP-5 output to the receiver input, the ground clip of the Output Test Cord (W-102) should always be connected to the grounded binding post of the receiver. The ground side of the Output Test Cord has no colored tracer. When coupling to the various stages of a receiver, the ground clip of the Output Test Cord may be connected to any available point on the chassis, preferably near the tube to which the voltage is applied.

CAUTION

Care must be taken to prevent the introduction of voltages back into the Attenuator from the circuit under test. The resistance of the Attenuator is 10 ohms for the first four positions of the MULTIPLIER and 50 ohms for the last position. *Currents greater than 50 milliamperes may burn out the resistance units incorporated within the Attenuator.* When at all feasible, therefore, and particularly when coupling to the various stages of a receiver, it is extremely desirable to insert a blocking capacitor (not less than 0.01 microfarads) in the ungrounded test lead from the generator. This capacitor will safeguard the Attenuator from any d.c. voltages which might be present in the receiver under test. Experience indicates that most casualties are due to the *accidental* dropping or touching of the output leads across batteries or other potential points. This precaution is not necessary when using the Dummy Antenna Unit (Type CFD-66017) since it contains a series condenser.

c. CONSTANT ONE-VOLT JACK OUTPUT.—This Output Jack (J-103) has an internal output resistance of 500 ohms shunted by the capacitance of the Output Jack. Due to the shunt capacity of the jack the actual output voltage at higher frequencies is lower than one

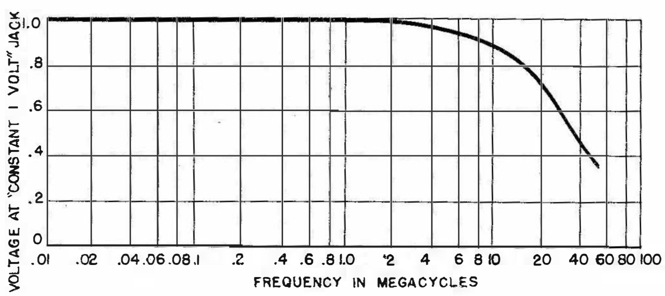


Figure 3-6—Voltage-Frequency Curve at the CONSTANT ONE-VOLT Output Jack (J-103)

volt, and any load connected to this output will further decrease it. Figure 3-6 shows the actual output voltage at the CONSTANT ONE-VOLT Output Jack plotted against frequency. The frequency error is due to the 16 micromicrofarad shunt capacitance of the Output Jack.

d. DUMMY ANTENNA UNIT USE.—When making over-all measurements or tests on a receiver designed for use with a *Standard Antenna* (see Par. *j* below for the electrical constants of a *Standard Antenna*) the Dummy Antenna Unit (Type CFD-66017) should always be connected between the Output Jack (J-102) of the Signal Generator Unit and the antenna terminal of the receiver, so that the input circuit of the receiver will function in a normal manner, without detuning, etc. The Dummy Antenna Unit closely approximates the electrical characteristics of a *Standard Antenna.* (See Sec. IV, Par. 14.)

e. 10:1 ATTENUATOR UNIT USE.—When making overall measurements or tests on a receiver designed to use a loop antenna the 10:1 Attenuator Unit (Type CFD-63710) should always be plugged in the Output Jack (J-102) of the Signal Generator Unit (Type CFD-60006-A) and the resultant reduced output (Sec. IV, Par. 15) should be introduced into the loop at a point and in such a manner that this insertion will not appreciably effect the operation of the equipment under test. This point is usually the electrical center of the loop and is usually the approximate mechanical center of the loop. In some of the direction finder equipments in the service, suitable terminals have been provided at the base of the loop for this purpose. Due to the fact that one side of the Signal Generator Unit output is connected to its case, the loop may be slightly unbalanced and exhibit an antenna effect upon insertion of the Signal Generator output. This unbalance or antenna effect is evidenced, when receiving an external signal, by unequal maxima and poor or non-opposite minima. Two maxima which agree to within 1 decibel, or minima which are within 2 degrees of being 180 degrees apart, indicate practical operating conditions. In this connection see Sec. IV, Par. 10, about the effects of using an output test cord other than the one provided with the equipment. (See also Sec. IV, Par. 15.)

f. RECEIVER SENSITIVITY TESTS.—At high radio frequencies, antenna characteristics cannot easily be reproduced, and considerable care must be taken in making receiver sensitivity tests. The voltage available at the Signal Generator Unit Output Jack (J-102) is always known, but not the voltage at the receiver input terminals a few feet away. This latter voltage is proportional to the Signal Generator output voltage, but it may be larger or smaller due to the characteristics and the termination of the "transmission line" between the instruments represented by the Output Test Cord. (See Sec. IV, Par. 10 and 11.)

g. MODULATION OPERATION. — In using the equipment with modulated output it should be realized that three waves are emitted, one at the carrier frequency and two "side bands" (one below and one above the carrier frequency). While either pure or modulated CW signals can be obtained from the Model LP-5 Signal Generator Equipment, considerable discretion must be used in employing the modulated method of receiver testing, based on the selectivity of the receiver and the

CAUTION

Do not attempt to use modulation if the receiver selectivity is such that appreciable attenuation is presented to the sidebands. The frequency at which this condition applies varies with different models of receivers but care should be exercised at frequencies below 500 kilocycles.

frequency of test, inasmuch as the carrier and both side bands must be received in true proportion in order to obtain accurate measurements.

h. RECEIVER TESTING.—In aligning or testing a receiver, an output meter should be employed, connected across the output terminals in parallel with a proper output load. Such a load should consist of a resistor unit and *not* a pair of telephone receivers, due to the fact that their impedance is not constant with frequency or conditions.

NOTE

Attention is invited to the fact that only one "ground" should be used for the combination of the LP-5 equipment and a receiver. In addition, when testing receivers with regenerative detectors for either CW or MCW Sensitivity, the regeneration control should be so adjusted (either to produce stronger oscillations for CW tests or to produce less regeneration for MCW tests) that the output signal voltage (for constant input) is 70 per cent of the maximum (approximately 3 decibels down) that can be obtained with critical regeneration or oscillations.

i. RECEIVER OVERALL SENSITIVITY. — Some radio receivers have an excess of sensitivity such that at certain frequencies the inherent noise level of the receiver is sufficient to saturate the detector or audio tubes, if the sensitivity, volume or gain control is advanced too far. Accordingly, all receivers are measured and rated for both CW and MCW sensitivity on the basis of the sensitivity, volume or gain control being adjusted so that *not more than 60 microwatts of noise* is present in the output, with no input signal impressed. When measuring receiver overall sensitivities obtainable on the first step of the Attenuator, it should be remembered that the output of the Signal Generator may not be attenuated at all frequencies throughout the range of the equipment to an absolute value of zero when the MULTIPLIER (E-114) is set at "1" and the MICROVOLTS dial (N-109) is set at "0" Signal potentials up to an order of 0.2 microvolts may exist at the terminal clips of the Output Test Cord (W-102) particularly at the higher frequencies. Such potentials should not be confused with stray or leakage outputs through the joint between the panel and the case, or those caused by circulating currents in the case itself. Disturbances from these sources may be minimized by properly spacing or orienting the Signal Generator with the receiver being tested. Regarding any undesired signal that might exist at the Output Test Cord clips [when the MULTIPLIER (E-114) is set at "1" and the MICROVOLTS dial at "0"], trial location of the (single) metallic "ground" connection for the receiver and the LP-5 equipment, with observation of the corresponding receiver output, will frequently permit the determination of a point for placing the "ground." When this point is determined the difficulty of false outputs from the output leads will be eliminated and will permit the accurate measurement of receiver sensitivities as low as one or two microvolts or less.

j. STANDARD ANTENNA ELECTRICAL CONSTANTS.—A *Standard Antenna* at low frequencies (below 1,600 kilocycles) has essentially the same impedance as a series circuit of 20 microhenries, 200 micromicrofarads and 25 ohms. The resonant frequency is about 2,500 kilocycles. The high-frequency impedance is approximately 400 ohms resistive. The Dummy Antenna Unit (Type CFD-66017) closely approximates the *Standard Antenna.* (See Sec. IV, Par. 14; also Par. 8 *d* above.)

k. STANDARD LEVELS.—Standard levels are as follows:

(1) The *Standard Output Level* of reference should be 6 milliwatts.

(2) The *Standard Noise Level* should be 60 microwatts.

(3) The *Standard Output Load* should be either 600 ohms for low impedance outputs, or 20,000 ohms for high impedance outputs, unless special impedances are provided in the receivers and noted in their instruction books.

l. OUTPUT METER USED AS VOLTMETER.—In making measurements when the output meter is used as a voltmeter, the following approximate voltages correspond to the desired wattages at the load impedances noted:

(1) 6 milliwatts	1.9	volts at 600 ohms
	11.0	volts at 20,000 ohms
(2) 60 microwatts	0.19	volts at 600 ohms
	1.1	volts at 20,000 ohms

(3) For receivers provided with output meters having a zero level of 6 milliwatts, —20 decibels equals 60 microwatts.

(4) For receivers provided with output meters having a zero level of 60 microwatts, +20 decibels equals 6 milliwatts.

SECTION IV

THEORY OF OPERATION

1. GENERAL.

a. The Model LP-5 Radio Frequency Signal Generator Equipment consists of four major units whose operational theory is covered below under the following headings and paragaphs:

(1) Signal Generator Unit .... Par 2
(2) Rectifier Power Unit............ Par 13
(3) Dummy Antenna Unit........... Par 14
(4) 10:1 Attenuator Unit............ Par 15

b. The above Signal Generator is composed of seven different circuits and each of these is covered below under the following headings and paragaphs:

(1) Carrier Oscillator .... Par 3
(2) Separator .... Par 4
(3) Modulation Oscillator .... Par 5
(4) Carrier V-T Voltmeter........... Par 6
(5) Attenuator .... Par 7
(6) Modulation V-T Voltmeter .... Par 8
(7) R. F. Filters .... Par 9

c. There is also supplied with the unit an Output Test Cord and Patch Cord and these are discussed in Par. 10 and Par. 11.

NOTE

All Symbol Designations of components and parts that are given in parenthesis in the text will be found on the individual element schematic diagrams (Fig. 4-1 to Fig. 4-19 inclusive) as well as on the photographic illustrations (Fig. 7-1 to Fig. 7-12 inclusive in Section VII). The same Symbol Designations will be found on the panel view of the equipment, (Fig. 7-13). The schematic wiring diagram (Fig. 7-14) is likewise marked with the same Symbol Designations. For a complete list of all elements see Section VI—PARTS AND SPARE PARTS.

2. SIGNAL GENERATOR UNIT.

a. The circuit of the Signal Generator Unit (Fig. 7-14) is basically simple and is best understood by considering each of the several associated circuits separately. This is done in Par. 3 to Par. 9, inclusive, which follow. Voltage from the Carrier Oscillator is impressed on the Attenuator circuit through an isolating amplifier (the Separator), a Carrier V-T Voltmeter serving to show when the carrier has been adjusted to the amplitude required to make the Attenuator calibration correct. Modulation of the carrier is accomplished in the grid circuit of the Separator, and the per cent modulation is indicated by the Modulation V-T Voltmeter.

3. CARRIER OSCILLATOR.

a. The Carrier Oscillator is of the conventional tuned-plate type having the coupling between grid and plate circuits essentially electromagnetic. The principal electrical features are shown in the schematic diagram, Figure 4-1; the details are covered in the wiring diagram (Fig. 7-14) at the end of Section VII.

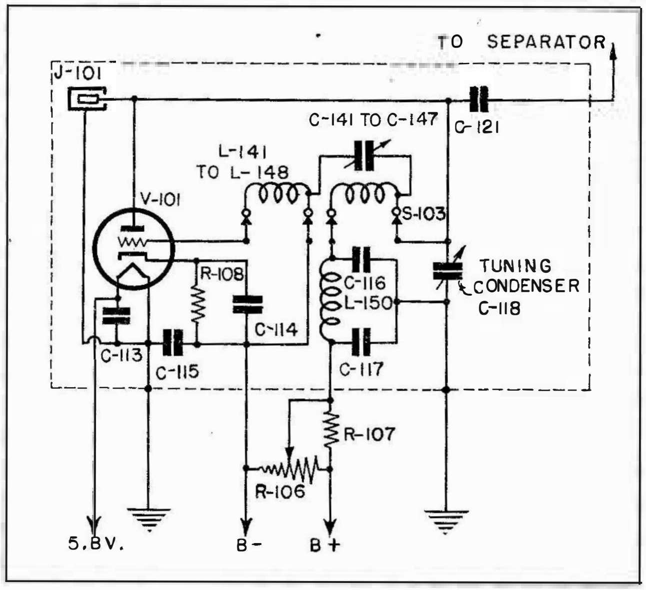


Figure 4-1—Schematic Diagram of the Carrier Oscillator

b. The Carrier Oscillator circuit is completely enclosed in a shield in the upper portion of the Signal Generator Unit, with the exception of the CARRIER control (R-106), and the 30,000-ohm resistor (R-107) associated with it to equalize the load on the plate supply.

c. The Type 76 Oscillator Tube (V-101) has a 450-ohm bias resistor (R-108) in its cathode-circuit, by-passed by a 0.005 microfarad capacitor (C-114).

d. Connected to the plate of the Oscillator Tube (V-101) is the 1465 micromicrofarad logarithmic variable tuning capacitor (C-118) by means of which the frequency for any coil (within the rated frequency range 9.5 to 30,000 kilocycles) selected by the FREQ. RANGE switch (S-103) can be varied by a factor of $\sqrt{10}$. Seven trimmer condensers, accessible from the front panel, and seven adjustable cores in the seven coils, are used to adjust the maximum and minimum frequencies of each coil in accordance with the tuning condenser calibration. The unusually large capacitance of the tuning condenser contributes greatly to the stability of the Oscillator and almost entirely eliminates the effect of changes in tube characteristics on carrier frequency. Owing to this large capacitance, the extended frequency range utilizes only a portion of the capacitance range and is limited to a maximum frequency of 50 megacycles.

e. The tuning condenser dial has four scales. One of the outside scales is linear from 0 to 300 divisions and covers an arc of 180 degrees. Frequency calibration charts for the eight bands A, B, C, D, E, F, G, H as selected by the FREQ. RANGE switch (S-103), are given in terms of this scale in Figures 3-2, 3-3, 3-4, 3-5. (See Par. *f.* below). The other outside scale provides a *direct-reading* calibration (accurate to within one per cent) for the 9.5 to 30 megacycles range (Band G). The two inner scales are *direct-reading* in frequency (accurate to within one per cent) for the range of 9.5 to 9,500 kilocycles (Bands A, C, E, and B, D, F). Although there are six coils, and hence six positions of the FREQ. RANGE switch for this range, only two scales are necessary because the alternate ranges differ in frequency by a factor of ten. The position of the decimal point is indicated on the FREQ. RANGE dial.

f. All the Model LP-5 equipment supplied under this contract use the calibration charts given by Figures 3-2, 3-3, 3-4, 3-5 (Sec. III). These are accurate to within one per cent [for all but the extended frequency range of 30 to 50 megacycles (Band H) where the accuracy is about 5 per cent] and the scales have been so chosen that either the "DIVISIONS" or the "FREQUENCY" scales can be read to at least one part in 1,500. The frequency calibration curve for Band H is given by Fig. 3-5 (Sec. III).

g. The calibration adjustments described in Par. *d* above have been made by the contractor and locked. Should recalibration be necessary consult Section V, CHART 4, for instructions.

h. A grid condenser and grid-leak combination in addition to cathode self-biasing is used in the oscillator circuits for the two lowest frequency ranges; for all other ranges cathode self-biasing alone is employed.

i. The carrier amplitude is adjusted to the required value by means of the CARRIER control (R-106), a tapered voltage divider that changes the voltage applied to the plate of the Oscillator Tube.

j. A Concentric Jack (J-101) is provided on the front panel to permit the use of an external frequency modulator. This jack is ordinarily covered by a snap-button (H-106). The center lead is connected to the "high" terminal of the variable tuning condenser of the Carrier Oscillator, which carries high d-c potential.

CAUTION

To prevent leakage from the Signal Generator Unit the snap button (H-106) must be in place whenever an external frequency modulator is not used. Whenever an external frequency modulator is used care must be taken not to ground the center lead which carries high d-c. potential.

k. A Concentric Plug (P-101) is provided to connect the external frequency modulator to the Concentric Jack (J-101). The external modulator, which is not furnished as part of the Model LP-5 equipment, consists essentially of a variable condenser which can be driven by a motor. The capacitance range of this condenser depends on the carrier frequency that should be modulated and on the frequency modulation desired. This can be determined as follows:

(1) Note which range is to be used for the desired carrier frequency. From the calibration shown by Figure 3-2 and Figure 3-3, determine the lowest carrier frequency for the range to be used.

(2) Compute the value of the tuning condenser capacitance from the following formula:

$$C = \left(\frac{f_o}{f}\right)^2 1465 \text{ (micromicrofarads)}$$

where f is the desired carrier frequency and f_0 is the lowest carrier frequency for the range to be used, as determined in (1) above.

(3) Compute the capacitance variation necessary to produce the desired frequency variation Δf at the carrier frequency by the following formula:

$$\Delta C = C \frac{\left(\frac{f+\Delta f}{f-\Delta f}\right)^2 - 1}{\left(\frac{f+\Delta f}{f-\Delta f}\right)^2 + 1}$$

(4) The motor-driven modulation condenser should vary by $2\Delta C$. When this capacitance value is determined, a condenser of proper value is connected to the Concentric Jack (J-101) by the Concentric Plug (P-101) and set at its mid-scale position. The Frequency Tuning Dial of the Signal Generator is then set to give the desired frequency f. Ths setting will always be at a higher frequency than that indicated by the direct-reading dial because the external capacitance is in parallel with that of the tuning condenser. When the variable modulation condenser is changed from its middle position to its minimum or maximum setting, the frequency f will increase or decrease by an amount Δf. As an example, assume that a frequency of 1.2 megacycles is to be modulated by ± 30 kilocycles. The correct range is Band E and from the calibration shown on Figures 3-2, 3-3, it is indicated that the lowest carrier frequency for this range is 0.92 megacycle. The value of the tuning condenser capacitance is therefore

$$C = \left(\frac{0.92}{1.20}\right)^2 1465 = 862 \text{ micromicrofarads}$$

The capacitance variation is $\Delta C = 44$ micromicrofarads. Since

$$\Delta C = 862 \frac{\left(\frac{1230}{1170}\right)^2 - 1}{\left(\frac{1230}{1170}\right)^2 + 1} = 44$$

The modulation condenser should, therefore, have a capacitance variation of 88 micromicrofarads. If this condenser varies between 12 and 100 micromicrofarads for instance, the capacitance in the middle position will be 56 micromicrofarads and the proper position of the main tuning condenser to produce 1,200 kilocycles will be at the 1.24 megacycles setting.

4. SEPARATOR.

a. The Separator is an amplifier inserted between the Carrier Oscillator and the Attenuator. It has two principal functions: first, it operates as a buffer stage to

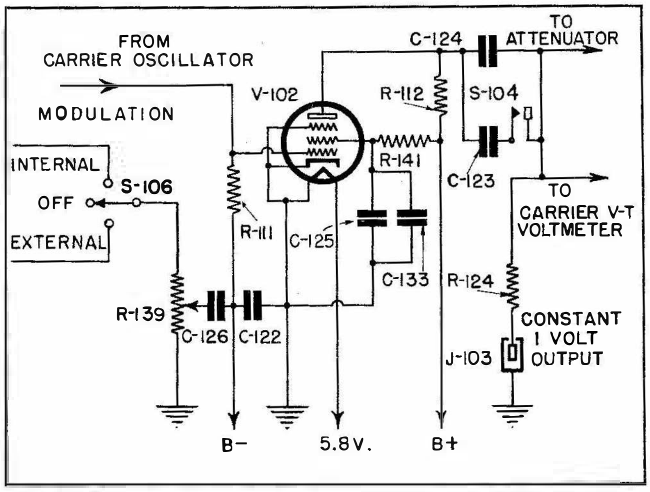


Figure 4-2—Schematic Diagram of the Separator

isolate the Carrier Oscillator from the Attenuator or output system, and, second, it provides for modulation of the Carrier by the Modulation Oscillator. Figure 4-2 shows the schematic circuit.

b. As a buffer stage, the Separator makes the frequency of the Carrier Oscillator independent of the setting of either that MICROVOLTS or MULTIPLIER controls as well as independent of the circuit to which the oscillator output may be connected.

c. Modulation is accomplished by introducing audio-frequency voltage into the control grid circuit of the Separator through a high resistance (R-111), therefore, frequency modulation is reduced to a minimum.

d. The Separator Tube (V-102) is coupled to the Attenuator circuit and to the Carrier V-T Voltmeter by a 500 micromicrofarad capacitor (C-124). When the switch S-104 shown in the schematic diagram is closed (NORMAL position E-117), this capacitor is shunted by a 5,000 micromicrofarad capacitor (C-123). This NORMAL position is intended for unmodulated carrier output and can be used for modulation frequencies up to about one kilocycle. Higher modulation frequencies must not be applied since a relatively large amount of audio-frequency voltage would appear at the output terminals of the Attenuator. With the switch S-104 open (EXTERNAL MOD. position E-117) the impedance of the coupling condenser is increased 10 to 1, and the amount of audio-frequency present in the output is reduced in about the same ratio. However, because of this increased coupling impedance, sufficient output at low carrier frequencies can be obtained *only by overloading* the Carrier Oscillator Tube; therefore, carrier frequencies below 300 kilocycles must not be used when switch S-104 is in the EXTERNAL MOD. position. (See Sec. III, Par. 7 *a* and 7 *c*.)

e. The output circuit of the Separator Tube (V-102) is coupled by a 500-ohm resistor (R-124) to the CONSTANT ONE-VOLT Output Jack (J-103). The higher level of output voltage available at this jack is useful for selectivity tests, for determining receiver performance when operating in strong electric fields and for interstage measurements at points where the receiver input voltage would normally have been amplified to a higher level. (See Sec. III, Par. 8 *c*.) Because of the one-volt output, the Model LP-5 equipment is more useful for other types of laboratory measurements; for example, as the oscillator in a radio-frequency bridge circuit.

5. MODULATION OSCILLATOR.

a. The Modulation (A.F.) Oscillator uses a conventional Hartley-type circuit. The circuit is shown schematically in Figure 4-3.

b. The frequency is 1,000 cycles ± 10 per cent.

c. The output of the Oscillator is switched to the MODULATION control (R-139) for setting the modulation voltage supplied to the Separator Tube and, therefore, the per cent modulation.

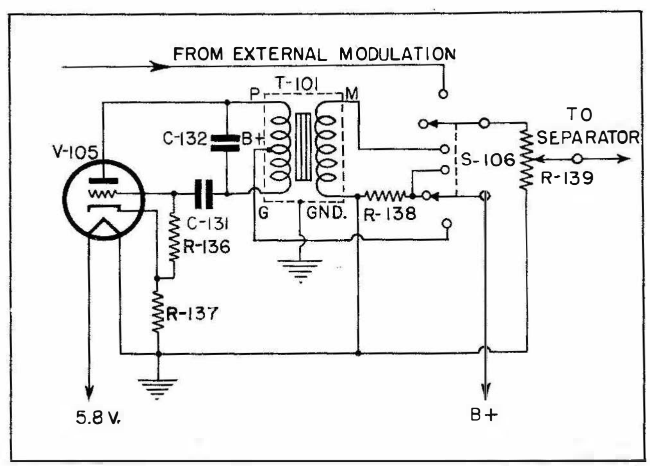


Figure 4-3—Schematic Diagram of the Modulation Oscillator

d. The per cent modulation can be set from the panel to any value up to 50 per cent modulation, as indicated by the Modulation V-T Voltmeter.

e. The plate voltage is removed by the MODULATION switch (S-106) when the Modulation Oscillator is not in use, and a dummy load of 35,000 ohms (R-138) is substituted for that of the tube to prevent any carrier frequency shift due to an unbalance in plate-supply load.

6. CARRIER V-T VOLTMETER.

a. The settings of the MICROVOLTS (N-109) and MULTIPLIER (E-114) dials show the amplitude of the carrier voltage at the Lower Output Jack (J-102) when

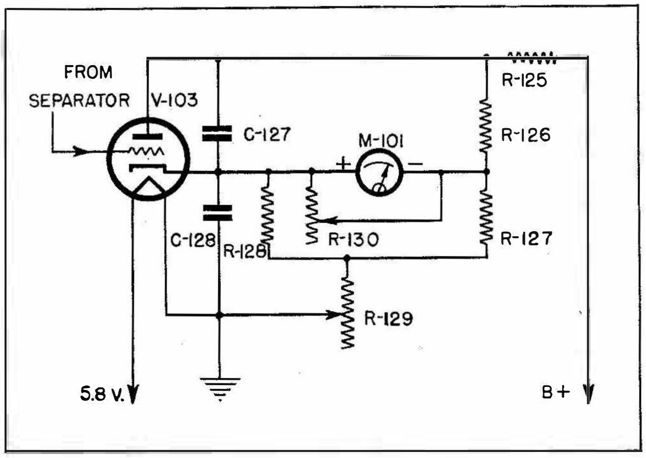


Figure 4-4—Schematic Diagram of the Carrier V-T Voltmeter

1.0 volt is maintained across the input terminals of the Attenuator. The Carrier V-T Voltmeter is connected across the Attenuator input, and the Meter (M-101) shows when the carrier voltage has been adjusted to the required value. Figure 4-4 is the schematic circuit diagram.

b. The Type 955 tube (V-103) is a separate-heater triode of the "acorn" type, chosen because its low input reactance assures equally accurate calibration over the entire band of frequencies which this equipment covers. Its grid circuit is connected across the Attenuator, and in the plate circuit is connected the indicating meter and a balancing circuit for suppressing the steady component of the plate current.

c. With grid voltage applied, the plate current will change by an amount proportional to the average grid voltage applied, and the Meter will read. Two adjustments are provided, the first a 1,000-ohm rheostat (R-129) located on the front panel produces the bias required for proper balance and must be adjusted from time to time to compensate for changes in the characteristic of the Type 955 tube (V-103). The second adjustment is a 1,000-ohm rheostat (R-130) shunting the Meter, which is set to give exactly half-scale deflection of the Meter when one volt appears across the Attenuator input. This point on the Meter is marked "SET CARRIER." The rheostat (R-130) is located inside the instrument and does not have to be adjusted unless the voltmeter tube is replaced. The usual drift in vacuum-tube voltmeter circuits due to line-voltage fluctuations is eliminated by the regulated power supply.

d. The voltmeter circuit was adjusted and calibrated by the contractor, and no attention is required from the operator. Should, for any reason, readjustment of the circuit be necessary, refer to Sec. V, CHART 3, for instructions.

7. ATTENUATOR.

a. The Attenuator circuit serves to control the amplitude of the carrier voltage as applied to the Lower Output Jack (J-102) so that a definite and continuously variable voltage is obtainable at this point. The entire circuit is resistive throughout and is so designed that the attenuation introduced is substantially independent of frequency within the limits of the equipment. While the Attenuator circuit is strictly a ratio operating device, the two panel controls are calibrated directly in terms of microvolts at the Lower Output Jack (J-102) with an Attenuator input of one volt as indicated by the vacuum-tube voltmeter heretofore described. The Attenuator circuit is shown schematically in Figure 4-5.

b. There are three principal circuits in the Attenuator. With a carrier voltage of one volt introduced from the Separator, the resistor (R-113) reduces this to 0.1 volt (100,000 microvolts) as applied to the MICROVOLTS control (R-114 and R-115) when in its ***maximum*** position. The MICROVOLTS control is a two-section, slide-wire continuously variable resistor unit connected as a T-type section in such manner as to provide a smooth control of the voltage supplied to the MULTIPLIER

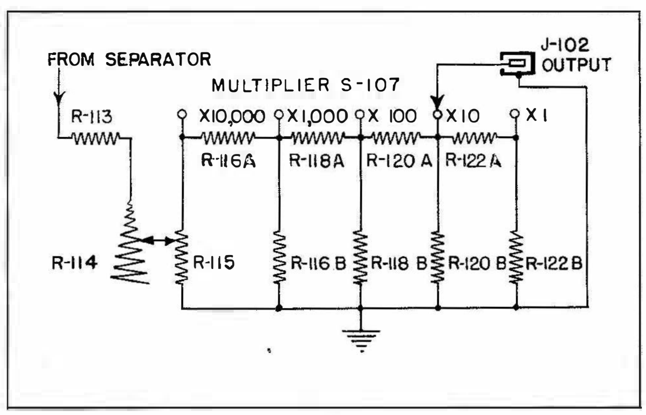


Figure 4-5—Schematic Diagram of the Attenuato

(S-107) from 100,000 microvolts to approximately zero, at the same time maintaining the impedance between R-113 and ground constant. The MULTIPLIER is a four section ladder network so designed that its input voltage is attenuated in four steps (five steps including the zero-attenuation point) with a ratio of 10:1 between steps. With these two controls in combination, any desired value of voltage between zero and 100,000 microvolts can be obtained at the Lower Output Jack (J-102), its value being indicated directly by the panel calibration associated with the controls. The lowest *calibrated* output voltage obtainable is 0.5 microvolt.

c. The output impedance of the Signal Generator Unit is independent of the MICROVOLTS dial setting and constant at 10-ohms with the exception of the last step from 10,000 to 100,000 microvolts (position of the MULTIPLIER—10,000), where the impedance is 50 ohms.

d. Over the rated frequency range (9.5-30,000 kilocycles) the CW output appearing at the Lower Output Jack (J-102) is indicated by the MICROVOLTS dial (N-109) the MULTIPLIER setting (E-114) and Meter (M-101) of the Carrier V-T Voltmeter and is accurate to better than 10 per cent down to a level of 2 microvolts, providing that the leakage and strays are balanced out by suitable positioning of the units with respect to the test receiver.

8. MODULATION V-T VOLTMETER.

a. The percentage modulation of the carrier frequency is determined by the modulation voltage applied to the control grid of the Separator Tube (V-102). This modulation voltage is taken off the 10,000-ohm MODULATION potentiometer (R-139) and measured with the Modulation V-T Voltmeter shown in Figure 4-6.

b. According to the position of the switch S-106, the MODULATION potentiometer can be connected either to the internal 1,000-cycle modulator or to the EXTERNAL MOD. binding posts (E-111). To eliminate distortion in the measuring circuit a full-wave Type 84 Rectifier Tube (V-104) is used to measure the modulation voltage. The two 10-000-ohm resistors (R-132 and R-133) provide an artificial center point. The 2,500-ohm potentiometer (R-131) determines the sensitivity of the voltmeter. The Meter is the same 200-microampere meter used to measure carrier amplitude and is shifted from one circuit to the other by the METER READS switch (S-105). The lower scale of the Meter is marked 20, 30, 40 and 50 per cent modulation.

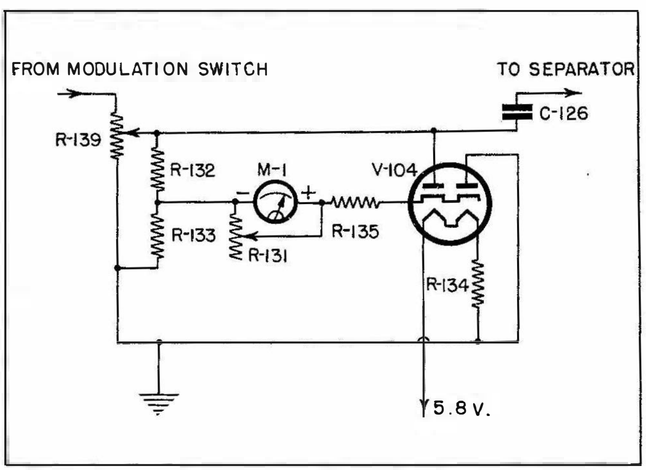


Figure 4-6—Schematic Diagram of the Modulation V-T Voltmeter

9. R.F. FILTERS.

a. The R.F. filters are circuits incorporating capacitors and inductors to keep carrier-frequency voltage out of the Interconnecting Cable (W-101) connecting the Rectifier Power Unit (or batteries) to the Signal Generator, and the external modulation circuits from which the carrier frequency may be radiated and picked up by the receiver under test. The filters are shown schematically in Figure 4-7.

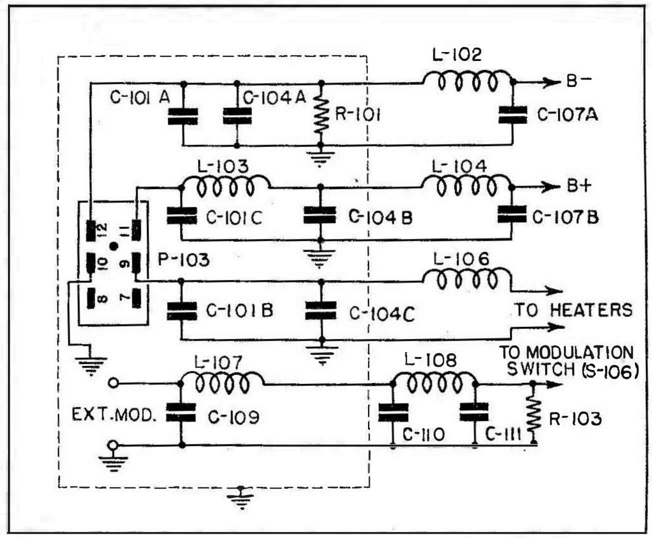


Figure 4-7—Schematic Diagram of the R.F. Filters

10. OUTPUT TEST CORD.

a. The Output Test Cord (W-102), Fig. 7-11, furnished with the LP-5 equipment is 20 inches long with a capacitance of 19 micromicrofarads per foot and a characteristic impedance of 90 ohms. At frequencies below 5 megacycles the error will be negligible, but as the carrier frequency is increased the wave length approaches the length of the cord and serious errors will occur. At high carrier frequencies the cord functions as a transmission line and must be properly terminated if errors in the output voltage at the end of the cord are to be avoided. The proper termination for the cord is 90 ohms. Since the output impedance of the Signal Generator Unit is 10 ohms, the output voltage at the end of the cord with a 90-ohm termination will be nine-tenths of that indicated by the MICROVOLTS dial and MULTIPLIER setting.

NOTE

If the requirements of a particular test necessitates the use of a different length or type of output cord, then separate tests with the regular cord and with the substitute cord will have to be made to determine the possible difference in results, and the substitute cord should have as small a capacitance per unit length as is practicable. WHENEVER POSSIBLE, USE THE 90 OHM OUTPUT CORD SUPPLIED.

b. The Table below lists the factors by which the indicated microvolt output value must be multiplied when the Output Test Cord (W-102) is terminated with a resistive load of 10, 90, or 400 ohms. When the cord is terminated with 10 ohms the output voltage at low frequencies is one-half that indicated by the Attenuator dials. When the MULTIPLIER knob (E-114) is set at X-10,000 the output impedance is 50 ohms and is not given in the Table below, due to the fact that exact voltage characteristics at that level are seldom used for exact voltage measurement. (See Par. 15).

MULTIPLICATION FACTOR FOR CABLE W-102 WHEN ATTENUATOR MULTIPLIER IS SET AT X-1, X-10, X-100, X-1000

Megacycles	*10*	*20*	*30*	*40*	*50*
10-Ohm Termination	0.43	0.25	0.18	0.15	0.13
90-Ohm Termination	0.90	0.90	0.90	0.90	0.90
400-Ohm Termination	0.99	1.03	1.11	1.24	1.45

11. PATCH CORD.

a. There is also supplied a 3-ft Patch Cord (W-103), known as a Coaxial Cable, with two female coaxial connectors—one on each end. This coaxial cable has a characteristic impedance of 75 ohms and a capacitance of 20 micromicrofarads per foot. (approx.) The information given in Par. 10 *a* above also applies to this cable, except that the proper termination should be 75 ohms; and as mentioned previously, the output of the Signal Generator when using this cable will be 88.3 per cent of that indicated by the MICROVOLT dial and MULTIPLIER when terminated by 75 ohms. (See Par. 15.)

b. The Table below lists the factors by which the indicated microvolt output value must be multiplied when the Patch Cord (W-103) is terminated with a resistive load of 10, 50, 75 or 400 ohms. When the MULTIPLIER knob (E-114) is set at X-10,000 the output impedance is 50 ohms and is not given in the Table below due to the fact that exact voltage characteristics at that level are seldom used for voltage measurements.

MULTIPLICATION FACTOR FOR CABLE W-103 WHEN ATTENUATOR MULTIPLIER IS SET AT X-1, X-10, X-100, X-1000

Megacycles	*10*	*20*	*30*	*40*	*50*
10-Ohm Termination	0.34	0.21	0.16	0.14	0.13
50-Ohm Termination	0.80	0.76	0.67	0.63	0.61
75-Ohm Termination	0.88	0.88	0.88	0.88	0.88
400-Ohm Termination	1.02	1.17	1.48	2.18	3.12

12. TERMINATING THE SIGNAL GENERATOR.

a. A cable which is short electrically on the operating frequency concerned may be considered to function as a lumped capacitance. The 3-ft 75-ohm Coaxial Cable supplied has a capacitance of approximately 20 micromicrofarads per foot or a total capacitance of about 60 micromicrofarads. At frequencies below 5 megacycles the three foot length of cable is less than 1/60 of a wavelength so that the cable may be considered as a 60 micromicrofarad lumped capacitance.

b. At 5 megacycles, the reactance of this cable, when considered as a lumped capacitance would be approximately 500 ohms. It is evident that this reactance when parallel with the 10 ohm internal impedance of the Signal Generator would not appreciably drop the output voltage which would appear at the end of the cable. Therefore, when using either the 20-inch 90-ohm Output Test Cord or the 3-ft 75-ohm Coaxial Cable at frequencies below approximately 5 megacycles errors due to standing waves will not enter into the termination problem.

c. Below 5 megacycles the voltage appearing at the end of either of the two cables will be approximately the Signal Generator output voltage when the external device into which the generator is feeding has an impedance which is high compared with the generator output impedance.

d. When higher generator frequencies than those specified above are to be used, termination of both the sending and receiving ends of the Coaxial Cable becomes desirable in order to eliminate standing waves.

e. The general procedure for properly matching the LP-5 Signal Generator with such terminations is outlined below. The examples given are for a 75-ohm Coaxial Cable.

f. The output impedance of the Signal Generator on the X-1, X-10, X-100, and X-1000 attenuator steps is 10 ohms. (See Fig. 4-8.) In order to match this impedance to the 75-ohm Coaxial Cable it is necessary to insert a 65-ohm non-inductive resistor between the Output Jack and the Coaxial Cable. (See Fig. 4-9.) If standing waves are present on a cable (incorrectly matched at either or both ends) the voltage varies periodically along the cable and the exact voltage appearing at the end will depend on the length of the cable. There will also be a power loss in the cable. Therefore it is necessary to match impedance carefully, to obtain the correct output voltage from the Signal Generator.

g. If a 75-ohm Coaxial Cable of infinite length is connected to the Signal Generator through a 65-ohm series resistor as shown in Fig. 4-10 the generator will be correctly terminated and there will be no standing waves on the cable even though the end of the cable is mismatched to either of the two extreme cases (open line $Z = \infty$, or shorted line $Z = 0$). However since the cable supplied is only 3 ft. long, standing waves may be present on the higher frequencies unless the end of the cable is terminated with the characteristic impedance (75 ohms). When the cable is terminated properly (see Fig.

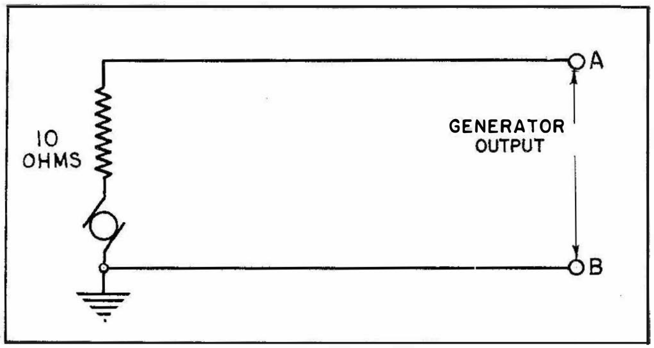


Figure 4-8—Schematic Diagram of Signal Generator Showing Output Impedance

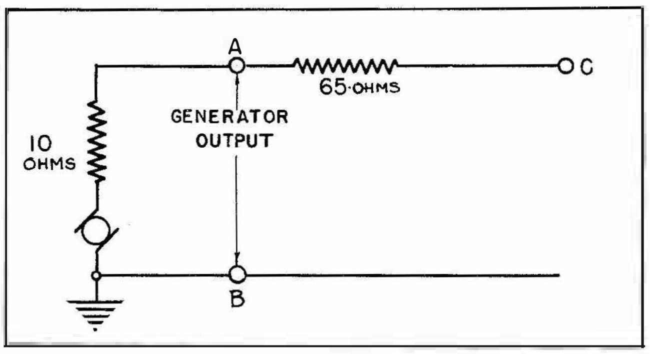


Figure 4-9—Schematic Diagram Figure 4-8 with Insertion Unit to Match 75-ohm Cable Added

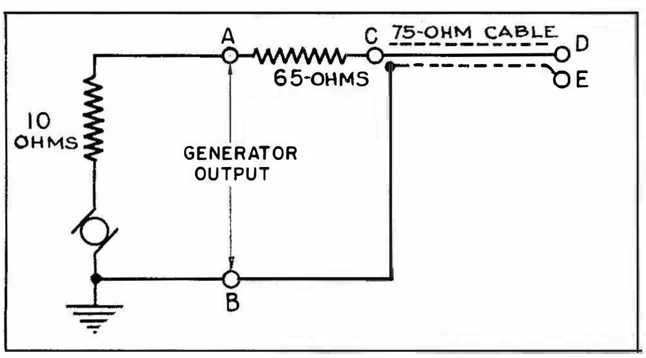


Figure 4-10—Schematic Diagram Figure 4-9 with 75-ohm Cable Added

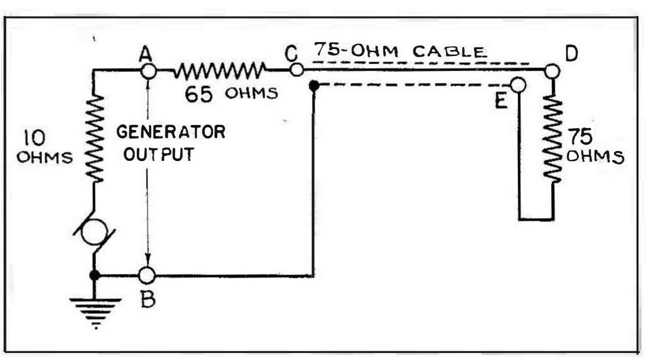


Figure 4-11—Schematic Diagram Figure 4-10 with 75-ohm Cable Terminated with 75-ohm Impedance

4-11) standing waves will not be present and the voltage appearing across the 75-ohm terminating impedance (DE) will be ½ the open-circuit voltage appearing across the generator output terminals (AB). This can very easily be verified since the terminating impedance is ½ the total series impedance in the circuit.

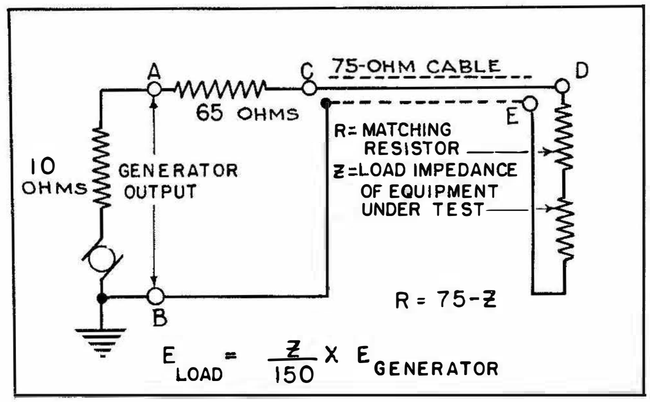


Figure 4-12—Method of Matching Cable to Receiver Having Lower Input Impedance than Cable

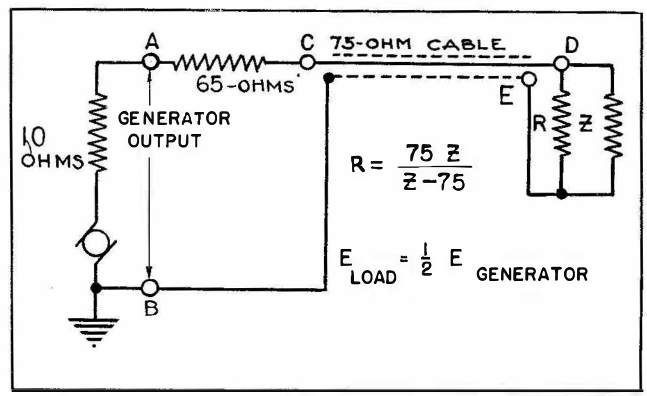


Figure 4-13—Method of Matching Cable to Receiver Having Higher Input Impedance than Cable

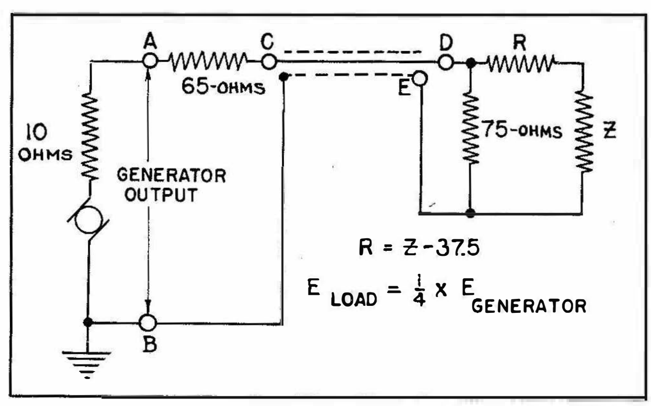


Figure 4-14—Method of Matching Cable to Receiver Having Very High Input Impedance

b. The 75-ohm terminating impedance (DE) should be the load to which the Signal Generator is connected. If the load is not 75 ohms, it must be matched (usually with non-inductive carbon resistors with very short leads) to 75 ohms. This can be done by placing the proper resistor in series with the load if less than 75 ohms (see Fig. 4-12) or placing the proper resistor in parallel with the load if more than 75 ohms. (See Fig. 4-13.) For the paralleled connection, the voltage across the load will be ½ the open circuit voltage across AB. For the series connection the voltage appearing across the load can be calculated as shown by the formula given in Figure 4-12. For the parallel connection the voltage may be calculated from the formula given in Figure 4-13.

i. The circuit shown in Fig. 4-13 is not desirable if the load impedance is considerably higher than 75 ohms since the shunting (matching) resistor may change the characteristics of the input circuit to which the cable is connected. The best method of matching is by means of a T-pad which will develope ¼ the open circuit voltage across the load (see Fig. 4-14).

j. Matching resistors should be assembled in shielded cases. The case and cover plate only of the 10:1 Attenuator Unit (Type CFD-63710) may be used to house the input matching unit between the Signal Generator and the cable. (See Fig. 4-15.) Likewise the case only of the Terminal Unit (Type CFD-49182) may be used to house the cable terminating and output matching resistors. (See Fig. 4-16.) These two units are not supplied with the Signal Generator.

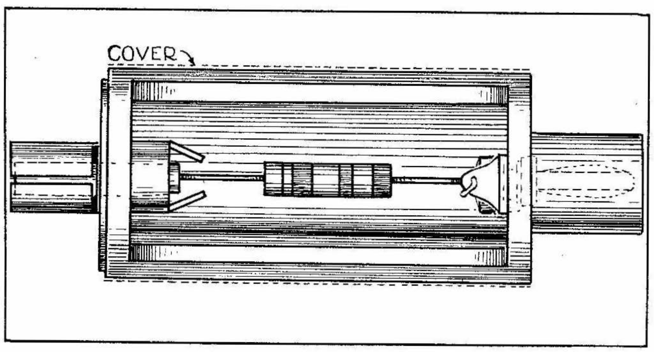


Figure 4-15—Coaxial Shielded Input Case Showing a Series Resistor Added as per Figure 4-9

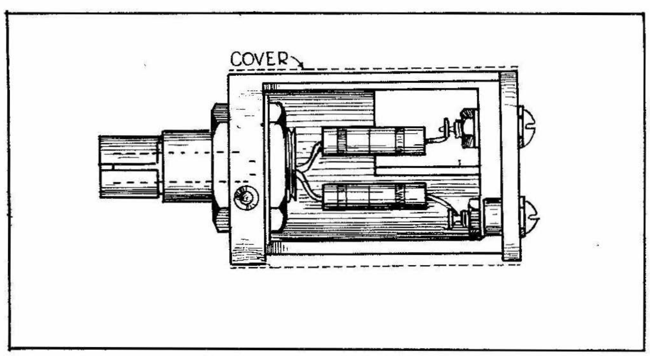


Figure 4-16—Coaxial Shielded Output Case Showing Two Resistors Added as per Figure 4-14

13. RECTIFIER POWER UNIT.

a. The Rectifier Power Unit (Fig. 7-13) is of conventional design and furnishes (from the 115-volt, single-phase, 60-cycle mains) all plate and heater voltages required by the Signal Generator Unit. Its principal features are shown schematically in Figure 4-17.

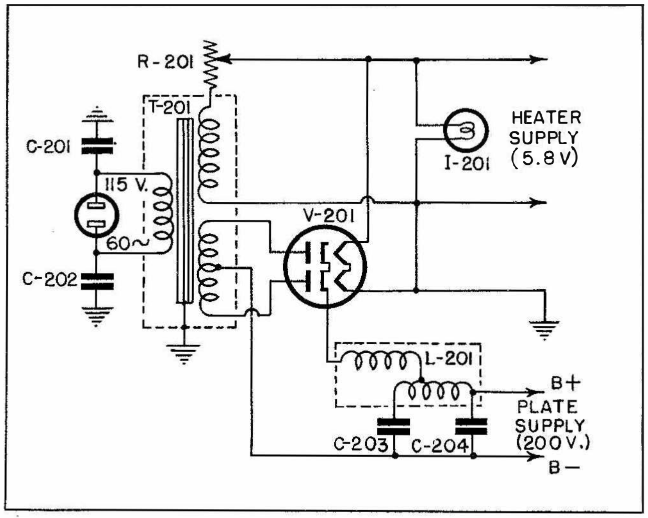


Figure 4-17—Schematic Diagram of the Rectifier Power Unit (Type CFD-20080-A)

b. The Rectifier Power Unit employs a flux-regulated transformer to compensate for line-voltage fluctuations. For this reason, the frequency of the power mains must be 60 cycles ± 2 cycles.

c. Each side of the 115-volt input circuit is separately fused, and, since neither side is grounded to the cabinet, the equipment can be operated safely on either "floating" or grounded mains without regard to which side of the line is grounded. Input and output circuits are completely isolated by the multi-winding power transformer, the case of which is grounded. The plate supply circuit is isolated from both the case and the heater-supply circuit, but one side of the heater-supply circuit is grounded to the cabinet.

d. Each side of the 115-volt circuit is by-passed to ground by a capacitor of 0.002 microfarads as a protection against leakage of radio frequency currents. Additional radio-frequency filtering is provided in the Signal Generator Unit.

e. Inspection of Figure 4-17 will show that when the equipment is operated from a line having one side "grounded", a small leakage current can flow through one of the by-pass capacitors to the Rectifier Power Unit cabinet and then to ground through any circuit that happens to be connected between the cabinet and ground. The current is very small (about 80 microamperes at most) because the impedance of the capacitor is so great at 60 cycles. Nevertheless, it is sufficient to make a small spark when the ground connection is broken. Also, a slight and entirely harmless shock can be experienced by an operator who happens to touch a grounded object and the cabinet simultaneously.

f. To remedy the foregoing situation, ground the cabinet of the Rectifier Power Unit when the equipment is operated on a grounded line. This is taken care of when the Interconnecting Cable (W-101) is in place and the Ground (G) Terminal (E-112) on the Signal Generator Unit (Fig. 7-13) is connected to ground, as it ordinarily would be when testing a receiver.

g. Plate voltage is obtained from the high-voltage transformer secondary and full wave, heater-type, high-vacuum rectifier (V-201). A two-section hum filter reduces the power-frequency ripple to a satisfactorily low level. This circuit delivers 200 volts at approximately 40 milliamperes.

h. The heater supply circuit has been adjusted, by means of the 1.5-ohm rheostat (R-201) to supply 5.8 volts (r.m.s.) to the heaters of the tubes in the Signal Generator Unit. This unit requires 1.7 amperes. An additional 0.65 ampere is used in the Rectifier Power Unit. (Total 2.35 amperes). To compensate for the voltage drop in the Interconnecting Cable (W-101) the voltage at the Rectifier Power Unit is 6.2 volts approx. (r.m.s.)

i. The 115-volt A.C. input power for the equipment is less than 55 watts.

14. DUMMY ANTENNA UNIT.

a. The Dummy Antenna Unit (Fig. 7-9) is contained in a small cylindrical aluminum casting 1-3/8 inches in diameter and about 4-1/2 inches in length. Plug and jack terminals are provided at the ends to fit the Output Jack (J-102) of the Signal Generator Unit and the plug of the Output Test Cord. (W-102).

b. The schematic diagram and resultant electrical characteristics for the Dummy Antenna Unit are given in Figure 4-18. The circuit consists of a 200 micromicrofarad capacitor (C-301) in series with a series-parallel arrangement of a 400 micromicrofarad capacitor (C-302), a 400-ohm resistor (R-301), and a 20 microhenry inductor (L-301).

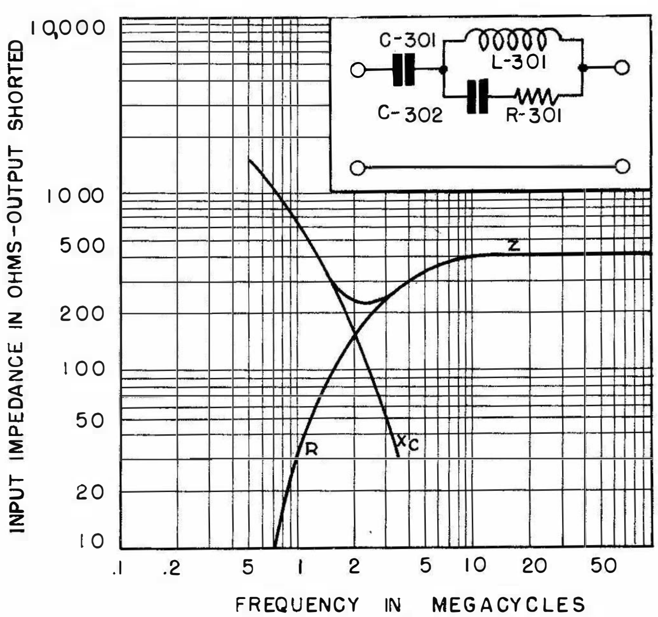


Figure 4-18—Schematic Diagram of the Dummy Antenna Unit (Type CFD-66017) with Input Impedance-Frequency Curve

c. At frequencies above 2.5 megacycles, the Dummy Antenna Unit simulates a resistance of from 220 ohms to 400 ohms. Below 1.6 megacycles, the circuit is equivalent to a capacitance of 200 micromicrofarads in series with an inductance of 20 microhenries and a resistance of 15 ohms. In normal use, the Dummy Antenna Unit is plugged into the Output Jack (J-102) of the Signal Generator Unit, and the net output resistance of the equipment, at frequencies below 1.6 megacycles, becomes 25 ohms since the 10 ohms output resistance of the Signal Generator Unit is in series with the equivalent 15 ohms resistance of the Dummy Antenna Unit.

15. 10:1 ATTENUATOR UNIT.

a. The 10:1 Attenuator Unit (Fig. 7-10) consists of a small cylindrical aluminum casting 1-3/8 inches in diameter and about 4-1/2 inches in length. Plug and jack terminals are provided at the ends to fit the Output Jack (J-102) of the Signal Generator Unit and the plug of the Output Test Cord (W-102).

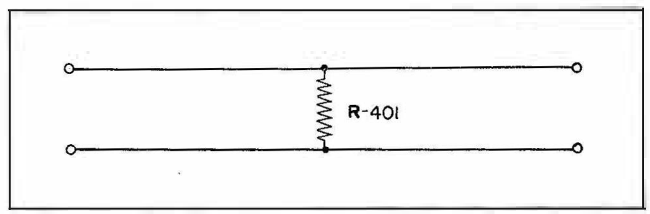


Figure 4-19—Schematic Diagram of the 10:1 Attenuator Unit (Type CFD-63710)

b. The schematic diagram of the 10:1 Attenuator Unit is shown by Figure 4-19. The unit contains a shunt resistor of 1.11 ohms (R-401). When plugged into the Output Jack (J-102) the resultant output resistance is reduced to one ohm for the first four MULTIPLIER positions (1-10-100-1000). Correspondingly, the output voltage is reduced by a factor of ten.

c. This unit must ***not be used*** when the MULTIPLIER switch (S-107) of the Signal Generator Unit is at the 10,000 position. The maximum output available from the Signal Generator when using the 10:1 Attenuator Unit is, therefore, 1,000 microvolts. (See Sect. III, Par. 8 *e.*)

IMPORTANT NOTE

When the 10:1 Attenuator Unit (Type CFD-63710) is used in conjunction with cords mentioned in Par. 10 and 11 the voltage output is reduced by a factor of 10 to 1; and at the same time this automatically reduces the output load impedance of the Signal Generator to 1 ohm when the Attenuator MULTIPLIER is set to X-1, X-10, X-100, X-1000.

SECTION V

MAINTENANCE

1. GENERAL.

a. The Model LP-5 Signal Generator Equipment is, functionally, a group of circuits listed in Sect. IV Par. 1. Each circuit is in itself an assembly of coils, capacitors, resistors, tubes and switches just as a radio receiver is made up from similar components. The first step in maintenance or repair should, therefore, be to localize the trouble, that is, first decide which circuit of the complete system has failed to function as it should. Once the search has been narrowed down to the power unit or vacuum-tube voltmeter or other circuit the remainder of the process is simply one of locating the defective part or parts by means of voltage, resistance, or capacitance tests in the conventional way. Exactly the same technique should then be used as would be followed in locating trouble in a receiver.

2. CHIEF MAINTENANCE PROBLEMS.

a. The chief parts of the Signal Generator Unit and Rectifier Power Unit, which are subject to wear or deterioration and which may require attention are the vacuum tubes, the FREQ. RANGE switch and the slide-wire combination associated with the MICROVOLTS dial. In addition, and as a result of aging or excessive temperature variation, the calibration of the inductors may show slight drifts.

3. METHOD OF DISASSEMBLING UNITS.

a. Before attempting to disassemble the units be sure that the equipment is disconnected from the power mains or the battery supply. To remove either the Signal Generator Unit or the Rectifier Power Unit from its cabinet, take out the round-head screws around the outer edge of the panel, and lift the unit from its cabinet. Two lifting knobs are provided for this purpose on the panel of the Signal Generator Unit. Allow the generator unit to rest on the table top with the panel almost vertical and bearing on the lower edge of the panel and the back edge of the lower shelf compartment. This will be found to be a convenient working position. When replacing the unit proceed with extreme care as so to avoid striking the internal structure against the sides of the cabinet. Be sure that all 16 panel screws have been tightened to insure a good electrical connection between the panel and cabinet on which the effectiveness of the shielding is dependent. (See "IMPORTANT NOTICE" CHART 4).

b. Whenever repairs are made involving the removal or replacement of any component parts, care should be taken to properly mark the part removed and its *exact* position in the equipment so that when the same or new part is replaced the equipment will be precisely as before. Care should also be taken to see that all connections, soldering, etc., are made in a workmanlike manner to assure good electrical performance.

c. There are, of course, some parts which cannot be repaired or replaced except in the factory or in a laboratory equipped similarly to the factory and using the same exact methods and equipment. If repairs or replacements other than those indicated by CHARTS 1, 2, 3, 4, are therefore necessary the equipment should be returned to the nearest Naval Test Equipment Repair Depot.

d. Whenever any parts are replaced by new ones always use the identical type listed and described in Table II, Sect. VI as *made by the manufacturer listed in* Column 6 of that Table. If such parts cannot be obtained, however, ones having *equivalent electrical and mechanical characteristics* (within the plus or minus limits as given by Column 3, Table II) may be used.

e. Resistance values of parts and spare parts furnished under JAN specifications as given in Table II, Section VI may vary slightly. The tolerances and values given are the nearest however to JAN specifications.

4. TROUBLE LOCATION AND REMEDY CHARTS.

a. It is assumed that the operator has before him the Model LP-5 Signal Generator Equipment and that, for some unknown reason, he is unable to secure a signal in a receiver connected in the prescribed manner to the end of the Output Test Cord. The receiver is known to be in normal working order. However, the mere fact that the equipment appears to meet a given test successfully is not conclusive evidence that the operation is entirely normal, and, for that reason, the word "probably" is emphasized many times. This procedure will, however, localize any ordinary case of "dead instrument" and give the operator a basis for further tests.

b. No attempt can be made to list every conceivable defect that will cause trouble, but the logical procedure that has been suggested will enable the operator to run down even the most stubborn faults. It is essential that the operator be thoroughly familiar with the contents of this instruction book, especially Section III—OPERATION, Section IV—THEORY OF OPERATION, and Section V—MAINTENANCE. The operator should furthermore be completely familiar with and have a good basic knowledge of the conventional methods used in servicing radio equipment.

c. The "trouble-shooting suggestions" will be found in two charts at the end of this Section V. The first chart will enable the operator to determine which unit or element is the cause of the trouble, and the second chart will give the suggested test for locating the trouble in any particular unit or element. These two charts are identified as follows:

CHART 1—General Test Procedure to Determine which Unit or Element is Cause of Trouble.

CHART 2—Suggested Tests for Locating Trouble in Any One Unit or Element.

d. If it is necessary to replace any tube or readjust the frequency calibration consult the following charts:

CHART 3—Method of Readjustment after Tube Replacements.

CHART 4—Method of Readjustment of Frequency Calibration.

5. PRACTICAL WIRING DIAGRAM.

a. In Section VIII there will be found a combination schematic and practical wiring diagram of the LP-5 Signal Generator Equipment. This is Figure 8-1. The wires and cable used in manufacturing are numbered rather than color-coded. Each end of every wire contains a number in a square box. These are shown on the drawing, and by making use of this diagram each wire can be traced without the use of any instrument. This makes for simplification of "trouble shooting" and checking with an absolute minimum of test equipment. By referring to this diagram and to the photographic illustrations (Figures 6-1 to 6-13), it is possible to trace and check every part of the equipment.

NOTE

Any items referred to on diagrams and parts list with Nos. 205 to 218 are part numbers of Federal Manufacturing & Engineering Corp. of Brooklyn, N. Y., U. S. A.

6. VOLTAGE AND CURRENT MEASUREMENTS MADE AT VACUUM TUBE SOCKET TERMINALS.

a. All tubes are of types that are standard in the Naval Service, and, except for the Carrier V-T Voltmeter Tube (See "CAUTION" Carrier V-T Voltmeter Tube—CHART 3) only the ordinary precautions need be observed in handling or replacing them. A means is provided for holding each tube in place to insure its remaining in position during transportation. The presence of the tube clamps has no effect on the operation of the equipment.

b. Tube and circuit voltages under normal operating conditions are given in the Table below. These measurements should be made with a Navy Model OE Series Radio Receiver Analyzing Equipment or equivalent. The measurements listed in the Table below were made with a Weston Type 772 Analyzer with the equipment set to Band "B" at 30 kilocycles with 50 per cent modulation applied and Carrier Meter set to "SET CARRIER".

VOLTAGE AND CURRENT MEASUREMENTS MADE AT VACUUM TUBE SOCKET TERMINALS

Socket Symbol Design	*Tube Symbol and Type*	VOLTAGE								CURRENT	
		No. 1 Heater Terminal	*No. 2 Heater Terminal*	*No. 2 Plate*	*No. 1 Plate*	*Sup Grid*	*Screen Grid*	*Control Grid*	*Cathode*	*Screen Current millamperes*	*Plate Current millamperes*
X-101	V-101 R.F.Oscillator Type 76	* 5.8 A.C.	0 A.C.	—	0 to 160 D.C.	—	—	−0.25 to −20	−20 to +6.0 D.C.	—	3 to 10
X-102	V-102 Separator Type 89	* 5.8 A.C.	0 A.C.	—	+ 150 D.C.	Ground	+ 135 to + 180 D.C.	− 12 D.C.	—	1.5	13.5
X-103	V-103 Carrier V.T. Voltmeter Type 955	* 5.8 A.C.	0 A.C.	—	+ 28 D.C.	—	—	1.0 A.C.	+ 1.5 D.C.	—	0.070
X-104	V-104 Modulation V.T. Voltmeter Type 84	* 5.8 A.C.	* 3.0 A.C.	4.2 A.C.	0	—	—	—	+ 1.5 D.C.	—	—
X-105	V-105 Modulation Oscillator Type 76	* 5.8 A.C.	0 A.C.	—	+ 175 D.C.	—	—	−9.0 D.C.	+1.7 D.C.	—	5.5
X-201	V-201 Power Rectifier Type 84	* 5.8 A.C.	0 A.C.	* 360 A.C. †	* 360 A.C. †	—	—	—	+ 205 D.C.	—	—

*Indicates r.m.s. volts in power source frequency. †Indicates measured from Plate to B—

All other measurements made from tube element indicated to chassis. Weston Model 772 Analyzer—20,000 ohm per volt—used throughout, except where A.C. (r.m.s.) voltages are indicated. In these instances a vane type A.C. voltmeter was used.

7. RESISTANCE MEASUREMENTS.

a. As a further aid in maintenance work the two Tables appearing below will be found useful. The first Table gives resistance values measured between socket terminals and chassis; the second Table gives resistance values measured across fixed capacitors.

b. As is indicated by footnotes to both Tables all measurements were made with a Weston Model 772 Analyzer —20,000 ohms per volt. As stated in Par. 6 a Navy Model OE Series Radio Receiver Analyzing Equipment can also be used.

RESISTANCES MEASURED BETWEEN SOCKET TERMINALS AND CHASSIS

Socket Design	*Tube Symbol*	*No. 1 Heater ohms*	*No. 2 Heater ohms*	*No. 2 Plate ohms*	*No. 1 Plate ohms*	*Sup Grid ohms*	*Screen Grid ohms*	*Control Grid*	*Cathode ohms*
X-101	(V-101) R.F. Oscillator	0	∞	—	1000	—	—	1100 ohms	1600
X-102	(V-102) Separator	0	∞	—	12,000	0	30,000	1.0 megohm	0
X-103	(V-103) Carrier V.T. Voltmeter	0	∞	—	20,000	—	—	500 ohms	*Do not check
X-104	(V-104) Modulation V.T.Voltmeter	8	∞	0	30	—	—	—	8000
X-105	(V-105) Modulation Oscillator	0	∞	—	10,000	—	—	2 megohms	480
X-201	(V-201) Power Rectifier	0	0.25 to 1.75†	∞	∞	—	—	—	∞

∞ Infinite ohms † Variable with setting of R-201 *Ohmmeter current may overload microammeter on panel.

All tests made with Weston Model 772 Analyzer—20,000 ohms per volt. All controls set counterclockwise; power cable disconnected; MODULATION switch set to INTERNAL; METER READS switch to CARRIER; FREQ. RANGE switch to Band "E"; POWER and PLATE switches to ON; tubes and pilot bulbs out of sockets. All resistance measurements made between socket terminals and chassis. Power Rectifier measurements made with Power Unit disconnected from Signal Generator; tube and pilot bulb removed from sockets; POWER switch ON.

RESISTANCES MEASURED ACROSS FIXED CAPACITORS

Symbol Design of Condenser	*Resistance*	*Symbol Design of Condenser*	*Resistance*	*Symbol Design of Condenser*	*Resistance*
*C-101	A—1000 ohms B—infinity C—10,000 ohms	C-114	450 ohms	C-128	†Do not check
		C-115	1150 ohms	C-129	†Do not check
		C-116	1000 ohms	C-130	†Do not check
*C-104	A—1000 ohms B—11,000 ohms C—infinity	C-117	1100 ohms	C-131	2.0 megohms
		C-119	100,000 ohms	C-132	20 ohms
		C-120	750,000 ohms	C-133	30,000 ohms
**C-107	A—1000 ohms B—10,000 ohms	C-121	1.0 megohm	C-134	1200 ohms
		C-122	1.0 megohm	C-201	infinite
C-109	11,000 ohms	C-123	13,000 ohms	C-202	infinite
C-110	11,000 ohms	C-124	13,000 ohms	C-203	30.0 megohms
C-111	10,000 ohms	C-125	30,000 ohms	C-204	10.0 megohms
C-112	500,000 ohms	C-126	1.0 megohm		
C-113	infinite	C-127	29,000 ohms		

*These capacitors are tested from their case to terminal. †Ohmmeter current may overload microammeter on panel.

**These capacitors are tested from their common terminal.

All other capacitors are tested from their respective terminals.

All tests made with a Weston Model 772 Analyzer—20,000 ohms per volt. All controls set counterclockwise; power cable disconnected; MODULATION switch set to EXT; METER READS switch set to CARRIER; FREQ. RANGE switch set to Band "E"; POWER and PLATE switches ON; tubes and pilot bulb out of sockets. Resistance measurements are for connected capacitors in a normally functioning Signal Generator.

CHART 1—GENERAL TEST PROCEDURE TO DETERMINE WHICH UNIT OR ELEMENT IS CAUSE OF TROUBLE

Location and Type of Trouble	*Suggested Method of Test and Remedy*
ANY UNIT OR COMPONENT Actual Trouble Unknown	1. Proceed no further until both pilot lamps have been made to light, as evidence that the 115-volt supply mains, fuses, and at least a part of the power-supply system are in working order—see CHART 2—Rectifier Power Unit. 2. With POWER switch OFF; lower Modulation switch at NORMAL; PLATE switch OFF; METER READS switch at CARRIER; MODULATION switch OFF; CARRIER control in extreme counterclockwise position; MODULATION control in extreme counterclockwise position; FREQ. RANGE switch properly set for any one of the eight ranges, then the needle of Meter should be at or very close to left-hand index. If it is not, Meter may be damaged—see CHART 2—Carrier V-T Voltmeter. 3. Turn POWER switches to ON for both units, and as heaters warm up, the needle of Meter should move to right. If it does, Carrier Voltmeter Tube (V-103) has heater power and its cathode is emitting electrons. If not—see CHART 2—Carrier V-T Voltmeter. 4. Turn PLATE switch to ON. The needle of Meter should move to or very close to left-hand index. If it does, Carrier V-T Voltmeter circuit is probably OK, and, since it has plate power, the plate supply system in the Rectifier Power Unit is probably OK. If not—see CHART 2—Carrier V-T Voltmeter; also Rectifier Power Unit. 5. Apply carrier voltage (i.e. turn CARRIER clockwise) and needle of Meter should move up-scale toward right-hand index. If it does, Carrier Oscillator (at least one range); Separator; and Carrier V-T Voltmeter circuits are probably OK. If not—continue with the next suggestion, Par. 6 below. 6. Set FREQ. RANGE switch successively for each range to see if operation (as in Par. 5 above) is secured for all ranges. If it is, the Carrier Oscillator and Separator are probably OK. Operations on some bands and not on others probably indicates a defect in Carrier Oscillator, inasmuch as the Separator and Carrier V-T Voltmeter are untuned and should respond at all frequencies if they respond at one. 7. Remove carrier voltage (CARRIER to extreme counterclockwise position.) Turn METER READS switch to MODULATION and MODULATION switch to INTERNAL. Needle of Meter should be at or near left-hand index of meter. As MODULATION control is advanced the Meter should indicate. It should be possible to obtain an indication of at least 50 per cent. modulation. If not—see CHART 2—Modulation V-T Voltmeter; also Carrier Oscillator. 8. If the equipment has met all of the foregoing tests in a satisfactory manner and there is still no output voltage at the end of the Output Test Cord, the trouble is in the Attenuator or the Output Test Cord—see CHART 2—Attenuator; also Output Test Cord.

CHART 2—SUGGESTED TESTS FOR LOCATING TROUBLE IN ANY ONE UNIT OR ELEMENT

Location and Type of Trouble	*Suggested Method of Test and Remedy*
CARRIER V-T VOLTMETER Inoperative	1. If preliminary tests have indicated that the Carrier V-T Voltmeter is inoperative, remove the Signal Generator Unit from its cabinet and proceed with the following tests. Note that the tube should be in its socket with the sharp tube end seal in the socket pointing toward the shelf on which the socket is mounted. Remove the shield plate to get at the terminals of the socket or other components. 2. Test d.c. voltage, with Carrier V-T Voltmeter tube in its socket, PLATE and POWER switches to ON and CARRIER turned as far counterclockwise as it will go. (See diagram Fig. 7-14 for proper socket terminal). *Heater Voltage:* 5.8 volts r.m.s. (root mean square) or d.c. *Plate Voltage:* 30 volts d.c. *Cathode Voltage:* 1.5 volts d.c. 3. If voltages are OK, install new tube, replace shield and repeat the original test procedure as outlined in CHART 1. 4. If Carrier V-T Voltmeter is still inoperative, make a circuit continuity test with ohmmeter until defect is located. Turn all POWER switches to OFF for this test.
Meter (M-101) Zero Adjustment and Reference Line Setting	1. The normal zero or no-current position of the needle is at the left-hand index when there are no plate or heater voltages applied. If, under this condition, the needle does not point to the left-hand index and it cannot be returned there by means of the "zero-adjust" screw (See CHART 3—Carrier V-T Voltmeter Tube), the Meter is probably damaged beyond any repair that the operator would be equipped to make, and the equipment should accordingly be returned to the Naval Test Equipment Repair Depot. 2. If it is found impossible to set the Meter to the reference line with carrier control adjustment try changing tubes (V-101) or (V-102) or both in order that more output may be obtained.
Erratic Fluctuation of Meter (M-101)	1. This may be caused by dirty contact of the arm on the slide-wire section. A piece of fine crocus cloth should be used for cleaning and the surfaces lubricated with a small amount of high-grade vaseline. 2. If the Meter becomes sticky or in any way defective, a replacement should be made. 3. If unable to set Meter at all frequencies, resistor R-113 may be open.
SEPARATOR Inoperative	1. If preliminary tests have indicated that the Separator is inoperative, remove the Signal Generator Unit from its cabinet and proceed with the following tests. 2. Test d.c. voltages with tube in socket and with PLATE and POWER switches to ON; CARRIER turned as far counterclockwise as it will go; and MODULATION switch to OFF. (See diagram Fig. 7-14 for proper socket terminals). *Heater Voltage:* 5.8 volts r.m.s. or d.c. **Plate Voltage:* 152 volts d.c. **Screen Voltage:* 135 volts d.c. **Suppressor Grid Voltage:* zero. **Cathode Voltage:* zero. **Control Grid:* −22 volts d.c. **All measurements made from Socket Terminal to Chassis.* (See CHART 3—Separator Tube) 3. If voltages are OK, install new tube and repeat original test procedure as outlined in CHART 1. 4. If Separator is still inoperative, make a circuit continuity test with ohmmeter until defect is located. Turn all POWER switches to OFF for this test.

CHART 2—(Continued)

Location and Type of Trouble	*Suggested Method of Test and Remedy*
CARRIER OSCILLATOR Inoperative	1. If preliminary tests have indicated that the Carrier Oscillator is inoperative in all ranges, remove the Signal Generator Unit from its cabinet and proceed with the following tests. 2. Test d.c. voltages with PLATE and POWER switches to ON. (See diagram Fig. 8-1 for proper socket terminals). *Heater Voltage:* 5.8 volts r.m.s. or d.c. **Plate Voltage:* Varies between 0 and 160 volts d.c. depending on setting of CARRIER control. Checking this may or may not cause circuit to stop oscillating. Repeat for all settings of FREQ. RANGE switch since this checks continuity of all plate coils. **Grid Voltage:* zero. **Measurements made from socket terminal to B –. (B – is the left hand terminal of R-106 as viewed from the back of the panel.)* 3. With PLATE and POWER switches to OFF, measure between cathode terminal and B – with ohmmeter. This should measure 450 ohms. This checks continuity of cathode-to-ground bias circuit. 4. If all voltages are OK, install new tube and repeat the original test procedure as outlined in CHART 1. 5. If Carrier Oscillator is still inoperative, test all capacitors, all grid coils, and all settings of FREQ. RANGE switch for continuity. Note that with PLATE switch at OFF, B – is switched through a dummy load B –.
Erratic Performance	1. Erratic performance of the Carrier Oscillator (such as failure of the circuit to oscillate at some settings of the main tuning capacitor C-118) in a given band is often difficult to trace. As a remedy the following may be tried: (*a*) Substitute a new tube. (*b*) Check operation of FREQ. RANGE switch. (*c*) The FREQ. RANGE switch (S-103) and the two rheostats of the slide-wire combination (R-114 and R-115) may after long use become erratic in operation as a result of dust accumulating on the contacts. When this occurs these should be carefully cleaned with a dry cloth. (*d*) Make visual inspection of main tuning capacitor (C-118) for a defect. (*e*) Make visual inspection of the oscillator coil for the range in question.
Excess Voltage Needed on Carrier Control	1. Often, defects in the coil system can be suspected if a greater than normal amount of plate voltage (CARRIER control) is necessary in order to make a full one volt of carrier voltage appear across the Carrier V-T Voltmeter. Normal voltages can be checked in the following manner: With PLATE and POWER switches ON; MODULATION switch OFF; lower Modulation switch at NORMAL; METER READS switch at CARRIER; and main tuning capacitor set at 0 divisions: adjust CARRIER CONTROL until Carrier V-T Voltmeter shows that one volt of carrier is being applied. The normal d.c. voltages that are obtained between the blade of the CARRIER control (R-106) and B – (left-hand terminal of R-106 as viewed from back of panel) are as follows: *Ranges A and G:* less than 160 volts d.c. *Ranges B, C, D, E and F:* less than 50 volts d.c.
Low Output	1. Low output below 20 kilocycles on the A-coil range is usually caused by the connector between C-123 and switch S-104 becoming unsoldered. To determine this condition adjust the carrier in the range of 9.5-30 kilocycles and turn switch S-104 from NOR. to EXT. MOD. position. A decrease in the Carrier Meter will be noted if condition is normal.

CHART 2—(Continued)

Location and Type of Trouble	*Suggested Method of Test and Remedy*
MODULATION V-T VOLTMETER AND OSCILLATOR Inoperative	1. If preliminary tests have indicated that the Modulation V-T Voltmeter and Oscillator is inoperative, remove the Signal Generator Unit from its cabinet and proceed with the following tests. 2. Connect a 1000 ohm per volt copper oxide-rectifier voltmeter between blade of R-139 and shield. This should read 16 volts or more with POWER and PLATE switches to ON; MODULATION control at maximum. If the voltage is low or zero, replace the Type 76 Tube (V-105)—see CHART 3—Modulation Oscillator Tube. If still inoperative, check switch S-106. Clean the contacts. 3. Test d.c. voltages with POWER and PLATE switches to ON; MODULATION switch at INTERNAL. (See diagram Fig. 7-14 for proper socket terminals.) *Heater:* 5.8 volts r.m.s. or d.c. *Plate:* 170 volts d.c. *"G" Terminal of T-101 to Chassis:* 170 volts d.c. This, with test on *Plate*, checks continuity of both halves of primary winding. 4. If Oscillator is OK, but Modulation Meter does not indicate, make sure that METER READS switch (S-105) is at MODULATION. Inspect switch and clean contacts if necessary. Check heater voltage of Type 84 Modulation V-T Voltmeter Tube (V-104). First heater terminal to chassis is 5.8 volts r.m.s. or d.c. Second heater terminal to chassis is 2.8 volts. 5. If all voltages are OK, install a new tube and repeat tests as outlined in CHART 1; also consult CHART 3—Modulation V-T Voltmeter Tube. 6. If oscillator or voltmeter circuit is still inoperative, make continuity tests of all wiring and circuit elements until the defect is located.
"Upscale Reading" of Meter (M-101)	1. The Modulation Meter will read slightly up-scale with the modulation control E-116 turned completely off. This is normal and due to the characteristics of the V-104 tube.
Modulation Control Erratic	1. The modulation control potentiometer will not operate properly if the contact arm is making poor contact on the winding. Tension can be increased by bending the contact arm.
Frequency Modulation	1. Vibration of main tuning condenser plates may result in frequency modulation. This effect may occasionally be observed at frequencies above 20 megacycles but is normally not troublesome at lower carrier frequencies. To correct this difficulty try mounting the generator on heavy spring rubber to reduce vibration. If this is tried without success the equipment should be returned to the Naval Test Equipment Repair Depot.
ATTENUATOR Inoperative	1. If a carrier voltage of one volt can be applied to the input of the Attenuator circuit (as indicated by the Carrier V-T Voltmeter) and no signal voltage is available at the terminal of the Output Test Cord, begin at the cable terminal and work back toward the Carrier V-T Voltmeter with an ohmmeter (PLATE and POWER switches to OFF). 2. Check Output Test Cord for continuity. 3. Inspect Plug and Output Jack for visible defects. 4. Connect ohmmeter to test lead and measure internal output resistance of Attenuator. Resistance should be 10 ohms for all settings of MULTIPLIER except 10,000 position where it should be 50 ohms. If values do not check, either R-115 or MULTIPLIER system is faulty. Remove from cabinet and check R-115. See Par. 6 about defective MULTIPLIER net works. If resistance shows open circuit on any or all MULTIPLIER points, look for defective switch (dirty contacts), defective Output Jack, or failure of MULTIPLIER unit or Output Jack to make contact with panel. NOTE The above measurements were made with a Leeds & Northrup Bridge Type Test Set No. 5430A. This instrument in no way places a current of any proportion through the Attenuator resistance network. Therefore, if the ordinary type of ohmmeter is used great care must be exercised to see that this ohmmeter does not place a current in excess of 50 milliamperes through the Attenuator circuit while testing.

CHART 2—(Continued)

Location and Type of Trouble	*Suggested Method of Test and Remedy*
	5. Remove from cabinet and measure resistance of R-113 (450 ohms). Resistance of tube end of R-113 to chassis should be 500 ohms for all settings of MICROVOLTS control. Measure resistance for all settings of MICROVOLTS control as a check on operation of contact arms, dirty contacts, etc. 6. If tests thus far indicate some defect in the MULTIPLIER network (probably an open circuited resistor), the faulty resistor in this unit cannot be repaired or replaced without special tools. If this is the case the equipment should be returned to the nearest Naval Test Equipment Repair Depot. (See Figure 7-5.) **CAUTION** **If the absolute level of attenuation seems to be in error, check CONSTANT ONE VOLT Output Jack at 90 kilocycles with an r.m.s. average reading type vacuum-tube voltmeter. See "IMPORTANT" CHART 3—Carrier V-T Voltmeter Tube.**
RECTIFIER POWER UNIT Inoperative	1. Defects in the Rectifier Power Unit, Interconnecting Cable (W-101), or power wiring (including R.F. Filter) in the Signal Generator Unit are readily traced by progressive voltage tests supplemented by ohmmeter tests in the conventional manner. The method of procedure will be obvious after a study of the wiring diagram. 2. In checking the Rectifier Power Unit, the Signal Generator Unit must be connected to provide the proper load. **CAUTION** **Do not at any time interrupt the PLATE CIRCUIT while the POWER switch is ON. The PLATE switch (S-102) in the Signal Generator Unit can, of course, be set to either ON or OFF at any time—Consult CHART 3—Power Supply Rectifier Tube.**
Overheating	1. This condition may be due to either short-circuited turns in the transformer or a breakdown of a condenser in the R.F. Filters or power circuit. A short circuit of the high-voltage in any part of the power unit will also cause overheating, and there will be an increase in the A.C. line power input.
OUTPUT TEST AND PATCH CORDS	1. If these are coiled in small loops the fine flexible conductor may become broken. Because of design and molded construction the Output Test Cord and Patch Cord *cannot* be repaired.
"HUM MODULATION"	1. If a power line hum is impressed on the carrier frequency (Hum Modulation), it may be due to the receiver under test having an excessive amount of hum in its power supply, or pick up from external fields by the receiver itself. An unshielded lead if used between the Signal Generator Unit and the receiver might also cause pick up hum. 2. In receiver checking, make certain to ground *only* the Signal Generator Unit. Condensers are connected between each side of power input plug and ground. On an unbalanced line (or panel of Signal Generator) current will flow from line to ground. To avoid circulating current in ground leads, ground Signal Generator Unit *only.* 3. The receiver will automatically be grounded when connected to the Signal Generator through the shielded lead. If, due to design considerations, receiver cannot be grounded, connect the Signal Generator to ground through a 2 to 4 microfarad condenser. Grounding both the receiver and the Signal Generator may produce increased hum. 4. If it is certain that there is hum modulation in the Signal Generator, the power transformer may be causing mechanical vibration of component parts, resulting in actual hum being impressed on the carrier. This may be due to improper mounting of transformer. 5. If the output of the Signal Generator is too high, the receiver will be overloaded causing the tubes in the receiver to become microphonic and resulting in what might be mistaken for hum modulation of the Signal Generator carrier.

CHART 3—METHOD OF READJUSTMENT AFTER TUBE REPLACEMENTS

Tube and Type	*Procedure*
GENERAL READJUSTMENTS After Replacement of Any Type of Tube	1. The following instructions apply for the readjustment (if necessary) of the appropriate circuit when a tube has been replaced. The notes should be carefully observed. (*a*) Operating voltages are given to facilitate checking the equipment. All d.c. voltages are measured with a 20,000 ohms per volt instrument. (*b*) Power frequency voltages should preferably be measured with an accurate iron-vane type instrument. Copper-oxide rectifier-type meters give readings slightly in error because the voltage-regulating transformer in the Rectifier-Power Unit produces a distorted waveform. (*c*) Audio-frequency voltages may be measured with a copper-oxide meter. (*d*) Radio-frequency voltage should be measured with a r.m.s. vacuum-tube voltmeter. (*e*) All voltages given are approximate except the radio frequency voltage on the grid of V-103 (Carrier V-T Voltmeter Tube).
V-101 CARRIER (R.F.) OSCILLATOR TUBE Type 76	1. The only requirement to be met by the Type 76 Carrier (R.F.) Oscillator Tube is that it give sufficient output for operation over the complete frequency range of the instrument. The most critical point is at a frequency of 9.5 megacycles on Coil G where the highest plate voltage is used. The radio-frequency carrier voltage delivered to the grid of the Separator Tube must be about 3 volts for coils B, C, D, E and F, and somewhat more for coils A, G and H. Since the tuning condenser has a high minimum capacitance, changing the Oscillator Tube ordinarily will not affect the frequency calibration. Any change will be most noticeable at the high-frequency end of each coil where compensation can be made by means of the trimmer capacitors. These capacitors are accessible from the front panel—see CHART 4—Method of Readjustment of Frequency Calibration. 2. Under normal operation, when the CARRIER control is advanced until the Meter on the panel indicates at the "SET CARRIER" position, the plate current for Type 76 Carrier (R.F.) Oscillator Tube is less than 3 milliamperes d.c. for ranges A, B, C,D, E and F and is less than 10 milliamperes d.c. for ranges G and H. 3. The approximate voltages appearing at the Carrier Oscillator Tube socket under normal operating conditions are as follows: *Heater:* 5.8 volts, r.m.s. or d.c. *Plate to B —:* *Frequency Range* A, G, H — *Volts* Less than 160 volts d.c. B, C, D, E, F — Less than 50 volts d.c. Except when checking coil continuity, it is recommended that these voltages be measured between the slider of the CARRIER control (R-106) and B—(left-hand terminal of R-106 as viewed from the back of the panel).
V-102 SEPARATOR TUBE Type 89	1. The Type 89 Separator Tube with shield and grid cap can be replaced without affecting the accuracy of the frequency calibration or of the output level. This tube is working satisfactorily when one volt is produced across the 500-ohm plate output resistance. 2. The approximate voltages and currents appearing at the Separator Tube socket under normal operation are as follows: *Heater:* 5.8 volts, r.m.s. or d.c. *Plate:* 150 volts d.c. at about 13.5 milliamperes. *Screen Grid:* 135 volts d.c. at about 1.5 milliamperes. *Control Grid:* −22 volts d.c. through a high resistance. A direct measurement with a 20,000-ohms-per-volt instrument of 50 volts full scale will indicate about—11 volts d.c.

CHART 3—(Continued)

Tube and Type	*Procedure*
V-105* MODULATION (A.F.) OSCILLATOR TUBE Type 76 *Same as V-101	1. The Type 76 (A.F.) Modulation Tube should be replaced when it is no longer possible to obtain sufficient 1,000-cycle voltage to give 50 per cent internal modulation with the MODULATION control set at maximum. A good tube will produce about 16 volts across the Modulation potentiometer (R-139). The plate voltage is approximately 170 volts d.c. at about 5.5 milliamperes. 2. The approximate voltages appearing at the Modulation Tube socket under normal operating conditions are as follows: *Heater:* 5.8 volts, r.m.s. or d.c. *Plate:* 170 volts d.c.
V-104 MODULATION V-T VOLTMETER TUBE Type 84	1. If the Type 84 Modulation V-T Voltmeter Tube is replaced, readjustment of the 2,500-ohm shunt rheostat (R-131) may be necessary. This rheostat is located on the left-hand side of the amplifier shelf viewed from rear and is set to make the indicating Meter read 30 per cent with 4.0 volts audio-frequency applied between the arm of the Modulation potentiometer (R-139) and ground. 2. For a more accurate setting, the actual percentage modulation of the Signal Generator Unit should be checked by some other means, such as a cathode-ray oscillograph or a modulation meter, since variations in the characteristic of the Type 89 Separator Tube may require a modulation voltage different from the average voltage given above. An audio-frequency voltage for this test is most conveniently obtained from the internal Modulation Oscillator by setting the MODULATION switch to INTERNAL and reading the voltage on an accurate high-impedance voltmeter connected between the arm of R-139 and ground. For this test the METER READS switch must be set to the MODULATION position. 3. The heater for this tube is operated at a low temperature. Heater voltages are approximately 5.8 volts (r.m.s. or d.c.) for one heater terminal to ground and approximately 2.8 volts for the other heater terminal to ground.
V-103 CARRIER V-T VOLTMETER TUBE Type 955	1. The Type 955 Carrier V-T Voltmeter Tube used in this circuit determines the accuracy of the output voltage and should be checked periodically since the emission current changes somewhat with age. Compensation for this effect can be made by readjusting the bias balance as explained in Sect. IV, Par. 6*c*. This readjustment will not affect the accuracy of the meter indication for a considerable range, but it will eventually be necessary to readjust R-130, which determines the sensitivity of the meter. With an old tube that has very low emission this adjustment will be impossible, and the tube should be replaced. 2. The procedure in adjusting the Carrier V-T Voltmeter is as follows: (*a*) Set meter needle to zero with meter adjusting screw with all POWER switches to OFF. After the power has been on for about five minutes, with PLATE switch to ON; METER READS switch on CARRIER; and the CARRIER control completely counterclockwise; set the bias for meter zero with a screw driver through the front panel at R-129. (See Fig. 7-13). (*b*) Connect an accurate high-impedance r.m.s. average reading type vacuum-tube voltmeter between ground and the grid of the Type 955 Carrier V-T Voltmeter tube (this connection can be made at J-103, the CONSTANT ONE-VOLT Output Jack if the voltmeter impedance is large compared to 500 ohms) and advance the CARRIER control until this voltmeter reads exactly one volt. The frequency of the Carrier Oscillator for this measurement should be low in order to avoid errors due to the leads connecting to the external meter. (*c*) The MODULATION switch must be set in the OFF position and the lower Modulation switch in the NORMAL position. **IMPORTANT** It must be emphasized that only a vacuum tube voltmeter of the r.m.s. (root-mean-square) type should be used. This is the only type of instrument that can be used, and this instrument must in turn be calibrated against an accurate known standard, such as a Standard Weston cell and bridge arrangement

CHART 3—(Continued)

Tube and Type	*Procedure*
Special Handling of V-103 Vacuum Tube	together with an accurate thermo-couple. The vacuum-tube voltmeter is first checked on direct current by the use of the Weston cell, and then by the use of a switch-over circuit and thermo-couple, the meter (having sine wave alternating current pass through it) is adjusted to read exactly 1 volt. The Hewlett Packard Model 400A V-T Voltmeter, or the Weston Model 695 Type 11 Output Meter, may be used. *When the usual type of peak reading vacuum tube voltmeter, either with or without a calibrated r-m-s scale, is used it reads about* ~~50%~~ "5%" *higher* due to the harmonic distortion present in the carrier voltage. 3. With the external meter reading one volt, the shunt rheostat (R-130) across the microammeter is adjusted to make the pointer of the Meter come exactly to the "SET CARRIER" mark. This rheostat is located at the rear center of the amplifier shelf and is locked by a flat-head screw. After resetting R-130, this screw should be locked again, and care must be exercised to be sure the rheostat arm does not move when this is done. Under normal operation, the plate-to-chassis voltage is about 30 volts d.c. with a plate current of about 70 microamperes. 4. The approximate voltages appearing at the carrier V-T voltmeter socket under normal operating conditions are as follows: *Heater:* 5.8 volts, r.m.s. or d.c. *Plate:* 30 volts d.c. *Cathode:* 1.5 volts d.c. **CAUTION** **The Carrier V-T Voltmeter Tube, because it is of an unusual type, requires the observance of special precautions in handling. Note the following instructions.** 1. *Do not remove the tube from its socket unless absolutely necessary, because the tube electrodes are supported in glass and may break with excessive handling.* Insert the tube in the five clips with its pointed end into the socket ring. 2. In replacing this tube be sure that it is installed in the same position as the original tube. If the position (hanging down) is reversed, the Meter will read off scale at zero set for carrier. There is no effect on the percentage modulation reading. A new tube should be operated for a period of about one hour to prevent drifting of the zero point after setting the Meter. 3. After installing a new tube, check to see that one volt is obtained at the CONSTANT ONE-VOLT Output Jack at 30 kilocycles when Carrier Meter is set at reference point. If this reading cannot be obtained by readjusting the shunt, try another new V-103 tube. 4. If the tube is not in its socket, the same effect as above will be noted. 5. A completely worn out tube will cause a very small deflection of the Meter. A weak tube will be recognized by the gradual increase of the R-129 grid-biasing rheostat which will be necessary to reduce Meter to zero.
V-201* POWER SUPPLY RECTIFIER TUBE Type 84 *Same as V-104	1. In checking the Rectifier Power Unit, the Signal Generator Unit must be connected by means of the Interconnecting Cable (W-101) to supply the proper load. **WARNING** **If the plate supply load is removed the Rectifier Power Unit will be seriously damaged because the voltage delivered by the Power Transformer reaches a sufficiently high value to arc across the filter condensers. Therefore, if plate current is measured, insert the milliammeter *BEFORE* turning the POWER switches (S-101 and S-201) to ON.**

CHART 4—METHOD OF READJUSTMENT OF FREQUENCY CALIBRATION

Part	*Procedure*
GENERAL	1. Readjustment of the frequency calibration for any range is readily accomplished, if it should ever become necessary, by the method described in the following paragraphs. Over the frequency range (9.5 to 30,000 kilocycles), each plate coil has connected across it a trimmer capacitor for adjusting the total capacitance associated with that coil. Each coil also has a movable iron core by means of which the inductance of that coil can be adjusted to the required value. The recalibration process therefore, is simply a matter of (1) adjusting the inductance of the plate coil for a calibration frequency at the low-frequency end of the range and (2) of adjusting the corresponding trimmer capacitor for a calibration point at the high-frequency end of the range. 2. Any sufficiently accurate method of measuring the frequency at each end of the range in question may be used, but the simplest and most satisfactory is with a heterodyne frequency meter such as one of the Model LD or the Model LR series. Connect the Output Test Cord of the Signal Generator to the heterodyne frequency meter and measure the frequency in the usual way. 3. The calibration was originally adjusted by the contractor at the frequencies given in the Table at the end of CHART 4 which also shows the corresponding number of dial divisions as taken from the calibration charts. (Fig. 3-2, 3-3, 3-4). Use these same frequencies when readjusting the calibration. First, measure the frequency at the low-frequency test point; then measure the frequency at the high-frequency test point to determine whether the inductance, the capacitance, or both will require readjustment. Note that if readjustment of the inductance is required, the calibration will be out at both ends of the band. No frequency adjustments are provided for the extended frequency range of 30-50 megacycles. (Coil H).
TO READJUST INDUCTANCE	1. Remove the Signal Generator Unit from its cabinet (See Sect. V, Par. 3 *a*) and remove the shield from the oscillator compartment. With the help of the photographic illustration (Fig. 7-1) identify the coils that must be readjusted and note that the cores for coils L-141 to L-146 (Bands A to F) are threaded on a stud concentric with the coil and employ a self-locking nut built integral with the core. The core for coil L-147 (Band G) is held securely by two set screws through the coil form. 2. Next, mark the original position of the core in the coil form with a pencil mark on the core for use as a reference point. Then move the core slightly in the required direction: (a) *out* of the coil to *reduce* inductance and *increase* frequency, (b) *into* the coil to *increase* inductance and *reduce* frequency. The self-locking nut arrangement (referred to in Par. 1 above) locks the core properly in position for coils L-141 to L-146 (Bands A to F). If coil L-147 (Band G) has required readjustment, tighten the two set screws to secure its core. Replace the shield, and measure the frequency with the Frequency Tuning Dial set at the required point. Repeat until the calibration is correct at this point. For the preliminary adjustments it may not be necessary to replace and tighten all of the screws holding the shield, but this should always be done for the final check because the position of the shield affects the frequency. The Signal Generator Unit need not be returned to its cabinet for these tests. Readjustment can be facilitated by holding the shield in its normal position by one or two screws.
TO READJUST CAPACITANCE	1. Access to all trimmer capacitors is obtained from the front of the Signal Generator Unit panel by removing the nameplate and three hex-head screws as shown in Fig. 5-1. Set the Frequency Tuning Dial at the required calibration point for the range in question and adjust the corresponding capacitor with a screwdriver, until the resulting frequency is correct. 2. The trimmer positions for each range are identified from the front of the panel by Figure 5-1. 3. After the foregoing instructions have been properly carried out, the frequency of the Signal Generator will be in very close agreement with the printed calibration at two points in each range. The frequency should agree to better than one percent at all other points in each range. If it does not, it is evident that the main tuning condenser has become damaged and requires readjustment, a difficult procedure that should not be attempted by the operator.

CHART 4 (Continued)

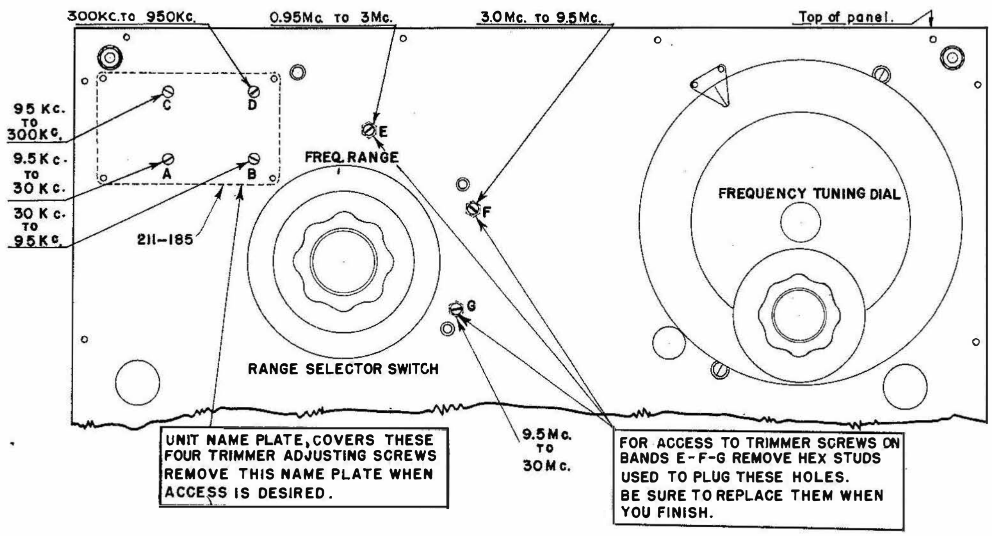


Figure 5-1—Skeleton View of Panel Showing Location of Trimmers and Frequency Band They Trim

FREQUENCY CALIBRATION DATA

Freq. Range	*Low End—Adjust Inductance*			*High End—Adjust Capacitance*		
	Freq.	*Div.*	*Coil*	*Freq.*	*Div.*	*Capacitor*
A	10 kc	22.8	L-141	30 kc	282.6	C-141
B	30 kc	10.6	L-142	95 kc	283.8	C-142
C	95 kc	10.1	L-143	300 kc	282.6	C-143
D	300 kc	10.6	L-144	950 kc	283.8	C-144
E	0.95 Mc	10.1	L-145	3 Mc	282.6	C-145
F	3 Mc	10.6	L-146	9.6 Mc	286.5	C-146
G	9.6 Mc	12.9	L-147	30 Mc	288.3	C-147

IMPORTANT NOTICE

Keep the sixteen screws which fasten the panel to the cabinet tight at all times to insure good electrical contact

At the time of manufacture, these panels were surfaced on their inside edges to insure a good electrical contact with the mounting angles on the inside of the metal cabinet. When these instruments have been in use for some time, especially in damp climates, or in salty atmospheric conditions, oxidation may take place between the inside edges of the panel and the mounting angles which can result in radio frequency leakage. Should this condition become evident it should be corrected as follows. Remove the entire unit from the cabinet and sandpaper lightly around the inner edges of the panel as well as along the top surfaces of the mounting angles. After cleaning these surfaces replace the unit in the cabinet and tighten every panel screw *securely.*

THIS IS IMPORTANT

(See Sect. V, Par. 3 a)

8. WINDING DATA.

a. Complete winding data for all wire-wound units or components (except resistors) found in the Model LP-5 Signal Generator Equipment is given in the chart below headed:

CHART 5—Winding Data.

The Symbol Designations are the same as used throughout the balance of the Instruction Book.

CHART 5—WINDING DATA

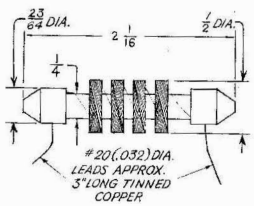
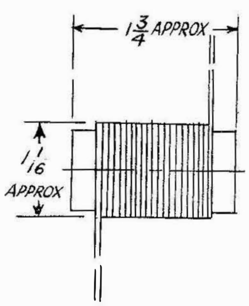
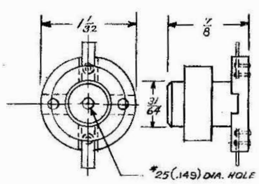
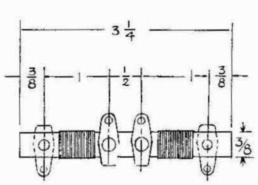
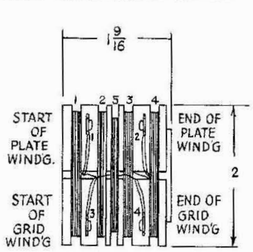
DESIG-NATION SYMBOL	FED. MFG. & ENG. CORP. DWG. NO.	DIAGRAM	WINDING	WIRE SIZE	TURNS	D. C. RESIST-ANCE IN OHMS	IMPEDANCE RATIO	HIPOT A-C VOLTS	REMARKS
L-102 L-103 L-104 L-107	215-326 215-326 215-326 215-326		Grouped Single			44			Inductance: 2.5 *mh.* Current Rating: 125 ma. Distributed Capacity: 1$\mu\mu f$ Dry in oven at 230° F for 10 minutes. Dip in fungus proof wax at 250° F for 15 minutes. Let cool to room temperature and then dip *once*, for about 1 second, in fungus proof wax.
L-106	217-70		Single	No. 20 DCC	20	0.05			Inductance: 5μh. Dry in oven at 230° F for 10 minutes. Dip in fungus proof wax at 230° F for 15 minutes. Let cool to room temperature and then dip *four* times, for about 1 second each dip, in fungus proof wax. Allow coil to cool between dips.
L-108	215-327-1		Single			58			Inductance: 25 *mh.* Current Rating: 60 ma. Coat with fungus proof varnish and then bake at 212° F for 1 hour.
L-109A L-109B	211-13-1		Two Windings	No. 32 E	70 for each winding	1.2 for each winding			Inductance: 22μh for each winding. Dry and fungus proof same as for L-102.
L-141	213-10-1		Random— Plate Winding Grid Winding	 No. 36 E No. 36 E	 2800 total: 700 each in slots #1, 2, 3, 4 250 in slot #5				Dry in oven at 230° F for 10 minutes. Dip in Superlawax at 230° F for 30 minutes. Let cool to room temperature and then dip *four* times, for about 1 second each dip, in Superlawax. Allow coil to cool between dips.

CHART 5—(Continued)

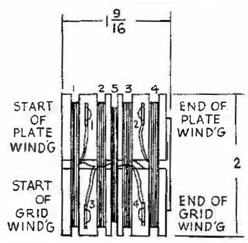
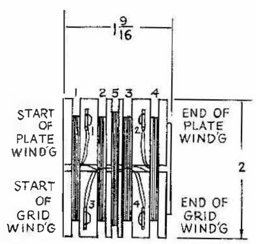
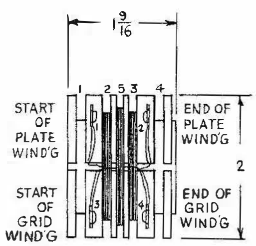
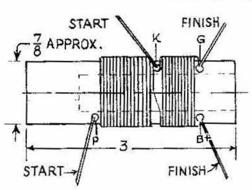
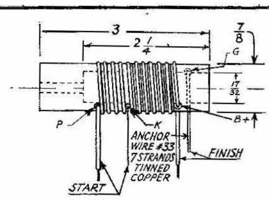
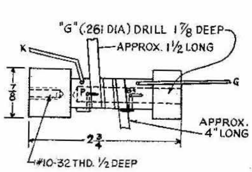
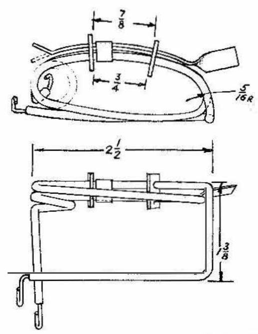
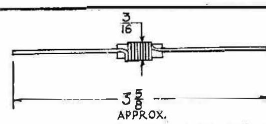
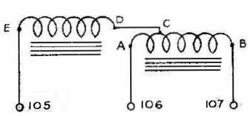
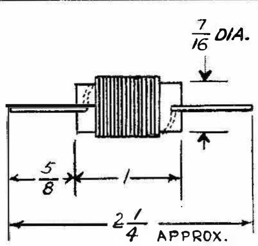
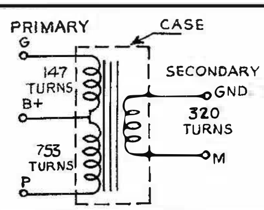
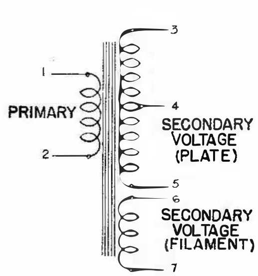
DESIGNATION SYMBOL	FED. MFG. & ENG. CORP. DWG. NO.	DIAGRAM	WINDING	WIRE SIZE	TURNS	D. C. RESISTANCE IN OHMS	IMPEDANCE RATIO	HIPOT A-C VOLTS	REMARKS
L-142	213-20-1		Random- Plate Winding Grid Winding	No. 32 DSC No. 35 DSC	868 total: 217 each in slots #1, 2, 3, 4 90 in slot #5				Dry and wax same as for L-141.
L-143	213-30-1		Random- Plate Winding Grid Winding	No. 32 DSC No. 35 DSC	278 total: 69 each in slots #1 & 4; 70 each in slots #2 & 3 45 in slot #5				Dry and wax same as for L-141.
L-144	213-40-1		Random- Plate Winding Grid Winding	No. 28 DSC No. 28 DSC	69 total: 34 in slot #2; 35 in slot #3 20 in slot #5				Dry and wax same as for L-141.
L-145	213-50-1		Single Layer— Plate Winding Grid Winding	No. 29 DSE No. 36 DSC	42 16				Dry and wax same as for L-141.
L-146	213-60-1		Single Layer— Plate Winding Grid Winding	No. 16 DSC No. 28 DSC	13¼ 8½				Dry and wax same as for L-141.
L-147	213-70-1		Layer Wound— Grid Winding Plate Winding	No. 22 DSC 5/32" x.005" silver plated copper ribbon	6½ 2¼				Dry and wax same as for L-141.

CHART 5-(Continued)

DESIG-NATION SYMBOL	FED. MFG. & ENG. CORP. DWG. NO.	DIAGRAM	WINDING	WIRE SIZE	TURNS	D. C. RESIST-ANCE IN OHMS	IMPEDANCE RATIO	HIPOT A-C VOLTS	REMARKS
L-148A L-148B	213-80		Special Form— A—Grid Winding B—Plate Winding	 No. 14 solid black Push-back wire ¼″ x .032″ Copper strip					Place a drop of shellac on each locating plate to secure in position.
L-150	213-90-1		Single	No. 32 DSC	30	0.25			Inductance: 1.8 μh. Dry and wax same as for L-141.
L-201	207-04		Single Winding Tapped Winding	No. 33 E No. 33 E	5000 from lead 105 to D 5000 from lead 106 to 107	400 from lead 105 to D 400 from lead 106 to 107; 374 from lead 107 to C		1000 1000	Inductance: 10 henries. Inductance: 10 henries total. Both windings sealed in pitch.
L-301	210-9		Single Layer	No. 34 DSC	57	1.82			20 μh fungus proof with Insul-X #25-X Lacquer.
T-101	218-0-1		Primary Secondary	No. 28 E No. 28 E	900 from P to G; 753 from P to B+ 320	19 from P to G; 15 from P to B+ 8	2.8 : 1 total pri. to secd.	600 600	Impedance: 1470 ohms P to G, 1040 ohms P to B+, 46 ohms B+ to G at 1000 cycles. Impedance: 195 ohms. Both windings sealed in pitch.
T-201	206-0-1		Primary Secondary High Voltage (plate) Secondary Low Voltage (filament)	No. 18 E No. 35 E No. 16 E	395	1.5 1350 ohms from 3 to 5 center tapped at 4 0.2		2000 2000 2000	Full Load Voltage / Full Load Current / Power Consumption: 115 / 1.45 amp. 720 from 3 to 5 center tapped at 4 / 40 ma. 6 / 2.4 amp. / 35 to 55 watts Regulating type. Both windings sealed in pitch.

ADDENDUM TO SECTION VI-PARTS AND SPARE PARTS LISTS

6. ADDENUM TO PARTS LIST.

a. The Radio Frequency Signal Generators, Navy Model LP-5, bought under contract NObsr-39320 contain the following components in the equipment and the accompanying spares which are interchangeable with the corresponding components in equipments previous supplied. Since these new components are in accordance with the latest JAN (Joint Army-Navy) specifications, they will, in general, be components supplied for any new reorder of the older components. Appropriate notations should be made in the parts lists of this book.

Symbol Desig.	Contract NObsr-39320	Previous Contracts	Fed. Mfg. & Eng. Corp. Dwg. No.
N-103	The Acceptance Plate is not used under this contract		
R-108	430 ohms±5%	450 ohms±5%	215-10
R-111	51,000 ohms±5%	50,000 ohms±10%	215-16
R-124	510 ohms±5%	500 ohms±10%	215-11
R-127	Same as R-124		
R-135	2400 ohms±5%	2500 ohms±10%	215-12
R-137	470 ohms±5%	450 ohms±5%	215-5
R-138	36,000 ohms±5%	35,000 ohms±10%	215-20
R-301	390 ohms±5%	400 ohms±5%	215-4
X-103	Mfg.—4, Part #UHS—900; Cont.—1, Part 215-319; Navy Type CFD-491836. This socket is supplied as an assembly with spacers and is interchangeable with X-103 furnished on previous contracts.	Mfg.—4, Part #S-900; Cont.—1, Part #215-302; Navy Type No. 38354.	

NOTICE

The Radio Frequency Signal Generators, Navy Model LP-5, supplied under contract NObsr-39320 will, in general, have different amounts of corresponding components supplied as spare parts. The list of spare parts as enclosed in the equipment spare parts box should be used to determine if a full complement of spares is on board.

SECTION VI

PARTS AND SPARE PARTS LISTS

1. GENERAL.

a. In this section of the Instruction Book for the LP-5 Radio Frequency Signal Generator Equipment there will be found a complete list of all component electrical parts and replaceable mechanical parts comprising the various units, together with a description of such part and its function. This information is conveniently set forth in several Tables using the Symbol Designations given in the text, and on the various drawings and photographic illustrations appearing throughout the book, as a means of identifying and locating any particular item or part. These Tables are explained briefly in Par. 2, 3, 4, 5, which follow.

2. LIST OF MAJOR UNITS.

a. A Major Unit, as referenced herein, is defined as a single complete mechanical assembly, capable of a particular function. The Major Units of the LP-5 Signal Generator are listed in Table I below.

3. PARTS LISTS BY SYMBOL DESIGNATIONS.

a. All electrical parts and such mechanical parts to which Navy Type Numbers have been assigned, or which are referred to on the drawings, or in the text of this Instruction Book, or for which replacement (including all spare parts) may be required during the service life of the LP-5 Signal Generator are given Symbol Designations. Parts and Spare Parts Lists according to such Symbol Designations are given by Table II.

b. Symbol Designations are made up of a capital letter. (Identifying the function of the part as listed below) and three significant figures (showing the Major Unit covered and the particular item of the unit). Whenever a particular item has several associated parts a suffix letter is added. (For example C-101A, C-101B, C-101C identify each part of a 3-section capacitor.) The capital letter portion of the Symbol Designation has the following meaning.

C—Capacitors of all types

E—Miscellaneous electrical parts, insulators, knobs

F—Fuses

H—Hardware, screws, bolts, etc.

I—Pilot lamps

J—Jacks and receptacles

L—Inductors (R.F. and A.F.)

M—Meters

N—Nameplates, dials

O—Mechanical parts

P—Plugs

R—Resistors (fixed and variable), potentiometers

S—Switches

T—Transformers

V—Vacuum tubes

W—Interconnecting cables, wires, etc.

X—Sockets

4. APPLICABLE COLOR CODES FOR CAPACITORS AND RESISTORS.

a. The only color code used to identify parts of the LP-5 Signal Generator applies to capacitors and resistors. Table III gives the code which is used.

5. LIST OF MANUFACTURERS.

a. A list of manufacturers of the various parts of the LP-5 Signal Generator is given in Table IV according to the Key Number in Column 6 of Table II.

TABLE I—LIST OF MAJOR UNITS

Navy Type Designation	Name of Major Unit	Symbol Group or Unit Number	Federal Mfg. and Eng. Corp. Number
CFD-60006-A	Signal Generator Unit	101-199	213-
CFD-20080-A	Rectifier Power Unit	201-299	205-
CFD-66017	Dummy Antenna Unit	301-399	210-
CFD-63710	10:1 Attenuator Unit	401-499	212-

TABLE II—PARTS LIST BY SYMBOL DESIGNATIONS
For Model LP-5 Signal Generator Equipment
(Also Spare Parts Supplied for Equipment, Tender, and Stock)

PART I—SIGNAL GENERATOR UNIT—CFD-60006A (101-199)

Symbol Desig.	Function	Description	Navy Type Number	Navy Spec. or Dwg. No.	Mfr.	Mfr. Desig.	Fed. Mfg. & Engr. Corp. Dwg. No.	All Symbol Designations Involved	SPARE PARTS Loran Equip. NXsr-40979	SPARE PARTS Tender NXsr-40979 NXsr-62309	SPARE PARTS Stock NXsr-40979 NXsr-62309
				CAPACITORS							
C-101A	B− Lead Filter Capacitor	CAPACITOR: Paper; three-section 0.1/0.1/.01 μf +10% −3% each section; 600 volts D.C. working.	48713B	RE 48AA 129C	2	DYR-6111-3	215-107	C-101, C-104	2	3	5
C-101B	Heater Lead Filter Capacitor										
C-101C	B+ Lead Filter Capacitor										
C-102	Not used.										
C-103	Not used.										
C-104A	B− Lead Filter Capacitor	Same as C-101	48713B								
C-104B	B+ Lead Filter Capacitor										
C-104C	Heater Lead Filter Capacitor										
C-105	Not used.										
C-106	Not used.										
C-107A	B− Lead Filter Capacitor	CAPACITOR: Paper; two-section 0.25/0.25 μf +10% −3% each section; 600 volts D.C. working.	481003	RE 48AA 128	2	DYRT-6022G	215-108		1	2	3
C-107B	B+ Lead Filter Capacitor										
C-108	Not used.										
C-109	EXT. MOD. Filter Capacitor	CAPACITOR: Mica; 0.0005 μf ±10%; 500 volts D.C. working.	481302-10	RE 48A 301	3	1460	215-109		1	1	1
C-110	EXT. MOD. Filter Capacitor	CAPACITOR: Mica; 0.0005 μf ±10%; 500 volts D.C. working.	48932-10	RE 48A 149A	2	3L-13050	215-114		1	1	1
C-111	EXT. MOD. Filter Capacitor	CAPACITOR: Mica; 0.001 μf ±10%; 600 volts D.C. working.	48645-10	RE 48AA 112N	2	4-12010	215-118		1	1	1
C-112	Separator Bias Filter Capacitor	CAPACITOR: Paper; 0.5 μf +10% −3%; 600 volts D.C. working.	481002	RE 48AA 128	2	DYRT-6050G	215-103		1	2	3

C-113	Heater Lead Filter Capacitor at V-101	CAPACITOR: Mica; 0.02 μf $\pm 10\%$; 600 volts D.C. working.	48428-10	RE 48AA 112N	2	4	215-119	C-113, C-115, C-117 C-119, C-120, C-125 C-127, C-128, C-131	5	6	9
C-114	R-F Oscillator Bias By-pass Capacitor	CAPACITOR: Mica; 0.005 μf $\pm 10\%$; 300 volts D.C. working.	48602-10	RE 48A 149A	2	3L-12050	215-115		1	1	1
C-115	R-F Oscillator Bias By-pass Capacitor	Same as C-113.	48428-10								
C-116	B+ Lead Filter Capacitor at V-101	CAPACITOR: Paper; 0.25 μf $+10\%$ -3%; 600 volts D.C. working.	48288A	RE 48AA 129C	2	PC-1267	215-117		1	2	3
C-117	B+ Lead Filter Capacitor at V-101	Same as C-113.	48428-10								
C-118	Main Tuning Capacitor	CAPACITOR: Air; variable; 1450-1500 $\mu\mu f$ max.; 500 volts D.C. working.			1	214-0	214-0				
C-119	Coil "B" (L-142) Grid-Leak-Cond. Capacitor	Same as C-113.	48428-10								
C-120	Coil "A" (L-141) Grid-Leak-Cond. Capacitor	Same as C-113.	48428-10								
C-121	Coupling Capacitor from V-101 to V-102	CAPACITOR: Mica; 0.00002 μf $\pm 10\%$; 250 volts D.C. working.	481007-10		3	1465	215-110		1	1	1
C-122	By-pass Capacitor for Grid of V-102	CAPACITOR: Mica; 0.0005 μf $\pm 10\%$; 600 volts D.C. working.	48665-10	RE 48AA 112N	2	4	215-120	C-122, C-124	1	2	2
C-123	Coupling Capacitor from V-102 to V-103	CAPACITOR: Mica; 0.005 μf $\pm 10\%$; 600 volts D.C. working.	48765-10	RE 48AA 112N	2	4-12050	215-121		1	1	1
C-124	Coupling Capacitor from V-102 to V-103	Same as C-122.	48665-10								
C-125	B+ Lead Filter Capacitor at V-102	Same as C-113.	48428-10								
C-126	Audio Coupling Capacitor	CAPACITOR: Paper; 1.0 μf $+10\%$ -3%; 600 volts D.C. working.	481004	RE 13A 488C	2	VC-1A430	215-104	C-126, C-133, C-134	3	5	8
C-127	R-F V-T V.M. Plate By-pass Capacitor	Same as C-113.	48428-10								
C-128	R-F V-T V.M. Cathode By-pass Capacitor	Same as C-113.	48428-10								
C-129	Meter Filter Capacitor (minus terminal)	CAPACITOR: Mica; 0.00025 μf $\pm 10\%$; 250 volts D.C. working.	48673-10		3	1465	215-111	C-129, C-130	1	2	2
C-130	Meter Filter Capacitor (plus terminal)	Same as C-129.	48673-10								

TABLE II—PARTS LISTS BY SYMBOL DESIGNATIONS (Continued)

Symbol Desig.	Function	Description	Navy Type Number	Navy Spec. or Dwg No.	Mfr.	Mfr. Desig.	Fed. Mfg. & Engr. Corp. Dwg. No.	All Symbol Designations Involved	SPARE PARTS Loran Equip. NXsr-40979	SPARE PARTS Tender NXsr-40979 NXsr-62309	SPARE PARTS Stock NXsr-40979 NXsr-62309
CAPACITORS (Continued)											
C-131	Mod. Osc. Grid-Leak-Cond. Capacitor	Same as C-113.	48428-10								
C-132	Mod. Osc. Tuning Capacitor	CAPACITOR: Paper; 0.1 μf $+10\%$ -3%; 600 volts D.C. working.	481001	RE 48AA 128	2	DYRT-6010G	215-102		1	2	3
C-133	B+ Lead Filter Capacitor at V-102	Same as C-126.	481004								
C-134	B− Lead Filter Capacitor at R-142	Same as C-126	481004								
C-135 to C-140	Not used.										
C-141	Trimmer Capacitor for L-141	CAPACITOR: Variable air; 14 plates; wax impregnated; ceramic base; 3.9 $\mu\mu f$ to 50 $\mu\mu f$ $\pm10\%$.	48787A		18	AP-9L	215-101	C-141, C-142, C-143 C-144, C-145, C-146	3	0	0
C-142	Trimmer Capacitor for L-142	Same as C-141.	48787A								
C-143	Trimmer Capacitor for L-143	Same as C-141.	48787A								
C-144	Trimmer Capacitor for L-144	Same as C-141.	48787A								
C-145	Trimmer Capacitor for L-145	Same as C-141.	48787A								
C-146	Trimmer Capacitor for L-146	Same as C-141.	48787A								
C-147	Trimmer Capacitor for L-147	CAPACITOR: Variable air; 7 plates; wax impregnated; ceramic base; 3 $\mu\mu f$ to 25 $\mu\mu f$ $\pm10\%$.	48628A		18	AP-9L	215-100		1	0	0
MISCELLANEOUS ELECTRICAL PARTS											
E-101	Heater Filter Lead Connector (L-106)	CONNECTOR: Insulated tie-point terminal.			1	213-106	213-106	E-101, E-102, E-103 E-104, E-105, E-106 E-107, E-108, E-129 E-130, E-132	0	0	11
E-102	Connector for Resistor (R-135)	Same as E-101.									

E-103	Connector for Resistor (R-105)	Same as E-101.									
E-104	Heater Filter Lead Connector (L-106)	Same as E-101.									
E-105	B+ Filter Lead Connector (L-104)	Same as E-101.									
E-106	B− Filter Lead Connector (L-102)	Same as E-101.									
E-107	B− Filter Lead Connector (L-102)	Same as E-101.									
E-108	B+ Filter Lead Connector (L-104)	Same as E-101.									
E-109	Bushings for Connector from R-F Osc. to Separator Output Jack	BUSHING: Low-loss ceramic feed through insulator; 3/4″ outside dia.; 0.615″ dia. at shoulder; 0.196″ inside dia.; 15/64″ thick overall; 9/16″ to shoulder; 2 req'd, 1 each side.	CFD-61656		1	213-101	213-101	E-109, E-110	2	4	8
E-110	Bushing for Connector from Resistor R-124 to CONSTANT ONE-VOLT Output Jack	Same as E-109. (2 reqd.)									
E-111A	EXT. MOD. Terminal	BINDING POST: Brass; chrome plated.			1	211-105	211-105		1	1	2
E-111B	EXT. MOD. Terminal	BINDING POST: Brass; chrome plated.			1	211-109	211-109		1	1	2
E-111C	EXT. MOD. Term. Plate	TERMINAL PLATE: Bakelite; molded.			1	211-111	211-111		1	1	2
E-111D	EXT. MOD. Term. Plate	TERMINAL PLATE: Bakelite; molded.			1	180-247	180-247		1	1	2
E-112	Ground Terminal	BINDING POST: Brass; chrome plated.			1	211-101	211-101		1	1	2
E-113	Knob for FREQ. RANGE Switch (S-103)	KNOB: Phenolic skirted.			17	S-312-64L-BBEE	215-517				
E-114	Knob for MULTIPLIER (S-107)	KNOB: Phenolic skirted.			17	S-311-64L-BBEE Modified Per Cntr. Dwg. 215-555	215-555	E-114, E-115			
E-115	Knob for CARRIER Potentiometer (R-106)	Same as E-114.									
E-116	Knob for MODULATION Potentiometer (R-139)	KNOB: Phenolic skirted.			17	S-311-64L-BBEE	215-516				

TABLE II—PARTS LISTS BY SYMBOL DESIGNATIONS (Continued)

Symbol Desig.	Function	Description	Navy Type Number	Navy Spec. or Dwg. No.	Mfr.	Mfr. Desig.	Fed. Mfg. & Engr. Corp. Dwg. No.	All Symbol Designations Involved	SPARE PARTS Loran Equip. NXsr-40979	SPARE PARTS Tender NXsr-40979 NXsr-62309	SPARE PARTS Stock NXsr-40979 NXsr-62309
MISCELLANEOUS ELECTRICAL PARTS (Continued)											
E-117	Knob for Selector Switch (S-104)	KNOB: Phenolic.			17	S-308-64-40269BB	180-354	E-117, E-118, E-119			
E-118	Knob for METER READS Switch (S-105)	Same as E-117.									
E-119	Knob for MODULATION Switch (S-106)	Same as E-117.									
E-120	Pilot Light Socket Assembly	SOCKET ASSEMBLY: Miniature bayonet-base socket; black nickel-plated bushing.			6	50	180-340	E-120, E-201	1	1	2
E-121	Pilot Light Jewel Assembly	JEWEL ASSEMBLY: Red color cap; black nickel plate hardware.			6	25-CSP	180-339	E-121, E-202	1	1	2
E-122	Indicator for Frequency Dial (Divisions Scale)	INDICATOR: Assembly with spring.			1	211-80	211-80	E-122, E-123	0	0	1
E-123	Indicator for Frequency Dial (Coil G)	Same as E-122.									
E-124	Indicator for Frequency Dial (Coils A to F)	INDICATOR: Clear plastic 0.040″ thick.			1	211-182	211-182				
E-125A	Separator Tube (V-102) Shield Base	SHIELD BASE: Aluminum.			7	02339	215-507				
E-125B	Separator Tube (V-102) Shield	SHIELD: Aluminum, perforated.			7	01220	215-508				
E-125C	Not used.										
E-125D	Separator Tube (V-102) Shield Coil Spring	SHIELD COIL SPRING: piano wire, 0.055″ cadmium plate.			1	217-86	217-86				
E-126	Meter Shield	SHIELD: Copper 0.025″; dull nickel plate.			1	211-10	211-10				
E-127	Shield for Meter Assembly	SHIELD: Aluminum 1/32″.			1	211-16	211-16				
E-128	Indicator for MICRO-VOLTS Dial	INDICATOR: Assembly with spring.			1	211-90	211-90		0	0	1

E-129	Connector for Resistor R-140	Same as E-101.									
E-130	Connector for Resistor R-140	Same as E-101.									
E-131	Feed-through Insulator for EXT. MOD. Filter	BUSHING: Insulated terminal; Shakeproof # 6.			1	180-379	180-379				
E-132	Connector for R-112, R-141	Same as E-101.									
E-133	Grid Clip Assembly	GRID CLIP: Molded Bakelite cap; phosphor bronze nickel plated clip.			1	215-543	215-543		1	0	1
E-134	Stator Support	INSULATOR: Ceramic.			1	214-17	214-17		1	2	4
		HARDWARE, SCREWS, ETC.									
H-101A	Clamp for Holding Instruction Book	CLAMP: Aluminum $1/16''$.			1	208-21	208-21				
H-101B	Mounting for Dummy Antenna Unit	FUSE CLIP: 30 amp. 600 volts			1	215-509	215-509	H-101B, H-101D			
H-101C	Mounting for Dummy Antenna Unit	FUSE CLIP: 30 amp. 250 volts			1	215-510	215-510	H-101C, H-101E			
H-101D	Mounting for 10:1 Attenuator Unit	Same as H-101B.									
H-101E	Mounting for 10:1 Attenuator Unit	Same as H-101C.									
H-102	Cover to Hole for R-F V.M. Adjustment (R-129)	COVER: Snap-button for $1/2''$ hole; black nickel plate.			8	50652	215-502		0	0	1
H-103	Cover to Hole for Access to Main Capacitor Mount (C-118)	COVER: Snap-button for $9/16''$ hole; dull nickel plate.			8	50772	215-503	H-103, H-104, H-105	0	0	3
H-104	Cover to Hole for Access to Main Capacitor Mount (C-118)	Same as H-103.									
H-105	Cover to Hole for Access to Main Capacitor Mount (C-118)	Same as H-103.									
H-106	Cover to Hole for R-F Modulator Jack (J-101)	COVER: Snap-button for $11/16''$ hole; black nickel plate.			8	48159	215-505		0	0	1
H-107	Cover for CONSTANT ONE-VOLT Output Jack (J-103)	COVER: Snap-button with knob and chain assembly.			1	211-168	211-168		0	0	1

TABLE II—PARTS LISTS BY SYMBOL DESIGNATIONS (Continued)

Symbol Desig.	Function	Description	Navy Type Number	Navy Spec. or Dwg. No.	Mfr.	Mfr. Desig.	Fed. Mfg. & Engr. Corp. Dwg. No.	All Symbol Designations Involved	SPARE PARTS Loran Equip. NXsr-40979	SPARE PARTS Tender NXsr-40979 NXsr-62309	SPARE PARTS Stock NXsr-40979 NXsr-62309
HARDWARE, SCREWS, ETC. (Continued)											
H-108	Knob for Removing Panel from Cabinet	LIFTING KNOB: Brass; black nickel plate.			1	211-189	211-189	H-108, H-109			
H-109	Knob for Removing Panel from Cabinet	Same as H-108.									
H-110	Cover to Hole for Coil E Trimmer (C-145)	COVER: $3/16''$ hexagonal head cap screw #10-32; black nickel plate.			1	211-164	211-164	H-110, H-111, H-112			
H-111	Cover to Hole for Coil F Trimmer (C-146)	Same as H-110.									
H-112	Cover to Hole for Coil G Trimmer (C-147)	Same as H-110.									
H-113	Cabinet Foot	CABINET FOOT: Rubber; shock mounts.			1	215-527	215-527	H-113, H-114, H-115, H-116	1	4	8
H-114	Cabinet Foot	Same as H-113.									
H-115	Cabinet Foot	Same as H-113.									
H-116	Cabinet Foot	Same as H-113.									
PILOT LAMPS											
I-101	Pilot Light	PILOT LAMP: T3¼ bulb; 6-8 v. 0.25 a.; miniature bayonet base.			15	Mazda #44	180-341	I-101, I-201	8	8	12
JACKS AND RECEPTACLES											
J-101	R-F Freq. Mod. Jack	JACK: Brass plug housing; dull nickel plate; concentric plug.			1	211-169	211-169	J-101, J-103	1	2	4
J-102	R-F Output Jack	JACK: Output, concentric, furnished as part of Attenuator (S-107)			1	212-40	212-40				
J-103	R-F CONSTANT ONE-VOLT Output Jack	Same as J-101.									

INDUCTORS

L-101	Not used.										
L-102	B− Lead Filter Inductor	INDUCTOR: 2.5 *mh*, 125 ma., 50 ohms.	CNA-47122		10	R-100	215-326	L-102, L-103, L-104 L-107	1	2	4
L-103	B+ Lead Filter Inductor	Same as L-102.									
L-104	B+ Lead Filter Inductor	Same as L-102.									
L-105	Not used.										
L-106	Heater Lead Filter Inductor	INDUCTOR: Special coil; 20 turns #20 D.C.C. on 7/8" form: 5 μh; 0.05 ohms.	CFD-472208		1	217-70	217-70		0	1	1
L-107	EXT. MOD. Filter Inductor	Same as L-102.									
L-108	EXT. MOD. Filter Inductor	INDUCTOR: 25 *mh* ±10%; 58 ohms.	CJA-472209		1	215-327-1	215-327-1		1	1	1
L-109A	Meter Plus Filter Inductor	INDUCTOR: Special coil; phenolic form; 70 turns #32 enameled copper wire; close wound; 22 μh; 1.2 ohms, each section.	CFD-472203		1	211-13	211-13	L-109A, L-109B	1	1	1
L-109B	Meter Minus Filter Inductor	Same as L-109A.									
L-110 to L-140	Not used.										
L-141	9.5-30 Kc. Tuning Coil A	INDUCTOR: Special coil; low-loss ceramic form; slotted.	CFD-472198		1	213-10	213-10		0	1	1
L-142	30-95 Kc. Tuning Coil B	INDUCTOR: Special coil; low-loss ceramic form; slotted.	CFD-472199		1	213-20	213-20		0	1	1
L-143	95-300 Kc. Tuning Coil C	INDUCTOR: Special coil; low-loss ceramic form; slotted.	CFD-472200		1	213-30	213-30		0	1	1
L-144	300-950 Kc. Tuning Coil D	INDUCTOR: Special coil; low-loss ceramic form; slotted.	CFD-472201		1	213-40	213-40		0	1	1
L-145	950-3,000 Kc. Tuning Coil E	INDUCTOR: Special coil; low-loss ceramic form; threaded.	CFD-472204		1	213-50	213-50		0	1	1

TABLE II—PARTS LISTS BY SYMBOL DESIGNATIONS (Continued)

Symbol Desig.	Function	Description	Navy Type Number	Navy Spec. or Dwg. No.	Mfr.	Mfr. Desig.	Fed. Mfg. & Engr. Corp. Dwg. No.	All Symbol Designations Involved	SPARE PARTS Loran Equip. NXsr-40979	SPARE PARTS Tender NXsr-40979 NXsr-62309	SPARE PARTS Stock NXsr-40979 NXsr-62309
INDUCTORS (Continued)											
L-146	3000-9500 Kc. Tuning Coil F	INDUCTOR: Special coil; low-loss ceramic form; threaded.	CFD-472205		1	213-60	213-60		0	1	1
L-147	9500-30,000 Kc. Tuning Coil G	INDUCTOR: Special coil; low-loss ceramic form; grooved.	CFD-472206		1	213-70	213-70		0	1	1
L148A	Grid Coil, 30,000-50,000 Kc. Tuning Coil H	INDUCTOR: Special coil; self-support.			1	213-80	218-80	L-148A, L-148B	0	0	0
L-148B	Plate Coil 30,000-50,000 Kc. Tuning Coil H	Same as L-148A.									
L-149	Not used.										
L-150	B+ Lead Filter Inductor for Bands G and H Frequency Settings	INDUCTOR: Special coil; 30 turns #32 D.S.C. wire; close wound on a 3/16" form; 0.25 ohms; 1.8 μh.	CFD-472207		1	213-90	213-90		1	1	1
METERS											
M-101	Carrier Output Meter/ Percent Modulation Meter	METER: Carrier Level/Modulation; 0 to 200 microamp. D.C. $\pm 2\%$; special scale; 3½" flush type.	CG-22290	17-I-12A	9	8DO-41 ADL-207 Special Scale	215-514-1		1	0	1
NAME PLATES AND DIALS											
N-101	Model Plate	NAME PLATE: Brass, nickel plated; 0.025" x 3" x 4".			1	208-5	208-5				
N-102	Type Plate	NAME PLATE: Brass, nickel plated; 0.025" x 2" x 3"			1	211-185	211-185				
N-103	Acceptance Plate	NAME PLATE: Brass, nickel plated; 0.025" x 9/16" x 3"			1	211-186	211-186				
N-104	Dial Plate for FREQ. RANGE Switch (S-103)	DIAL: Nickel silver; 1/32" x 4" diam.			1	211-114	211-114				
N-105	Dial Plate for MULTIPLIER (S-107)	DIAL: Nickel silver; 1/32" x 2¾" diam.			1	211-115	211-115				

N-106	Not used.										
N-107	Frequency Tuning Dial	DIAL: Nickel silver; 1/16" x 6" diam.			1	211-132	211-132				
N-108	Vernier (Percent Frequency-Increment) Dial and Knob Assembly	DIAL AND KNOB: Nickel silver; 1/32" x 2 1/8" diam.			1	211-139	211-139				
N-109	MICROVOLT Dial and Knob Assembly	DIAL AND KNOB: Nickel silver; 1/32" x 2 3/4" diam.			1	211-116	211-116				
MECHANICAL PARTS											
O-101	Shaft Connecting Coupling	COUPLING: Insulating.			1	217-52	217-52		0	1	1
PLUGS											
P-101	Concentric Plug for R-F Freq. Mod. Jack	PLUG: Concentric; shielded; hard rubber shell; two terminals.	UG-424/U		1	211-120	211-120	P-101, P-102	1	1	2
P-102	Plug for Output Test Cord W-102	Same as P-101.									
P-103	Receptacle for Interconnection to Rectifier Power Unit	PLUG: Fixed; 6-terminal.	CJC-491828		5	P-406-AB-1/16 Modified to Contractor's drawing 211-6-1	211-6-1		1	1	2
RESISTORS											
R-101	Bias Supply for Separator	RESISTOR: Fixed; molded; wire wound; pigtail; 1,000 ohms ±5%; 2 watts	-63705-5	RE 13A 346V	11	BW-2	215-21		1	2	3
R-102	Dummy Load for "B" Supply at PLATE-OFF	RESISTOR: Fixed; wire wound; Style V; 5,000 ohms ±5%.	-63634-E	RE 13A 372J Grade I Class II	11	DG	215-1		1	2	3
R-103	EXT. MOD. Filter Termination Resistor	RESISTOR: Fixed; composition; pigtail; 10,000 ohms ±10%; 1 watt.	-63288	RE 13A 346V	11	BT-1	215-13	R-103, R-128	2	3	5
R-104	Bias RC Filter Resistor for Separator Tube (V-102)	RESISTOR: Fixed; composition; pigtail; 500,000 ohms ±10%; 1/2 watt.	-63360	RE 13A 346V	11	BT-1/2	215-8	R-104, R-105	2	3	5
R-105	Bias RC Filter Resistor for Separator Tube (V-102)	Same as R-104.	-63360								
R-106	Carrier Control	POTENTIOMETER: Wirewound; linear taper; large end is clockwise end, 0 to 15,000 ohms; 8 watts.	CAG-635631-R		16	371-405	211-40		1	3	5

TABLE II—PARTS LISTS BY SYMBOL DESIGNATIONS (Continued)

Symbol Desig.	Function	Description	Navy Type Number	Navy Spec. or Dwg. No.	Mfr.	Mfr. Desig.	Fed. Mfg. & Engr. Corp. Dwg. No.	All Symbol Designations Involved	SPARE PARTS Loran Equip. NXsr-40979	SPARE PARTS Tender NXsr-40979 NXsr-62309	SPARE PARTS Stock NXsr-40979 NXsr-62309
				RESISTORS (Continued)							
R-107	Load Compensator for "B" Supply	RESISTOR: Fixed; composition; pigtail; 30,000 ohms ±10%; 2 watts.	-63474	RE 13A 346V	11	BT-2	215-19		1	2	3
R-108	R-F Osc. Bias Resistor	RESISTOR: Fixed; molded, wire wound; pigtail; 450 ohms ±5%; ½ watt.	-63678-5	RE 13A 346V	11	BW-½	215-10		1	2	3
R-109	Grid-Leak Bias Resistor Coil B (30-95 kc.)	RESISTOR: Fixed; composition; pigtail; 100,000 ohms ±10%; 1 watt.	-63288	RE 13A 346V	11	BT-1	215-17	R-109, R-125	2	3	5
R-110	Grid-Leak Bias Resistor Coil A (9.5-30 kc.)	RESISTOR: Fixed; composition; pigtail; 750,000 ohms ±10%; 1 watt.	-63288	RE 13A 346V	11	BT-1	215-18		1	2	3
R-111	Grid Resistor for Separator Tube (V-102)	RESISTOR: Fixed; composition; pigtail; 50,000 ohms ±10%; 1 watt.	-63288	RE 13A 346V	11	BT-1	215-16		1	2	3
R-112	Separator Tube Load Resistor	RESISTOR: Fixed; composition; pigtail; 2,000 ohms ±10%; ½ watt.	-63360	RE 13A 346V	11	BT-½	215-6		1	2	3
R-113	Attenuator Resistor	RESISTOR: Special on mica card; 450 ohms, ±1%.	CFD-636848		1	217-73	217-73		1	3	5
R-114	Variable Network of Attenuator	*RHEOSTAT: Special; wire-wound; linear taper; resistance *increases* with clockwise rotation; 50 ohms; 2 watts.	CAG-636856		1	217-30	217-30				
R-115	Variable Network of Attenuator	*POTENTIOMETER: Special; wire-wound;no taper; clockwise end grounded; 95 ohms; 1½ watts.	CAG-636856		1	217-20	217-20				
		*SLIDE WIRE ASSEMBLY Consists of R-114 and R-115, mounted on Bracket (217-5) and connected together with Shaft (217-39) including Bakelite Shaft Ext. (217-44). *Relative relation of Contact Arms is adjusted and can only be supplied for replacement as an assembly.*			1	217-10	217-10		1	3	5

R-116A	Attenuator Fixed Resistor	RESISTOR: Special; mica form; 95 ohms; *Furnished as part of Atten. Assem.* (S-107).			1	212-56	212-56				
R-116B	Attenuator Fixed Resistor	RESISTOR: Special; mica form; 11.7 ohms. *Furnished as part of Atten. Assem.* (S-107).									
R-117	Not used.										
R-118A	Attenuator Fixed Resistor	RESISTOR: Special; mica form; 99 ohms. *Furnished as part of Atten. Assem.* (S-107).			1	212-59	212-59	R-118A, R-120A			
R-118B	Attenuator Fixed Resistor	RESISTOR: Special; mica form; 12.2 ohms. *Furnished as part of Atten. Assem.* (S-107).						R-118B, R-120B			
R-119	Not used.										
R-120A	Attenuator Fixed Resistor	Same as R-118A.									
R-120B	Attenuator Fixed Resistor	Same as R-118B.									
R-121	Not used.										
R-122A	Attenuator Fixed Resistor	RESISTOR: Special; mica form; 99 ohms. *Furnished as part of Atten. Assem.* (S-107).			1	212-61	212-61				
R-122B	Attenuator Fixed Resistor	RESISTOR: Special; mica form; 11 ohms. *Furnished as part of Atten. Assem.* (S-107).									
R-123	Not used.										
R-124	Coupling Resistor to CONSTANT ONE-VOLT Output Jack	RESISTOR: Fixed; composition; pigtail; 500 ohms ±10%; 1 watt.	-63288	RE 13A 346V	11	BT-1	215-11	R-124, R-127	1	3	5
R-125	Plate-Supply Resistor to R-F V-T V.M. (V-103)	Same as R-109.	-63288								
R-126	R-F V-T V.M. Circuit Resistor	RESISTOR: Fixed; composition; pigtail; 20,000 ohms; ±10%; 1 watt.	-63288	RE 13A 346V	11	BT-1	215-15		1	2	3
R-127	R-F V-T V.M. Circuit Resistor	Same as R-124.	-63288								
R-128	R-F V-T V.M. Circuit Resistor	Same as R-103.	-63288								
R-129	Zero Adj. Control for R-F V-T V.M.	RHEOSTAT: Wire-wound; no taper; resistance *decreases* with clockwise rotation; 1000 ohms; 6 watts.	CAG-636853		16	301-418	215-23		1	3	5

TABLE II—PARTS LISTS BY SYMBOL DESIGNATIONS (Continued)

Symbol Desig.	Function	Description	Navy Type Number	Navy Spec. or Dwg. No.	Mfr.	Mfr. Desig.	Fed. Mfg. & Engr. Corp. Dwg. No.	All Symbol Designations Involved	SPARE PARTS Loran Equip. NXsr-40979	Tender NXsr-40979 NXsr-62309	Stock NXsr-40979 NXsr-62309
				RESISTORS (Continued)							
R-130	Sensitivity Adj. for R-F V-T V.M.	RHEOSTAT: Wire-wound; no taper; resistance *increases* with clockwise rotation; 1000 ohms; 6 watts.	CAG-635649		16	301-425	215-24		1	3	5
R-131	Sensitivity Adj. for A-F V-T V.M.	RHEOSTAT: Wire-wound; no taper; resistance *increases* with clockwise rotation; 2500 ohms; 6 watts.	CAG-635651		16	301-438	215-25		1	3	5
R-132	Mod. V-T V.M. Resistor	RESISTOR: Fixed; composition; pigtail; 10,000 ohms ±5%; 1 watt.	-63291	RE 13A 346V	11	BT-1	215-14	R-132, R-133	2	3	5
R-133	Mod. V-T V.M. Resistor	Same as R-132.	-63291								
R-134	Mod. V-T V.M. Tube Heater Resistor	RESISTOR: Fixed; wire wound; pigtail; 8 ohms ±5%; 2 watts.	-63715E	RE 13A 372J Grade I Class II	11	AA	215-2		1	2	3
R-135	Mod. V-T V.M. Cathode Resistor	RESISTOR: Fixed; composition; pigtail; 2,500 ohms, ±10%; 1 watt.	-63288	RE 13A 346V	11	BT-1	215-12		1	2	3
R-136	Mod. Osc. Grid Resistor	RESISTOR: Fixed; composition; pigtail; 2 megohm ±10%; ½ watt.	-63360	RE 13A 346V	11	BT-½	215-9		1	2	3
R-137	Mod. Osc. Cathode Bias Resistor	RESISTOR: Fixed; composition; pigtail; 450 ohms, ±5%; ½ watt.	-63355	RE 13A 346V	11	BT-½	215-5		1	2	3
R-138	"B" Supply Dummy Load	RESISTOR: Fixed; composition; pigtail; 35,000 ohms, ±10%; 2 watts.	-63474	RE 13A 346V	11	BT-2	215-20		1	2	3
R-139	Modulation Control	POTENTIOMETER: Wire-wound; no taper; counter-clockwise end is grounded; 0 to 10,000 ohms; 3 watts.	CAG-636854-O		16	410-404	215-26		1	3	5
R-140	B− Lead RC Filter Resistor	RESISTOR: Fixed; composition; pigtail; 100 ohms, ±10%; ½ watt.	-63360	RE 13A 346V	11	BT-½	215-3	R-140, R-142	2	3	5
R-141	RC Filter Resistor for V-102 Screen Grid	RESISTOR: Fixed; composition; pigtail; 20,000 ohms, ±10%; ½ watt.	-63360	RE 13A 346V	11	BT-½	215-7		1	2	3
R-142	B− Lead RC Filter Resistor	Same as R-140.	-63360								

SWITCHES

S-101	POWER Supply Switch	SWITCH: D.P.S.T.; 3 amp. at 125 volts.	-24001	RE 24AA 118A	9	GA 2A 23	215-512	S-101, S-201	1	1	2
S-102	PLATE Supply Switch	SWITCH: S.P.D.T.; 3 amp. at 125 volts.	-24002	RE 24AA 118A	9	GA 3C 22	215-506		1	1	2
S-103	FREQ. RANGE Switch	SWITCH: Special design; silver contacts; rotary; 4 gangs of 8 positions each.			1	216-0	216-0				
S-103A	Part of S-103	SWITCH PART: Terminal Strip Assembly for S-103.			1	216-12	216-12		2	4	8
S-103B	Part of S-103	SWITCH PART: Contact Spring Assembly for S-103.			1	216-6	216-6		1	1	1
S-103C	Part of S-103	SWITCH PART: Locating or Detent Spring for S-103			1	216-4	216-4		2	4	10
S-104	NORMAL—EXTERNAL MOD. Switch	SWITCH: D.P.D.T.; silver contacts; rotary control; low capacity; one pole used as S.P.S.T.; other pole not used.			1	211-70	211-70	S-104, S-105	1	1	2
S-104A	Part of S-104 and S-105	SWITCH PART: Switch Contact Blade for S-104 and S-105.			1	180-186	180-186		3	6	12
S-104B	Part of S-104 and S-105	SWITCH PART: Switch Transfer Blade for S-104 and S-105.			1	180-187	180-187		2	3	6
S-105	METER READS Switch	Same as S-104.	CFD-241323		1	211-70	211-70				
S-106	MODULATION Switch	SWITCH: D.P.; 3 position silver contacts; rotary control; low capacity.	CFD-241322		1	211-60	211-60		1	i	1
S-107	MULTIPLIER Switch	SWITCH: Special assembly resistance network (R-116A R11[illegible]3, R-118A, R-118B, R-1[illegible]0A, R-120B, R-122A, R-122B; and J-102, all mounted in shielded casing; rotary tap; 5-position; shielded between contacts.	CFD-636855		1	212-0	212-0		1	1	1

TRANSFORMERS

T-101	Modulation Transformer	TRANSFORMER: Iron core; encased: *Primary:* 900 turns; tapped at 147 turns; 19 ohms (approx.) d.c.; 235-255 *mh*; tested at 1000 cycles with 21 volts across coil. *Secondary:* 320 turns, shielded; 8 ohms (approx.) d.c.; 32 *mh*.	CFD-304512		1	218-0	218-0		1	2	3

TABLE II—PARTS LISTS BY SYMBOL DESIGNATIONS (Continued)

Symbol Desig.	Function	Description	Navy Type Number	Navy Spec. or Dwg. No.	Mfr.	Mfr. Desig.	Fed. Mfg. & Engr. Corp. Dwg. No.	All Symbol Designations Involved	SPARE PARTS Loran Equip. NXsr-40979	SPARE PARTS Tender NXsr-40979 NXsr-62309	SPARE PARTS Stock NXsr-40979 NXsr-62309
VACUUM TUBES											
V-101	Carrier (R-F) Oscillator Tube	TUBE: Super Triode Amplifier Detector	-38076 JAN-76 VT-76	RE 13A 600B JAN-1 A	12	76		V-101, V-105	12	6	0
V-102	Separator Tube	TUBE: Triple Grid Power Amplifier.	-38089 JAN-89Y VT-89	RE 13A 600B JAN-1 A	12	89			12	6	0
V-103	Carrier V-T Voltmeter Tube	TUBE: Detector Amplifier Oscillator "Acorn" Type.	-38955 JAN-955 VT-121	RE 13A 600B JAN-1 A	12	955			6	3	0
V-104	Modulation V-T Voltmeter Tube	TUBE: Full-wave, High-vacuum Rectifier.	-38184 JAN-84/6Z4 VT-84	RE 13A 600B JAN-1 A	12	84		V-104, V-201	24	12	0
V-105	Modulation (A-F) Oscillator Tube	Same as V-101.									
INTERCONNECTING CABLES											
W-101	Interconnecting Cable (For connecting Signal Generator Unit to Rectifier Power Unit)	CABLE: Complete assembly of parts (W-101A/B/C) as below.	CFD-62409		1	209-0	209-0		1	1	2
W-101A	Part of W-101	CABLE PART: 6-terminal plug.			1	215-303	215-303				
W-101B	Part of W-101	CABLE PART: 6-terminal socket.			1	215-304	215-304				
W-101C	Part of W-101	CABLE PART: 6-terminal shielded cable; 10½ ft. long (approx.)			1	209-1	209-1				
W-102	R-F Output Test Cord	CORD: 20″ shielded cable with 2 clips at one end and Plug P-102 (similar to P-101) at other end; 90 ohms impedance.	CG-506/U		1	209-10	209-10		1	1	2
W-103	Coaxial Insertion Cord for R-F Output (Patch Cord)	CORD: 3 ft. Coaxial Patch Cord with female coaxial connector at each end; either end can connect into J-102; 75 ohm impedence.	RG-11/u CG-505/U	Cable only JAN-C-17	1	209-20	209-20		1	1	2

SOCKETS

X-101	Socket for R-F Oscilator Tube (V-101)	SOCKET: Low-loss, ceramic; 5-prong.	CAXD-491827		19	291 Modified as per Contr. Dwg. 215-305	215-305		1	1	1
X-102	Socket for Separator Tube (V-102)	SOCKET: Phenolic; small; 6-prong.	CAXD-491825		19	2482 Modified as per Contr. Dwg. 215-307	215-307		1	1	1
X-103	Socket for R-F V-T V.M. Tube (V-103)	SOCKET: Low-loss; ceramic; for "Acorn" type tubes.	-38354		4	Code S-900	215-302		1	1	1
X-104	Socket for Mod. V-T V.M. Tube (V-104)	SOCKET: Phenolic; small; 5-prong.	CAXD-491826		19	2481 Modified as per Contr. Dwg. 215-306	215-306	X-104, X-105, X-201	2	2	3
X-105	Socket for Mod. Osc. Tube (V-105)	Same as X-104.									

PART II—RECTIFIER POWER UNIT—CFD-20080-A (201-299)

CAPACITORS

C-201	Input Filter Capacitor for R-F	CAPACITOR: Mica; 0.002 μf $\pm$ 10%; 500 volts D.C. working.	-48856-10	RE 48AA 143D	2	1 W-12020	215-116	C-201, C-202	1	2	2
C-202	Input Filter Capacitor for R-F.	Same as C-201.	-48856-10								
C-203	PowerFilterCapacitor	CAPACITOR: Paper; 2 μf $\pm$ 10%; 600 volts D.C. working.	-481005-10	RE 13A 488C	2	TDF-6020	215-105		1	2	3
C-204	PowerFilterCapacitor	CAPACITOR: Paper; 4 μf $\pm$ 10%; 600 volts D.C. working.	-481006-10	RE 13A 488C	2	TDF-6040	215-106		1	2	3

MISCELLANEOUS ELECTRICAL PARTS

E-201	Pilot Light Socket Assembly	Same as E-120.									
E-202	Pilot Light Jewel Assembly	Same as E-121.									

FUSES

F-201	Line Fuse	FUSE: 2.5 amp.	CFA-28112-2B5		14	7-AG	215-542	F-201, F-202	40	40	100
F-202	Line Fuse	Same as F-201.									

TABLE II—PARTS LIST BY SYMBOL DESIGNATIONS (Continued)

Symbol Desig.	Function	Description	Navy Type Number	Navy Spec. or Dwg. No.	Mfr.	Mfr. Desig.	Fed. Mfg. & Engr. Corp. Dwg. No.	All Symbol Designations Involved	SPARE PARTS Loran Equip. NXsr-40979	SPARE PARTS Tender NXsr-40979 NXsr-62309	SPARE PARTS Stock NXsr-40979 NXsr-62309
HARDWARE, SCREWS, ETC.											
H-201	Line Fuse Clips	FUSE CLIPS: ¼″.			20		215-511		1	1	4
H-202	Cabinet Feet	FOOT: Rubber; shock mounts			1	215-540	215-540		2	8	16
PILOT LAMPS											
I-201	Pilot Light	Same as I-101.									
JACKS AND RECEPTACLES											
J-201	Receptacle for Connection to Signal Generator Unit	RECEPTACLE: Heavy duty; fixed; 6-terminal.	CJC-491648-A		5	S-406-LAB Modified as per Contr. Dwg. 205-21-1	205-21-1		1	1	2
J-202	MotorBaseConnector	CONNECTOR: Phenolic; flush mounting; nickel-plated brass shell; 15 amp. 125 volts; 10 amp. 250 volts.	CG-491831		9	GE 2291	215-301		1	1	2
INDUCTORS											
L-201	Power Filter Inductor	INDUCTOR: Encased; potted; two iron-core coils; each 400 ohms approx. d.c. resistance; and 10 henrys approx. at full load.	CFD-304511		1	207-0	207-0		1	2	3
NAMEPLATES											
N-201	Type Plate	NAMEPLATE: Brass; nickel plated 0.025″ x 2″ x 3″.			1	205-17	205-17				
N-202	Not Used										
PLUGS											
P-201	Power Input Plug	PLUG: Black phenolic connector body; 15 amp. 125 volts; 10 amp. 250 volts; 0.4062″ cord hole; single circuit.	CG-491830		9	GE 2802	215-300		1	1	2

				RESISTORS							
R-201	Heater Current Adjusting Rheostat	RHEOSTAT: Wire-wound; no taper; resistance *increases* with clockwise rotation; 1.5 ohms; 6 watts.	CAG-635648		16	301-424	215-22		1	3	5
				SWITCHES							
S-201	POWER Switch	Same as S-101.									
				TRANSFORMERS							
T-201	Power Transformer	TRANSFORMER: Encased; potted; saturated core type. *Primary:* (#1 and #2) approx. 1.5 ohms d.c.; 103.5 to 126.5 volts; 0.9 to 2.0 amp.; 36 to 55 watts. *Secondary:* (#3 and #5 tapped at #4) approx. 1350 ohms d.c.; approx. 192 to 215 volts; 40 ma. d.c. *Secondary:* (#6 and #7) 0.2 ohm; 6.0 volts; 2.4 amp.	CFD-304510		1	206-0	206-0		1	2	3
				VACUUM TUBES							
V-201	Rectifier Tube	Same as V-104.	-38184								
				SOCKETS							
X-201	Socket for Rectifier Tube (V-201)	Same as X-104.									
				PART III—DUMMY ANTENNA UNIT—CFD-66017 (301-399)							
				CAPACITORS							
C-301	Series Capacitor	CAPACITOR: Mica; 0.0002 μf $\pm 5\%$; 250 volts D.C. working.	-481008-5		3	1465	215-112		1	1	1
C-302	Network Capacitor	CAPACITOR: Mica; 0.0004 μf $\pm 5\%$; 250 volts D.C. working.	-481009-5		3	1465	215-113		1	1	1

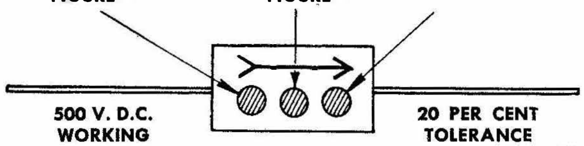
TABLE II—PARTS LISTS BY SYMBOL DESIGNATIONS (Continued)

Symbol Desig.	Function	Description	Navy Type Number	Navy Spec. or Dwg. No.	Mfr.	Mfr. Desig.	Fed. Mfg. & Engr. Corp. Dwg. No.	All Symbol Designations Involved	SPARE PARTS Loran Equip. NXsr-40979	SPARE PARTS Tender NXsr-40979 NXsr-62309	SPARE PARTS Stock NXsr-40979 NXsr-62309
				INDUCTORS							
L-301	Inductor of Dummy Antenna Unit	INDUCTOR: Special; 20 microhenries.	CFD-472202		1	210-9	210-9		1	2	3
				NAMEPLATES							
N-301	Type Plate	NAMEPLATE: Brass; nickel plated; 0.025″ x 2⅝″ x 1 11/16″.			1	210-12					
				DUMMY ANTENNA UNIT							
P-301	Terminates Output of Signal Generator	DUMMY ANTENNA UNIT: Complete assembly.	CFD-66017		1	210-0	210-0		0	1	2
				RESISTORS							
R-301	Resistor of Dummy Antenna Unit	RESISTOR: Fixed; composition; pigtail; 400 ohms ±5%; ½ watt.	-63355	RE 13A 346V	11	BT-½	215-4		1	2	3
				PART IV—10:1 ATTENUATOR UNIT—CFD-63710 (401-499)							
				NAMEPLATE							
N-401	Type Plate	NAMEPLATE: Brass; nickel plated; 0.025″ x 2⅝″ x 1 11/16″.			1	210-22	210-22				
				ATTENUATOR UNIT							
P-401	Attenuates Output to 10:1 Ratio	10:1 ATTENUATOR UNIT: Complete assembly.	CFD-63710		1	210-20	210-20		1	1	2
				RESISTORS							
R-401	Resistor for Attenuator Pad	RESISTOR: Special; # 38 manganin bare wire; approx. ¾″ long; 1.11 ohm ±2%. *Not furnished as a spare part due to difficulty in calibration.*			1	210-23	210-23				

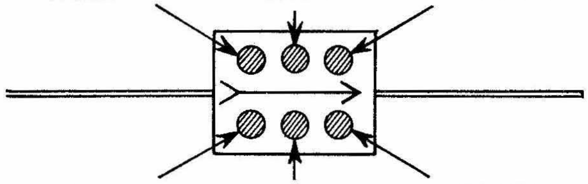
TABLE III—APPLICABLE COLOR CODES FOR CAPACITORS AND RESISTORS

COLOR CODE FOR CAPACITORS (MMFD)

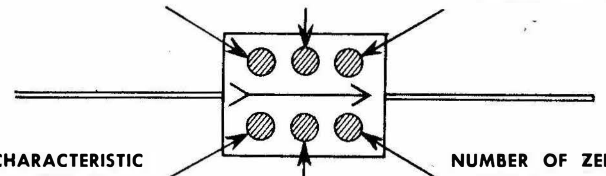
RMA 3 DOT CODE



RMA 6 DOT CODE



ASA 6 DOT CODE AS PER JAN-C-5



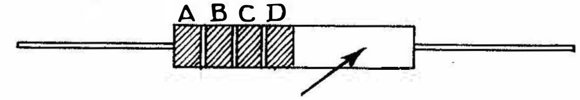
COLOR	NUMERAL	VOLTS*	MULTIPLIER	CHARACTERISTIC LETTER**	TOLERANCE
BLACK	0		1	A	20% (M)**
BROWN	1	100	10	B	1%
RED	2	200	100	C	2% (G)
ORANGE	3	300	1,000	D	3%
YELLOW	4	400	10,000	E	4%
GREEN	5	500	100,000	F	5%
BLUE	6	600	1,000,000	G	6%
VIOLET	7	700	10,000,000	—	7%
GRAY	8	800	100,000,000	—	8%
WHITE	9	900	1,000,000,000	—	9%
GOLD		1000	0.1	—	5% (J)
SILVER		2000	0.01	—	10% (K)
NO COLOR		500			20%

*Applies only to RMA Code. **Applies only to JAN-C-5 Code

COLOR CODE FOR RESISTORS (OHMS)

NEW COLOR ARRANGEMENT

RMA AND JAN-R-11 CODES



COLOR	A 1ST DIGIT	B 2ND DIGIT	C MULTIPLIER
SILVER			0.01
GOLD			0.1
BLACK		0	1.0
BROWN	1	1	10
RED	2	2	100
ORANGE	3	3	1,000
YELLOW	4	4	10,000
GREEN	5	5	100,000
BLUE	6	6	1,000,000
VIOLET	7	7	10,000,000
GRAY	8	8	100,000,000
WHITE	9	9	

D—TOLERANCE

GOLD = 5%(J) SILVER = 10%(K) NO COLOR = 20%(M)

BODY COLOR (New Color Arrangement Only)—Indicates Type of Resistor as Follows:

BLACK—Composition, Non-Insulated.
TAN, OLIVE OR WHITE—Composition, Insulated.
DARK BROWN—Wire-wound, Insulated.

OLD COLOR ARRANGEMENT

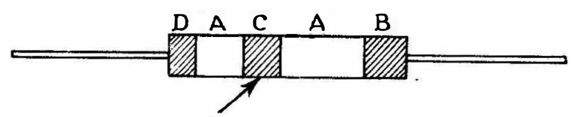


TABLE IV—LIST OF MANUFACTURERS

(As given by Key Number—Column 6—of Table II)

Key Number	Mfr. Prefix	Manufacturers Name	Address
1	CFD	Federal Manufacturing & Engineering Corp.	Brooklyn, New York
2	CD	Cornell-Dubilier Corp.	South Plainfield, N. J.
3	CAW	Aerovox Corp.	New Bedford, Mass.
4	CHC	Hammarlund Mfg. Company	New York, N. Y.
5	CJC	Howard B. Jones	Chicago, Ill.
6	—	Drake Manufacturing Co.	Chicago, Ill.
7	—	Aluminum Goods Manufacturing Company	Manitowoc, Wisc.
8	CUF	United Carr Fastener Co.	Cambridge, Mass.
9	CG	General Electric Co.	Schenectady, N. Y.
10	CNA	National Company, Inc.	Malden, Mass.
11	CIR	International Resistance Corp.	Philadelphia, Pa.
12	CRC	RCA Mfg. Co. (Radiotron Div.)	Harrison, N. J.
14	CFA	Bussmann Mfg. Co.	St. Louis, Mo.
15	CAY	Westinghouse Elec. & Mfg. Co.	Baltimore, Md.
16	CAG	General Radio Co.	Cambridge, Mass.
17	—	Kurz-Kasch, Inc.	Dayton, Ohio
18	CTN	Teleradio Engineering Corp.	New York, N. Y.
19	—	Insuline Corp.	New York, N. Y.
20	—	Star Fuse Company, Inc.	New York, N. Y.
21	CJA	James Millen Mfg. Co., Inc.	Malden, Mass.

SECTION VII

PHOTOGRAPHS AND DRAWINGS

1. GENERAL.

a. The photographic illustration and drawings which appear on the following pages are divided into five groups as follows:

(1) Figures 7-1 to 7-5 inclusive show various *interior* views of the Signal Generator Unit.

(2) Figures 7-6 to 7-8 inclusive show various *interior* view of the Rectifier Power Unit.

(3) Figures 7-9 to 7-12 inclusive illustrate the various auxiliary items supplied, namely:

Dummy Antenna Unit—Figure 7-9

10:1 Attenuator Unit—Figure 7-10

Interconnecting Cable (W-101), Output Test Cord (W-102),) Patch Cord (W-103) and Concentric Plug (P-101) — Figure 7-11

Method of Stowing Interconnecting Cable (W-101), Output Test Cord (W-102), Patch Cord (W-103), and Concentric Plug (P-101) on Panel of the Signal Generator—Figure 7-12

(4) Figure 7-13 gives the panel views of the Rectifier Power Unit and Signal Generator Unit. Constant reference is made to this figure in Section III—OPERATION, and Section IV—THEORY OF OPERATION and it is therefore printed on a fold-in page for the conveniences of the reader.

(5) Figure 7-14 is the practical wiring diagram of the LP-5 Signal Generator Equipment.

b. The combination schematic and practical wiring diagram of the LP-5 Signal Generator Equipment (Fig. 7-14) appearing in this section is discussed in Section V—MAINTENANCE, Par. 5. As is there stated the wires and cables used in manufacturing the Signal Generator are numbered rather than color coded. Each end of every wire contains a number in a square box, and by making use of the diagram each wire can be traced without the use of any instrument.

c. Reference is also made to this wiring diagram (Figure 7-14) at many places throughout the Instruction Book especially in Section IV—THEORY OF OPERATION and Section V—MAINTENANCE, and it is for the convenience of the reader that it is printed on a fold-in page at the back of the book.

d. All individual parts and units shown by the above photographic illustrations and drawings are identified by the Symbol Designations used throughout the text of the Instruction Book and are listed fully in Section VI—PARTS AND SPARE PARTS LISTS.

2. QUICK REFERENCE DATA LIST.

a. Opposite Figure 7-14 will be found QUICK REFERENCE DATA—ELECTRICAL PARTS. This list is intended to provide conveniently located data on capacitors, resistors, etc., but is not intended to take the place in any way of the complete PARTS AND SPARE PARTS LIST given in Sec. VI.

b. To make the same QUICK REFERENCE DATA—ELECTRICAL PARTS available for use with any of the illustrations throughout the Instruction Book it appears again on the fold-in page showing Figure 7-13.

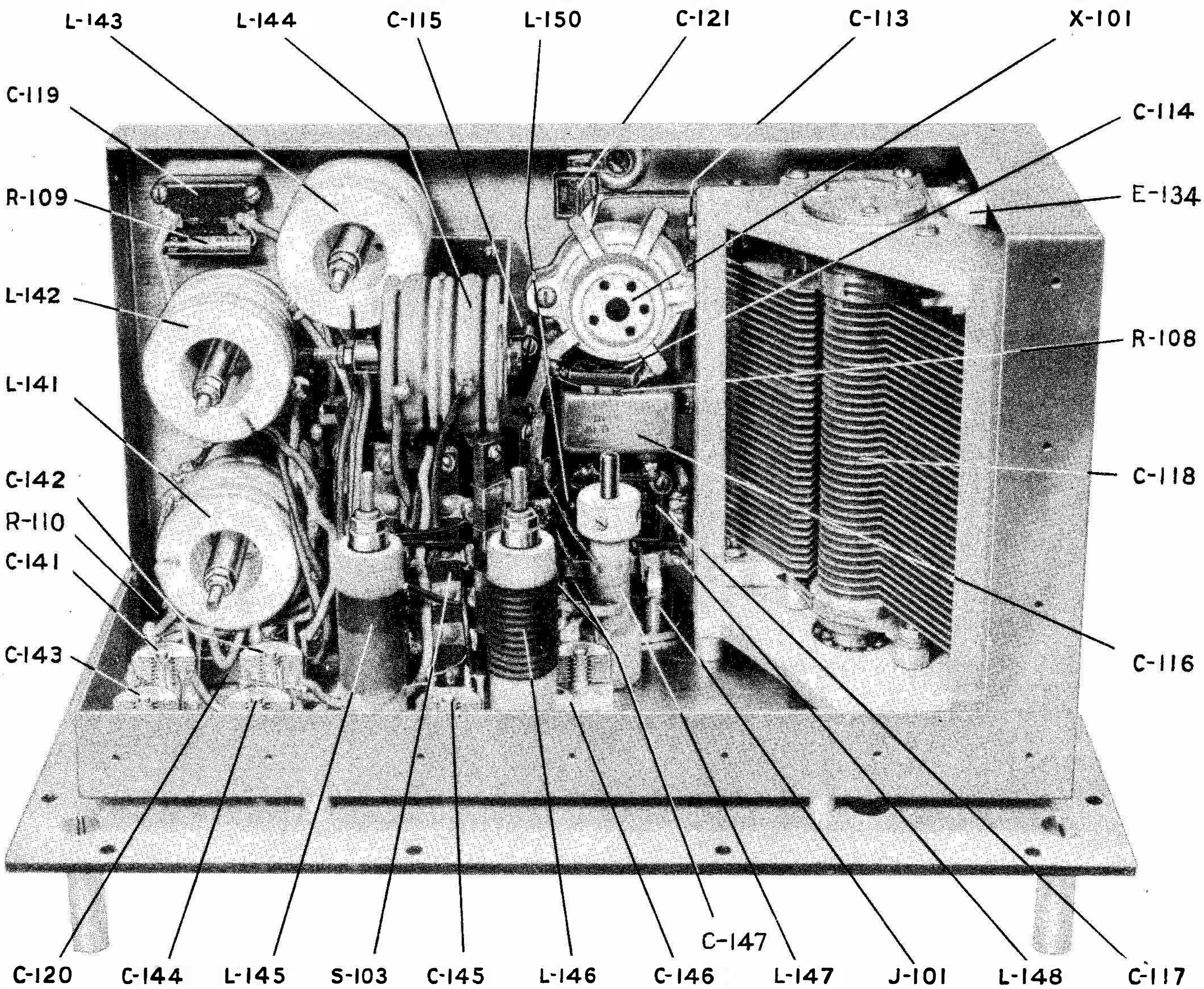


Figure 7-1—Interior View of the Signal Generator (Viewed from Above)

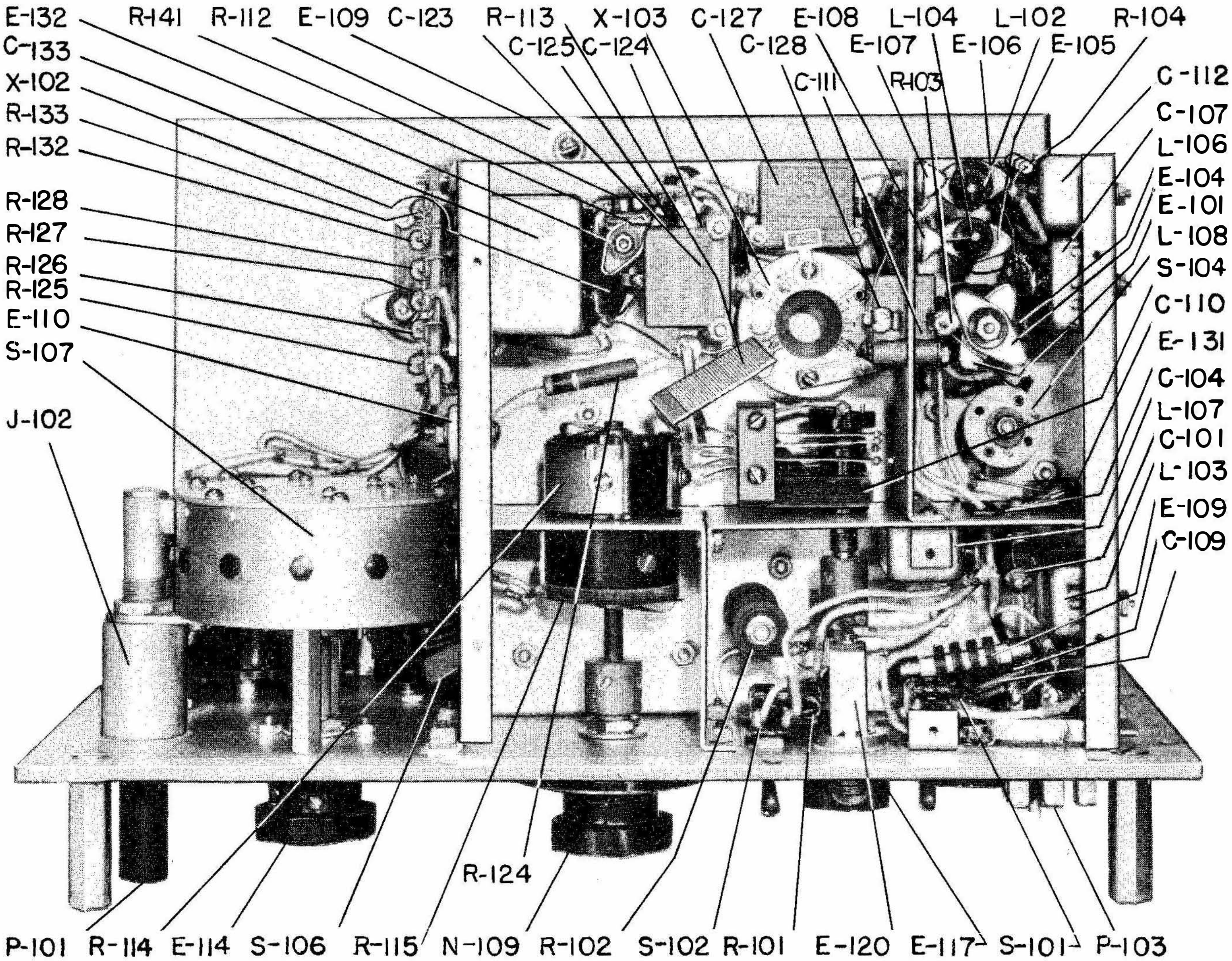


Figure 7-2—Interior View of the Signal Generator With Shield Plate Removed (Viewed from Underneath)

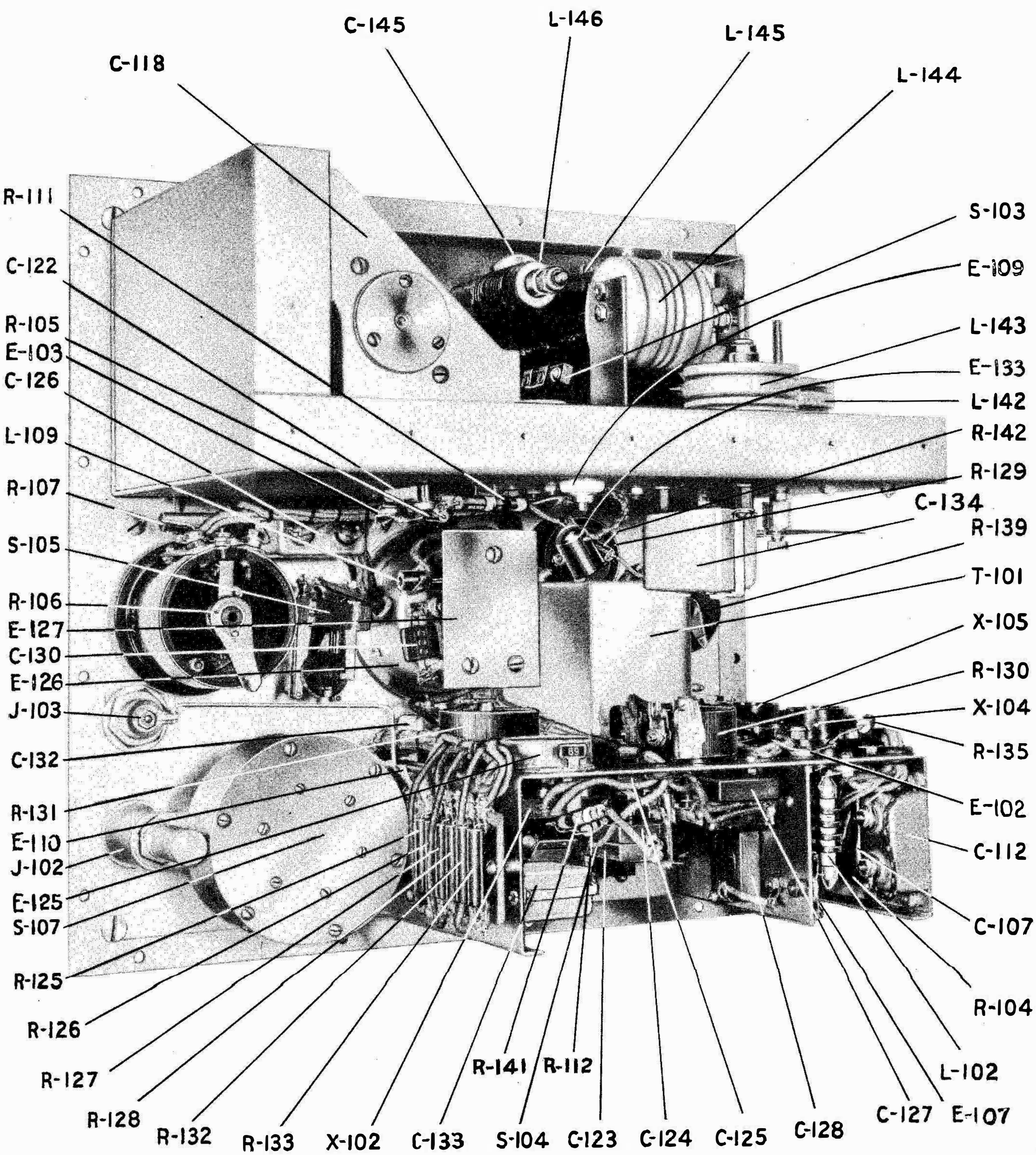


Figure 7-3—Interior View of the Signal Generator (Viewed from the Left)

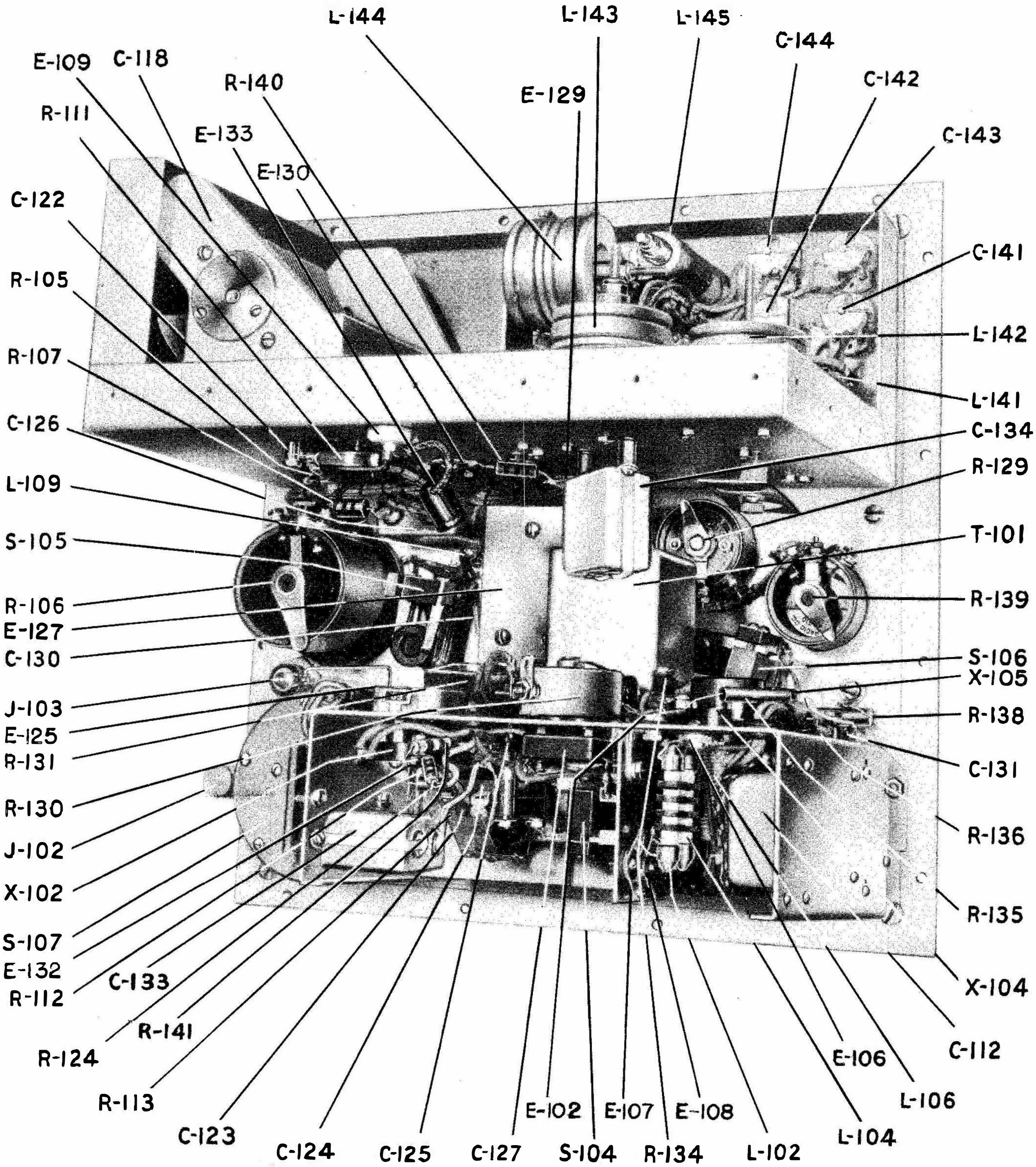


Figure 7-4—Interior View of the Signal Generator (Viewed from the Right)

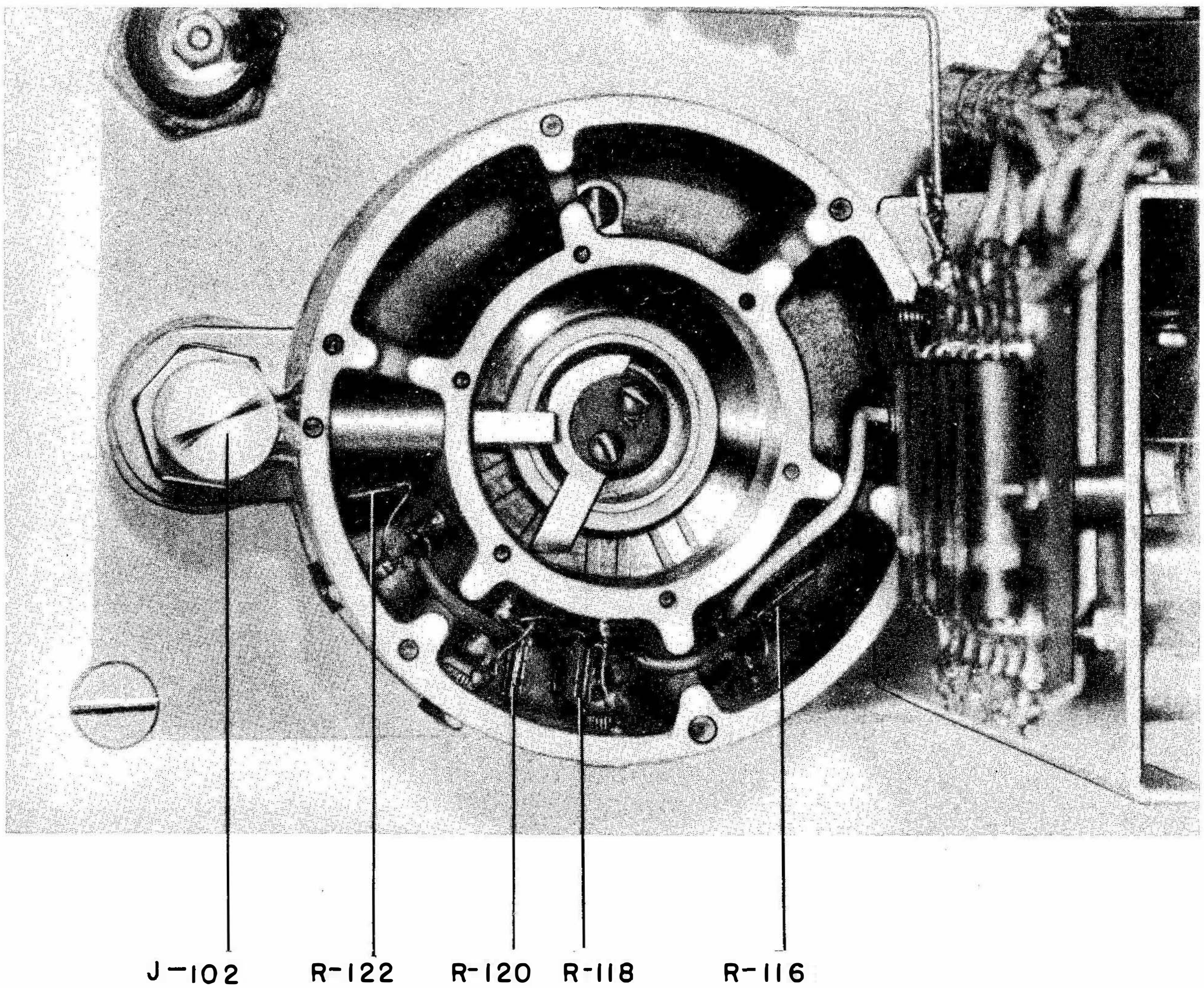


Figure 7-5—Interior View of Attenuator (S-107)

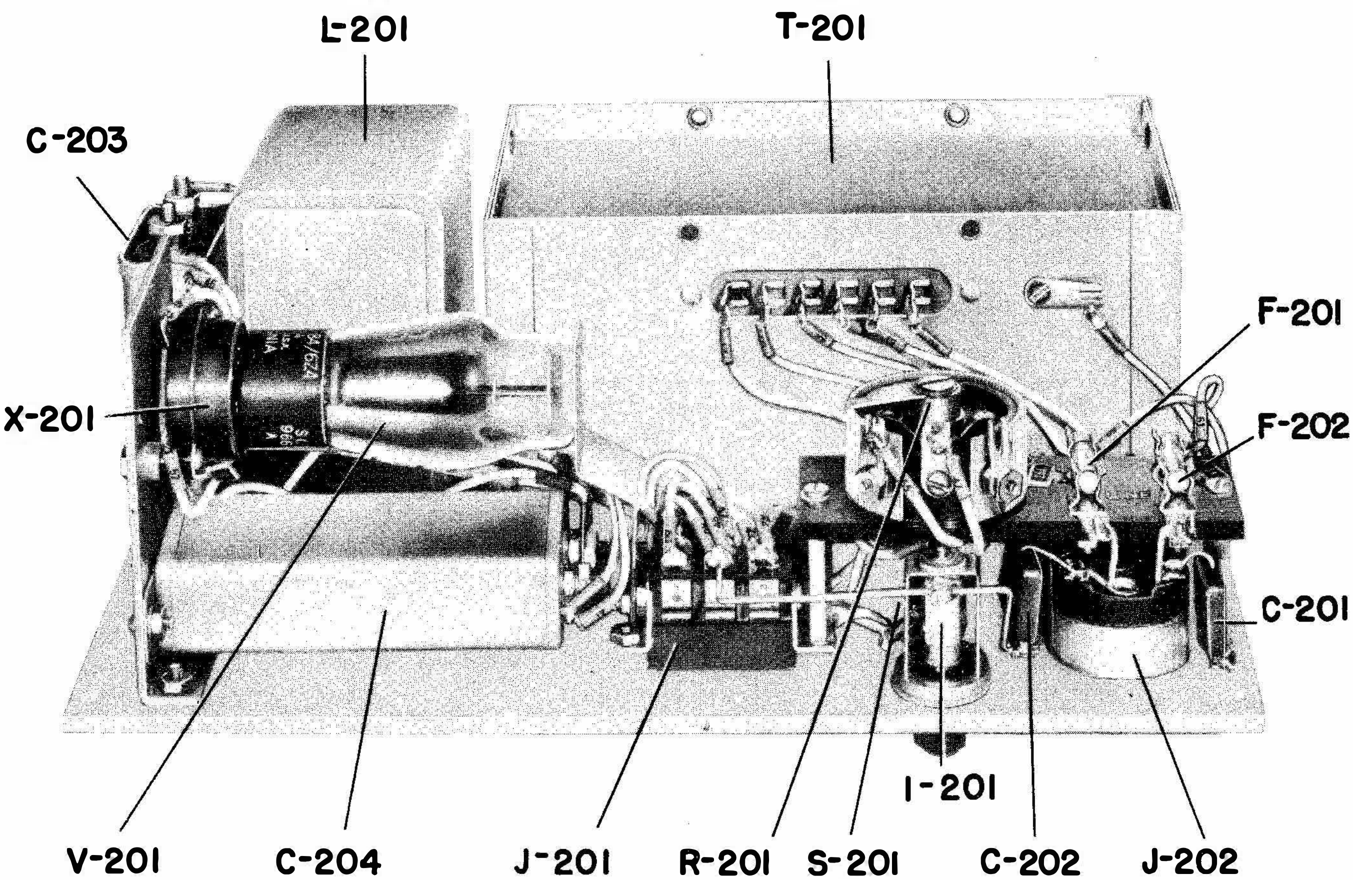


Figure 7-6—Interior View of the Rectifier Power Unit (Viewed from Underneath)

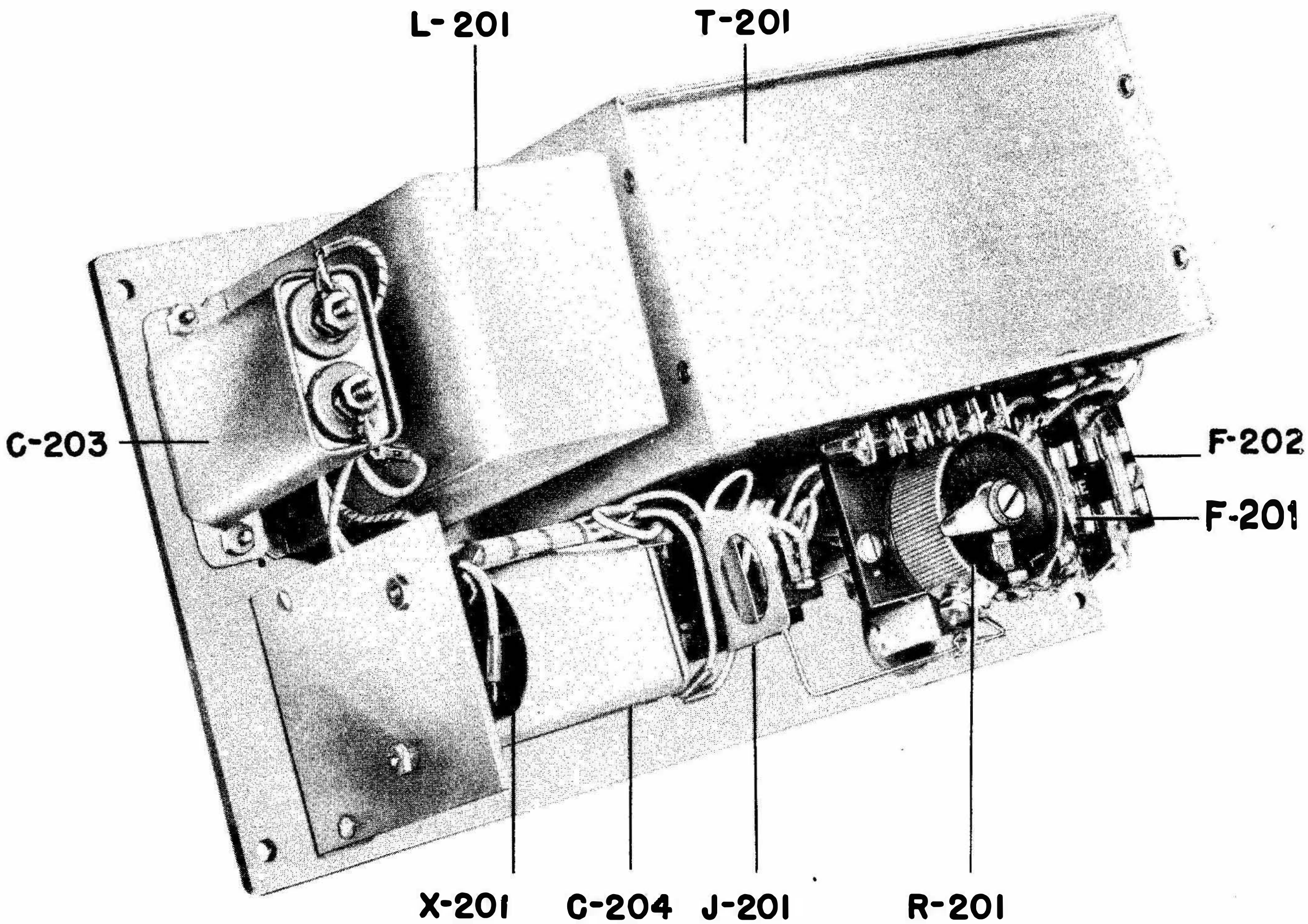


Figure 7-7—Interior View of the Rectifier Power Unit (Viewed from the Left)

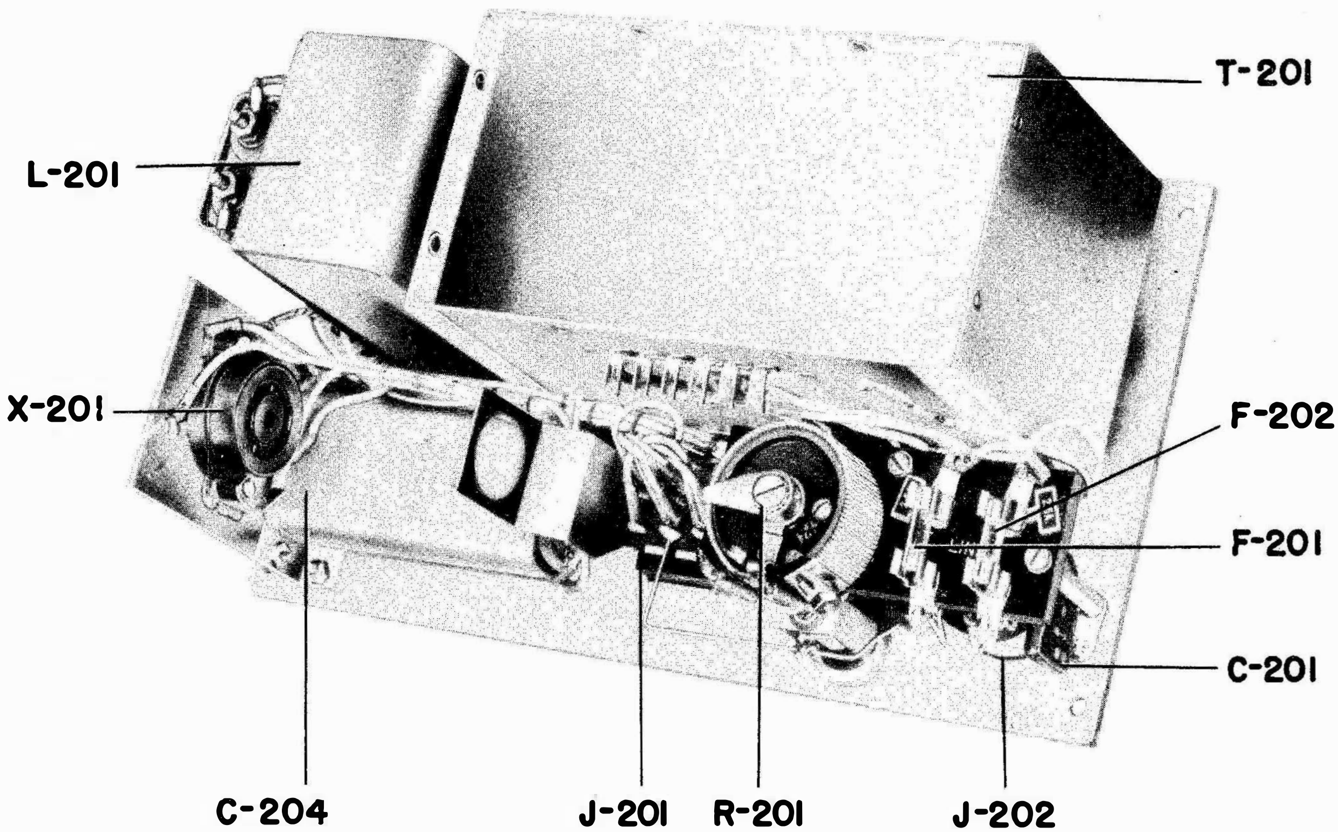
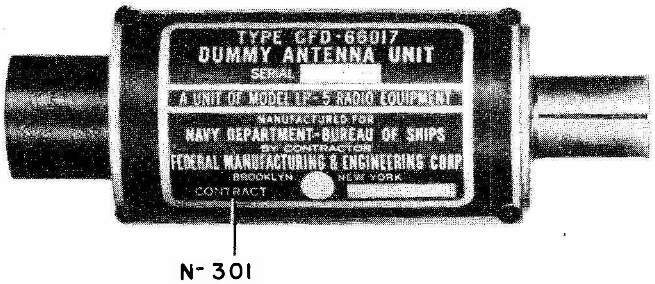


Figure 7-8—Interior View of the Rectifier Power Unit (Viewed from the Right)



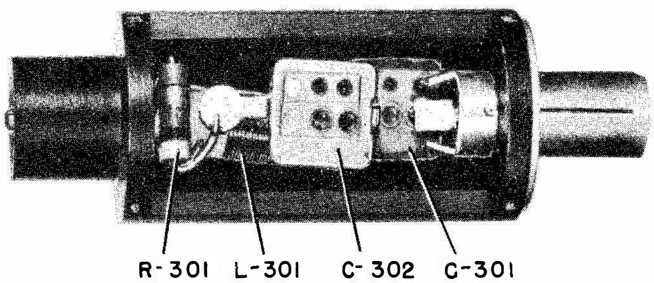
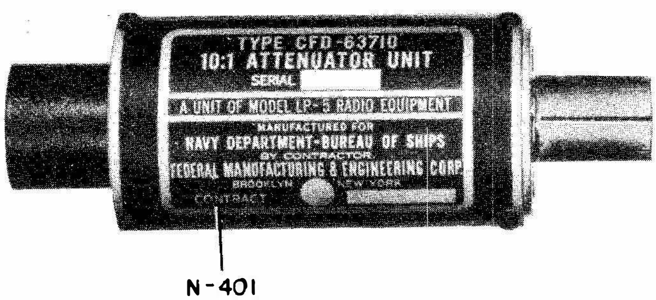


Figure 7-9—Exterior and Interior Views of the Dummy Antenna Unit



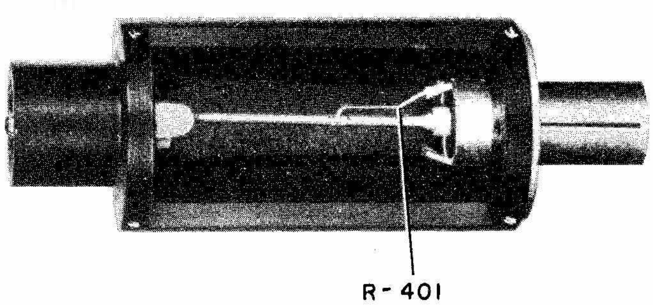


Figure 7-10—Exterior and Interior Views of the 10:1 Attenuator Unit

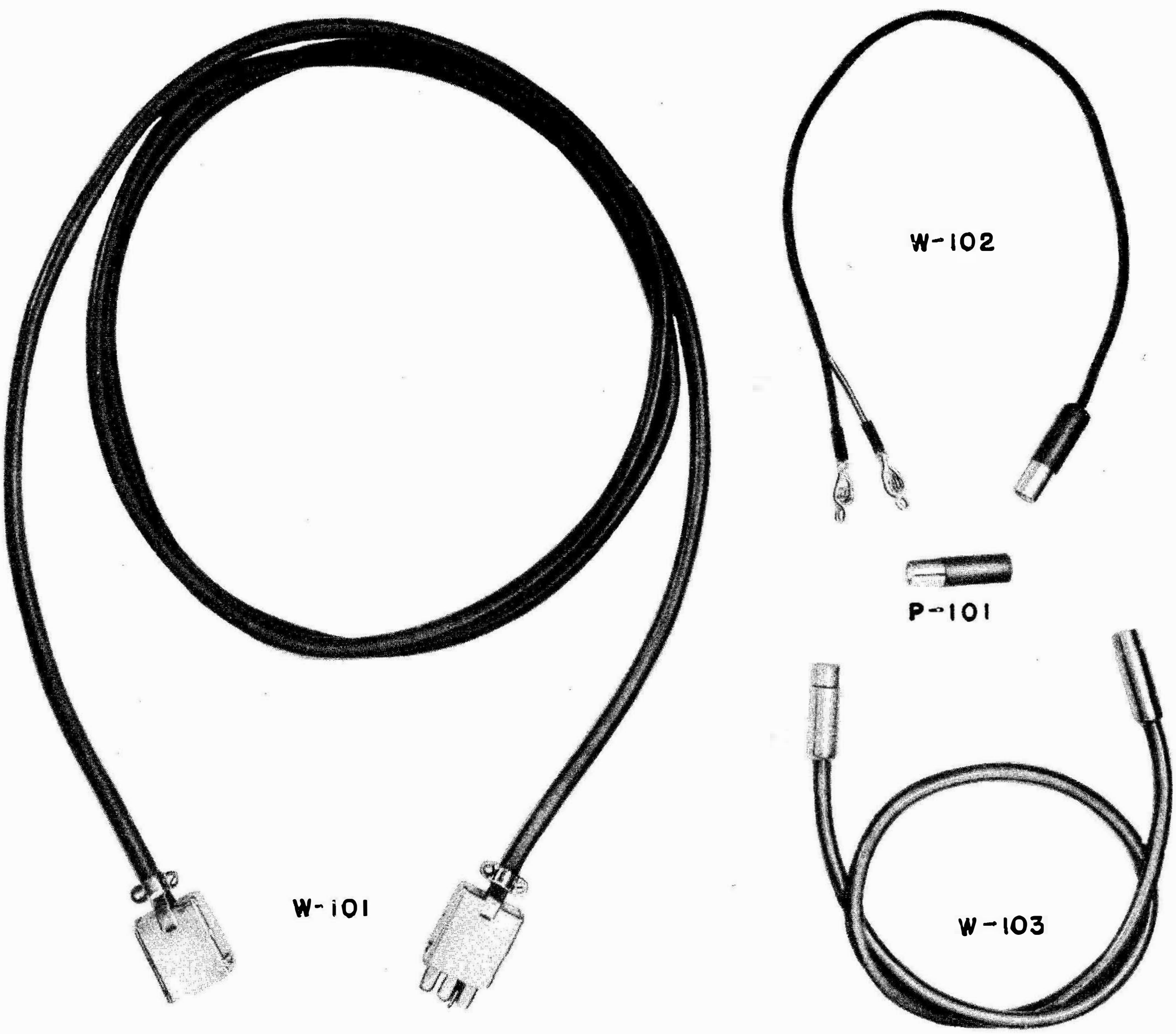
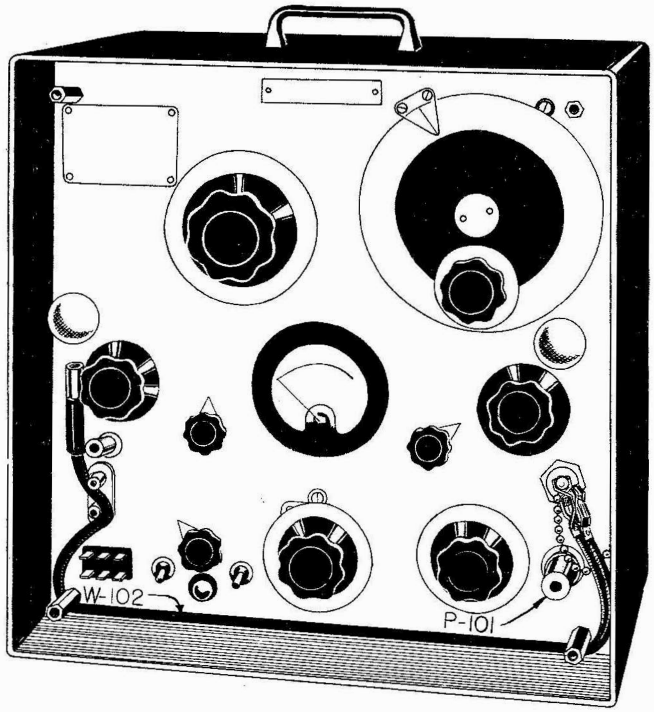
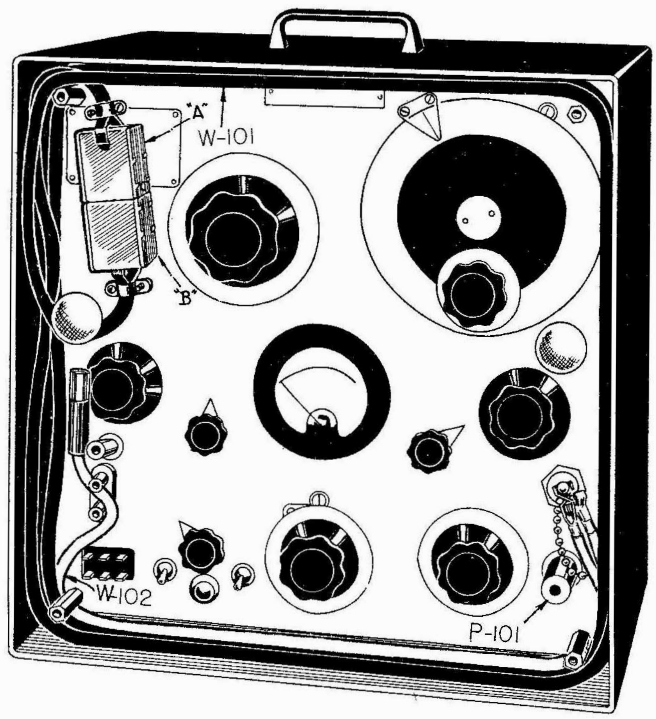


Figure 7-11—Interconnecting Cable (W-101), Output Test Cord (W-102), Patch Cord (W-103), and Concentric Plug (P-101)



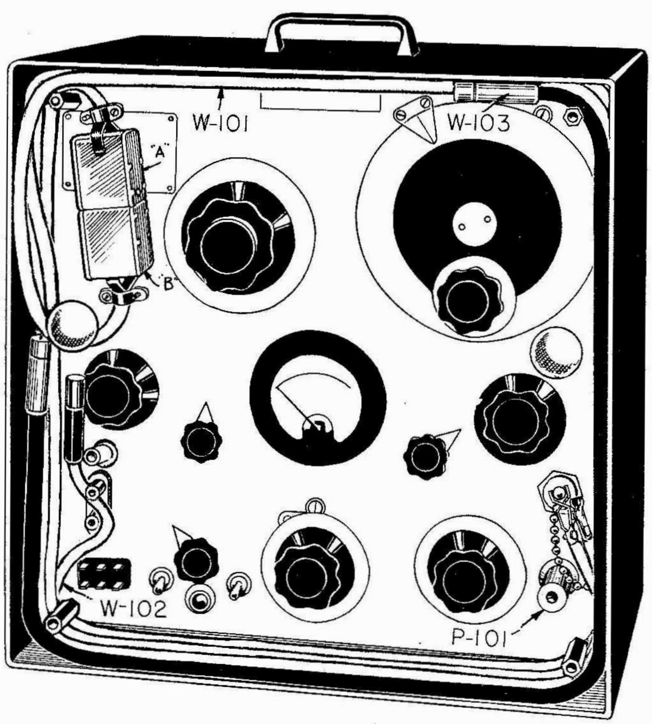
←FIRST STEP

The Output Test Cord (W-102) is first packed in the manner shown. The Concentric Plug (P-101) is also inserted as indicated.



SECOND STEP→

The Interconnecting Cable (W-101) is wound around outside of studs over the Output Test Cord (W-102) as shown. Be sure to start with "A" and wind down in a counterclockwise direction. On completion plug "A" and "B" together.



←THIRD STEP

The Patch Cord (W-103) is packed last. Start with either end in upper right hand corner above Frequency Tuning Dial and wind around studs as shown.

Figure 7-12—Method of Stowing Interconnecting Cable (W-101), Output Test Cord (W-102), Patch Cord (W-103), and Concentric Plug (P-101) on Panel of the Signal Generator

QUICK REFERENCE DATA—OPERATING CONTROLS & INDICATING PARTS

(For Use with Figure 7-13 Only—for Complete Parts List see Section VI)

RECTIFIER POWER UNIT (Top Illustration)

Symbol Designation	*Function**
E-202	Pilot Light Jewel Assembly (I-201)
J-201	Receptacle for Interconnecting Cable (W-101)
J-202	Motor Base Connector
N-201	Type Plate
P-201	Power Input Plug
S-201	POWER Switch

SIGNAL GENERATOR UNIT (Bottom Illustration)

Symbol Designation	*Function**
E-111	EXT-MOD. Terminals
E-112	Ground Terminal
E-113	Knob for FREQ. RANGE Switch (S-103)
E-114	Knob for MULTIPLIER (S-107)
E-115	Knob for CARRIER Potentiometer (R-106)
E-116	Knob for MODULATION Potentiometer (R-139)
E-117	Knob for NORMAL—EXTERNAL MOD. Switch (S-104)
E-118	Knob for METER READS Switch (S-105)
E-119	Knob for MODULATION Switch (S-106)
E-121	Pilot Light Jewel Assembly (I-101)
E-122	Indicator for Frequency Tuning Dial (Divisions Scale)
E-123	Indicator for Frequency Tuning Dial (Coil G)
E-124	Indicator for Frequency Tuning Dial (Coils A to F)
E-128	Indicator for MICROVOLTS Dial
H-102	Cover to Hole for R-F V.M. Adjustment (R-129)
H-103, H-104, H-105	Covers to Holes for Access to Main Capacitor Mount (C-118) Holes are Underneath Tuning Dial (N-107)
H-106	Cover to Hole for R-F Modulator Jack (J-101)
H-107	Cover for CONSTANT ONE VOLT Output Jack (J-103)
H-108, H-109	Knobs for Removing Panel from Cabinet
	Coil A Trimmer (C-141)
	Coil B Trimmer (C-142)
	Coil C Trimmer (C-143)
	Coil D Trimmer (C-144)
	Holes are Underneath Type Plate (N-102)
H-110	Cover to Hole for Coil E Trimmer (C-145)
H-111	Cover to Hole for Coil F Trimmer (C-146)
H-112	Cover to Hole for Coil G Trimmer (C-147)
J-101	R-F Modulation Jack
J-102	R-F Output Jack
J-103	R-F CONSTANT ONE-VOLT Output Jack
M-101	Carrier Output/Percent Modulation Meter
N-102	Type Plate (C-141; C-142; C-143; C-144)
N-103	Acceptance Plate
N-104	Dial Plate for FREQ. RANGE Switch (S-103)
N-105	Dial Plate for MULTIPLIER (S-107)
N-107	Frequency Tuning Dial (C-118)
N-108	Vernier (Percent Frequency-Increment) Dial and Knob
N-109	MICROVOLTS Dial and Knob Assembly (R-114; R-115)
P-101	Concentric Plug for R-F Freq. Mod Jack
P-103	Receptacle for Interconnecting Cable (W-101) to Rectifier Power Unit
S-101	POWER Switch
S-102	PLATE Switch
S-103	FREQ. RANGE Switch
S-104	NORMAL—EXTERNAL MOD. Switch
S-105	METER READS Switch
S-106	MODULATION Switch
S-107	MULTIPLIER Switch

* Symbol Designation in parenthesis, thus (S–103) indicate part controlled or covered. (See Figure 7-11 for Cables and Cords)

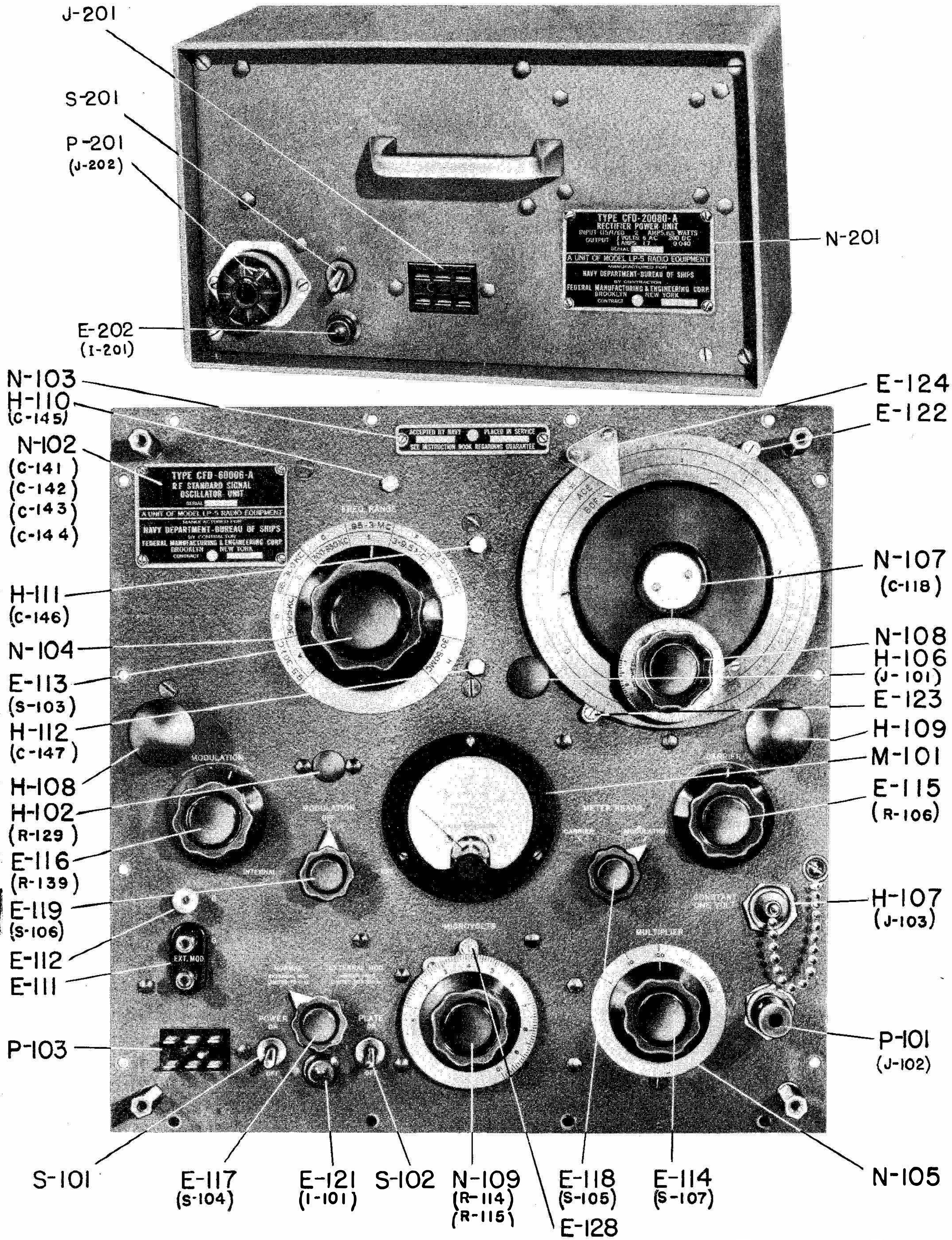


Figure 7-13—Panel Views of the Rectifier Power Unit (Top) and Signal Generator Unit Unit (Bottom)

QUICK REFERENCE DATA—OPERATING CONTROLS & INDICATING PARTS

(For Use with Figure 7-13 Only—for Complete Parts List see Section VI)

Symbol Designation	*Function**
	RECTIFIER POWER UNIT (Top Illustration)
E-202	Pilot Light Jewel Assembly (I-201)
J-201	Receptacle for Interconnecting Cable (W-101)
J-202	Motor Base Connector
N-201	Type Plate
P-201	Power Input Plug
S-201	POWER Switch
	SIGNAL GENERATOR UNIT (Bottom Illustration)
E-111	EXT-MOD. Terminals
E-112	Ground Terminal
E-113	Knob for FREQ. RANGE Switch (S-103)
E-114	Knob for MULTIPLIER (S-107)
E-115	Knob for CARRIER Potentiometer (R-106)
E-116	Knob for MODULATION Potentiometer (R-139)
E-117	Knob for NORMAL—EXTERNAL MOD. Switch (S-104)
E-118	Knob for METER READS Switch (S-105)
E-119	Knob for MODULATION Switch (S-106)
E-121	Pilot Light Jewel Assembly (I-101)
E-122	Indicator for Frequency Tuning Dial (Divisions Scale)
E-123	Indicator for Frequency Tuning Dial (Coil G)
E-124	Indicator for Frequency Tuning Dial (Coils A to F)
E-128	Indicator for MICROVOLTS Dial
H-102	Cover to Hole for R-F V.M. Adjustment (R-129)
H-103, H-104, H-105	Covers to Holes for Access to Main Capacitor Mount (C-118) Holes are Underneath Tuning Dial (N-107)
H-106	Cover to Hole for R-F Modulator Jack (J-101)
H-107	Cover for CONSTANT ONE VOLT Output Jack (J-103)
H-108, H-109	Knobs for Removing Panel from Cabinet
	Coil A Trimmer (C-141) Coil B Trimmer (C-142) Coil C Trimmer (C-143) Coil D Trimmer (C-144) } Holes are Underneath Type Plate (N-102)
H-110	Cover to Hole for Coil E Trimmer (C-145)
H-111	Cover to Hole for Coil F Trimmer (C-146)
H-112	Cover to Hole for Coil G Trimmer (C-147)
J-101	R-F Modulation Jack
J-102	R-F Output Jack
J-103	R-F CONSTANT ONE-VOLT Output Jack
M-101	Carrier Output/Percent Modulation Meter
N-102	Type Plate (C-141; C-142; C-143; C-144)
N-103	Acceptance Plate
N-104	Dial Plate for FREQ. RANGE Switch (S-103)
N-105	Dial Plate for MULTIPLIER (S-107)
N-107	Frequency Tuning Dial (C-118)
N-108	Vernier (Percent Frequency-Increment) Dial and Knob
N-109	MICROVOLTS Dial and Knob Assembly (R-114; R-115)
P-101	Concentric Plug for R-F Freq. Mod Jack
P-103	Receptacle for Interconnecting Cable (W-101) to Rectifier Power Unit
S-101	POWER Switch
S-102	PLATE Switch
S-103	FREQ. RANGE Switch
S-104	NORMAL—EXTERNAL MOD. Switch
S-105	METER READS Switch
S-106	MODULATION Switch
S-107	MULTIPLIER Switch

* Symbol Designation in parenthesis, thus (S-103) indicate part controlled or covered. (See Figure 7-11 for Cables and Cords)

QUICK REFERENCE DATA—ELECTRICAL PARTS

(For Complete Parts List See Table II, Section VI)

CAPACITORS

C101A/B/C. . .B−/Heater/B+ Lead Filt. Cap; 0.1/0.1/0.1 μf
C-104A/B/C. . .B−/B+/Heater Lead Filt. Cap; 0.1/0.1/0.1 μf
C-107A/B. . . .B−/B+ Lead Filter Capacitor. . . . .0.25/0.25 μf
C-109. . . .EXT. MOD. Filter Capacitor. . . . . .0.0005 μf
C-110. . . .EXT. MOD. Filter Capacitor. . . . . .0.0005 μf
C-111. . . .EXT. MOD. Filter Capacitor. . . . . .0.001 μf
C-112. . . .Separator Bias Filter Capacitor. . . . . .0.5 μf
C-113. . . .Heater Lead Filter Capacitor at V-101. . . . . . .0.02 μf
C-114. . . .R-F Oscillator Bias By-pass Capacitor. . . . . .0.005 μf
C-115. . . .R-F Oscillator Bias By-pass Capacitor. . . . . . .0.02 μf
C-116. . . .B+ Lead Filter Capacitor at V-101. . . . . .0.25 μf
C-117. . . .B+ Lead Filter Capacitor at V-101. . . . . .0.02 μf
C-118. . . .Main Tuning Capacitor (variable). . .1450-1500 μμf
C-119. . . .Coil "B" (L-142) Grid-Leak Cond. Cap. . . . . .0.02 μf
C-120. . . .Coil "A" (L-141) Grid-Leak Cond. Cap. . . . .0.02 μf
C-121. . . .Coupling Capacitor V-101 to V-102. . . .0.00002 μf
C-122. . . .By-pass Capacitor for Grid of V-102. . . . .0.0005 μf
C-123. . . .Coupling Capacitor from V-102 to V-103; 0.005 μf
C-124. . . .Coupling Capacitor from V-102 to V-103; 0.0005 μf
C-125. . . .B+ Lead Filter Capacitor at V-102. . . . . .0.02 μf
C-126. . . .Audio Coupling Capacitor. . . . . .1.0 μf
C-127. . . .R-F V-T V.M. Plate By-pass Capacitor. . . . . .0.02 μf
C-128. . . .R-F V-T V.M. Cathode By-pass Capacitor. . .0.02 μf
C-129. . . .Meter Filter Capacitor (minus terminal); 0.00025 μf
C-130. . . .Meter Filter Capacitor (plus terminal). . .0.00025 μf
C-131. . . .Mod. Osc. Grid-Leak Cond. Cap. . . . . .0.02 μf
C-132. . . .Mod. Osc. Tuning Capacitor. . . . . .0.1 μf
C-133. . . .B+ Lead Filter Capacitor at V-102. . . . . .1.0 μf
C-134. . . .B− Lead Filter Capacitor at R-142. . . . . .1.0 μf
C-141. . . .Trimmer Capacitor for L-141. . . . . 3.9 to 50 μμf
C-142. . . .Trimmer Capacitor for L-142. . . . . 3.9 to 50 μμf
C-143. . . .Trimmer Capacitor for L-143. . . . . 3.9 to 50 μμf
C-144. . . .Trimmer Capacitor for L-144. . . . . 3.9 to 50 μμf
C-145. . . .Trimmer Capacitor for L-145. . . . . 3.9 to 50 μμf
C-146. . . .Trimmer Capacitor for L-146. . . . . 3.9 to 50 μμf
C-147. . . .Trimmer Capacitor for L-147. . . . . .3 to 25 μμf
C-201. . . .Input Filter Cap. (R-F); 0.002 μf; 500 v.D.C. working
C-202. . . .Input Filter Cap. (R-F); 0.002 μf; 500 v.D.C. working
C-203. . . .Power Filter Capacitor. . . . 2 μf; 600 v.D.C. working
C-204. . . .Power Filter Capacitor. . . . 4 μf; 600 v.D.C. working

INDUCTORS

L-102. . . .B− Lead Filter Inductor. . 2.5 mh; 125 ma; 50 ohms
L-103. . . .B+ Lead Filter Inductor. . 2.5 mh; 125 ma; 50 ohms
L-104. . . .B+ Lead Filter Inductor. . 2.5 mh; 125 ma; 50 ohms
L-106. . . .Heater Lead Filter Inductor. . . . . . . 5 μh; 0.05 ohms
L-107. . . .EXT. MOD. Filter Inductor; 2.5 mh; 125 ma; 50 ohms
L-108. . . .EXT. MOD. Filter Inductor. . . . . . . .25 mh; 58 ohms
L-109A/B. .Meter+/Meter− Filter Inductor; 22 μh; 1.2 ohms

μf microfarads. μh microhenries. ma milliamperes.
μμf micromicrofarads. mh millhenries. kc kilocycles.

L-141. . . .Tuning Coil A. . . . . .9.5–30 kc
L-142. . . .Tuning Coil B. . . . . .30–95 kc
L-143. . . .Tuning Coil C. . . . . .95–300 kc
L-144. . . .Tuning Coil D. . . . . .300–950 kc
L-145. . . .Tuning Coil E. . . . . .950–3000 kc
L-146. . . .Tuning Coil F. .3000–9500 kc
L-147. . . .Tuning Coil G. . . . . .9500–30,000 kc
L-148A/B. .Grid/Plate Coil Tuning Coil H; 30,000-50,000 kc
L-150. . . .B+Lead Filter Induc. Bands G&H; 1.8 μh; 0.25 ohms
L-201. . . .Power Fil. Induc.; 400 ohms, d.c.; 10 henry (approx)

RESISTORS

R-101. . . .Bias Supply for Separator. . . . . .1000 ohms; 2 watts
R-102. . . .Dummy Load ("B" Supply PLATE-OFF); 5000 ohms
R-103. . . .EXT. MOD. Filter Term. Resis.; 10,000 ohms; 1 watt
R-104. . . .Bias RC Filter Resis. (V-102); 500,000 ohms; ½ watt
R-105. . . .Bias RC Filter Resis. (V-102); 500,000 ohms; ½ watt
R-106. . . .Carrier Control. . . . . .0 to 15,000 ohms; 8 watts
R-107. . . .Load Compen. for "B" Supply; 30,000 ohms; 2 watts
R-108. . . .R-F Oscillator Bias Resistor. . . . .450 ohms; ½ watt
R-109. . . .Grid-Leak Bias Resistor. . . . . .100,000 ohms; 1 watt
R-110. . . .Grid-Leak Bias Resistor. . . . . .750,000 ohms; 1 watt
R-111. . . .Grid Resistor for V-102. . . . . . .50,000 ohms; 1 watt
R-112. . . .Separator Tube Load Resistor; 2,000 ohms; ½ watt
R-113. . . .Attenuator Resistor. .450 ohms
R-114. . . .Variable Network of Attenuator. . 50 ohms; 2 watts
R-115. . . .Variable Network of Attenuator; 95 ohms; 1½ watts
R-116A/B. . . .Attenuator Fixed Resistor. . . . . .95/11.7 ohms
R-118A/B. . . .Attenuator Fixed Resistor. . . . . .99/12.2 ohms
R-120A/B. . . .Attenuator Fixed Resistor. . . . . .99/12.2 ohms
R-122A/B. . . .Attenuator Fixed Resistor. . . . . . . .99/11 ohms
R-124. . . .Coupling Resistor to J-103. . . . . . . 500 ohms, 1 watt
R-125. . . .Plate Supply Resistor to V-103; 100,000 ohms; 1 watt
R-126. . . .R-F V-T V.M. Circuit Resistor; 20,000 ohms; 1 watt
R-127. . . .R-F V-T V.M. Circuit Resistor. . . . 500 ohms; 1 watt
R-128. . . .R-F V-T V.M. Circuit Resistor; 10,000 ohms; 1 watt
R-129. . . .Zero Adj. (R-F V-TV.M.) . . . . . . 1,000 ohms; 6 watts
R-130. . . .Sensitivity Adj. (R-F V-TV.M.); 1,000 ohms; 6 watts
R-131. . . .Sensitivity Adj. (A-F V-TV.M.); 2,500 ohms; 6 watts
R-132. . . .Mod. V-T V.M. Resistor. . . . . . 10,000 ohms; 1 watt
R-133. . . .Mod. V-T V.M. Resistor. . . . . . 10,000 ohms; 1 watt
R-134. . . .Mod. V-T V.M. Heater Resistor. . . . 8 ohms; 2 watts
R-135. . . .Mod. V-T V.M. Cath. Resistor. . . 2,500 ohms; 1 watt
R-136. . . .Mod. Osc. Grid Resistor. . . . . 2 megohm; ½ watt
R-137. . . .Mod. Osc. Cathode Bias Resistor; 450 ohms; ½ watt
R-138. . . ."B" Supply Dummy Load. . . . 35,000 ohms; 2 watts
R-139. . . .Modulation Control. . . . .0 to 10,000 ohms; 3 watts
R-140. . . .B− Lead RC Filter Resistor . . . .100 ohms; ½ watt
R-141. . . .RC Filter Resistor for V-102
Screen Grid. . . . . .20,000 ohms; ½ watt
R-142. . . .B− Lead RC Filter Resistor. . . . .100 ohms; ½ watt
R-201. . . .Heater Current Adjusting Rheostat; 1.5 ohms; 6 watts

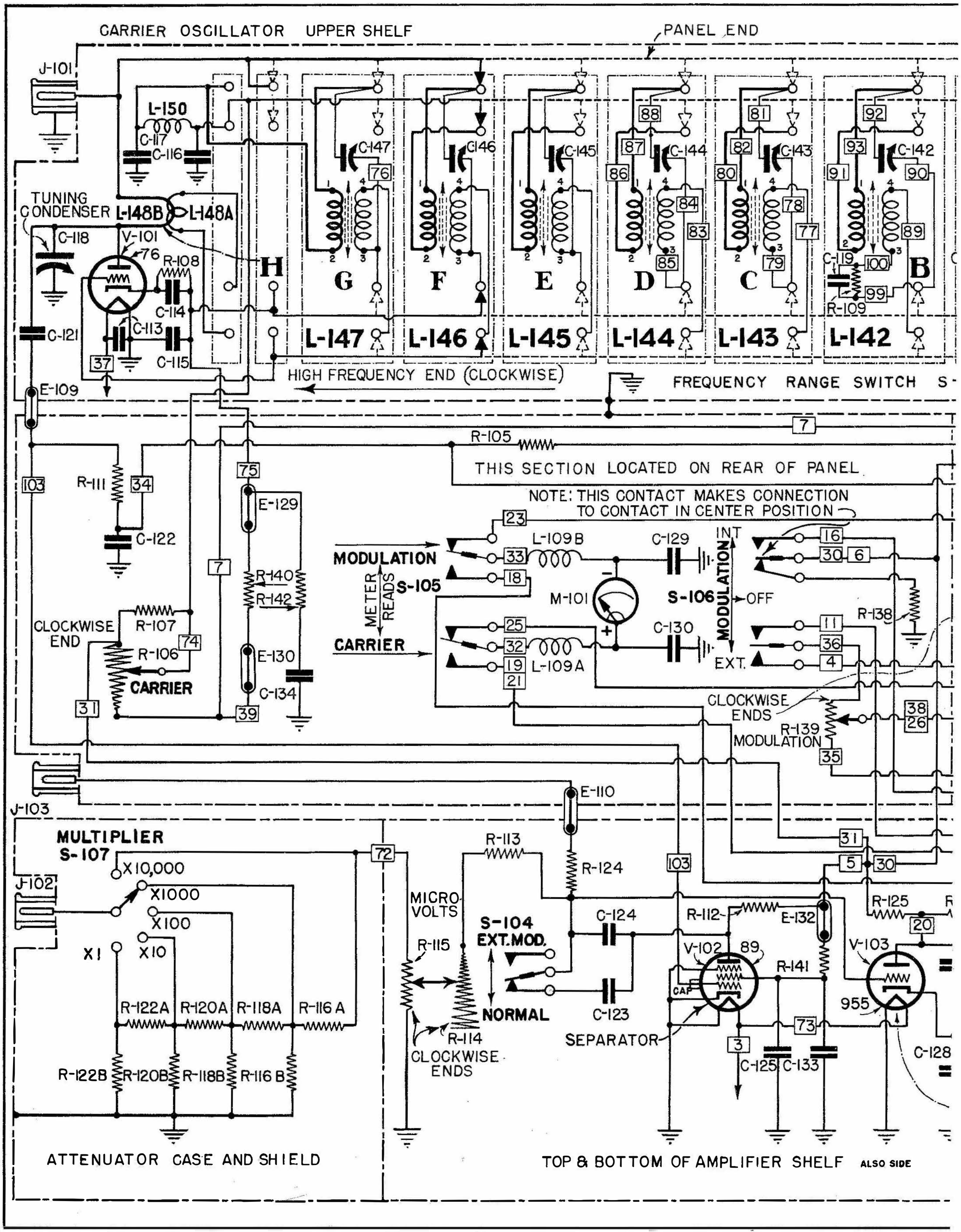
CONNECTORS, JACKS, METERS, SWITCHES, VACUUM TUBES, ETC.

E-101. . . .Heater Filter Lead Connector (L-106)
E-102. . . .Connector for Resistor (R-135)
E-103. . . .Connector for Resistor (R-105)
E-104. . . .Heater Filter Lead Connector (L-106)
E-105. . . .B+ Filter Lead Connector (L-104)
E-106. . . .B− Filter Lead Connector (L-102)
E-107. . . .B− Filter Lead Connector (L-102)
E-108. . . .B+ Filter Lead Connector (L-104)
E-109. . . .Bushing (Connects R-F Osc. to Separator Output Jack)
E-110. . . .Bushing (Connects Resistor R-124 to J-103)
E-129. . . .Connector for Resistor R-140
E-130. . . .Connector for Resistor R-140
E-131. . . .Feed-through Insulator for EXT. MOD. Filter
E-132. . . .Connector for R-112, R-141
F-201, F-202. . . .Line Fuses; 2.5 amp. each
I-101, I-201 . . . . Pilot Lights

J-101. . . .R-F Freq. Mod. Jack
J-102. . . .R-F Output Jack
J-103. . . .R-F CONSTANT ONE-VOLT Output Jack
J-201. . . .Receptacle (Connection to Generator)
J-202. . . .Motor Base Connector
M-101. . .Carrier Level Meter,/Modulation Meter. . . . . .0 to 200 microamp. D.C.
P-103. . . Receptacle (Connection to Power Unit)
S-101. . . .POWER Switch. . D.P.S.T.; 3 amp. at 125 volts
S-102. . . .PLATE Switch. . S.P.D.T.; 3 amp. at 125 volts
S-103. . . .FREQ. RANGE Switch. Special: gauge of 8 positions
S-104. . . .NORMAL—EXTERNAL MOD. Switch. . . . . D.P.D.T.; one pole used
S-105. . . .METER READS Switch. . . . . .D.P.D.T.

S-106. . . .MODULATION Switch. . . . . .D.P.; 3 positions
S-107. . . .MULTIPLIER Switch. . . . . .Special; 5 positions
S-201. . . .POWER Switch. . D.P.S.T.; 3 amp. at 125 volts
T-101. . . .Modulation Transformer. . . See Table II, Sect. VI
T-201. . PowerTransformer. See Table II, Sect. VI
V-101. . . . Carrier (R-F) Oscillator Tube. Type 76
V-102. . . . Separator Tube. . . . . .Type 89
V-103. . . . Carrier V-T Voltmeter Tube. Type 955
V-104. . . . Modulation V-T Voltmeter Tube. . . . . .Type 84
V-105. . . . Modulation (A-F) Oscillator Tube. . . . . .Type 76
V-201. . . . Rectifier Tube. . . . . .Type 84

For complete Vacuum Tube Operating Data see Section V.


CARRIER OSCILLATOR UPPER SHELF
PANEL END
J-101
L-150
C-117
C-116
TUNING CONDENSER
L-148B
L-148A
C-118
V-101
76
R-108
C-114
C-113
C-115
C-121
37
E-109
H
G
F
E
D
C
B
L-147
L-146
L-145
L-144
L-143
L-142
C-147
C-146
C-145
C-144
C-143
C-142
C-119
R-109
HIGH FREQUENCY END (CLOCKWISE)
FREQUENCY RANGE SWITCH
R-105
THIS SECTION LOCATED ON REAR OF PANEL
NOTE: THIS CONTACT MAKES CONNECTION TO CONTACT IN CENTER POSITION
R-111
C-122
E-129
R-140
R-142
E-130
C-134
CLOCKWISE END
R-107
R-106
CARRIER
MODULATION
METER READS
S-105
L-109B
L-109A
M-101
C-129
C-130
INT
S-106
MODULATION
OFF
EXT.
R-138
CLOCKWISE ENDS
R-139
MODULATION
J-103
E-110
MULTIPLIER
S-107
X10,000
X1000
X100
X10
X1
J-102
R-122A
R-120A
R-118A
R-116 A
R-122B
R-120B
R-118B
R-116 B
ATTENUATOR CASE AND SHIELD
R-113
R-124
MICRO-VOLTS
R-115
R-114
CLOCKWISE ENDS
S-104
EXT.MOD.
NORMAL
C-124
C-123
SEPARATOR
R-112
E-132
V-102
89
CAP
R-141
C-125
C-133
R-125
V-103
955
C-128
TOP & BOTTOM OF AMPLIFIER SHELF ALSO SIDE

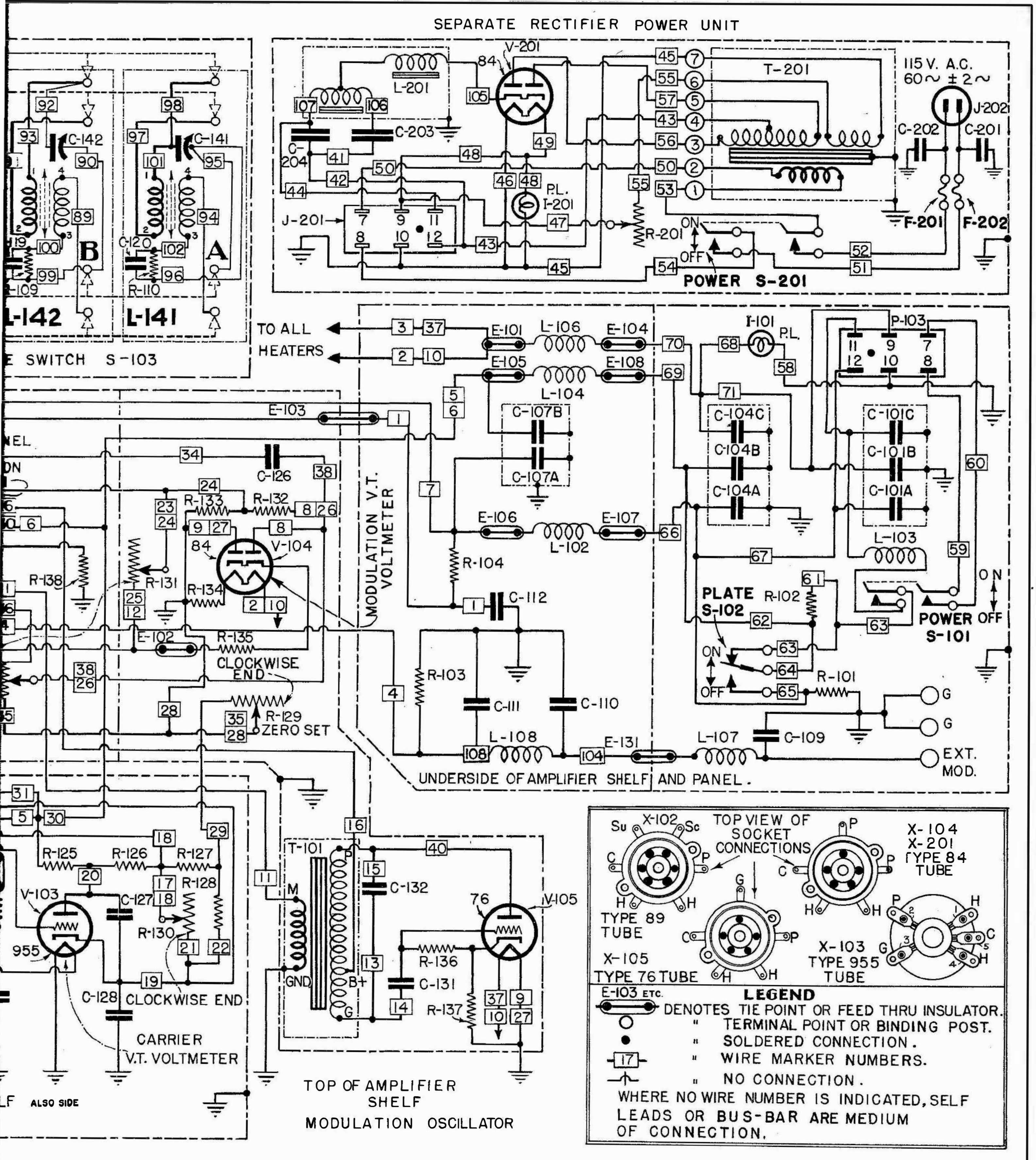


Figure 7-14—Practical Wiring Diagram of the LP-5 Signal Generator Equipment

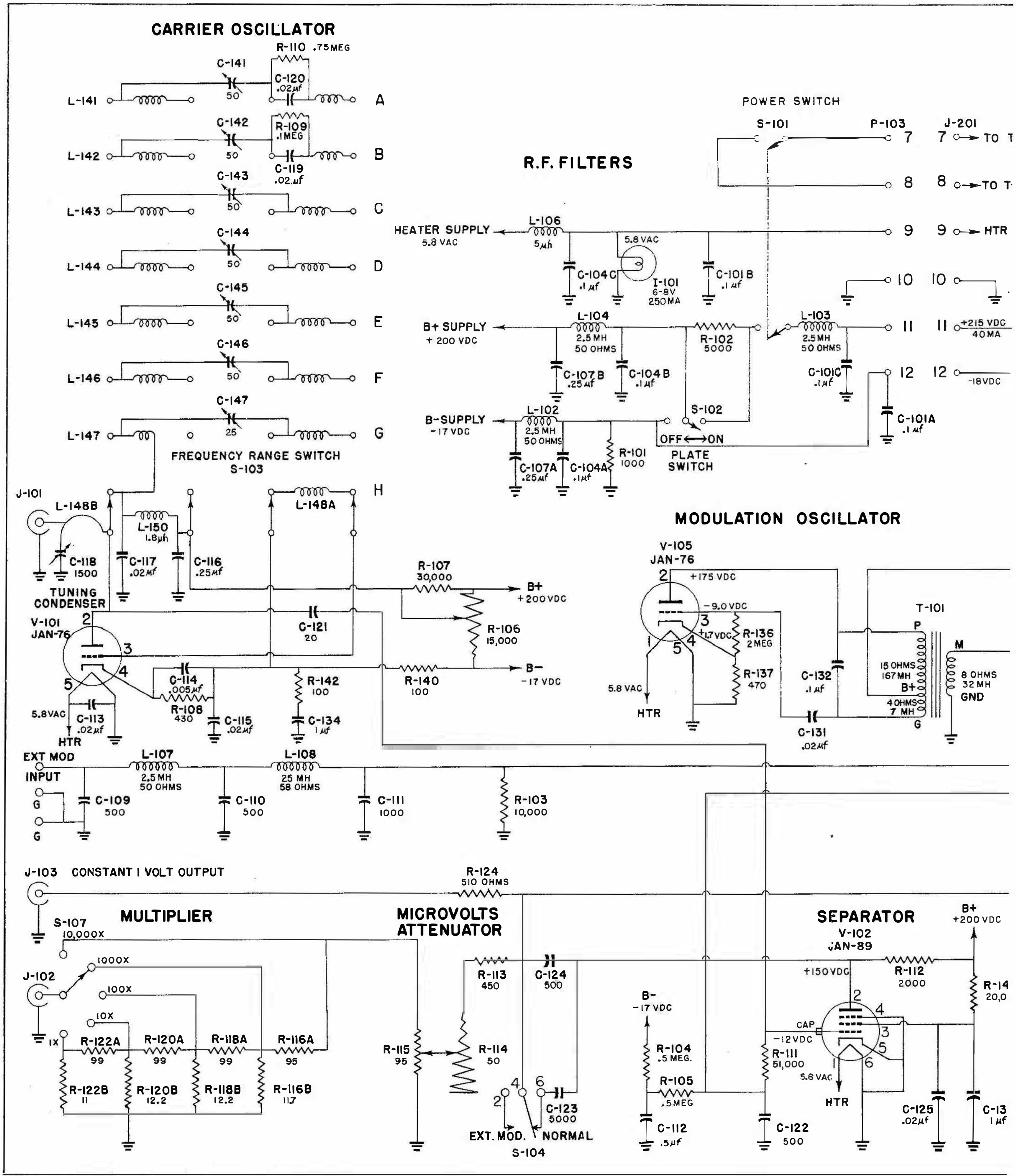


Figure 7-15—Schem

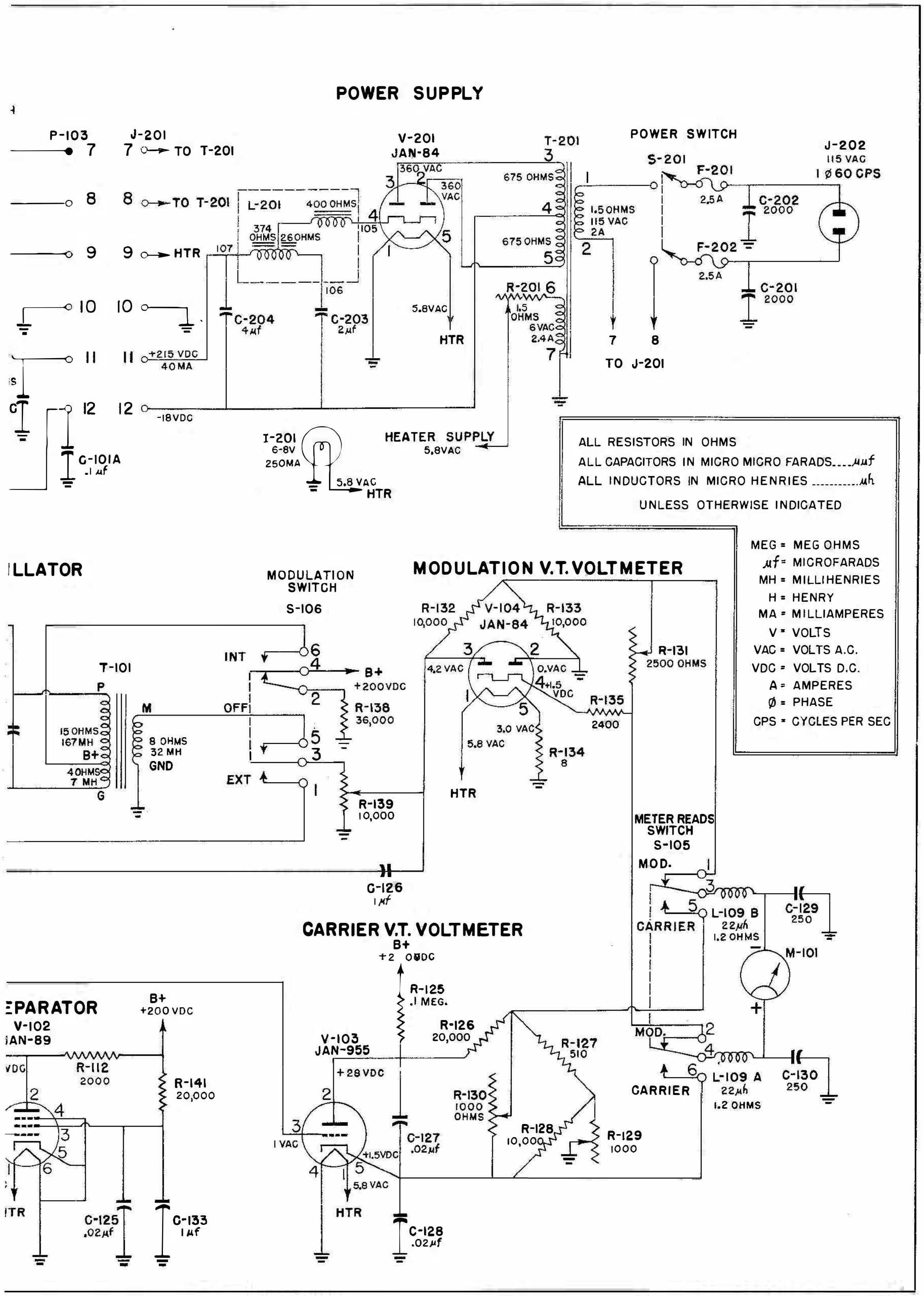


Figure 7-15—Schematic Wiring Diagram of the LP-5 Signal Generator Equipment