PRELIMINARY

INSTRUCTION BOOK

for

MODEL DAK-3

INTERMEDIATE FREQUENCY

RADIO DIRECTION FINDER EQUIPMENT

NAVSHIPS 900,264-1B

RESTRICTED

For Official Use Only

MANUFACTURED BY

Federal Telephone and Radio Corporation

NEWARK, N. J.

for

U.S. NAVY DEPT. BUREAU OF SHIPS

Contract NXSS-*33628*

PRELIMINARY INSTRUCTION BOOK MODEL DAK-3

ERRATA SHEET NUMBER 3

MAKE THESE CORRECTIONS IN YOUR BOOK NOW!

1. Page vi; The acceptance plate for the Model DAK-3 Equipment is located on the side of the cabinet, not on the front of the receiver rack.

2. Page 5, figures 5 and 6; The leads from the black terminal board of Loop B should go to pin B of J-452.

3. Page 10, figure 13; J-102 should be J-112.

4. Page 26, paragraph 3.2; delete sentences "As mentioned in subparagraph 3.11 etc., Ground the lower sections etc." Change Bureau of Ships Specifications RA-69A-220 and RA-69A-221" to read "NRL Specifications RA-69A-200 and RA-69A-221".

5. Page 31, paragraph 3.53; Instructions for mounting the radio Receiver on the table should indicate that both the modulator receiver and power indicator should be removed from the cabinet, the cabinet bolted to the table with the hardware supplied, the glass tubes inserted into the power indicator and finally both sections replaced in the cabinet.

   Paragraph 3.4; It should be indicated that the Navy will be required to furnish a shelf or table to mount the CFT-46245 Radio Receiver Assembly.

6. Page 37, paragraph 4.0; change calibrating boat circling radius to 500 yards. Change sentence "A brief report is also submitted to the Bureau of Ships" to read "A brief report and a copy of the calibration data is also submitted to the Bureau of Ships."

7. Page 38, paragraph 4.22; eliminate remainder of paragraph starting with the sentence "This requires that the target boats distance etc."

   Paragraph 4.4; Change sentence reading "The target boat then begins circling" to read "The target boat then begins circling at a radius of not less than 500 yards." Change sentence reading "Take readings for approximately every 200 kilocycles" to read "Take readings as specified by the Bureau of Ships over the frequency range of the equipment and at every 3° interval of the pelorus."

8. Page 41, paragraph 4.61; change "Bureau of ships Specifications RA-69A-220 and RA-69A-221" to read "NRL Specifications RA-69A-200 and RA-69A-221" in second sentence.

9. Make the following corrections in the Spare Parts List:

Page	*Symbol Number*	*Correction*
72	C-256	quantity in Colum B should be 1 instead of 2
	J-101	quantity should be 6, 11, 11 instead of 5, 10, 10
	J-211	quantity should be 2, 4, 2 instead of 0, 1, 2
	L-301	unit is wound on bakelite, not ceramic core
75	L-601 to L-606 inc.	quantity in column B should be 1 instead of 2 each
76	R-101	quantity in column A should be 2 instead of 3
79.	R-260 and R-261	same as R-136, not R-221
80	R-851	quantity should be 1, 3 and 2 instead of 2, 5 and 4
81	S-107	delete SPDT
82	All vacuum tubes	Specification is JAN-1A not RE-13A-600
82	Add I-205	quantity 2, 3 and 1 description 1/4 W Neon T-4 1/2
83	Add X-209	similar to X-102
84		Only 1 goniometer is used in Model DAK-3
85	Interconnecting cables	Model DAK-3 requires 1 each of the first three cables listed

10. Correct the following Navy Type Designations:

Page No.	*Symbol Desig.*	*Correct Navy Type Desig.*	*Page No.*	*Symbol Desig.*	*Correct Navy Type Desig.*
68, 87	C-109	48770	80, 88	R-606	63355
76, 87	R-112	63355	80, 88	R-608	63355
76, 88	R-116	63355	80, 88	R-609	63355
76, 88	R-117	631342-10	80, 88	R-614	63355
78, 88	R-239	63355	80, 88	R-621	63355
78, 88	R-247	63355	80, 88	R-622	63474
79, 88	R-257	63426	80, 88	R-623	63474
79, 88	R-457	63355	82, 87	V-101	T2
79, 88	R-460	63355			

11. Page 82, V-101 add Navy Spec. No. RE-38F-149D.

12. Page 82, V-603, add Navy Spec. No. RE-38F-149D and X-102 add Navy Spec. No. RE-49AA-314B.

13. Page 83, X-215 add Navy Spec. No. RE-49AA-313B.

14. Page 30, delete paragraph 3.32.

PRELIMINARY INSTRUCTION BOOK
FOR
MODEL DAK-3
INTERMEDIATE FREQUENCY RADIO DIRECTION FINDER EQUIPMENT

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DESTRUCTION NOTICE

WHY——To prevent the enemy from using or salvaging this equipment for his benefit.

WHEN——When ordered by your commander, or when you are in immediate danger of capture.

HOW——1. Smash —Use sledges, axes, hand-axes, pick-axes, hammers, crowbars, heavy tools, etc.
2. Cut —Use axes, hand-axes, machete, etc.
3. Burn —Use gasoline, kerosene, oil, flame-throwers, incendiary grenades, etc.
4. Explosives—Use firearms, grenades, TNT, etc.
5. Disposal —Where possible bury or throw in streams, rivers or ocean. Scatter.

USE ANYTHING IMMEDIATELY AVAILABLE FOR DESTRUCTION OF THIS EQUIPMENT.

WHAT——1. Smash—All tubes, meters, switches, relays, instrument boards, castings, heaters, shelters, chests, gasoline engines, generator; every electrical and mechanical part whether moving or fixed.
2. Cut —All wires, cables, generator fuel lines.
3. Bend and/or Break—Every antenna mast and panel.
4. Burn —Antenna masts, charts, diagrams, and instruction books.
5. Bury or scatter—Any or all of the above pieces after destroying.

DESTROY EVERYTHING

CONTRACTUAL GUARANTEE

Applicable only to Model DAK-3 Contract NXss 33628

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

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

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

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

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 failure and give the date of installation of the equipment. Refer to latest revision of Bureau of Engineering Circular letter No. 40 for instructions concerning report of failures, etc.

PERTINENT DATES AFFECTING REPLACEMENTS UNDER THE GUARANTEE

Serial number of equipment..

Date of acceptance by the Navy..

Date of delivery to contract destination..

Date of complete installation..

Date placed in service..

Blank spaces in the book shall be filled in at time of installation. Operating personnel shall also mark the "date placed in service" on the acceptance date plate located on the front of the receiver rack.

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

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

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.

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.

SECURITY NOTICE

This document contains information affecting the National Defense of the United States within the meaning of the Espionage Act (U.S.C. 50:31, 32). The transmission of this document or the revelation of its contents in any manner to any unauthorized person is prohibited.

This Instruction Book is furnished for the information of commissioned, warranted, enlisted and civilian personnel of the Navy and persons authorized by the Bureau of Ships whose duties involve design, manufacture, instruction, operation and installation of radio, radar, or underwater sound equipment. The word "Restricted" as applied to this instruction book signifies that it is to be read only by the above personnel, and that its contents should not be made known to unauthorized persons not connected with the Navy.

RECORD OF CORRECTIONS MADE

CHANGE NO.	DATE	SIGNATURE OF OFFICER MAKING CORRECTION

SECTION I DESCRIPTION

1.0 MODEL DAK-3 INTERMEDIATE FREQUENCY RADIO DIRECTION FINDER EQUIPMENT.–

1.00 General.–

The Model DAK-3 is an intermediate frequency radio direction finder equipment using a fixed crossed loop and a sense antenna for use on board ship. It covers the frequency range between 250 and 1500 kilocycles. A photograph of the equipment is shown in figure 2 and a block diagram in figure 1. R-f transmission lines of sufficient length connect the antenna system to the self-contained receiving and indicating equipment assembly which may be located in the radio equipment room or any similar suitable place. The operating components are shock mounted in a cabinet designed so that the operating controls are within easy reach, and bearing indications within easy view, of the operator. The equipment is designed to withstand the affects of vibration, gunfire shock, pitch and roll ordinarily encountered in Naval service. It is finished in oven-baked gray scratchproof enamel. A list of major components is included in Table I, and characteristics are given in subparagraph 1.02.

1.01—Modes of Operation.–

Two modes of bearing determinations are provided as follows:

(1) A manually operated goniometer and a two-inch cathode-ray tube in the receiver provide bearing indications by the matched-line method.

(2) A second position on the indication switch provides bearings by null methods. The nulls may be observed aurally on the loudspeaker, or visually on the two-inch cathode-ray tube in the receiver.

1.02 Model DAK-3 Direction Finder Characteristics.–

Signal receptions	C-w, m-c-w, i-c-w	
Bearing indications	Manual matched-line visual Aural null Visual null	
Power requirements (approx.)	150 va at 115 volts, single phase, 60 cycle, a-c	
Frequency range In two bands	*Band*	*Nominal Range*
	1	250 to 610 kc
	2	610 to 1500 kc
Type of receiver circuit	Superheterodyne	
Receiver intermediate frequency	175 kc	
Bandwidth for 2 times (6 db) down (approx.)		
At 1500 kc	3.5 kc (SHARP) 9.0 kc (BROAD)	
At 250 kc	2.0 kc (SHARP) 3.0 kc (BROAD)	
Direction finder sensitivity for ±2° repeatability	2 microvolts*	
Audio output power	15 milliwatts, undistorted earphone output 1.5 watts maximum loudspeaker output (less than 5% harmonic distortion)	

* Open circuit input to receiver

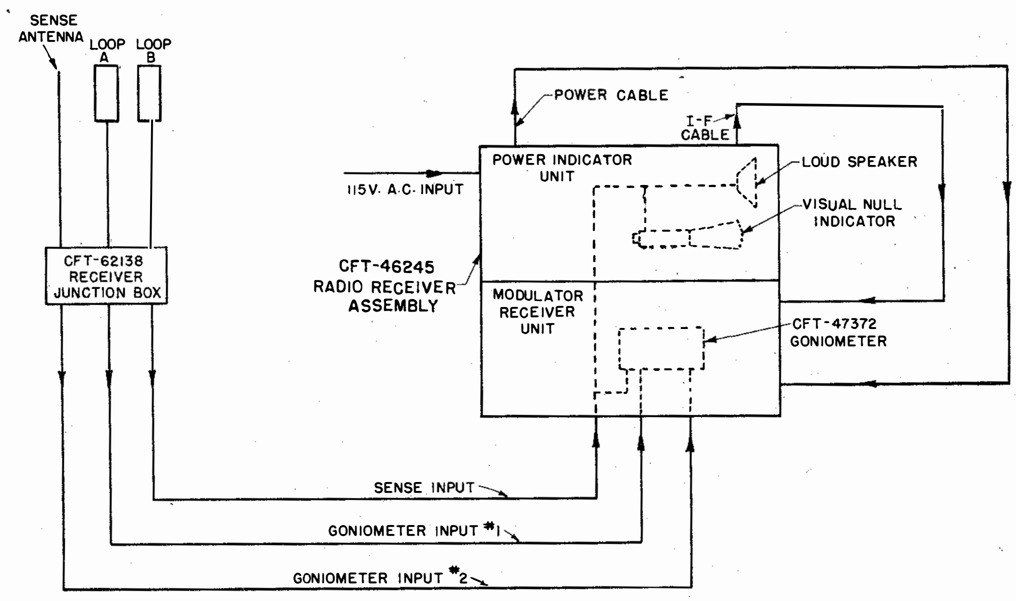


Figure 1. Block diagram of Model DAK-3 Intermediate Frequency Radio Direction Finder.

1.03 Table I. Components.–

Quantity	Navy Type Designation	NAME OF UNIT	Symbol Group	Overall Dimensions (Inches)			Pounds	Assembly Dwg. Number
				Width	Height	Depth		
1	46245	Radio Receiver Assembly	100 to 299	19	28 27/32	21 5/16	180	RF-2573-14
1	69089	Crossed Loop Assembly		27	61 15/16	27	73	RF-1155-14
1	66093	Sense Antenna Assembly	300 to 349	9½	25⅔	13	43	RF-1269-14
1	62138	Junction Box	450 to 499	9	7 3/16	5 27/32	6½	RF-2536-14
1	60054-A	*Test Oscillator	600 to 629	16¼	9¾	16¾	59	F-41060-14-2
1	66082	*Antenna (Target)	—	(15 ft extended x ½" max. dia.)			5½	F-40586-1
1	47372	Goniometer	850 to 899	8⅛	5¾	5¾	4¼	RF-1485-14
1 set	—	Interconnecting Cables	—	—	—	—	—	RF-2705-1
1 set	—	R-f Transmission Lines	—	—	—	—	—	RF-1667-1

* Not shipped as a part of the Model DAK-3.

1.04 Table II. Tube Complement.–

1.041 CFT-46245 Radio Receiver Assembly.–

Symbol Desig.	JAN Desig.	Function	Tube Type
V-101	—	Sense channel, overload-protection	GE T-2
V-102	6AC7	Sense channel, amplifier	6AC7
V-103	6SK7	R-f amplifier	6SK7
V-104	6SA7	First detector	6SA7
V-105	—	Goniometer channel overload protection	GE T-2
V-106	6AC7	Goniometer channel amplifier	6AC7
V-107	6AC7	Phase inverter	6AC7
V-108	6AC7	Balanced modulator	6AC7
V-109	6AC7	Balanced modulator	6AC7
V-110	6SJ7	R-f oscillator	6SJ7
V-201	6SK7	First i-f amplifier	6SK7
V-202	6SK7	Second i-f amplifier	6SK7
V-203	6H6	Second detector	6H6
V-204	6SJ7	Beat-frequency oscillator	6SJ7
V-205	6SK7	Indicator amplifier	6SK7
V-209	6SK7	A-f amplifier	6SK7
V-210	6K6-GT/G or 6V6-GT/G	Power output	6K6GT/G or 6V6GT/G
V-211	6SQ7	Low-frequency oscillator	6SQ7
V-212	6SN7-GT	Oscillator amplifier	6SN7-GT
V-213	5U4-G	B-supply rectifier	5U4-G
V-214	6H6	Bias supply rectifier	6H6
V-215	2X2	H-v supply rectifier	2X2/879
V-216	2AP1	Bearing indicator	2AP1
V-217	6H6	Trigger rectifier	6H6

*1.044 *CFT-60054-A Test Oscillator.–*

Symbol Desig.	JAN Desig.	Function	Tube Type
V-601	6SK7	Oscillator	6SK7
V-602	6SK7	Amplifier	6SK7
V-603	—	Tuning indicator	NE-2
V-604	6X5-GT/G	Rectifier	6X5GT/G

* Not shipped as a part of the Model DAK-3.

1.045 Summary.–

The Model DAK-3 Intermediate Frequency Radio Direction Finder Equipment employs twenty-eight tubes as listed above. A summary of these follows:

1–2AP1	2–6SJ7
1–2X2/879	7–6SK7
1–5U4G	1–6SN7GT
5–6AC7	1–6SQ7
3–6H6	1–6X5GT/G
1–6K6GT/G or 6V6GT/G	2–GE T-2
1–6SA7	1–NE-2

1.1 CFT-69089 CROSSED LOOP AND CFT-66093 SENSE ANTENNA ASSEMBLY.–

1.10 General.–

The CFT-69089 Crossed Loop and CFT-66093 Sense Antenna Assembly, consisting of two crossed electrostatically shielded loops and a whip antenna

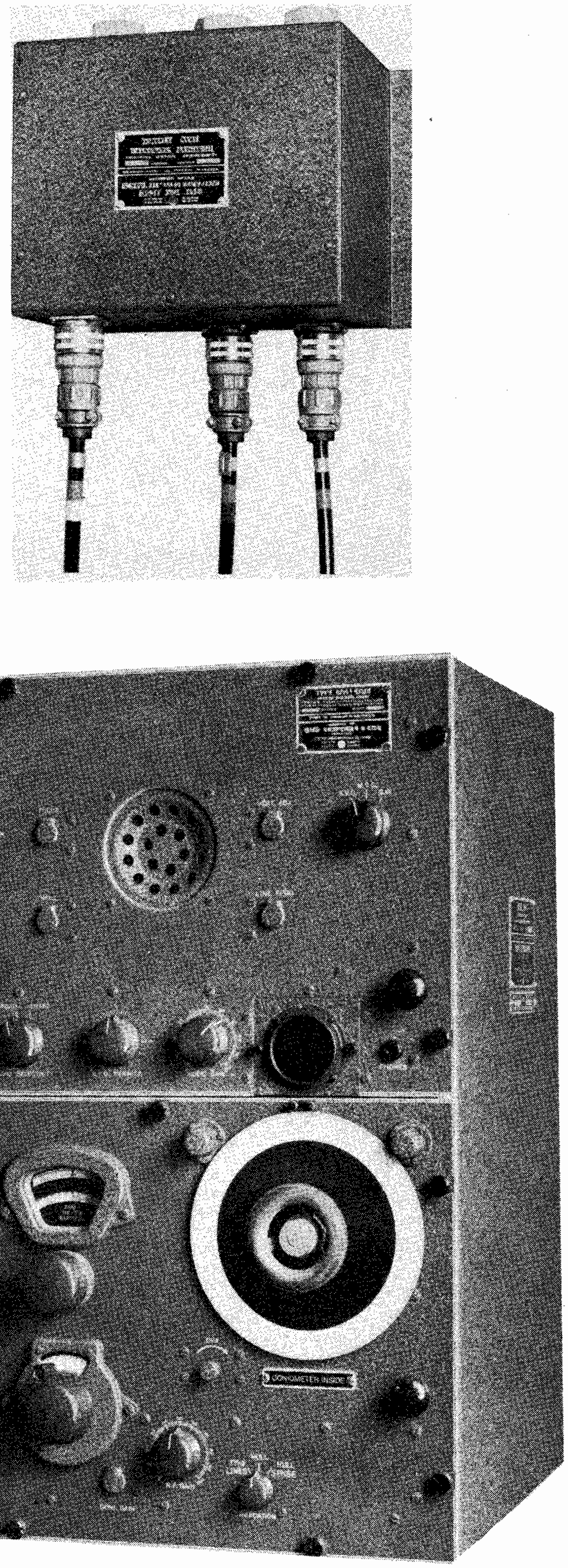


Figure 2. Model DAK-3 Intermediate Frequency Radio Direction Finder.

compose the collector system for the Model DAK-3 Intermediate Frequency Ship Type Direction Finder Equipment. A photograph showing both units is given in figure 3 and a circuit diagram in figure 4.

1.11 CFT-69089 Crossed Loop.–

The two crossed loop antennae are positioned at right angles to each other. They are oval in shape

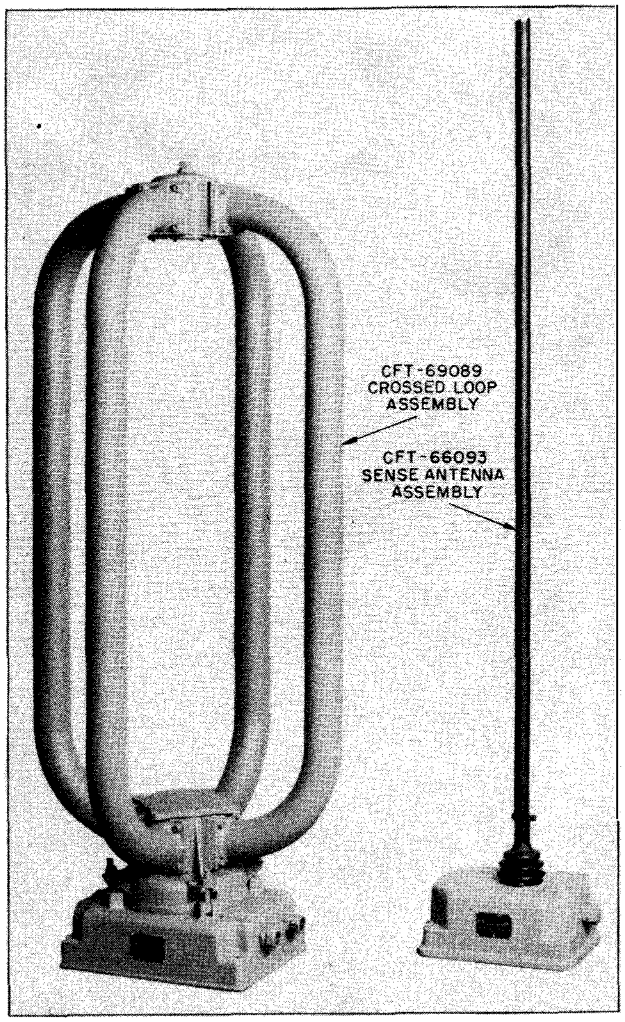


Figure 3. CFT-69089 Crossed Loop and CFT-66093 Sense Antenna.

with long and short diameters of $51\frac{1}{2}$ and 27 inches, respectively, outside. Each loop winding consists of five turns of insulated, stranded, tinned copper wire. A bakelite insulator assembly with suitable leaders and spacers holds each winding in place inside an aluminum shielding. The shielding is made up of 3-inch outside diameter aluminum tubing, cut in four lengths and bent to shape. These tubes are welded to flanges which in turn bolt (with suitable insulation between at the top) to the loop top and bottom. The completed assembly plugs into the top of a sturdy cast aluminum base. The overall height is $61\frac{15}{16}$ inches. Connections to the loop winding are made to terminal strips in the base casting. The individual terminals are color coded to assure proper connection to the r-f transmission lines which feed through Thomas and Betts connectors in the base casting.

1.12 CFT-66093 Sense Antenna.–

A 25-foot, 3-section, stainless steel whip antenna on a cast aluminum base, is used as the sense collector. Connections to the sense antenna are made to screw terminals in the base casting. The individual terminals are color coded to assure proper connections to the r-f transmission line which feeds through a Thomas and Betts connector in the base.

1.13 Electrical Description of the Antenna System.–

The loop antennae are of the shielded balanced type. Electrostatic shielding is provided by the aluminum tubing described in subparagraph 1.11. The electrical continuity of the tubing is interrupted at the top with suitable insulation to prevent the shielding from acting as a closely coupled shorted turn. The two loops are electrically matched to each other to provide the necessary phase and amplitude tracking over the complete frequency range of the equipment. In the base of the sense antenna a "dummy-loop", consisting of an electrostatically shielded r-f transformer (L-301) and a condenser (C-302), reflects the electrical constants of the loop to the transmission line. A separate high frequency coaxial transmission line connects each loop and the sense antenna to the junction box.

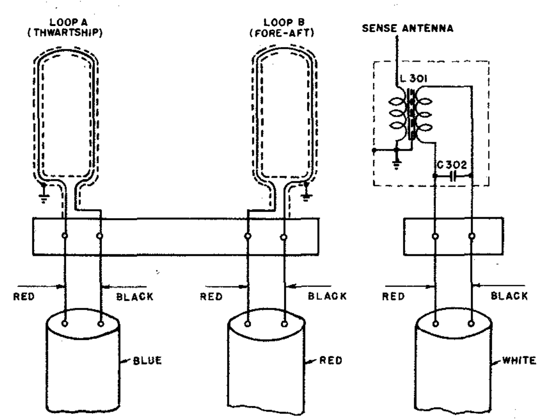


Figure 4. Schematic diagram of CFT-69089 Crossed Loop and CFT-66093 Sense Antenna.

1.14 Transmission Lines.–

The Model DAK-3 uses armored dual coaxial high-frequency transmission lines from the base of the loop and sense antennae to the junction box. These transmission lines are solid dielectric, flexible coaxial cables containing two central conductors, each of which is inside a copper braid. Another copper braid and an outer vinylite sheath encases the entire assembly. The three lines from the antennae are accurately

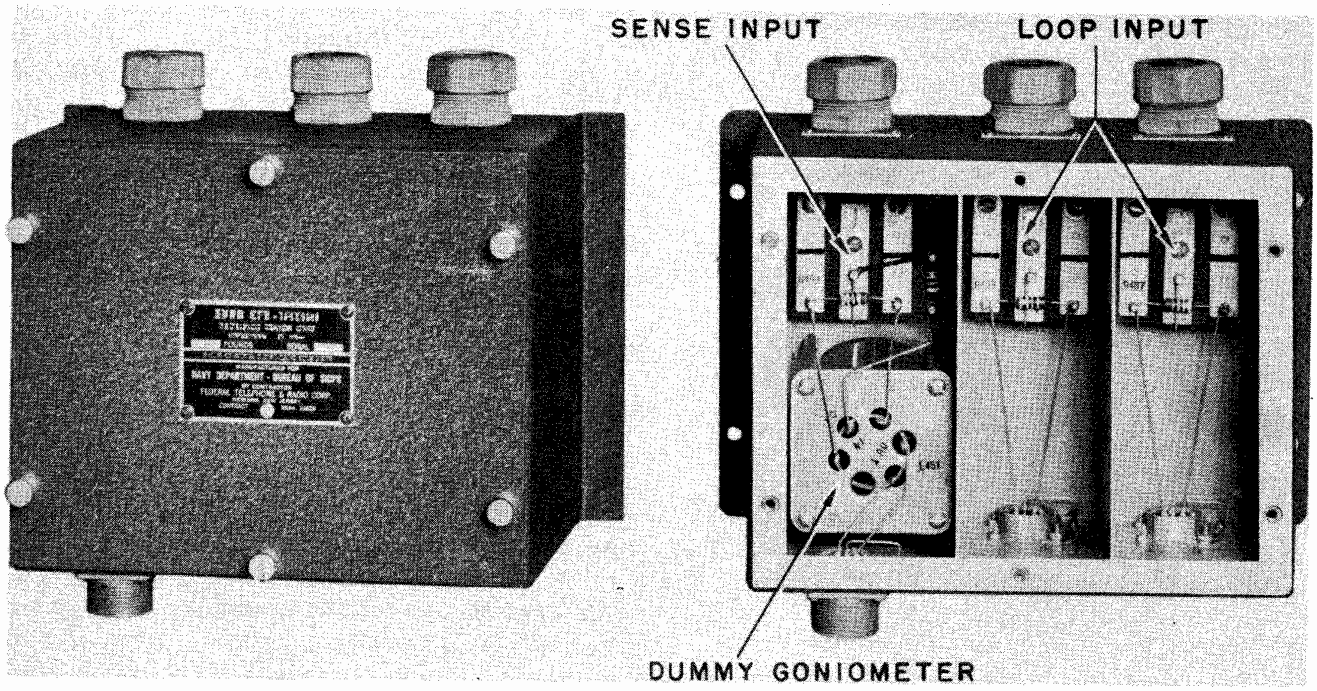


Figure 5. CFT-62138 Junction Box.

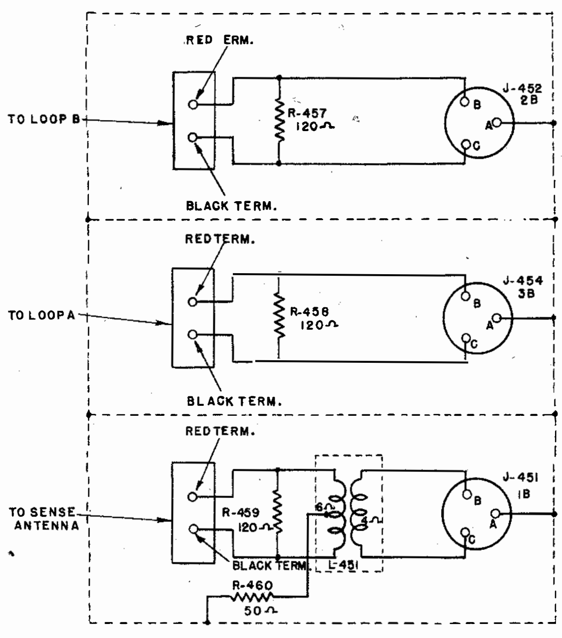


Figure 6. Schematic diagram of CFT-62138 Junction Box.

balanced to equal electrical lengths. The proper performance of the entire direction finder system depends upon the m·intenance of this electrical balance.

1.2 CFT-62138 JUNCTION BOX.–

1.20 General.–

The r-f cables from the antenna system and from the receiver and indicator goniometers connect to the CFT-62138 Junction Box. A photograph of the junction box is shown in figure 5 and a circuit diagram in figure 6.

1.21 Mechanical Construction.–

The junction box is made of 3⁄32-inch sheet aluminum on a rigid steel framework. It is finished in ovenbaked scratchproof gray wrinkle enamel to match the other DAK-3 components, and has overall dimensions of 9 by 7 3⁄16 by 5 27⁄32 inches. Three AN type receptacles on the bottom connect to the receiver goniometer, and to the receiver sense input channel. Three Thomas and Betts connectors on top feed the high frequency transmission lines to terminal strips inside the junction box. The individual connectors, on top and bottom, are color coded and numbered for easy identification of the connecting cables. Shields separate the junction box into three individual compartments, one for each directional circuit, and one for the sense circuit and dummy goniometer.

1.22 Electrical Circuits.–

Three 120-ohm resistors (R-457, R-458, R-459) one across each of the dual lines, reduce peaks and assure a more uniform output from the lines over the frequency range of the equipment. The individual sets of three resistors for each junction box are selected

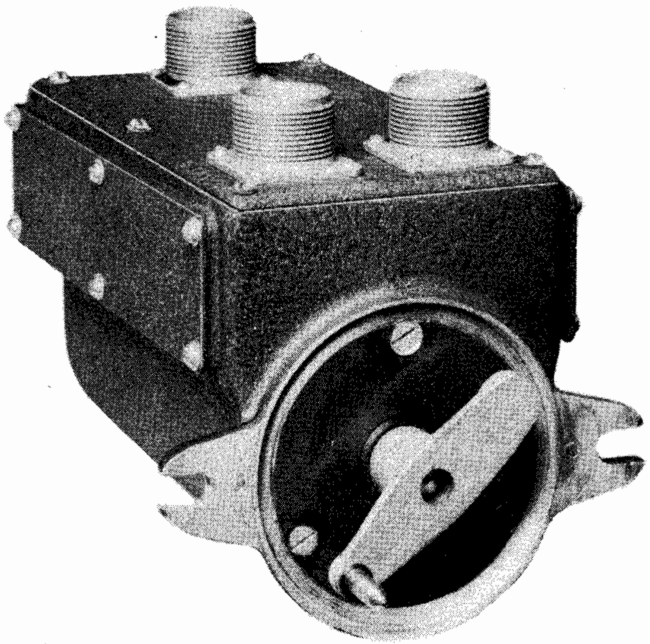


Figure 7. CFT-47372 Goniometer.

within very close tolerances to provide uniform impedance and voltage characteristics among the lines. A "dummy goniometer" circuit consisting of an r-f transformer (L-451) and a resistor (R-460) in the sense antenna circuit simulates the electrical constants of the goniometer in that it reflects the same impedance to the receiver sense channel as the goniometer does to the receiver directional channel.

1.3 CFT-47372 GONIOMETER.–

1.30 General.–

The goniometer is a rotating r-f transformer which combines the outputs of two stationary loop antennae in proper relationship and supplies the output from a rotor to the directional input channel of the receiver. Rotation of the goniometer rotor produces the same result that would be obtained by rotating a single loop antenna. The electrical functioning of the goniometer is discussed in subparagraph 1.32 and its operation in connection with the Model DAK-3 equipment is described in Section II. A photograph is shown in figure 7 and a circuit diagram in figure 8.

1.31 Mechanical Description.–

The components of CFT-47372 goniometer are inside a die-cast aluminum housing 8⅛ wide by 5¾ high by 5¾ deep. The casting is finished in oven-baked scratchproof gray wrinkle enamel. Three type AN-3102-18-5P receptacles on bottom connect to high frequency cables from the antenna circuits in the junction box and to the receiver input. It is mounted inside the modulator receiver section of the radio receiver assembly and is coupled to a 7½-inch, 360 degree calibrated dial on the front panel.

1.32 Electrical Description.–

The goniometer has two stator windings at right angles to each other and a rotatable secondary search coil or rotor. The goniometer output alternates between zero and maximum, for every 90 degree turn of the rotor. The zero positions relative to a fixed scale depend upon the relative magnitude of the stator currents, which in turn depend upon the direction of arrival of the radio wave.

To permit the transfer of energy from the rotor to the output receptacle without the use of brushes a rotating transformer primary is wound on the same form with the rotor winding of the goniometer. The secondary winding of this transformer is assembled over the rotating primary and is connected to the output receptacle J-853. The coupling between the rotating primary and the secondary winding is independent of the position of the primary. The directional antennae inputs are introduced to the stator windings

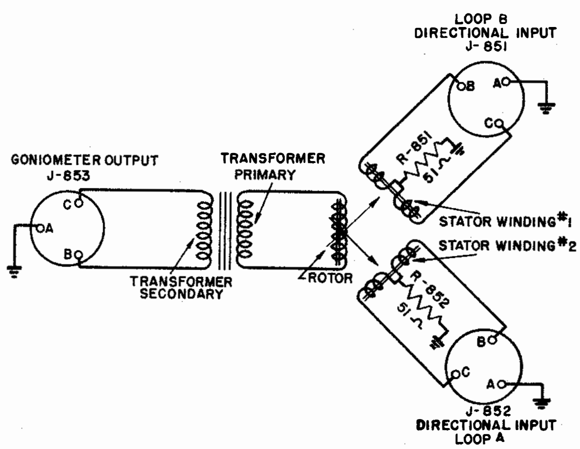


Figure 8. Schematic diagram of CFT-47372 Goniometer.

at receptacles J-851 and J-852. Each stator winding is center tapped and a 51-ohm resistor connects from each stator tap to ground to provide a balanced condition so that capacitative coupling to the rotor is minimized.

1.4 CFT-46245 RADIO RECEIVER.–

1.40 *General.–*

The CFT-46245 Radio Receiver is a highly sensitive superheterodyne developed especially for use in the DAK-3 Intermediate Frequency Ship Direction Finder. It consists of two separate units mounted one above the other in one cabinet. The lower unit is the modulator receiver and the upper the power indicator. A photograph is shown in figure 9, a block diagram in figure 10 and circuit diagram of the two units in figures 11 and 12.

1.41 *Function.–*

The function of the receiver is to amplify and rectify the characteristic goniometer and antenna response. It has the conventional beat-frequency oscillator and audio circuit with loudspeaker and phone outputs so that it can be used independently for monitoring. It receives and gives bearings for c-w, i-c-w, or m-c-w signals and has avc for fading signals.

1.42 *Characteristics.–*

1.421 *Frequency Range.–*

The frequency range is from 250 to 1500 kc. The low end of each band extends approximately 5

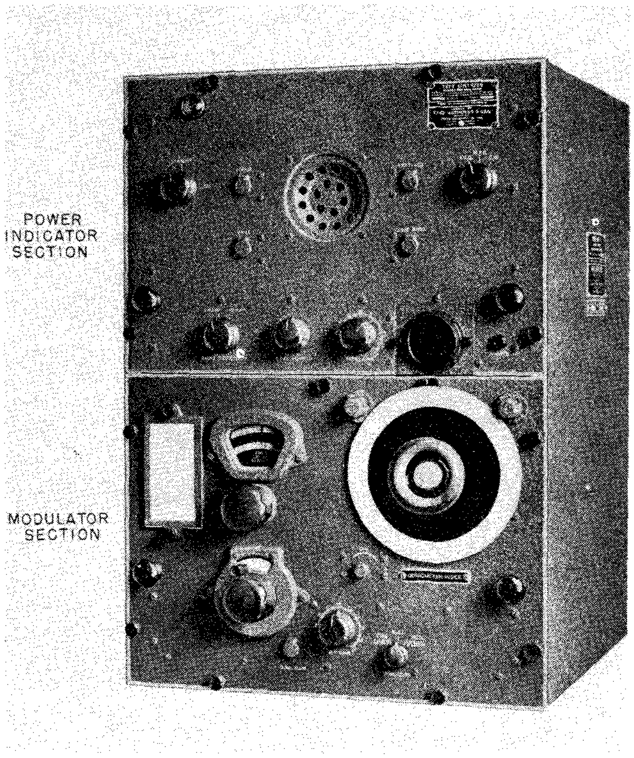


Figure 9. CFT-46245 Radio Receiver.

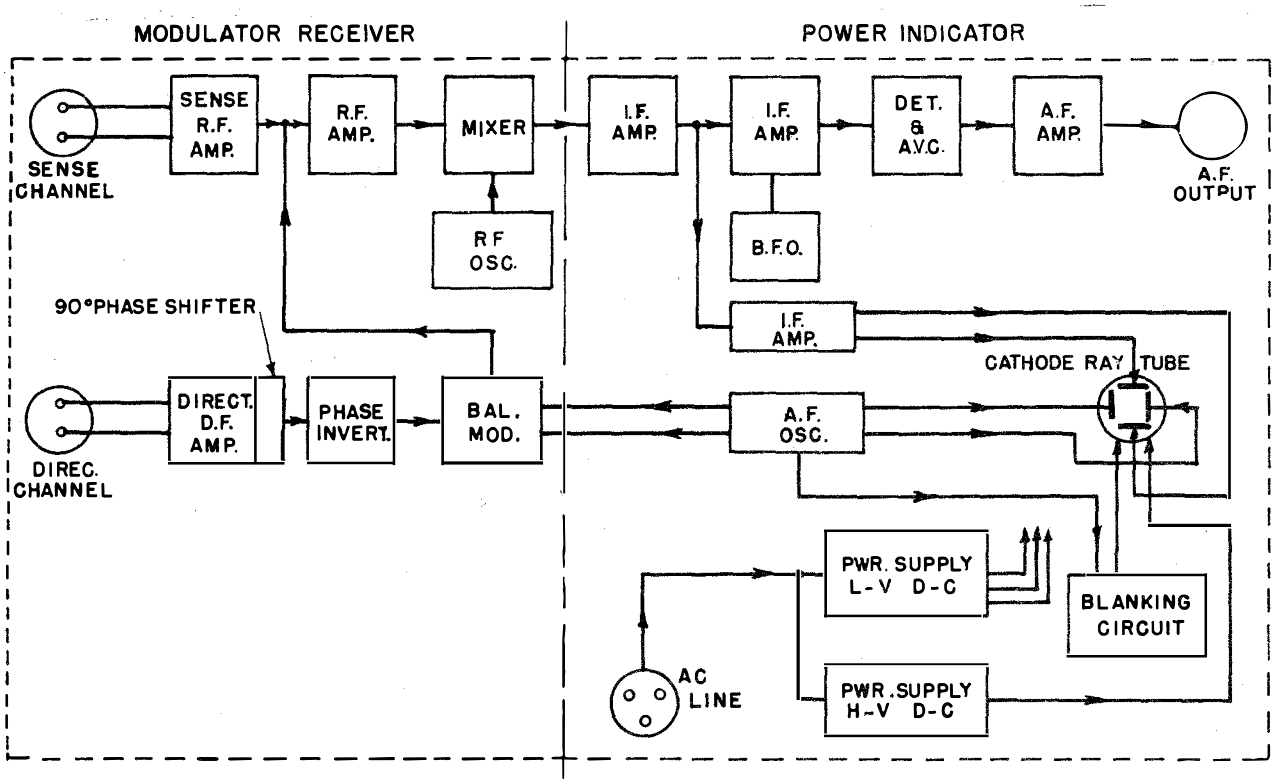


Figure 10. Block diagram CFT-46245 Radio Receiver.

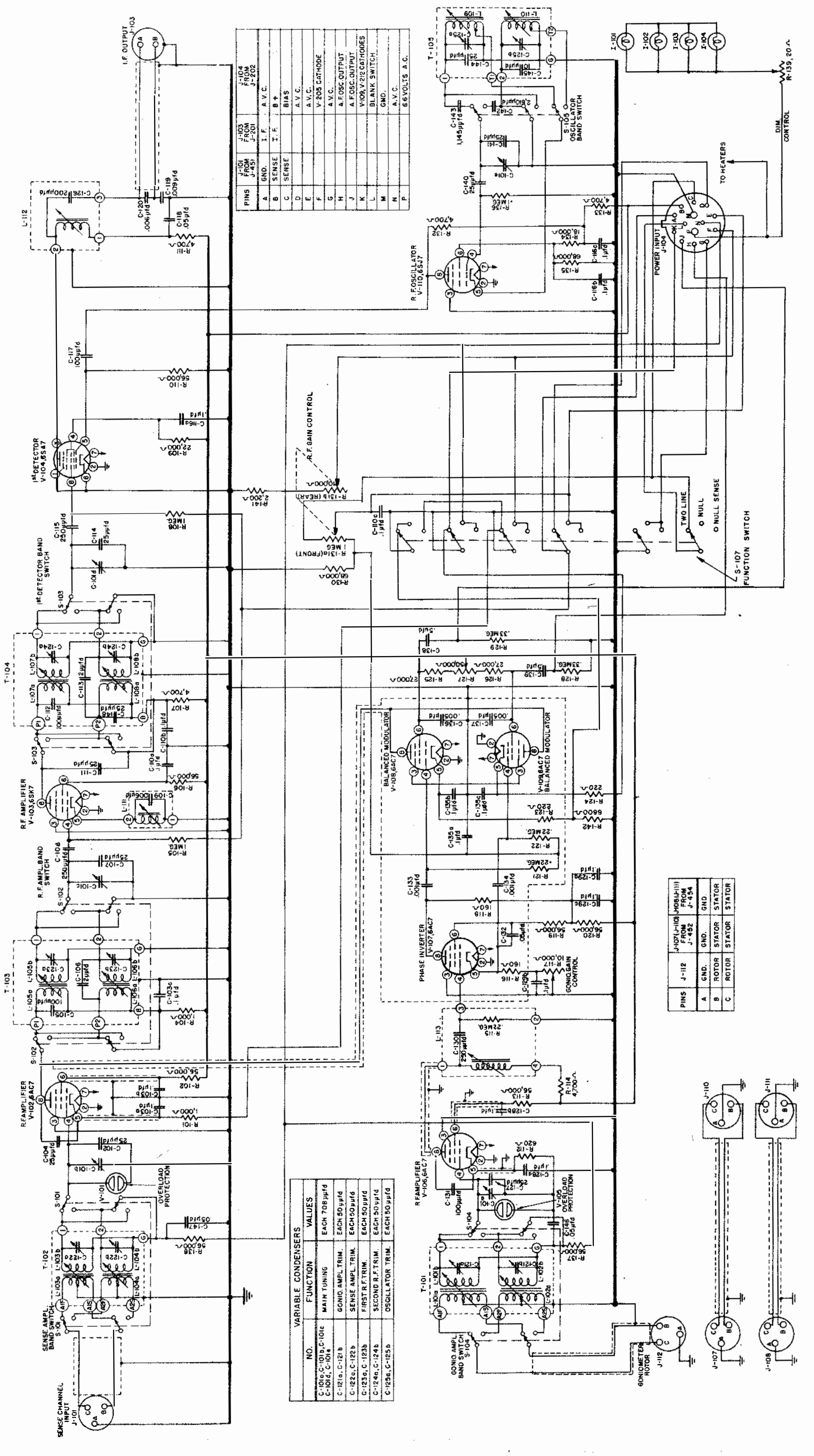


Figure 11. Schematic diagram modulator section.

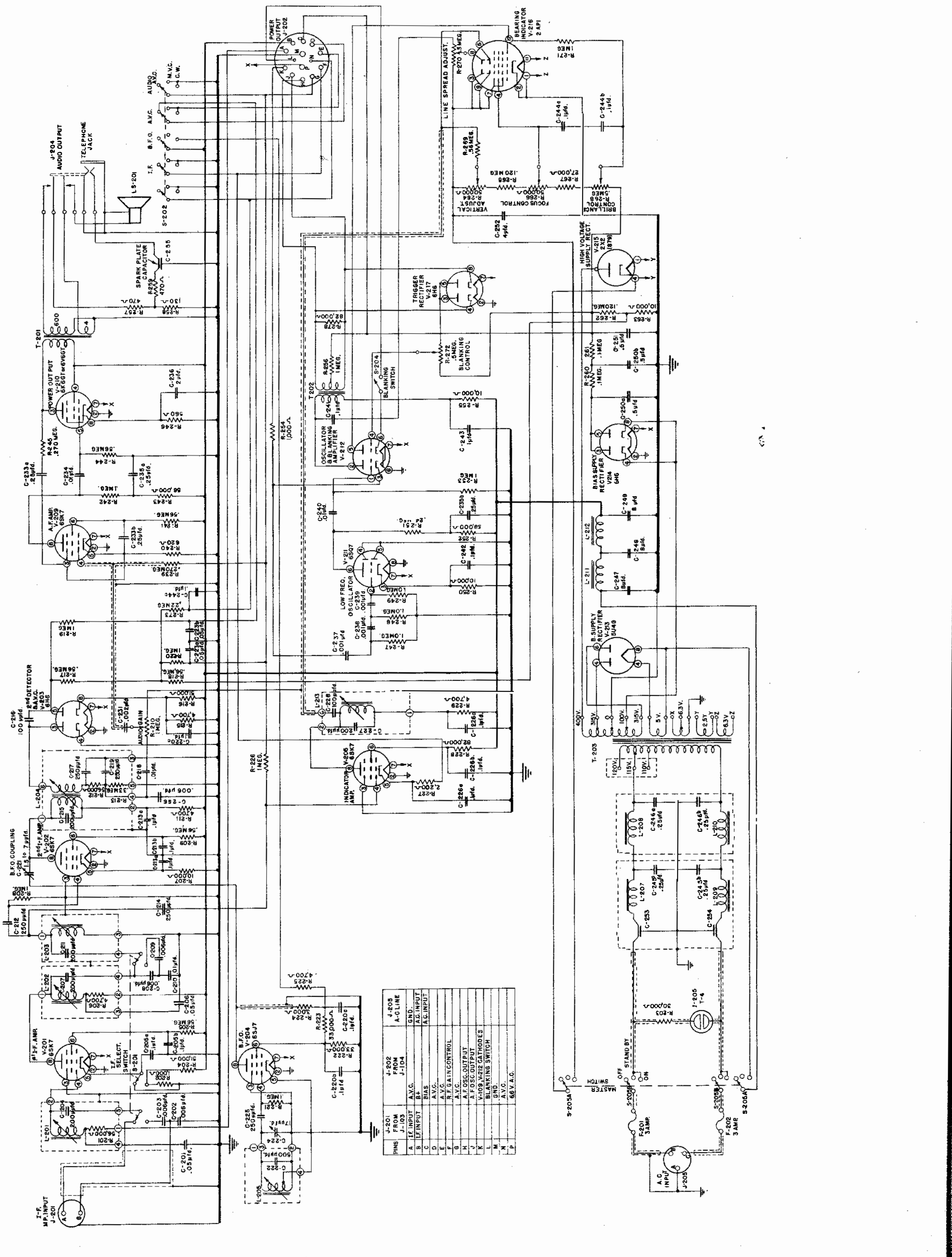


Figure 12. Schematic diagram power indicator section.

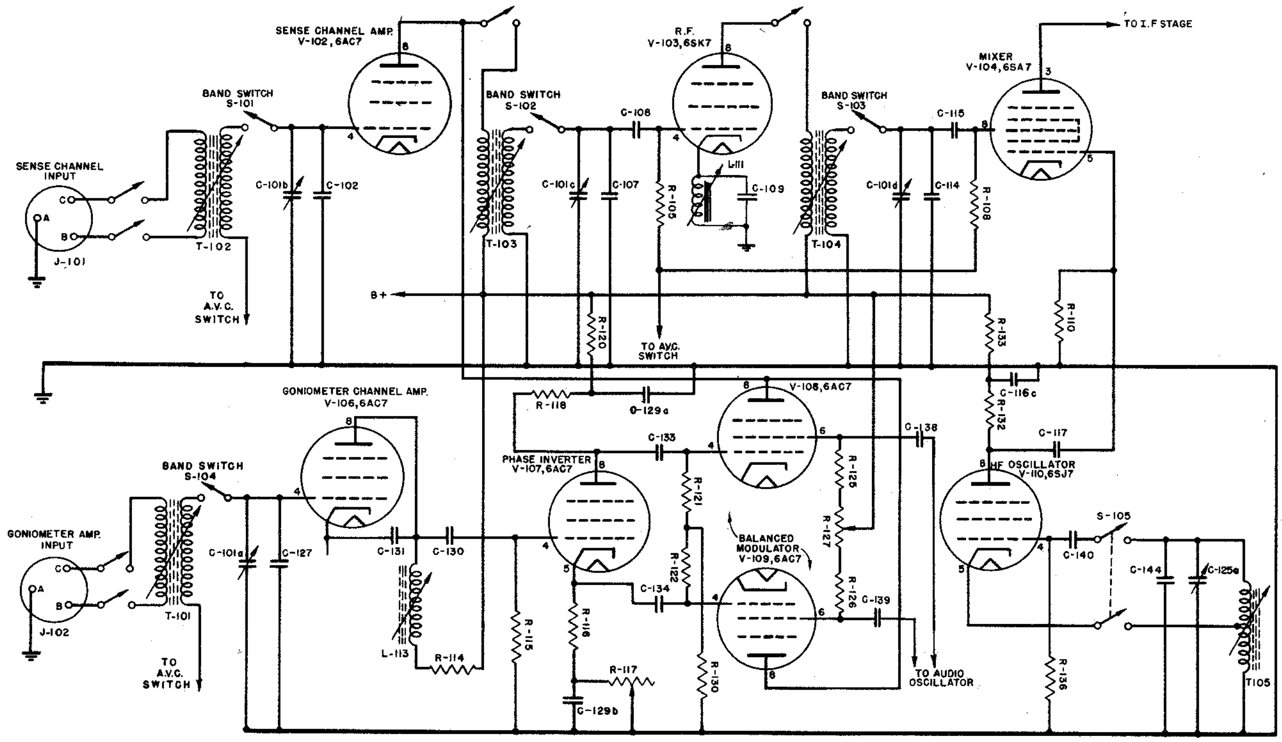


Figure 13. Radio frequency amplifier circuits.

percent below its nominal value and the high end extends approximately 2.5 percent above its nominal value.

Band	*Nominal Range (kc)*
1	250 to 610
2	610 to 1500

The frequency calibrated scales are accurate to within 1 percent of the indicated values.

1.422 Power Requirements.–

Approximately 143 watts with a power factor of 0.995 at 115 volts, 60 cycles, are required for operation. The current drain at 115 volts is approximately 1.38 amperes.

1.423 Maximum Undistorted A-F Output.–

(1) 15 milliwatts into 600 ohm load (phones).
(2) 1.5 watts into 4-ohm load (loudspeaker).

1.424 Minimum Sensitivity for 20-db Signal to Noise Ratio.–

BROAD 3.0 microvolts*
SHARP 2.0 microvolts*

* With signal fed directly into the receiver through 120-ohm dummy antenna.

1.425 R-F Selectivity.–

The r-f selectivity in terms of band width for 6-db reduction from midband maximum response is as follows:

SELECTIVITY *Switch Position*	*Input Frequency (kc)*	*Bandwidth (kc)*
BROAD	1500	9.0
	250	3.0
SHARP	1500	3.5
	250	2.0

1.426 Intermediate Frequency.–

The intermediate-frequency for the CFT-46245 Radio Receiver is 175 kc.

1.43 R-F Circuits.–

1.430 General.–

The radio receiver has two r-f channels, one for the directional voltage from the goniometer, the other for the sense voltage (see figure 13).

1.431 Goniometer Amplifier Input.–

The goniometer output is fed to a tuned r-f transformer (T-101) through a balanced primary winding. This voltage is amplified by the goniometer channel amplifier tube (V-106, 6AC7) the load of which (C-131, L-113, R-114) is capacitive at the operating frequencies and shifts the phase of the directional signal into proper relationship with respect to the sense voltage. The directional voltage is then impressed upon the grid of a phase inverter (V-107, 6AC7), the output of which is balanced with respect to ground and impressed upon the grids of the balanced modulator tubes (V-108 and V-109, 6AC7's).

When the switch S-107 is on two line position the grids of the balanced modulator tubes are in push-pull and the plates are tied together in parallel. A modulating audio voltage is impressed from screen to screen through capacitors C-138 and C-139, so that as one screen becomes more positive, the other becomes less positive. The output of the balanced modulator under these conditions consists of the same type of voltage that would be obtained if the directional voltage were modulated by the audio and the carrier were suppressed. That is, the output of the balanced modulator consists of the upper and lower side frequencies only.

When switch S-107 is on the null position one of the balanced modulator tubes (V-109, 6AC7) is rendered inactive and the audio modulating voltage is removed from the screen grids. The remaining active tube (V-108, 6AC7) acts as an r-f amplifier.

1.432 Sense Channel Input.–

The sense channel input is fed to a tuned r-f transformer (T-102) through a balanced primary winding, and is then amplified by the sense channel amplifier (V-102, 6AC7). This voltage is then combined with the balanced modulator output.

When the goniometer is on a NULL, and the controls are set for TWO LINE, the output of the balanced modulator is zero. Thus, under these conditions the input to the second r-f amplifier (V-102, 6AC7) consists of the sense voltage only. However if the goniometer is rotated off the null, a signal is fed into the balanced modulator and the two side frequencies in the output combine with the sense output from V-102 (which acts as a carrier) to form a modulated signal. The degree of modulation increases as the goniometer is further rotated off the null.

The sense channel is open while bearings are being taken on the NULL position. For NULL SENSE operation this channel is combined with the goniometer channel voltage in order to yield an output suitable for sense determination.

1.433 Second R-F Amplifier.–

After combination of the sense and goniometer channels, the resultant is fed into a tuned amplifier (V-103, 6SK7) through r-f transformer T-103. This amplifier, in conjunction with the previous tuned amplifiers insures adequate preselectivity and reduces

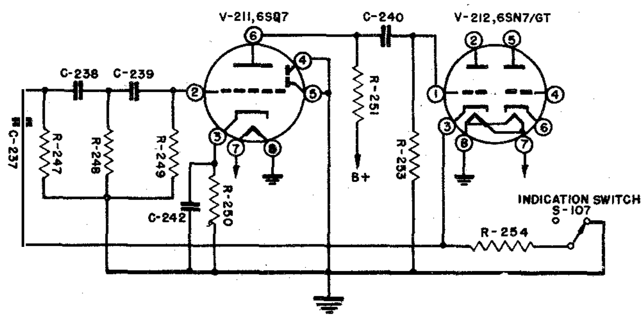


Figure 14. Low frequency oscillator circuits.

image response to a minimum. An i-f trap (L-111) in the cathode circuit of V-103 prevents stray signals at the intermediate frequency from entering the i-f circuits.

1.434 Sensitivity Control.–

The receiver sensitivity is manually controlled by the variable resistors R-131a and R-131b. The gain of these stages is maintained essentially constant at any given RF GAIN control setting, by the avc bias applied to the grids through their associated transformer secondaries when the AVC-MVC-CW switch is on AVC.

1.435 Tuning.–

The r-f amplifiers, mixer, and high-frequency oscillator circuits are tuned by the corresponding sections of the five-gang tuning capacitor C-101. The h-f oscillator (V-110, 6SJ7) tracks at 175 kc above the r-f amplifier and mixer circuits to produce the 175-kc intermediate-frequency output from the mixer stage (V-104, 6SA7).

1.44 A-F Oscillator.–

Modulation of the goniometer channel is obtained by impressing a low frequency (100 cps) voltage upon the screen grids of the balanced modulator. The same audio voltage is impressed upon the horizontal deflection plates of the cathode-ray tube (V-216, 2AP1) in the power-indicator section of the receiver so as to yield the pattern characteristic of the matched line system of bearing indication. The source of this audio voltage is the low frequency oscillator (see figure 14) consisting of V-211 (6SQ7) and V-212 (6SN7). The latter is a dual triode tube and only half is used with the oscillator. The oscillator is of the resistance-capacity phase shift type employing inverse feedback (across R-254) to insure a high degree of voltage and frequency stability. The feedback voltage necessary for oscillation is fed from the cathode of V-212 to the phase shift network through C-237 and from there to the grid of V-211. The frequency of oscillation is that at which the total phase shift from the plate of V-211 (through V-212 and the phase shift network) to the grid of V-211, is 180°.

1.45 I-F Amplifier.–

Two stages of i-f amplification are used (see figure 15). After amplification in the first i-f stage, (V-201, 6SK7) the i-f signal is split into two channels. One feeds the audio channel, and the other feeds the indicator channel. This separation is required so that the beat-frequency oscillator, used for reception of c-w signals, produces an audible note from the speaker or earphones without appearing as modulation on the bearing patterns obtained.

Two degrees of selectivity (broad and sharp) are obtained by switching the coupling reactance of the interstage i-f circuits. The interstage coupling consists of two tuned circuits with part of the tuning capacitance X_{cb} and X_{cs} common to both circuits. The magnitude of the coupling capacity determines the degree of coupling, which in turn determines the bandwidth or selectivity of the stage. When the selectivity (S-201) is on BROAD the coupling reactance is X_{cb}, and when it is on SHARP, the coupling reactance is X_{cs}. Changing the selectivity does not alter the i-f tuning, since the total tuning capacity (series combination of 200 mmfd, 0.006 mfd, and 0.015 mfd for the first stage and 200 mmfd, 0.006 mfd and 0.01 mfd for the second stage) is the same for both settings of the selectivity switch.

1.46 A-F Channel.–

The audio frequency signal is taken from the diode load (R-213) (see figure 16) of the detector tube (V-203, 6H6) which has a frequency characteristic (introduced by the presence of C-256) which discriminates against high audio frequency noise voltages. The audio voltage is impressed upon the grid of a voltage amplifier (V-209, 6SK7) and after amplification is fed to a power amplifier (V-210, 6K6GT/G). The audio output voltage is coupled to the speaker or headphones by means of the output transformer (T-201) which has a 600-ohm winding for headphones and a 4-ohm winding for the speaker. The audio amplification is varied by means of the A. F. GAIN control R-210.

1.47 Beat Frequency Oscillator.–

The beat frequency oscillator (see figure 13) is designed to insure a high degree of frequency stability. Its operating frequency is near that of the intermediate frequency and it is coupled to the output of the second i-f stage in the audio channel, where it mixes with the i-f signal to produce a difference of audible pitch. This pitch can be varied by changing the frequency of the beat-frequency oscillator with the tuning capacitor C-224.

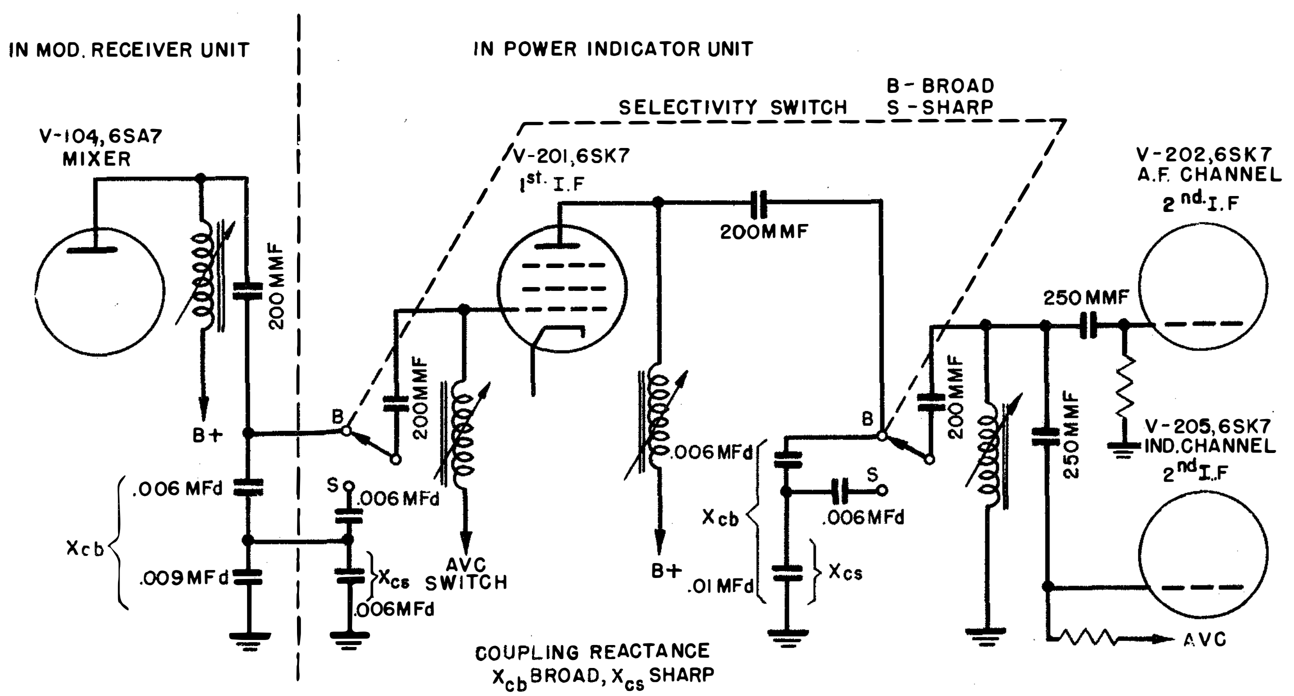


Figure 15. Intermediate frequency amplifier circuits.

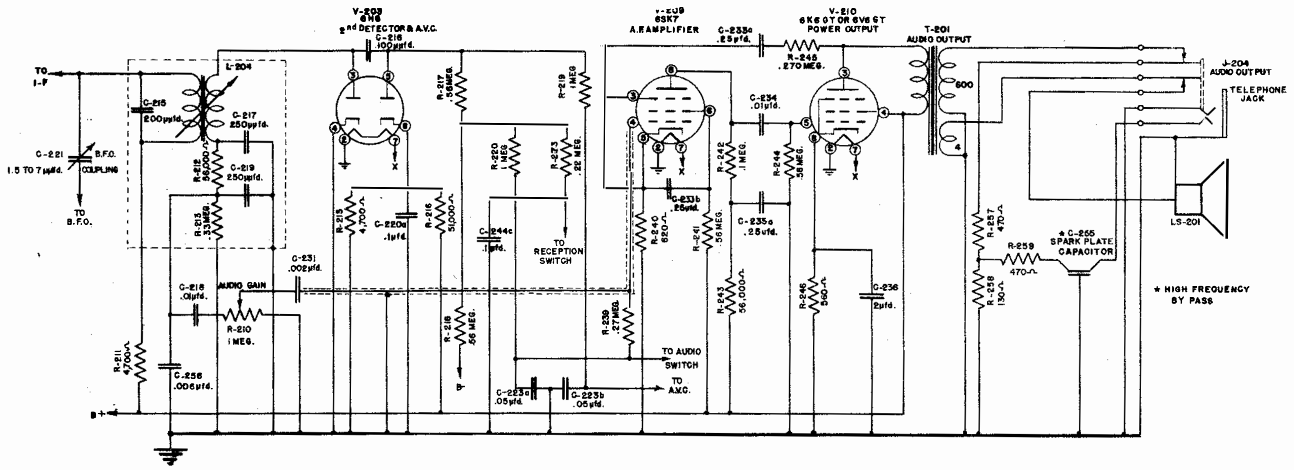


Figure 16. Audio frequency circuits.

1.48 Cathode-Ray Tube Circuits.–

The circuits associated with the cathode-ray tube (V-216, 2AP1) used for the matched-line system of bearing indication are shown in figure 17. The audio voltage from the low-frequency oscillator is fed to the horizontal deflection plates DJ1 and DJ2 through C-241. Potentiometer R-270 controls the horizontal displacement of the spot.

The 100 cps modulated i-f output from the indicator channel is impressed upon the vertical plates through the capacitor (C-228). Vertical positioning of the spot is controlled by potentiometer R-264. The brilliance and focus are controlled by potentiometers R-268 and R-266, respectively.

The center portion of the pattern is suppressed, leaving only two vertical lines, by a trigger circuit consisting of a rectifier (V-217, 6H6) and an amplifier (half of V-212, 6SN7). The trigger rectifier acts as a full-wave rectifier with its 100 cps input applied directly from the low-frequency oscillator through the transformer (T-202). These rectified pulses control the plate current of the amplifier (V-212) which in turn controls the bias on the control electrode (G1) and hence the brilliance of the pattern. During the peaks of the audio wave, the rectified pulses are sufficiently high to completely blank out the tube. The degree to which the pattern is blanked out can be adjusted by the blanking adjustment R-272. The blanking action can be removed entirely by the blanking switch S-204 which opens the cathode circuit of the amplifier tube.

1.49 Voltage Supply Circuits.–

1.491 A-c Circuits.–

The a-c input to the radio receiver is introduced at receptacle J-205. Each leg of the a-c connections to the receiver power transformer (T-203), is shielded and fused (F-201, F-202) and filtered by a two section capacity input network. The input capacitors (C-253, C-254) are spark plates. The primary of transformer T-203 is tapped for operation on 110-, 115- or 120-volt lines. The OFF-STANDBY-ON switch controls the a-c supply to the primary and interrupts the d-c output of the low- and high- voltage rectifiers in the OFF and STANDBY positions. The secondary of transformer T-203 has five windings. One 6.3-volt winding supplies the heaters of all the 6.3-volt tubes, except V-216 (2AP1) which has its own 6.3-volt winding. A 2.5-volt winding supplies heater voltage to V-215 (2X2) and a 5-volt winding to V-213 (5U4G).

1.492 Rectifier Circuits.–

The high-voltage winding is tapped at 400, 315, 0, 100 and 315. Three separate rectifiers are used with the CFT-46245 Radio Receiver. A half-wave rectifier (V-215, 2X2) connected to the 400-volt tap, supplies the high-voltage to the receiver cathode-ray tube circuits. A full-wave rectifier (V-213, 5U4G) connected to the 315-volt tap, supplies the plate and screen voltages for the receiver circuits. A type 6H6 (V-214), connected as a half-wave rectifier to the 100-volt tap, supplies bias voltage for the cathode-ray tube, the trigger amplifier, and the avc return circuits. The output voltages of these tubes have suitable filter and bleeder networks.

1.5 ACCESSORIES.–

1.51 Model OAN Test Oscillator Equipment.–

The Model OAN Test Oscillator equipment consists of one Type CFT-60054-A Test Oscillator unit;

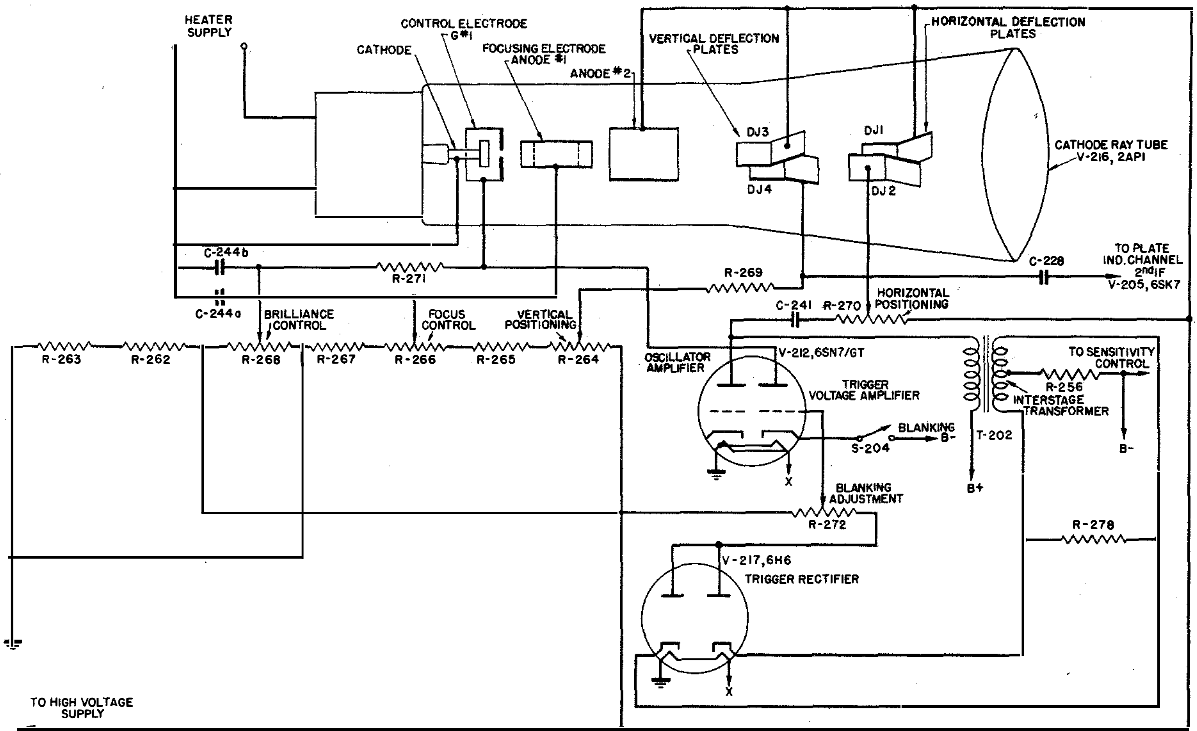


Figure 17. Cathode-ray tube circuits and controls.

complete with tubes, internal a-c power supply and battery pack, cable accessories and waterproof carrying case; and one 15-foot Type CFT-66082 Whip Antenna assembly with carrying case. The test oscillator is designed to function as a target transmitter for checking the collector system and for alignment of the input stage in accordance with instructions given in paragraph 6.6. Operation and service notes are in paragraph 8.1.

SECTION II FUNDAMENTALS OF DIRECTION FINDING

2.0 PRINCIPLE.–

The principle involved in determining the bearing of a radio transmitter is to find the direction of arrival of the received wave, which experience has shown to be the direction in which the signal source lies. Some of the factors tending to alter this relationship are minimized by careful design of the receiving antenna equipment.

2.1 ESSENTIAL ELEMENTS OF A DIRECTION FINDER.–

The essential elements of a radio direction finder (see figure 18) are a directional receiving antenna, a sensitive radio receiver, and a suitable indicating device. The determination of the direction of arrival of the signal is accomplished by rotating the antenna to the position characteristic of its directional response. The radio receiver serves only to detect and amplify the antenna response, while the indicator shows the direction, on an azimuth

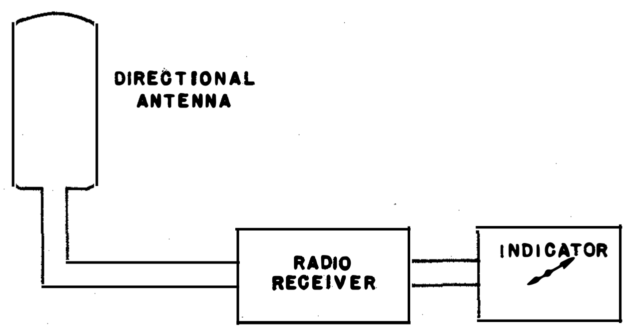


Figure 18. Essential components of a radio direction finder.

scale, corresponding to the characteristic antenna response.

2.2 ANTENNA CHARACTERISTICS.–

2.20 General.–

When a conductor is cut by magnetic lines of force a voltage is induced which is proportional to the rate at which it is cut by the lines of force. This is a fundamental law of electromagnetism. Equally fundamental is the fact that the electric and magnetic field components in a radio wave are inseparably related to one another. Therefore only the magnetic component need be considered when analyzing the interaction between an incident wave and a receiving antenna. A normal or vertically polarized wave may be defined as one which will induce voltage only in a vertical section of a conductor, that is one whose magnetic field is horizontal.

2.21 Vertical Monopole Antenna.–

The simplest form of antenna consists of a vertical wire or monopole. When a vertically polarized radio wave passes over it, it will be cut by the horizontal lines of flux in the wave. The induced voltage will depend only on the height of the antenna and the intensity of the alternating flux of the wave, and will be independent of the direction of wave arrival for all directions in the horizontal plane. Furthermore, the induced voltage will be *in phase* with the flux variations of the incident wave. Figure 19 is a polar response diagram of a vertical monopole antenna for vertically polarized waves, showing the response to be equal for all angles of incidence.

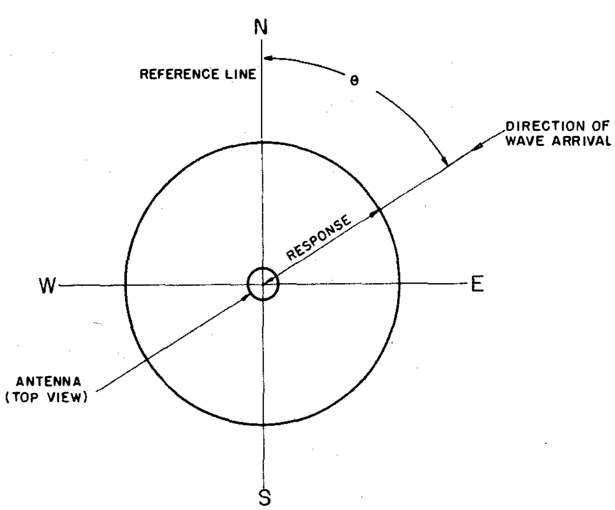


Figure 19. Polar response diagram of a vertical monopole antenna.

2.22 Loop Antenna.–

The response of a loop antenna is quite different from that of a vertical monopole. When the horizontal lines of flux in the incident wave cut the

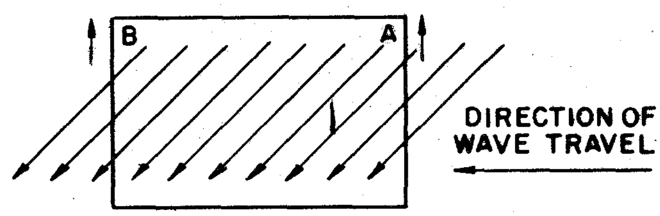


Figure 20. Radio wave inducing opposing currents around a loop antenna.

two vertical members of the loop (see figure 20) the instantaneous voltages induced in members A and B are in the same direction. Corresponding currents then flow in opposite directions around the loop (see arrows in figure 20) and will completely neutralize one another if the instantaneous voltages induced in members A and B are the same. Since the magnetic field of the wave is alternating, the instantaneous flux density at any point along the line of wave travel varies sinusoidally as shown in figure 21a. The lengths of the flux lines represent the flux density or magnetic intensity of the wave at any phase of the motion while the arrow heads show their direction.

When the phase of the wave at the loop is 0°, as at loop position L_1 in figure 21a, the lines of flux cutting the loop are in opposite directions at its two vertical members. Therefore the induced voltages in the vertical members are in opposite directions. The resulting currents are then in the same direction around the loop, and the loop voltage is maximum (see figure 21b). At the 180° phase point (loop position L_4) the loop voltage is again maximum but in the opposite direction around the loop. At the 90° and 270° phase points (loop positions L_3, L_5), the flux density and direction is the same at both sides of the loop, so that the resultant loop voltage is zero. At all other phase points the flux density is different at the two sides of the loop although the flux direction is the same. The effective loop current is then the difference of the two opposing currents induced in the two sides, and the loop voltage is proportional to the current difference. A comparison of figures 21a and b shows that *the effective loop voltage differs in phase from the incident wave by 90°. This is an important point to remember.*

Observe that the resultant instantaneous loop voltage induced at any phase of the incident wave depends upon the difference in density of the flux

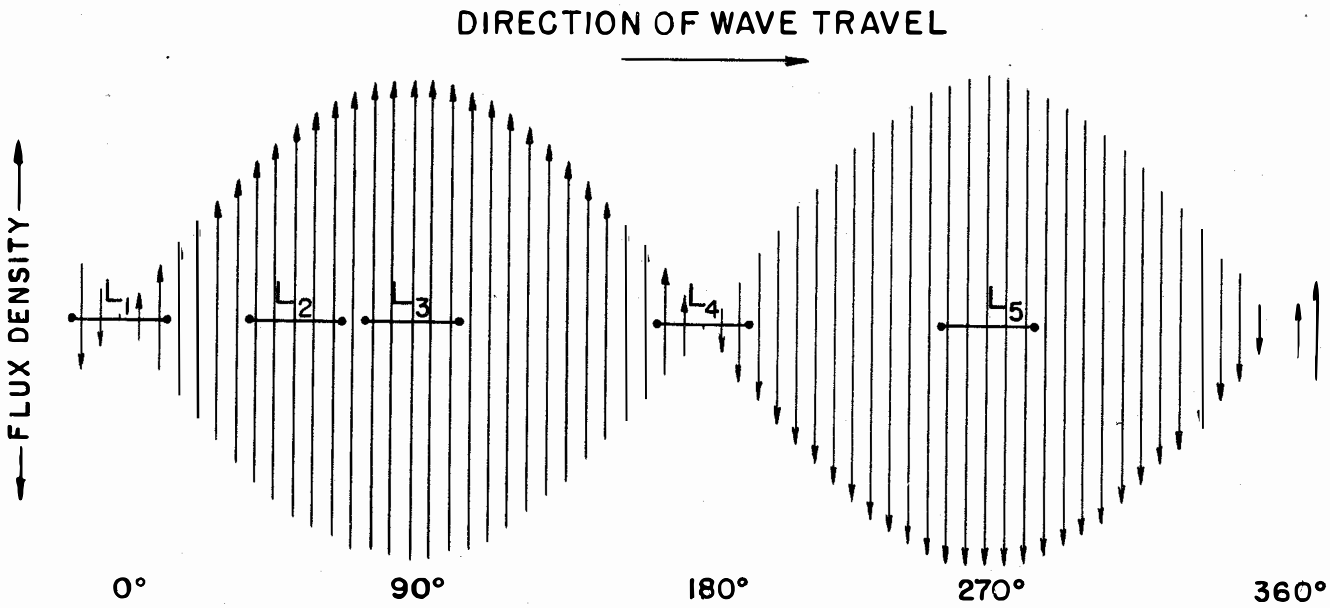


Figure 21a. Top view of loop at various phases of the incident wave.

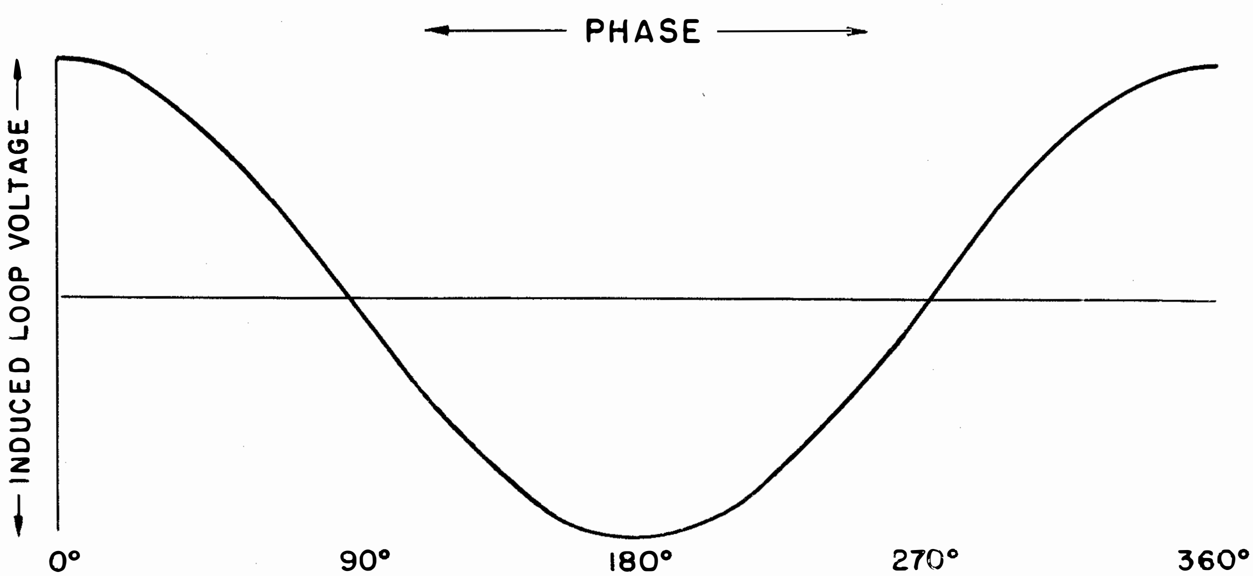


Figure 21b. One cycle of induced loop voltage.

Figure 21. Induction of alternating voltage in a loop antenna 90° out of phase with the incident radio wave.

cutting the vertical members of the loop. The wider the loop the greater the difference in flux density at the side members. Since the voltage induced in the side members is proportional to the loop height, the effective loop voltage is proportional to its area. Furthermore, the flux linked by the loop is proportional to its area, so the loop voltage is also proportional to the flux linkage. The loop antenna response is therefore maximum when the plane of the loop is parallel to the direction of wave travel (maximum flux linkage) and decreases to zero as the plane of the loop is turned perpendicular to the direction of wave travel (zero flux linkage).

Figure 22 shows an enlarged section from figure 21a for purposes of detailed analysis of the marked directional properties of a loop as it is turned relative to the direction of wave travel. The width of the loop is here considered to be small compared to a wave length so that the instantaneous flux in its neighborhood may be assumed to be essentially uniform. When the loop is in position $L_{0°}$ its plane is parallel to the lines of flux and perpendicular to the direction of wave travel so there is no flux linkage and hence zero or null response. As the loop is turned to successive positions as shown (positions $L_{30°}$, $L_{60°}$, etc.) it will link successively more and more lines of flux until, at position $L_{90°}$, its plane is parallel to the direction of wave travel and it links the maximum flux. As the loop is rotated further it links less and less flux until, at position $L_{180°}$, the flux linkage is again zero and its response is again a null. The flux linkage and loop response increases with continued clockwise rotation, reaching a maximum in the $L_{270°}$ position, in which the loop is again parallel to the direction of wave travel. The response decreases over the remainder of the rotation back to the original null. Observe that for the first half of the loop rotation from the original null to the second null position, the flux linkage relative to the loop is always in the same direction, whereas for the remainder of the rotation from the second null position back to the first, the flux linkage relative to the loop is in the opposite direction (see curved arrows of figure 22). The phase of the loop voltage for the two halves of the rotation will then differ by 180°, the phase reversal occurring as the loop is turned through its null position.

If the flux linkage is counted for the various loop positions of figure 22 and the results plotted as a polar graph, the characteristic response diagram for a loop will be obtained (see figure 23). Since the flux is linked through the loop in opposite directions over the two halves of its rotation, the response shown by one lobe of the diagram is considered (+) and that of the other lobe (−). This type of response is known as the cosine or figure of eight diagram and illustrates the extreme directional characteristics of the loop.

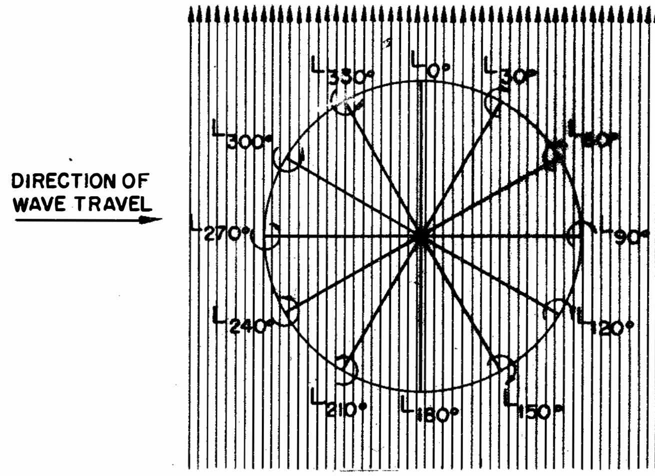


Figure 22. Variation in flux linkage due to loop rotation about a vertical axis.

The null points of a loop are always used in direction finding because of the phase reversal of the output voltage and because the loop may be much more accurately aligned to the direction of wave travel at the nulls than at the maxima. The line of arrival of a radio wave may be determined from the position of a loop for zero response or a null. However, since there are two nulls 180° apart, there is a 180° uncertainty as to the true radio bearing or direction of the transmitter from the receiving station. Sense, or the determination of absolute direction, is obtained from the combined characteristics of a loop and a vertical monopole antenna.

2.23 *Combined Response from a Loop and Monopole Antenna.–*

If the outputs of a loop and vertical monopole are combined *in phase** the response diagram of the

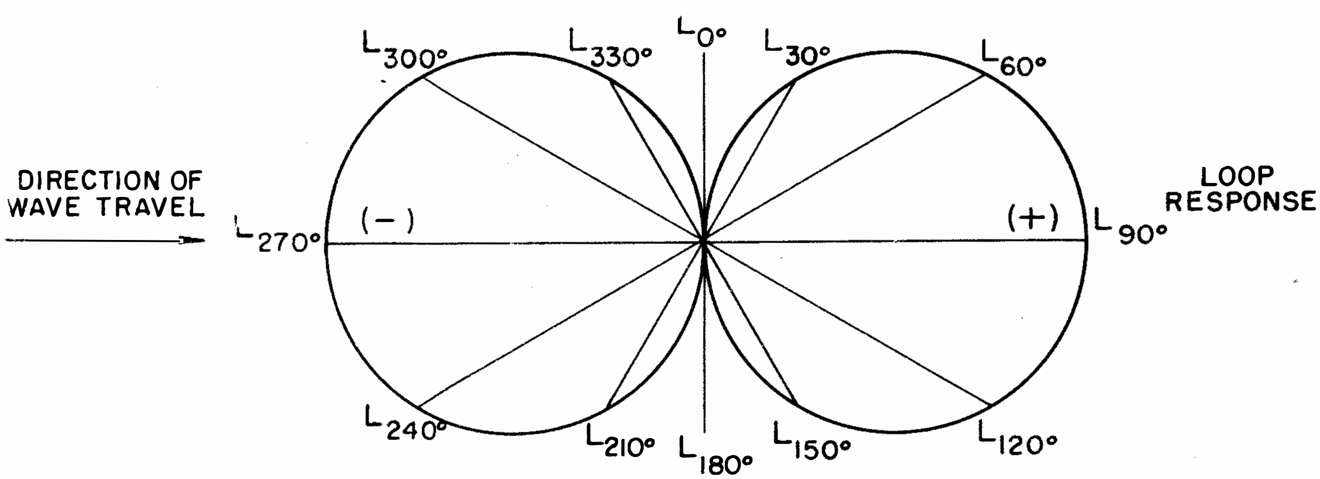


Figure 23. Figure of eight polar response diagram of a rotating loop antenna.

combination will be the algebraic sum of the figure of eight and circle diagrams. It was pointed out in paragraph 2.22 that the phase of the loop voltage reverses as the loop is rotated through a null so that one lobe of the figure eight diagram (see figure 23) is to be considered (+) and the other is (−). The phase of the monopole voltage, being independent of the direction of wave arrival (see paragraph 2.21) is also considered (+). In figure 24 the loop and monopole response diagrams are shown dotted while the solid curves show the combined response. These are commonly referred to as cardioid response diagrams because they are heart shaped. The differences in the four diagrams of figure 24 are due to the differences in the amplitudes of the monopole and maximum loop response. Since the cardioid diagrams are unsymmetrical with respect to the line through the loop nulls, *ie.*, the direction of wave arrival, they provide a means for determining absolute direction or sense, free from the 180° ambiguity inherent in the figure of eight diagram. In the particular case illustrated in figure 24c, in which the maximum loop and monopole response are equal, the single null may be directly correlated to the absolute direction of wave arrival.

* As shown in paragraphs 2.21 and 2.22 the monopole voltage is in phase with the radio wave while the loop voltage is 90° out of phase with the radio wave. Therefore, the two outputs will normally be 90° out of phase with each other. This means that the phase of one output must be shifted 90° to bring it in phase with the other before they are combined.

2.24 *Crossed Loops and Goniometer System.–*

It is not always convenient to rotate the loop antenna, especially in shipboard installations, because of the size of the loop or its required location, or for

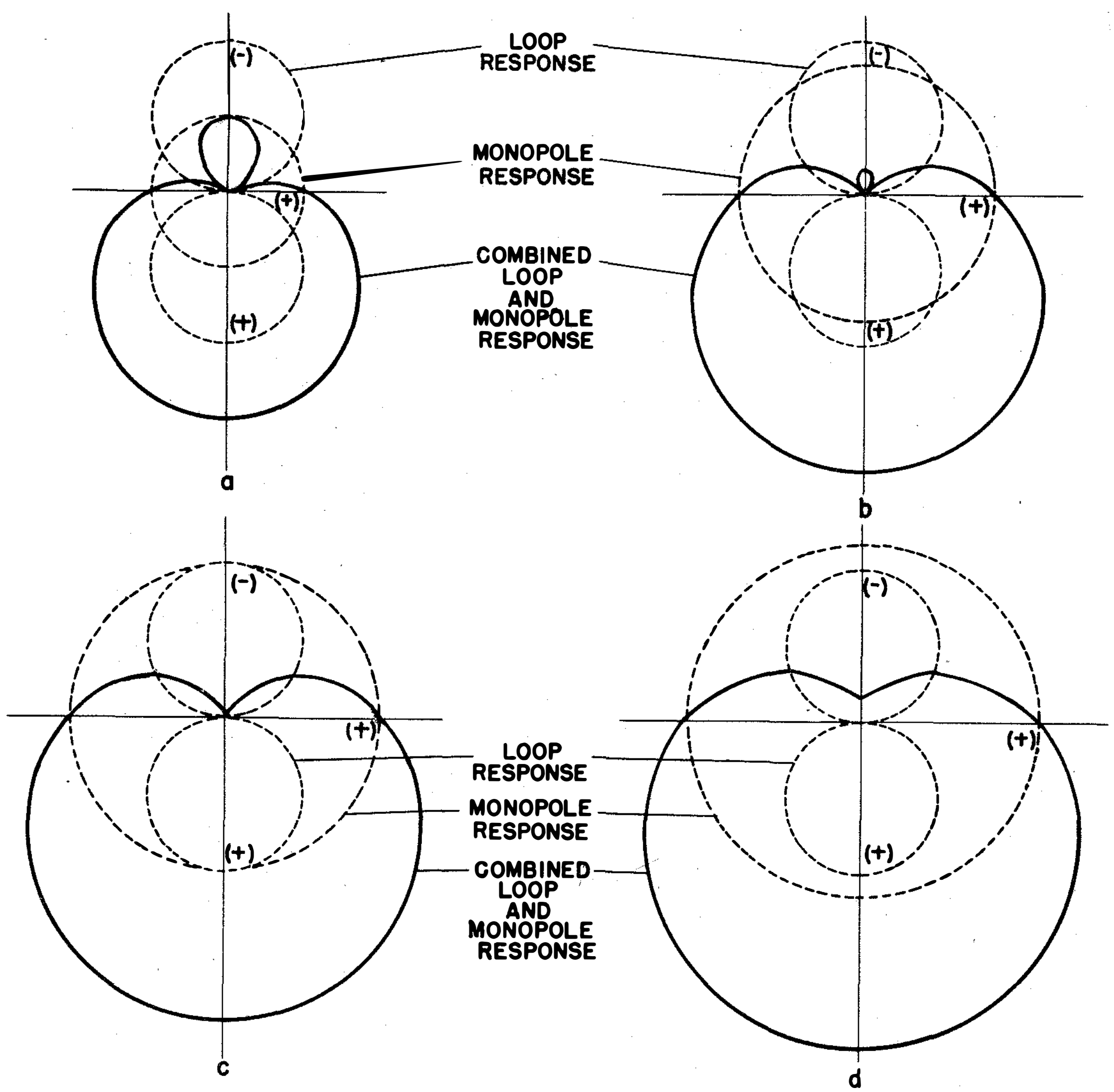


Figure 24. Cardioid series of polar response diagrams for the combined output of a monopole and rotating loop antenna as the monopole output is increased relative to the maximum loop output.

other considerations. However, equivalent results may be obtained from a pair of stationary loops, at right angles to each other, connected by any desired length of r-f transmission line to a goniometer. The goniometer may then be conveniently located near the receiver and indicating equipment. Figure 25 shows two crossed loops. Imagine a third or search loop mounted within the crossed loops so that its axis of rotation coincides with the vertical axis of the two crossed loops. A, B and C represent radio waves arriving in the directions shown. The pointer P is assumed to be mounted on the search loop perpendicular to its plane as shown. If, for the moment, we imagine the cross loops to be absent the response of the search loop alone will vary with respect to the direction of arrival of any one of the three waves A, B, or C as described in paragraph 2.22. At the nulls the pointer P will point one way or the other along the line of arrival of the wave in question.

If the crossed loops are in position as shown, the voltages induced and therefore the current which will flow in either loop is just as outlined in paragraph 2.22. For example, wave A will induce a maximum current in loop 1 and zero current in loop 2, since loop 2 is perpendicular to the line of arrival of wave A. Forget wave A for the moment and consider only the current it has induced in loop 1. Loop 1 will then induce a current in the search loop proportional to the cosine of the angle that the plane of the search loop makes with loop 1. The current and hence the voltage in the search loop will be maximum when the plane of the search loop coincides with the plane of loop 1 and will be zero when their planes are perpendicular. The phase of the search loop voltage will reverse as it passes through its nulls or positions of perpendicularity to loop 1. This is exactly the cosine or figure of eight response diagram.

When the plane of the search loop is perpendicular to loop 1 it is also perpendicular to the line of wave arrival so that its response is the same whether considered as being induced from loop 1 or directly from wave A. Similarly the search loop response is the same whether considered as being induced from loop 2 or directly from the arriving wave in the case of wave B. A wave arriving in the direction C of figure 25 induces currents in both loops, the magnitudes and phases of which depend upon the inclination of the wave to the two loops. Again the resultant current induced in the search loop by loops 1 and 2 will be equivalent to the current which wave C would induce directly, and the search loop nulls will occur when its pointer P lies along the line of arrival of wave C.

A goniometer is simply a device for duplicating the response characteristics of the search coil and crossed loops as described above. It consists of two field coils or stators whose axes are at right angles

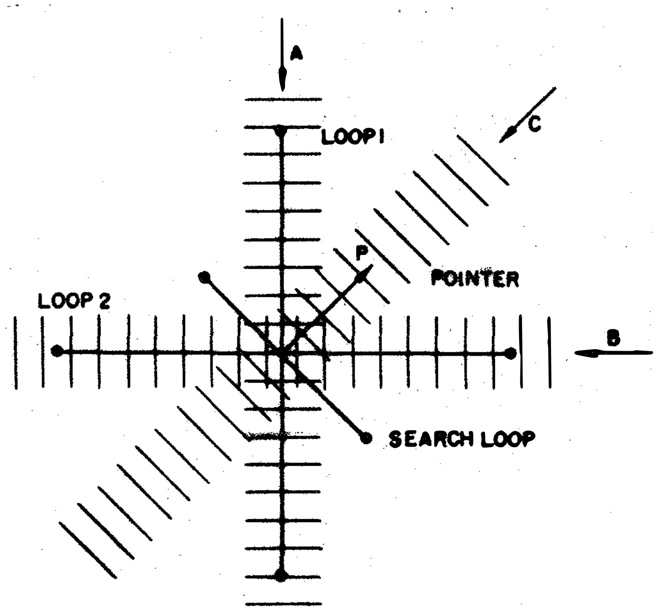


Figure 25. Crossed loops with coaxial rotating search loop.

to one another, and a rotating search coil or rotor (see figure 26). Each loop is connected to its corresponding goniometer stator so that the currents flowing in the goniometer stators are proportional to the currents in the crossed loops and equal to them in phase. The position of the goniometer rotor for null response relative to the stators will then correspond exactly to the positions of null response of the equivalent search loop relative to the crossed loops. Since the search loop was shown to respond exactly as though it were receiving directly, the goniometer rotor response characteristic is the same as that of a single rotating loop. A pointer mounted on the rotor shaft and referred to a properly aligned azimuth scale will then give bearings subject to the same 180° uncertainty. Similarly its output may be combined with that of a vertical monopole antenna to give the characteristic cardioid response diagram from which absolute direction or sense may be determined. In the arrangement shown in figure 26 the rotor output is inductively coupled to a rotating transformer to eliminate the necessity for slip ring connections.

2.3 RECEIVING AND INDICATING EQUIPMENT.–

The antenna characteristics outlined in the above paragraphs may be used in various ways in practical direction finder systems. The type of receiving and indicating equipment depend upon the methods of indication which, in turn, are governed by the service requirements of the direction finder.

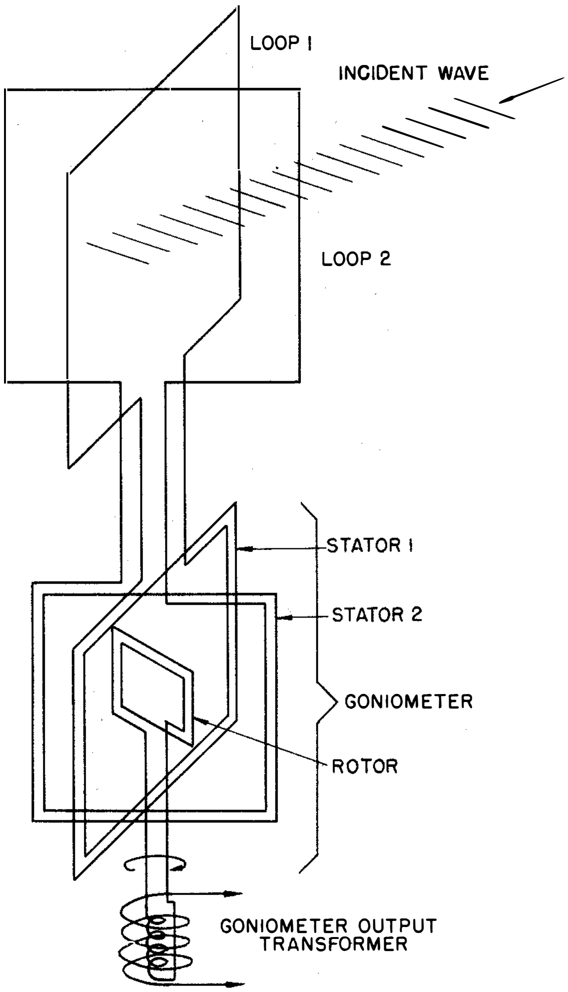


Figure 26. Crossed loops and goniometer system equivalent to a single rotating loop.

The Model DAK-3 Direction Finder provides bearings by null and by visual matched-line indication.

The same antenna system, consisting of a pair of crossed loops and goniometer and a vertical monopole for sense, is used for both indication systems.

2.4 NULL INDICATION.–

The receiver is first tuned to the desired signal using only the goniometer input. The loudspeaker or a telephone headset is used to locate the goniometer nulls as the goniometer dial is turned. The 180° bearing ambiguity, due to the two nulls, is eliminated by shifting the phase of the directional input 90° and then combining the voltages in the directional and sense input channels. This results in an increase of receiver response from the null by an amount corresponding to the added sense input. If the goniometer dial is rotated from its former null position, the voltage in the directional channel will either add or subtract from the sense channel voltage to further increase or to decrease the receiver response (see cardioid diagram of figure 34). The polarities of the sense antenna and goniometer connections are arranged so that a clockwise goniometer rotation from the null corresponding to the direct transmitter bearing will increase the receiver response. A counterclockwise rotation from the goniometer null will then decrease the receiver response.

Two 360° scales, displaced 180° from each other on the goniometer dial, are provided to facilitate the bearing determination. The direct transmitter bearing corresponds to the null reading on the black scale if the receiver response decreases with clockwise rotation of the goniometer after sense has been added. But if the response increases with clockwise rotation the bearing null is read on the red scale.

A visual bearing indication is also provided by a single line pattern on the two-inch cathode-ray tube. The length of the line is proportional to the receiver response. At a null the line shrinks to a spot. When sense is added the spot becomes a line. If the line increases or decreases in length with clockwise goniometer rotation, the bearing is read on the red or black scales, respectively. The aural and visual null indications may be used independently or to supplement each other.

2.5 VISUAL MATCHED-LINE INDICATION.–

2.50 General.–

In this method two parallel lines appear on the cathode-ray tube. Their relative lengths for a given signal depend on the goniometer setting. Nulls are determined by turning the goniometer dial until the two lines are of equal length. The bearing reading is taken from the black or red scale, depending upon whether the right hand line increases or decreases relative to the left line as the goniometer is turned clockwise.

2.51 Basic Principles Underlying the Matched-Line System.–

2.511 Amplitude Modulation.–

If the amplitude of a radio-frequency voltage is varied periodically at an audio frequency rate, it is said to be amplitude modulated. The r-f voltage is referred to as the carrier; the a-f voltage, the modulating voltage; and the resulting combination, the modulated voltage. A curve drawn through the amplitude peaks of the modulated voltage is known as the modulation envelope, and has the same shape as the modulating voltage. Figures 27 a, b, c, d, illustrate respectively (a) the unmodulated r-f voltage or carrier, (b) the a-f modulating voltage, (c) the modulated voltage, and (d) the modulation envelope drawn through the amplitude peaks. C in figure 27 (a) is the unmodulated r-f amplitude which is the same as the average amplitude of the modulated voltage (figure 37c). A and B of figure 27c are respectively the maximum and minimum amplitudes.

The percentage modulation of a modulated voltage is defined as 100 times the ratio of the difference in average and minimum envelope amplitudes to the average envelope amplitude, or % Mod. = $\frac{C-B}{C}$ x 100.

Analysis of a modulated voltage shows that it has three frequency components. One is the carrier, and the other two are the side frequencies or modulation products. The side frequencies are respectively the sum and difference frequencies of the carrier and the modulating voltages. *The carrier may also be modulated by combining it with the proper side frequencies.*

2.512 Balanced Modulator.–

The balanced modulator provides a simple means for generating the side frequencies and at the same time suppressing the r-f carrier voltage. An r-f input is introduced in push-pull to the grids of two pentodes, while the a-f modulating voltage is applied in push-pull to the screens. The plates are connected in parallel so that the r-f carrier and a-f modulating voltage on the plates will be combined out of phase and will be balanced out. This leaves only the two side frequencies. If the modulating voltage is held constant the amplitudes of the side frequencies will depend only upon the r-f input voltage, varying from zero to maximum as the r-f input is varied in a similar manner.

When the side frequencies are combined with another carrier of the same frequency and phase as the original carrier, a modulated voltage like that shown in figure 27c will be obtained. Shifting the phase of the r-f carrier to the balanced modulator by 180° relative to the new carrier reverses the phase of the side frequencies and hence the phase of the modulation envelope on the new carrier. The percentage modulation of the new carrier will depend in either case upon the amplitude of the original r-f carrier applied to the balanced modulator.

2.513 Trapezoid Modulation Pattern.–

Characteristic patterns are formed on a cathode-ray tube if the modulated r-f voltage is applied to the vertical plates while the modulating voltage is applied to the horizontal plates. Figure 28a shows the resulting trapezoid pattern whose sides are proportional to the maximum and minimum amplitudes,

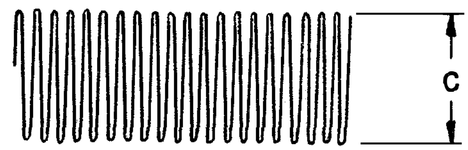


Figure 27a. Unmodulated radio-frequency voltage or carrier.

Figure 27b. Audio-frequency modulating voltage.

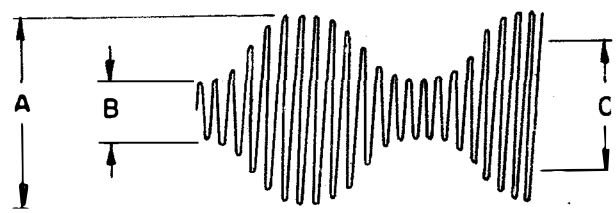


Figure 27c. Modulated radio-frequency voltage.

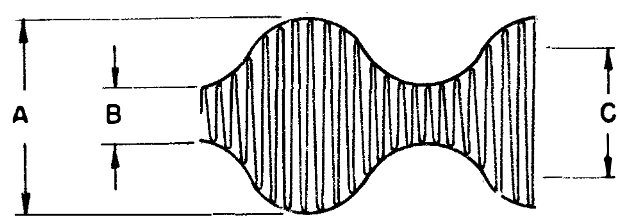


Figure 27d. Modulation envelope curve drawing through amplitude peaks of modulation voltage.

Figure 27. Amplitude Modulation.

A and B, of the modulation envelope. If the modulation is removed (0 percent modulation) without altering the magnitude of the modulating voltage applied to the horizontal plates, the rectangular pattern of figure 28b will be obtained. Its sides are proportional to the unmodulated carrier amplitude C. If the carrier is again modulated, but with the phase of its modulation envelope reversed (shifted 180°), the pattern shown in figure 27c will be obtained. This pattern is the reverse of the one shown in figure 28a.

If the modulation of an r-f voltage is gradually reduced from 100 percent to 0 percent and back to 100 percent, but with the phase of the modulation envelope reversed, the series of patterns shown in

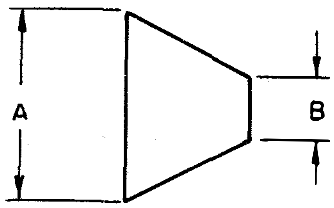


Figure 28a. Modulation envelope in phase with modulating voltage.

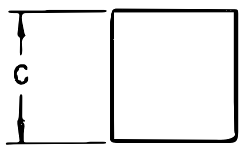


Figure 28b. Modulation removed from r-f carrier.

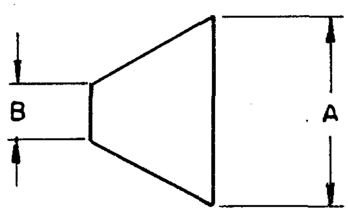


Figure 28c. Modulation envelope out of phase with modulating voltage.

Figure 28. Trapezoid cathode-ray tube patterns with modulated r-f voltage on vertical plates, a-f modulating voltage on horizontal plates.

figures 29a and 29c will be obtained. Over-modulation will distort the modulation envelope as shown in figures 30a and b and produce distorted patterns like those of figures 30c and d. *Observe that these series of patterns provide a means for detecting nulls and phase reversals of an r-f voltage by modulating an equivalent fixed voltage with its side frequencies.*

2.52 *Application of the Trapezoid Pattern to Matched-Line Bearing Indication.–*

Figure 31 shows a block diagram of the principle circuit components for matched-line bearing indication. The goniometer output is amplified by an r-f amplifier in the direction channel of the receiver, shifted in phase 90°, and applied to the balanced modulator. The a-f modulating voltage is simultaneously applied to the modulator and to the horizontal plates of the cathode-ray tube. The sense antenna output is amplified by the r-f amplifier in the receiver sense channel and fed to the mixer r-f amplifier where it is combined with the side frequencies from the goniometer voltage. The modulated output of the mixer r-f amplifier is then applied to the vertical plates of cathode-ray tube where it forms the trapezoid pattern as outlined in paragraph 2.513.

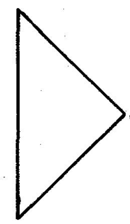


Figure 29a. 100% modulation.

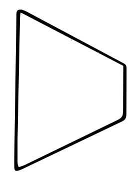


Figure 29b. 50% modulation.

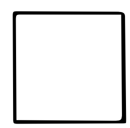


Figure 29c. 0% modulation.

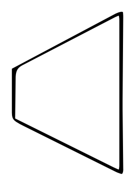


Figure 29d. 50% modulation with phase reversal of modulation envelope.

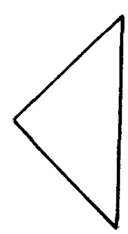


Figure 29e. 100% modulation with phase reversal of modulation envelope.

Figure 29. Series of trapezoid cathode-ray tube patterns corresponding to a change from 0 to 100% modulation envelope.

As the goniometer is rotated, the input to the balanced modulator varies according to the figure

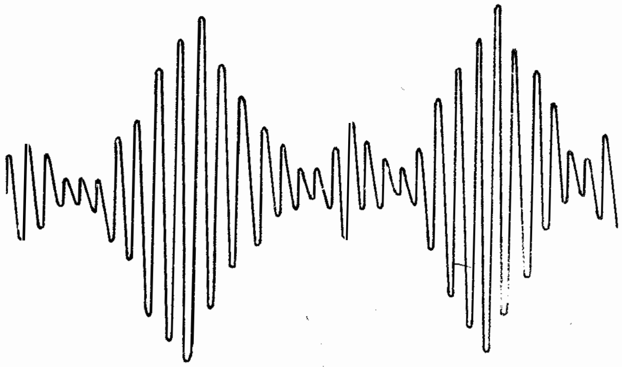


Figure 30a. Overmodulated voltage.

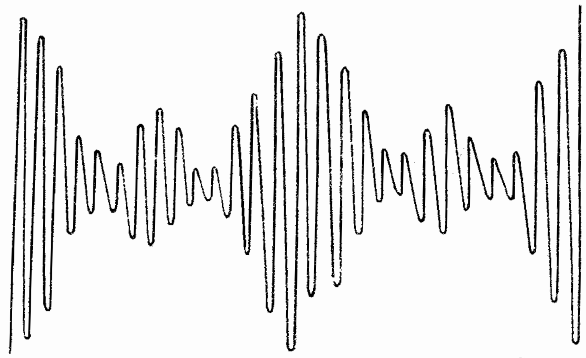


Figure 30b. Overmodulated with phase reversal of modulation envelope.

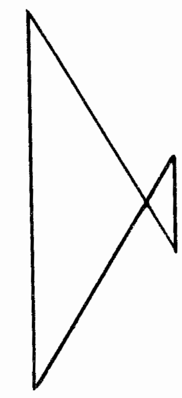


Figure 30c. Distorted trapezoid due to voltage a.

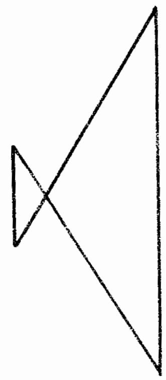


Figure 30d. Distorted trapezoid due to voltage b.

Figure 30. Overmodulated voltage and corresponding trapezoid patterns.

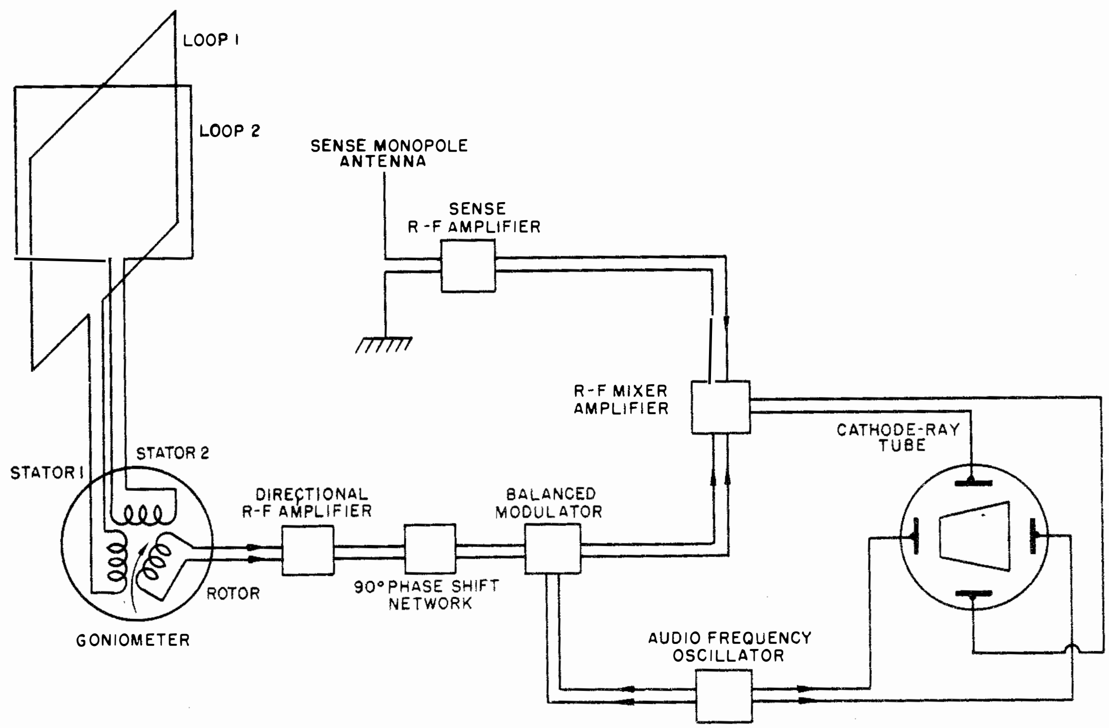


Figure 31. Block diagram of matched line bearing indicator system.

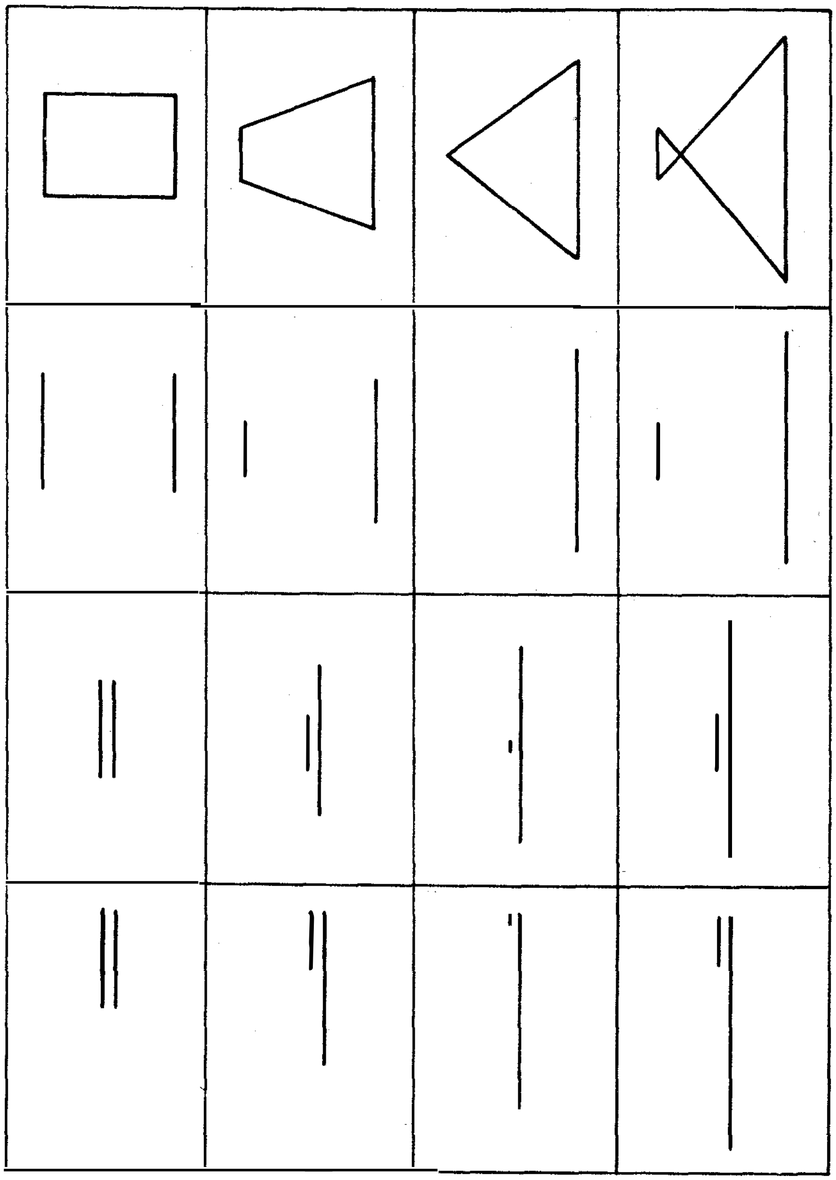


Figure 32a. Trapezoid patterns before center blanking.

Figure 32b. After center blanking.

Figure 32c. After reduction of a-f amplitude on horizontal plates of cathode-ray tube.

Figure 32d. Lower halves of patterns (c) amplified.

0% modulation. 50% modulation. 100% modulation. Overmodulation.

Figure 32. Evolution from trapezoid to matched line series of cathode-ray tube patterns.

of eight goniometer response. At the nulls the modulator input is zero so that the amplified sense voltage applied to the cathode-ray tube plates is unmodulated. Therefore, at the goniometer nulls the tube pattern is rectangular. As the goniometer is rotated one way from a null the modulator input will increase and be in phase with the sense voltage. The side frequency amplitudes will increase, thereby increasing the modulation on the sense carrier to give a trapezoid pattern. A similar effect will result as the goniometer is rotated in the other direction from the null, or in the same direction from the opposite null, except that the phase of the modulator input will shift by 180°. This will produce a trapezoid pattern whose long and short sides are reversed (see paragraph 2.513). The direct transmitter bearing or the absolute direction of the received signal is then definitely related to the way in which the sides of the trapezoid pattern change, with goniometer rotation, from the rectangular null pattern.

In practice the center portion of the trapezoid pattern is suppressed by a blanking circuit on the cathode-ray tube so that only the vertical lines corresponding to the sides of the pattern remain. These are brought close together in order to facilitate matching them in height, by reducing the amplitude of the modulating voltage applied to the horizontal plates.

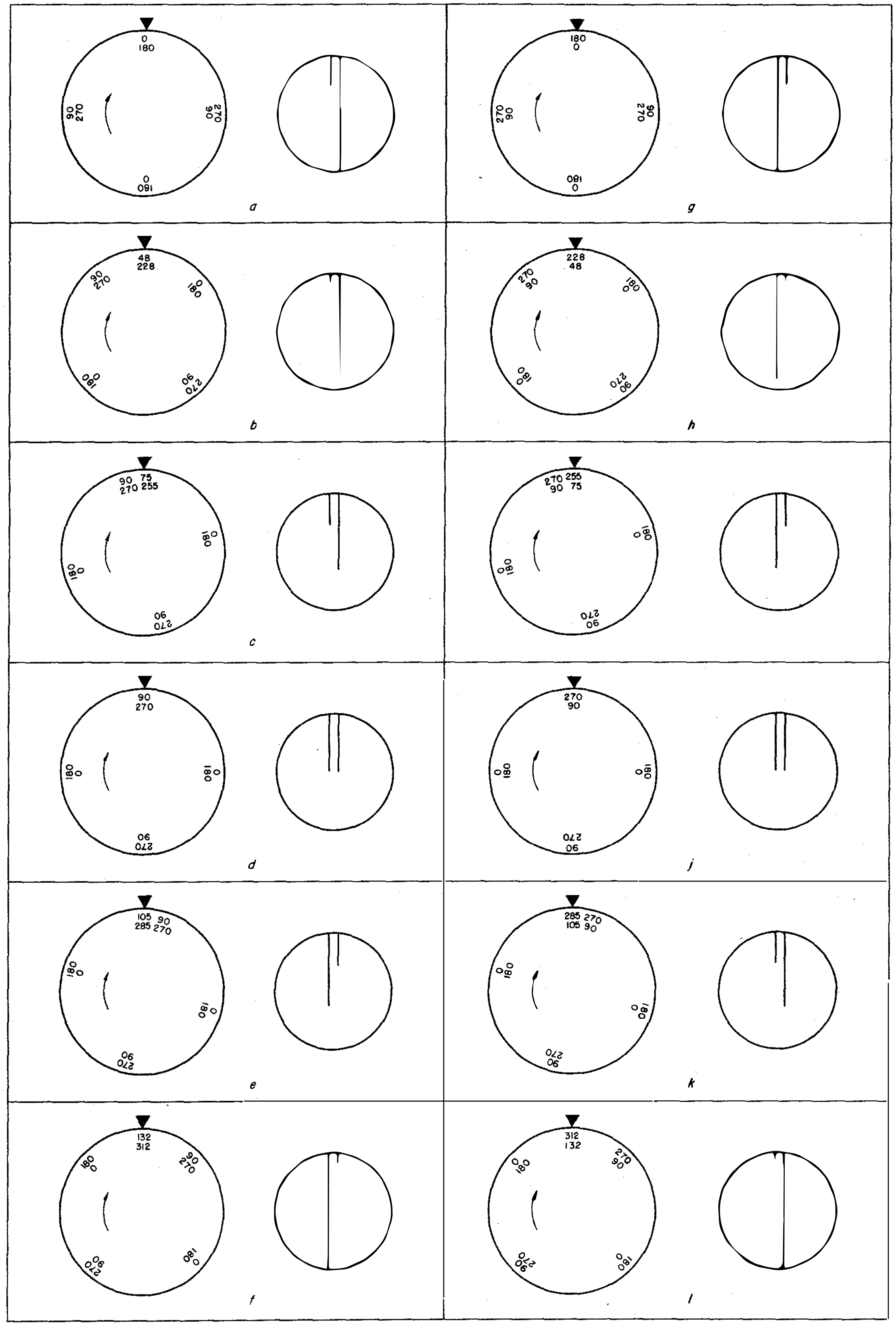


Figure 33. Pattern variation for 360° rotation of goniometer dial for 270° bearing.

Since only the upper or lower halves of the lines are necessary, greater sensitivity for a given cathode-ray tube size is obtained by eliminating half the pattern and amplifying the other half to the full size of the screen. Figure 32 shows a series of patterns from 0 percent modulation to over-modulation, including the evolution from the trapezoid to matched-line series.

2.53 Typical Matched-Line Indicator Patterns.–

The goniometer dial has two 360° scales displaced 180° with respect to each other. The outer scale is black and the inner one is red. All connections are phased so that the direct transmitter bearing is determined without ambiguity by reading the black scale if clockwise rotation of the dial from the null causes the right hand line to lengthen. If the right hand line shortens with clockwise rotation, the red scale reading gives the bearing. In either case the bearings are given by the proper scale reading for which the two lines are exactly equal in length.

Figure 33 shows a sequence of patterns corresponding to 360° of rotation of the goniometer dial in a clockwise direction. As the dial is rotated through the first null (figures 33d and e) the left line lengthens and the right line shortens. The red or inner scale shows the bearing to be 270°. As the dial is rotated still further and passes through the second null (figures 33j and k), the left line shortens and the right line lengthens. The black or outer scale now shows the bearing which is the same as before, namely 270°.

SECTION III INSTALLATION NOTES AND DRAWINGS

3.0 INTRODUCTION.–

3.00 General.–

Successful performance will be realized *only* if each part of the job is thoroughly and properly carried out. Don't attempt to assemble or install the equipment *until* these instructions have been carefully read. Certain units require special handling in conformity to these instructions so as to avoid damage.

3.1 SELECTION OF SITE.–

3.10 General.–

The proper location for the loop, the sense antenna and the operating equipment will be specified by the Radio Materiel Officer at each particular installation.

The location will affect the quality of performance obtained. Select the site for the cross loop as far from metallic reradiating objects as is possible. The hull of the ship, the superstructure, the guns, the rigging, etc. may act as antennae which resonate at various frequencies within the range of the equipment. Such objects reradiate signals for which the direction finder indicates false bearings. It is impossible to remove the effects of such sources of error entirely, but a very satisfactory installation can be made if the precautions listed below are observed.

3.11 Installation Precautions.–

(1) There should be no metallic stays or riggings within a fifteen foot radius of the base of the loop. Rigging, stays, etc. outside this radius should, where possible, be broken by insulators in accordance with instructions issued by NRL (see paragraph 3.2). Check all metallic objects to see that they do not form a part of intermittent grounds, which might change the electrical characteristics of the ship after calibration of the direction finder.

(2) Don't select a site for the sense antenna in line (fore and aft) with the cross loop. Allow sufficient space for the possible use of a corrector wire, (see paragraph 4.7).

3.2 PREPARATION OF SHIP.–

Modify the electrical characteristics of the ship as soon as possible during its construction. As mentioned in subparagraph 3.11 break rigging, stays, etc. by insulators in accordance with instructions issued by the Bureau of Ships. Ground the lower sections to the hull with flexible braids. NRL Specifications RA-69A-200 and RA-69A-221 enumerate general precautions for rigging in this connection. Procedure outlined in these specifications should be followed.

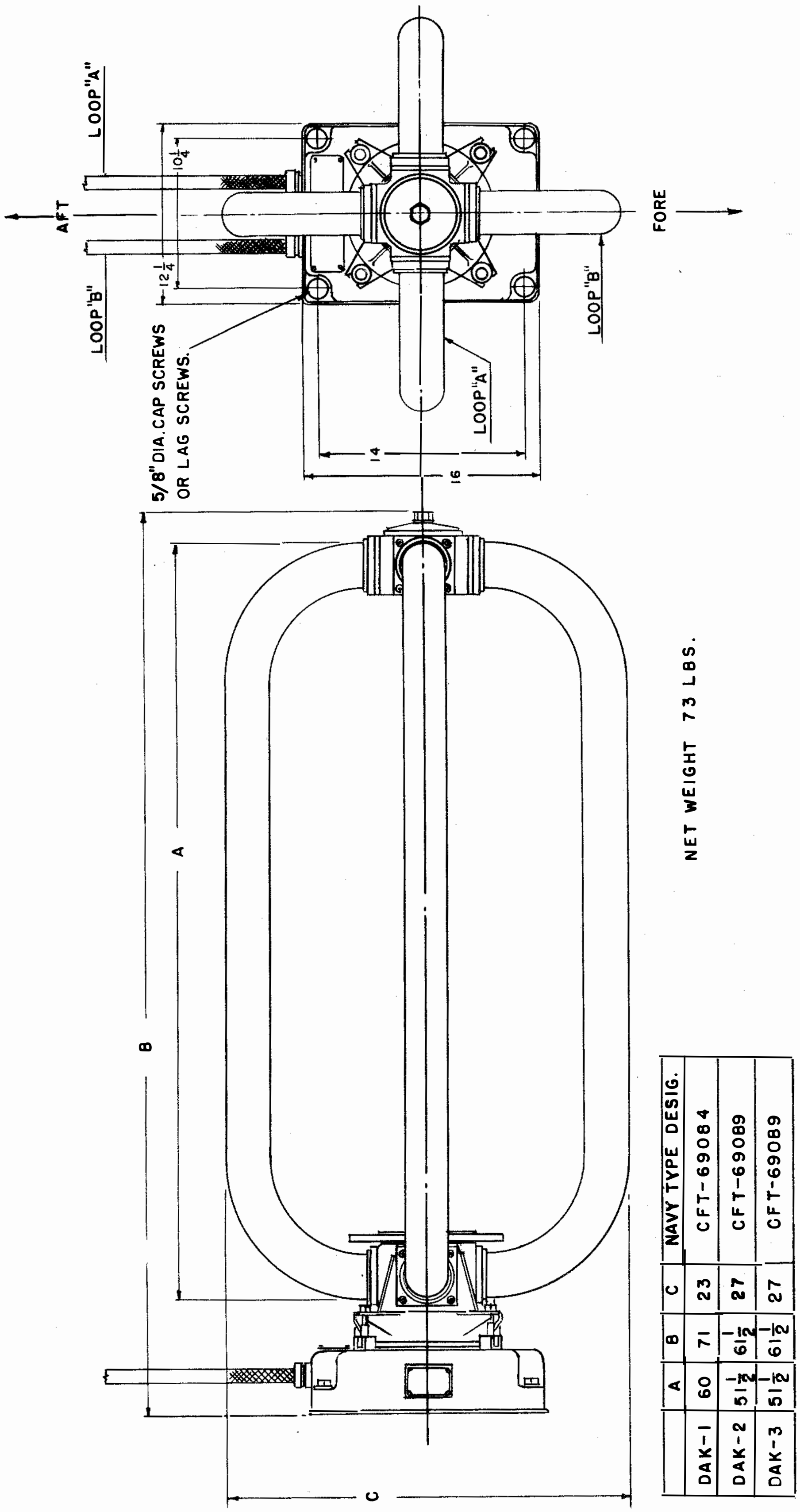
3.3 ACCESSORY DEVICES.–

3.30 General.–

Prepare the shipboard location of the Model DAK-3 Control Unit before the unit is brought aboard ship by installing the accessory devices listed below.

3.31 Gyro Repeater.–

Locate a gyro repeater station conveniently to the Model DAK-3 equipment to enable conversion of relative direction finder bearings to true bearings.



	A	B	C	NAVY TYPE DESIG.
DAK-1	60	71	23	CFT-69084
DAK-2	$51\frac{1}{2}$	$61\frac{1}{2}$	27	CFT-69089
DAK-3	$51\frac{1}{2}$	$61\frac{1}{2}$	27	CFT-69089

Figure 34. Outline drawing CFT-69089 Crossed Loop Assembly.

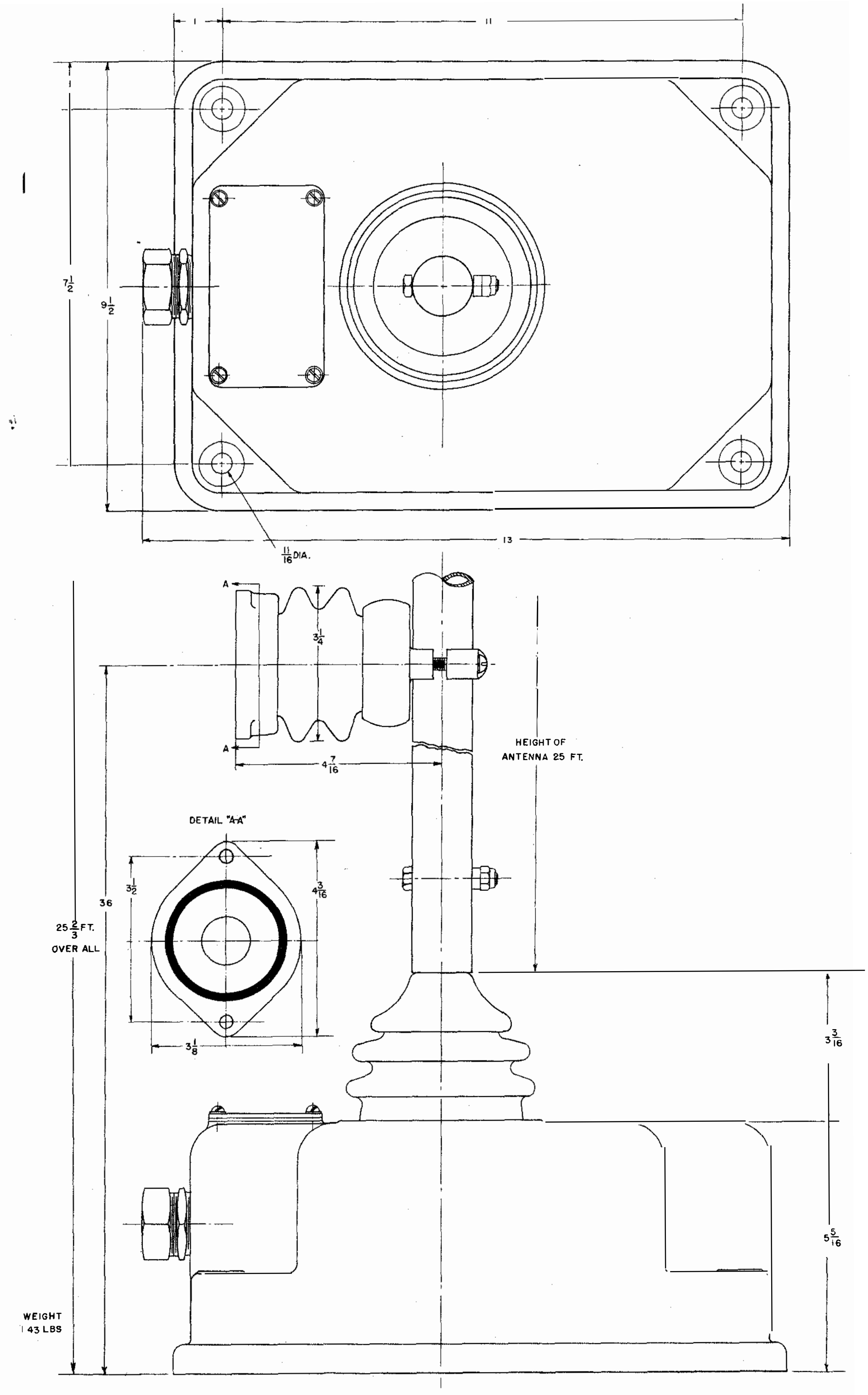


Figure 35. Outline drawing CFT-66093 Sense Antenna Assembly.

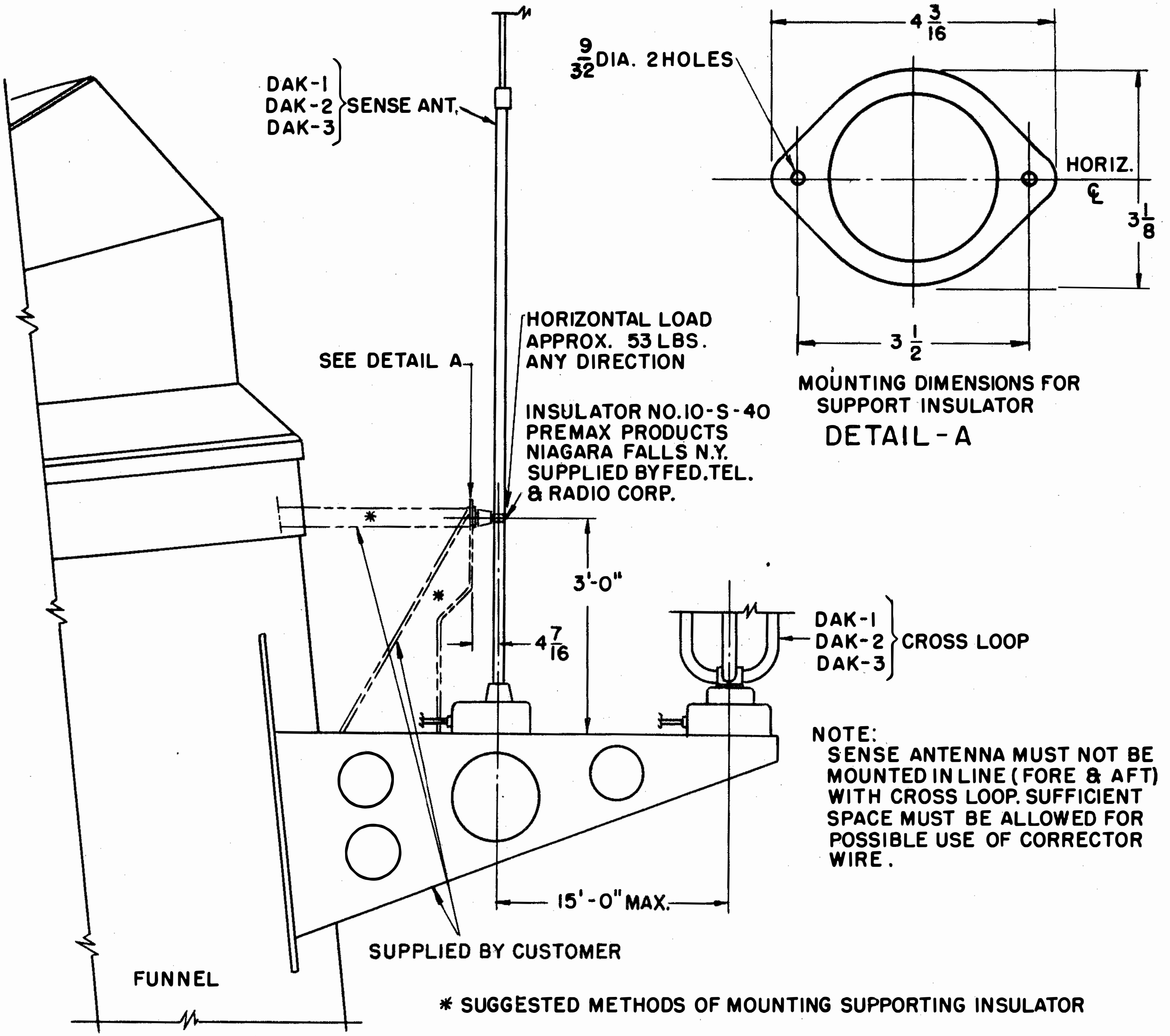


Figure 36. Typical Model DAK-3 antenna installation.

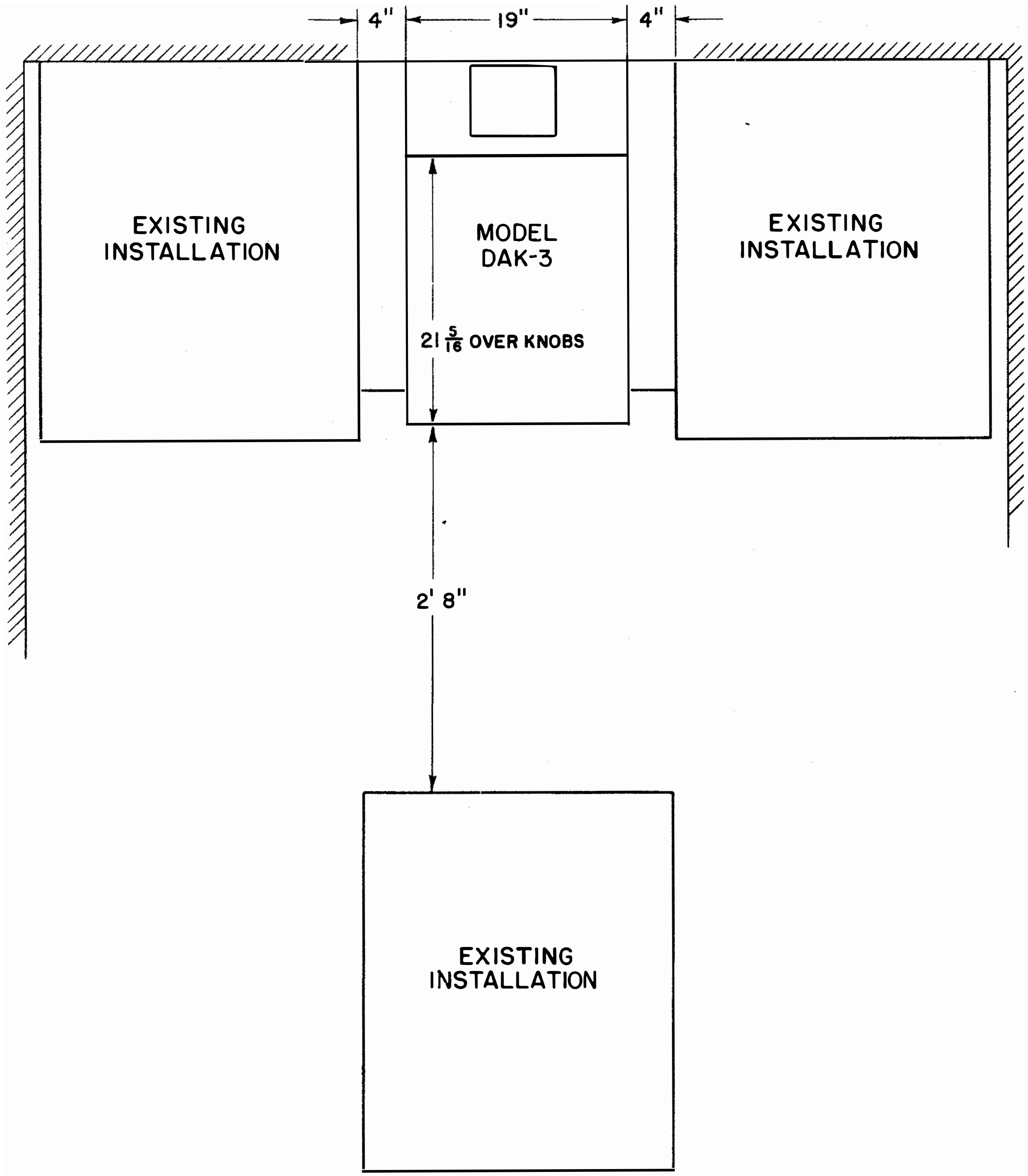


Figure 37. Minimum space requirements.

If an additional repeater unit is not available it may be necessary to move an existing unit into a position where it may be used for two adjacent equipments.

3.32 TBS Remote Control.–

Locate the remote control unit of the TBS or equivalent transmitter in such a manner that it may be available for the use of the DAK-3 operator as well as for its other intended purposes.

3.33 Clock.–

If available, install a suitable clock in such a position as to be visible to the operator of the DAK-3 equipment.

3.34 Power.–

Make provision for the supply of power to the direction finder equipment. Only one 110 to 120 volt, 60 cycle, single phase power connection is required. The drain is approximately 150 va.

3.35 Telephone.–

Provide direct telephone connections between the direction finder equipment and the stations from which the vessel will be conned. These circuits must be constantly available to the director finder operator. A connection with the main radio room is also desirable.

3.4 ADDITIONAL INSTALLATION MATERIAL.–

(To be furnished by Navy)

(1) Loop tripod or platform as required.

(2) Sense antenna platform or shelf as required.

(3) Sense antenna brace.

(4) Cable clamps.

(5) Cable troughs.

(6) Stuffing tubes.

3.5 INSTALLATION DETAILS.–

3.51 CFT-69089 Cross Loop and CFT-66093 Sense Antenna.–

Drawings showing the antennae installation details for the particular installation will be supplied by the Radio Materiel Officer. Mount the loop symmetrically to its supporting structure with all stays, riggings and antennae symmetrical with respect to the loop. Bolt the base of each unit to its supporting stand or shelf as indicated in the drawings. The fore-aft positioning of the loop is indicated in figure 34. The axis of loop B must be aligned fore-aft to within ±½°. Align the sense antenna rod vertically. Make sure it is not in line fore and aft with the loop. The loop base mounting dimensions are given in figure 34 and those for the sense antenna in figure 35. A typical installation is shown in figure 36.

3.52 CFT-62138 Junction Box.–

Installation details for the junction box are given in figures 37 and 39. Mounting dimensions are given in figure 38. Weld the mounting brackets to the bulkhead or to a plate secured to the bulkhead, in the proper position so that the three type AN connectors on the junction box face downward. Allow sufficient clearance over the top of the junction box to permit lazy loops and easy bends as described in subparagraph 3.61.

3.53 Radio Receiver.–

(1) Prepare the mounting position for Radio Receiver assembly by drilling the four (4) holes required (see figure 39).

(2) Unpack the radio receiver.

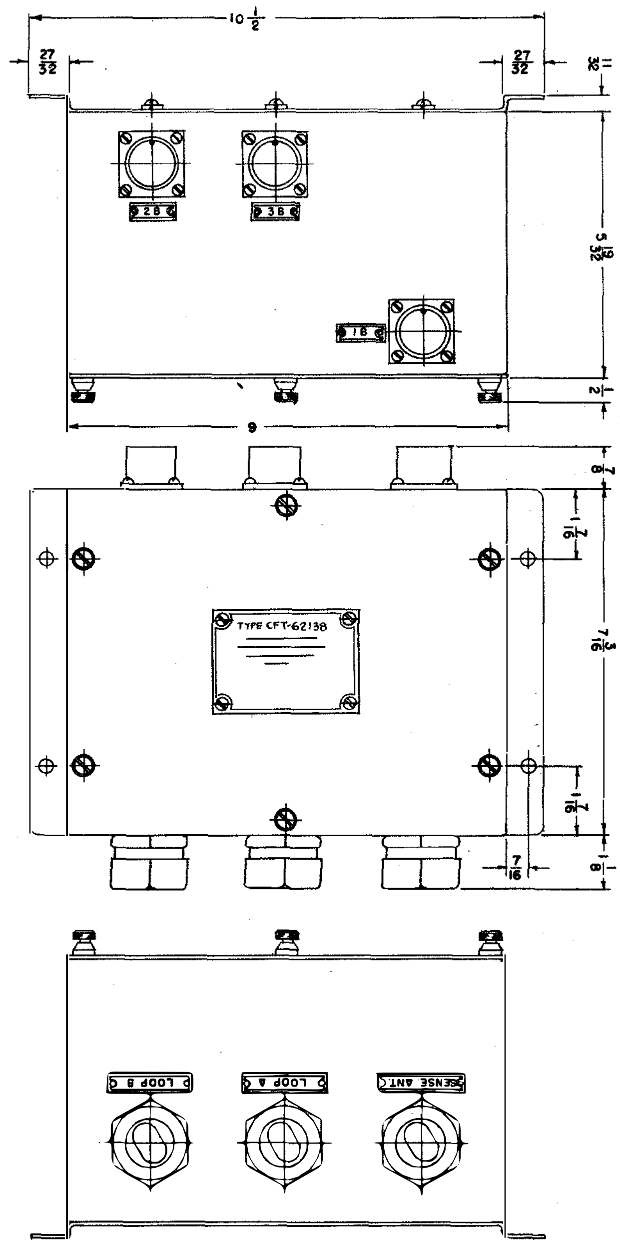


Figure 38. Outline drawing CFT-62138 Junction Box.

(3) Loosen the captive screws that hold the power indicator unit panel to the cabinet and remove the unit from the cabinet.

(4) Insert the glass tubes supplied in their proper sockets. Replace the unit and tighten the captive screws.

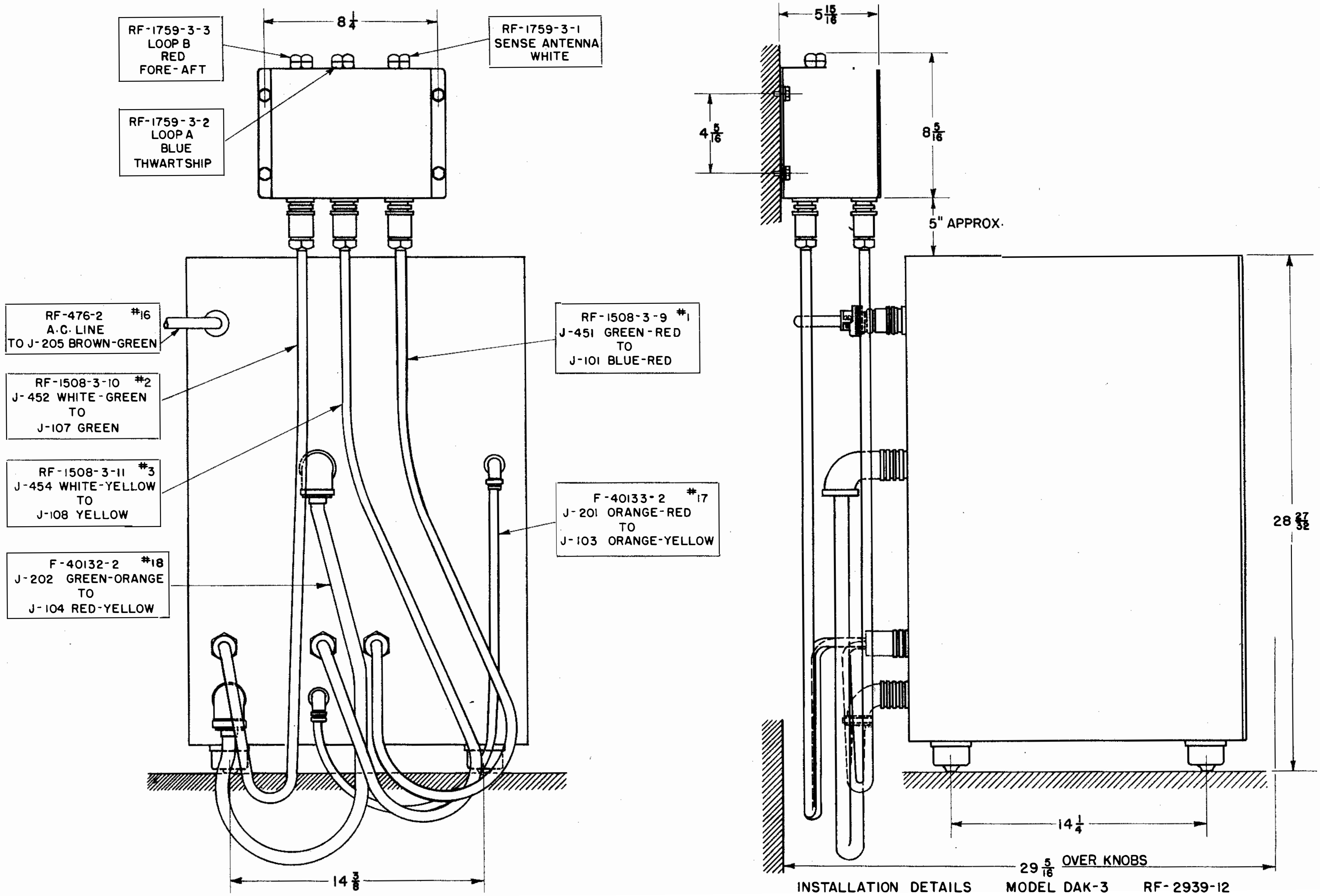


Figure 39. Installation details.

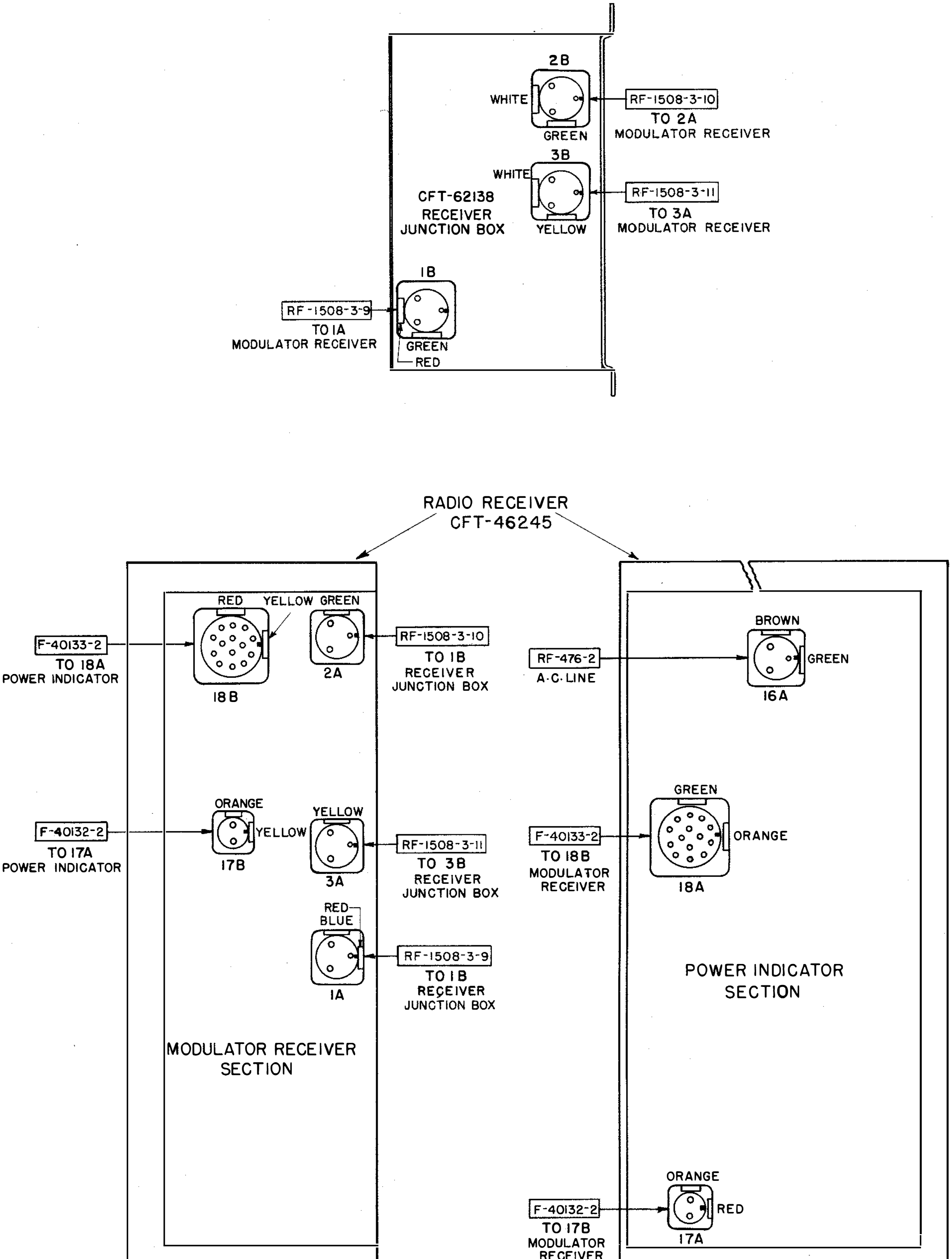


Figure 40. Cable interconnection details.

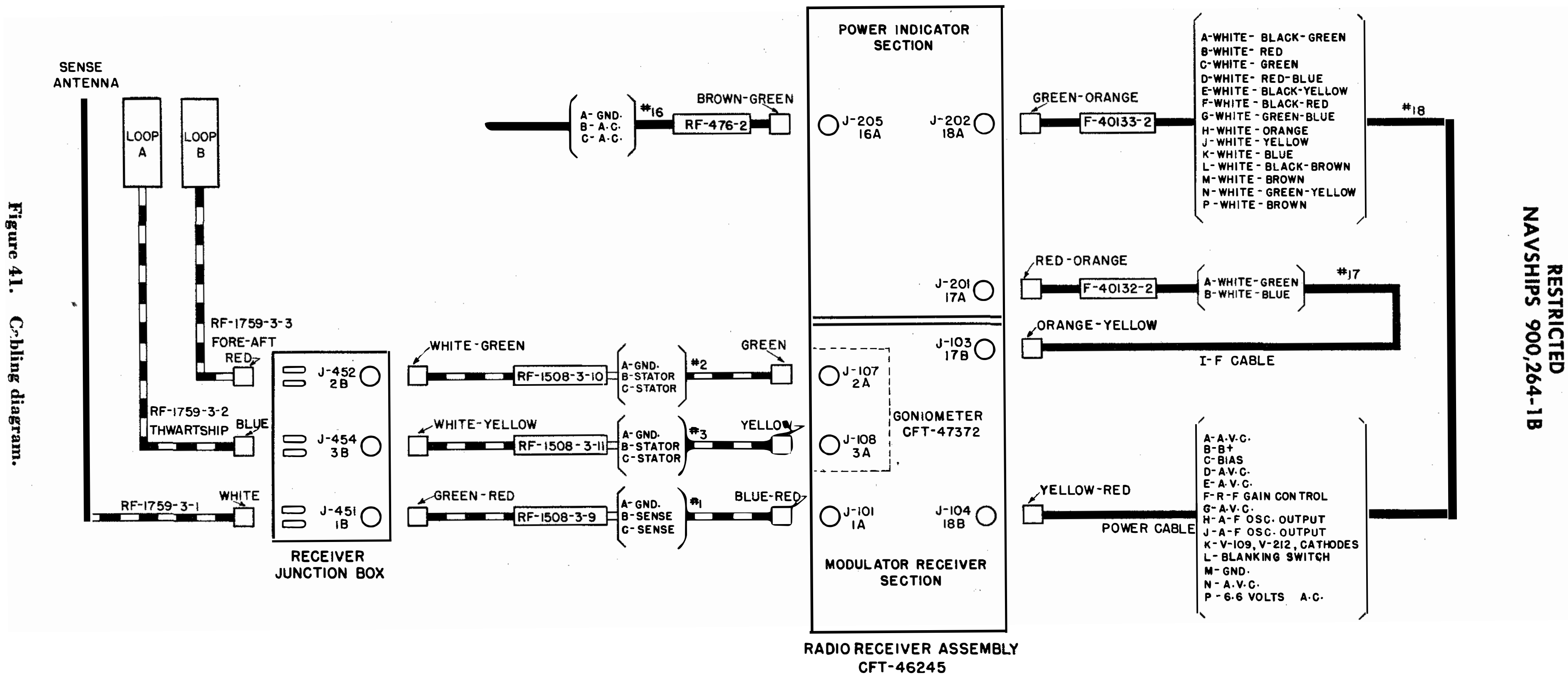


Figure 41. Cabling diagram.

(5) Connect the two receiver interconnecting cables (no. 17, 18) and the two goniometer cables (no. 2, 3) the sense cable (no. 1) and the a-c input cable (no. 16) to the receiver. (See figures 40 and 41.)

(6) Temporarily tie the loose top ends of the goniometer and a-c cables over the top of the receiver with a cord, fastening the other end of the cord to one of the pull knobs.

(7) Slide the receiver in place and mount using the hardware supplied.

(8) Connect goniometer and sense cables to junction box.

(9) Connect a-c cable to 115 v, 60 cycle a-c source.

3.6 HOW TO HANDLE AND INSTALL THE HIGH FREQUENCY CABLES.–

3.60 General.–

The cables carrying the radio currents from the loop antenna to the junction box are of a special type. Don't handle them the same as you would handle electric power cables. They are different, and require special care in handling. *Read these instructions carefully and follow them:*

3.61 How to Handle Cables.–

Figure 42 shows several do's and don'ts for handling and installing cables. Study them carefully. It is very important.

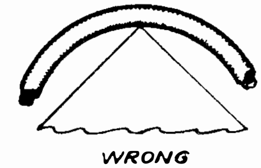


Figure 42a. NEVER bend cable around sharp corners. Build up corner to a radius of eight inches or more. A little extra time taken in installation will save countless wasted hours if the cable is damaged.

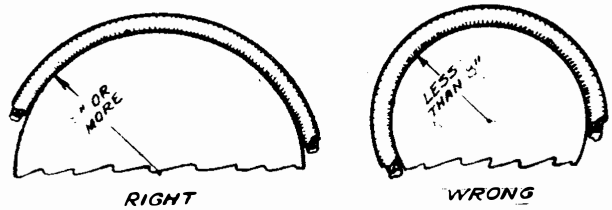


Figure 42b. NEVER bend cable on a radius of less than eight inches. ALWAYS use more than eight inches.

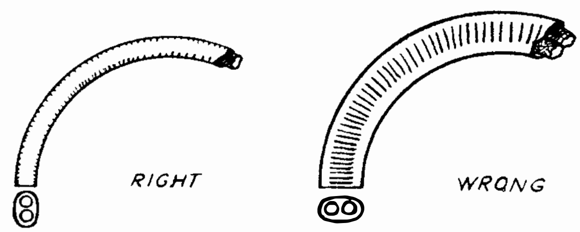


Figure 42c. NEVER bend cable edgewise. ALWAYS bend cable flat.

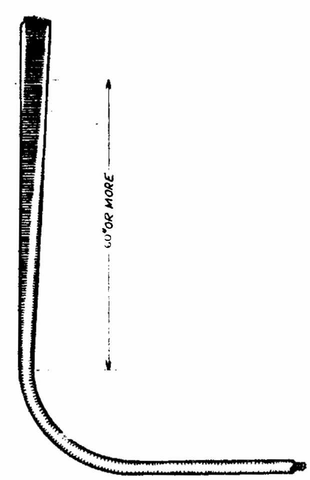


Figure 42d. To make a right angle twist in the cable use at least 60 inches. NEVER make a right angle twist in less than 60 inches of cable.

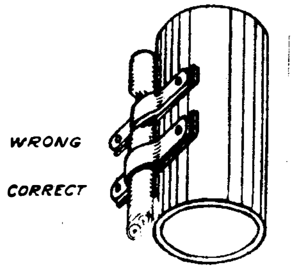


Figure 42e. Clamp cable securely but don't make clamp so tight that cable is dented. ALWAYS lay cable flat on clamp.

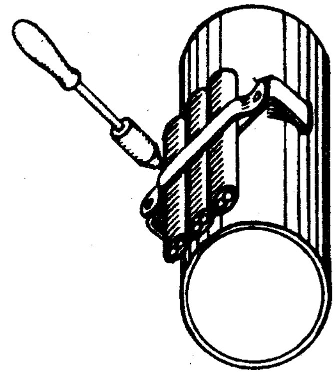


Figure 42f. NEVER use an open flame for soldering cable to cable clamp. Use heavy iron, and apply wet rag for rapid cooling.

3.62 How to Make and Install Cable Clamps.–

Figures 43 and 44 show the shape and dimensions of different types of cable clamps for use with the high frequency cables. Follow these dimensions carefully otherwise the cables will be damaged.

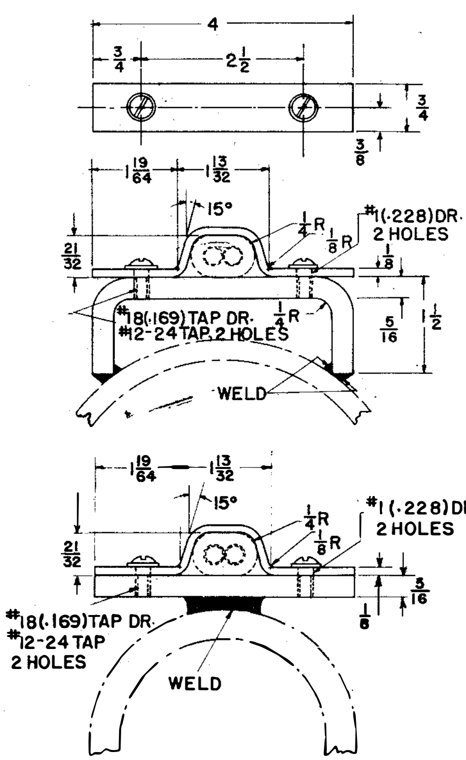


Figure 43. Single cable clamps.

Make up all the required cable clamps before attempting to install any of the cables. Install the fixed portion of the clamp before hauling the cables into position.

Space cable clamps along the path of the cable so that they are not more than 30 inches apart. Clamp cables along their entire lengths. Use the same type of clamp for horizontal and vertical runs.

3.63 How to Install Cables.–

3.631 How to Haul Cables into Position.–

(1) Set up the reel containing the cables on reel jacks on the deck.

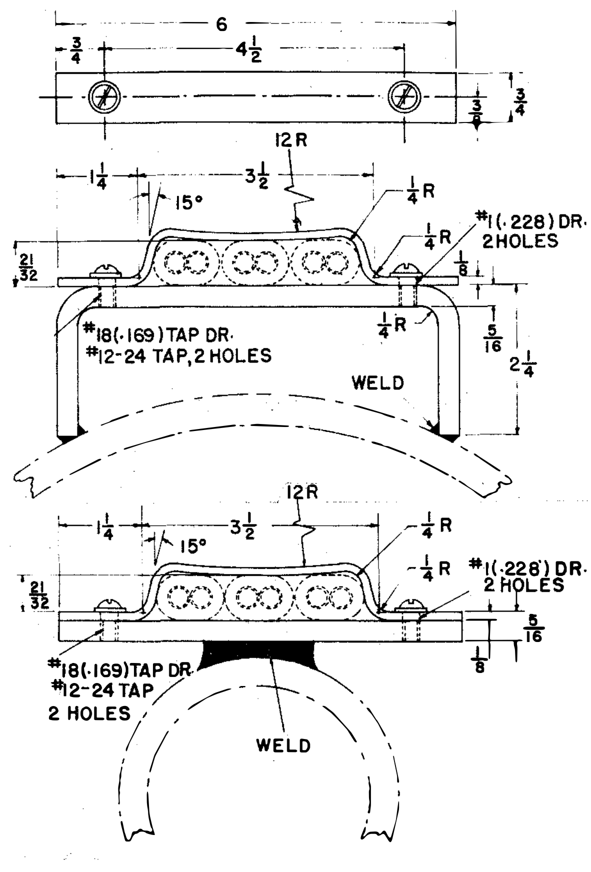


Figure 44. Multiple cable clamps.

(2) Haul the cables into position one by one lashing them temporarily until all are in place. Use enough temporary lashing so that the top clamp does not hold the full weight of the cable.

(3) Leave only sufficient length of the cables at the top to permit connection to the terminals in antenna without tension.

(4) Install cables with lazy loop and easy bends, without tension.

(5) Substitute the clamps one by one, for the lashing, until a permanent installation is made.

(6) Attach the lugs or connectors to the proper terminals at the antenna first and then to the junction box.

3.632 How to Dispose of Excess Cable.–

(1) Usually a loop of excess cable, between the base of the antenna and the junction box is evident. Observe all the precautions given in paragraph 3.61 in handling this excess cable. *Don't cut off the excess.* The relative length of these cables is critical and must be maintained.

(2) Loop this cable in a long loop next to a bulkhead or deck where it will be out of the way. Remember, don't make bends of less than eight inches and don't bend the cable along its larger diameter. (See figure 42.) Make all 90° twists in the cable, in lengths that are more than 60 inches, never less.

3.64 How to Pass Cables Through Bulkheads or Decks.–

3.640 General.–

Stuffing tube adaptors are included in each shipment. Use these together with standard Navy stuffing tubes wherever it is necessary to pass cables through decks or bulkheads (see figure 45).

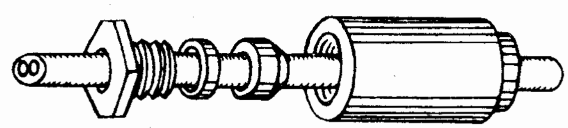


Figure 45. Stuffing tube.

3.641 Installing Stuffing Tubes.–

(1) Before passing cable through deck or bulkhead slide stuffing tube adaptor over the end of cable and insert in a standard Navy stuffing tube.

(2) Coat cables, armor, adaptor and stuffing tube with a thin coat of Permatex number 2 or equivalent before stuffing tube is sealed.

(3) Observe the same precautions concerning bending, squeezing, and cutting of the cables as discussed in subparagraph 3.61.

SECTION IV CALIBRATION

4.0 GENERAL.–

The calibration is made with the ship at anchor while a special boat carrying a target transmitter circles it. It is preferable that the vessel being calibrated is so located that the calibrating boat may circle it in a radius of twelve hundred yards or more (see subparagraph 4.22). Select a location at least two miles from nearest land. Simultaneous radio and optical bearings are taken on the target vessel and recorded by the calibrating crew. The final calibration data is rearranged to provide the operating personnel with the information needed for the operation of the equipment under service conditions. A brief report is also submitted to the Bureau of Ships.

4.1 FACILITIES REQUIRED.–

(1) Sufficient trained personnel to operate the pelorus, the direction finder equipment, to take readings and plot data, to operate the target transmitter, and for communication between target boat and vessel.

(2) Target boat adequately equipped to transmit continuous wave signals between 250 kc to 1500 kc, 100 percent vertically polarized, with an output of at least 50 watts.

(3) The complete Model DAK-3 Intermediate Direction Finding Equipment properly installed and *fully adjusted* in accordance with instructions given in subparagraph 5.3 of this instruction book.

(4) Communication facilities between vessel and target boat and between the pelorus observer, the direction finder operator and other members of the calibration crew.

(5) Standard Navy pelorus.

(6) Standard Navy antenna wire of sufficient length for use in the erection of a corrector wire, if necessary.

(7) Sheets, graphs, etc., for recording and plotting data.

4.2 PRECAUTIONS.–

4.20 General.–

Only a fully trained crew should attempt calibration. *Before attempting to calibrate an equipment, a thorough inspection of the entire installation should be made by the calibration crew. If this is done, much time will be saved by avoiding unexpected difficulties after the vessel has arrived at the calibration location.* Alignment of the input stages of the CFT-46245 Radio Receiver and the preliminary adjustments prescribed in subparagraph 5.3 must be completed before calibration.

4.21 Surrounding Reradiators.–

Precautions must be taken to keep all receiving and transmitting antennae in the *normal sea condition* as determined by the vessel's communication officer for the operations in which the vessel will be involved. *It is very important that the condition of all such antennae be indicated on each calibration sheet.* It is advisable that the calibration officer personally assures himself in each case that the communication officer of the vessel understands that any changes in the pertinent electrical characteristics of the ship may invalidate the calibration and render the direction finder temporarily useless.

4.22 Parallax Errors.–

Exercise care to keep the true (pelorus) bearing to a minimum of parallax error (less than 1°). This requires that the target boat's distance from the crossed loops be 57 (or more) times the distance between the pelorus station and the support on which the loops are mounted. Thus if the pelorus station is approximately 30 yards from the support, the target boat should circle no closer than one mile from the ship being calibrated.

4.3 OPERATIONAL CHECK OF EQUIPMENT.–

(1) Set the Model DAK-3 in operation (see paragraph 5.4).

(2) Tune in a strong signal in the vicinity of 1500 kc, which gives two steady, clearly defined lines.

(3) Disconnect the port starboard loop (loop A, blue) at the junction box and adjust the receiver until the lines are exactly the same length. The goniometer should indicate 0° and 180° on its red and black scales (see paragraph 6.4).

(4) Check the 90°-270° indication by disconnecting the fore-aft loop (loop B, red) and reconnecting loop A. The readings should not be off by more than 1° (see paragraph 6.4).

4.4 CALIBRATION PROCEDURE.–

After all the preliminary tests and adjustments have been made, and the calibration personnel drilled and assigned, the ship to be calibrated proceeds to a suitable location and anchors. The target boat then begins circling at a radius of not less than 1200 yards (see subparagraph 4.22), and at a speed such as to complete a full revolution in 20 to 25 minutes. Take readings for approximately every 200 kilocycles over the range of the equipment and for every 3° interval of the pelorus.

Set up the pelorus to start the run approximately 10° in advance of the target boat, on a multiple of 3°. When the target boat crosses the index, the pelorus operator calls "MARK" into the intercommunicating system. This is heard by the direction finder operator who immediately takes bearing and sense readings. Record these opposite the pelorus indication (see figure 46). The pelorus operator then moves the pelorus ahead 3° and makes ready to sing out another "MARK" when the target boat again crosses the index line.

Take readings at 1500 kilocycles first to determine if the loop site is such that bearings seem to stay on the fore-aft indication or to move only a few degrees for much larger angular movement of the target boat. This condition is called locking and exists for some loop locations because of high quadrature voltages caused by excessive reradiation from metal parts on the ship. Make an attempt to eliminate locked bearings by installing a corrector wire (see paragraph 4.7) before trying a new loop site.

After the 1500-kc run is completed, plot the results before continuing with the calibration. If the reciprocal bearings observed don't agree check modulator balance as indicated in paragraph 5.31 (8).

If excessive quadrantal error is evident, the need for correction is indicated. In extreme cases a new loop site may be required. Often, however, the use of a corrector wire will be sufficient (see paragraph 4.7). If a corrector wire is used the calibration must be made with this wire in its proper position.

4.5 READING AND RECORDING DATA.–

4.50 General.–

The question of what data to record at the time of calibration must be determined by the calibration officer on the basis of the available time. However, the more detailed the data recorded, the more complete will be the knowledge obtained of the per-

CONFIDENTIAL

DATE ______

RECORDER ________

C - CORRECT

R - REVERSE

U - UNCERTAIN

U.S.S. ________

DIAL FREQ. ___

PELORUS BEARING	D F BEARING	DEVIATION	BLUR	SENSE			PELORUS BEARING	D F BEARING	DEVIATION	BLUR	SENSE		
				C	R	U					C	R	U
000							180						
003							183						
006							186						
009							189						
012							192						
015							195						
018							198						
021							201						
024							204						
027							207						
030							210						
037							213						
036							216						
039							219						
042							222						
045							225						
048							228						
051							231						
054							234						
057							237						
060							240						
063							243						
066							246						
069							249						
072							252						
075							255						
078							258						
081							261						
084							264						
087							267						
090							270						
093							273						
096							276						
099							279						
102							282						
105							285						
108							288						
111							29i						
114							294						
117							297						
120							300						
123							303						
126							306						
129							309						
132							312						
135							315						
138							318						
141							321						
144							324						
147							327						
150							330						
153							333						
156							336						
159							339						
162							342						
165							345						
168							348						
171							351						
174							354						
177							357						

Figure 46. Calibration recording chart.

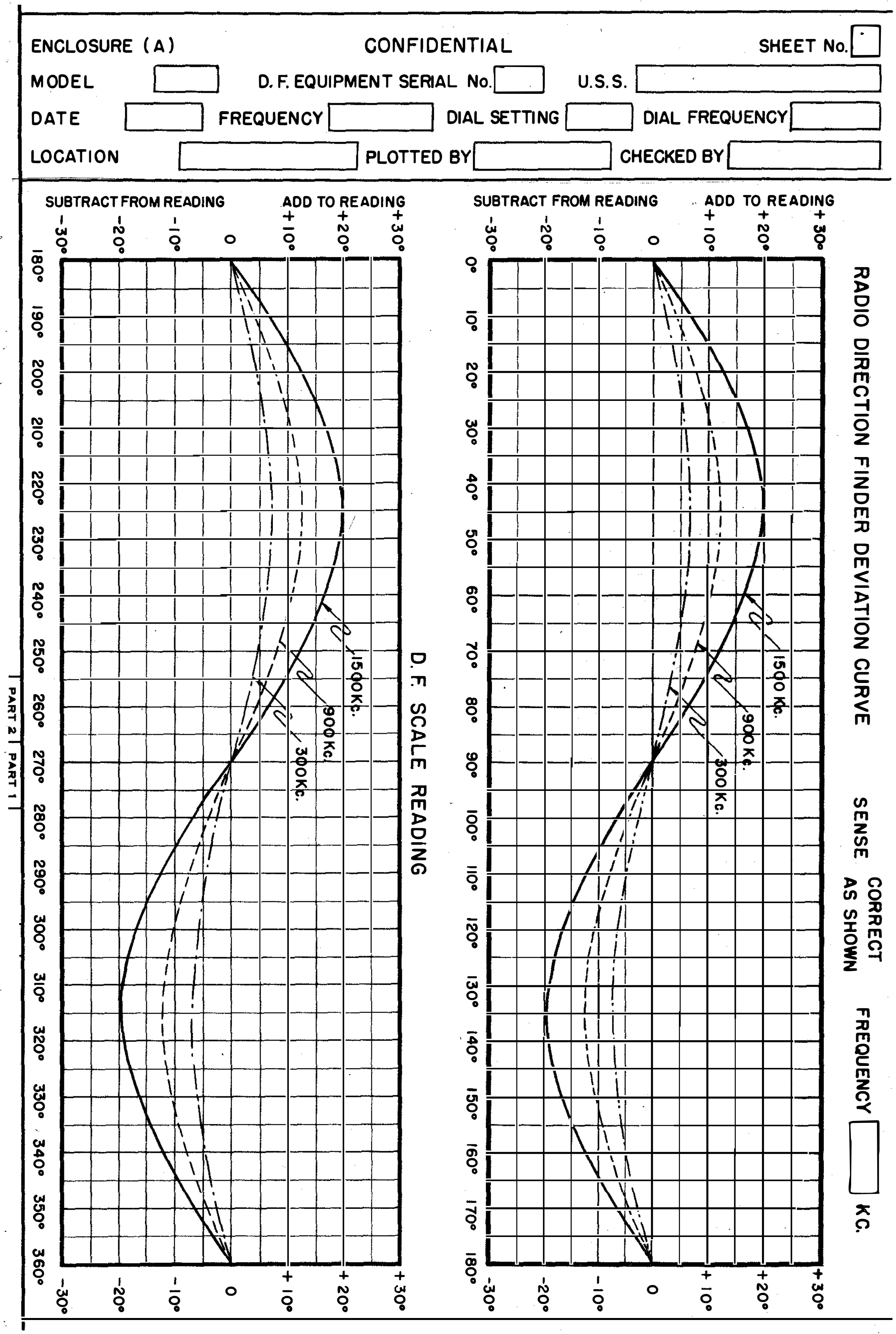


Figure 47. Typical quadrantal correction curve.

formance of the equipment. It is anticipated that calibrations of this type of equipment will provide very useful data for a more complete understanding of shipboard direction finding.

4.51 Unopposing Minima.–

Unopposing minima is the term applied to the condition where reciprocal readings of a bearing are not 180° apart. This condition is often obtained if the target is too close to the vessel being calibrated. Move the boat further away if this condition is evident (also see paragraph 4.61).

4.52 Bearing Indications.–

In recording the deviations on the data sheets choose the sign, using the radio bearings as references, such that when the pelorus reading is greater than the radio bearing the deviation is recorded as plus and when the pelorus bearing is less than the radio bearing the deviation is recorded as minus. To eliminate ambiguity when charts are drawn the ordinate should be labeled "add to reading" and "subtract from reading" as shown in figure 47. The exact conditions of all antennae or other reradiating objects should be indicated *on each chart plotted.*

When the calibration curves are accurately plotted, transfer the data to a table of corrected relative bearings as shown in figure 48. These tables are for use by the ship's operators and the calibration officer should insure that the tables are correctly prepared and that the operators are completely familiar with their use.

4.6 CALIBRATION DIFFICULTIES.–

4.60 General.–

The following points are to aid calibration personnel in finding causes of difficulties which may come up during the calibration procedure.

4.61 Unopposing Minima.-

Unopposing minima is usually caused by horizontal or vertical reradiators of the ship's structure. General precautions for rigging have been enumerated in Bureau of Ships Specifications RA-69A-220 and RA-69A-221. Procedure outlined in these specifications should be followed.

4.62 Intermittent Operation.–

Patterns which vary irregularly or noise of an intermittent nature, indicate either that the target transmitter is intermittent, that some reradiator on the ship has an intermittent connection, that some reradiator in the vicinity of the target transmitter has an intermittent connection, or that there is an intermittent circuit within the Model DAK-3 equipment. This must be corrected before calibration is made.

4.63 Deviations of Over 30°.–

Deviations greater than 30° usually indicate that the installation has been improperly made and that not enough clearance has been allowed between the cross loop and the reradiators comprising the ship's structure. Check all antennae, guys, masts, stays, etc

4.7 CORRECTOR WIRE.–

4.70 General.–

To reduce excessive quadrature voltages which cause bearing deviations up to 30° it is common practice in shipboard installations to employ a device known as a corrector wire. This device is actually a large loop surrounding the direction finder loop. In practice, however, parts of the ship and its riggings are used to form the lower conductors of the loop and it is only necessary to install a single wire to connect the upper sections and complete the loop. (See figure 49.)

4.71 Installation.–

Erect the corrector loop around the Model DAK-3 fore-aft loop. Use portions of the ship's rigging for part of the corrector loop so that only a single wire will be required to connect two upper sections of the rigging. Erect this wire for a trial about four feet above the Model DAK-3 loop. (See figure 49.) Adjust this loop for the proper degree of correction by adjusting the height of the corrector wire above the Model DAK-3 loop.

SECTION V OPERATION

5.0 GENERAL.–

Operation of the Model DAK-3 Intermediate Frequency Direction Finder Equipment consists of selecting the proper switch positions for the required mode of operation, tuning the receiver to the required frequency and setting the goniometer to the null point.

DIAL ☐☐ **RADIO DIRECTION FINDER TABLE OF CORRECTED RELATIVE BEARINGS** ☐ KC.

CONFIDENTIAL , U.S.S. ____________ SHEET NO. ☐

D/F RDG.	COR. REL. BEARING/s	BL	D/F RDG.	COR. REL. BEARING/s	BL	D/F RDG.	COR. REL. BEARING/s	BL	D/F RDG.	COR. REL. BEARING/s	BL	D/F RDG.	COR. REL. BEARING/s	BL	D/F RDG.	COR. REL. BEARING/s	BL	D/F RDG.	COR. REL. BEARING/s	BL	D/F RDG.	COR. REL. BEARING/s	BL
001			046			091			136			181			226			271			316		
002			047			092			137			182			227			272			317		
003			048			093			138			183			228			273			318		
004			049			094			139			184			229			274			319		
005			050			095			140			185			230			275			320		
006			051			096			141			186			231			276			321		
007			052			097			142			187			232			277			322		
008			053			098			143			188			233			278			323		
009			054			099			144			189			234			279			324		
010			055			100			145			190			235			280			325		
011			056			101			146			191			236			281			326		
012			057			102			147			192			237			282			327		
013			058			103			148			193			238			283			328		
014			059			104			149			194			239			284			329		
015			060			105			150			195			240			285			330		
016			061			106			151			196			241			286			331		
017			062			107			152			197			242			287			332		
018			063			108			153			198			243			288			333		
019			064			109			154			199			244			289			334		
020			065			110			155			200			245			290			335		
021			066			111			156			201			246			291			336		
022			067			112			157			202			247			292			337		
023			068			113			158			203			248			293			338		
024			069			114			159			204			249			294			339		
025			070			115			160			205			250			295			340		
026			071			116			161			206			251			296			341		
027			072			117			162			207			252			297			342		
028			073			118			163			208			253			298			343		
029			074			119			164			209			254			299			344		
030			075			120			165			210			255			300			345		
031			076			121			166			211			256			301			346		
032			077			122			167			212			257			302			347		
033			078			123			168			213			258			303			348		
034			079			124			169			214			259			304			349		
035			080			125			170			215			260			305			350		
036			081			126			171			216			261			306			351		
037			082			127			172			217			262			307			352		
038			083			128			173			218			263			308			353		
039			084			129			174			219			264			309			354		
040			085			130			175			220			265			310			355		
041			086			131			176			221			266			311			356		
042			087			132			177			222			267			312			357		
043			088			133			178			223			268			313			358		
044			089			134			179			224			269			314			359		
045			090			135			180			225			270			315			360		

Figure 48. Table of corrected relative bearings.

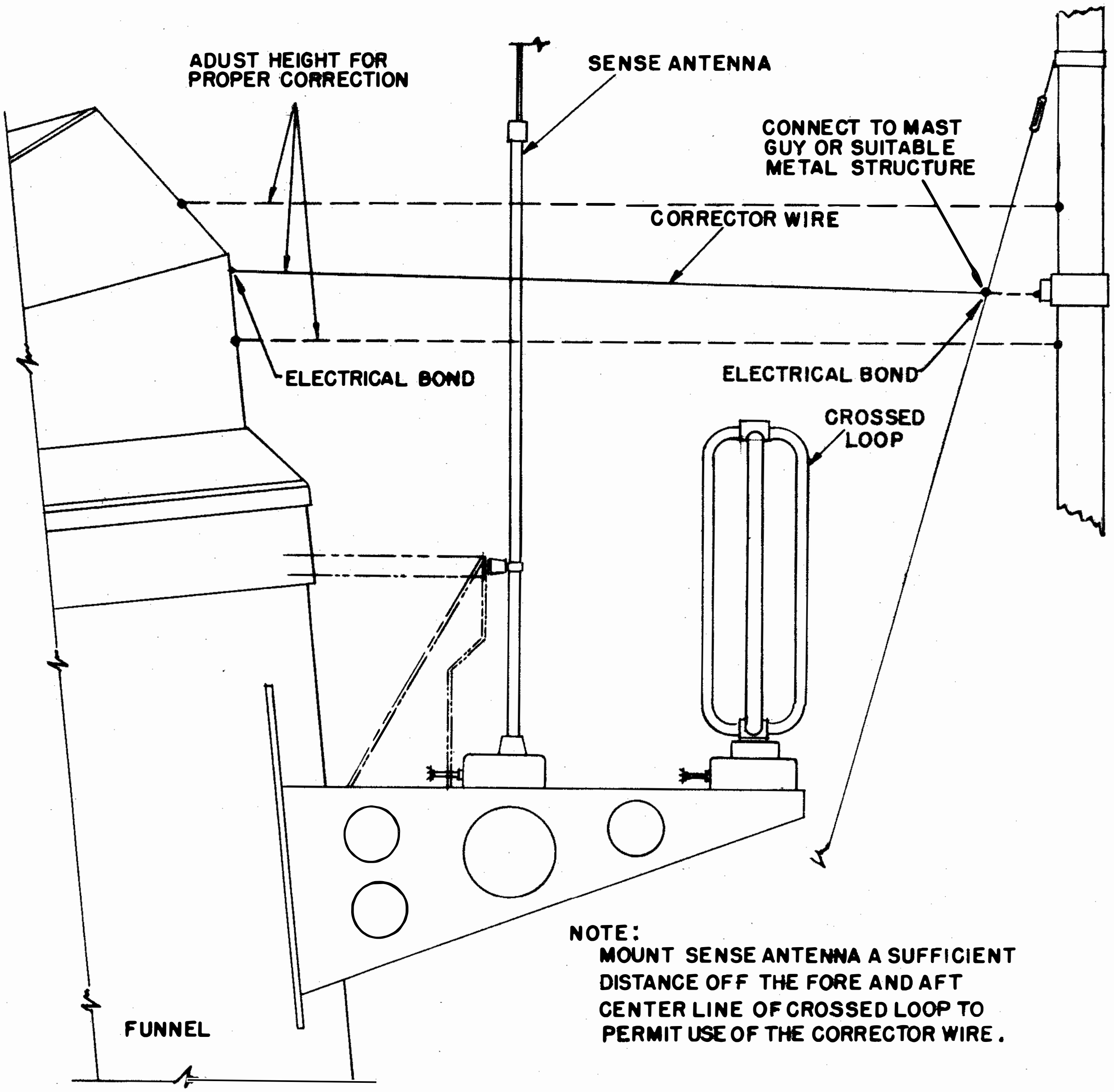


Figure 49. Corrector wire installation.

5.1 PANEL CONTROLS AND DEVICES.–

5.11 Modulator Section.–

The front operating panel of the modulator section (see figure 50) includes the following controls and devices:

(1) *Tuning Control.–* Includes frequency calibrated dial.

(2) *Frequency Band Change Switch.–*

(3) *R. F. GAIN (R-131).–* Varies sensitivity of receiver as follows:

(a) For M.V.C. or C.W. operation R-131-A varies amplification of second r-f, mixer, and first i-f stages by adjusting bias voltage applied to grid of these tubes.

(b) For A.V.C. operation R-131-b varies amplification of indicator i-f by adjusting cathode bias on this tube.

(4) *INDICATION Switch (S-107)* (TWO LINE-NULL-NULL SENSE).– Rearranges circuits as required for various methods of bearing indication.

(a) *TWO LINE Position.*– Matched-line method of bearing indication. Goniometer and cathode-ray indicator used. Sense indication is obtained automatically.

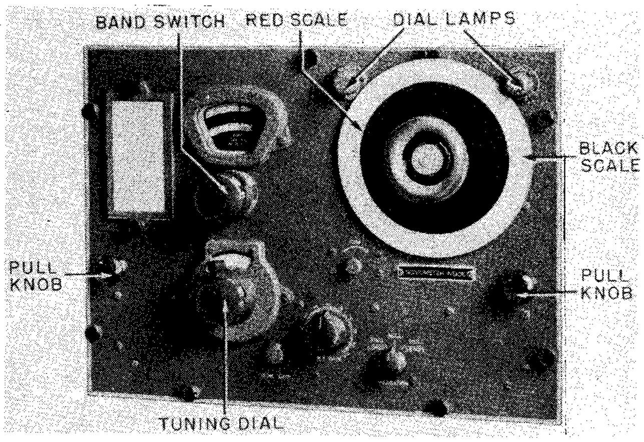


Figure 50. Front panel of modulator section.

(b) *NULL Position.*– Aural indication with loudspeaker or earphones or visual indication on cathode-ray tube.

(c) NULL SENSE Position.– Rotation of goniometer after bearing has been obtained in NULL position results in increase or decrease in output which is utilized to indicate sense.

(5) *GONIOMETER (Inside Receiver).*– Manual operation permits reading of bearing for both null and matched-line methods. The goniometer inside receiver is provided with a 7½ inch 360° dial.

(6) *GONI. GAIN (R-117).* (Screwdriver Slotted).– Permits adjustment of amplification of directional channel amplifier. Presetting of this control adjusts the gain of the goniometer channel to the proper proportion with respect to the gain of the sense channel for optimum performance of the matched line indicating system.

(7) *DIM Control (R-139).*– Dims or extinguishes receiver dial lamps.

5.12 Power Indicator Section.–

The front operating panel of the power indicator section (see figure 51) includes the following controls and devices:

(1) *OFF-STANDBY-ON Switch (S-205).*– Controls power input to receiver.

(a) *OFF Position.*– A-c power to receiver circuits turned off.

(b) *STANDBY Position.*– High-voltage d-c disconnected from receiver circuits; filament and bias voltages left on.

(c) *ON Position.*– A-c power supply to receiver circuits on.

(2) *A.V.C.-M.V.C.-C.W. Switch (S-202).*– Permits reception of either modulated or unmodulated signals as follows:

(a) *A.V.C. Position.*– For automatic volume control. Beat-frequency oscillator off.

(b) *M.V.C. Position.*– For manual volume control. Beat-frequency oscillator off.

(c) *C.W. Position.*– For unmodulated signals using manual volume control. Beat-frequency oscillator on.

(3) *AUDIO GAIN Control (R-210).*– Varies audible output from the receiver by controlling audio voltage applied to first a-f stage.

(4) *RADIO SELECTIVITY (BROAD-SHARP) Switch (S-201).*– Controls band width of intermediate-frequency amplifier to secure two steps (BROAD-SHARP) of selectivity.

(5) *LINE SPRD. Control (R-270).* (Screwdriver Slotted).– Varies spacing between two lines obtained on receiver cathode-ray tube in the TWO LINE position of INDICATION switch.

(6) *VERT. ADJ. Control (R-264)* (Screwdriver Slotted).– Controls vertical position of trace on cathode-ray tube.

(7) *FOCUS Control (R-266)* (Screwdriver Slotted).– Permits focusing of the beam of cathode-ray tube by variation of voltage applied to first anode.

(8) *BRILL. Control (R-268)* (Screwdriver Slotted).– Permits adjustment of brilliance (intensity) of the trace on cathode-ray tube by variation of bias on control electrode.

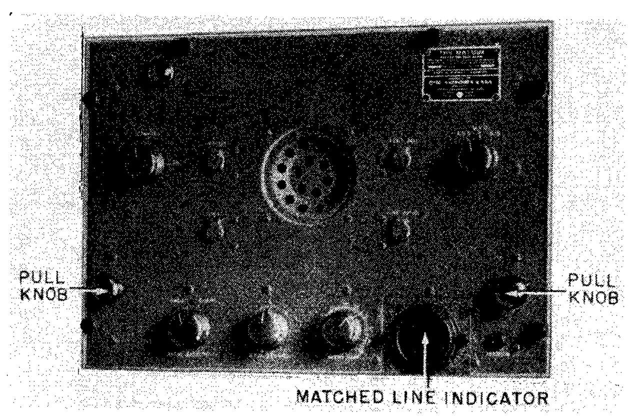


Figure 51. Front panel of power indicator section.

(9) PHONES Jack (J-204).– A phone jack is mounted on front panel to provide connection to the

audio output tube. Connected headset carries no d-c or r-f currents. Insertion of earphone plug automatically disconnects loudspeaker. One side of connected headset is grounded through inserted plug.

(10) *BFO VERNIER (C-224).–* Permits variation of pitch of beat note obtained when the A.V.C.-M.V.C.-C.W. switch is on C.W.

(11) Pilot Lamp.– Indicates when a-c power is on.

5.2 OTHER CONTROLS.–

5.21 Modulator Section.–

(1) *Balanced Modulator Adjustment (R-127).–* Adjusts the screen voltage supply to the balanced modulator tubes (6AC7, V-108 and V-109) to balance their amplification. Located on the right hand side of the chassis approximately 6 inches from the front panel.

5.22 Power Indicator Section.–

(1) *Blanking Switch (S-204).–* Turns trigger circuit ON or OFF for blanking center portion of receiver cathode-ray tube pattern. Located on the right hand side of the chassis about 8 inches from the front panel.

(2) *Blanking Control (R-272).–* Adjusts the amount of blanking of receiver cathode-ray tube pattern by varying the trigger voltage supply to the control grid of the trigger amplifier tube. Located in the right hand front corner of the chassis.

5.3 PRELIMINARY ADJUSTMENTS.–

5.30 General.–

When the equipment is first made ready for operation, and as soon as the power is turned ON, make the adjustments described in the following paragraphs.

5.31 Matched Line Bearing Adjustments.–

(1) Set INDICATION switch to TWO LINE.

(2) Tune in a strong signal.

(3) Adjust BRILL. control for optimum cathode-ray tube intensity.

(4) Set LINE SPRD. so that lines are approximately 1/16 inch apart.

(5) Adjust FOCUS control for sharpness of lines.

(6) With R.F. GAIN set at 0, adjust VERT. ADJ. so that two dots on cathode-ray tube are just at the top of the screen.

(7) Disconnect sense input cable at the junction box (number 1).

(8) Turn up R.F. GAIN, turn GONIOMETER to maximum and adjust balanced modulator control (R-127) to make the two lines on 2-inch cathode-ray tube equal. If lines will not equalize, interchange modulator tubes (V-108 and V-109).

(9) Replace sense input cable.

5.32 Other Adjustments.–

(1) Align sense input stage in accordance with instructions given under Radio Receiver Alignment in paragraph 6.68.

(2) Align directional input stage in accordance with instructions given under Radio Receiver Alignment in paragraph 6.69.

(3) *GONI. GAIN.–*

(a) Set RADIO SELECTIVITY to SHARP.

(b) Set A.V.C.-M.V.C.-C.W. to M.V.C.

(c) Set INDICATION switch to TWO LINE.

(d) Tune in a strong signal near 610 on band 2.

(e) Adjust GONIOMETER until two lines on receiver cathode-ray tube match in length.

(f) Set VERT. ADJ. to bring the two lines to the center of the tube.

(g) Turn GONIOMETER off course 15°.

(h) Adjust GONI. GAIN until the longer line is approximately twice the length of the shorter line.

(i) Turn down R.F. GAIN until the lines become dots.

(j) Reset VERT. ADJ. to bring dots to the top of the cathode-ray tube.

NOTE:

All the adjustments must be checked frequently for optimum equipment operation.

5.4 OPERATING INSTRUCTIONS.–

5.40 General.–

With this equipment you can take bearings by matched-line or null bearing indications. To operate the equipment make the adjustments listed below.

5.41 Operating Adjustments.–

(1) TWO LINE-NULL-NULL SENSE switch on NULL SENSE.

(2) SELECTIVITY switch on BROAD.

(3) Select proper frequency band and tune main tuning dial to required frequency.

(4) Set R.F. GAIN and AUDIO GAIN to approximately ¾ of maximum.

(5) Turn ON beat frequency oscillator (BFO) to assist in tuning or monitoring c-w or i-c-w signals.

(6) After the signal is tuned in, turn RADIO SELECTIVITY switch to SHARP.

5.42 Null Bearings.–

(1) Set INDICATION switch to NULL.

(2) Rotate GONIOMETER dial until an aural null is obtained. The lines on the receiver cathode-ray tube will have minimum length at the GONIOMETER dial setting giving an aural null.

(3) Increase R.F. GAIN control setting as much as necessary to accurately determine the null position on the GONIOMETER dial.

(4) Note the bearing obtained on both the black and red scales of the GONIOMETER dial.

(5) Switch TWO LINE-NULL-NULL SENSE switch to NULL SENSE.

(6) If the signal decreases when the GONIOMETER dial is rotated *clockwise,* read the bearing on the black scale. If the signal increases when the GONIOMETER dial is rotated *clockwise,* read the bearing on the red scale.

5.43 Manual Bearing Indications.–

(1) Set INDICATION switch to TWO LINE.

(2) Rotate the goniometer dial slowly clockwise until the two lines on the receiver cathode-ray tube are the same length. Note the goniometer dial reading on both the black and red scales.

(3) Continue to rotate the goniometer dial slowly clockwise past the position for which the lines match. If the left-hand line shortens and the right hand line lengthens the black numeral indicates the bearing. If, on the other hand, the left line lengthens and the right shortens, the red numerals indicate the bearing.

Remember the correct bearing is obtained when the two lines are matched in length!

5.44 Correction of Errors.–

To assure accuracy of bearing indication each Model DAK-3 is carefully calibrated on installation (see Section IV). Readings taken require correction because of quadrature voltages induced in the loop by reradiation from metal parts of the ship. The calibration crew has prepared special curves (see figure 47) and charts (see figure 48) for your ship.

Apply the proper corrections to each reading taken by reference to the charts prepared for your ship!

SECTION VI MAINTENANCE

6.0 GENERAL.–

Locate faults by following an orderly, systematic procedure. First determine whether the trouble is in the antenna circuit, the junction box, the associated cables, the receiver, the goniometer, etc. After the difficulty is traced to one definite unit proceed in a series of logical steps to further isolate the fault. For example, if the difficulty is in the receiver determine whether it is common to all frequency bands. If it is found to be in one band only, probably the trouble exists only in the radio-frequency or oscillator circuit, since the intermediate frequency, audio frequency and indicator channel circuits are in use on all bands. Moreover, if the trouble is confined to a single frequency band, elements common to all bands are not at fault. Thus the main tuning capacitor, vacuum tubes and associated sockets and circuit components, the power supply and control circuits, may be exempt from suspicion. You would then suspect one of the elements selected by the switching operation or the switching device itself. The coil assemblies and the wave-band switch should, therefore, receive attention. At this point make a resistance analysis of the radio-frequency amplifier and oscillator circuits to determine which is defective. If, in the defective circuit, the indicated resistance value changes with a slight movement of the band switch, it might indicate a faulty contact; but if the abnormal resistance value remains constant the fault is probably in the coil assembly or wiring. Examine the switch and wiring of the particular stage, and if these appear to be in operating condition, investigate the coil assembly.

A rough guide to the circuit position of the fault is the amount and nature of background noise in the loudspeaker. Complete absence of any sound would possibly be due to power failure or to trouble in the output stage or output circuits. Normal microphonic sounds, without hiss, probably indicates a normal audio amplifier system but a faulty radio-frequency system. Weak signals accompanied by background noise might indicate some fault in the antenna system or transmission lines. The bearing indication is also an excellent guide in trouble location. For example, if the bearing remains fixed at 0° and 180° or at 90° and 270° regardless of the direction of arrival of the radio signal, this indicates trouble in one of the directional channels and its associated cables and goniometer winding.

Some of the troubles which may be encountered in installations of this type together with common causes are listed in the trouble chart of paragraph 6.1.

6.1 TROUBLE SHOOTER CHART.–

TROUBLE INDICATION	PROBABLE SOURCE	PROBABLE CAUSE	REMEDY
All pilot and dial lamps out	Failure of a-c power supply	Blown fuse	Replace
		Faulty ON-OFF switch	Replace
		Break in continuity of power input or output cable cords (possibly at a plug)	Repair Seat plugs firmly in their mating receptacles. Coupling rings on plugs must be tight
	Failure of filament voltage	Open circuit in filament voltage circuit	Repair
No signal, weak signal, or incorrect indication	Failure of power supply in receiver	Burned out or weak rectifier tube	Replace
		Faulty contact to rectifier tube pins	Clean
		Break in continuity of power unit cords	Repair
		Shorted filter or bypass capacitor	Replace
	Faulty antenna connection	Poor contact between input receptacles and mating plug or adapter	Correct
		Ground or open circuit in junction box, h-f cables, goniometer, or interconnecting cables	Correct
	Weak or burned out vacuum tube		If possible, check the tubes with a suitable test set. If this is not available, replace each tube, in turn, with a new one or with one known to be in good condition
	All d-c voltages are low	Weak rectifier tube	Replace
		Open filter capacitor	Replace
No signal, weak signal, or incorrect indication	All d-c voltage are low	Short circuit in plate circuits	Repair
	Incorrect cable connections		Correct
	Shorted trimmer capacitor or tuning capacitor	Drop of solder on plates or bent plates	Locate cause and correct
Noisy or intermittent reception	Noise pickup in antenna system		To locate short circuit the antenna inputs and observe whether noise stops

TROUBLE INDICATION	PROBABLE SOURCE	PROBABLE CAUSE	REMEDY
	Faulty cable connection	Connectors loosely mated; or due to breakage of a cord conductor	Locate and correct
	Defective control	Wear in the control	Replace
	Defective switch		Replace
	Poor contact between vacuum tube and its socket		Locate and clean
	Defective vacuum tube		Tap each tube lightly; to locate; replace
	Frayed or broken connection in wiring		Correct
	Poor contact between pilot or dial lamp and its socket		Locate and correct
	Defective bypass or coupling capacitor		Locate and replace
	Loose retaining nut on shield can		Locate and tighten
Fading	Defective or intermittent bypass or coupling capacitor		Locate and replace
	Vacuum tube with intermittent heater	Heater element periodically makes and breaks contact due to expansion of ceramic heater	Tube tester does not generally indicate this type of defect. Check each tube in turn with tube known to be operating
Fading	Unfavorable transmitting conditions	Magnetic "storm"	Condition will eventually improve by itself even if only for short time intervals
Sense indications reversed	Transmission lines	Transmission lines incorrectly connected at loop or junction box	Correct making sure that each cable is connected to its proper terminal at each end

6.2 ROUTINE INSPECTION.–

6.20 General.–

(1) At periodic intervals spot check the entire equipment using a target transmitter as a signal source. Check both direction and sense. Investigate any abnormal deviations to locate and correct the cause. As a part of the check move the target transmitter about the antenna while an operator observes the bearing indication. The bearing indication should follow the target transmitter in the same direction. Reversal of rotation indicates that the r-f transmission lines may have been interchanged.

6.21 Overall Inspection.–

At intervals of every week or ten days the equipment should be inspected and serviced as follows:

(1) Check mechanical operation of all knob controls and switches and tighten any loose set screws.

(2) Tune in a signal in each frequency band.

(3) See that the pilot and dial lamps function properly when control switches are turned ON and OFF.

(4) Inspect cable connections and fittings for tightness.

6.3 GENERAL OVERHAUL INSPECTION.–

6.30 General.–

General overhaul inspection involves a complete examination of the equipment as to the condition of the internal wiring, mechanical and general electrical operation, and any necessary cleaning to remove dust,

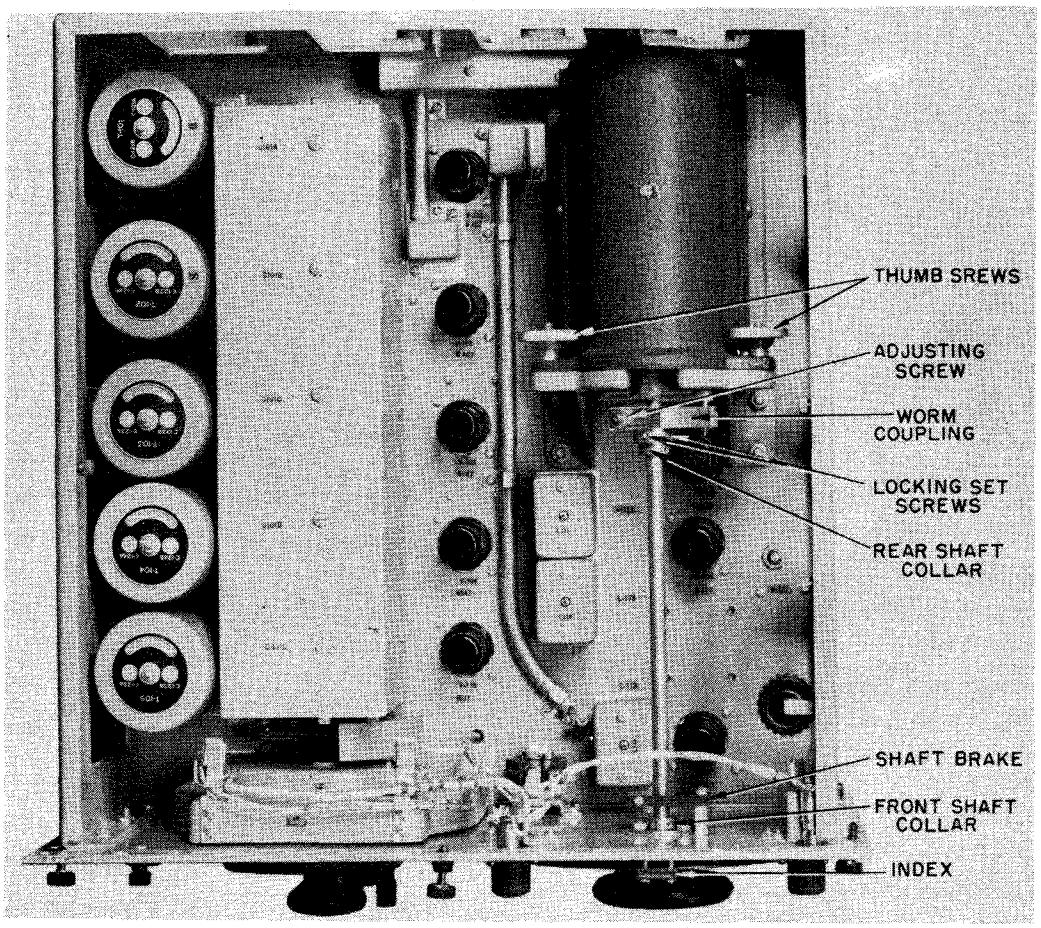


Figure 52. Top view of modulator section showing goniometer coupling.

which may have seeped inside. The intervals such inspection is required depends largely upon service conditions and whether or not faults have developed.

An overhaul inspection is recommended as a precautionary measure after the first or second month of service and then during availability periods.

Major repairs, electrical alignments, and most replacements of circuit components should not be attempted in the field but rather at a depot base equipped with adequate laboratory equipment. In general, the less the equipment is tampered with the better except to clean, locate trouble, and correct for short or open circuits. In the event of trouble which has been traced to a particular component first check the tubes and then analyze the circuit voltages and resistances as given in paragraph 6.9.

6.31 Electrical Inspection.–

(1) See that all dial and pilot lamps light when the respective switches are turned on. Replace if necessary.

(2) Check electrical and mechanical operation of *all* switches and controls.

(3) Tune in a signal in each frequency band of the receiver.

(4) Check all tubes with a suitable tube checker and replace all which are less than 75% of normal for a heater voltage of 6.3 volts. In replacing tubes be sure they are well seated and that the pins and contacts are clean. When cleaning is required use carbon tetrachloride on a soft rag or brush, *never use sandpaper or emery cloth.*

(5) Receiver realignment (see paragraph 6.6) should never be attempted except by experienced maintenance personnel with a suitably calibrated signal generator and vacuum tube voltmeter.

6.32 Mechanical Inspection.–

(1) For this inspection disconnect the cables and remove the two units from the cabinet, remove bottom plates, examine and repair component parts and wiring where necessary.

(2) If more than two strands of a stranded conductor are broken at a soldered joint cut off the defec-

tive lead as close to the joint as possible and resolder.

(3) Clean tube socket contacts, tube base pins, and contact elements of cable plugs and receptacles, if necessary, with carbon tetrachloride on a rag or brush. NEVER USE SANDPAPER OR EMERY CLOTH.

(4) Clean out dust, chips, and loose solder, if any, and check for traces of corrosion. Clean and touch up where necessary.

(5) Tighten all loose nuts, bolts, and screws above and below chassis and on panels of all units. Do not tamper with glyptal coated screws unless you are sure they are loose. In that case remove the old glyptal, tighten screw, and recoat with fresh glyptal.

(6) Check tightness of control knob set screws with the proper Allen head wrench.

(7) Reassemble and attach all bottom cover plates and shields. Be sure to replace all screws and lockwashers.

(8) Replace each unit in its proper operating position, securely connect all cables, and check overall performance.

6.4 GONIOMETER MECHANICAL ALIGNMENT.–

(1) Remove all interconnecting cables from the modulator section (the lower half of radio receiver).

(2) Loosen all captive screws and remove unit from cabinet.

(3) Place unit on its left side near the receiver cabinet.

(4) Reconnect cables to the unit using power test cable (RF-1813-3) and i-f test cable (RF-1812-2) in place of cables 18 and 17, respectively.

(5) Turn power ON and INDICATION switch to TWO LINE.

(6) Disconnect loop B (red) and tune in a station whose approximate location is known.

(7) Bearings should be obtained at 90° and 270°. If the station is located off the starboard side of loop, the correct bearing should be at 90° with the reciprocal at 270°. If the station is off the port side of the loop, the correct bearing should be at 270° with the reciprocal at 90°.

(8) If the bearing does not read exactly 90° or 270°, loosen the locking set screws on the worm coupling (see figure 52) and set the goniometer to the indicated bearing.

(9) Set dial to desired reading and tighten bakelite brake on goniometer shaft. Turn adjusting screw on worm coupling unit until on-course indication is obtained.

(10) Tighten the locking screw and loosen brake to desired "drag".

(11) Check if the bearing is correct. If not, the adjustment must be repeated until the indicated bearing is correct.

(12) Replace Loop B cable at the junction box.

(13) Remove loop A (blue) cable and repeat. The indicated bearing should be either 0° or 180°. If the indicated bearing is more than ±2° from 0° or 180° the goniometer should be checked for faults. If reciprocal bearings differ by more than ±1° check modulator balance as outlined in paragraph 5.3.

(14) Turn power OFF and disconnect the test set-up.

(15) Replace equipment in normal operating condition and check.

6.5 RADIO RECEIVER SERVICE NOTES.–

6.51 Replacing Potentiometer Controls and Switches.–

(1) Remove bottom cover plate, if necessary.

(2) Remove knob after loosening set screws with Allen head wrench.

(3) Unsolder connections one at a time and tag them to insure proper reconnection.

(4) Remove hex nuts and washers from shaft bushings and remove unit from panel.

(5) Mount replacement unit replace washers and hex nuts and resolder connections.

(6) Replace bottom cover plate.

6.52 Replacing I-F Transformer Components.–

(1) Remove bottom cover plate.

(2) Remove two tap screws and lift shield from the required transformer assembly associated with L-201 to L-205, L-213 and L-111 to L-113 (see figure 55).

(3) Remove nearby tubes.

(4) Before unsoldering any leads make a sketch showing all connections and record color codes of associated leads, or tag them for identification.

(5) Place receiver on its left side while soldering or unsoldering.

(6) It may be found more convenient to remove the entire assembly for repair.

(7) To do this, disconnect under chassis connections for the assembly in question, being careful to identify all terminals and leads for reconnection, and remove frame mounting nuts.

(8) All assemblies may be removed directly after connections are unsoldered.

6.53 Removing R-F, Mixer, or H-F Oscillator Coil Assemblies.–

(1) Remove bottom cover plate.

(2) Remove shield holding nut on top center of shield can (see figure 53).

(3) Remove connections from lugs on bottom coil assembly, tagging each for identification.

(4) Remove nuts, washers and bushings holding coil to chassis (see figure 53).

(5) Coil may now be removed directly.

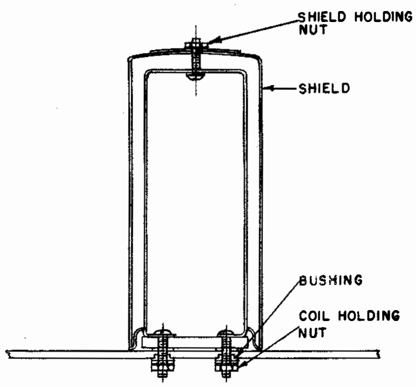


Figure 53. R-f coil removal detail.

6.54 Servicing Main Tuning Capacitor.–

NOTE: The main tuning capacitor should not be removed unless the necessity for this operation is definitely indicated. Access to the interior of the capacitor may be obtained without removing the capacitor from the chassis—it is only necessary to remove the capacitor shield. Proceed as follows if main tuning capacitor must be removed.

(1) Remove bottom cover plate.

(2) Loosen the two Allen head set screws securing the counterweighted coupling to the capacitor shaft and drive out the taper pin. Be sure to drive the small end of the taper pin; if in doubt as to which end is the smaller, test each end by a few light hammer blows.

(3) Disconnect all wiring to the five stator terminals, and unsolder the five rotor-grounding braided leads from the chassis ground terminals.

(4) The capacitor is secured to the chassis by three fillister-head machine screws, one at the rear and two at the front. The screws are accessible from the bottom side of the chassis. Each mounting screw passes through an adjustable mounting device, which permits precise control of elevation and alignment of the tuning capacitor shaft with the drive shaft. The adjustment of these mountings has been carefully made at the factory for the particular capacitor in the receiver; the adjustment is locked by the large hexagon nut. To remove the capacitor, remove the fillister-head machine screws—don't loosen the mounting lock nut.

(5) To proceed, turn the chassis on the right hand side (as seen facing the panel), place the left hand under the rear of the main tuning capacitor and remove the rear mounting screw.

(6) Holding the rear of the capacitor to avoid strain on the shafts, turn the chassis on its base (that is, to the normal operating position) allowing the front edge of the chassis to overhang the edge of the table by a few inches. Remove the two front capacitor-mounting machine screws with the chassis in this position, to avoid strains on the capacitor and drive shafts.

(7) Slide the capacitor directly to the rear and lift up and out.

(8) If a new capacitor is to be installed, it may be necessary to readjust the height of the three mounting assemblies. To do this, loosen the lock nuts and elevate or lower the threaded spacers as required to align the capacitor shaft with the coupling. This adjustment should be made with the mounting screws in place, but not tightened; for this operation the chassis must be resting on its base.

(9) When rewiring the capacitor, take care not to drop solder into the plates through the terminal clearance holes; it is advisable to lay the chassis on its left side when soldering.

6.55 How to Remove Receiver Goniometer.–

In order to remove the receiver goniometer it is necessary to release the goniometer dial and drive shaft before disengaging the thumb screws. With the modulator section out of the cabinet, this can be accomplished as follows:

(1) Remove the plastic goniometer dial index pointer from the front panel by removing its two screws (see figure 52). Be careful not to scatter the washers and spacers.

(2) Loosen front shaft collar by loosening the Allen head screws.

(3) Slide the dial and shaft out sufficiently for the shaft to clear the goniometer coupling.

(4) Loosen the goniometer thumb screws and swing them clear.

(5) Remove the goniometer by pulling straight up.

(6) After the goniometer is replaced check its mechanical alignment (see paragraph 6.4).

6.6 RADIO RECEIVER ALIGNMENT.–

6.60 General.–

THE RECEIVER HAS BEEN CAREFULLY AND COMPLETELY ALIGNED AT THE FACTORY; DON'T ATTEMPT *COMPLETE REALIGNMENT* IN THE FIELD!

6.61 Equipment Required.–

(1) One standard signal generator accurately calibrated at 175 kc, 260 kc, 580 kc, 640 kc, and 1420 kc.

(2) A target transmitter or test oscillator transmitter calibrated at frequencies of 260 kc, 580 kc, 640 kc, and 1420 kc.

(3) One d-c vacuum tube voltmeter with a range to 50 v d-c.

(4) One output meter, 600-ohm input impedance.

(5) One fixed condenser, 0.01 mfd or larger.

(6) The complete DAK-3 antenna system, comprising crossed loop, sense antenna and r-f transmission lines and the receiver junction box installed as used with the receiver to be aligned (for input stage alignment only).

(7) I-f test cable (RF-1812-2) and power test cable (RF-1813-3).

6.62 Preliminary Preparations for Alignment.–

(1) Remove all interconnecting cables from both power-indicator and modulator-receiver units.

(2) Loosen all captive screws and remove both units from cabinet.

(3) Place units on a bench, each on its left side.

(4) Remove bottom plate from each unit.

(5) Reconnect power cable 18 (F-40133-2), i-f cable 17 (E-40132-2).

(6) Connect a-c power cable (No. 16) directly to a-c power input on power-indicator unit.

(7) Switch OFF-STANDBY-ON to ON and allow ½ hour to warm up.

6.63 Control Settings.–

AUDIO GAIN	Maximum
RADIO SELECTIVITY	SHARP
A.V.C.-M.V.C.-C.W.	M.V.C.
INDICATION	NULL
R.F. GAIN	As required
GONI. GAIN	½ maximum
GONIOMETER	As required

NOTE: Use a 0.01 mfg capacitor in series with the signal generator to the grids of the various tubes.

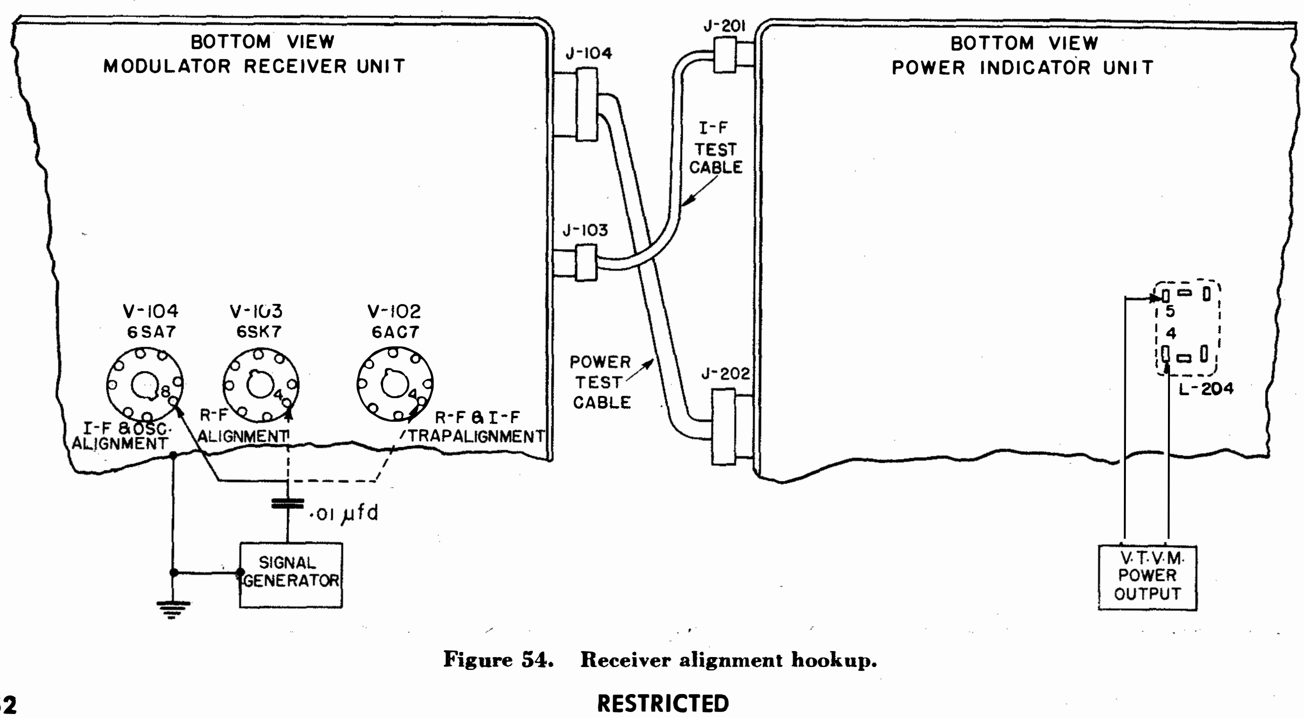


Figure 54. Receiver alignment hookup.

6.64 I-f Alignment.–

(1) Set signal generator to 175 kc. Connect the vacuum tube voltmeter across diode load (R-213) or from lug number 4 on L-204 to ground (see figure 54).

(2) Before attempting alignment set the powdered-iron cores of all i-f transformers all the way out. Feed in sufficient signal *without modulation* to the control grid (pin number 8) of V-104 (see figure 54) to get a reading on the vtvm.

(3) Adjust core of L-204 (see figure 55) for maximum reading on vtvm and the core of L-213 maximum line length on cathode-ray tube.

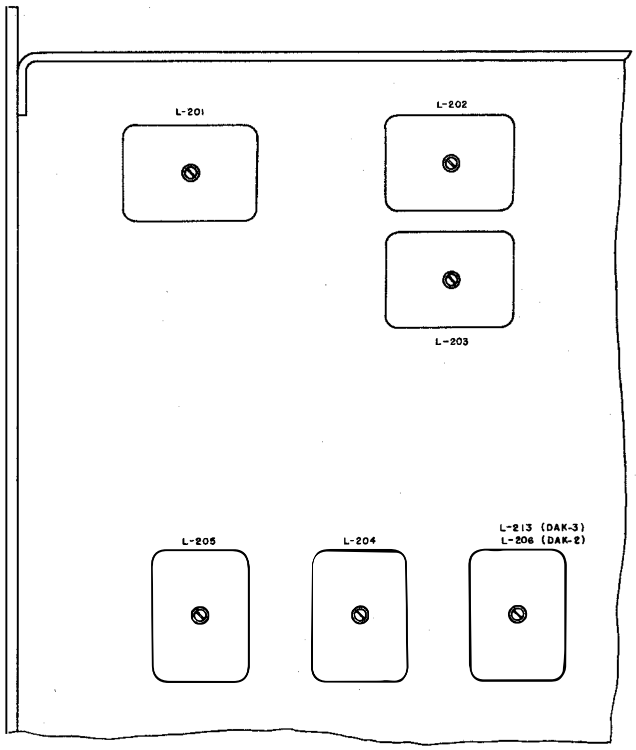


Figure 55. I-f trimmer locations.

(4) Adjust L-203, L-202, L-201, and L-112, individually for maximum reading on vtvm.

(5) Readjust L-204 for maximum reading of the vtvm.

(6) Readjust L-203, L-202, L-201, and L-112, individually for maximum reading of vtvm.

(7) Repeat (6) as often as necessary to secure a final peak.

(8) Vary frequency and observe whether vtvm and line length on cathode-ray tube peak together. If they do, the alignment is complete.

(9) If they do not peak together, check alignment of L-213 and L-204.

6.65 I-f Trap and BFO Output Alignment.–

(1) With the equipment set up as for the i-f alignment feed sufficient 175 kc signal to the control grid (pin number 4) of the 6AC7 sense input tube (V-102) to make vtvm read near the center of its scale.

(2) Adjust the iron core L-111 for *minimum* indication on vtvm.

(3) Increase the generator output and repeat the adjustment.

(4) Connect the output meter to the telephone jack (J-204).

(5) Increase the generator output to overload the i-f channel.

(6) Turn BFO ON set BFO VERNIER to 0.

(7) Adjust L-205 (see figure 55) for 1000 cycle note in loudspeaker.

(8) Adjust C-221 for 25 milliwatts reading on the output meter.

6.66 Low-Band Alignment.–

Alignment frequencies:

Inductance (core adjustment) 260 kc.

Capacitance (trimmer adjustment) 580 kc.

(1) With the equipment set up as for i-f alignment connect the signal generator to the signal grid (pin number 8) of V-104 in the modulator-receiver unit (see figure 54). Adjust the oscillator coil L-109 (see figure 56) and trimmer C-125a for maximum output at the frequencies given above. Repeat until the alignment is accurate at both frequencies.

(2) Connect the signal generator to the grid (pin number 4) of V-102 (see figure 54) and adjust the inductance L-107 and the trimmer C-124a for maximum output and switch TWO LINE-NULL-NULL SENSE to NULL SENSE. Adjust the inductance L-105 and trimmer C-123a for maximum output at the frequencies given. Repeat until the alignment is accurate at both frequencies.

6.67 High Band 610 to 1500 kc.–

(1) Alignment frequencies:

Inductance (core adjustment) 640 kc.

Capacitance (trimmer adjustment) 1420 kc.

(2) Align the high band in the same manner as the low band adjusting the following circuits:

Circuit	*Inductance*	*Trimmer*
Oscillator	L-110	C-125b
Mixer	L-108b	C-124b
R-f amplifier	L-106b	C-123b

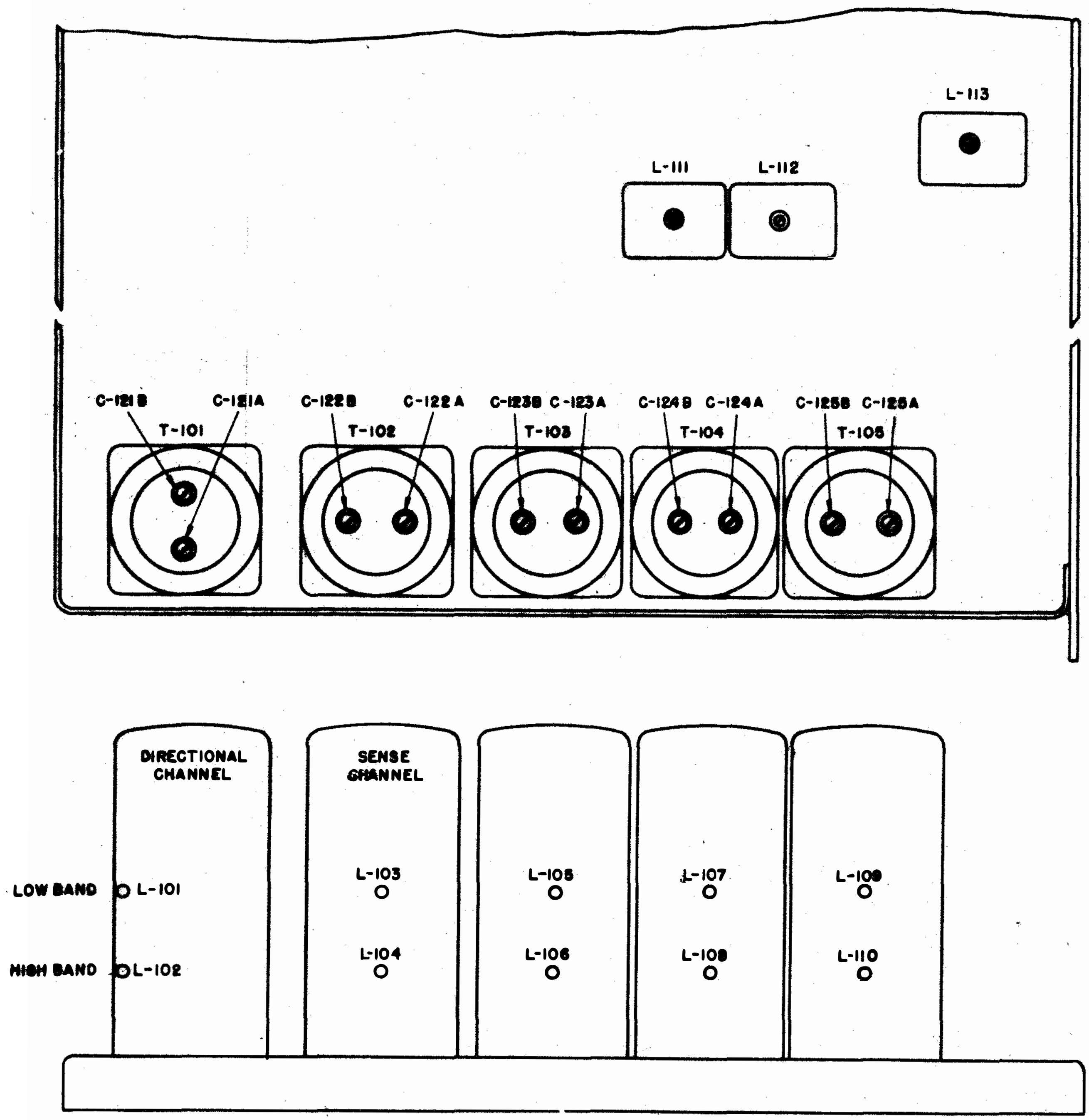


Figure 56. R-f trimmer locations.

6.68 Sense Input Stage Alignment.–

(1) With the equipment set up in its normal operating position remove all interconnecting cables from the modulator-receiver unit (the lower half or radio receiver).

(2) Loosen all captive screws and remove unit from cabinet.

(3) Place unit on its left side on a bench.

(4) Reconnect cables to the unit using power test cable (RF-1813-3) and i-f test cable (RF-1812-2) in place of cables numbered 18 (F-40133-2) and 17 (F-40132-2) respectively.

(5) Set target transmitter to 580 kc and place it as far as possible up to 500 feet from the Model DAK-3 antenna system. Tune the receiver to the signal.

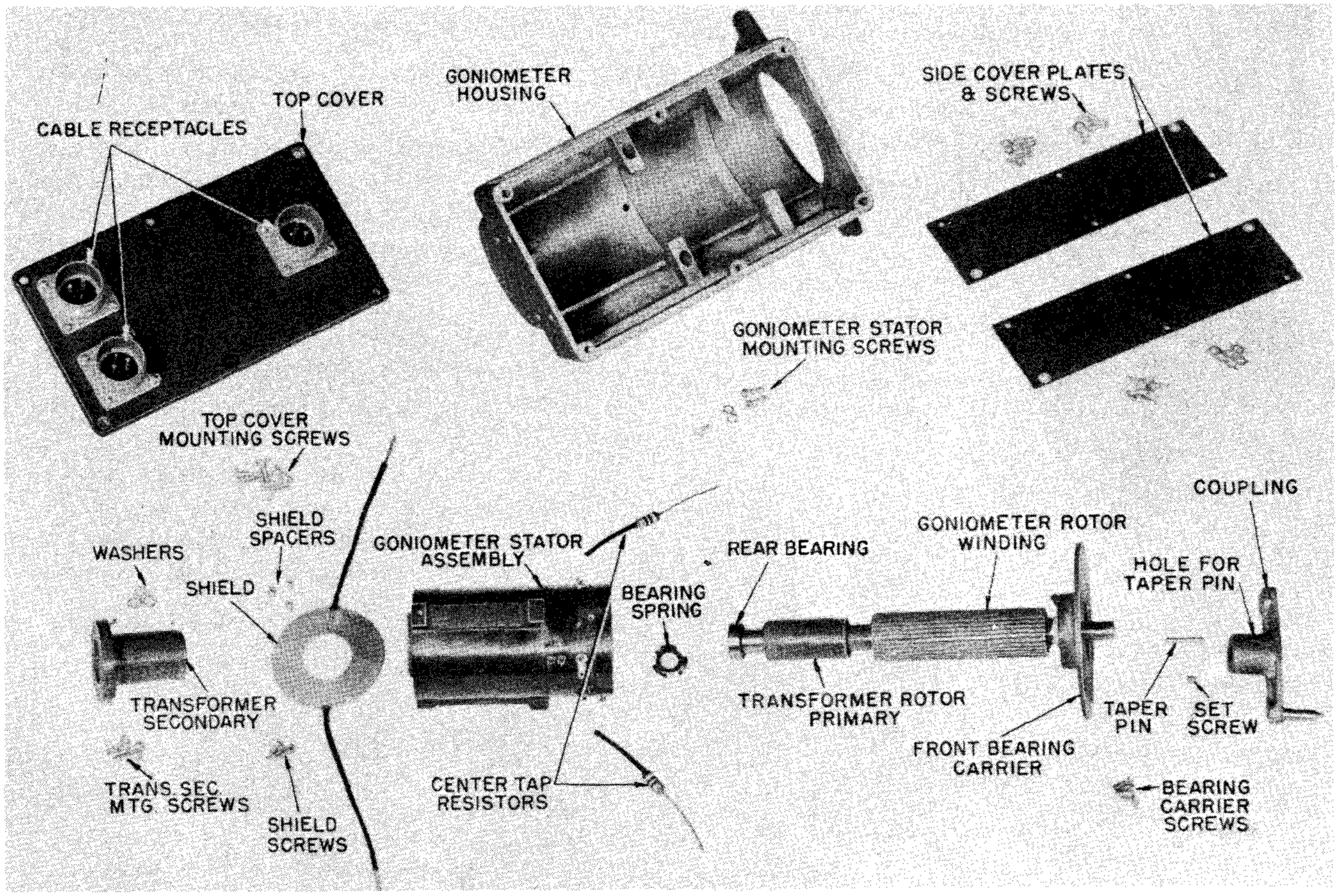


Figure 57. Goniometer dismantled.

(6) Leave controls as indicated in paragraph 6.63. Adjust GONIOMETER for minimum length of line then switch INDICATOR switch to NULL SENSE.

(7) Set R.F. GAIN so as to give a line approximately 1½ inches long on the receiver cathode-ray tube.

(8) Accurately adjust trimmer C-122A for maximum length of line.

(9) Tune target and receiver to 260 kc and set R.F. GAIN control so as to give a line approximately 1½ inches long.

(10) Accurately adjust L-103 for maximum length of line.

(11) Repeat instructions (5) through (10) as often as is necessary until no further improvement in alignment is possible at both of the above frequencies.

(12) Using frequencies of 1420 kc and 640 kc repeat instructions (5) through (11) adjusting C-122B and L-104.

6.69 Directional Input Stage Alignment.–

(1) Set INDICATION switch to NULL.

(2) Tune target and receiver to 580 kc.

(3) Set receiver GONIOMETER to give maximum length on cathode-ray tube.

(4) Set R.F. GAIN control so as to give a line approximately 1½ inches long.

(5) Accurately adjust C-121A for maximum length of line.

(6) Tune target and receiver to 260 kc and set GONIOMETER to give maximum length of line.

(7) Accurately adjust inductance L-101 for maximum line length on the cathode-ray tube.

(8) Repeat instructions (2) through (7) as often as is necessary until no further improvement in alignment is possible at both of the above frequencies.

(9) Using frequencies of 1420 kc and 640 kc repeat instructions (3) through (8) above, adjusting C-121B and L-102.

6.7 GONIOMETER SERVICE NOTES.–

6.70 General.–

Interior connections of the goniometer are accessible through the side or top openings by removing the cover plates. Figure 57 shows a dismantled view of the goniometer as a guide for servicing.

6.71 How to Replace Rotor Shaft Bearings.–

(1) Remove the three bearing carrier screws and remove carrier, rotor, and bearing spring.

(2) Drive out taper pin holding coupling to shaft and remove coupling and front bearing carrier.

(3) Pull off bearing using a wheel puller if necessary. Use proper precautions to prevent damage to shaft and bearing seat.

(4) Clean shaft and bearing spring with a clean piece of cheese cloth saturated with carbon tetrachloride.

(5) Prepare two wood blocks with a hole in each just larger than the rotor shaft.

(6) Slide the new bearing over the shaft. Mount the rotor in a vise between the two blocks.

(7) Force the bearing onto the shaft by tightening the vise slowly until the bearing makes contact with the shoulder.

(8) Reassemble front bearing carrier and coupling to shaft.

(9) Replace bearing spring and rotor into goniometer housing and replace screws.

(10) After assembly press on projecting end of shaft with sufficient finger pressure to compress the flat spring under the rear bearing. When properly assembled the bearing must be free enough in the housing to permit the shaft to return to its original position when the pressure is removed.

6.8 TUBE AND FUSE LOCATIONS.–

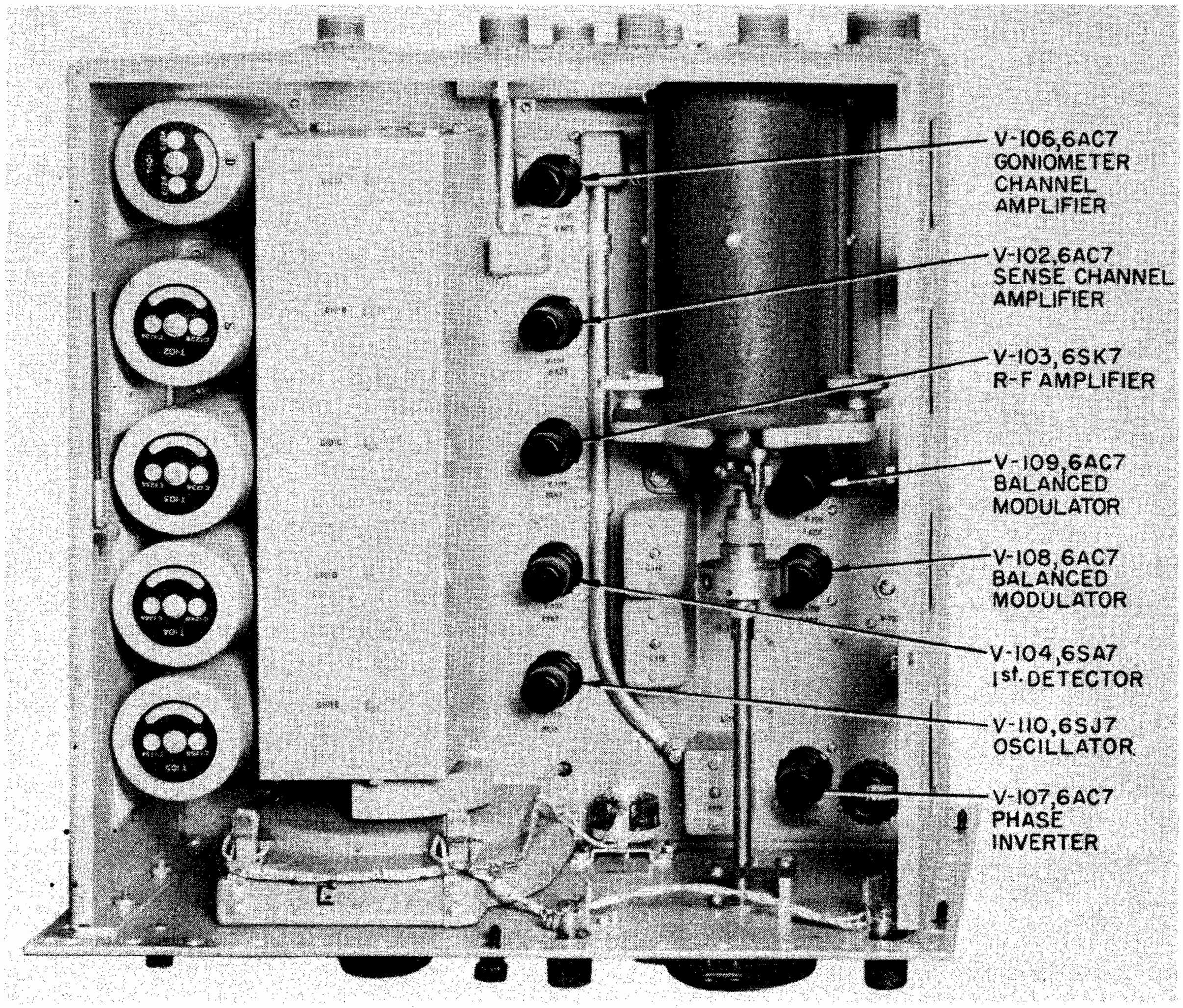


Figure 58. Modulator section tube locations.

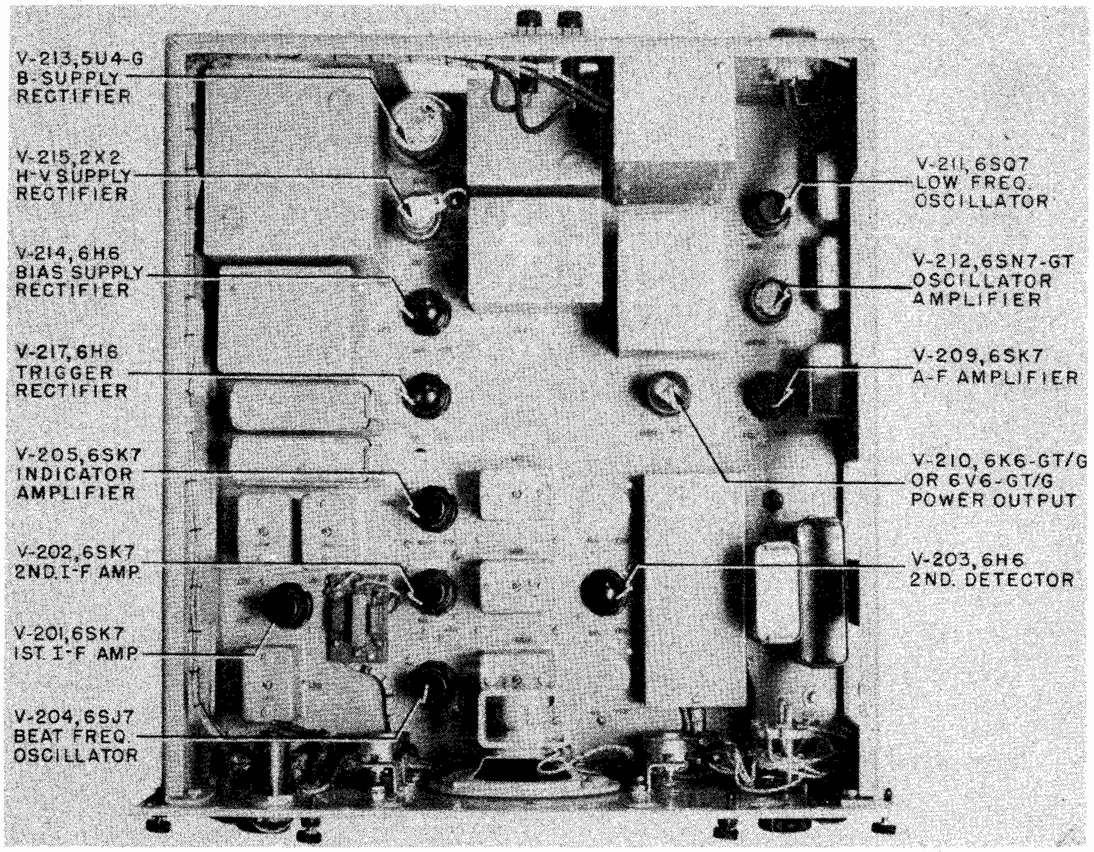


Figure 59. Power indicator section tube locations.

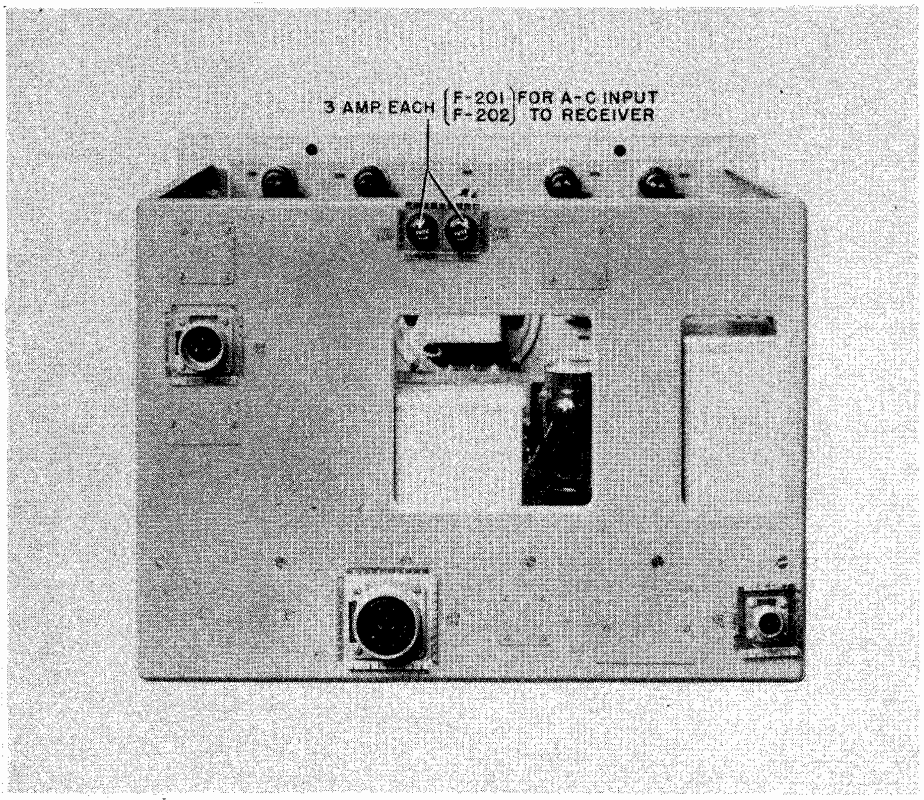


Figure 60. Power indicator section fuse locations.

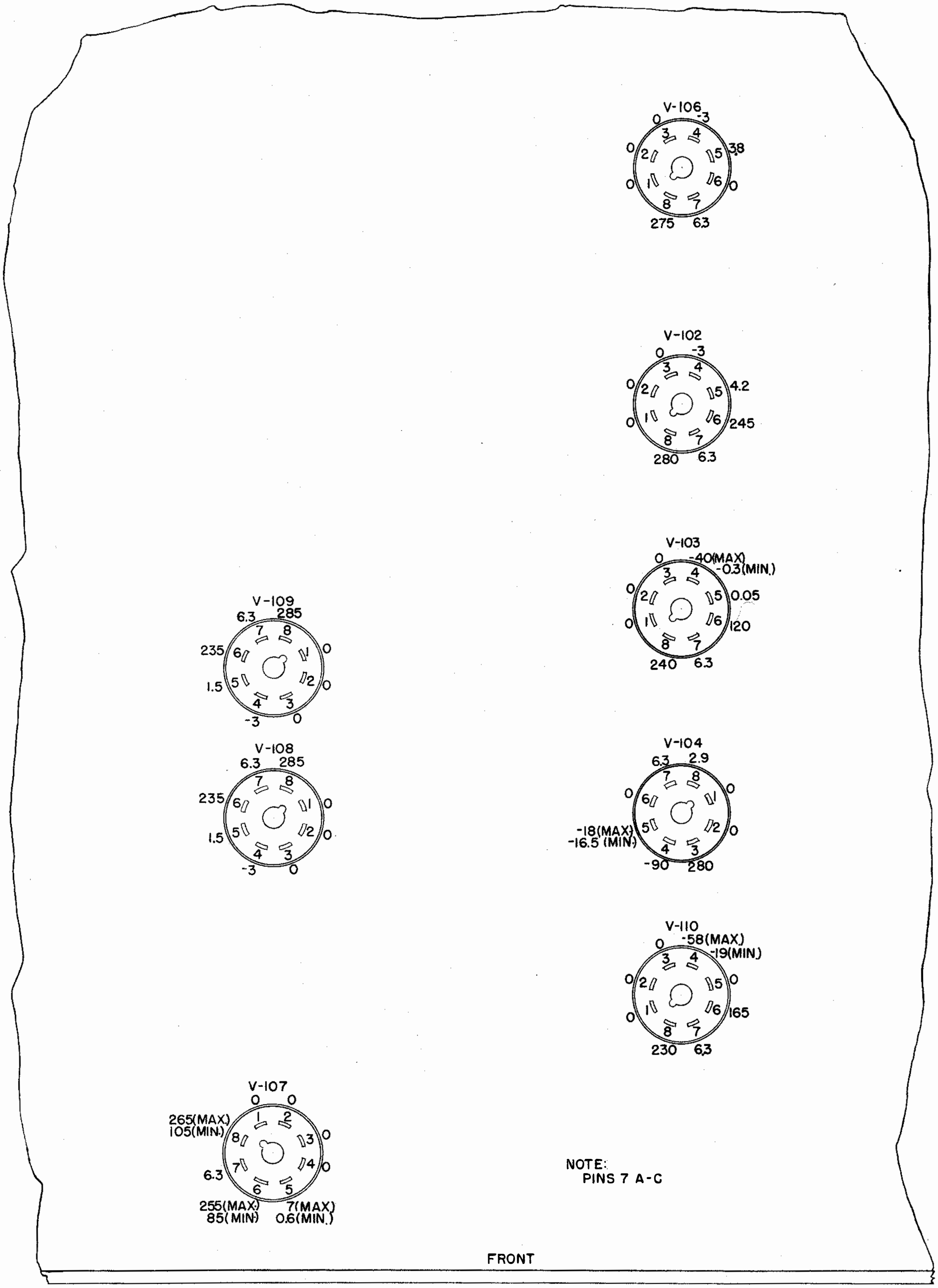


Figure 61. Modulator section voltage measurements.

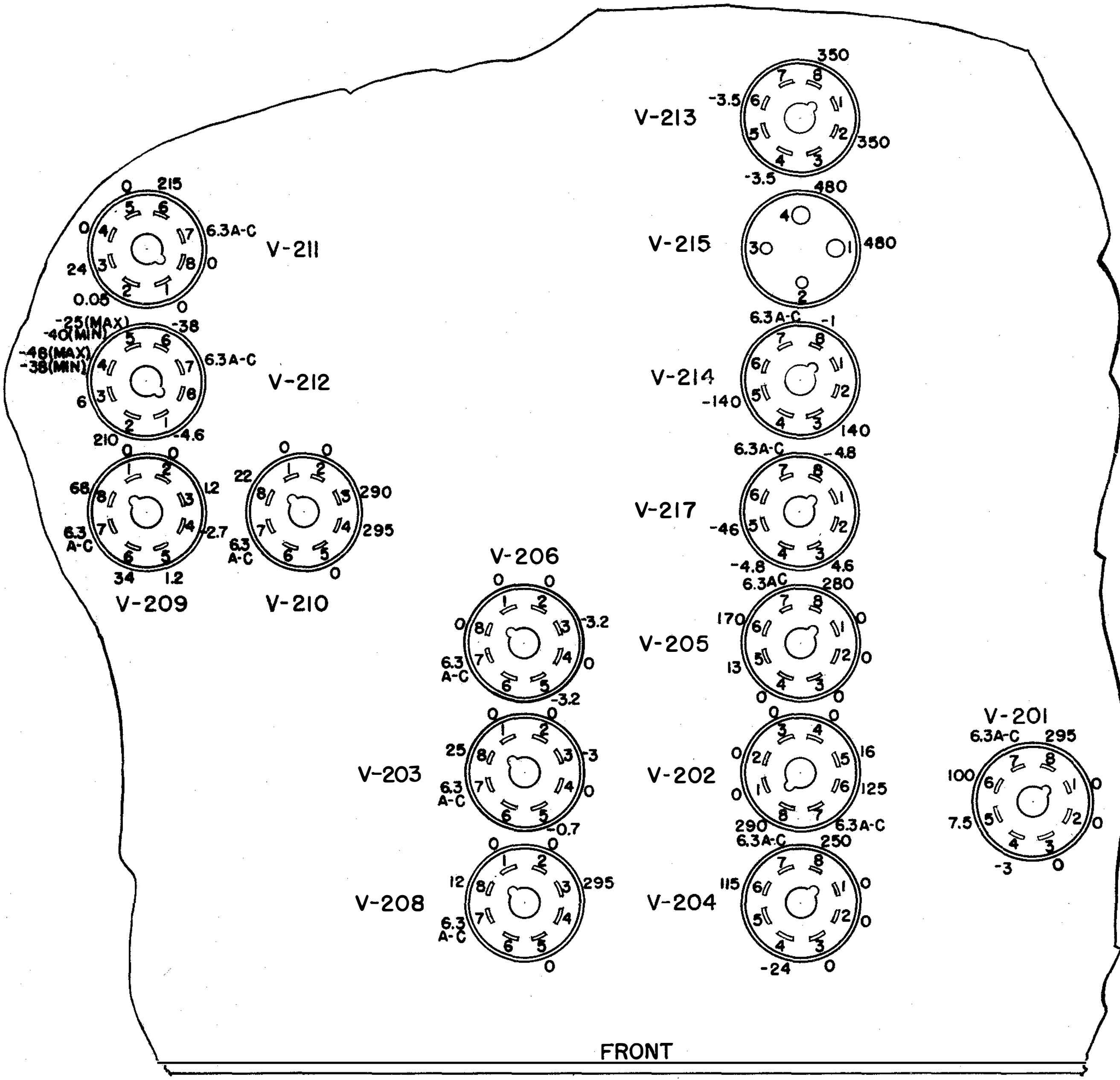


Figure 62. Power indicator voltage measurements.

6.9 VOLTAGE AND RESISTANCE MEASUREMENTS.–

6.90 General.–

The accompanying illustrations and charts give voltage and resistance readings from the respective points indicated as measured with a Navy Type OE Analyzer under the conditions listed. Variation of more than 20% from the values shown indicates trouble in the circuit being measured or in directly connected circuits.

6.91 Modulator Section Voltage Measurements.–

(1) Adjust line voltage to 115 volts (primary voltage link, see figure 60, adjusted to 115 v tap). Take readings from tube pin to chassis.

(2) All tubes in sockets.

(3) AVC-MVC-CW switch on AVC.

(4) Vary R-137 for V-103 readings.

(5) Vary R-117 for V-107 readings.

(6) Adjust R-127 to half maximum for V-108 and V-109 readings.

(7) Take readings on both band 1 and 2 for V-104 and V-110.

(8) See figure 61 for voltage measurements.

6.92 Power Indicator Section Voltage Measurements.–

(1) Adjust line voltage to 115 volts (primary voltage link, see figure 60, adjusted to 115 volt tap). Take readings from tube pin to chassis.

(2) All tubes in sockets.

(3) AVC-MVC-CW switch on AVC for all readings except V-203 and V-204.

(4) AVC-MVC-CW switch on CW for V-203 and V-204.

(5) RADIO SELECTIVITY switch on SHARP for V-201 readings.

(6) Vary VERT. ADJ., FOCUS and BRILL. adjustments for V-216 readings.

(7) Blanking switch (S-204) ON.

(8) Vary blanking control (R-272) for V-212 readings.

(9) See figure 62 for voltage measurements.

6.93 Modulator Section Resistance Measurements.–

(1) Line voltage disconnected.

(2) Tubes out of sockets, except for OAN Test Oscillator.

(3) Cables disconnected.

(4) Other settings as noted.

(5) See figures 61 and 63 for pin locations.

From Tube or or Receptacle	Pin No.	To	Conditions	Resistance (Ohms)
V-102	4	T-102 (G)	Band 1	6.5
			Band 2	1.5
	8	J-104 (B)	Band 1	1200
	8	J-104 (B)	Band 2	1100
	2	Chassis		0.0
	3	Chassis		0.0
	4	Chassis		Inf.
	5	Chassis	TWO LINE	1000
	6	J-104 (B)	Band 1 and Band 2	56,000
	7	Chassis	Vary R-139, pilot lights in	4 to 25
	7	Chassis	Pilot lights out	open
V-103	2	Chassis		0.0
	3	Chassis		0.0
	4	Chassis	NULL only, vary R.F. GAIN	1 to 2 meg.
	5	Chassis		2
	6	J-104 (B)		50,000

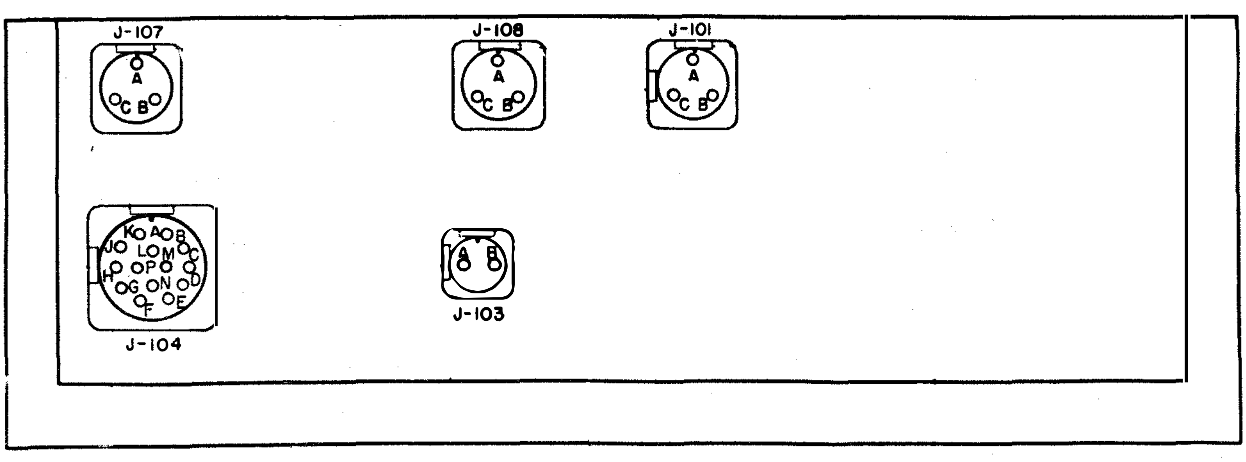


Figure 63. Modulator section receptacle pin positions.

From Tube or Receptacle	Pin No.	To	Conditions	Resistance (Ohms)
V-104	2	Chassis		0.0
	3	J-104 (B)		4700
	5	Chassis		56,000
	6	Chassis		0.0
	8	Chassis		2 meg.
V-106	2	Chassis		0.0
	3	Chassis		0.0
	5	Chassis		620
	6	J-104 (B)		56,000
	8	J-104 (B)		4700
V-107	2	Chassis		0.0
	3	Chassis		0.0
	4	Chassis		220,000
	5	Chassis	Vary R-117	160 to 10,260
V-108	2	Chassis		0.0
	3	Chassis		0.0
	4	Chassis		220,000
	5	Chassis	on TWO LINE and NULL	220
	6	J-104 (B)	Vary-R-127	27,000 to 70,000
	8	J-104 (B)		1000
V-109	5	Chassis	on TWO LINE and NULL	220
V-110	2	Chassis		0.0
	3	Chassis		0.0
	4	Chassis		100,000
	6	Chassis	TWO LINE and NULL	80,000
J-101	A	Chassis		0.0
	C	J-101 (B)	Band 1 and Band 2	2
	B	Chassis	Band 1 and Band 2	1
	C	Chassis	Band 1 and Band 2	1
J-103	A			Inf.
	B	Chassis		Inf.
J-104	A	J-104 (D)		Two Line Null
				0.0 Inf.
	C	J-104 (L)		0.0 Inf.
	E	J-104 (A)		Inf. 0.0
	F	Chassis	Vary R-131	2200 to 12,000
				Man. 0.0
	G	Chassis		Inf. 0.0
	N	Chassis		Inf. 0.0
	M	Chassis		0.0 0.0
	K	Chassis		0.0 Inf.
	H	Chassis	S-107 all positions	330,000
	B	V-110 (8)		9,400
	P	J-105 (A)		0.0
	E	Chassis	Vary R-131	68,000 to 1 meg
V-102	4	V-101		0.0
V-106	4	V-105		0.0
V-103	8	T-104 (B)	Band 1	200
			Band 2	100
V-104	3	L-112 (1)	Band 1 and Band 2	28

From Transformer or Coil Assembly	Pin No.	To	Conditions	Resistance (Ohms)
T-105	1	Chassis	Band 1	5
	2	Chassis	Band 2	2
V-106	8	L-113 (4)	Band 1 and Band 2	220
J-107	A	Chassis		0
	C	B		3
	C	Chassis		50
	B	Chassis		50
J-108	A	Chassis		0
	B	Chassis		40
	C	Chassis		40
	B	C		3
J-110	C	J-107 (C)		0
	B	J-107 (B)		0
	A	J-107 (A)		0
J-111	A	J-108 (C)		0
	B	J-108 (B)		0
	C	J-108 (C)		0
J-112	A	Chassis		0
	B	Chassis		Inf.
	C	Chassis		Inf.
	1	V-106 (4)	Band 1	0
			Band 2	2
	2	V-106 (4)	Band 1	5
			Band 2	0
T-101	A1S	Chassis		0.5
	A2S	Chassis		0.5
	A1F	J-102 (B)		0.5
	A2F	J-102 (C)	Band 1	1
			Band 2	0
	G	V-106 (4)	Band 1	5
			Band 2	2
T-102	1	V-102 (4)	Band 1	0
			Band 2	2
	2	V-102 (4)	Band 1	5
			Band 2	0
	A1S	Chassis		0.5
	A1F	Chassis		0.5
	A2S	Chassis		0.5
	A2F	Chassis		0.5
	G	V-102 (4)	Band 1	5
			Band 2	2
T-103	1	Chassis	Band 1	4.5
			Band 2	0
	2	Chassis	Band 1	0
			Band 2	2
	B	V-102 (8)	Band 1	180
			Band 2	100
	P1	V-102 (8)	Band 1	0
			Band 2	60
	P2	V-102 (8)	Band 1	120
			Band 2	0
	B	J-104 (B)		1000

From Transformer or Coil Assembly	Pin No.	To	Conditions	Resistance (Ohms)
	1	Chassis	Band 1	4.5
			Band 2	0
	2	Chassis	Band 1	0
			Band 2	2
T-104	P1	V-103 (8)	Band 1	0
			Band 2	110
	P2	V-103 (8)	Band 1	220
			Band 2	0
	B	J-104 (B)		4700
	1	V-110 (5)	Band 1	4.5
			Band 2	0.5
T-105	2	V-110 (5)	Band 1	1
			Band 2	2
	T1	Chassis		1
	T2	Chassis		.5
	G	Chassis		0
L-111	1	V-103 (5)		1.5
	2	Chassis		1.5
	1	V-104 (3)		28
L-112	2	J-104 (B)		4700
	3	J-103 (A)		0
	1	J-104 (B)		5000
L-113	2	V-107 (4)		220,000
	3	Chassis		220,000
	4	V-106 (8)		230

6.94 Power Indicator Section Resistance Measurements.–
See figures 62 and 64 for pin locations.

	2	Chassis		0
	3	Chassis		0
	4	L-201 (1)		56,000
	5	Chassis	RADIO SELECTIVITY on SHARP	1000
V-201	5	Chassis	RADIO SELECTIVITY on BROAD	0
	6	J-202 (B)		560,000
	7	Chassis		0.1
	8	J-202 (B)		4700
	2	Chassis		0
	3	Chassis		0
	4	Chassis		1 meg.
V-202	5	Chassis		10,000
	6	J-202 (B)		560,000
	7	Chassis		0.2
	8	J-202 (B)		4700
	2	Chassis		0
	3	Chassis		506,000
	4	Chassis		0
V-203	5	J-202 (D)	AVC-MVC-CW switch on AVC	1 meg.
	5	Chassis	AVC-MVC-CW switch on MVC	600,000
	8	J-202 (B)	AVC and MVC	30,000
			CW	20,000
	8	Chassis		4700
	2	Chassis		0
	3	Chassis		0
V-204	4	Chassis		100,000
	5	Chassis		0.4

From Tube or Receptacle	Pin No.	To	Conditions	Resistance (Ohms)
V-204	6	Chassis	AVC-MVC-CW switch on CW	20,000
	6	J-202 (B)	AVC-MVC-CW switch on AVC	56,000
	7	Chassis		0.2
	8	J-202 (B)	AVC-MVC-CW switch on CW	7700
V-205	2	Chassis		0
	3	Chassis		0
	4	J-202 (G)		1 meg.
	4	Chassis	AVC-MVC-CW switch on MCW or CW	1 meg.
	5	J-202 (F)		2200
	5	Chassis	AVC-MVC-CW switch on MCW or CW	2200
	6	J-202 (B)		82,000
	7	Chassis		0.2
	8	J-202 (B)		4,700
V-209	2	Chassis		0
	3	Chassis		620
	4	Chassis	AVC-MVC-CW switch on MCW or CW	240,000
	4	Chassis	AVC-MVC-CW switch on AVC	1.84 meg.
	5	Chassis		620
	6	J-202 (B)		560,000
	7	Chassis		2
	8	J-202 (B)		156,000
V-210	2	Chassis		0
	3	J-202 (B)		200
	4	J-202 (B)		0
	5	Chassis		560,000
	6	Chassis		300,000
	7	Chassis		0.2
	8	Chassis		560
V-211	2	Chassis		750,000
	3	Chassis		10,000
	4	Chassis		0
	5	Chassis		0
	6	J-202 (B)		296,000
	7	Chassis		0.2
	8	Chassis		0
V-212	1	Chassis		1 meg.
	2	J-202 (B)		10,000
	3	J-202 (K)		1000
	4	Chassis	Vary R-272	90,000 to 590,000
	5	V-216 (10)		0
	6	J-202 (L)	S-204-OFF	Inf.
			S-204-ON	0
	7	Chassis		0.2
	8	Chassis		0
V-213	2	J-202 (B)	S-205A ON	300
	4	V-213 (6)		90
	6	Chassis		45
	8	Chassis	S-205 ON	25,000
V-214	2	Chassis		0
	3	Chassis		330,000
	4	Chassis		15
	5	Chassis		330,000
	7	Chassis		0.2
	8	Chassis		15

From Tube or or Receptacle	Pin No.	To	Conditions	Resistance (Ohms)
V-215	1	Chassis	S-205 OFF	Inf.
	4	Chassis	S-205 ON	250,000
	Plate Cap	Chassis		70
V-217	2	Chassis		0
	3	Chassis		590,000
	4	J-202 (H)		0
	5	Chassis		590,000
	7	Chassis		.2
	8	J-202 (J)		0
V-216	1	Chassis		0
	2	Chassis		0
	3	Chassis		247,000
	4	Chassis	Vary R-266	30,000 to 77,000
	6	Chassis		800,000
	7	Chassis		247,000
	8	Chassis	Vary R-270	200,000 to 747,000
	9	Chassis		200,000
	10	Chassis	Vary R-268	1 meg. to 1.14 meg.
	11	Chassis		0.2
L-201	2	V-201 (4)		0
	3	J-201 (A)	RADIO SELECTIVITY switch on BROAD	0
	3	J-201 (A)	RADIO SELECTIVITY switch on SHARP	Inf.
	4	V-201 (4)		25
	4	J-202 (A)		56,000
L-202	1	V-201 (8)		0
	2	L-202 (1)		4700
	3	J-202 (B)		4700
	4	L-203 (4)	RADIO SELECTIVITY switch on BROAD	0
L-203	1	Chassis		25
	3	Chassis		0
	4	L-202 (4)	RADIO SELECTIVITY on SHARP	Inf.

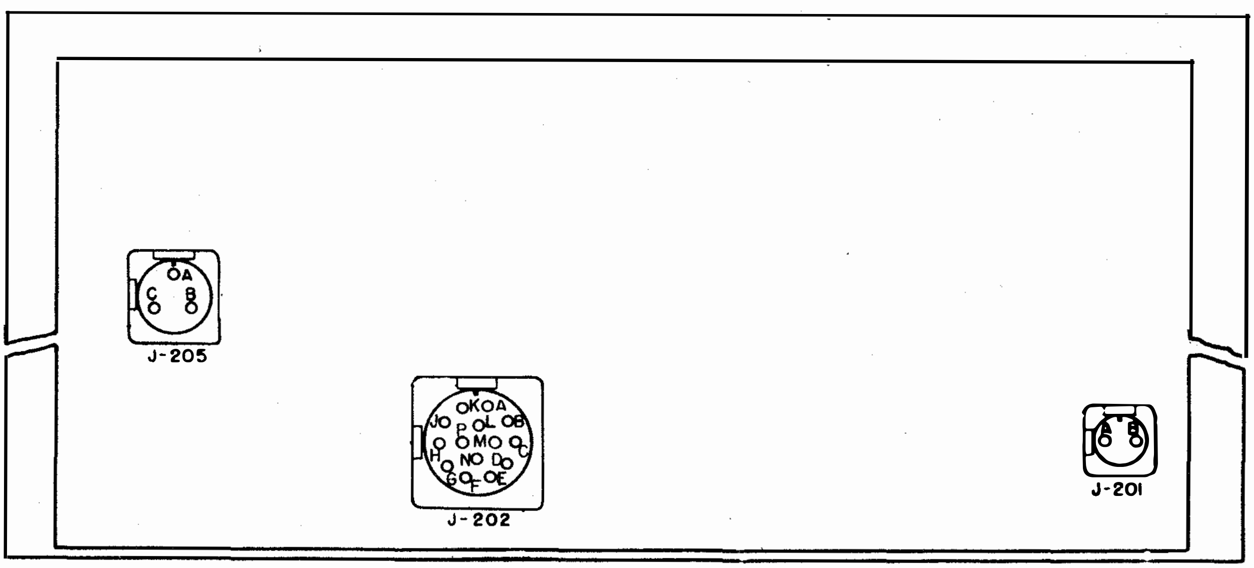


Figure 64. Power indicator section receptacle pin positions.

From Tube or Receptacle	Pin No.	To	Conditions	Resistance (Ohms)
L-204	1	V-202 (8)		0
	2	V-202 (8)		10
	3	Chassis		0
	4	Chassis		450,000
	5	Chassis		0
	6	L-204 (4)		56,000
L-205	1	Chassis		15
	2	Chassis		0
	3	Chassis		15
	4	Chassis		2
L-213	1	V-205 (8)		10
	2	J-202 (B)		4700
J-201	B	Chassis	RADIO SELECTIVITY SHARP and BROAD	Inf.
	A	Chassis		Inf.
J-202	A	Chassis		Inf.
	B	Chassis	AVC-MVC-CW on CW	20,000
			On AVC and MVC	25,000
	C	Chassis		100,000
	D	Chassis	AVC	2 meg.
	E	Chassis		Inf.
	F	Chassis	AVC-MVC-CW switch on MVC or CW	0
	G	Chassis	AVC	1.5 meg.
	H	Chassis		1 meg.
	J	Chassis		1 meg.
	K	Chassis		Inf.
	L	Chassis		Inf.
	M	Chassis		0
	N	Chassis	AVC-MVC-CW switch on MVC or CW	0
	P	Chassis		0
J-205	A	Chassis		0
	B	Chassis	S-205 OFF	Inf.
	C	Chassis	S-205 OFF	Inf.
	C	J-205 (B)	S-206 and S-205 ON	2.8

6.95 Junction Box Resistance Measurements.– See figure 65 for pin locations.

J-451	A	Chassis		0
	B	J-451 (C)		4
J-452	A	Chassis		0
	B	J-452 (C)		120
J-453	A	Chassis		0
	B	J-453 (C)		120
			Across loop A input terminals	120
			Across loop B input terminals	120
			Across sense input terminals	5

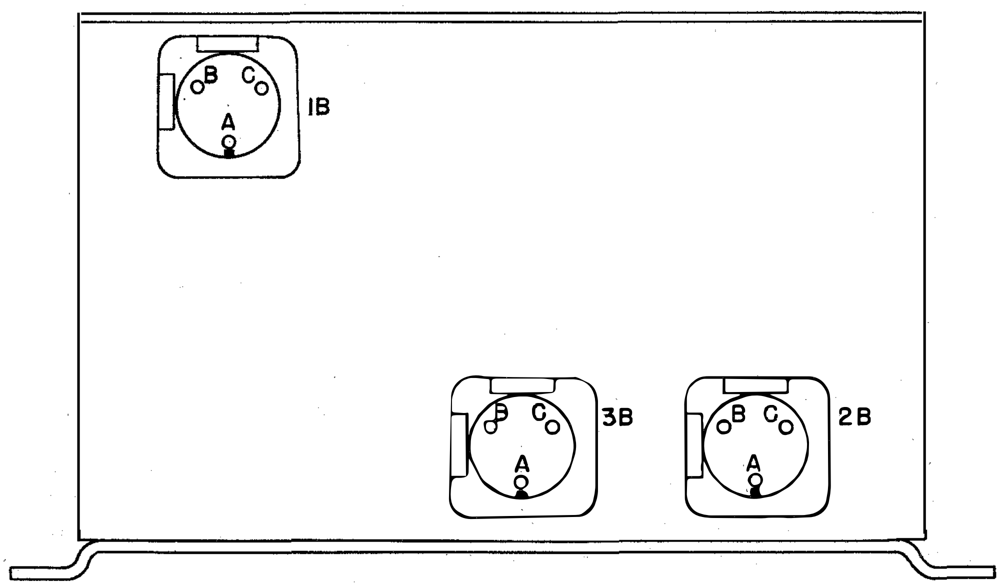


Figure 65. Junction box receptacle pin positions.

6.96 Goniometer Resistance Measurements.–
See figure 66 for pin locations.

From Tube or Receptacle	Pin No.	To	Conditions	Resistance (Ohms)
J-851	A	J-851 (B)		48
	A	J-851 (C)		48
	B	J-851 (C)		3
	A	Chassis		0
	B	Chassis		48
	C	Chassis		48
J-852	A	J-852 (B)		48
	A	J-852 (C)		48
	B	J-852 (C)		3
	A	Chassis		0
	B	Chassis		48
	C	Chassis		48
J-853	B	J-853 (C)		1
	A	Chassis		0

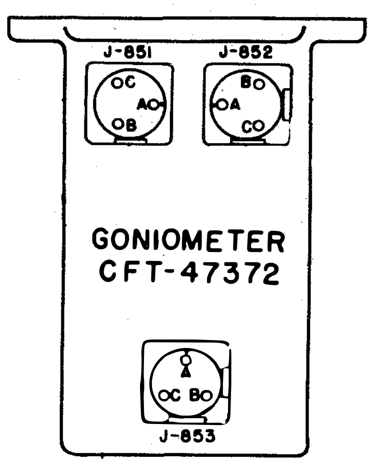


Figure 66. Goniometer receptacle pin positions.

7.1 TABLE III PARTS LIST BY SYMBOL DESIGNATION.–

Quantity (a)	Quantity (b)	Quantity (c)	Symbol Desig.	Function	Description	Navy Type Desig.	Navy Dwg. or Spec. No.	†Mfg.	Mfg. Desig.	Contractor's Dwg. No.
					Batteries					
0	0	3	B-601	Power supply	45 v B battery max. dimensions: L-3$\frac{9}{16}$ W-1$\frac{13}{16}$, H-5$\frac{5}{8}$ (Same as B-602, 603)	–19021	RE-15A-101	BS	—	—
			B-602	Power supply	Same as B-601	—	—	—	—	—
			B-603	Power supply	Same as B-601	—	—	—	—	—
0	0	4	B-604	Power supply	1.5 v A battery max. dimensions: L-2$\frac{5}{8}$, W-2$\frac{5}{8}$, H-3$\frac{15}{16}$ (Same as B-605, 606, 607)	–19010	RE-19AA-105	BB	4FH	—
			B-605	Power supply	Same as B-604	—	—	—	—	—
			B-606	Power supply	Same as B-604	—	—	—	—	—
			B-607	Power supply	Same as B-604	—	—	—	—	—
					Capacitors					
0	0	1	C-101	Main tuning capacitor	Capacitor, 0-708 mmfd (effective) aligned per Spec. F-41516-1	—	—	FTR	—	F-33747-14
2	6	10	C-102	Sense amplifier fixed minimum frequency	Capacitor, mica, 25 mmfd ±10% 500 v d-c low-loss case (Same as C-104, 107, 111, 114, 127, 140, 141, 144, 148)	–48711	—	SM	MOSCW	—
6	17	11	C-103	Sense amplifier bypass	Capacitor, paper, 0.1/0.1/0.1 mfd ±20% 600 v d-c (Same as C-110, 116, 128, 129, 135, 205, 213, 220, 226, 244)	–48849	—	CD	—	F-36416-1
			C-104	First r-f common primary shunt	Same as C-102	—	—	—	—	—
2	6	9	C-105	First r-f band 1 primary shunt	Capacitor, mica, 100 mmfd ±10% 500 v d-c low-loss case (Same as C-112, 117, 131, 216, 228, 302, 606, 608)	–48674	—	SM	MOBW	—
1	2	2	C-106	First r-f band 2 coupling	Capacitor, mica 2 mmfd ±0.5 mmfd 500 v d-c low-loss case (Same as C-113)	–48842	—	SM	MOBW	—
			C-107	R-f amplifier fixed minimum frequency	Same as C-102	—	—	—	—	—
2	5	8	C-108	R-f amplifier blocking	Capacitor, mica, 250 mmfd ±10% 500 v d-c (Same as C-115, 130, 212, 214, 217, 219, 225)	–48690	—	SM	MOBW	—
2	4	6	C-109	I-f trap tuning	Capacitor, mica, 0.006 mfd ±5% 500 v d-c (Same as C-120, 202, 203, 208, 209)	–48874	—	SM	MWSCW	—
			C-110	R-f amplifier	Same as C-103	—	—	—	—	—
			C-111	Second r-f common primary shunt	Same as C-102	—	—	—	—	—
			C-112	Second r-f band 1 primary shunt	Same as C-105	—	—	—	—	—

			C-113	Second r-f band 2 coupling	Same as C-106	—	—	—	—	—
			C-114	Mixer stage fixed minimum frequency	Same as C-102	—	—	—	—	—
			C-115	Mixer stage blocking	Same as C-108	—	—	—	—	—
			C-116	Mixer stage bypass	Same as C-103	—	—	—	—	—
			C-117	Oscillator coupling	Same as C-105	—	—	—	—	—
3	9	6	C-118	Converter plate bypass	Capacitor, paper, 0.05 mfd ±10% 600 v d-c (Same as C-132, 146, 147, 201, 206)	-481391	—	CD	DY	F-36432-1
1	1	1	C-119	First i-f coupling (sharp)	Capacitor, mica, 0.009 mfd ±5% 300 v d-c, temperature cycled	—	—	CD	1W	—
			C-120	First i-f coupling (broad)	Same as C-109	—	—	—	—	—
1	3	5	C-121	Goniometer amplifier trimmer	Capacitor, variable 50 mmfd +20% −5% dual trimmer (Same as C-122, 123, 124, 125)	-481376	—	FTR	—	F-28180-2-2
			C-122	Sense amplifier trimmer	Same as C-121	—	—	—	—	—
			C-123	First r-f trimmer	Same as C-121	—	—	—	—	—
			C-124	Second r-f trimmer	Same as C-121	—	—	—	—	—
			C-125	Oscillator trimmer	Same as C-121	—	—	—	—	—
2	4	6	C-126	Converter plate coil tuning	Capacitor, mica, 200 mmfd ±5% 500 v d-c (Same as C-207, 211, 215, 227, 204)	-48675	—	SM	MOSCW	—
			C-127	Goniometer amplifier fixed minimum	Same as C-102	—	—	—	—	—
			C-128	Goniometer amplifier bypass	Same as C-103	—	—	—	—	—
			C-129	Phase inverter bypass	Same as C-103	—	—	—	—	—
			C-130	Phase inverter blocking	Same as C-108	—	—	—	—	—
			C-131	Goniometer amplifier plate load	Same as C-105	—	—	—	—	—
			C-132	Phase inverter screen bypass	Same as C-118	—	—	—	—	—
1	2	2	C-133	Balanced modulator r-f coupling	Capacitor, mica, 0.001 mfd ±10% 500 v d-c (Same as C-134)	-48983	—	SM	MWBW	—
			C-134	Balanced modulator r-f coupling	Same as C-133	—	—	—	—	—
			C-135	Balanced modulator bypass	Same as C-103	—	—	—	—	—
1	2	2	C-136	Balanced modulator screen	Capacitor, mica, 0.005 mfd ±10% 500 v d-c (Same as C-137)	-481037	—	SM	MWBW	—
			C-137	Balanced modulator screen	Same as C-136	—	—	—	—	—
2	5	3	C-138	Balanced modulator audio coupling	Capacitor, paper, 0.5 mfd ±10% 600 v d-c (Same as C-139, 251)	-481002	—	CD	DY	F-36430-1
			C-139	Balanced modulator audio coupling	Same as C-138	—	—	—	—	—
			C-140	R-f oscillator grid blocking	Same as C-102	—	—	—	—	—

† See list of Manufacturers (a) Equipment Spares (b) Applicable parts in DAK-2, DAK-3 tender spares group (c) Replaceable Parts

7.1 TABLE III PARTS LIST BY SYMBOL DESIGNATION (Cont'd).–

Quantity (a)	Quantity (b)	Quantity (c)	Symbol Desig.	Function	Description	Navy Type Desig.	Navy Dwg. or Spec. No.	†Mfg.	Mfg. Desig.	Contractor's Dwg. No.
					Capacitors (Cont'd)					
			C-141	R-f oscillator fixed minimum frequency	Same as C-102	—	—	—	—	—
1	1	1	C-142	R-f oscillator band 2 padder	Capacitor, mica, 2610 mmfd ±1% 500 v d-c	—	—	SM	MWSCW	--
1	1	1	C-143	R-f oscillator band 1 padder	Capacitor, mica, 1145 mmfd ±1% 500 v d-c	—	—	SM	MWSCW	—
			C-144	Band 1 oscillator fixed minimum frequency	Same as C-102	—	—	—	—	—
1	1	1	C-145	Band 2 oscillator fixed minimum frequency	Capacitor, mica, 10 mmfd ±10% 500 v d-c	-48710	—	SM	MOSCW	—
			C-146	Goniometer amplifier a-v-c bypass	Same as C-118	—	—	—	—	—
			C-147	Sense amplifier a-v-c bypass	Same as C-118	—	—	—	—	—
			C-148	Band 2 primary shunt	Same as C-102	—	—	—	—	—
			C-201	First i-f a-v-c bypass	Same as C-118	—	—	—	—	—
			C-202	First i-f coupling (sharp)	Same as C-109	—	—	—	—	—
			C-203	First i-f coupling (broad)	Same as C-109	—	—	—	—	—
			C-204	First i-f grid tuning	Same as C-126	—	—	—	—	—
			C-205	First i-f amplifier bypass	Same as C-103	—	—	—	—	—
			C-206	First i-f amplifier plate bypass	Same as C-118	—	—	—	—	—
			C-207	First i-f amplifier plate tuning	Same as C-126	—	—	—	—	—
			C-208	Second i-f coupling (broad)	Same as C-109	—	—	—	—	—
			C-209	Second i-f tuning compensator	Same as C-109	—	—	—	—	—
1	1	1	C-210	Second i-f coupling (sharp)	Capacitor, mica, 0.01 mfd ±5% 300 v d-c, temperature cycled	—	—	CD	1W	—
			C-211	First i-f amplifier plate tuning	Same as C-126	—	—	—	—	—
			C-212	Second i-f amplifier blocking	Same as C-108	—	—	—	—	—
			C-213	Second i-f amplifier bypass	Same as C-103	—	—	—	—	—
			C-214	Indicator amplifier blocking	Same as C-108	—	—	—	—	—
			C-215	Indicator amplifier plate tuning	Same as C-126	—	—	—	—	—

			C-216	A-v-c coupling	Same as C-105	—	—	—	—	—
			C-217	Diode filter	Same as C-108	—	—	—	—	—
1	1	1	C-218	First a-f coupling	Capacitor, mica, 0.01 mfd ±10% 300 v d-c	-48848	—	SM	MWBW	—
			C-219	Diode filter	Same as C-108	—	—	—	—	—
			C-220	B-f-o bypass	Same as C-103	—	—	—	—	—
1	1	1	C-221	B-f-o coupling	Capacitor, ceramic, 1.5 to 7 mmfd	-481617	—	—	—	F-38149-1
1	1	1	C-222	B-f-o tuning	Capacitor, mica, 500 mmfd ±5% 500 v d-c	-48691	—	SM	MOSCW	—
1	2	1	C-223	A-v-c bypass	Capacitor, paper, 0.05/0.05 mfd ±15% 600 v d-c	-48315	RE-48AA-129	—	—	—
1	1	1	C-224	B-f-o vernier	Capacitor, variable 17 mmfd +20% −5% (effective) trimmer	-481618	—	FTR	—	F-34481-2-1
			C-225	B-f-o oscillator blocking	Same as C-108	—	—	—	—	—
			C-226	Indicator amplifier bypass	Same as C-103	—	—	—	—	—
			C-227	Indicator amplifier plate tuning	Same as C-126	—	—	—	—	—
			C-228	Cathode-ray tube coupling	Same as C-105	—	—	—	—	—
1	1	1	C-231	Second a-f coupling	Capacitor, mica, 0.002 mfd ±10% 500 v d-c low-loss case	—	—	SM	MWBW	—
2	6	4	C-233	Inverse feedback coupling	Capacitor, paper, 0.25/0.25 mfd ±15% 600 v d-c (Same as C-235, 245, 246)	—	—	CD	DYRT-6022-2	F-37825-1
1	2	2	C-234	Power amplifier coupling	Capacitor, mica, 0.01 mfd ±10% 500 v d-c (Same as C-240)	—	—	SM	XBBW	—
			C-235	A-f amplifier plate decoupling	Same as C-233	—	—	—	—	—
2	5	3	C-236	Power amplifier cathode bypass	Capacitor, paper, 2 mfd ±10% 600 v d-c (Same as C-613, 614)	-48403-B10	RE-48A-129	CD	DYR-6200-5	F-36435-1
1	2	3	C-237	Oscillator phase shift network	Capacitor, mica, 0.001 mfd ±2% 500 v d-c (Same as C-238, 239)	—	—	SM	MWSCW	—
			C-238	Oscillator phase shift network	Same as C-237	—	—	—	—	—
			C-239	Oscillator phase shift network	Same as C-237	—	—	—	—	—
			C-240	Oscillator amplifier coupling	Same as C-234	—	—	—	—	—
1	2	1	C-241	Cathode-ray sweep coupling	Capacitor, paper, 0.1 mfd ±10% 1000 v d-c	-48197	—	—	—	F-36434-1
1	3	2	C-242	Oscillator cathode bypass	Capacitor, paper, 1 mfd ±10% 600 v d-c (Same as C-243)	—	—	—	—	F-36436-1
			C-243	Oscillator plate decoupling	Same as C-242	—	—	—	—	—
			C-244	Cathode-ray tube bypass	Same as C-103	—	—	—	—	—
			C-245	Line filter bypass	Same as C-233	—	—	—	—	—
			C-246	Line filter bypass	Same as C-233	—	—	—	—	—
2	5	3	C-247	Power supply filter	Capacitor, paper, 8 mfd ±10% 600 v d-c (Same as C-248, 249)	—	—	—	—	F-36695-1
			C-248	Power supply filter	Same as C-247	—	—	—	—	—

† See list of Manufacturers (a) Equipment Spares (b) Applicable parts in DAK-2, DAK-3 tender spares group (c) Replaceable Parts

7.1 TABLE III PARTS LIST BY SYMBOL DESIGNATION (Cont'd).–

Quantity (a)	Quantity (b)	Quantity (c)	Symbol Desig.	Function	Description	Navy Type Desig.	Navy Dwg. or Spec. No.	†Mfg.	Mfg. Desig.	Contractor's Dwg. No.
					Capacitors (Cont'd)					
			C-249	Power supply filter	Same as C-247	—	—	—	—	—
1	2	1	C-250	Bias supply filter	Capacitor, paper, 0.5/0.5 mfd ±15% 600 v d-c	-481339	—	—	—	F-38362-1
			C-251	Bias supply filter	Same as C-138	—	—	—	—	—
1	2	1	C-252	H-v supply filter	Capacitor, paper, 4 mfd ±10% 1000 v d-c	-481903	—	—	—	F-36694-1
0	0	1	*C-253	Filter	Spark plates (Same as C-254)	—	—	—	—	—
0	0	1	*C-254	Filter	Same as C-253	—	—	—	—	—
0	0	1	*C-255	Headphone padder	Spark plates	—	—	—	—	—
1	2	1	C-256	Audio padder	Capacitor, mica, 0.006mfd ±10% 500 v d-c	—	—	SM	MWBW	—
			C-302	Simulates distributed capacitance	Same as C-105	—	—	SM	MOBW	—
0	0	1	C-601	Oscillator and amp. tuning	Capacitor, 402 mmfd effective per section 4 section ganged adjustable capacitor per Spec. F-35866-1	—	—	RC	—	F-35867-2
1	2	3	C-602	Oscillator trimmer Band 1	Capacitor, 50 mmfd +20% −5% 0.0195″ air gap ceramic base per Spec. RF-1489-1 (Same as C-603, 604)	-481695	—	FTR	—	F-34356-2-3
			C-603	Oscillator trimmer Band 2	Same as C-602	—	—	—	—	—
			C-604	Oscillator trimmer Band 3	Same as C-602	—	—	—	—	—
1	1	1	C-605	Oscillator padder	Capacitor, 50 mmfd ±5% 500 v d-c silver mica	-48895-D5	RE-48A-148	CD	5RST	—
			C-606	Oscillator grid bypass and amp. coupling	Same as C-105	-48674-B-10	RE-48A-148	CD	5WLS	—
1	3	2	C-607	Oscillator screen and plate bypass	Capacitor, 0.1/0.1 mfd ±15% 600 v d-c (Same as C-609)	-481674-15	RE-48A-128	CD	DYRT-6011-12	—
			C-608	Amplifier coupling	Same as C-105	—	—	—	—	—
			C-609	Amp. screen and plate bypass	Same as C-607	—	—	—	—	—
1	1	1	C-610	Amp. tuning trimmer	Capacitor, 100 mmfd + 20% −5% 0.0245″ air gap ceramic base per Spec. RF-1489-1	-481696	—	FTR	—	F-41846-2
1	3	2	C-611	Line filter shunt	Capacitor, 0.25/0.25 mfd ±15% 600 v d-c (Same as C-612)	-481003-15	RE-48A-128	CD	DYRT-6022-1	—
			C-612	Line filter shunt	Same as C-611	—	—	—	—	—
			C-613	Rectifier filter shunt	Same as C-236	-48403-B10	RE-48A-129	CD	DYR-6200-5	—
			C-614	Rectifier filter shunt	Same as C-236	—	—	—	—	—

					Fuses					
40	80	4	F-201	Receiver	Fuse, 3 amp 250 v (Same as F-202)	—	—	B	3AG	F-37711-1-4
			F-202	Receiver	Same as F-201	—	—	—	—	—
40	80	2	F-601	Power input	Fuse, 1 amp, 250 v (Same as F-602)	—	—	L	3AG	F-37711-1-5
			F-602	Power input	Same as F-601	—	—	—	—	—
					Lamps					
8	16	4	I-101	Pilot	Tubular bulb, miniature bayonet base, 6-8 v, 0.15 amp (Same as I-102, 103, 104)	—	—	GE	47	—
			I-102	Pilot	Same as I-101	—	—	—	—	—
			I-103	Goniometer pilot	Same as I-101	—	—	—	—	—
			I-104	Goniometer pilot	Same as I-101	—	—	—	—	—
			I-105	Master	Lamp, ¼ ratio neon glow	—	—	—	—	—
					Receptacles					
5	10	10	J-101	Sense channel input	Receptacle, 3 contacts, male connector (Same as J-107, 108, 851, 852, 853, 451, 452, 454, 602)	-3102-18-5P	—	AN	AN-3102-18-5P	—
1	2	2	J-103	I-f output	Receptacle, 2 contacts, female connector (Same as J-201)	-3102-12S-3S	—	AN	AN-3102-12S-3S	—
1	2	2	J-104	Power input	Receptacle, 14 contacts, female connector (Same as J-202)	-3102-28-2S	—	AN	AN-3102-28-2S	—
			J-107	Goniometer input a	Same as J-101	—	—	—	—	—
			J-108	Goniometer input b	Same as J-101	—	—	—	—	—
2	3	3	J-110	Goniometer input a	Receptacle, 3 contacts, female connector (Same as J-111, 112)	-5105-18-5S	—	AN	AN-5105-18-5S	—
			J-111	Goniometer input b	Same as J-110	—	—	—	—	—
			J-112	Goniometer rotor	Same as J-110	—	—	—	—	—
			J-201	I-f amplifier input	Same as J-103	—	—	—	—	—
			J-202	Power output	Same as J-104	—	—	—	—	—
1	1	1	J-204	Audio output	Telephone jack	—	—	—	—	F-36116-1
1	2	2	J-205	A-c input	Receptacle, 3 contacts, male connector (Same as J-601)	-3102-20-6P	—	AN	AN-3102-20-6P	—
			J-451	Receiver non-directional channel input	Same as J-101	-3102-18-5P	—	AN	AN-3102-18-5P	—
			J-452	Receiver goniometer input	Same as J-101	—	—	—	—	—
			J-454	Receiver goniometer input	Same as J-101	—	—	—	—	—
			J-601	Power	Same as J-205	-3102-20-6P	—	AN	AN-3102-20-6P	—
			J-602	Output	Same as J-101	-3102-18-5P	—	AN	AN-3102-18-5P	—
1	1	1	J-603	Battery	Receptacle, 3 contacts, male	—	—	CI	M-30	—
			J-851	Stator input	Same as J-101	-3102-18-5P	—	AN	AN-3102-18-5P	—
			J-852		Same as J-101	—	—	—	—	—
			J-853	Rotor output	Same as J-101	—	—	—	—	—

† See list of Manufacturers (a) Equipment Spares (b) Applicable parts in DAK-2, DAK-3 tender spares group (c) Replaceable Parts

Quantity (a)	Quantity (b)	Quantity (c)	Symbol Desig.	Function	Description	Navy Type Desig.	Navy Dwg. or Spec. No.	†Mfg.	Mfg. Desig.	Contractor's Dwg. No.
					Reactors and Inductances					
1	1	2	L-101	Directional input band 1	R-f transformer, secondary inductance 545 mh ±4% at 700 and 305 kc, secondary d-c resistance 5.3 ohms, primary 4 ft #38 SS enamel wire (Same as L-103)	—	—	FTR	—	F-38329-3-3
1	1	2	L-102	Directional input band 2	R-f transformer, secondary inductance 92 mh ±4% at 1600 and 800 kc, secondary d-c resistance 2 ohms, primary 5 ft #38 SS enamel wire (Same as L-104)	—	—	FTR	—	F-38329-3-6
			L-103	Sense input	Same as L-101	—	—	—	—	—
			L-104	Sense input	Same as L-102	—	—	—	—	—
1	1	2	L-105	R-f transformer band 1	R-f transformer, secondary inductance 537 mh ±4% at 700 and 350 kc, primary 350 ft #38 SS enamel wire, primary d-c resistance 209 ohms, secondary 5.1 ohms wound on ceramic tube with powdered iron core (Same as L-107)	—	—	FTR	—	F-38329-3-2
1	1	2	L-106	R-f transformer band 2	R-f transformer, secondary inductance 91.2 mh ±4% at 1600 and 800 kc, secondary d-c resistance 1.9 ohms, primary d-c resistance 110 ohms, primary 180 ft #38 SS enamel wire (Same as L-108)	—	—	FTR	—	F-38329-3-5
			L-107	First detector band 1	Same as L-105	—	—	—	—	—
			L-108	First detector band 2	Same as L-106	—	—	—	—	—
1	1	1	L-109	Oscillator band 1	Coil, total inductance 287 mh ±4% at 1100 and 550 kc, total d-c resistance 4.8 ohms	—	—	FTR	—	F-38329-3-1
1	1	1	L-110	Oscillator band 2	Coil, total inductance 70 mh ±4% at 2000 and 1000 kc, total d-c resistance 2.5 ohms	—	—	FTR	—	F-38329-3-4
1	1	1	L-111	I-f trap	Coil, inductance 0.028 mh, d-c resistance 1.50 ±0.06 ohms	—	—	FTR	—	F-35510-3-6
1	2	3	L-112	Converter plate	Coil, inductance 2.21 mh, d-c resistance 29.5 ±5 ohms (Same as L-201, 202)	—	—	FTR	—	F-35510-3-1
1	1	1	L-113	Goniometer plate amplifier	Coil, inductance 31.3 mh, d-c resistance 193 ±20 ohms	—	—	FTR	—	F-35510-3-7
			L-201	First i-f amplifier grid coil	Same as L-112	—	—	FTR	—	F-35510-3-1
			L-202	First i-f amplifier plate coil	Same as L-112	—	—	—	—	—
1	1	1	L-203	Second i-f amplifier grid coil	Coil, inductance 0.28 mh, d-c resistance 29.0 ±5 ohms	—	—	FTR	—	F-35510-3-2

1	1	1	L-204	I-f output	Coil, secondary inductance 1.99 mh secondary d-c resistance 43 ±5. ohms, primary inductance 1.26 mh, primary d-c resistance 11.4 ±5 ohms	—	—	FTR	—	F-35510-3-3
1	1	1	L-205	B-f-o	Coil, inductance 0.983 mh, d-c resistance 18.4 ±4. ohms	—	—	FTR	—	F-35510-3-5
0	2	4	L-207	R-f line filter	Filter choke, inductance 20 mh ±20%, d-c resistance 0.193 ohms	—	—	FTR	—	RF-1633-1
			L-208	R-f line filter	Same as L-207	—	—	—	—	—
			L-209	R-f line filter	Same as L-207	—	—	—	—	—
			L-210	R-f line filter	Same as L-207	—	—	—	—	—
0	1	2	L-211	Filter choke	Filter choke, rated at 10 henrys +30%-0% at 150 ma d-c, d-c resistance 150 ohms 3260 turns #26 E rated at 0.15 amps (Same as L-212)	-30933	—	UT	—	F-33094-1
			L-212	Filter choke	Same as L-211	—	—	—	—	—
1	1	1	L-213	Indicator channel i-f trans.	Output transformer, d-c resistance 11 ohms ±5%	—	—	FTR	—	F-35510-3-8
1	1	1	—	I-f trap	Assembly, i-f trap coil	—	—	FTR	—	F-40647-2
1	1	1	—	Converter plate	Assembly, converter plate	—	—	FTR	—	F-40648-2
1	1	1	—	Goniometer amplifier plate	Assembly, goniometer amplifier plate	—	—	FTR	—	F-40653-2
1	1	1	—	First i-f amplifier grid	Assembly, i-f amplifier	—	—	FTR	—	F-40651-2
1	1	1	—	First i-f amplifier plate	Assembly, i-f amplifier	—	—	FTR	—	F-40652-2
1	1	1	—	Second i-f amplifier grid	Assembly, i-f amplifier	—	—	FTR	—	F-40646-2
1	1	1	—	I-f output	Assembly, i-f output	—	—	FTR	—	F-40650-2
1	1	1	—	B-f-o	Assembly, b-f-o	—	—	FTR	—	F-40654-2
1	1	1	—	Indicator channel i-f output	Assembly, i-f output	—	—	FTR	—	F-40649-2
1	1	1	L-301	Dummy loop coil	Coil, primary 1275 turns #38 SS enamel wire, secondary 56 turns 10/41 SS litz wire, wound on ceramic core	—	—	—	—	RF-633-1
1	1	1	L-451	Simulates goniometer in sense channel	Coil and shield assembly, primary 565 ohms d-c resistance, secondary 3.27 ohms d-c resistance	—	—	FTR	—	RF-723-2
1	2	1	L-601	Plate and grid windings	Coil, oscillator, band 1	—	—	FTR	—	RF-1411-3-1
1	2	1	L-602	Plate and grid windings	Coil, oscillator, band 2	—	—	FTR	—	RF-1411-3-2
1	2	1	L-603	Plate and grid windings	Coil, oscillator, band 3	—	—	FTR	—	RF-1411-3-3
1	2	1	L-604	Plate and tank windings	Transformer, amplifier, band 1	—	—	FTR	—	RF-1411-3-4
1	2	1	L-605	Plate and output windings	Transformer, amplifier, band 2	—	—	FTR	—	RF-1411-3-5
1	2	1	L-606	Plate and tank windings	Transformer, amplifier, band 3	—	—	FTR	—	RF-1411-3-6
0	2	4	L-607	R-f line filter	Reactor (Same as L-608, 609, 610)	-30966	—	FTR	—	F-36920-1-5
			L-608	R-f line filter	Same as L-607	—	—	—	—	—
			L-609	R-f line filter	Same as L-607	—	—	—	—	—
			L-610	R-f line filter	Same as L-607	—	—	—	—	—
1	2	1	L-611	Power supply	Reactor, 120 henrys 17 m-a per Spec. F-35868-1	-301189	—	TE	—	F-35869-1

† See list of Manufacturers (a) Equipment Spares (b) Applicable parts in DAK-2, DAK-3 tender spares group (c) Replaceable Parts

7.1 TABLE III PARTS LIST BY SYMBOL DESIGNATION (Cont'd).–

Quantity (a)	Quantity (b)	Quantity (c)	Symbol Desig.	Function	Description	Navy Type Desig.	Navy Dwg. or Spec. No.	†Mfg.	Mfg. Desig.	Contractor's Dwg. No.
					Resistors					
3	5	3	R-101	Sense amplifier cathode	Resistor, 1000 ohms ±10%, ½ watt per Spec. F-25192-1 (Same as R-202, 254)	-63360	—	IRC	BT-½	—
2	6	4	R-102	Sense amplifier screen	Resistor, 56,000 ohms ±10%, 1 watt per Spec. F-25192-1 (Same as R-106, 113, 120)	-63288	—	IRC	BT-1	—
1	2	1	R-104	Sense amplifier plate	Resistor, 1000 ohms ±5%, 1 watt per Spec. F-25192-1	-63291	—	IRC	BT-1	—
5	14	9	R-105	R-f amplifier a-v-c	Resistor, 1 megohm ±10%, ½ watt per Spec. F-25192-1 (Same as R-108, 208, 219, 220, 226, 253, 256, 271)	-63360	—	IRC	BT-½	—
			R-106	R-f amplifier screen	Same as R-102	—	—	—	—	—
5	15	10	R-107	R-f amplifier plate	Resistor, 4700 ohms ±10%, ½ watt per Spec. F-25192-1 (Same as R-111, 114, 132, 133, 206, 211, 215, 225, 229)	-63360	—	IRC	BT-½	—
			R-108	Converter a-v-c	Same as R-105	—	—	—	—	—
1	2	1	R-109	Converter screen	Resistor, 22,000 ohms ±10%, 2 watt per Spec. F-25192-1	-63474	—	IRC	BT-2	—
4	11	7	R-110	Injector grid leak	Resistor, 56,000 ohms ±10%, ½ watt per Spec. F-25192-1 (Same as R-119, 137, 138, 201, 243, 252)	-63360	—	IRC	BT-½	—
			R-111	Converter plate	Same as R-107	—	—	—	—	—
1	3	2	R-112	Goniometer amplifier cathode	Resistor, 620 ohms ±5%, ½ watt per Spec. F-25192-1 (Same as R-240)	-63335	—	IRC	BT-½	—
			R-113	Goniometer amplifier screen	Same as R-102	—	—	—	—	—
			R-114	Goniometer amplifier plate	Same as R-107	—	—	—	—	—
2	6	4	R-115	Phase inverter grid leak	Resistor, 0.22 megohms ±10%, ½ watt per Spec. F-25192-1 (Same as R-121, 122, 273)	-63360	—	IRC	BT-½	—
1	3	2	R-116	Phase inverter cathode	Resistor, 160 ohms ±5%, ½ watt per Spec. F-25192-1 (Same as R-118)	-63335	—	IRC	BT-½	—
1	3	1	R-117	Goniometer gain control	Potentiometer, 10,000 ohms ±10% taper E per Spec. F-34326-1	-631432	—	IRC	Type C	F-34327-2-2
			R-118	Phase inverter plate	Same as R-116	—	—	—	—	—
			R-119	Phase inverter screen	Same as R-110	—	—	—	—	—
			R-120	Phase inverter plate filter	Same as R-102	—	—	—	—	—
			R-121	Balanced modulator grid leak	Same as R-115	—	—	—	—	—
			R-122	Balanced modulator grid leak	Same as R-115	—	—	—	—	—

1	3	2	R-123	Balanced modulator cathode	Resistor, 220 ohms ±10%, ½ watt per Spec. F-25192-1 (Same as R-124)	-63360	—	IRC	BT-½	—
			R-124	Balanced modulator cathode	Same as R-123	—	—	—	—	—
1	3	2	R-125	Balanced modulator screen	Resistor, 27,000 ohms ±10%, 1 watt per Spec. F-25192-1 (Same as R-126)	-63288	—	IRC	BT-1	—
			R-126	Balanced modulator screen	Same as R-125	—	—	—	—	—
2	9	3	R-127	Modulator balance	Potentiometer, 50,000 ohms ±10%, taper A, per Spec. F 34326-1 (Same as R-264, 266)	-631343	—	IRC	Type C	F-34327-2-3
1	3	2	R-128	Modulator coupling capacitor leak	Resistor, 0.33 megohms ±10%, ½ watt per Spec. F-25192-1 (Same as R-129)	-63360	—	IRC	BT-½	—
			R-129	Modulator coupling capacitor leak	Same as R-128	—	—	—	—	—
1	3	2	R-130	R-f grids fixed bias	Resistor, 68,000 ohms ±10%, ½ watt per Spec. F-25192-1 (Same as R-135)	-63360	—	IRC	BT-½	—
1	3	1	R-131	R-f gain control	Potentiometer, dual, 1 megohm ±10%, taper A front, and 10,000 ohms ±10%, taper E rear, per Spec. F-34326-1	-631341	—	IRC	Type C	F-34327-2-1
			R-132	Oscillator plate load	Same as R-107	—	—	—	—	—
			R-133	Oscillator plate filter	Same as R-107	—	—	—	—	—
1	2	1	R-134	Oscillator screen	Resistor, 18,000 ohms ±10%, ½ watt per Spec. F-25192-1	-63360	—	IRC	BT-½	—
			R-135	Oscillator screen bleeder	Same as R-130	—	—	—	—	—
4	11	7	R-136	Oscillator grid leak	Resistor, 0.1 megohms ±10%, ½ watt per Spec. F-25192-1 (Same as R-221, 242, 260, 261, 602, 604)	-63360	—	IRC	BT-½	—
			R-137	Goniometer amplifier a-v-c	Same as R-110	—	—	—	—	—
			R-138	Sense amplifier a-v-c	Same as R-110	—	—	—	—	—
1	3	1	R-139	Dial dimmer	Rheostat, 20 ohms 25 watt	—	—	O	#0146	F-41545-1
1	3	2	R-141	Indicator i-f amplifier cathode	Resistor, 2200 ohms ±10%, ½ watt per Spec. F-25192-1 (Same as R-227)	-63360	—	IRC	BT-½	—
1	2	1	R-142	Balance modulator cathode	Resistor, 6800 ohms ±10%, ½ watt per FTR Spec. F-25192-1	—	—	IRC	BT-½	—
			R-201	I-f a-v-c	Same as R-110	—	—	—	—	—
			R-202	First i-f amplifier cathode	Same as R-101	—	—	—	—	—
1	2	1	R-203	Neon light series resistor	Resistor, 30,000 ohms ±10%, ½ watt per Spec. F-25192-1	-63360	—	IRC	BT-½	—
1	3	2	R-204	First i-f amplifier cathode bleeder	Resistor, 51,000 ohms ±10%, 2 watt per Spec. F-25192-1 (Same as R-216)	-63474	—	IRC	BT-2	—
4	11	7	R-205	First i-f amplifier screen	Resistor, 0.56 megohms ±10%, ½ watt Spec. F-25192-1 (Same as R-209, 217, 218, 241, 244, 269)	-63360	—	IRC	BT-½	—
			R-206	First i-f amplifier plate	Same as R-107	—	—	—	—	—

† See list of Manufacturers (a) Equipment Spares (b) Applicable parts in DAK-2, DAK-3 tender spares group (c) Replaceable Parts

7.1 TABLE III PARTS LIST BY SYMBOL DESIGNATION (Cont'd).–

Quantity (a)	(b)	(c)	Symbol Desig.	Function	Description	Navy Type Desig.	Navy Dwg. or Spec. No.	†Mfg.	Mfg. Desig.	Contractor's Dwg. No.
					Resistors (Cont'd)					
2	5	3	R-207	Second i-f amplifier cathode	Resistor, 10,000 ohms ±10%, ½ watt per Spec. F-25192-1 (Same as R-250, 263)	-63360	—	IRC	BT-½	—
			R-208	Second i-f amplifier grid leak	Same as R-105	—	—	—	—	—
			R-209	Second i-f amplifier screen	Same as R-205	—	—	—	—	—
1	3	1	R-210	Audio gain	Potentiometer, 1 megohm ±10%, taper C per Spec. F-34326-1	-631314	—	IRC	Type C	F-34327-2-5
			R-211	Second i-f plate	Same as R-107	—	—	—	—	—
			R-215	A-v-c delay	Same as R-107	—	—	—	—	—
			R-216	A-v-c delay bleeder	Same as R-204	—	—	—	—	—
			R-217	A-v-c diode load	Same as R-205	—	—	—	—	—
			R-218	A-v-c diode load	Same as R-205	—	—	—	—	—
			R-219	A-v-c filter	Same as R-105	—	—	—	—	—
			R-220	A-v-c filter	Same as R-105	—	—	—	—	—
			R-221	B-f-o grid leak	Same as R-136	—	—	—	—	—
1	3	2	R-222	B-f-o screen bleeder	Resistor, 33,000 ohms ±10%, 1 watt per Spec. F-25192-1 (Same as R-223)	-63288	—	IRC	BT-1	—
			R-223	B-f-o screen	Same as R-222	—	—	—	—	—
1	2	1	R-224	B-f-o plate load	Resistor, 3000 ohms ±10%, ½ watt per Spec. F-25192-1	-63360	—	IRC	BT-½	—
			R-225	B-f-o plate filter	Same as R-107	—	—	—	—	—
			R-226	Indicator amplifier grid leak	Same as R-105	—	—	—	—	—
			R-227	Indicator amplifier cathode	Same as R-141	—	—	—	—	—
1	3	2	R-228	Indicator amplifier screen	Resistor, 82,000 ohms ±10%, 1 watt per Spec. F-25192-1 (Same as R-278)	-63288	—	IRC	BT-1	—
			R-229	Indicator amplifier plate	Same as R-107	—	—	—	—	—
1	3	2	R-239	Second a-f grid	Resistor, 0.270 megohms ±5%, ½ watt per Spec. F-25192-1 (Same as R-245)	-63335	—	IRC	BT-½	—
			R-240	Second a-f cathode	Same as R-112	—	—	—	—	—
			R-241	Second a-f screen	Same as R-205	—	—	—	—	—
			R-242	Second a-f plate load	Same as R-221	—	—	—	—	—
			R-243	Second a-f plate filter	Same as R-110	—	—	—	—	—
			R-244	Power amplifier grid leak	Same as R-205	—	—	—	—	—
			R-245	Audio feedback	Same as R-239	—	—	—	—	—
1	2	1	R-246	Power amplifier cathode	Resistor, 560 ohms ±10%, 2 watt per Spec. F-25192-1	-63474	—	IRC	BT-2	—
2	5	3	R-247	Phase shift network	Resistor, 1.0 megohms ±5%, ½ watt per Spec. F-25192-1 (Same as R-248, 249)	-63335	—	IRC	BT-½	—

			R-248	Phase shift network	Same as R-247	—	—	—	—	—
			R-249	Phase shift network	Same as R-247	—	—	—	—	—
			R-250	L-f oscillator cathode	Same as R-207	—	—	—	—	—
1	2	1	R-251	L-f oscillator plate load	Resistor, 0.24 megohms ±10%, ½ watt per Spec. F-25192-1	-63360	—	IRC	BT-½	—
			R-252	L-f oscillator plate filter	Same as R-110	—	—	—	—	—
			R-253	Oscillator amplifier grid leak	Same as R-105	—	—	—	—	—
			R-254	Oscillator amplifier cathode	Same as R-101	—	—	—	—	—
1	3	2	R-255	Oscillator amplifier plate filter	Resistor, 10,000 ohms ±10%, 1 watt per Spec. F-25192-1 (Same as R-605)	-63288	—	IRC	BT-1	—
			R-256	Negative bias dropping	Same as R-105	—	—	—	—	—
1	3	2	R-257	Headphone padder	Resistor, 470 ohms ±5%, 2 watt per Spec. F-25192-1 (Same as R-259)	-63474	—	IRC	BT-2	—
1	2	1	R-258	Headphone padder	Resistor, 130 ohms ±5%, 1 watt per Spec. F-25192-1	-63291	—	IRC	BT-1	—
			R-259	Headphone padder	Same as R-257	—	—	—	—	—
			R-260	Bias supply filter	Same as R-221	—	—	—	—	—
			R-261	Bias supply filter	Same as R-221	—	—	—	—	—
1	3	2	R-262	Bias supply bleeder	Resistor, 0.120 megohm ±10%, 1 watt per Spec. F-25192-1 (Same as R-265)	-63288	—	IRC	BT-1	—
			R-263	Bias supply divider	Same as R-207	—	—	—	—	—
			R-264	Vertical adjustment	Same as R-127	—	—	—	—	—
			R-265	Cathode-ray voltage divider	Same as R-262	—	—	—	—	—
			R-266	Focus control	Same as R-127	—	—	—	—	—
1	2	1	R-267	Cathode-ray voltage divider	Resistor, 27,000 ohms ±10%, ½ watt per Spec. F-25192-1	-63360	—	IRC	BT-½	—
2	9	3	R-268	Brilliance control	Potentiometer, 0.5 megohms ±10%, taper A, per Spec. F-34326-1 (Same as R-270, 272)	-631344	—	IRC	Type C	F-34327-2-4
			R-269	Anode dropping	Same as R-205	—	—	—	—	—
			R-270	Line spread adjustment	Same as R-268	—	—	—	—	—
			R-271	Grid dropping	Same as R-105	—	—	—	—	—
			R-272	Blanking adjustment	Same as R-268	—	—	—	—	—
			R-273	A-v-c filter	Same as R-115	—	—	—	—	—
			R-278	Oscillator amplifier loading	Same as R-228	—	—	—	—	—
3	6	3	*R-457	Loop transmission line terminating	Resistor, 120 ohms ±5%, ½ watt (Same as R-458, 459)	-63335	—	E	504	—
			R-458	Loop transmission line terminating	Same as R-457	—	—	—	—	—
			R-459	Sense antenna transmission terminating	Same as R-457	—	—	—	—	—
1	2	1	R-460	From goniometer center tap to ground	Resistor, 51 ohms ±5%, ½ watt	-63335	—	E	504	—

† See list of Manufacturers (a) Equipment Spares (b) Applicable parts in DAK-2, DAK-3 tender spares group (c) Replaceable Parts ** Matched in sets of three to ± 1%.*

Quantity (a)	Quantity (b)	Quantity (c)	Symbol Desig.	Function	Description	Navy Type Desig.	Navy Dwg. or Spec. No.	†Mfg.	Mfg. Desig.	Contractor's Dwg. No.
					Resistors (Cont'd)					
1	3	2	R-601	Oscillator grid bias	Resistor, 33,000 ohms ±10% ½ watt (Same as R-603)	–63360	RE-13A-340	IRC	BT-½	—
			R-602	Oscillator screen bias	Same as R-136	–63360	RE-13A-340	IRC	BT-½	—
			R-603	Oscillator plate	Same as R-601	—	—	—	—	—
			R-604	Amplifier grid bias	Same as R-136	—	—	—	—	—
			R-605	Amplifier screen bias	Same as R-25[illegible]	–63288	—	—	—	—
1	3	2	R-606	Attenuator series	Resistor, 116 ohms, ±5%, ½ watt except 120 ohm marking (Same as R-607)	–63335	RE-13A-340	IRC	BT-½	—
			R-607	Attenuator series	Same as R-606	—	—	—	—	—
2	6	4	R-608	Attenuator shunt	Resistor, 111 ohms ±5%, ½ watt except 110 ohm marking (Same as R-611, 624, 625)	–63335	RE-13A-340	IRC	BT-½	—
1	3	2	R-609	Attenuator series	Resistor, 1747 ohms ±5%, ½ watt except 1700 ohm marking (Same as R-610)	–63335	RE-13A-340	IRC	BT-½	—
			R-610	—	Same as R-609	—	—	—	—	—
			R-611	Attenuator shunt	Same as R-608	—	—	—	—	—
4	12	8	R-612	Attenuator series	Resistor, 105 ohms ±5%, ½ watt except 100 ohm marking (Same as R-613, 615, 616, 618, 619, 620, 628)	—	RE-13A-340	IRC	BT-½	—
			R-613	Attenuator series	Same as R-612	—	—	—	—	—
2	6	4	R-614	Attenuator shunt	Resistor, 210 ohms ±5%, ½ watt (Same as R-617, 626, 627)	–63335	RE-13A-340	IRC	BT-½	—
			R-615	Attenuator series	Same as R-612	—	—	—	—	—
			R-616	Attenuator series	Same as R-612	—	—	—	—	—
			R-617	Attenuator shunt	Same as R-614	—	—	—	—	—
			R-618	Attenuator series	Same as R-612	—	—	—	—	—
			R-619	Attenuator series	Same as R-612	—	—	—	—	—
			R-620	Attenuator shunt	Same as R-612	—	—	—	—	—
1	2	1	R-621	Output load	Resistor, 140 ohms ±5%, ½ watt	–63335	RE-13A-340	IRC	BT-½	—
1	2	1	R-622	Rectified filter bleeder	Resistor, 0.1 megohm ±10%, 2 watt	—	RE-13A-340	IRC	BT-2	—
1	2	1	R-623	Series plate supply	Resistor, 3300 ohms ±10%, 2 watt	—	RE-13A-340	IRC	BT-2	—
			R-624	Attenuator shunt	Same as R-608	—	—	—	—	—
			R-625	Attenuator shunt	Same as R-608	—	—	—	—	—
			R-626	Attenuator shunt	Same as R-614	—	—	—	—	—
			R-627	Attenuator shunt	Same as R-614	—	—	—	—	—
			R-628	Attenuator shunt	Same as R-612	—	—	—	—	—
2	6	4	R-851	Stator center tap to ground	Resistor, 51 ohms ±10%, ½ watt insulated (Same as R-852)	–63360	—	IRC	BT-½	—
			R-852	Stator center tap to ground	Same as R-851	—	—	—	—	—

					Switches					
1	1	2	S-101	Sense amplifier band switch	Rotary ceramic wafer switch, 2 position—4 circuits per Spec. F-36334-1 (Same as S-104)	—	—	OK	Type H	F-36709-1
1	1	2	S-102	R-f amplifier band switch	Rotary ceramic wafer switch, 2 position—4 circuits per Spec. F-36334-1 (Same as S-103)	—	—	OK	Type H	F-36708-1
			S-103	First detector band switch	Same as S-102	—	—	—	—	—
			S-104	Goniometer amplifier band switch	Same as S-101	—	—	—	—	—
1	1	1	S-105	Oscillator band switch	Rotary ceramic wafer switch, 2 position—3 circuits per Spec. F-36334-1	—	—	OK	Type H	F-36710-1
1	1			Function switch	Rotary switch SPDT, 3 position 2 section per Spec. F-36938-1	—	—	OK	Type H	F-34455-2-3
1	1			I-f selectivity switch	Rotary ceramic wafer switch, 2 position—4 circuits per Spec. F-36968-1	—	—	OK	Type H	F-34455-2-1
1	1	1		Blanking	Switch, SPDT, 3 amp 250 v toggle	-24000	RE-24AA-118A	HH	—	F-38822-1
1	1	1	S-205	Power-standby	Switch, rotopower per Spec. F-34628-1	-24161	—	HH	1570NF	F-34629-1
1	1	1	S-601	Band switch	Switch, 3 position 3 section ceramic per Spec. F-41417-1	—	—	OK	H	F-38517-2
1	1	1	S-602	Output control	Switch, 6 position 4 section ceramic per Spec. F-41417-1	—	—	OK	H	F-38515-2
1	1	1	S-603	Power input	Switch, DPST 3 amp 125 v, ⅝" long bushing	—	RE-24AA-118	HH	2902-GP	—
1	1	1	S-604	Battery "ON-OFF" switch	Switch, DPDT 3 amp, 125 v	—	RE-24AA-118	HH	20905-GL	—
					Transformers					
1	2	1	T-201	Audio output	Output transformer, primary d-c resistance 188 ohms, secondaries d-c resistance 15.3 ohms and 0.22 ohms, per Spec. RF-2498-1	-30934	—	UT	—	F-33093-1
1	2	1	T-202	Interstage	Transformer, primary d-c resistance 1025 ohms, secondary d-c resistance 4500 ohms, center tapped, per Spec. RF-2498-1	-30935	—	UT	66389	F-33096-1
1	2	1	T-203	Power	Transformer, primary: tapped 110 to 120 volts, secondaries: High voltage tapped at 400, 315.0, 100, 315 v. Low voltage 2.5 v, 1.75 amps 6.3 v, 0.6 amps, 6.6 v, 8 amps per Spec. RF-2498-1	-30936	—	UT	66391	F-33039-1
1	2	1	T-601	Power supply	Transformer, primary 115 v 60 cycles, secondary 510 v ct, 25 ma, 6.3 v 2.1 a per Spec. F-35864-1	—	—	TE	—	F-35865-1

† See list of Manufacturers (a) Equipment Spares (b) Applicable parts in DAK-2, DAK-3 tender spares group (c) Replaceable Parts

7.1 TABLE III PARTS LIST BY SYMBOL DESIGNATION (Cont'd).–

Quantity (a)	Quantity (b)	Quantity (c)	Symbol Desig.	Function	Description	Navy Type Desig.	Navy Dwg. or Spec. No.	†Mfg.	Mfg. Desig.	Contractor's Dwg. No.
					Vacuum Tubes					
6	9	3	V-101	Over load protection	Neon lamp (no base) (Same as V-105, V-603)	—	—	GE	T-2	—
10	15	5	V-102	Sense channel amplifier	Type 6AC7 vacuum tube (Same as V-106, 107, 108, 109)	6AC7	RE-13A-600	RCA	6AC7	—
14	21	7	V-103	R-f amplifier	Type 6SK7 vacuum tube (Same as V-201, 202, 205, 209, 601, 602)	6SK7	RE-13A-600	RCA	6SK7	—
2	3	1	V-104	First detector	Type 6SA7 vacuum tube	6SA7	RE-13A-600	RCA	6SA7	—
			V-105	Over load protection	Same as V-101	—	—	—	—	—
			V-106	Goniometer channel amplifier	Same as V-102	—	—	—	—	—
			V-107	Phase inverter	Same as V-102	—	—	—	—	—
			V-108	Balanced modulator	Same as V-102	—	—	—	—	—
			V-109	Balanced modulator	Same as V-102	—	—	—	—	—
4	6	2	V-110	R-f oscillator	Type 6SJ7 vacuum tube (Same as V-204)	6SJ7	RE-13A-600	RCA	6SJ7	—
			V-201	First i-f amplifier	Same as V-103	—	—	—	—	—
			V-202	Second i-f amplifier	Same as V-103	—	—	—	—	—
6	9	3	V-203	Second detector	Type 6H6 vacuum tube (Same as V-214, 217)	6H6	RE-13A-600	RCA	6H6	—
			V-204	B-f-o	Same as V-110	—	—	—	—	—
			V-205	Indicator amplifier	Same as V-103	—	—	—	—	—
			V-209	A-f amplifier	Same as V-103	—	—	—	—	—
2	3	1	V-210	Power output	Type 6K6GT or 6V6GT vacuum tube	6K6GT 6V6GT	RE-13A-600	RCA	6K6GT 6V6GT	—
2	3	1	V-211	Low frequency oscillator	Type 6SQ7 vacuum tube	6SQ7	RE-13A-600	RCA	6SQ7	—
2	3	1	V-212	Oscillator amplifier	Type 6SN7GT vacuum tube	6SN7GT	RE-13A-600	RCA	6SN7GT	—
2	3	1	V-213	Bias supply rectifier	Type 5U4G vacuum tube	5U4G	RE-13A-600	RCA	5U4G	—
			V-214	Bias supply rectifier	Same as V-203	—	—	—	—	—
2	3	1	V-215	High voltage supply rectifier	Type 2X2 vacuum tube	2X2	RE-13A-600	RCA	2X2/879	—
2	3	1	V-216	Bearing indicator	Type 2AP1 cathode-ray tube	2AP1	RE-13A-600	RCA	2AP1	—
			V-217	Bias rectifier	Same as V-203	—	—	—	—	—
			V-601	Oscillator	Same as V-103	6SK7	—	RCA	6SK7	—
			V-602	Amplifier	Same as V-103	—	—	—	—	—
			V-603	Tuning indicator	Same as V-101	—	—	GE	NE-2	—
2	3	1	V-604	Power supply rectifier	Tube, rectifier	6X5GT/G	—	RCA	6X5GT/G	—
					Tube Sockets					
10	10	20	X-102	For V-102	Socket, tube, octal, ceramic	-49367	—	EJ*	—	—
			X-103	For V-103	Same as X-102	—	—	—	—	—
			X-104	For V-104	Same as X-102	—	—	—	—	—
			X-106	For V-106	Same as X-102	—	—	—	—	—

			X-107	For V-107	Same as X-102	—	—	—	—	—
			X-108	For V-108	Same as X-102	—	—	—	—	—
			X-109	For V-109	Same as X-102	—	—	—	—	—
			X-110	For V-110	Same as X-102	—	—	—	—	—
			X-201	For V-201	Same as X-102	—	—	—	—	—
			X-202	For V-202	Same as X-102	—	—	—	—	—
			X-203	For V-203	Same as X-102	—	—	—	—	—
			X-204	For V-204	Same as X-102	—	—	—	—	—
			X-205	For V-205	Same as X-102	—	—	—	—	—
			X-210	For V-210	Same as X-102	—	—	—	—	—
			X-211	For V-211	Same as X-102	—	—	—	—	—
			X-212	For V-212	Same as X-102	—	—	—	—	—
			X-213	For V-213	Same as X-102	—	—	—	—	—
			X-214	For V-214	Same as X-102	—	—	—	—	—
1	1	1	X-215	For V-215	Socket, tube, 4 prong, ceramic	–49362	—	EJ	—	—
1	1	1	X-216	For V-216	Socket, tube, 11 prong, ceramic	–49387	—	AN	49-11-L	RF-1790-1
			X-217	For V-217	Same as X-102	—	—	—	—	—
2	2	3	X-601	For V-601	Same as X-102	—	RE-49AA-313	AN	RSS8	—
			X-602	For V-602	Same as X-102	—	—	—	—	—
			X-604	For V-604	Same as X-102	—	—	—	—	—
					Miscellaneous Mechanical Parts (Receiver)					
0	0	1		PI*	Grid cap	—	—	—	—	F-41035-1
0	0	1		MR*	Goniometer line up coupling	—	—	—	—	F-34241-2-1
1	1	2		MR	Fuse holder	—	—	—	—	F-25330-1
1	2	6		PI	Fuse extractor post	—	—	—	—	F-37118-1
0	1	1		MR	Condenser drive assembly	—	—	—	—	F-34340-14
1	0	1		MR	Spring	—	—	—	—	F-19647-1
1	0	1		MR	Spring	—	—	—	—	F-19646-1
0	9	9		MR	Insulator, Isolantite or equal	—	—	I	395L½	—
0	5	5		MR	Insulator, Isolantite or equal	—	—	I	395L¾	—
0	9	9		MR	Insulator, Isolantite or equal	—	—	I	395L 1″	—
0	0	2		MR	Shoulder, bushing Isolantite or equal	—	—	I	4AL¼	—
0	40	40		B*	Insulator, beads, single	—	—	AN	73	—
0	7	7		MR	Insulator, beads, double	—	—	AN	73-2	—
0	1	1		PI	Pilot light assembly	—	—	—	—	F-28790-1
0	4	4		PI	Pilot light assembly Lock-tite	—	—	—	—	NCP-38-38
0	4	4		PI	Shock mount	—	—	LM	200XP60	—
1	1	1		PI	**Dielectric mica	—	—	—	—	F-36175-1
1	1	1		PI	**Dielectric mica	—	—	—	—	F-35075-1
1	1	1		PI	***Dielectric mica	—	—	—	—	F-36800-1-1
1	1	1		PI	***Dielectric mica	—	—	—	—	F-36800-1-2

† See list of Manufacturers (a) Equipment Spares (b) Applicable parts in DAK-2, DAK-3 tender spares group (c) Replaceable Parts

** EJ Edward Johnson, Wasseka, Minnesota.*
** B signifies item is used in both components.*
** PI signifies item is used in Power Indicator.*
*** Used with C-253, C-254.*
** MR signifies item is used in Modulator Receiver.*
**** Used with C-255.*

Quantity (a)	Quantity (b)	Quantity (c)	Symbol Desig.	Function	Description	Navy Type Desig.	Navy Dwg. or Spec. No.	†Mfg.	Mfg. Desig.	Contractor's Dwg. No.
					Miscellaneous Mechanical Parts (Antenna Assembly)					
0	0	1			Antenna	-66093	—	—	—	RF-1269-14
1	2	1			Gasket	—	—	—	—	F-37704-1
1	2	1			Gasket	—	—	—	—	F-37703-1
1	2	1			Gasket	—	—	—	—	F-37715-1
12	24	12			Gasket	—	—	—	—	F-37761-1
1	2	1			Gasket	—	—	—	—	F-42216-2
1	2	1			Gasket	—	—	—	—	RF-166-1
1	2	1			Gasket	—	—	—	—	RF-1146-2
1	2	1			Gasket	—	—	—	—	RF-1417-2
1	2	1			Gasket	—	—	—	—	RF-1423-1
1	2	1			Gasket	—	—	—	—	RF-167-1
					Miscellaneous Mechanical Parts (Test Oscillator)					
1	1	1			Key, 1/16" hex socket for #6 headless set screw	—	—	AB	—	—
2	6	1			Contact No. 22 gauge phosphor bronze wiper	—	—	—	—	F-40984-1
					Fuse extractor post (Same as used in receiver)	—	—	—	—	F-37118-1
1	2	1			Gasket, black neoprene	—	—	—	—	RF-217-1
0	1	1			Antenna 15 feet, 5 section with bag	-66082	—	—	—	F-40586-1
0	1	1			Cable 10 feet, dual coaxial line	—	—	—	—	RF-1516-2-2
					Miscellaneous Mechanical Parts (Goniometer)					
0	2	2			Goniometer	—	—	—	—	RF-1485-14
					Tools					
1	1	1			Trimming tool	—	—	—	—	F-28621-1
1	1	1			Screwdriver assembly	—	—	—	—	RF-776-1
1	1	1			Allen hex key #10	—	—	AB	—	—
1	1	1			Allen hex key #8	—	—	AB	—	—
2oz	2oz	2oz			Cement, gasket, Permatex	—	—	—	—	—
0	0	1			Power test cable	—	—	FTR	—	RF-1813-3
0	0	1			I-f test cable	—	—	FTR	—	RF-1812-2

† See list of Manufacturers (a) Equipment Spares (b) Applicable parts in DAK-2, DAK-3 tender spares group (c) Replaceable Parts

7.2 TABLE IV PACKING LIST.–

(1) *Case No. 1.–*

1 – CFT-69089 Cross Loop Assembly

(2) *Case No. 2.–*

1 – CFT-46245 Radio Receiver consisting of:

1 – Radio Receiver complete with all metal tubes, but less all glass tubes and interconnecting cables

1 – CFT-47372 Goniometer mounted inside receiver

1 – Paper box containing assembly hardware

(3) *Case No. 3.–*

1 – Metal Box containing:

1 – Set of test and maintenance material

1 – Set of equipment spares

1 – Envelope with spare parts list

1 – Base for CFT-66093 Sense Antenna

1 – CFT-62138 Junction Box

1 – Set of glass tubes for receiver

1 – 6V6GT/G   1 – 5U4G

1 – 2X2   1 – 6SN7GT/G

1 – 2API

6 – Interconnecting cables

1 – 12S40 Reinforcing insulator for CFT-66093 Sense Antenna

(4) *Case No. 4.–*

1 – R-f transmission line (on reel) RF-1759-3-1

(5) *Case No. 5.–*

1 – R-f transmission line (on reel) RF-1759-3-2

(6) *Case No. 6.–*

1 – R-f transmission line (on reel) RF-1759-3-3

(7) *Case No. 7.–*

3 – 8 foot sense antenna rods for CFT-66093 Sense Antenna

7.3 TABLE V INTERCONNECTING CABLES.–

Quantity			Connects		Cable No.	Fed. Tel. Dwg. No.
(a)	(b)	(c)	From	To		
0	1	0	J-451	J-101	#1	RF-1508-3-1
0	1	0	J-452	J-107	#2	RF-1508-3-2
0	1	0	J-454	J-108	#3	RF-1508-3-3
0	1	1	AC line	J-205	#16	RF-476-2
0	1	1	J-201	J-103	#17	F-40132-2
0	1	1	J-104	J-202	#18	F-40133-2

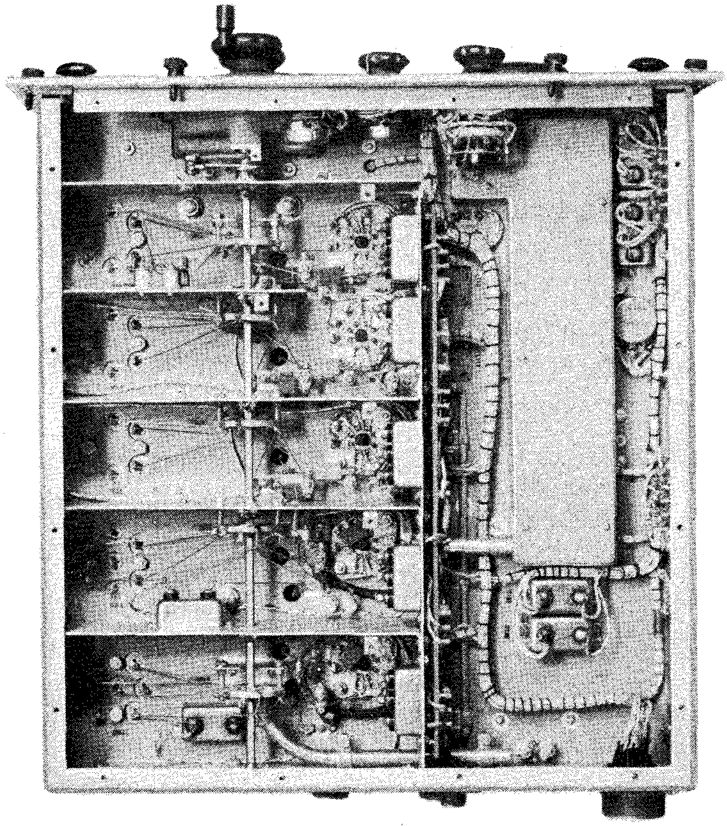


Figure 67. Bottom view modulator section.

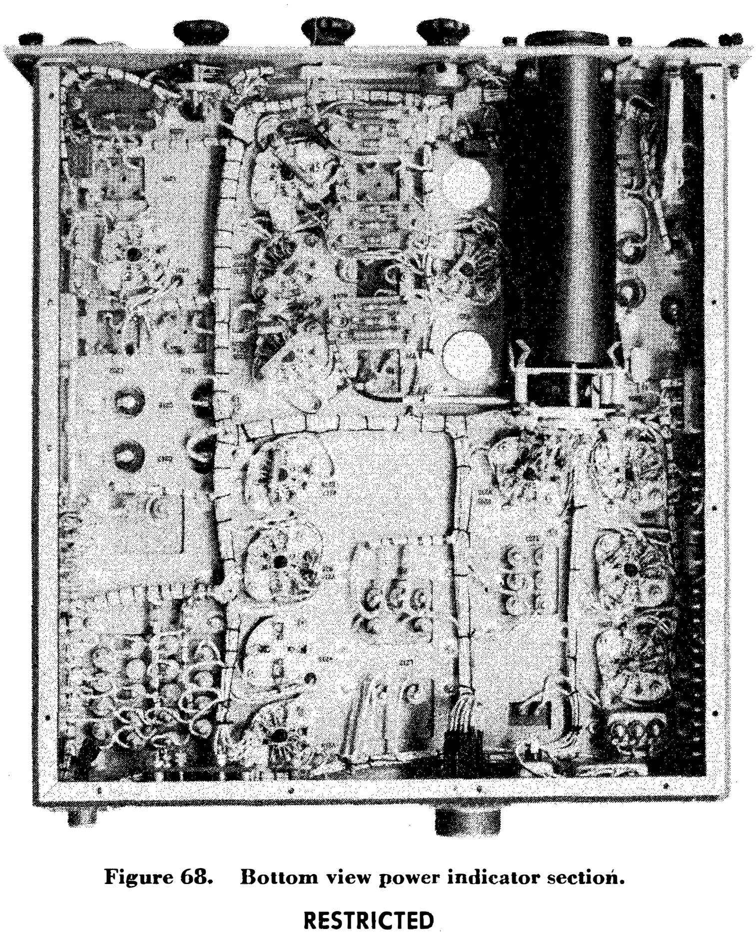


Figure 68. Bottom view power indicator section.

7.4 TABLE VI ELECTRICAL PARTS LIST BY NAVY TYPE DESIGNATION.–

Quantity* of Spares (a)	(b)	(c)	Navy Type Desig.	Symbol Designation
Miscellaneous Class 10				
40	80	4		F-201, 202, 451, 452
40	80	2		F-601, 602
8	16	4		I-101, 102, 103, 104
2	4	1		I-205
Switches Class 24				
1	1	1	-24000	S-204
1	1	1	-24161	S-205
1	1	1		S-107
1	1	2		S-101, 104
1	1	2		S-102, 103
1	1	1		S-105
1	1	1		S-201
1	1	1		S-601
1	1	1		S-602
1	1	1		S-603
1	1	1		S-604
Reactors and Inductances Class 30				
1	1	2		L-101, 103
1	1	2		L-102, 104
1	1	2		L-105, 107
1	1	2		L-106, 108
1	1	1		L-109
1	1	1		L-110
1	1	1		L-111
1	2	3		L-112, 201, 202
1	1	1		L-113
1	1	1		L-203
1	1	1		L-204
1	1	1		L-205
0	2	4		L-207, 208, 209, 210
0	1	2		L-211, 212
1	1	1		L-213
1	1	1		L-301
1	1	1		L-451
1	2	1		L-601
1	2	1		L-602
1	2	1		L-603
1	2	1		L-604
1	2	1		L-605
1	2	1		L-606
0	2	4		L-607, 608, 609, 610
1	2	1		L-611
1	2	1		T-201
1	2	1		T-202
1	2	1		T-203
1	2	1		T-601
Vacuum Tubes Class 38				
10	15	5	6AC7	V-102, 106, 107, 108, 109
14	21	7	6SK7	V-103, 201, 202, 205, 209, 601, 602
2	3	1	6SA7	V-104
4	6	2	6SJ7	V-110, 204
6	9	3	-38566-H	V-203, 214, 217
2	3	1	6K6GT or 6V6GT	V-210
2	3	1	6SQ7	V-211
2	3	1	6SN7GT	V-212
2	3	1	5U4G	V-213
2	3	1	2X2	V-215
2	3	1	2AP1	V-216
2	3	1	6X5GT	V-604
6	9	3		V-101, 105, 603
Capacitors Class 48				
3	9	6	-48139	C-118, 132, 146, 147, 201, 206
1	2	1	-48197	C-241
1	2	1	-48315-B	C-223
2	6	9	-48674	C-105, 112, 117, 131, 216, 228, 302, 606, 608
2	4	6	-48675	C-126, 207, 211, 215, 227, 204
2	5	8	-48690	C-108, 115, 130, 212, 214, 217, 219, 225
1	1	1	-48691	C-222
1	1	1	-48710	C-145
2	6	10	-48711	C-102, 104, 107, 111, 114, 127, 140, 141, 144, 148
1	2	2	-48842	C-106, 113
1	1	1	-48848	C-218
6	17	11	-48849	C-103, 110, 116, 128, 129, 135, 205, 213, 220, 226, 244
1	2	2	-48983	C-133, 134
2	5	3	-481002	C-138, 139, 251
1	2	2	-481037	C-136, 137
1	2	1	-481339	C-250
2	3	5	-481376	C-121, 122, 123, 124, 125
1	1	1	-481617	C-221
1	1	1	-481618	C-224
1	2	1	-481619	C-252
1	2	3	-481695	C-602, 603, 604
1	1	1	-481696	C-610
Capacitors Class 48 (Cont'd)				
1	2	3		C-237, 238, 239
1	1	1		C-143
1	1	1		C-231
1	1	1		C-142
2	4	6		C-109, 120, 202, 209, 203, 208
1	1	1		C-210
1	2	2		C-234, 240
2	6	4		C-233, 235, 245, 246
1	3	2		C-242, 243
1	2	1		C-236
2	5	3		C-247, 248, 249
1	1	1		C-256
1	3	2		C-611, 612
1	3	2		C-613, 614
1	1	1		C-605
1	3	2		C-607, 609
Plugs and Sockets Class 49				
1	1	1	-49362	X-215
10	10	20	-49367	X-102, 103, 104, 106, 107, 108, 109, 110, 201, 202, 203, 204, 205, 209, 210, 211, 212, 213, 214, 217
1	1	1	-49387	X-216
2	2	3		X-601, 602, 604
5	10	10		J-101, 107, 108, 851, 852, 853, 451, 452, 454, 602
1	2	2		J-103, 201
1	2	2		J-104, 202
2	3	3		J-110, 111, 112
1	1	1		J-204
1	1	2		J-205, 601
1	1	1		J-603
Resistors Class 63				
2	6	4	-63288	R-102, 106, 113, 120
1	3	2	-63288	R-125, 126
1	3	2	-63288	R-278, 228
1	3	2	-63288	R-222, 223
1	2	1	-63288	R-255
1	3	2	-63288	R-262, 265
1	2	1	-63291	R-104
1	2	1	-63291	R-258
1	3	2	-63335	R-112, 240

(a) Equipment Spares (b) Applicable parts in DAK-2, DAK-3 tender spares group (c) Replaceable Parts

7.4 TABLE VI ELECTRICAL PARTS LIST BY NAVY TYPE DESIGNATION (Cont'd).–

Quantity* of Spares (a)	(b)	(c)	Navy Type Desig.	Symbol Designation
Resistors Class 63 (Cont'd)				
1	3	2	–63335	R-116, 118
1	3	2	–63335	R-239, 245
2	5	3	–63335	R-247, 248, 249
1	2	1	–63335	R-460
1	3	2	–63335	R-606, 607
2	6	4	–63335	R-608, 611, 624, 625
1	3	2	–63335	R-609, 610
4	12	8	–63335	R-612, 613, 615, 616, 618, 619, 620, 628
2	6	4	–63335	R-614, 617, 626, 627
1	2	1	–63335	R-621
3	5	3	–63360	R-101, 202, 254
5	14	9	–63360	R-105, 108, 208, 219, 220, 226, 253, 256, 271

Quantity* of Spares (a)	(b)	(c)	Navy Type Desig.	Symbol Designation
Resistors Class 63 (Cont'd)				
5	15	10	–63360	R-107, 111, 114, 132, 133, 206, 211, 215, 225, 229
4	11	7	–63360	R-110, 119, 137, 138, 201, 243, 252
1	3	2	–63360	R-123, 124
1	3	2	–63360	R-128, 129
1	3	2	–63360	R-130, 135
2	5	3	–63360	R-207, 250, 263
4	11	7	–63360	R-136, 221, 242, 260, 261, 602, 604
1	3	2	–63360	R-141, 227
1	2	1	–63360	R-142
1	2	1	–63360	R-203
4	11	7	–63360	R-205, 209, 217, 218, 241, 244, 269

Quantity* of Spares (a)	(b)	(c)	Navy Type Desig.	Symbol Designation
Resistors Class 63 (Cont'd)				
1	2	1	–63360	R-224
1	2	1	–63360	R-251
1	2	1	–63360	R-267
2	6	2	–63360	R-851, 852
3	6	3	–63360	R-457, 458, 459
1	3	2	–63360	R-601, 603
1	2	1	–63474	R-109
1	3	2	–63474	R-204, 216
1	2	1	–63474	R-246
1	3	2	–63474	R-257, 259
1	3	1	–631314	R-210
1	3	1	–631341	R-131
2	9	3	–631343	R-127, 264, 266
2	9	3	–631344	R-268, 270, 27
1	3	1	–631432	R-117
1	2	1		R-509
1	3	1		R-139
1	2	1		R-622
1	2	1		R-623

(a) Equipment Spares (b) Applicable parts in DAK-2, DAK-3 tender spares group (c) Replaceable Parts

INDEX OF MANUFACTURERS.–

Manufacturer

AE Advance Electric Company, 53 Park Pl., New York, N. Y.
A Aerovox Corporation, New Bedford, Mass.
AB Allen Bradley Company, 1326 So. 2nd St., Milwaukee, Wis.
AN American Phenolic Corporation, Chicago, 50, Ill.
HH Arrow, Hart & Hegeman, 103 Hawthorne St., Hartford, Conn.
AI Atlantic India Rubber Works, Inc., Chicago, Ill.
AL American Lava Corporation, Chattanooga, 5, Tenn.
BB Burgess Battery Company, Freeport, Ill.
BE Baldor Electric Company, 4351-59 Duncan Ave., St. Louis, Mo.
BR Birnbach Radio Company, New York, N. Y.
BS Bright Star Battery Company, Clifton, N. J.
BI Brunson Instrument Company, Kansas City, Mo.
BY Bryant Electric Company, 1421 State St., Bridgeport, Conn.
B Bussman Manufacturing Company, St. Louis, Mo.
CED Cannon Electric Development Co., 3209 Humboldt St., Los Angeles, California
C Celanese Corporation of America, 290 Ferry St., Newark, N. J.
CE Centralab Incorporated, 900 E. Keefe Ave., Milwaukee, Wisc.
CS Chace-Shawmut, Newburyport, Mass.
CTC Chicago Telephone Supply Company, Elkhart, Ind.
CUT Chicago Transformer Company, 3501 Addison St., Chicago, 18, Ill.
CI Cinch Manufacturing Corporation, 2335 W. Van Buren St., Chicago, Ill.
CL Clarostat Manufacturing Company, 285 N. 6th St., Brooklyn, N. Y.
CC Continental Carbon Incorporated, Cleveland, Ohio
CD Cornell Dubilier Electric Corp., 1000 Hamilton Blvd., S. Plainfield, N. J.
CH Cutler-Hammer, Incorporated, Milwaukee, Wis.
CRD C. R. Daniels Company, Newark, N. J.
D Daven Company, Newark, N. J.
DR Drake Manufacturing Company, 1713 W. Hubbard St., Chicago, 22, Ill.
DL Dial Light Company of America, Inc., 90 West St., New York, 6, N. Y.
EA Eagle Manufacturing Company, Wellsburg, W. Va.
EB H. H. Eby, Incorporated, 18 W. Chelton Ave., Philadelphia, Pa.
EJ Ed Johnson, Wasseka, Minn.
E Erie Resistor Corporation, Erie, Pa.
FTR Federal Telephone and Radio Corporation, 1226 S. Broad St., Newark, 5, N. J.
F A. W. Franklin Manufacturing Company, 175 Varick St., New York, 14, N. Y.
GA Gaynor Electric Company, Bridgeport, Conn.
GE General Electric Company, Schenectady, N. Y.
GR General Radio Company, Cambridge, 39, Mass.
GRA Graybar Electric Company, Inc., 2 Liberty St., Newark, N. J.
HA Hatfield Wire and Cable Company, Hillside, N. J.
HBS H. B. Sherman Mfg. Company, 1934 Sperry St., Battle Creek, Mich.
H Heineman Circuit Breaker Company, 137 Plum St., Trenton, N. J.
HK Holo-Krome Company, Hartford, Conn.
HM Hammarlund Manufacturing Co., Inc., 424-438 W. 33rd St., New York, N. Y.

HH Arrow, Hart & Hegeman, 103 Hawthorne St., Hartford, Conn.
HS Hubbard Spool Company, Chicago, Ill.
HU Hubbell, Incorporated, Bridgeport, Conn.
ICC Industrial Condenser Corporation, 27 Park Pl., New York, N. Y.
IRC International Resistance Company, 403 N. Broad St., Philadelphia, Pa.
J Jensen Radio Manufacturing Company, 6601 S. Laramie Ave., Chicago, Ill.
EJ Ed Johnson, Wasseka, Minn.
HBJ H. B. Jones, 2300 Wabansia Ave., Chicago, Ill.
KN Kenyon Transformer Company, Inc., 840 Barry St., New York, N. Y.
K Kurman Electric Company, 30-30 Northern Blvd., Long Island City, N. Y.
LM Lord Manufacturing Company, Erie, Pa.
LP Lapp Insulator Company, Inc., 4793 Ravenswood Ave., Leroy, N. Y.
L Littelfuse Incorporated, Chicago, 40, Ill.
LE Leach Relay Company, New York, N. Y. (Sales Office)
LR The Lufkin Rule Company, Saginaw, Michigan
MA Magnavox Company, Fort Wayne, Indiana
ML P. R. Mallory Company, Incorporated, Indianapolis, Ind.
ME Maryland Engineering Company, Pikesville, 8, Md.
MMC Meissner Manufacturing Company, Mt. Carmel, Ill.
MM J. Millen Manufacturing Company, Inc., Malden, Mass.
MS Micro Switch Corporation, Freeport, Ill.
M Donald P. Mossman, Inc., 6133 N. Northwest Highway, Chicago, 31, Ill.
N National Company, Incorporated, Malden, Mass.
ND New Departure Bearing Company, Bristol, Conn.
NY New York Transformer Company, 26 Waverly Pl., New York, N. Y.
OK Oak Manufacturing Company, 711 West Lake St., Chicago, Ill.
O Ohmite Manufacturing Company, 4818 Flourney St., Chicago, Ill.
OT Oxford Tartak Radio Corporation, 915 W Van Buren St., Chicago, Ill.
PF Plastic Film Corporation, 37 William St., New York, N. Y.
PN Pyle, National Company, Chicago, Ill.
RC Radio Condenser Corporation, Camden, N J.
RCA Radio Corporation of America, Harrison, N. J.
RE Reading Electric, 200 William St., New York, N. Y.
R Rome Cable Company, Rome, N. Y.
RY Royal Electric Company, Pawtucket, R. I.
SH Shakeproof, Incorporated, 2501 N. Keeler Ave., Chicago, Ill.
HBS H. B. Sherman Manufacturing Company, 1934 Sperry St., Battle Creek, Mich.
SW Simplex Wire and Cable Company, 79 Sidney St., Cambridge, Mass.
SM Solar Manufacturing Corporation, Bayonne, N. J.
STC Spencer Thermostat Company, Attleboro, Mass.
SPG Sperry Gyroscope Company, Inc., Brooklyn, N. Y
SP Sprague Specialties Company, North Adams, Mass.
ST Stackpole Carbon Company, St. Mary's, Pa.
SS F. W. Sickles, 300 Main St., Springfield, Mass.
SY Stanley Company, New Britain, Connecticut
SN Stevens Walden Incorporated, 459 Shrewsbury St., Worcester, Mass.
SI Supreme Instruments Corporation, Greenwood, Miss.
S Sylvania Electric Company, Emporium, Pa.
TE Thordarson Electric Manufacturing Company, Chicago, Ill.
T Trimm Radio Manufacturing Company, 1770 W. Berteau Ave., Chicago, Ill.
UC United Carr Fastener Corp., 31 Ames St., Cambridge, Mass.
UN Standard Oil Company of N. J. (Univis)
UT United Transformer Company, 148 Varick St., New York, N. Y
U Utah Radio Products, 837 Orleans St., Chicago, Ill.
WL Ward-Leonard, Mount Vernon, N. Y.
WG Edwin L. Weigand, Pittsburgh, Pa.
W Westinghouse Electric and Manufacturing Company, Inc., E. Pittsburgh, Pa.
WE Weston Electrical Instrument Company, 618 Frelinghuysen Ave., Newark, 5, N. J.
WB Whitney Blake, New Haven, Conn.
WI J. H. Williams Company, Buffalo, N. Y.
Y North Brothers Manufacturing Company (Yankee), Philadelphia, Pa.
YM Yaxley Manufacturing Div., Indianapolis, Ind.
Z Zierick Manufacturing Company, 385 Girard Ave., New York, N. Y.

7.6 RMA COLOR CODES.-

7.61 Three Dot Condenser Code.–

The two arrangements commonly employed in marking the capacity and tolerance values on receiving type mica capacitors are explained below.

Capacity values are invariably expressed in terms of micromicrofarads, for example 500 $\mu\mu$fd (= 0.0005 μfd). In the RMA color code colors are employed to designate significant digits in mmfd in accordance with the listings below. The codes are read from left to right in the position required for reading of wording molded in the case, or by an arrow.

RMA THREE-DOT COLOR CODE

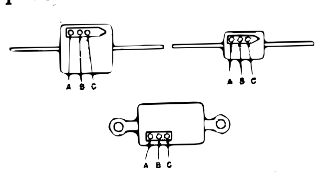
Dot Color	A 1st Digit	B 2nd Digit	C Ciphers
Black	–	0	.0
Brown	1	1	0
Red	2	2	00
Orange	3	3	000
Yellow	4	4	0000
Green	5	5	00000
Blue	6	6	000000
Purple	7	7	0000000
Gray	8	8	00000000
White	9	9	000000000

The three-dot code is generally used to indicate capacity where the working voltage is 500 volts, d-c and the capacity tolerance ±20%. In this code three colored dots are painted across the case of the condenser.

First dot indicates first significant digit;

Second dot indicates second significant digit;

Third dot indicates the number of ciphers to follow, for example:

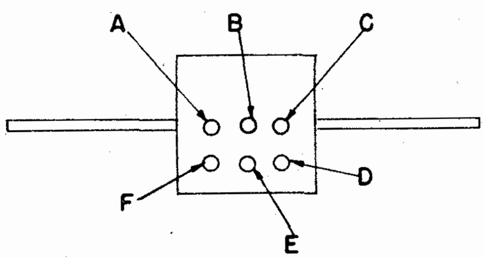


	A	B	C	
The three dots:-	Red	Green	Black	
	2	5	.0	$\mu\mu$fd

7.62 Six Dot Condenser Code.–

More recently the RMA system ot color-coding capacitors has been extended in accordance with the six-dot listing below. On units marked with six dots the upper three dots A, B and C are significant figures and are to be multiplied by the multiplier indicated by the lower right hand dot (D). The remaining dots are tolerance and d-c working voltage rating as indicated in the listing.

Dot Color	Significant Figure (A, B, C)	Decimal Multiplier (D)	Capacity Tolerance (E)	Voltage Rating (F)
Black	0	1	—	—
Brown	1	10	1%	100
Red	2	100	2%	200
Orange	3	1000	3%	300
Yellow	4	10000	4%	400
Green	5	100000	5%	500
Blue	6	1000000	6%	600
Purple	7	10000000	7%	700
Gray	8	100000000	8%	800
White	9	1000000000	9%	900
Gold	–	0.1	5%	1000
Silver	–	0.01	10%	2,000
None	–	—	20%	500



Examples:

A	B	C	D	E	F	DESCRIPTION
Brown	Black	Black	Red	None	Orange	10,000 mmfd (.01 mfd) ±20%; 300 v.
Green	Black	Black	Brown	Silver	Green	5,000 mmfd (.005 mfd) ±10%; 500 v.
Red	Black	Black	Brown	Silver	Green	2,000 mmfd (.002 mfd) ±10%; 500 v.
Red	Black	Black	Black	Silver	None	200 mmfd ±10%; 500 v.
Black	Red	Black	Black	Green	None	20 mmfd ±5%; 500 v.

7.63 Silver Mica Identification.–

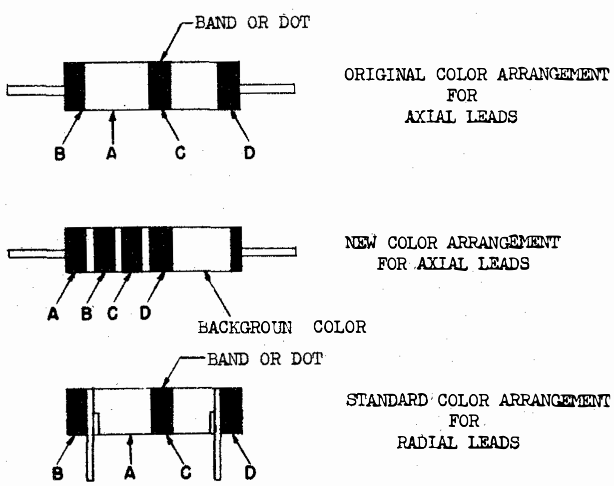
Silver mica capacitors are molded in red low-loss bakelite.

7.64 Three Dot Resistor Code.–

The three dot RMA color code is also commonly used to indicate resistance values. The values are expressed in ohms in accordance with the listings in the three-dot code shown above.

A fourth dot or band (D) is added to indicate the resistance tolerance as follows:

Gold = 5%   Silver = 10%   Omitted = 20%



Examples:

A	B	C	D	Description
Brown	Black	Red	Silver	1,000 ohms ±10%
Red	Green	Orange	Gold	25,000 ohms ±5%
Green	Black	Yellow	None	500,000 ohms ±20%

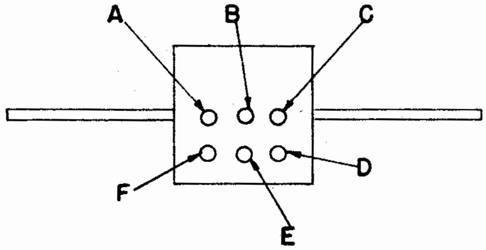
Three and four color RMA resistor marking.

7.7 AMERICAN WAR STANDARDS—

SIX DOT COLOR CODE.–

On units marked with six dots the upper three dots A, B and C are significant figures (A invariably is color coded black) and are to be multiplied by the multiplier indicated by the lower right hand dot (D). The remaining dots are tolerance and characteristics as indicated in the listing.

Color	Significant Figure A B C	Decimal Multiplier D	Tolerance E	Characteristic F
Black	0	1		A
Brown	1	10		
Red	2	100		
Orange	3	1,000		
Yellow	4			
Green	5			
Blue	6			
Violet	7			
Gray	8			
White	9			
Gold	–	0.1	5% (J)	
Silver	–	0.01	10% (K)	
Black	–		20% (M)	



Characteristic	O	Temperature Coefficient Parts/ Million/deg. C.	Maximum Capacitance Drift (F-6)	Verification of Characteristics by Production Test
A	Not specified	Not specified	Not specified	Not required
B	(As specified	Not specified	Not specified	Not required
C	in D-5c (1))	–200 200	0.5%	Not required
	”	–100 to 100	0.2%	Not required
	”	0 to 100	0.05%	Not required
	”	0 to 50	0.025%	Required
	”	0 to –50	0.025%	Required

SECTION VIII SUPPLEMENTARY DATA

8.1 MODEL OAN TEST OSCILLATOR.–

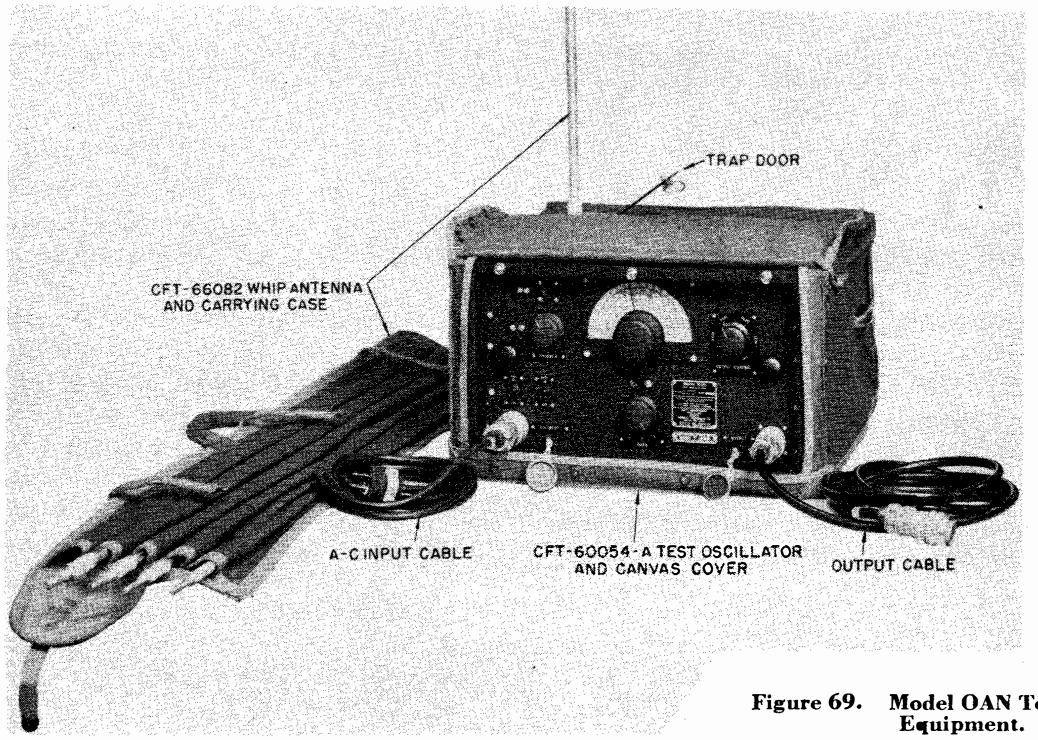


Figure 69. Model OAN Test Oscillator Equipment.

8.11 Function.–

The test oscillator is designed to function as a target transmitter for measuring collector system unbalance, overall direction finder bearing accuracy, and for alignment of the input stages in accordance with instructions given in paragraph 6.6.

8.12 Frequency Range.–

The frequency range is from 200 to 2000 kc divided into three bands each having approximately 5% overlap between bands, as follows:

Band	*Nominal Frequency Range (kc)*
1	200-500
2	500-1000
3	1000-2000

8.13 Power Requirements.–

The equipment operates either from a 115-volt, 60-cycle, single-phase a-c source, or from its internal battery pack. The a-c power required is approximately 21 watts. The 135 volts d-c for the plate and screen supplies are obtained from three 45 volt batteries (B-601, 602, 603). Four 1.5 volt batteries (B-604, 605, 606, 607) furnish the 6 volt d-c heater supply.

8.14 Components.–

Quantity	Navy Type No.	Name of Component	Dimensions (Inches)			Length (Ft.)	Unit Weight (In Lbs.)	FTRC Dwg. No.
			Width	Depth	Height			
1	-60054-A	OAN Test Oscillator	16¼	16¼	9⁵⁄₁₆		52	F-41060-14
1	-66082	Whip Antenna and Case				15	5½	F-40586-1
1		A-c input cable				10	1¼	F-41685-2
1		Output cable				10	1¼	RF-1516-2

8.15 Mechanical Description.–

8.151 CFT-60054-A Test Oscillator.–

The oscillator consists of a welded sheet steel cabinet and a removable chassis and panel assembly, upon which the component parts are mounted. The center portion of the panel is recessed so that no control knobs or receptacles project beyond panel border. The exterior of the cabinet and panel are finished with scratchproof, oven-baked gray wrinkle enamel and all interior surfaces are cadmium plated. Demountable shielded compartments are provided for the a-c line filter components, oscillator, amplifier, and output attentuator circuit.

The power transformer, rectifier tube (V-604) and associated filter are at the rear of the chassis. The batteries are clamped in the rear of the cabinet behind the chassis and are connected by a cable and plug to the receptacle (J-603) on the rear of the chassis. The battery cable is sufficiently long to permit removal of the chassis from the cabinet without disconnecting the batteries.

A spring wiper contact connects with the whip antenna socket on top of the cabinet when the chassis is secured in place. A trap door over the antenna socket acts as a radiation shield when the whip antenna is not used.

8.152 CFT-66082 Antenna.–

The antenna is of the screw-in whip type having an assembled length of 15 feet. It is constructed in five three-foot sections from cold drawn seamless steel tubing, of wall thickness 0.065 inches. The diameters of the sections, starting from the base, are respectively ½, 7⁄16, ⅜, 5⁄16 and ¼ inches. The sections are fitted with brass screw type slotted expansion plugs and sockets, with the slotted plugs located at the base end of each section. The finish consists of cadmium plating over copper. A five pocket water proof canvas carrying bag stencilled with the Navy type designation is furnished with the antenna.

8.16 Electrical Description.–

The Type CFT-60054-A Test Oscillator is of the master-oscillator, tuned-amplifier type with a fixed antenna output, and a variable 140-ohm balanced output, incorporating a constant impedance attenuator (see schematic diagram figure 69 and functional diagram figure 70). This output may be varied from maximum, in steps of 0.04, 0.02, 0.01, 0.005 of maximum, to zero. Zero output corresponds to the off position of the output control in which the attenuator is disconnected from the amplifier circuit. The a-c power supply and internal battery pack have separate on-off controls. The a-c control operates in the power input circuit and the battery control performs the double function of switching the oscillator amplifier circuits from the a-c power supply outputs to the batteries and vice versa. When the battery power is on, the output of the a-c supply is disconnected and cannot deliver

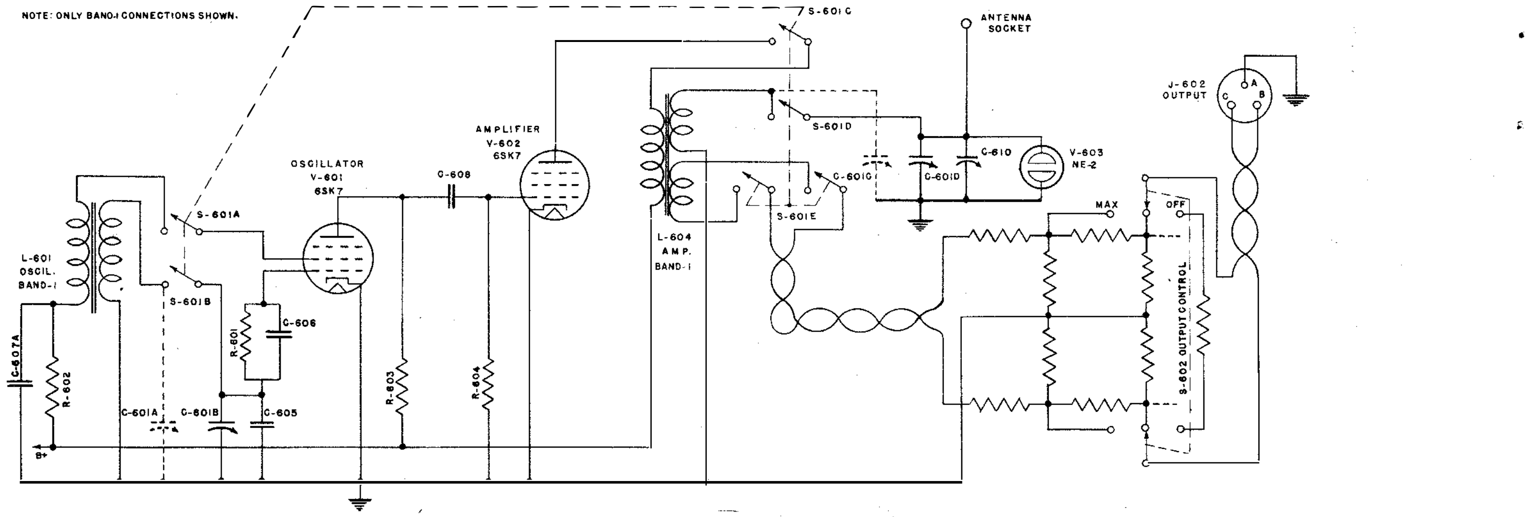


Figure 71. Functional diagram oscillator—amplifier circuits.

power whether energized or not. The battery switch *must* be OFF when a-c operation is desired. Turn ON only that control corresponding to the type of operation required; i-e., a-c or battery.

Type 6SK7 tubes are normally supplied for the oscillator amplifier circuits but for increased battery life type 6SS7 tubes are recommended, since the total heater current required by them is 0.3 amps compared to 0.6 amps for 6SK7's. The unit operates equally well with either type. The tube sockets are labeled for both type tubes.

The battery life in hours is approximately as follows:

	Continuous Service	6 hr/day Intermittent Service
With 6SK7 tubes A batteries–	5	8
B batteries–	35	50

The nominal voltages supplied by either power pack are as follows:

6.3 volts – tube heater circuits
135 volts – plate and screen circuits–

The current drains are as follows:

6.3-volt circuit – 0.9 amps a-c
0.6 amps d-c
135-volt circuit – 0.016 amps d-c

The a-c power supply is provided with a shielded r-f line filter for keeping r-f interference from feeding into the power lines.

8.17 Operation.–

8.171 Panel Controls.–

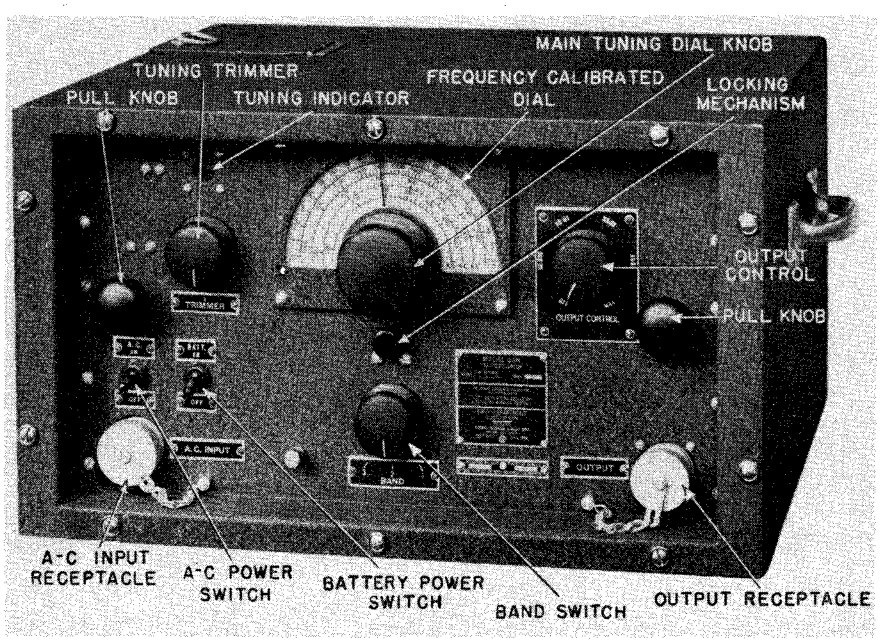


Figure 72. Front view of test oscillator showing panel controls.

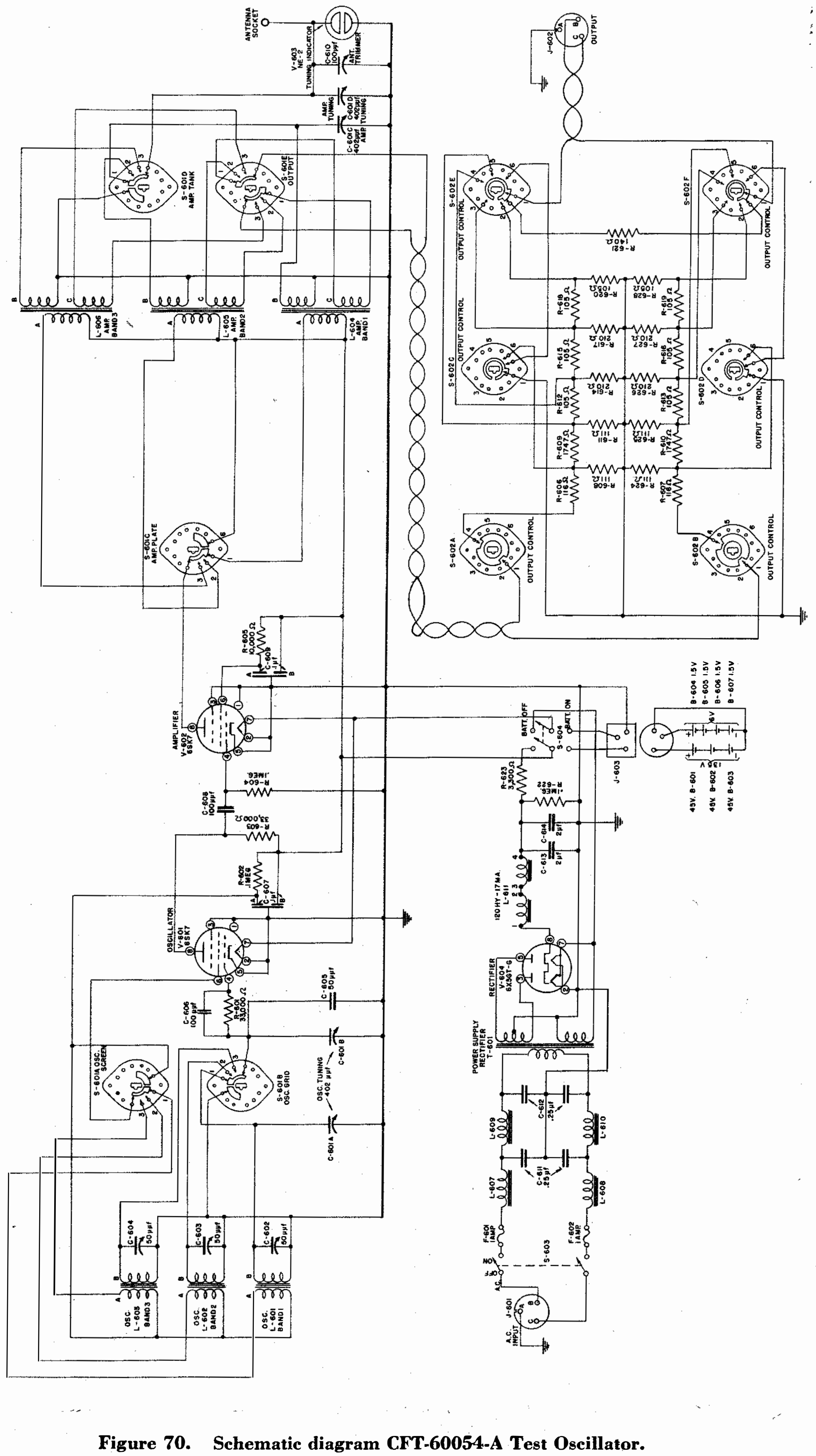


Figure 70. Schematic diagram CFT-60054-A Test Oscillator.

8.172 Operation as a Target Transmitter.–

Assemble the Type CFT-66082 Whip Antenna and insert it in the antenna receptacle of Type CFT-60054-A Test Oscillator. Locate the oscillator on a reasonably level spot so that the antenna is vertical. The unit is now ready to operate.

Turn on the battery switch and allow about one minute for the tubes to warm up. Select the desired frequency by means of the band switch and tuning control and lock the tuning by means of the lock knob below the tuning knob. Now adjust the trimmer for maximum antenna current which is indicated when the neon bulb back of the window in the panel glows at maximum brilliance. Be sure the output control on the panel is OFF. This decouples the attenuator circuit loading from the amplifier and insures maximum antenna output. The unit is now ready for direction finder bearing measurements.

When moving the oscillator for a new bearing measurement turn off the power to conserve battery drain. It will also be found convenient to remove the antenna. After setting up at the new location recheck the trimmer adjustment for maximum antenna current. This does not change the oscillator tuning, which has been locked, but merely compensates for any possible change in effective antenna capacity due to changing ground conditions.

8.18 Tube Complement and Locations.–

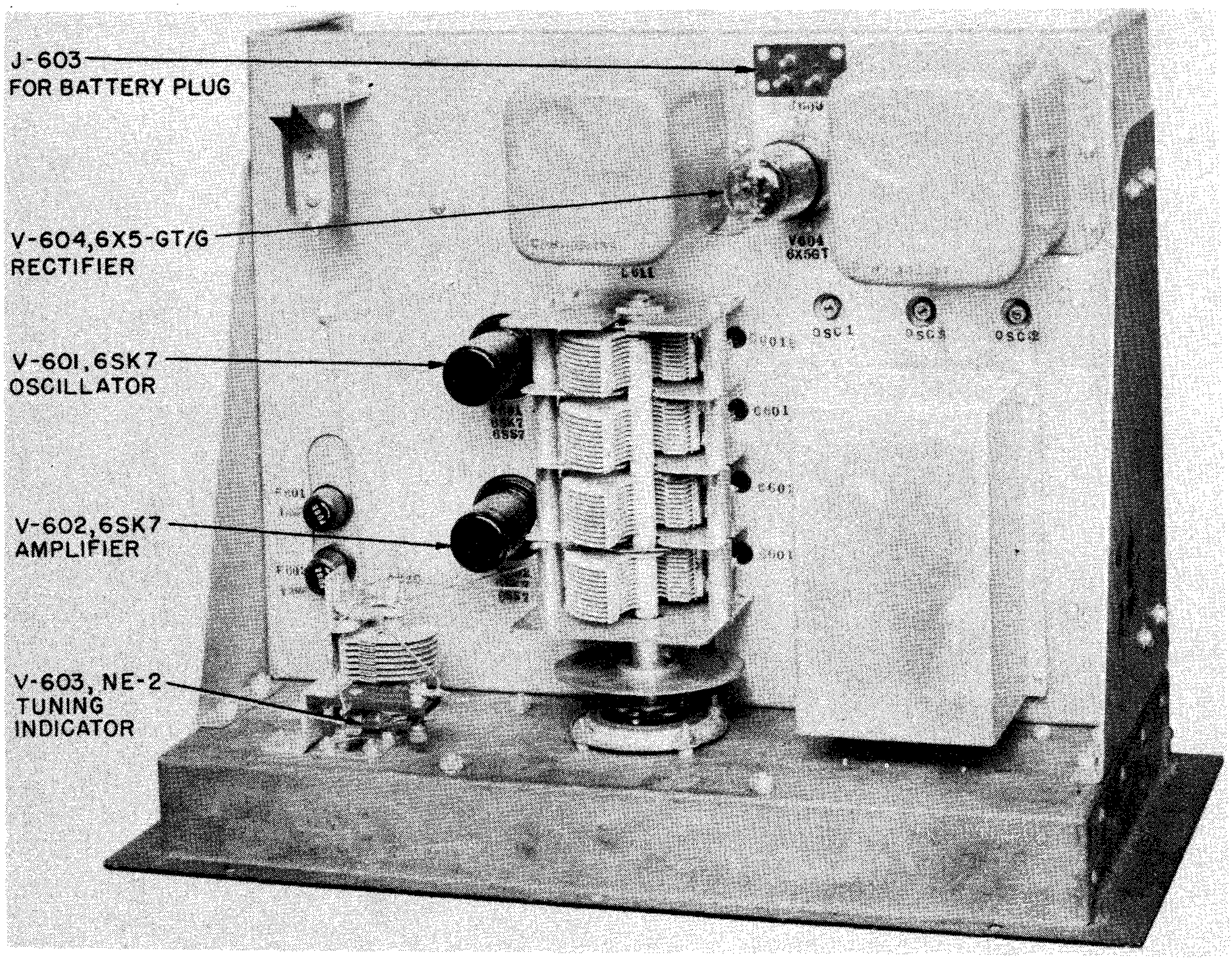


Figure 73. Top view of test oscillator showing tube locations and functions.

8.19 Battery Complement and Hookup.–

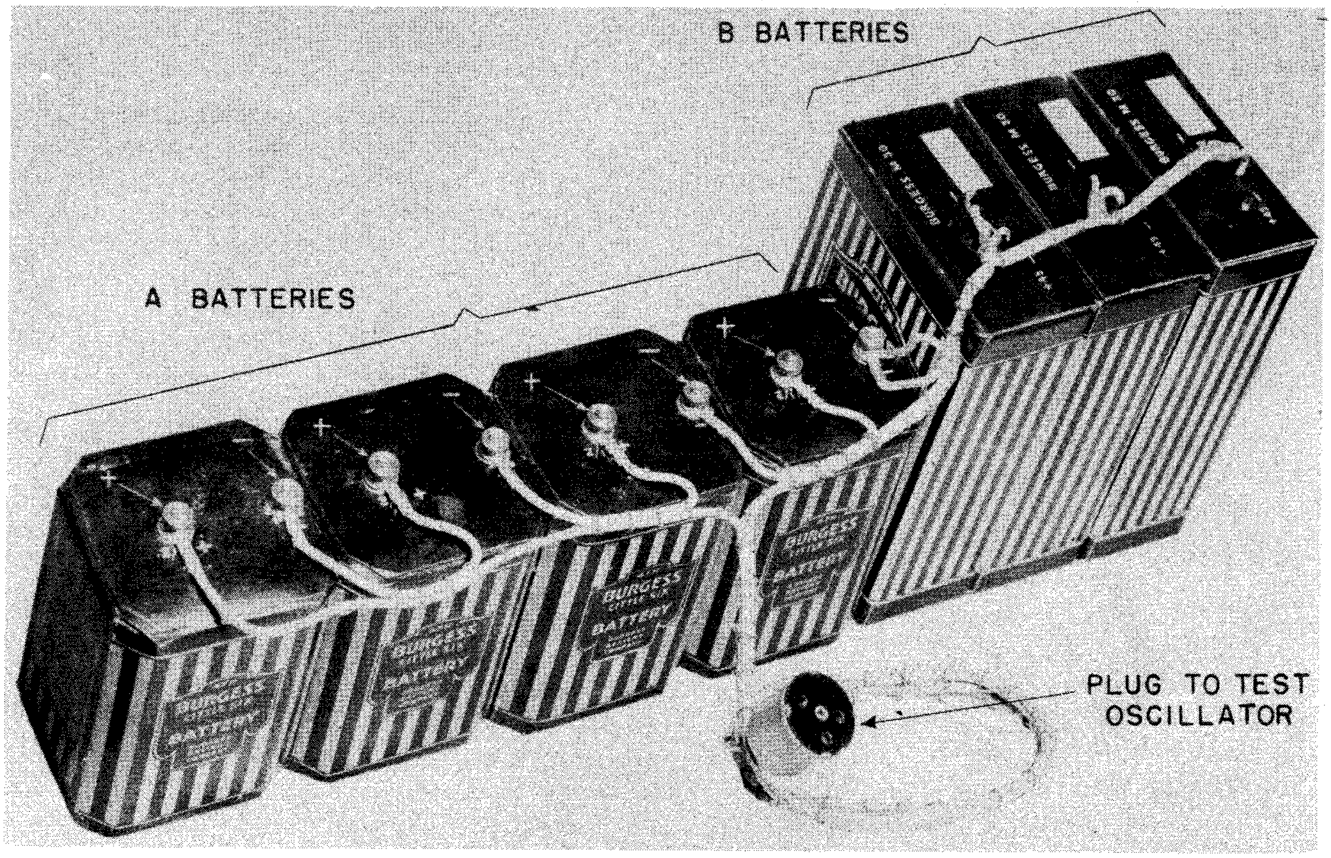


Figure 74. Battery hookup.

8.20 Fuse Locations.–

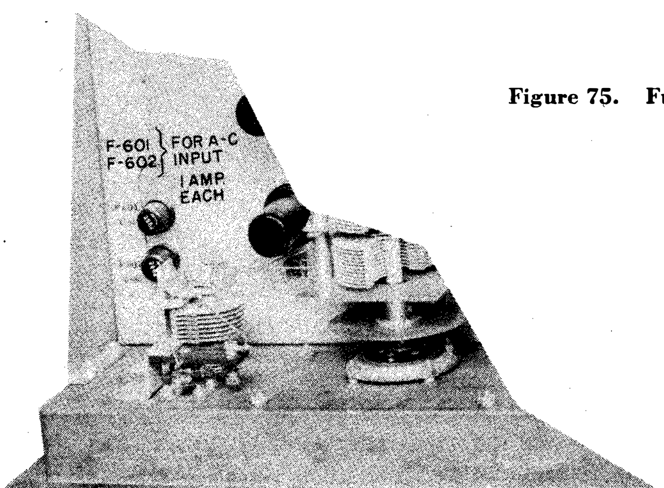


Figure 75. Fuse locations.

8.21 Voltage Measurements.–

The measurements shown in figure 75 were taken from the respective tube pin to chassis with a Navy Type OE Analyzer with the equipment oscillating under normal conditions. Measurements are given for band 2, 700-kc operation with an a-c input voltage of 115 volts, 60 cycles. Battery operation should give similar readings for fresh batteries except that pin number 7 on V-601 and V-602 will read d-c. V-604 is not used for battery operation.

Variation of more than 20 percent from values given indicates trouble in the circuit being measured or indirectly connected circuits.

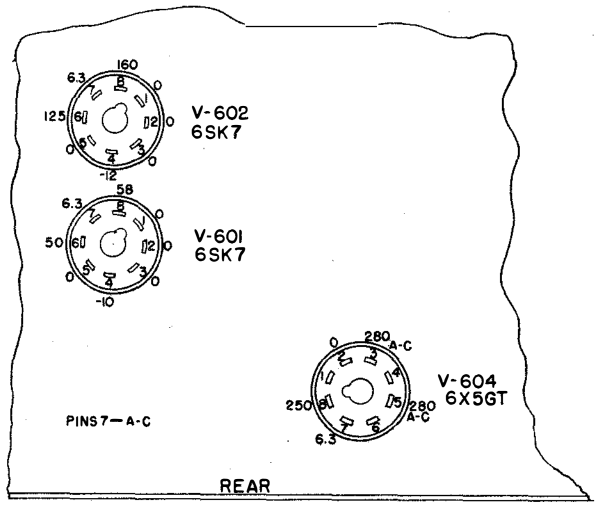


Figure 76. Voltage measurements.

8.22 Resistance Measurements.–

The accompanying chart lists resistance readings measured from the respective pin to chassis. Variation of more than 20 percent from the values shown indicates trouble in the circuit being measured or in directly connected circuits.

(1) *A.C.* and *BATT.* power switches **OFF.**

(2) Tubes in the sockets.

From		To	Conditions	Resistance (In Ohms)
Tube	Pin			
V-601	1	Chassis	—	0
	2	Chassis	—	0
	3	Chassis	—	0
	4	Chassis	—	33,000
	5	Chassis	—	0
	6	Chassis	—	203,000
	7	Chassis	—	0.2
	8	Chassis	—	136,000
V-602	1	Chassis	—	0
	2	Chassis	—	0
	3	Chassis	—	0
	4	Chassis	—	100,000
	5	Chassis	—	0
	6	Chassis	—	103,000
	7	Chassis	—	0.2
	8	Chassis	—	103,000
V-603	1	Chassis	—	—
	2	Chassis	—	0
	3	Chassis	—	550
	4	Chassis	—	—
	5	Chassis	—	550
	6	Chassis	—	—
	7	Chassis	—	0.2
	8	Chassis	—	100,000

8.23 Underchassis Parts Locations.–

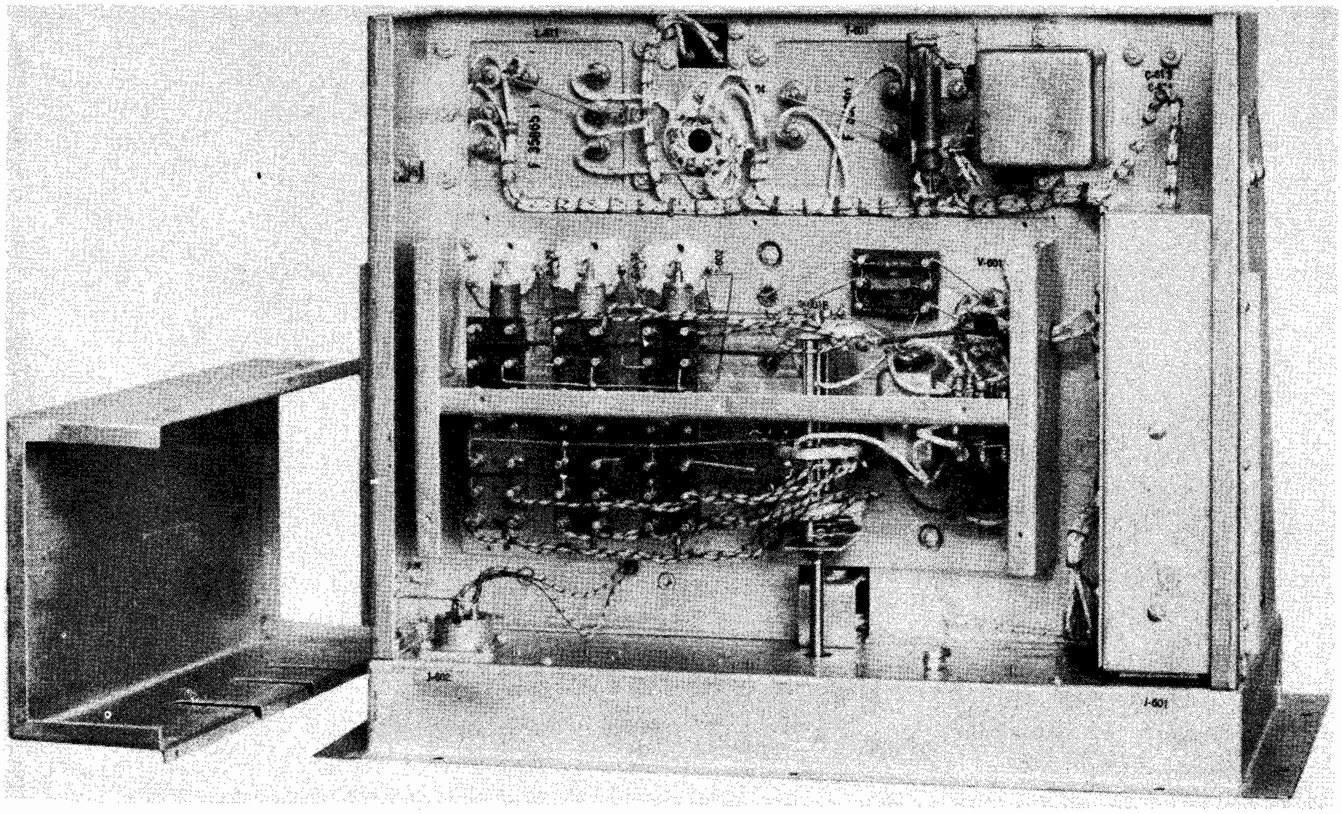


Figure 77. Bottom view of test oscillator.

8.24 Outline Drawing.–

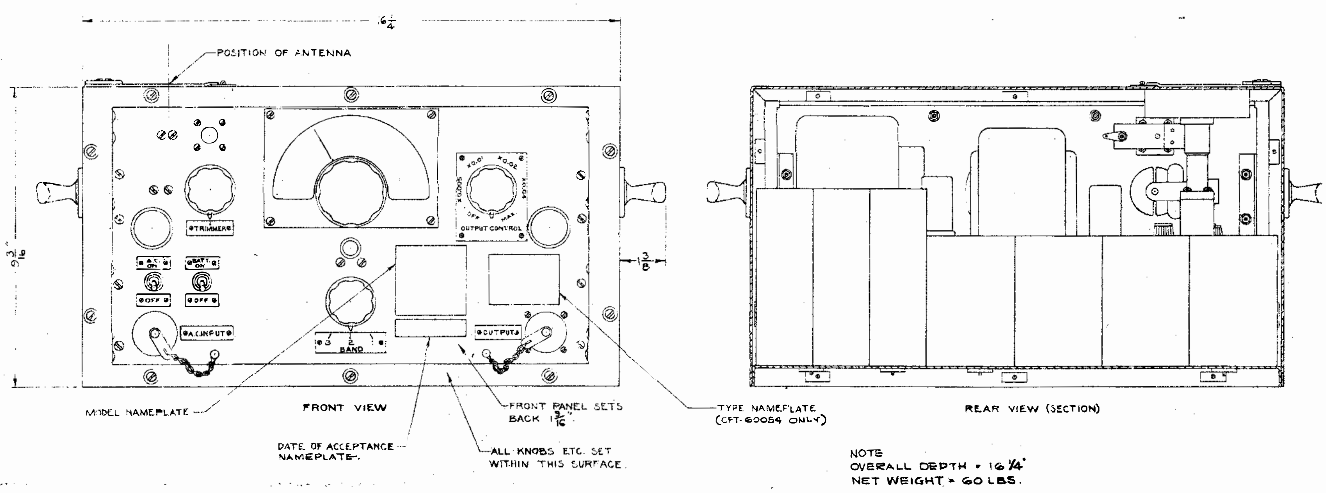


Figure 78. Outline drawing OAN Test Oscillator.