RESTRICTED SERIAL NO. 2304

INSTRUCTION BOOK

FOR

NAVY MODELS DAG-1 & DAG-2

PORTABLE RADIO DIRECTION FINDER EQUIPMENT

Reception	Frequency Range
Phone or CW	1.6 to 18.2 MC.

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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.

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U. S. NAVY DEPARTMENT – BUREAU OF SHIPS
BY
AIRPLANE & MARINE INSTRUMENTS, INC.
CLEARFIELD PENNSYLVANIA

CONTRACT NXss-19775
NXss-31234

DATE: 21 DECEMBER, 1942
14 JUNE, 1943

WARNING

Read this instruction book carefully before setting up or operating Model DAG-1 Portable Radio Direction Finder Equipment.

The Model DAG-1 Equipment is ruggedly built to withstand reasonably severe treatment. However, it should not be unnecessarily severely treated due to the possibility of damage to the miniature tubes used in the equipment, or of upsetting the accuracy of the various controls.

Before connecting the battery cable to the batteries, make sure that all tubes are in their proper sockets. The procedure covered in Sections 3 and 4 should be followed closely to avoid damage to the equipment.

THE ATTENTION OF OFFICERS AND OPERATING PERSONNEL IS DIRECTED TO BUREAU OF SHIPS MANUAL OF ENGINEERING INSTRUCTIONS, CHAPTER 31 (MIMEOGRAPHED FORM) OR SUBSEQUENT REVISIONS THEREOF ON THE SUBJECT OF "RADIO—SAFETY PRECAUTIONS TO BE OBSERVED."

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GUARANTEE

This equipment including all parts and spare parts except vacuum tubes, is guaranteed for a service period of one year. All items found to be defective as to design, material, workmanship or manufacture will be replaced without delay and at no expense to the Government, provided however that any failure of defective material exclusive of normal shelf life deterioration, occurs within a period of two years from the date of delivery of the equipment to, and acceptance by the Government, and provided further that if any part or parts (except vacuum tubes) fail in service or are found defective in ten percent or more, but not less than two of the total number of equipments furnished under the contract, such part or parts either supplied in the equipment or as spares shall be conclusively presumed to be of defective design and subject to one hundred percent replacement of all similar units supplied by suitably redesigned replacements. All defective parts furnished with the equipment will be subject to return to the manufacturer. The guarantee period of two years and the service period of one year shall not include any portion of the time that the equipment fails to give satisfactory performance due to defective items, and the necessity of replacement thereof. Any replacement part covered by the above guarantee is also guaranteed to give one year of satisfactory service.

INSTRUCTIONS TO OPERATING PERSONNEL REGARDING REPORTS OF FAILURE

Report of failure of any part of this equipment, during its service life, shall be made to the Bureau of Ships in accordance with current instructions. The report shall cover all details of the failure and give the date of installation of the equipment. For procedure in reporting failures see Chapter 31 (mimeographed form) of the Manual of Engineering Instructions, or Bureau of Ships Radio and Sound Bulletin No. 7, dated July, 1942, or superseding instructions.

The blank spaces indicated below shall be filled in by operating personnel immediately upon completion of the initial service installation. The date of acceptance by the Navy is stamped on the small plate located on the front cover immediately below the nameplate. On this same plate, operating personnel shall mark the "date placed in service", using suitable methods and care to avoid damaging the equipment.

Contract NXss-19775 - Date of contract: 21 December, 1942

Serial number of equipment .....

Date of acceptance by the Navy .....

Date of delivery to contract destination .....

Date of completion of installation .....

Date placed in service .....

PROCUREMENT OF REPLACEMENT PARTS

In order to expedite the procurement of replacement parts, all requests or requisitions for replacement material should be addressed to the Bureau of Ships, and should include complete descriptive data covering the part desired, in the following form:

1. Name of part desired.
2. Navy Type number (if assigned) (including prefix and suffix as applicable)
3. Model designation (including suffix) of equipment in which used.
4. Navy Type designation (including prefix and suffix where applicable) of a 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.

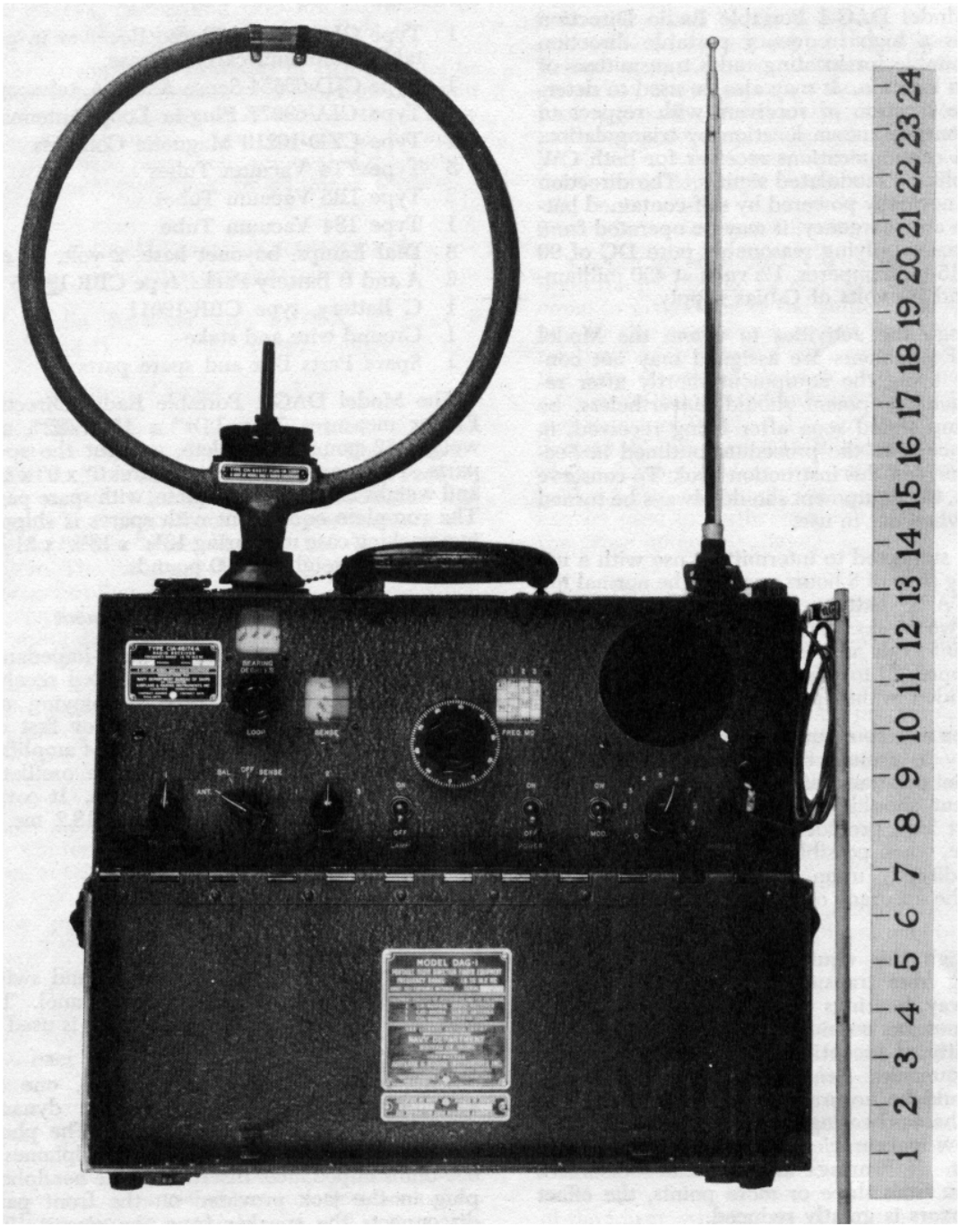


Figure 1, MODEL DAG-1 PORTABLE RADIO DIRECTION FINDER EQUIPMENT, UPPER HALF OF COVER OPEN

1—INTRODUCTION

1-1 Function

The Model DAG-1 Portable Radio Direction Finder is a high frequency portable direction finder suitable for locating radio transmitters of unknown location. It may also be used to determine the location of receivers with respect to transmitters of known location by triangulation, and as a communications receiver for both CW and amplitude modulated signals. The direction finder is normally powered by self-contained batteries. In an emergency, it may be operated from any source supplying reasonably pure DC of 90 volts at 15 milliamperes, 1½ volts at 450 milliamperes, and 7½ volts of C-bias supply.

Although the activities to whom the Model DAG-1 Equipments are assigned may not contemplate using the equipment shortly after receipt, each equipment should, nevertheless, be set up and tested soon after being received, in accordance with the procedure outlined in Sections 3 and 4 of this instruction book. To conserve batteries, the equipment should always be turned "OFF" when not in use.

When subjected to intermittent use with a net operating time of 8 hours per day, the normal life of the "A-B" battery unit should be approximately two weeks. Batteries should be tested at regular intervals and replaced when the voltage has dropped 20 to 30 per cent. Spare batteries are provided in the Spare Parts Box.

For use as a communications receiver, it is not necessary to ground the equipment. However, to obtain accuracy as a direction finder, the equipment should be properly grounded with the short lead provided for that purpose. It is desirable, when possible, to have the equipment resting directly upon the ground, as this improves the accuracy of the direction finder bearings.

Although this equipment may be used for receiving from transmitters many thousands of miles away, bearings taken on such transmitters should not be considered reliable due to the probability of reception over multiple paths at high frequencies. Bearings at the lower frequencies should be accurate at distances up to 200 miles, whereas bearings at the higher frequencies may show inaccuracies at distances greater than 50 miles. If bearings at the greater distances are taken from three or more points, the effect of the errors is greatly reduced.

1-2 Composition of Equipment

The Model DAG-1 Portable Radio Direction Finder Equipment is complete with loop, vertical sense antenna, compass and batteries. The spare parts box includes two spare tubes of each type and the electrical components which may be at some time needed for replacements. One set of spare batteries is also supplied, packed with the spare parts. The equipment consists of the following:

1 Type CIA-46174-A Radio Receiver in portable aluminum carrying case.
1 Type CJD-66054 Sense Antenna, telescopic
1 Type CIA-69077 Plug-in Loop Antenna
1 Type CZD-10210 Magnetic Compass
5 Type 1T4 Vacuum Tubes
2 Type 1R5 Vacuum Tubes
1 Type 1S4 Vacuum Tube
3 Dial Lamps, boyonet base, 2 volt, 60 ma.
2 A and B Battery Packs, type CBR-19045
1 C Battery, type CBR-19011
1 Ground wire and stake
1 Spare Parts Box and spare parts

The Model DAG-1 Portable Radio Direction Finder measures 7" x 14½" x 15-17/32", and weighs 32 pounds complete, without the spare parts. The spare parts box measures 6" x 9" x 12", and weighs 22 pounds complete, with spare parts. The complete equipment with spares is shipped in a packing case measuring 13⅜" x 18¼" x 31$\frac{1}{16}$", with a total weight of 100 pounds.

1-3 General Description of Equipment

This equipment employs a low-impedance, shielded loop, working into a shielded receiver of the superheterodyne type, employing one stage of r-f amplification, a mixer or first detector, an r-f oscillator, two stages of i-f amplification, a second detector, a beat note oscillator, and one stage of audio amplification. It covers the frequency range of 1.6 mc. to 18.2 mc. in three bands as follows:

Band 1 - 1.6 to 3.6 mc.
Band 2 - 3.6 to 8.1 mc.
Band 3 - 8.1 to 18.2 mc.

Band selection is provided by a band switch controlled by a knob on the front panel. The one loop supplied with the equipment is used on all bands.

Two audio outputs are provided, one for a self-contained permanent magnet dynamic speaker, the other for headphones. The phone jack circuit is designed for use of headphones of 600-ohms impedance. Insertion of the headphone plug in the jack provided on the front panel disconnects the speaker from the circuit. The only external connection which may be required at any time is a ground lead connected from the ground post located on the front panel, to the ground stake which should be driven into the ground.

The Direction Finder Receiver Type CIA-46174-A, together with accessories necessary for

operation, is enclosed in a portable case provided with a hinged cover. The receiver is mounted in the case with eight thumb screws through the front panel which is integral with the chassis. The chassis, panels and case are fabricated of aluminum alloy to minimize the weight.

The power supply consists of two type CBR-19045 "A and B" battery packs and one 7½ volt "C" battery. These are housed in the battery compartment in the lower section of the case. Access is made possible by removal of the battery compartment panel held by six thumb screws.

2—DETAILED DESCRIPTION OF EQUIPMENT

2-1 Radio Receiver CIA-46174-A (Figures 6 and 7)

2-1-1 Filament Circuit

The filaments of all vacuum tubes and dial lamps are connected in parallel. The "Power" switch controls the filament supply to all vacuum tubes and the "Lamp" switch controls the dial lamps. The "Beat Note" oscillator filament circuit is further controlled by the "Beat Note" switch. The dial lamps for the loop dial are further controlled by the antenna switch, which selects the proper lamp for the dial window to be used; i.e., with the antenna switch in the "OFF" or the "Balance" position, the "Bearing" window lamp is lighted; with the antenna switch in the "Sense" position, the "Sense" window lamp is lighted; and with the antenna switch in the "Antenna" position, neither loop dial window is lighted. The negative side of all filaments is connected to the ground. A filter is included between the r-f filaments and all other circuits to prevent feed-back from the "Beat Note" oscillator when receiving CW signals.

2-1-2 Plate Circuits

The plates of all vacuum tubes are connected to the 90 volt "B" supply through their respective plate loads. A filter is included between the r-f plate circuits and all other circuits to prevent feed-back from the "Beat Note" oscillator and i-f stages.

2-1-3 "C" Bias Circuits

All tubes secure their bias from the 7½ volt "C" battery. The 1S4 output tube secures its bias by direct connections to the 7½ volt battery, bypassed with condenser C-134A.

The second detector is properly biased through a voltage divider consisting of R-113 and R-115.

The r-f amplifier, the mixer, and the i-f amplifier "C" bias is controlled by the gain control R-101.

2-1-4 R-F Amplifier and Loop Circuit

One stage of r-f amplification is employed on each frequency band. The loop circuit, which is tightly coupled to the secondary of the r-f transformer, is tuned by the secondary tuning being reflected into the primary of the r-f transformer. Balancing of the loop circuit is obtained by grounding the electrical center of the r-f transformer primary, and shielding it electrostatically from the secondary. Permeability trimming is provided in all r-f transformers in addition to the ceramic capacitor trimmers.

2-1-5 Sense Antenna Circuit

A sense antenna circuit is employed to place upon the grid of the r-f amplifier tube, a voltage equal in magnitude to the voltage placed on the grid by the loop circuit, and of the proper phase relationship to secure a cardoid characteristic as the loop is rotated through 360°. This circuit consists of the vertical antenna Type CJD-66054 and Resistors R-121, R-122 and R-123, and condensers C-118, and C-119 employed both as phase shifting devices and antenna voltage adjusters. The telescopic feature of the antenna can be used to further adjust the magnitude of the sense antenna voltage.

2-1-6 Balancer Circuit

The balancer circuit consists of the telescopic vertical Type CJD-66054 antenna and the balancing condenser, the stators of which are connected to the ends of the loop winding. By adjusting this condenser, a voltage of proper magnitude may be applied to the proper side of the loop to counteract the antenna effect of the loop, resulting in a much sharper null being obtained.

2-1-7 Receiving Antenna Circuit

With the antenna switch in the "Ant." position, the vertical antenna is directly connected to one side of the loop, coupling maximum signal into the circuit so that the equipment may be used as a communications receiver.

2-1-8 Converter Circuit

The converter circuit employs two tubes, a 1R5 as a mixer, and a 1T4 as a triode r-f oscillator of the inductively coupled feed-back type, the grid circuit being tuned. Since a separate oscillator tube is used, variable bias may be applied to the 1R5 mixer to vary the gain of the circuit without affecting the oscillator frequency. The oscillator voltage is injected into the No. 1 grid of the mixer, whereas the signal is applied to the No. 3 grid.

2-1-9 Intermediate Frequency Amplifier Circuit

Two stages of i-f amplification at 465 kc. are employed, using two 1T4 r-f pentodes. Permeability tuned i-f transformers are used to couple between stages.

2-1-10 Second Detector

The second detector, a 1R5, is of the grid biased type, grid No. 1 being used as the signal input, or control grid, operating at a fixed negative bias provided from resistors R-113 and R-115 and the "C" battery. Grid No. 3 is used as the injector grid, for coupling the "Beat Note" oscillator into the detector.

2-1-11 Beat Note Oscillator

The "Beat Note" oscillator is of the inductively coupled feed-back type, using a type 1T4 tube connected as a triode. Adjustment of frequency is controlled in the grid circuit by a slug adjustment in the top of the shield can. The "Beat Note" oscillator is coupled to the detector by a small capacitor, injection being made into grid No. 3 of the 1R5 detector.

2-1-12 Audio Power Amplifier

The Audio power amplifier is a type 1S4 pentode, operated "Class A." The output of this tube is connected to a transformer having two secondary windings, one of 4 ohms to match the impedance of the 4 ohm voice coil on the speaker, the other of 600 ohms to match a 600 ohm head-set. A two circuit jack is used which disconnects the speaker when the phone plug is inserted.

2-1-13 Vacuum Tube Characteristics

The average electrical characteristics of the vacuum tubes are shown in Table IX, Page 36.

2-1-14 Ganged Tuning Capacitor

The tuning capacitor in this equipment is a ganged three-section unit with a capacity of 7.5 to 275 micromicrofarads per section. This capacitor is especially designed for the Model DAG-1 Equipment and is constructed of a cadmium plated steel frame and brass capacitor plate assembly securely soldered, and silver plated to prevent corrosion. The capacitor wiper springs are of solid beryllium-silver alloy. The rotary section of the capacitor is driven by a split gear and worm assembly.

2-1-15 R-F and I-F Transformers

Each r-f transformer consists of a universal wound secondary coil on a small diameter Synthane form provided with an adjustable powdered iron core for permeability trimming. The primary is a layer wound coil placed over the low potential end of the secondary. Each loop transformer is provided with a center tapped primary and a grounded electrostatic shield between the primary and secondary. The center tap of the primary is grounded to provide a balanced loop circuit. The r-f transformers are enclosed in very compact shielding cans. The i-f transformers consist of universal wound primaries and secondaries, spaced for approximately critical coupling on forms similar to the r-f coil forms. They are designed for operating at 465 kc, tuned by fixed capacitors, and provided with permeability trimming of both primary and secondary. They are enclosed in shielding cans similar to the r-f transformer shielding cans.

2-1-16 Band Switch

The band switch assembly is constructed with a stainless steel shaft, a nickel index head, and wax treated ceramic switch sections. The rotary contact blades are of solid coin silver whereas the fixed contact fingers are of solid beryllium-silver alloy.

2-2 Sense Antenna, Type CJD-66054 (Figure 9)

The sense antenna is of the telescopic type, the lower sections being constructed of brass tubing and the top section of stainless steel. The lower end is provided with a "Jumbo" plug for mounting in the receiver. The antenna measures approximately 14½ inches in the closed position and approximately 57 inches when extended to its full length. It is heavily nickel plated, with a final finish of chromium, for protection against corrosion.

2-3 Loop Antenna, Type CIA-69077 (Figure 8)

The loop antenna is a low-impedance loop consisting of three turns of insulated wire assembled on spacers and mounted in a shielding housing of aluminum tubing. The stem of the loop assembly is provided with a three terminal plug for mounting in the receiver unit. The loop is also provided with a clip for mounting and securing the compass.

2-4 Magnetic Compass, Type CZD-10210

The magnetic compass is provided for orienting the loop. It consists of a night marching type of compass especially designed for this equipment and provided with sighting vanes. The compass points are marked with luminous paint for night use.

3—ASSEMBLY FOR OPERATION

The Model DAG-1 Radio Direction Finder is packed for shipment with the batteries in place, but disconnected, and with the tubes already mounted in their sockets. The tubes should be checked after unpacking, to make sure that they are all firmly mounted in their sockets. The Receiver Type CIA-46174-A must be removed from the case in order to check the tubes. To remove the receiver, remove the eight thumb screws holding the chassis in the case, slide the chassis out about three inches, and then tilt it downward

as it is moved out, so that the rear of the chassis clears the power plug receptacle which is fastened to the shelf of the case. See that the tubes are in their proper sockets, and replace the receiver in the reverse order in which it was removed. When replacing the receiver, do not attempt to force it into place as the power plugs must be lined up properly in order that the receiver may be inserted.

Remove the cover from the battery compartment, insert the power plugs in the batteries, and connect the bias leads on the "C" battery. Then replace the battery compartment cover.

After unscrewing the chained caps on the top of the case, remove the plug-in loop Type CIA-69077 and the vertical antenna Type CJD-66054 from their spring clips in the case cover, and insert them in the openings in the top of the case. These openings are normally closed when the equipment is not in use.

The compass Type CZD-10210 is a delicate instrument and is kept in a leather carrying case in the phone compartment. Remove the compass from its case, release the dial lock, and install the compass in the clip provided on the loop as follows: With the loop bearing dial reading "0", place the compass in the clip so that the compass index is on the left side of the loop when facing the receiver, or toward the loop end of the case. The compass may be locked in place by a slight clockwise twist.

NOTE: It is very important that the Model DAG-1 Portable Radio Direction Finder be grounded if accurate bearings are to be secured. A ground lead and stake are provided for this purpose.

4—OPERATION

4-1 Use as Direction Finder

To secure a bearing on a transmitter proceed as follows:

With the Model DAG-1 Portable Radio Direction Finder set up for operation, place the case on a level, substantial surface away from all metal objects if possible. (Nearby metal objects may cause large errors in the readings obtained). Turn the loop until the loop dial reads "0" at the "Bearing" window. The loop correction, or reference point in degrees clockwise from magnetic north, may then be read on the compass and recorded.

Turn the antenna switch to "Balance" and turn the balance knob to the mid-position and the "Band" switch to the desired frequency band. Tune in the transmitter to be located. Rotate the loop until a null in the signal is located. Adjust the "Balance" knob until the null is sharpest, rotating the loop back and forth slightly at the same time to locate the exact null. The "Gain" control should be advanced until the noise level is apparent. The "Relative Bearing" may then be read at the "Bearing" window. Another null will be found 180° from the first null. Record these bilateral "Relative Bearings."

The sense antenna is then used to determine to which "Relative Bearing" to add the loop correction in order to secure the "Compass Bearing" which is expressed in degrees from north in a clockwise direction. Throw the antenna switch to the "Sense" position and decrease the "Gain" slightly to prevent overloading. Rotate the loop and observe the reading at the "Sense" window at which the signal is minimum. This reading will be found to agree with the proper "Relative Bearing" to which the loop correction is to be added to secure the "Compass Bearing." Due to the overload characteristics of the direction finder, care must be observed that the gain of the receiver is not advanced too far when the sense antenna is used. The "Gain" should be just high enough to give a good sense indication, and no higher. Due to the deviation of magnetic north from true north, the magnetic correction for the particular locality should be applied to the bearing to obtain the true azimuth.

Since all bearings are to be taken in a clockwise direction in degrees from true north, it is very necessary that the loop correction reading mentioned in the above paragraphs be thoroughly understood. Example: The direction finder is set up and with the "Bearing" window reading 0° it is found that the compass reads 40° from north. A transmitter is tuned in and the bilateral nulls found to be 60° and 240°, reading the "Bearing" window. The "Sense" is then turned on and the maximum is found to be at about 240° on the "Sense" window. The minimum is found to be at about 60°. This means that 60° is the proper bearing null to use. Considering the loop correction factor of 40° the magnetic bearing is 60° + 40° equals 100°. If the local magnetic correction is + 5°, then the true bearing or azimuth is 105°. If the bearing in degrees as read on the "Bearing" window, plus the correction, is more than 360°, subtract 360° from the sum to secure the true bearing.

The loop correction factor may be eliminated if the case is rotated so that "0°" on the loop dial "Bearing" window agrees with "North" on the compass. In many cases this may be done easily if the direction finder is resting on a smooth flat surface.

NOTE: In operation as a direction finder, for "Bearing" the gain control should be operated as high as possible without blocking the second detector, in order to secure sharp nulls.

In some cases, it may be necessary to secure bearings very quickly as in the case of an enemy transmitter which may go off the air very soon.

In this case, more rapid results may be obtained by using the "Sense" first, turning the "Loop" dial to a rough minimum, then switching to "Balance" and turning the "Loop" dial counterclockwise to the first null, which will be approximately 90° from "Sense" minimum. Then if time permits, an accurate bearing may be taken using the "Balance" circuit.

4-2 Use on CW Signals

If CW signals are to be received, it is only necessary to move the "Beat Note" control from the "Mod." position to "CW". The pitch may be changed as desired, by a slight detuning of the receiver.

4-3 Use as Communications Receiver

When the direction finder is used as a communications receiver, the loop must be inserted in the receiver, as its removal will throw the r-f circuit out of alignment. The antenna switch is thrown to "Ant." position with the vertical antenna Type CJD-66054 extended to its full length.

The direction finder will prove valuable when receiving signals which the enemy is attempting to "jam." Its use as a communications receiver under these conditions should be as follows: Throw the antenna switch to "Balance" position and tune in the desired signal. The loop should then be rotated and the "Balance" knob adjusted until the interfering signal is at a minimum. The interfering signal can be reduced by 20 to 40 decibels in this manner, allowing uninterrupted communication with the desired station.

5—MAINTENANCE

5-1 General Maintenance

A periodic check of the equipment will be well repaid by uniform and satisfactory performance. If a tube checker is available, each tube should be tested at regular intervals. This test should include a check for noisy tubes as well as for shorts and inefficiency. The battery voltages should be measured at regular intervals with the receiver turned "On". Batteries which show a decrease of 20% from their rated voltages should be replaced. Should the "C" battery voltage drop below seven volts, it should be replaced immediately as a drop in "C" bias will greatly affect the life of the "B" section of the "A and B" packs. Loop contact plugs and vertical antenna contact plugs should be kept clean at all times, as dirt will result in noisy operation due to poor contacts.

5-2 Location and Remedy of Faults

(a) No Signal

(1) If no click is heard in the earphones or speaker when the power switch is turned "On" and "Off", check the batteries and battery connections.

(2) If the batteries show normal voltage, check all tubes. If no tube checker is available, replace the tubes one at a time with tubes known to be good, starting with the output tube and working toward the loop end of the receiver.

(3) If a click is heard in the phones as the power switch is turned "On" and "Off", with the set turned "On", throw the "Beat Note" switch to "CW". If noise is heard, the trouble is probably ahead of the i-f amplifier. If good tubes do not correct the trouble, remove the chassis from the case and connect the set to the case with the power test cable supplied with the equipment. Check all voltages at the tube sockets against those listed in the table of Resistance and Voltage, Table VII. These voltages should be measured with an electronic d-c voltmeter such as the RCA Voltohmist. Be sure that all tubes are in their proper sockets.

(b) Weak Signals

(1) Examine the loop and the vertical antenna for dirty contact plugs.

(2) Follow the procedure in paragraph (a).

(c) Noisy Reception

(1) First determine whether the noise originates in the direction finder or in some external source. To do this remove the loop and the vertical antenna from their sockets. If the noise persists, it is undoubtedly in the receiver, which should be checked as follows: All tubes should first be checked for shorts or loose elements. If the tubes are satisfactory, examine the receiver for loose connections or dirty wiping contacts. Dirty wiping contacts may be cleaned with carbon tetrachloride applied with a small brush or pipe cleaner. The loop drive mechanism may require cleaning from time to time to prevent any possible trouble from this source.

(d) Low Voltage

(1) If fresh batteries give low voltage when the set is turned on, check the tubes for shorts. If trouble still persists, check point to point resistances as shown in Table VII. If plates or screens show low resistances, examine the capacitor nearest to plate or screen of lowest resistance to ground.

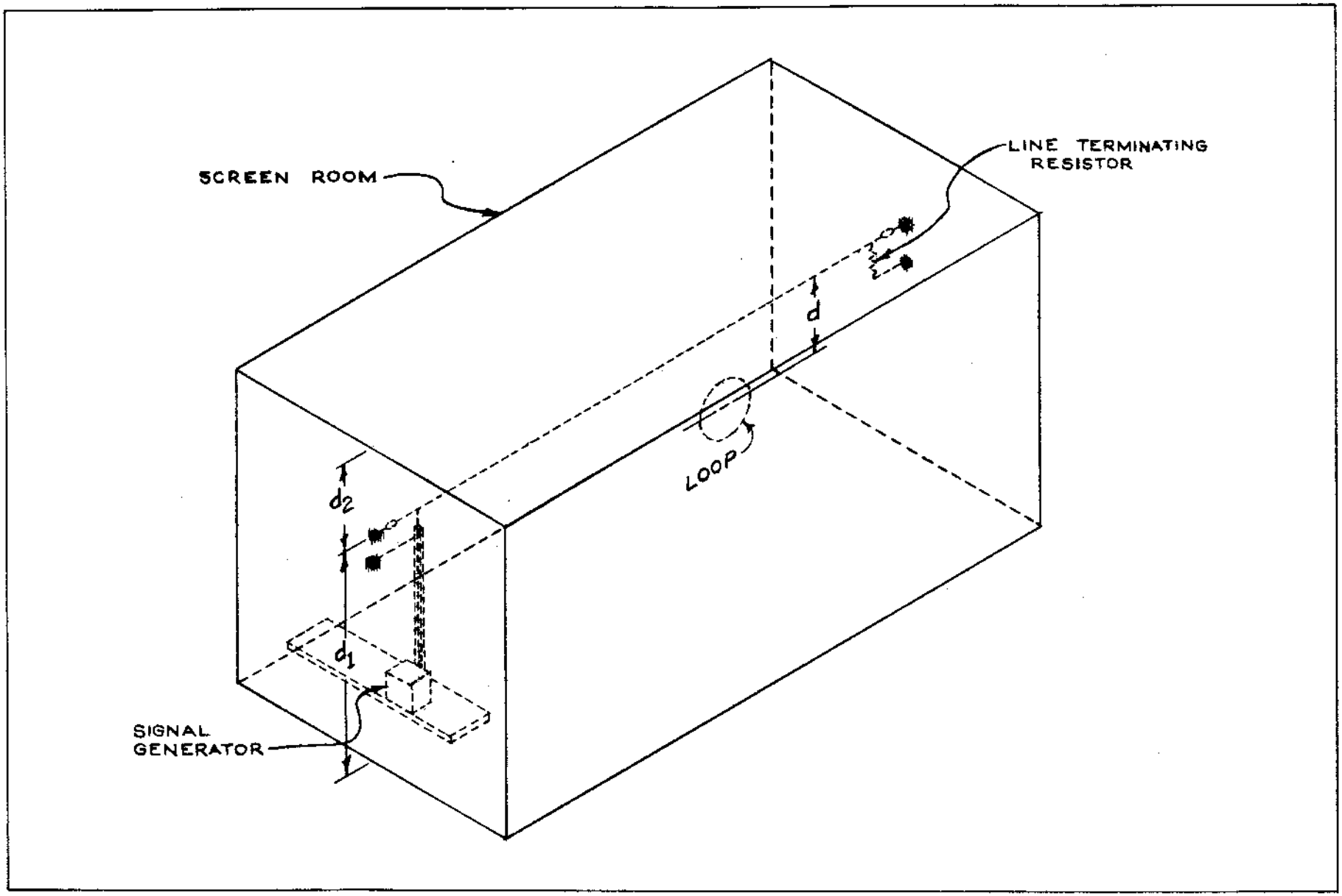


Figure 2, SET-UP FOR R-F TEST AND ALIGNMENT

5-3 Alignment Procedure

Note: Alignment should not be attempted unless the need for it has been definitely proven and proper equipment is at hand.

(a) Apparatus necessary for proper alignment.

(1) An accurately calibrated signal generator with provisions for either modulated or unmodulated signals from 350 kc, to 19.0 mc.

(2) A suitable output meter such as General Radio type 583-A, Weston model 571, or a vacuum tube voltmeter. Note: If the output meter does not have a load resistor of 600 ohms built in, one must be provided so that the output tube is properly loaded.

(3) A screened room with a proper transmission line and terminating impedance.

(b) Construction of Screened Room Transmission Line

Any good screened room may be used provided it is at least seven feet long. The transmission line is constructed preferably of bare No. 14 B&S gauge copper wire suspended by insulators at each end. The distance from this wire to the top of the screened room may be any convenient distance, depending upon the height of the screened room. With respect to the width of the room, it should be erected in the exact center, and the distance to the side walls should be at least as great as the distance to the top. This line is terminated by a non-inductive resistance of the same value as the impedance of the line. Calculation of the impedance of the line is as follows:

$$Z_L = 138 \log_{10} \frac{b}{a}$$

where a equals the radius of the conductor and b equals the distance from the center of the line to the top of the screened room.

The terminating resistance may differ by 10% from the line impedance without seriously affecting the results. After erection of the line, it is well to check for standing waves along the line. This may be done by sliding a vacuum tube voltmeter along the line with one side of the vacuum tube voltmeter grounded. If the maximum voltage does not differ by more than 10% from the minimum voltage, the results will not be seriously affected.

It is then necessary to determine the ratio of the microvolts input to line, to the microvolts per meter field strength at a distance d from the line. The formula as follows refers to Figure 2:

$$\text{Ratio} = \frac{Z_L}{2360\left(\frac{1}{d} + \frac{1}{2d_1 - d} - \frac{1}{2d_2 + d}\right)}$$

where Z_L equals the impedance of the line.

If it is desired to know the number of microvolts induced in the loop, the effective height of the loop must be considered. The effective height of the loop for all frequencies may be read from the graph of Figure 10.

The intermediate frequency amplifier and "Beat Note" oscillator should be aligned as follows: Connect the signal generator through a condenser of between .001μF and .01 μF to the grid of amplifier tube V-105. Turn Band Switch selector to Band 1 and the tuning dial to the low end of the band. Remove the 1T4 r-f oscillator tube V-103 from its socket. Set the signal generator at 465 KC, modulated 30% at 400 cycles. Align for maximum output by adjusting the trimming screws on T-112.

Shift the generator leads to the Grid of the 1T4 1st i-f amplifier tube V-104 and adjust the trimming screws on T-111 for maximum output. Shift the generator connections to the grid of 1R5 mixer tube V-102 and adjust the trimming screws on T-110 for maximum output.

While adjustments are being made, the generator output should be kept as low as possible, consistent with good indication on the output meter.

To adjust the beat frequency oscillator, disconnect the output meter, turn the 400 cycle modulation off, set the "Beat Note" switch to "CW", and adjust the trimming of T-113 until a 1000 cycle note is heard in the speaker. Adjustment should be on the high side: i.e., the "Beat Note" oscillator should be at 466 KC. This may be checked by increasing the frequency of the signal generator slightly. A slight increase in the frequency of the signal generator will lower the beat note if proper adjustment is obtained.

For r-f alignment, proceed as follows: Replace the 1T4 oscillator tube in its socket. Connect the signal generator to the transmission line and modulate the generator 30% at 400 cycles. Set the "Beat Note" switch to the "Mod." position, set the antenna switch to the "Off" position. Turn the "Balance" control to the index line (mid-position). The gain control should be kept in an advanced position, but at a point where the ratio of signal plus noise to noise is six to one or better.

5-4 Sequence of Adjustments

The proper sequence of adjustments at the radio frequencies are shown in table VIII, page 36.

Note: Only very slight adjustments should be required. If very much adjustment is required, it is necessary to adjust at each end of the band several times until the desired sensitivity is obtained.

5-5 Loop Drive Mechanism

If trouble should develop in the loop drive, either due to back-lash in the gears or slipping

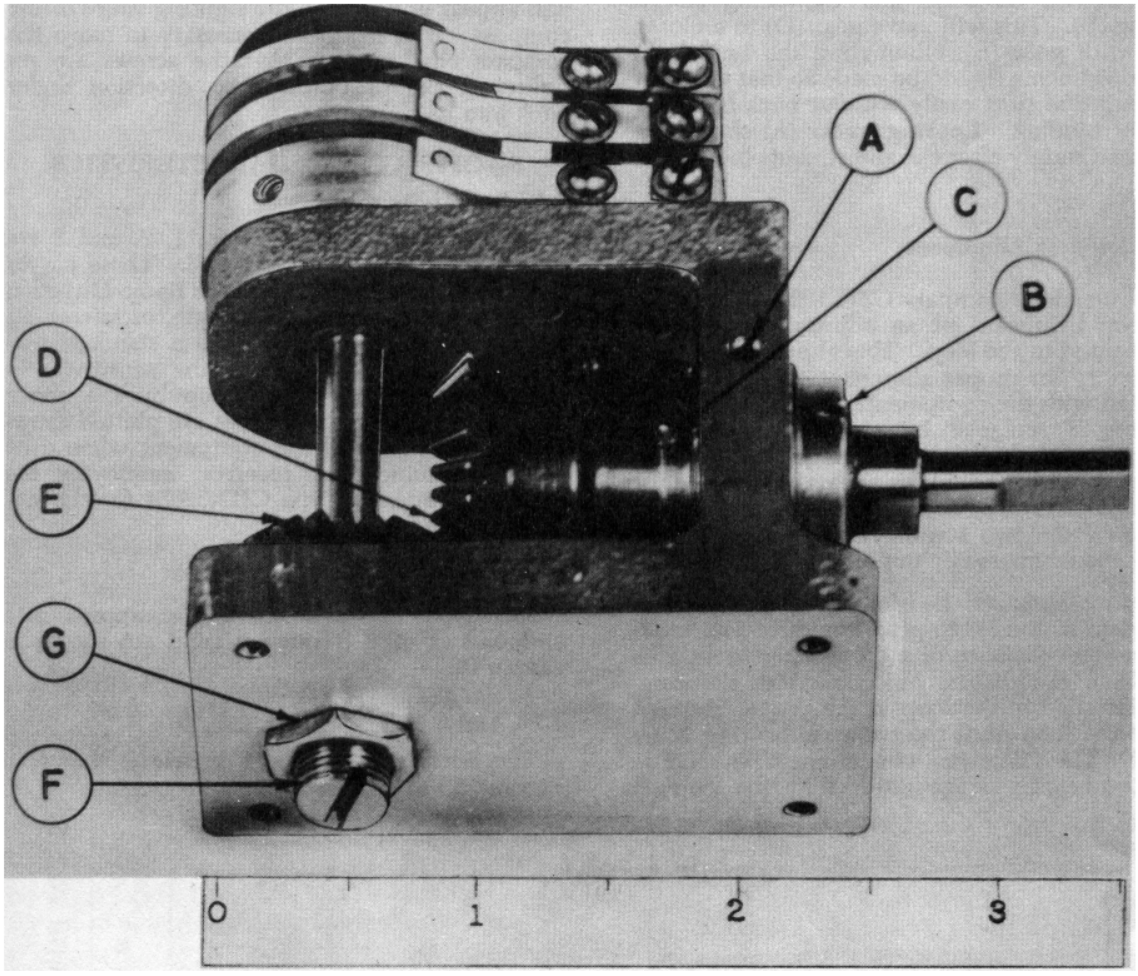


Figure 3, TYPE CIA-46174-A RADIO RECEIVER, LOOP DRIVE ASSEMBLY

of the drive shaft, it may be corrected as follows, referring to Fig. 3. If slipping of the drive shaft occurs, it is due to too loose an adjustment of sleeve bearings (B) and (C). To correct this, loosen the locking screw (A) and take up slightly in a clockwise direction on sleeve bearing (C) until the loop drive knob produces rotation of the loop without slipping or binding, then tighten locking screw (A) again and the trouble should be corrected. If back-lash should develop between gears (D) and (E), this may be corrected by loosening locking screw (A), then loosening sleeve bearing (C) slightly by rotating in a counter clockwise direction and tightening sleeve bearing (B). This will move gear (D) to a closer mesh with gear (E), eliminating the back-lash. The adjustments should be made so that the loop and loop dial turn easily without back-lash and without binding. Locking screw (A) should be tightened snugly after the adjustments have been made.

5-6 Compass Alignment

The magnetic compass CZD-10210 mounts in the loop by means of an adjustable mounting clip secured to the loop. This clip is adjusted at the factory for proper alignment of the compass supplied with the equipment. If at any time the compass is replaced by another compass, or alignment is found to have changed due to tampering or wear, it will be necessary to readjust the alignment. The compass clip may be rotated slightly if the two screws holding the plate on top of the compass clip are loosened.

Two methods may be used to effect alignment. The ideal method is to place the direction finder within sight distance of a transmitter in an area free from re-radiating objects. With the compass installed in the loop in the proper manner, rotate the loop until the compass bearing is secured. The "Balance" circuit must be used so that the bearing is accurate. With the loop set on the bearing, sight through the compass sighting vanes and if necessary, adjust the clip until the sighting vanes are in line with the transmitter.

The second method which may be used is as follows: Set the direction finder assembled for operation on a long table. A straight edge, six to ten feet long, is placed against the side of the loop and a narrow marker placed at the other end, $\frac{1}{16}$" from the edge of the straight edge. With the straight edge removed, rotate the loop 90° clockwise, using the loop dial for this purpose. With the proper adjustment, the marker will appear in line with the sighting vanes of the compass. If it has been necessary to move the compass clip, be sure that the screws are retightened before putting the direction finder back into use.

6—OPERATING CHARACTERISTICS

6-1 Sensitivity

Sensitivity curves for Bands, 1, 2, and 3 are shown in Figures 11, 12, and 13. These curves show the Model DAG-1 Portable Radio Direction Finder sensitivity in field strength, or microvolts per meter, required to produce a standard output. The curves also show the sensitivity in microvolts induced in the loop by the above field strength. Further curves are plotted showing the sensitivity of the equipment when used as a communications receiver, employing the telescopic antenna Type CJD-66054 for the signal input circuit.

6-2 Selectivity

Selectivity curves taken at the approximate midpoint of each frequency band are shown in Figure 14.

6-3 Audio Fidelity

The fidelity of the audio system is shown in Figure 15.

TABLE I
LIST OF MAJOR UNITS
FOR MODEL DAG-1 PORTABLE RADIO DIRECTION FINDER EQUIPMENT

QUANTITY	SYMBOL GROUP	NAVY TYPE DESIGNATION	NAME OF MAJOR UNIT	ASSEMBLY DRAWING NUMBER
1	101-199	CIA-46174-A	Radio Receiver	D5498.1A
1		CIA-69077	Plug-in Loop	D5531.1
1		CJD-66054	Sense Antenna	D5531.1
1		CZD-10210	Compass	D5608.1

TABLE II
PARTS LIST BY SYMBOL DESIGNATION
FOR MODEL DAG-1 PORTABLE RADIO DIRECTION FINDER EQUIPMENT

SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY SPEC. OR DWG. NO.	MFR.	MFR. DESIGNATION	SPECIAL TOLERANCE RATING OR MOD.	CONTRACTOR'S DRAWING & PART NUMBER
C-101	Band 1 R-F Trimmer	Ceramicon 5-20 $\mu\mu$f Temp Coef. -300×10^{-6} $\mu\mu f/\mu\mu f/C^{\circ}$			12	N300TS2A		D5586-44
C-102	Band 2 R-F Trimmer	Same as C-101						
C-103	Band 3 R-F Trimmer	Same as C-101						
C-104	Band 1 Mixer Trimmer	Same as C-101						
C-105	Band 2 Mixer Trimmer	Same as C-101						
C-106	Band 3 Mixer Trimmer	Same as C-101						
C-107	Band 1 Osc. Trimmer	Same as C-101						
C-108	Band 2 Osc. Trimmer	Same as C-101						
C-109	Band 3 Osc. Trimmer	Same as C-101						
C-110	R-F, Mixer and Osc. Tuning	Three Gang Tuning Capacitor, Capacity 7.5-275 $\mu\mu$f per section			25			D5590.1 NSA-16
*C-113	Band 1 Osc. Padder	750 $\mu\mu$f $\pm$ 5%, Mica Capacitor, Low Loss Bakelite case, 500 V DC working	-481155-B5	RE48A143F RE48A154F	23	Type W		D5586-45
*C-114	Band 2 Osc. Padder	2250 $\mu\mu$f $\pm$ 5%, Mica Capacitor, Low Loss Bakelite case, 500 V DC working		RE48A143F RE48A154F	23	Type W		D5586-46
*C-115	Band 3 Osc. Padder	5000 $\mu\mu$f $\pm$ 5%, Mica Capacitor, Low Loss Bakelite case, 500 V DC working	-481037-B5	RE48A143F RE48A154F	23	Type W		D5586-47
*C-116	Osc. Mixer Coupling	Ceramicon Capacitor, 25 $\mu\mu$f $\pm$ 10%, 500 V DC working			12	N750K		D5586-48
*C-117	Osc. Grid Capacitor	Ceramicon Capacitor, 50 $\mu\mu$f $\pm$ 10%, 500 V DC working	-481024-10		12	N750K		D5586-49
*C-118	Band 2 Sense Ant. Phase Corrector	Same as C-116						
*C-119	Band 3 Sense Ant. Phase Corrector	Same as C-116						
C-120	Balancing Capacitor	Split stator variable Air Capacitor, 15-3-15 $\mu\mu$f			17	NSA-9		D5498-46
*C-121	Beat Note Osc. Coupling Capacitor	Ceramicon Capacitor, 10 $\mu\mu$f $\pm$ 10%, 500 V DC working	-481692-10		12	N750K		D5548-47

* FOR ACTUAL QUANTITY OF SPARES FURNISHED REFER TO TABLE IV

TABLE II (CONT.)

SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY SPEC. OR DWG. NO.	MFR.	MFR. DESIGNATION	SPECIAL TOLERANCE RATING OR MOD.	CONTRACTOR'S DRAWING & PART NUMBER
*C-122	R-F Grid Return, Mixer Grid Return, B+ By-Pass Capacitor	3x.1 μf 400 V DC working, Oil Filled Capacitor			32	2533-6		D5498-48
*C-125	Osc. Plate Return, R-F & Mixer Screens, B+ By-Pass Capacitor	3x.1 μf 600 V DC working, Oil Filled Paper Capacitor	-48713-B	RE48A129H	18	Type 6BA111		D5498-49
*C-128	Mixer Plate Return, I-F Filament, R-F Filament By-Pass Capacitor	Same as C-125	-48713-B					
*C-131	Beat Note Osc. Plate Return, Beat Note Osc. Filament, 2nd Det. Screen By-Pass Capacitor	Same as C-125	-48713-B					
*C-134	A-F Grid Return, A-F Screen By-Pass Capacitor	2x.25 μf 600 V DC working, Oil Filled Paper Capacitor	-48618-B	RE48A129H	18	Type 6BA22		D5498-50
*C-136	I-F Screen, I-F Aud. Plate Supply, I-F Grid Return By-Pass Capacitor	Same as C-122						
*C-139	Det.-Amp Coupling Capacitor	Same as C-115	-481037-B5					
*C-140	Det. Grid Return By-Pass Capacitor	300 μμf ± 10% Mica Capacitor, 500 V DC working, Low Loss Bakelite case	-481014-B10	RE48A148C RE48A154F	23	Type O		D5586-51
C-141	Beat Note Osc. Fixed Tuning Capacitor	250 μμf ± 10% Silver Mica Capacitor, 500 V DC working	-481707-D10	RE48A233A RE48A154F	29	Silver Cap.		
C-142	T-110 Primary Tuning Capacitor	60 μμf ± 10% Silver Mica Capacitor, 500 V DC working		RE48A233A	29	Silver Cap.		
C-143	T-110 Secondary Tuning Capacitor	65 μμf ± 10% Silver Mica, 500 V DC working		RE48A233A	29	Silver Cap.		
C-144	T-111 Primary Tuning Capacitor	Same as C-142						
C-145	T-111 Secondary Tuning Capacitor	Same as C-143						
C-146	T-112 Primary Tuning Capacitor	Same as C-142						
C-147	T-112 Secondary Tuning Capacitor	Same as C-143						
*C-148	Beat Note Osc. Grid Capacitor	100 μμf ± 20% Mica Capacitor, 500 V DC working	-48674-B20	RE48A148C RE48A154F	23	Type O		D5586-52
*C-149	Det. Plate R-F Filter Capacitor	250 μμf ± 20% Mica Capacitor, 500 V DC working	-48690-B20	RE48A148C RE48A154F	23	Type O		D5586-53

* FOR ACTUAL QUANTITY OF SPARES FURNISHED REFER TO TABLE IV

TABLE II (CONT.)

SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY SPEC. OR DWG. NO.	MFR.	MFR. DESIGNATION	SPECIAL TOLERANCE RATING OR MOD.	CONTRACTOR'S DRAWING & PART NUMBER
*C-150	Det. Plate R-F Filter Capacitor	Same as C-149	-48690-B20					
E-101	Vertical Antenna Insulator	Ceramic Stand-off			20	66J		D5498-68
*I-101	Freq. Dial Lamp	2 V 60 ma Dial Lamp Bayonet Base			35	Type T49		D5498-60
*I-102	Sense Window Lamp	Same as I-101						
*I-103	Bearing Window Lamp	Same as I-101						
J-101	Phone Jack	2 Circuit, Black Nickel Plate			22	"Midget" Type A-2A		D5498-65
J-102	Case Power Socket	4 Contact Bracket Mtg.			13	S-304-AB		D5497-71
J-103	Power Test Cable Socket	4 Contact with Shell			13	S-304-CCT		D5533-1
J-105	Vertical Antenna Socket	1 Contact, Silver Plated			20	76 Jack		D5498-68
J-106	Loop Antenna Receptacle	3 Contact with Slip Rings			1			D5587-16
L-101	R-F, I-F B Supply Isolation Choke Coil	500 μh Universal Wound Wire - 10-40 Litz			28			D5525-7
L-102	R-F, I-F Filament Isolation Choke Coil	63 μh Random Wound on Synthane Form, 15' #26 Cotton covered wire			1			D5525-6
L-103	Beat Note Osc. Filament Isolation Choke Coil	Same as L-102						
P-101	Power Test Cable Plug	4 Contact with Shell			13	P-304-CCT	Contacts Silver Plated	D5533-15
P-102	Chassis Power Plug	4 Contact Bracket M'tg.			13	P-304-AB	Contacts Silver Plated	D5498-66
P-103	Battery Cable Plug	4 Contact Male Wafer			9	M-120		D5497-80
P-104	Battery Cable Plug	Same as P-103						
P-105	Sense Antenna Plug	1 Contact Silver Plated			38	674-P "Jumbo"	Modified as per contractors DWG	D5531.1
P-106	Loop Antenna Plug	3 Contact Silver Plated Contacts, Synthane Insulation			1			D5531.1
*R-101	Gain Control	75 K ohm Variable Potentiometer, Tol. ± 20% 2 Watt, Brass Shaft ¼" dia. ¾" lg. Flat $\frac{5}{16}$" Type CP, Taper E		RE13A492-C	19	9701-11976		D5498-40
*R-102	R-F Grid Isolation Resistor	25 K ohms ½W Insulated Carbon Resistor, Pigtail Leads Tol. ± 10%	-63360	RE13A340C	12	Type 504		D5586-20

* FOR ACTUAL QUANTITY OF SPARES FURNISHED REFER TO TABLE IV

TABLE II (CONT.)

SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY SPEC. OR DWG. NO.	MFR.	MFR. DESIGNATION	SPECIAL TOLERANCE RATING OR MOD.	CONTRACTOR'S DRAWING & PART NUMBER
*R-103	Mixer Grid Isolation Resistor	Same as R-102						
*R-104	Mixer Injector Grid Resistor	.1 Megohm ½W Insulated Carbon Resistor, Pigtail Leads, Tol. ± 10%	-63360	RE13A340C	12	Type 504		D5586-21
*R-105	2nd Det. Grid #3 Resistor	Same as R-104	-63360					D5498-41
*R-106	R-F Osc. Grid Resistor	Same as R-104	-63360					
*R-107	Osc. Plate Isolation Resistor	10 K ohms ½W Insulated Carbon Resistor, Pigtail Leads, Tol. ± 10%	-63360	RE13A340C	12	Type 504		D5586-22
*R-108	R-F & Mixer Screen Resistor	Same as R-102	-63360					
*R-111	I-F Grid Isolation Resistor	Same as R-102	-63360					
*R-112	1st & 2nd I-F Screen Resistor	.25 Megohm ½W Insulated Carbon Resistor, Pigtail Leads, Tol. ± 10%	-63360	RE13A340C	12	Type 504		D5586-23
*R-113	Det. Grid Bias Bleeder Resistor	Same as R-112	-63360					
*R-114	Det. Grid Resistor	3 Megohm ½W Insulated Carbon Resistor, Pigtail Leads, Tol. ± 10%	-63360	RE13A340C	12	Type 504		D5586-24
*R-115	Det. Grid Bias Bleeder Resistor	.17 Megohm ½W Insulated Carbon Resistor, Pigtail Leads, Tol. ± 10%	-63360	RE13A340C	12	Type 504		D5586-25
*R-116	Audio Grid Resistor	1 Megohm ½W Insulated Carbon Resistor, Pigtail Leads, Tol. ± 10%	-63360	RE13A340C	12	Type 504		D5586-26
*R-117	Beat Note Osc. Anode Resistor	50 K ohms ½W Insulated Carbon Resistor, Pigtail Leads, Tol. ± 10%	-63360	RE13A340C	12	Type 504		D5586-28
*R-118	Beat Note Osc. Grid Resistor	Same as R-117	-63360					
*R-119	Det. Plate Load Resistor	Same as R-112	-63360					
*R-120	A-F Screen Resistor	15 K ohms ½W Insulated Carbon Resistor, Pigtail Leads, Tol. ± 10%	-63360	RE13A340C	12	Type 504		D5586-29
*R-121	Band 3 Sense Antenna Phasing Resistor	3 K ohms ½W Insulated Carbon Resistor, Pigtail Leads, Tol. ± 10%	-63360	RE13A340C	12	Type 504		D5586-30
*R-122	Band 2 Sense Antenna Phasing Resistor	.2 Megohm ½W Insulated Carbon Resistor, Pigtail Leads, Tol. ± 10%	-63360	RE13A340C	12	Type 504		D5586-31

* FOR ACTUAL QUANTITY OF SPARES FURNISHED REFER TO TABLE IV

TABLE II (CONT.)

SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY SPEC. OR DWG. NO.	MFR.	MFR. DESIGNATION	SPECIAL TOLERANCE RATING OR MOD.	CONTRACTOR'S DRAWING & PART NUMBER
*R-123	Band 1 Sense Antenna Phasing Resistor	500 K ohm ½W Insulated Carbon Resistor, Pigtail Leads, Tol ± 10%						D5586-32
*R-124	Det. Plate R-F Filter Resistor	Same as R-102						
*R-125	2nd Det. Screen Resistor	.15 Megohm ½W Insulated Carbon Resistor, Pigtail Leads, Tol ± 10%	-63360	RE18A40C	12	Type 504		D5586-34
S-101	Loop Band Switch	3 position 2 Circuit Ceramic Wafer Switch, Silver Alloy Contacts			25	22561HC		D5590.1
S-102	R-F Grid & Sense Antenna Band Switch	Same as S-101						
S-103	R-F Plate & Mixer Grid Band Switch	Same as S-101						
S-104	R-F Osc. Band Switch	Same as S-101						
S-105	Antenna Selector & Loop Dial Lamp Selector Switch	4 Position 2 Circuit Ceramic Wafer Switch, Silver Alloy Contacts			25	24688-HIC		D5590.1
S-106	Power Switch	DPST Toggle Switch, Bat Handle, Contacts Rated 3A.125 V DC	-24001	RE24AA118A	16			D5498-70
S-107	Dial Lamp Switch	Same as S-106						
S-108	Beat Note Osc. Switch	Same as S-106						
T-101	Band 1 Ant-Loop Transformer	Adjustable Iron Core Transformer, Electrostatic Shield between Pri. & Sec. M = 2.19 μμh, Pri. #38 wire 1.64 μh, Sec. #7-46 wire 15.6 μh			29			D5525.1 NSB-17
T-102	Band 2 Ant-Loop Transformer	Adjustable Iron Core Transformer, Electrostatic Shield between Pri. & Sec. M = 1.82 μh, Pri. #38 wire 2.11 μh, Sec. #32 wire 4.2 μh			29			D5525.1 NSB-17
T-103	Band 3 Ant-Loop Transformer	Adjustable Iron Core Transformer, Electrostatic Shield between Pri. & Sec. M = 0.68 μh, Pri. #38 wire 1.03 μh, Sec. #26 wire 0.93 μh			29			D5525.1 NSB-17
T-104	Band 1 R-F Transformer	Adjustable Iron Core Transformer, Pri. #38 wire 3.68 μh, Sec. #7-46 wire 13.83 μh, M = 3.92 μh			29			D5525.1 NSB-17

* FOR ACTUAL QUANTITY OF SPARES FURNISHED REFER TO TABLE IV

TABLE II (CONT.)

SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY SPEC. OR DWG. NO	MFR.	MFR. DESIGNATION	SPECIAL TOLERANCE RATING OR MOD.	CONTRACTOR'S DRAWING & PART NUMBER
T-105	Band 3 R-F Transformer	Adjustable Iron Core Transformer, Pri. #38 wire 2.29 μh, Sec. #32 wire 4.26 μh, M-2.73 μh			29			D5525.1 NSB-17
T-106	Band 3 R-F Transformer	Adjustable Iron Core Transformer, Pri. #38 wire 1.09 μh, Sec. #26 wire .964 μh, M = .62 μh			29			D5525.1 NSB-17
T-107	Band 1 Osc. Transformer	Adjustable Iron Core Transformer, Pri. #38 wire 1.85 μh, Sec. #34 wire 9.58 μh, M = 2.47 μh			29			D5525.1 NSB-17
T-108	Band 2 Osc. Transformer	Adjustable Iron Core Transformer, Pri. #38 wire 1.36 μh, Sec. # 32 wire 3.56 μh, M = 1.27 μh			29			D5525.1 NSB-17
T-109	Band 3 Osc. Transformer	Adjustable Iron Core Transformer, Pri. #38 wire 1.15 μh, Sec. #26 wire .909 μh, M = .447 μh			29			D5525.1 NSB-17
T-110	1st I-F Transformer	Adjustable Iron Core Transformer, Pri. #40 wire 776 μh, Sec. #40 wire 776 μh			29			D5525.1 NSB-17
T-111	2nd I-F Transformer	Adjustable Iron Core Transformer, Pri. #40 wire 776 μh, Sec. #40 wire 776 μh			29			D5525.1 NSB-17
T-112	3rd I-F Transformer	Adjustable Iron Core Transformer, Pri. #40 wire 776 uh, Sec. #40 wire 776 μh			29			D5525.1 NSB-17
	Note: Inductances of T-101	— T-112 measured with core and shield	removed.					
T-113	Beat Note Osc. Transformer	Adjustable Iron Core Transformer, Pri. #40 wire 306 μh, Sec. #40 wire 468 μh			29			D5525.1 NSB-17
T-114	A-F output Transformer	Iron Core, Pri. 8000 ohms, Sec. 4 ohms and 600 ohms			36	64624		D5498-72
TS-101	"C" Battery Terminal Strip	Single Screen Terminal 2 hole Mt'g. Bakelite Insulation			9	1787		D5497-70
*V-101	R-F Amplifier Tube	Midget Radio Tube	1T4	JAN-1	27	1T4		D5498-55
*V-102	1st Det. Mixer Tube	Midget Radio Tube	1R5	JAN-1	27	1R5		D5498-56
*V-103	R-F Osc. Tube	Same as V-101	1T4					
*V-104	1st I-F Amp. Tube	Same as V-101	1T4					

* FOR ACTUAL QUANTITY OF SPARES FURNISHED REFER TO TABLE IV

TABLE II (Concluded)

SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY SPEC. OR DWG. NO.	MFR.	MFR. DESIGNATION	SPECIAL TOLERANCE RATING OR MOD.	CONTRACTOR'S DRAWING & PART NUMBER
*V-105	2nd I-F Amp. Tube	Same as V-101	1T4					
*V-106	2nd Det. Tube	Same as V-102	1R5					
*V-107	Audio Power Amp.	Midget Radio Tube	1S4	JAN-1	27	1S4		D5498-57
*V-108	Beat Note. Osc.	Same as V-101	1T4					
W-101	Test Power Cable	4 Conductor #20 wire 28 inches long			1			D5533-9
W-102	Ground Wire	1 Conductor #20 wire 7 strand with Mueller #48C Clip and Spade Lug			1			D5533-21
W-103	Power Cable	4 Conductor #20 wire 14 inches long			1			D5497.18
*X-101	R-F Amp. Socket	Mica Filled, Low Loss Midget Tube Socket			3	78-7PT		D5498-61
*X-102	Mixer Socket	Same as X-101						
*X-103	R-F Osc. Socket	Same as X-101						
*X-104	1st I-F Amp. Socket	Same as X-101						
*X-105	2nd I-F Amp. Socket	Same as X-101						
*X-106	2nd Det. Socket	Same as X-101						
*X-107	Audio Amp. Socket	Same as X-101						
*X-108	Beat Note Osc. Socket	Same as X-101						
X-109	Freq. Dial Lamp Socket	Bayonet Base			9	3105		D5498-63
X-110	Sense Window Lamp Socket	Same as X-109						
X-111	Bearing Window Lamp Socket	Same as X-109						

* FOR ACTUAL QUANTITY OF SPARES FURNISHED REFER TO TABLE IV

TABLE III
PARTS LIST BY NAVY TYPE NUMBER
FOR MODEL DAG-1 PORTABLE RADIO DIRECTION FINDER EQUIPMENT

QUANTITY	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED
	MISCELLANEOUS Class 10	
8		I-101, I-102, I-103
1		E-101
1		W-101
1		W-102
1		W-103
1		TS-101
	SWITCHES Class 24	
4		S-101, S-102, S-103 S-104
1		S-105
3	-24001	S-106, S-107, S-108
	VACUUM TUBES Class 38	
5	-1T4	V-101, V-103, V-104 V-105, V-108
2	-1R5	V-102, -106
1	-1S4	V-107
	R-F TRANSFORMERS & INDUCTORS Class 47	
1		L-101
2		L-102, L-103
1		T-101
1		T-102
1		T-103
1		T-104
1		T-105
1		T-106
1		T-107
1		T-108
1		T-109
1		T-110
1		T-111
1		T-112
1		T-113

QUANTITY	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED
	CAPACITORS Class 48	
9		C-101, C-102, C-103 C-104, C-105, C-106 C-107, C-108, C-109
1		C-110
1	-481155-B5	C-113
1		C-114
2	-481037-B5	C-115, C-139
1		C-116, C-118, C-119
1	-481024-10	C-117
1		C-120
1	-481692-10	C-121
2		C-122, C-136
3	-48713-A	C-125, C128, C-131
1	-48618-A	C-134
1	-481014-B10	C-140
1	-481707-D10	C-141
8		C-142, C-144, C-146 C-143, C-145, C-147
1	-48674-B20	C-148
2	-48690-B20	C-149, C-150
	PLUGS & SOCKETS Class 49	
1		J-101
1		J-102
1		J-103
1		J-105
1		J-106
1		P-101
1		P-102
1		P-103
1		P-104
1		P-105

QUANTITY	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED
	PLUGS & SOCKETS – (CONTINUED) Class 49	
1		P-106
8		X-101, X-102, X-103, X-104, X-105, X-106, X-107, X-108
3		X-109, X-110, X-111
	RESISTORS Class 63	
1		R-101
5	-63360	R-102, R-103, R-108, R-111, R-124
3	-63360	R-104, R-105, R-106
1	-63360	R-107
3	-63360	R-112, R-113, R-119
1	-63360	R-114
1	-63360	R-115
1	-63360	R-116
2	-63360	R-117, R-118
1	-63360	R-123
1	-63360	R-120
1	-63360	R-121
1	-63360	R-122
1	-63360	R-125
	A-F TRANSFORMERS & REACTORS Class 30	
1		T-114

TABLE IV
SPARE PARTS LIST BY NAVY TYPE DESIGNATION
FOR MODEL DAG-1 PORTABLE RADIO DIRECTION FINDER EQUIPMENT

QUANTITY	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	DESCRIPTION	NAVY DRAWING OR SPEC.	MFR.	MFR. DESIG.	SPECIAL TOLERANCE RATING OR MODIFICATION	CONTRACTORS DRAWING AND PART NUMBER
MISCELLANEOUS CLASS 10								
2		I-101, I-102, I-103	2V 60 ma Bayonet Base Dial Lamp Bulb		35	T-49		D5498-60
2	-19045		A & B Battery Packs 1½ V-A, 90V-B		7	4TA60		
1	-19011		7½ V-C Battery		7	5540		
1			#6 Allen Set Screw Wrench		39			
1			#8 Allen Set Screw Wrench		39			
VACUUM TUBES CLASS 38								
2	1T4	V-101, V-103, V-104, V-105, V-108	Midget Radio Tube	JAN-1	27	1T4		D5498-55
2	1R5	V-102, V-106	Midget Radio Tube	JAN-1	27	1R5		D5498-56
2	1S4	V-107	Midget Radio Tube	JAN-1	27	1S4		D5498-57
CAPACITORS CLASS 48								
1	-481155-B5	C-113	750 $\mu\mu$f ± 5%, Mica Capacitor, Low Loss Bakelite case, 500 V DC working	RE48A143F RE48A154F	23	Type W		D5586-45
1		C-114	2250 $\mu\mu$f ± 5%, Mica Capacitor, Low Loss Bakelite Case, 500 V DC working	RE48A143F RE48A154F	23	Type W		D5586-46
1	-481037-B5	C-115, C-139	5000 $\mu\mu$f ± 5%, Mica Capacitor, Low Loss Bakelite Case, 500 V DC working	RE48A143F RE48A154F	23	Type W		D5586-47
2		C-116, C-118, C-119	Ceramicon Capacitor, 25 $\mu\mu$f ± 10%, 500 V DC working		12	N750K		D5586-48
1	-481024-10	C-117	Ceramicon Capacitor, 50 $\mu\mu$f ± 10%, 500 V DC working		12	N750K		D5586-49
1	-481692-10	C-121	Ceramicon Capacitor, 10 $\mu\mu$f ± 10% 500 V DC working		12	N750K		D5498-47

TABLE IV (CONT.)

QUANTITY	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	DESCRIPTION	NAVY DRAWING OR SPEC.	MFR.	MFR. DESIG.	SPECIAL TOLERANCE RATING OR MODIFICATION	CONTRACTORS DRAWING AND PART NUMBER
CAPACITORS CLASS 48 (CONT.)								
2	-48713-B	C-125, C-128, C-131	3x.1 μf 600 V DC working Oil Filled Paper Capacitor		18	Type 6BA111		D5498-49
1		C-122, C-136	3x.1 μf 400 V DC working, Oil Filled Paper Capacitor		32	2533-6		D5498-48
1	-48618-A	C-134	2x.25 μf 600 V DC working, Oil Filled Paper Capacitor		18	6BA22		D5498-50
1	-481014-B10	C-140	300 μμf ± 10%, Mica Capacitor, 500 V DC working, Low Loss Bakelite Case	RE48A148C RE48A154F	23	Type 0		D5586-51
1	-48674-B20	C-148	100 μμf ± 20%, Mica Capacitor, 500 V DC working	RE48A148C RE48A154F	23	Type 0		D5586-52
1	-48690-B20	C-149, C-150	250 μμf ± 20%, Mica Capacitor, 500 V DC working	RE48A148C RE48A154F	23	Type 0		D5586-53
PLUGS & SOCKETS CLASS 49								
2		X-101, X-102, X-103, X-104, X-105, X-106, X-107, X-108	Mica Filled Midget Tube Socket with Mounting Ring		3	78-7PT		D5498-61
1		W-101	Power Test Cable with Plug & Socket		1			D5533.4
RESISTORS CLASS 63								
1		R-101	75 K ohm Variable Potentiometer, Tol. ± 20% 2 Watt, Brass Shaft ¼" dia. ¾" lg. Flat $\frac{5}{16}$" type CP	RE13A492C	19	9701-11976		D5498-40
3	-63360	R-102, R-103, R-108 R-111, R-124	25 K ohm Resistor		12	Type 504		D5586-20
2	-63360	R-104, R-105, R-106	100 K ohm Resistor		12	Type 504		D5586-21 D5498-41
1	-63360	R-107	10 K ohm Resistor		12	Type 504		D5586-22
2	-63360	R-112, R-113, R-119	250 K ohm Resistor		12	Type 504		D5586-23
1	-63360	R-114	3 Megohm Resistor		12	Type 504		D5586-24

TABLE IV (Concluded)

QUANTITY	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	DESCRIPTION	NAVY DRAWING OR SPEC.	MFR.	MFR. DESIG.	SPECIAL TOLERANCE RATING OR MODIFICATION	CONTRACTORS DRAWING AND PART NUMBER
			RESISTORS CLASS 63 (CONT.)					
1	-63360	R-115	170 K ohm Resistor		12	Type 504		D5586-25
1	-63360	R-116	1 Megohm Resistor		12	Type 504		D5586-26
1	-63360	R-117, R-118	50 K ohm Resistor		12	Type 504		D5586-28
1	-63360	R-123	500 K ohm Resistor		12	Type 504		D5586-32
1	-63360	R-120	15 K ohm Resistor		12	Type 504		D5586-29
1	-63360	R-121	8 K ohm Resistor		12	Type 504		D5586-30
1	-63360	R-122	200 K ohm Resistor		12	Type 504		D5586-31
1	-63360	R-125	150 K ohm Resistor		12	Type 504		D5586-34

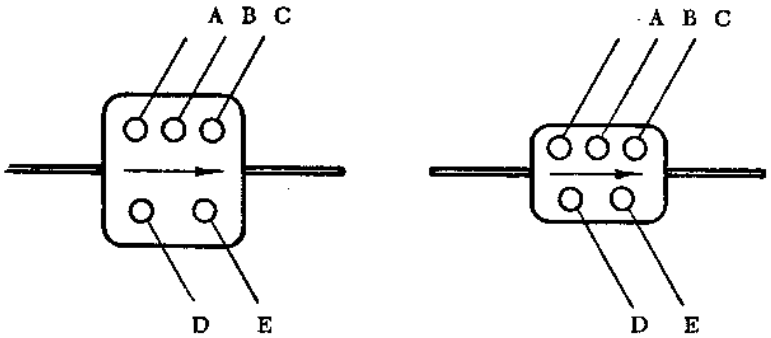
Note: All Resistors with the exception of R-101 are ½ watt Insulated Carbon Resistors with Pigtail leads. Tolerance ± 10%. Physical size ½" long x 7/32" in diameter.

TABLE V
APPLICABLE COLOR CODES AND MISCELLANEOUS DATA
FOR MODEL DAG-1 PORTABLE RADIO DIRECTION FINDER EQUIPMENT

5-DOT R.M.A. COLOR CODE
FOR MICA CAPACITORS IN MICROMICROFARADS

COLOR	A 1ST DIGIT	B 2ND DIGIT	C MULTIPLIER	D VOLTS
Black	0	0	1	
Brown	1	1	10	100
Red	2	2	100	200
Orange	3	3	1,000	300
Yellow	4	4	10,000	400
Green	5	5	100,000	500
Blue	6	6	1,000,000	600
Violet	7	7	10,000,000	700
Grey	8	8	100,000,000	800
White	9	9	1,000,000,000	900
Gold			.1	1000
Silver			.01	

NOTE: D no color indicates 500 Volts



E

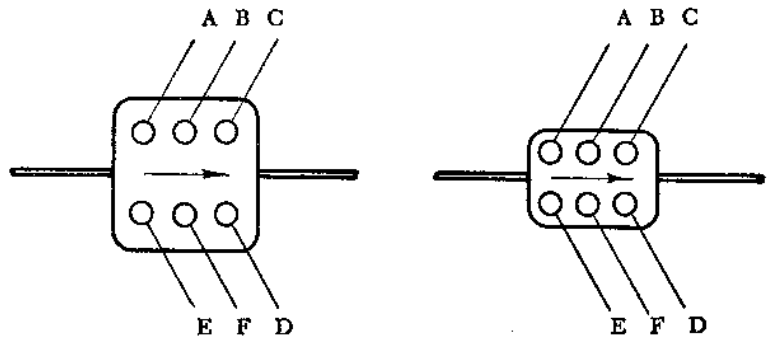
TOLERANCE

5%.....Green
10%.....Silver
20%.....No Color

6-DOT R.M.A. COLOR CODE
FOR MICA CAPACITORS IN MICROMICROFARADS

COLOR	A 1ST DIGIT	B 2ND DIGIT	C 3RD DIGIT	D MULTIPLIER	E VOLTS
Black	0	0	0	1	
Brown	1	1	1	10	100
Red	2	2	2	100	200
Orange	3	3	3	1,000	300
Yellow	4	4	4	10,000	400
Green	5	5	5	100,000	500
Blue	6	6	6	1,000,000	600
Violet	7	7	7	10,000,000	700
Gray	8	8	8	100,000,000	800
White	9	9	9	1,000,000,000	900
Gold				.1	1000
Silver				.01	

NOTE: E no color indicates 500 Volts



F

TOLERANCE

5%.....Green
10%.....Silver
20%.....No Color

TABLE V (Concluded)

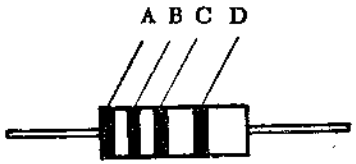
R.M.A. COLOR CODE FOR RESISTORS

COLOR	A 1ST DIGIT	B 2ND DIGIT	C CIPHERS
Black	0	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

D - Tolerance Code

Gold = 5% Silver = 10%

Omit = 20%



Wiring Color Code

Color of Wire:	Circuit used in:
White	Filaments (A+)
Black Tracer	Grounds and Grid Returns
Red Tracer	B+
Yellow Tracer	Cathodes
Blue Tracer	Plate Leads
Green Tracer	Grid Leads and Main Filament Supply
Orange Tracer	A.V.C.

TABLE VI
LIST OF MANUFACTURERS
FOR MODEL DAG-1 PORTABLE RADIO DIRECTION FINDER EQUIPMENT

CODE NUMBER	MFR. PREFIX	NAME	ADDRESS
1	CIA	AIRPLANE & MARINE INSTRUMENTS, INC.	CLEARFIELD, PENNSYLVANIA
2	CAW	AEROVOX CORPORATION	NEW BEDFORD, MASS.
3	CPH	AMERICAN PHENOLIC CORPORATION	CICERO, ILLINOIS
4	CMH	AMERICAN RADIO HARDWARE COMPANY	NEW YORK, NEW YORK
5		ATLANTIC INDIA RUBBER WORKS, INC.	CHICAGO, ILLINOIS
6		BELDEN MANUFACTURING COMPANY	CHICAGO, ILLINOIS
7	CBR	BURGESS BATTERY COMPANY	FREEPORT, ILLINOIS
8		CINAUDAGRAPH SPEAKERS, INC.	CHICAGO, ILLINOIS
9	CMG	CINCH MANUFACTURING COMPANY	CHICAGO, ILLINOIS
10	CD	CORNELL-DUBILIER ELECTRIC CORPORATION	SOUTH PLAINFIELD, NEW JERSEY
11		CROWE NAMEPLATE & MANUFACTURING COMPANY	CHICAGO, ILLINOIS
12	CER	ERIE RESISTOR CORPORATION	ERIE, PENNSYLVANIA
13	CJC	HOWARD B. JONES	CHICAGO, ILLINOIS
14	CEB	HUGH E. EBY COMPANY	PHILADELPHIA, PENNSYLVANIA
15		ERIE ART METAL COMPANY, INC.	ERIE, PENNSYLVANIA
16	CG	GENERAL ELECTRIC COMPANY	BRIDGEPORT, CONNECTICUT
17	CHC	HAMMARLUND MANUFACTURING COMPANY	NEW YORK, NEW YORK
18	CIE	INDUSTRIAL CONDENSER CORPORATION	CHICAGO, ILLINOIS
19	CIR	INTERNATIONAL RESISTANCE CORPORATION	PHILADELPHIA, PENNSYLVANIA
20	CEJ	E. F. JOHNSON COMPANY	WASECA, MINNESOTA
21	CLF	LITTELFUSE, INC.	CHICAGO, ILLINOIS
22	CMA	P. R. MALLORY & COMPANY	INDIANAPOLIS, INDIANA
23	CMR	MICAMOLD RADIO CORPORATION	BROOKLYN, NEW YORK
24		NICE BALL BEARING COMPANY	NICETOWN, PHILADELPHIA, PENNA.
25	COC	OAK MANUFACTURING COMPANY	CHICAGO, ILLINOIS
26	CJD	J. F. D. MANUFACTURING COMPANY	BROOKLYN, NEW YORK
27	CRC	RCA MANUFACTURING COMPANY	HARRISON, NEW JERSEY
28		S-W INDUCTOR COMPANY	CHICAGO, ILLINOIS
29	CFW	F. W. SICKLES COMPANY	CHICOPEE, MASS.
30	CSL	SOLAR MANUFACTURING COMPANY	BAYONNE, NEW JERSEY
31		SPECIALTY LEATHER PRODUCTS COMPANY	NEWARK, NEW JERSEY
32	CSF	SPRAGUE SPECIALTY COMPANY	NORTH ADAMS, MASS.
33	CSA	STACKPOLE CARBON COMPANY	ST. MARYS, PENNSYLVANIA
34		SYNTHANE CORPORATION	OAKS, PENNSYLVANIA
35	CTL	TUNG-SOL LAMP WORKS	NEWARK, NEW JERSEY
36	CUT	UNITED TRANSFORMER CORPORATION	NEW YORK, NEW YORK
37	CZD	DAVID WHITE COMPANY	MILWAUKEE, WISCONSIN
38		GENERAL RADIO	CAMBRIDGE, MASS.
39		ACTIVE SCREW & MANUFACTURING COMPANY	CHICAGO, ILLINOIS

TABLE VII

RESISTANCE AND VOLTAGE TESTS

Note: All measurements taken with R.C.A. Volt-Ohmist Junior, and "Gain" control setting at "10"

		Resistance	Voltage
V101	Filament to Ground	2.3 ohms	1.42
V101	Grid to Ground	25 K	0
V101	Screen to Ground	Infinity	38
V101	Plate to Ground	Infinity	90
V102	Grid #1 to Ground	100 K ohms	-1.75
V102	Grid #3 to ground	25 K ohms	0
V102	Screen to Ground	Infinity	38
V102	Plate to Ground	Infinity	90
V103	Grid to Ground	100 K ohms	-2
V103	Screen to Ground	Infinity	66
V103	Plate to Ground	Infinity	66
V104	Filament to Ground	2.3 ohms	1.5
V104	Grid to Ground	25 K ohms	0
V104	Screen to Ground	Infinity	22
V104	Plate to Ground	Infinity	86
V105	Filament to Ground	2.3 ohms	1.5
V105	Grid to Ground	25 k ohms	0
V105	Screen to Ground	Infinity	22
V105	Plate to Ground	Infinity	90.
V106	Filament to Ground	2.3 ohms	1.5
V106	Grid #1 to Ground	3 meg. ohm	-4.5

		Resistance	"Beat Note" Switch	Voltage
V109	Grid #3 to Ground	.1 meg ohm	CW	-0.15
V106	Screen to Ground	Infinity		36
V106	Plate to Ground	Infinity		15
V107	Filament to Ground	2.3 ohms		1.5
V107	Grid to Ground	1 Meg-ohm		-7.5
V107	Screen to Ground	Infinity		67
V107	Plate to Ground	Infinity		86
V108	Filament to Ground	20 ohms	Mod.	1.45
V108	Grid to Ground	50 K ohms	CW	-1.1
V108	Screen to Ground	Infinity	Mod.	90
V108	Plate to Ground	Infinity	Mod.	90
V108	Plate to Ground	Infinity	CW	32
V108	Screen to Ground	Infinity	CW	32

TABLE VIII

Band	Generator Setting	Receiver Setting	Adjust to Max.		
1	1.6 MC	1.6 MC	T-107	T-104	T-101
1	3.6 MC	3.6 MC	C-107	C-104	C-101
2	3.6 MC	3.6 MC	T-108	T-105	T-102
2	8.1 MC	8.1 MC	C-108	C-105	C-102
3	8.1 MC	8.1 MC	T-109	T-106	T-103
3	18.1 MC	18.1 MC	C-109	C-106	C-103

TABLE IX

AVERAGE ELECTRICAL CHARACTERISTICS OF VACUUM TUBES

Tube Type	1T4	1R5	1S4
Function	Amplifier and Osc.	Mixer & Detector	Power Amplifier
Filament Voltage	1.4	1.4	1.4
Filament Current	.05 amps.	.05 amps.	.1 amp.
Plate Voltage	90	90	90
Screen Voltage	67.5	67.5	67.5
Grid Voltage	0 (Min.)	0 (min.)	-7
Supressor	Tied to fil. in tube	Tied to fil. in tube	Tied to fil. in tube
Plate Resistance	.5 megohms	.5 megohms	.1 megohm
Trans-conductance	900 micromhos	300 micromhos	1550 micromhos
Plate Current (MA)	3.7	1.7	7.2
Screen Current (MA)	1.25	3	1.5
Interelectrode Cap.			
Input Cap.	3.5 uuf.	7 uuf.	
Output Cap.	7.3 uuf.	7 uuf.	
Grid-Plate Cap.	.01 uuf.	.4 uuf.	
Max. Power Output (undistorted)			.18 watts

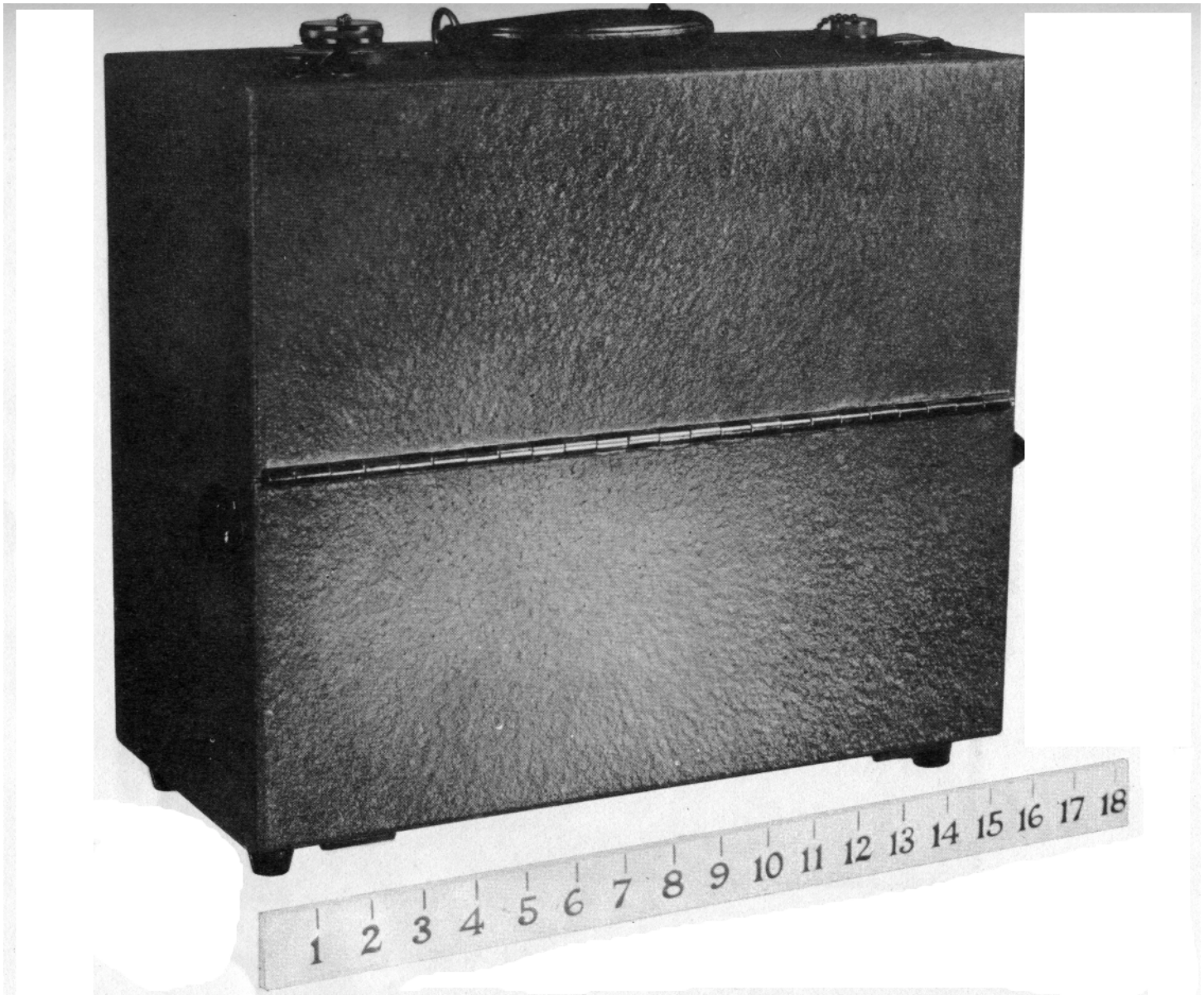


Figure 4, MODEL DAG-1 PORTABLE RADIO DIRECTION FINDER EQUIPMENT, CASE CLOSED

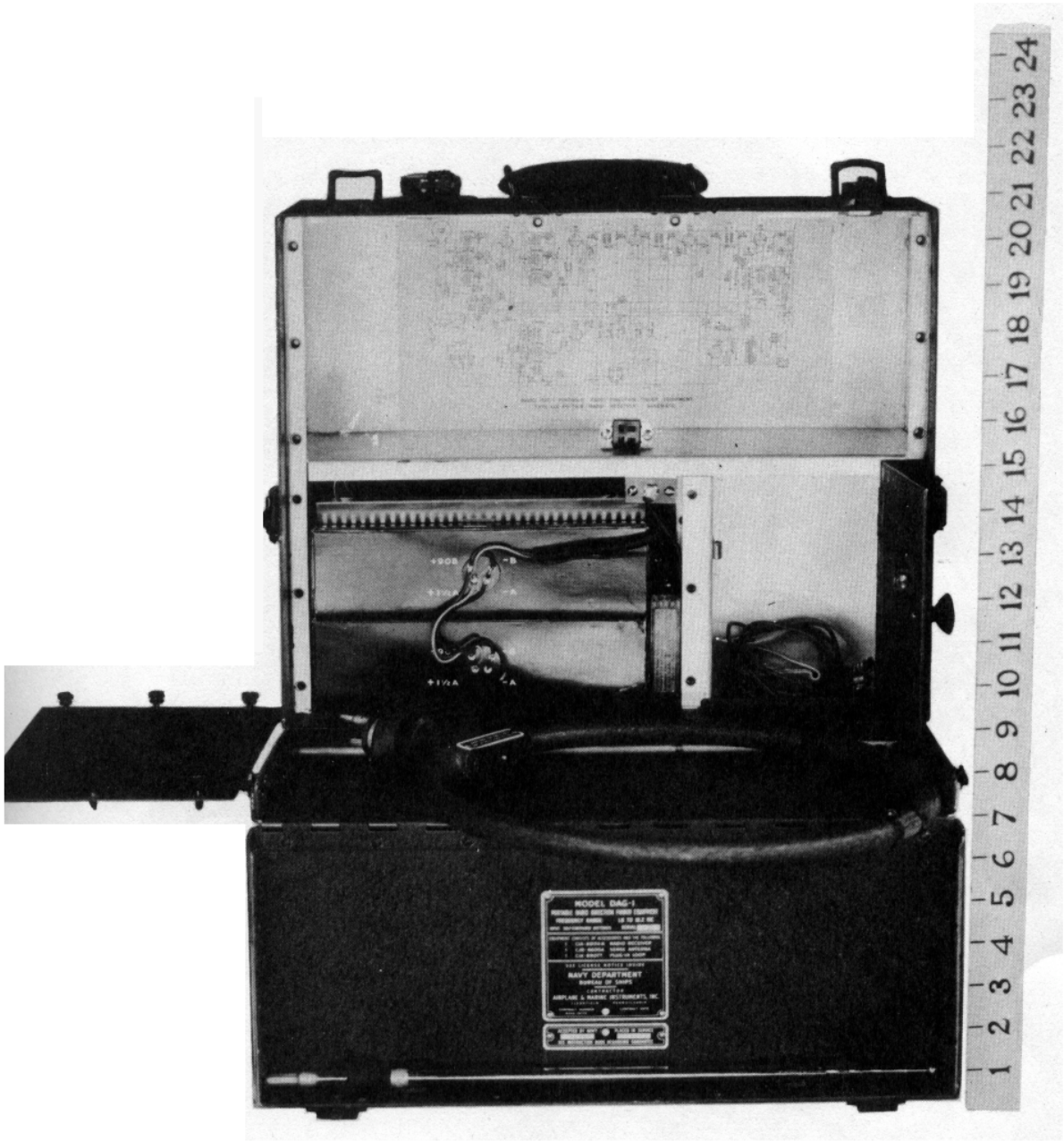


Figure 5, MODEL DAG-1 PORTABLE RADIO DIRECTION FINDER EQUIPMENT, INTERIOR VIEW OF CASE

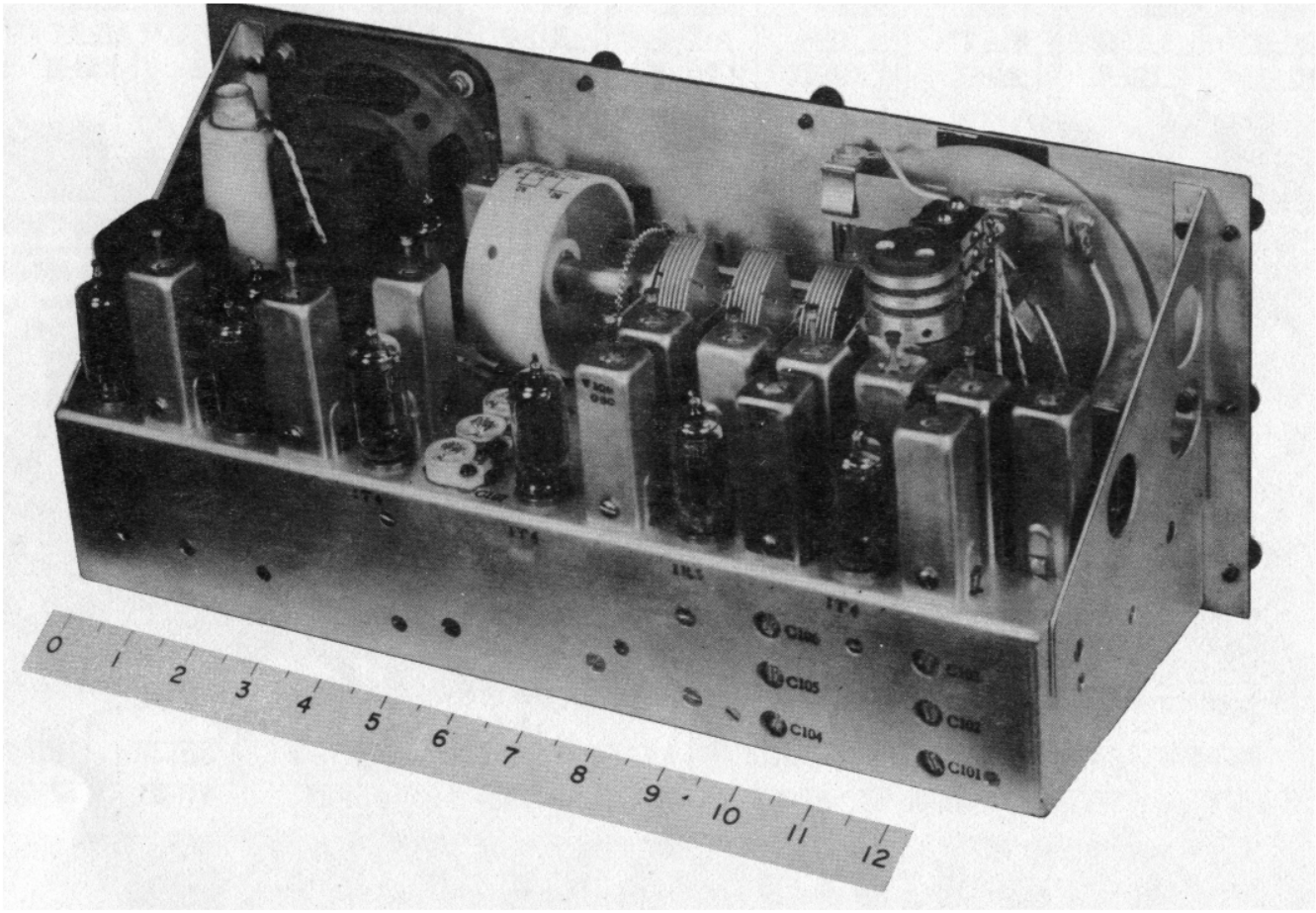


Figure 6, TYPE CIA-46174-A RADIO RECEIVER, REAR PERSPECTIVE VIEW

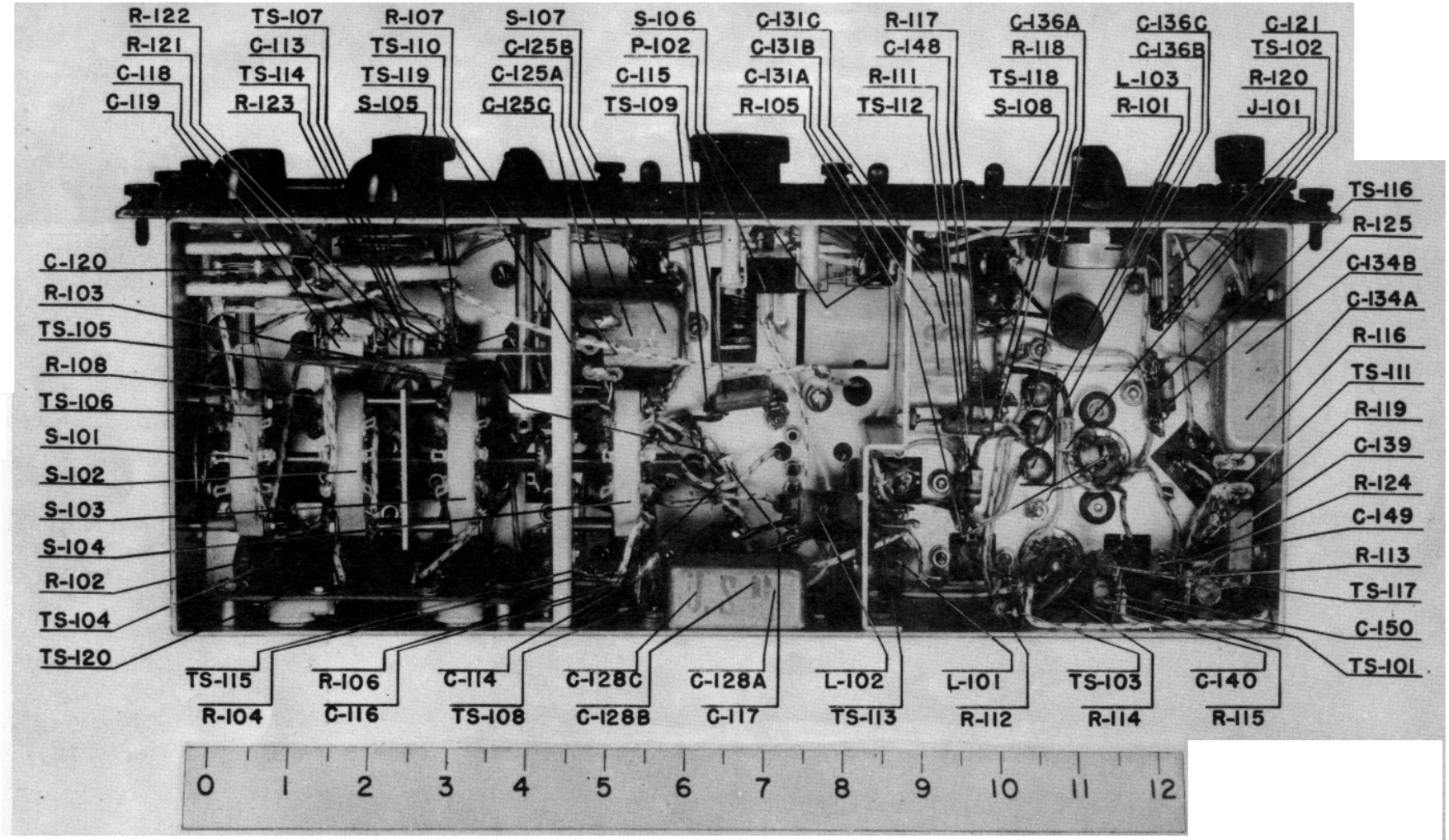


Figure 7, TYPE CIA-46174-A RADIO RECEIVER, BOTTOM VIEW

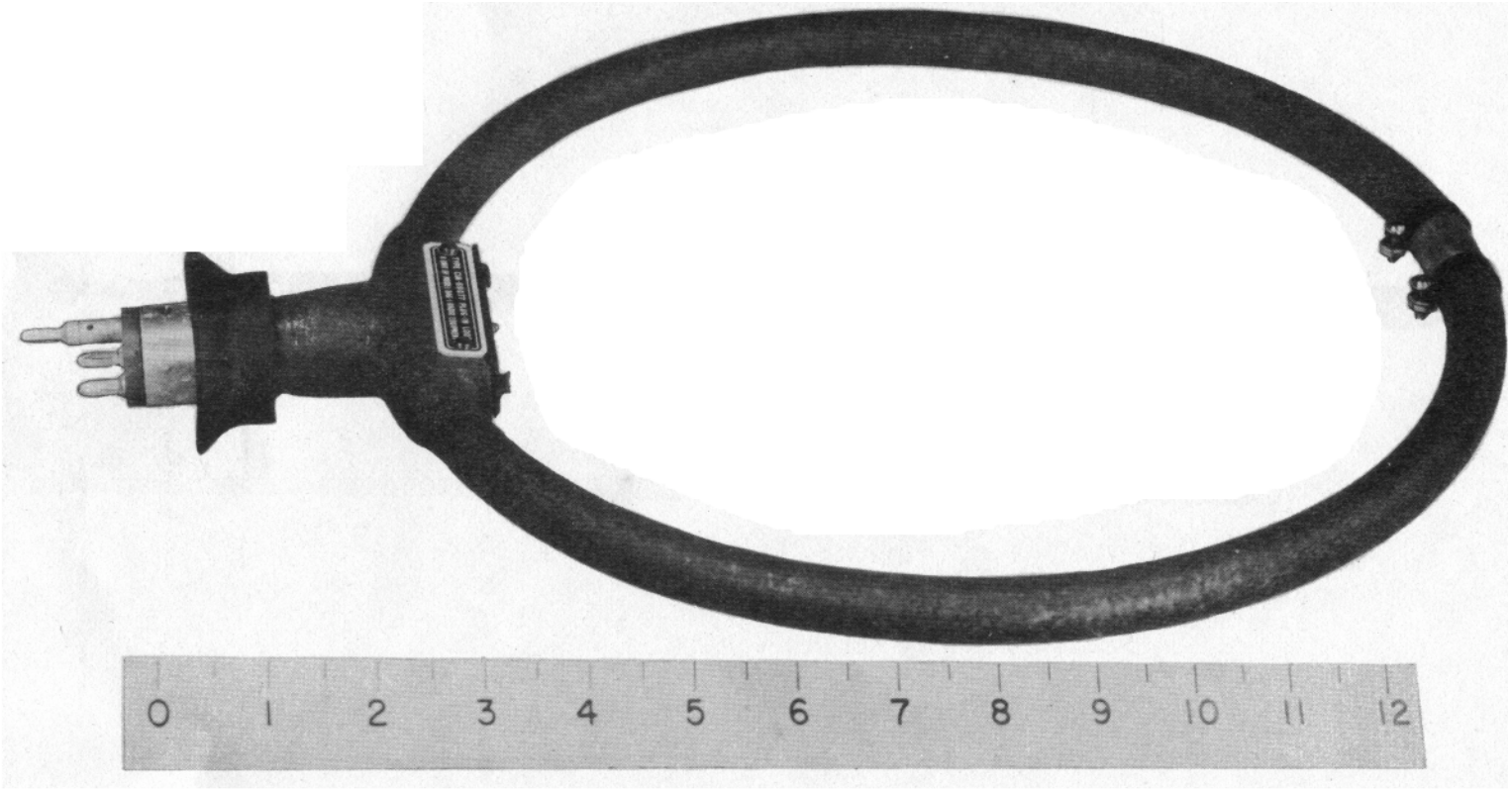


Figure 8, TYPE CIA-69077 PLUG-IN LOOP

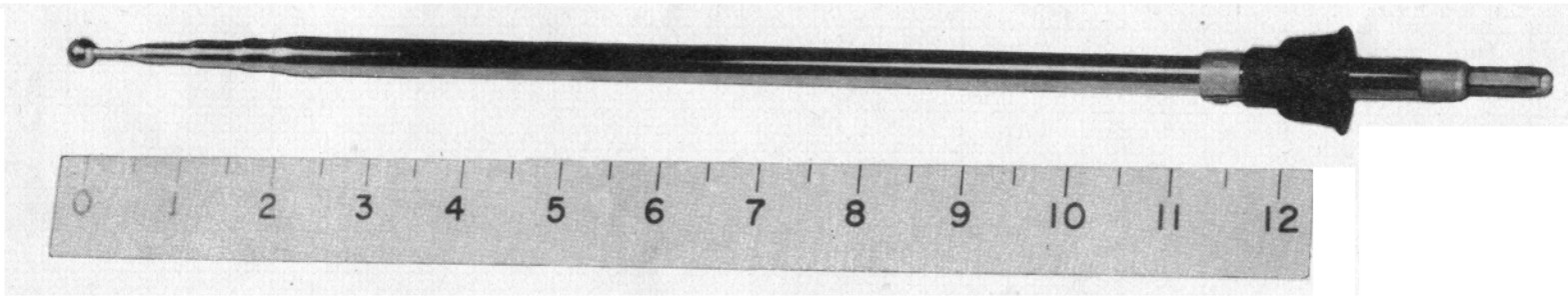


Figure 9, TYPE CJD-66054 SENSE ANTENNA

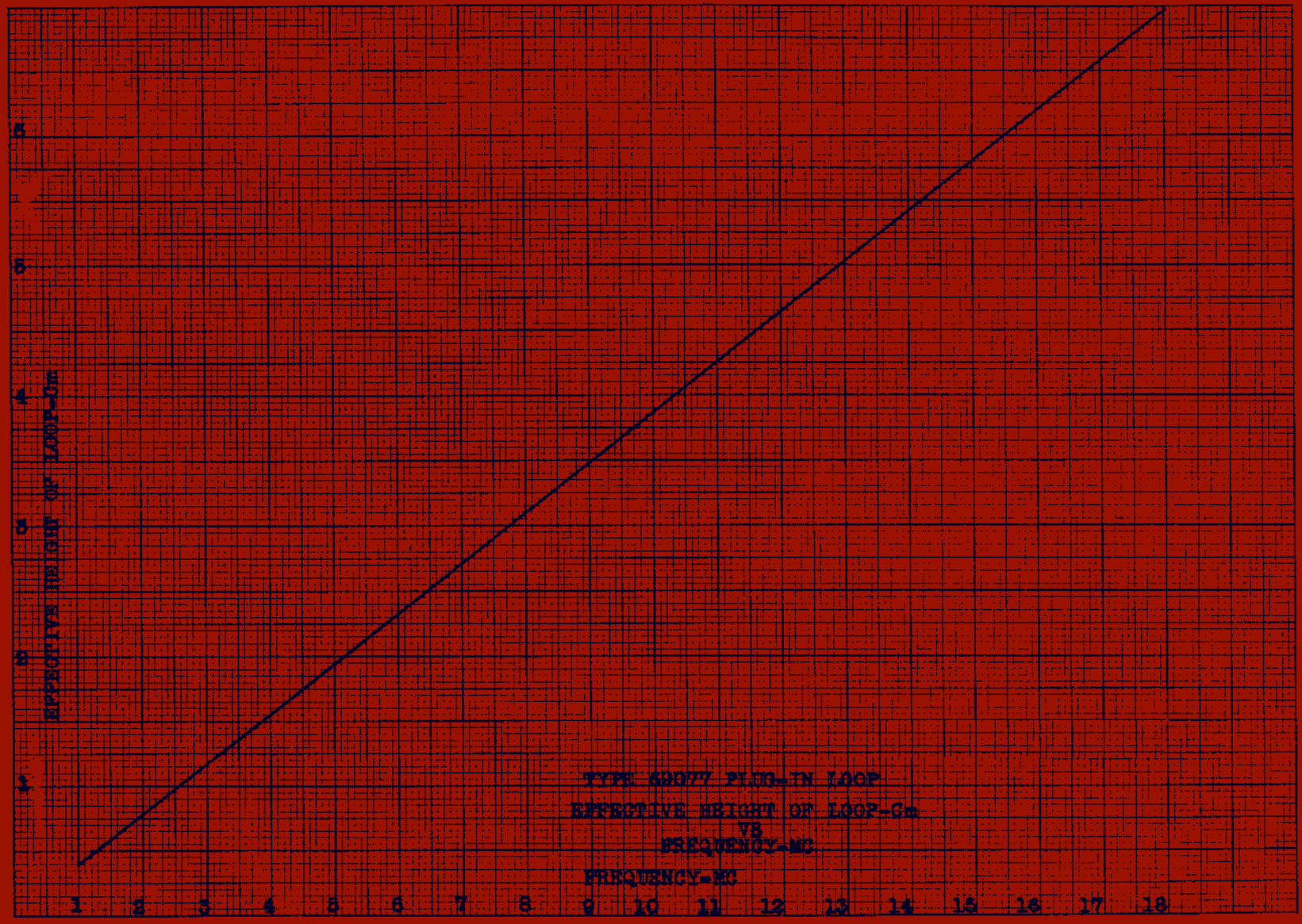


Figure 10, TYPE CIA-69077 PLUG-IN LOOP, EFFECTIVE HEIGHT

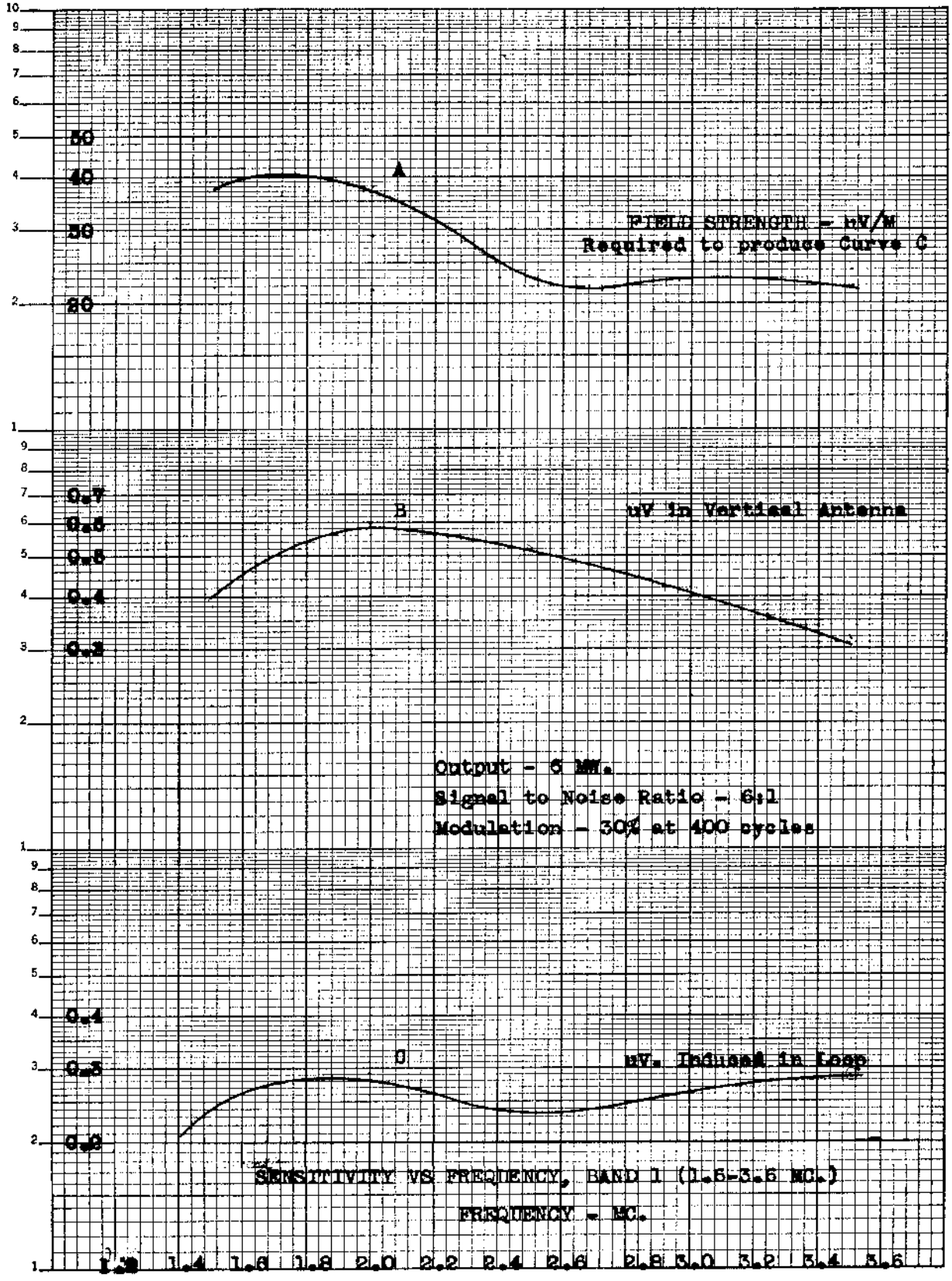


Figure 11, SENSITIVITY CURVE, BAND 1

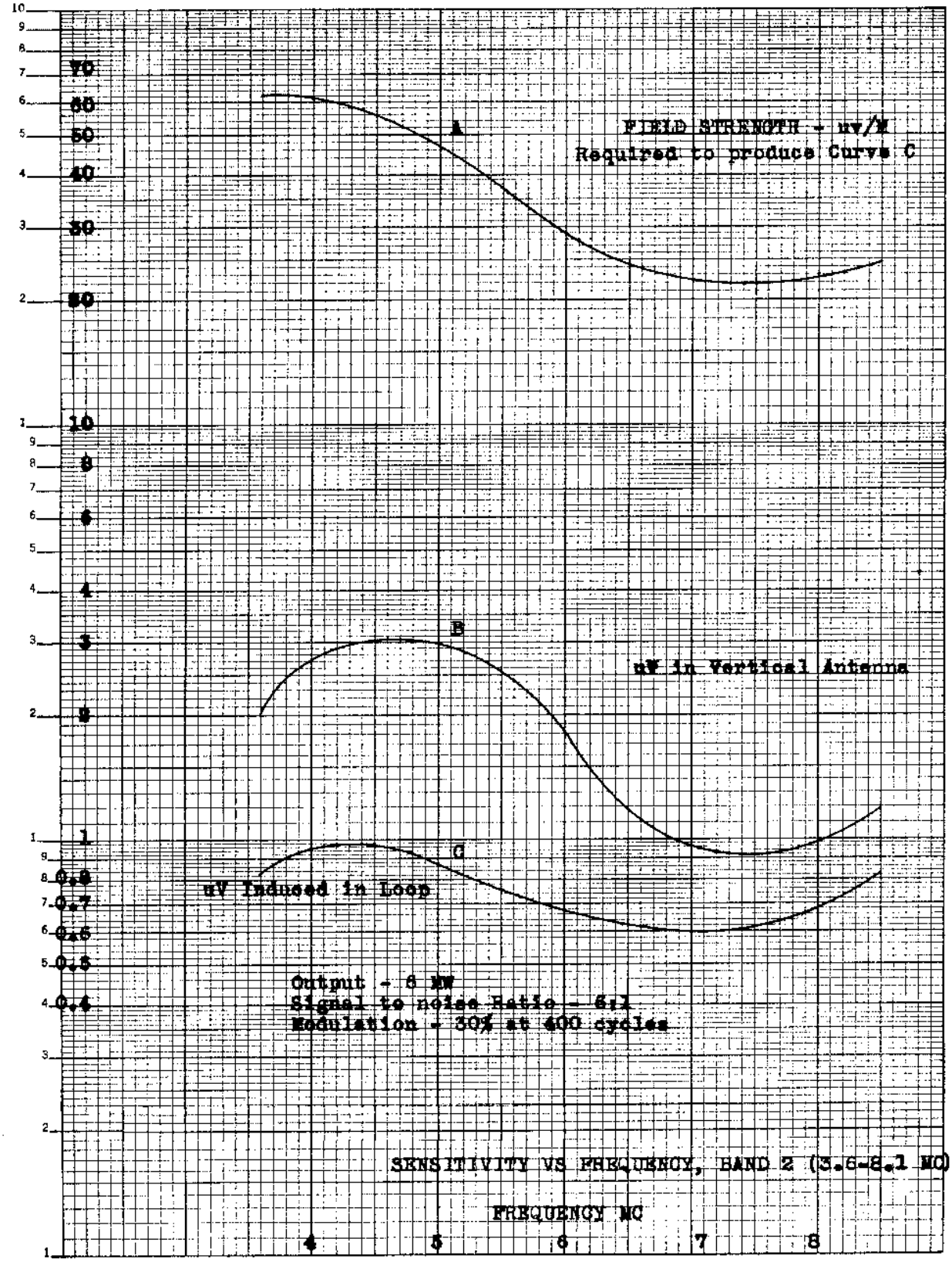


Figure 12. SENSITIVITY CURVE, BAND 2

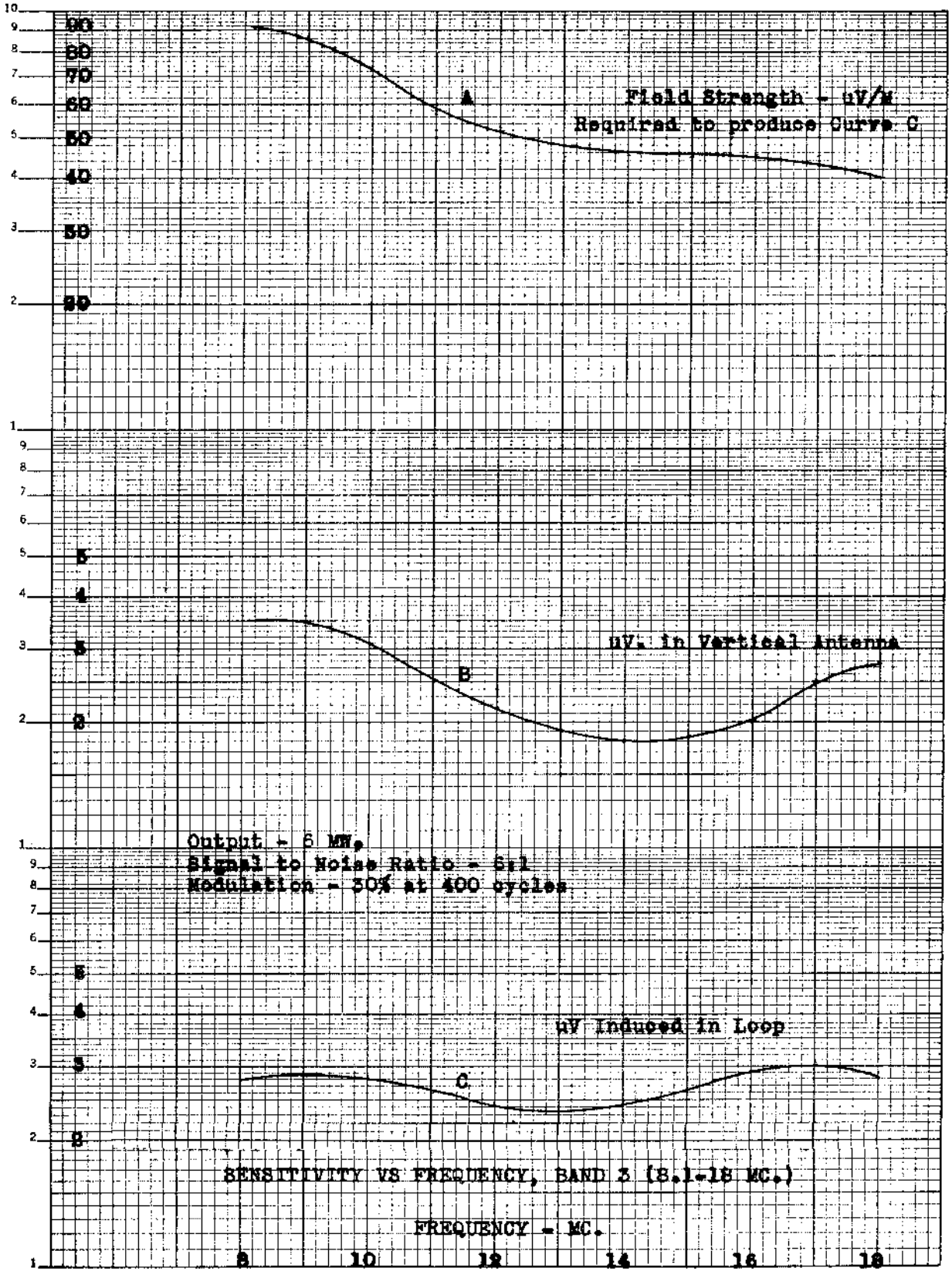


Figure 13, SENSITIVITY CURVE, BAND 3

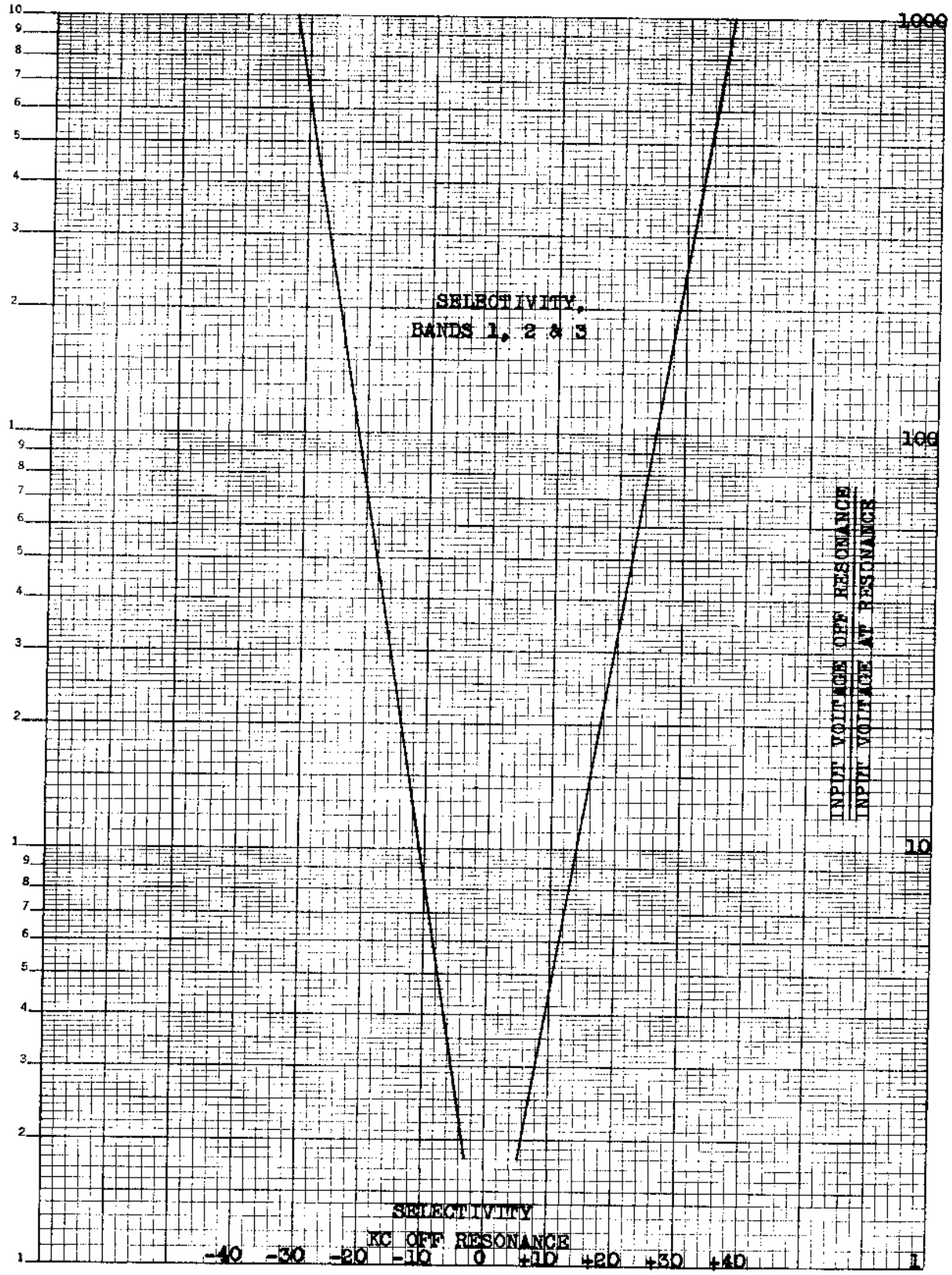


Figure 14, SELECTIVITY CURVE

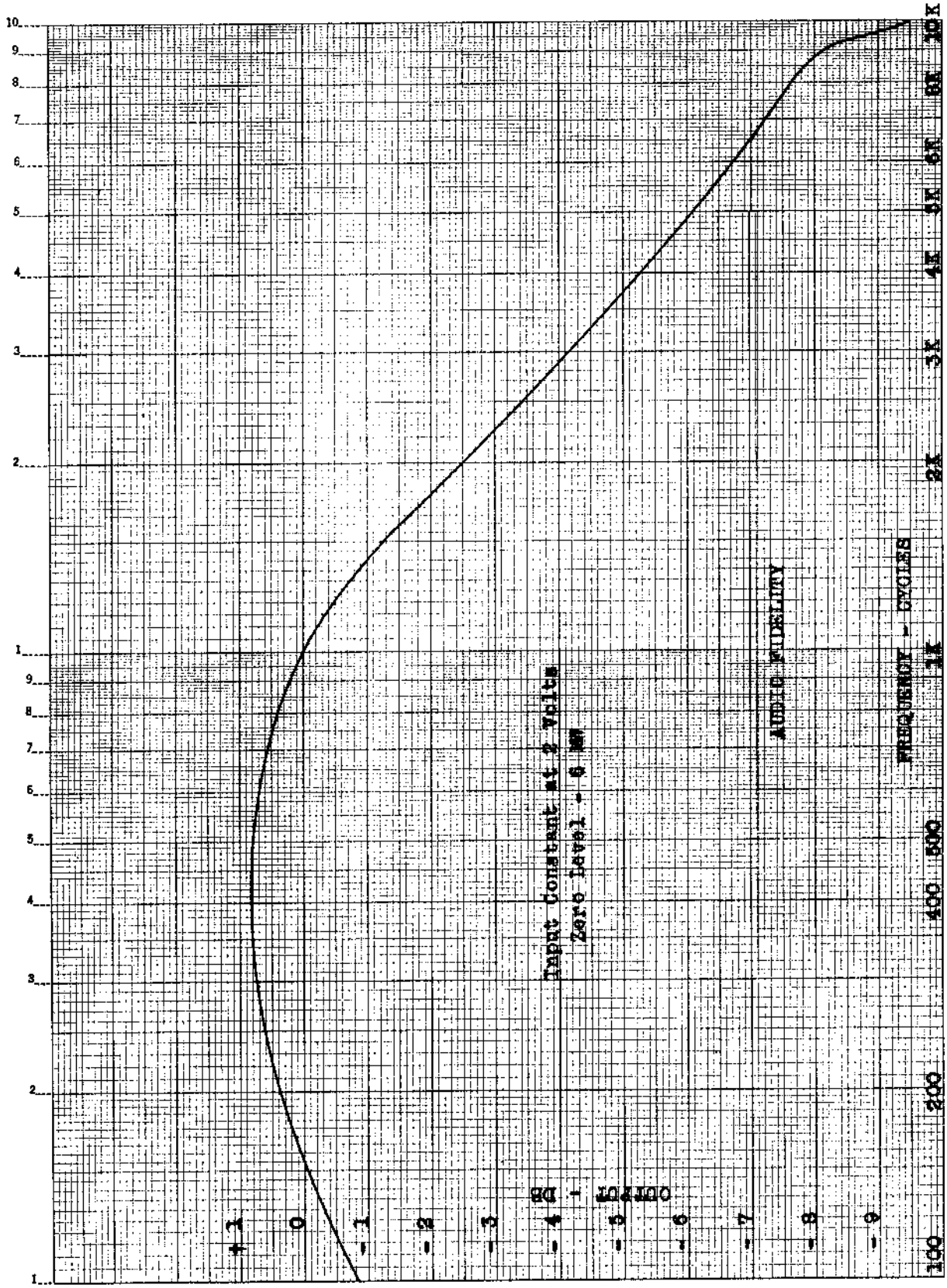


Figure 15, FIDELITY CURVE

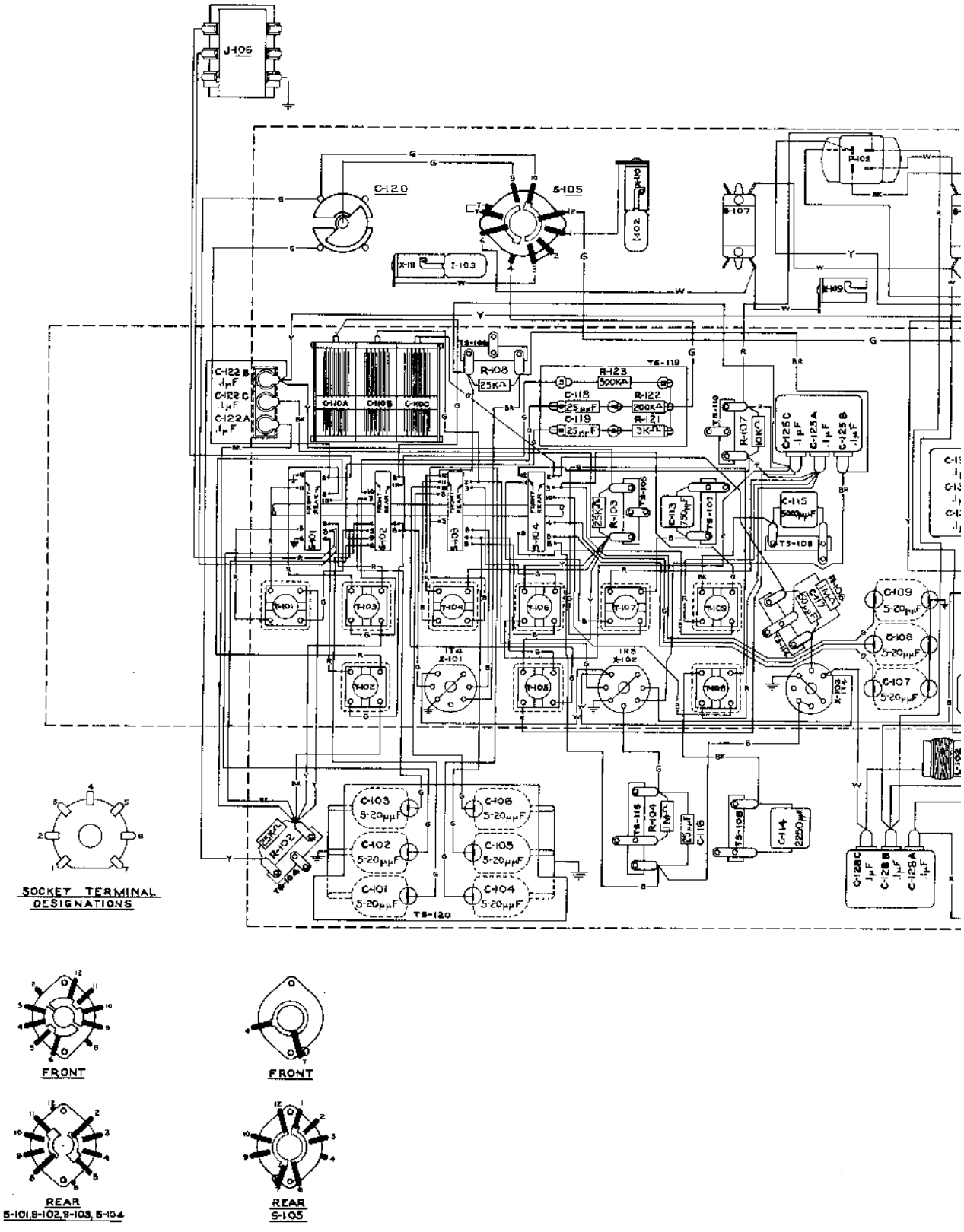
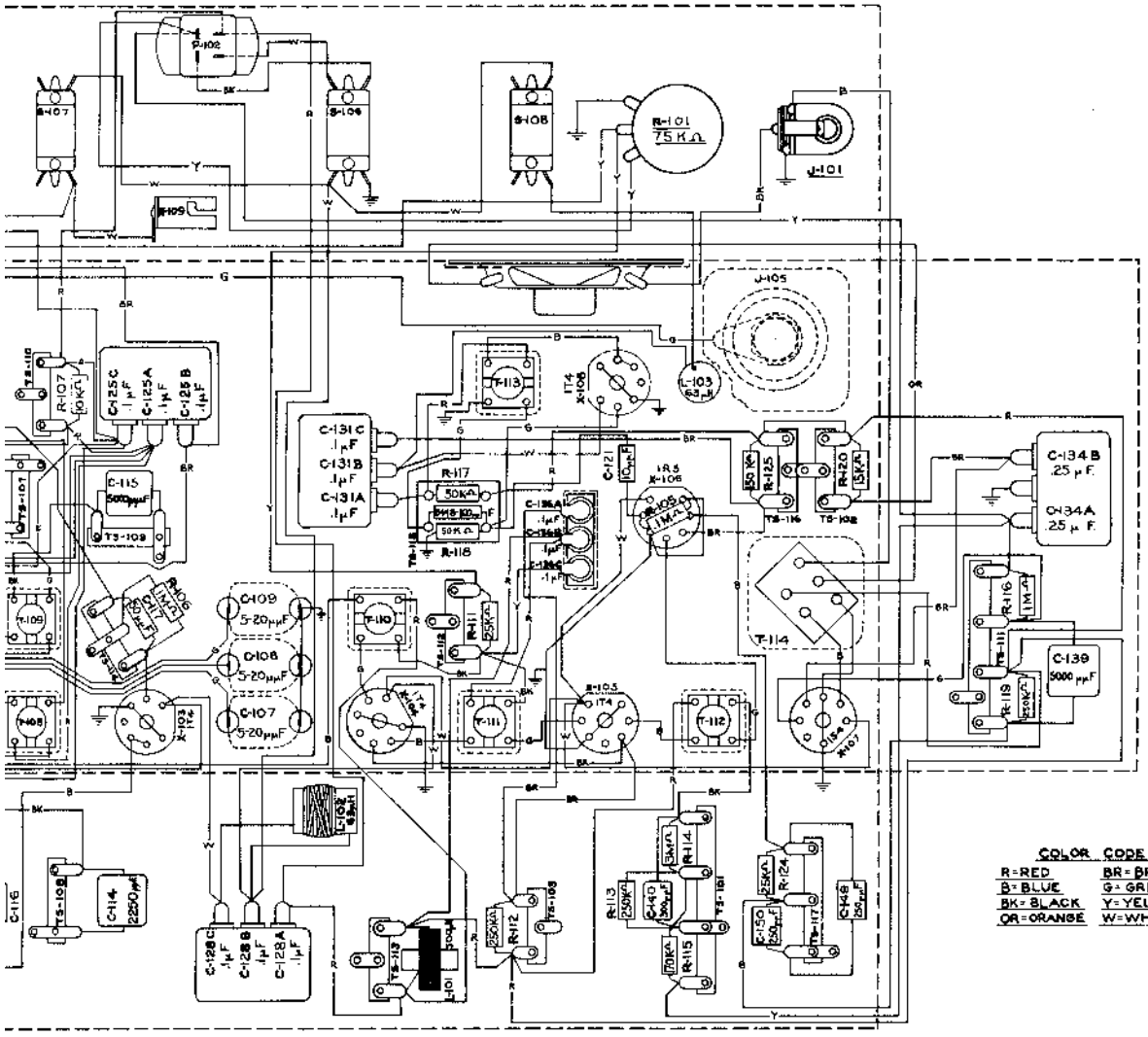
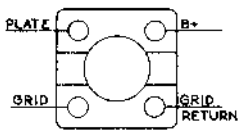


Figure 16, MODEL DAG-1 PORTABLE RADIO DIREC
TYPE CIA-46174-A RADIO RECEIVER, V

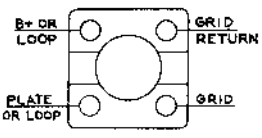


COLOR CODE

R=RED	BR=BROWN
B=BLUE	G=GREEN
BK=BLACK	Y=YELLOW
OR=ORANGE	W=WHITE



BOTTOM VIEW
T-110, T-111, T-112, & T-113



BOTTOM VIEW
T-101, T-102, T-103, T-104, T-105, T-106, T-107, T-108 & T-109

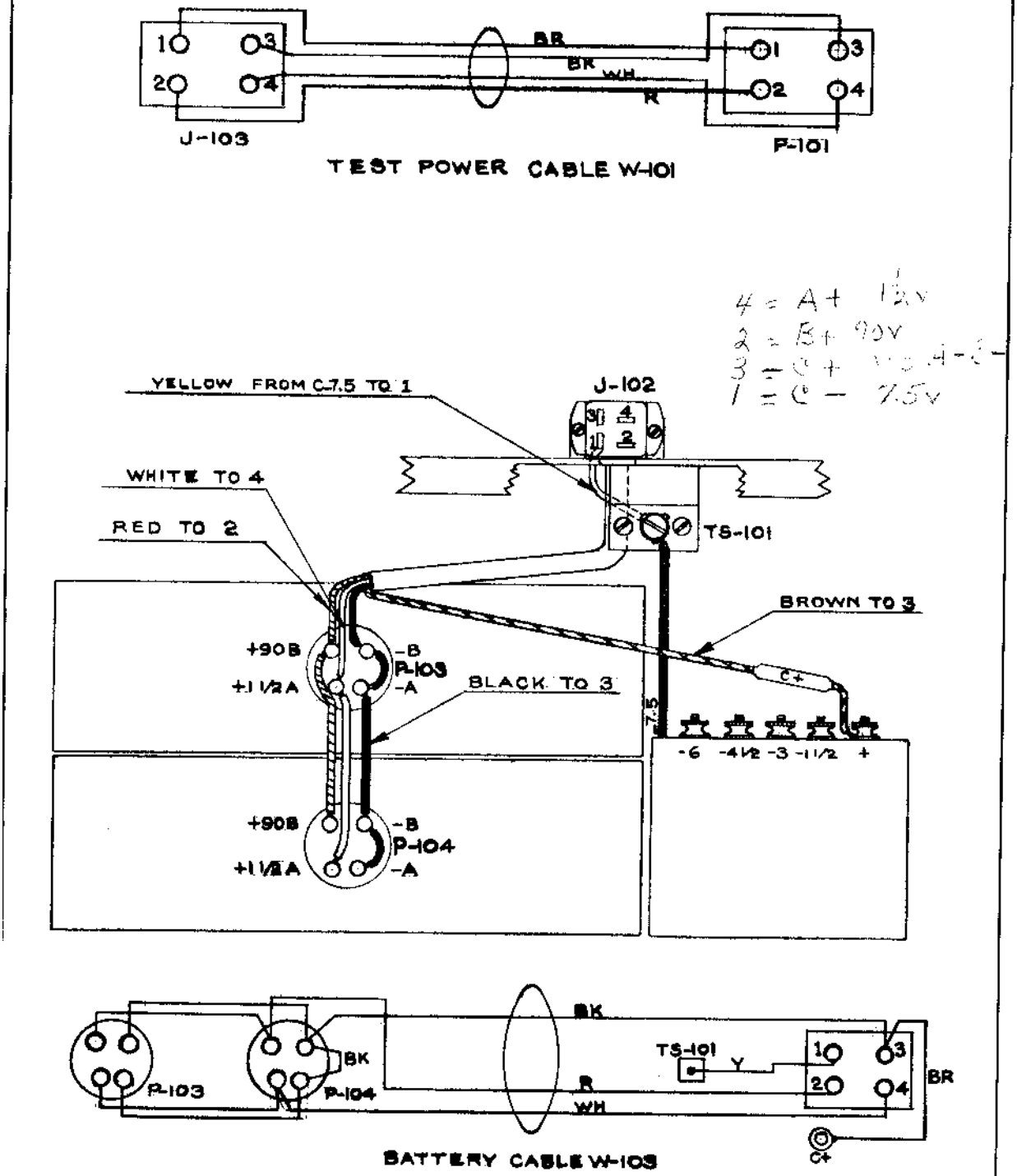


Figure 17, MODEL DAG-1 PORTABLE RADIO DIRECTION FINDER EQUIPMENT—BATTERY CABLE ASSEMBLY AND CONNECTIONS

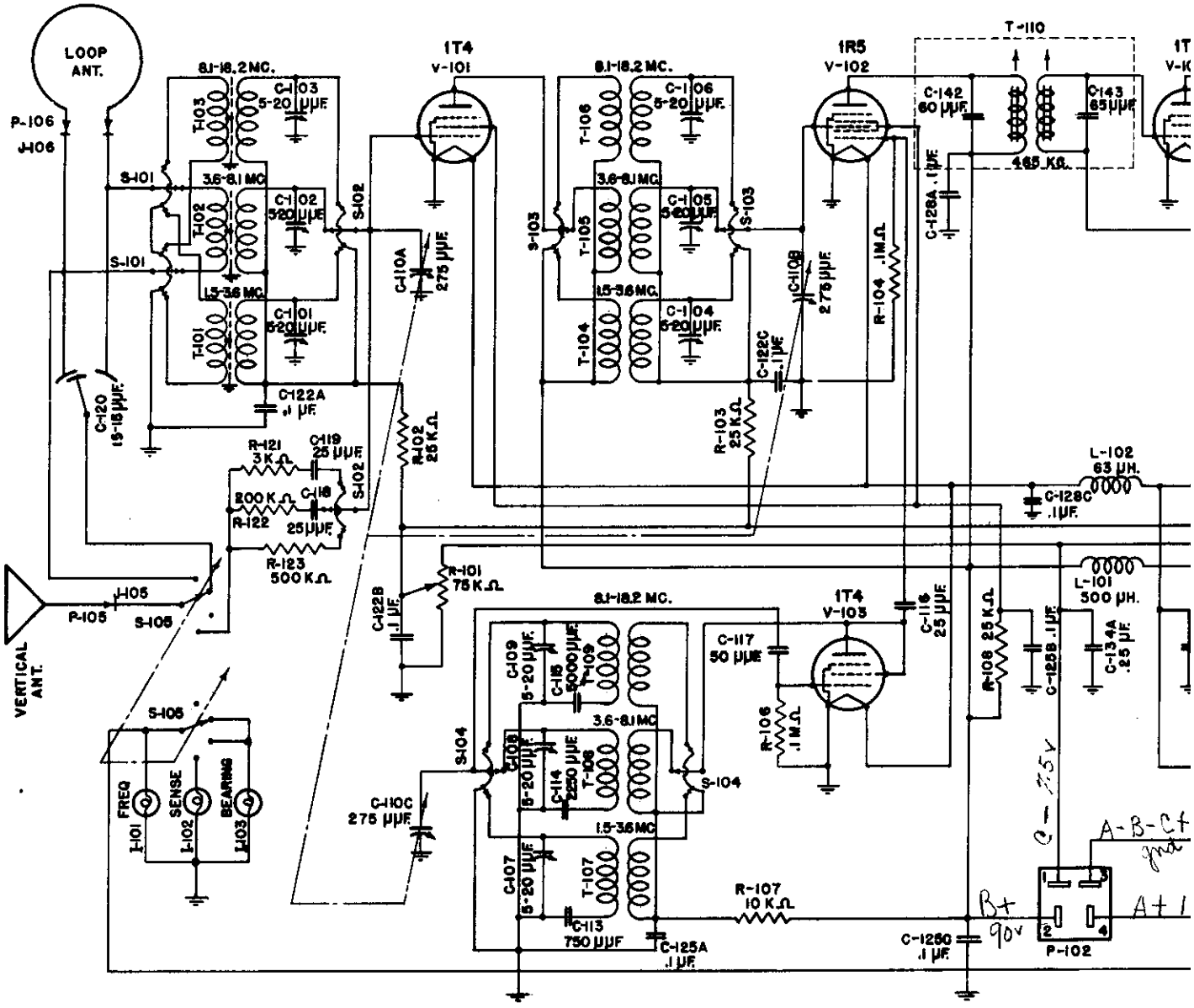
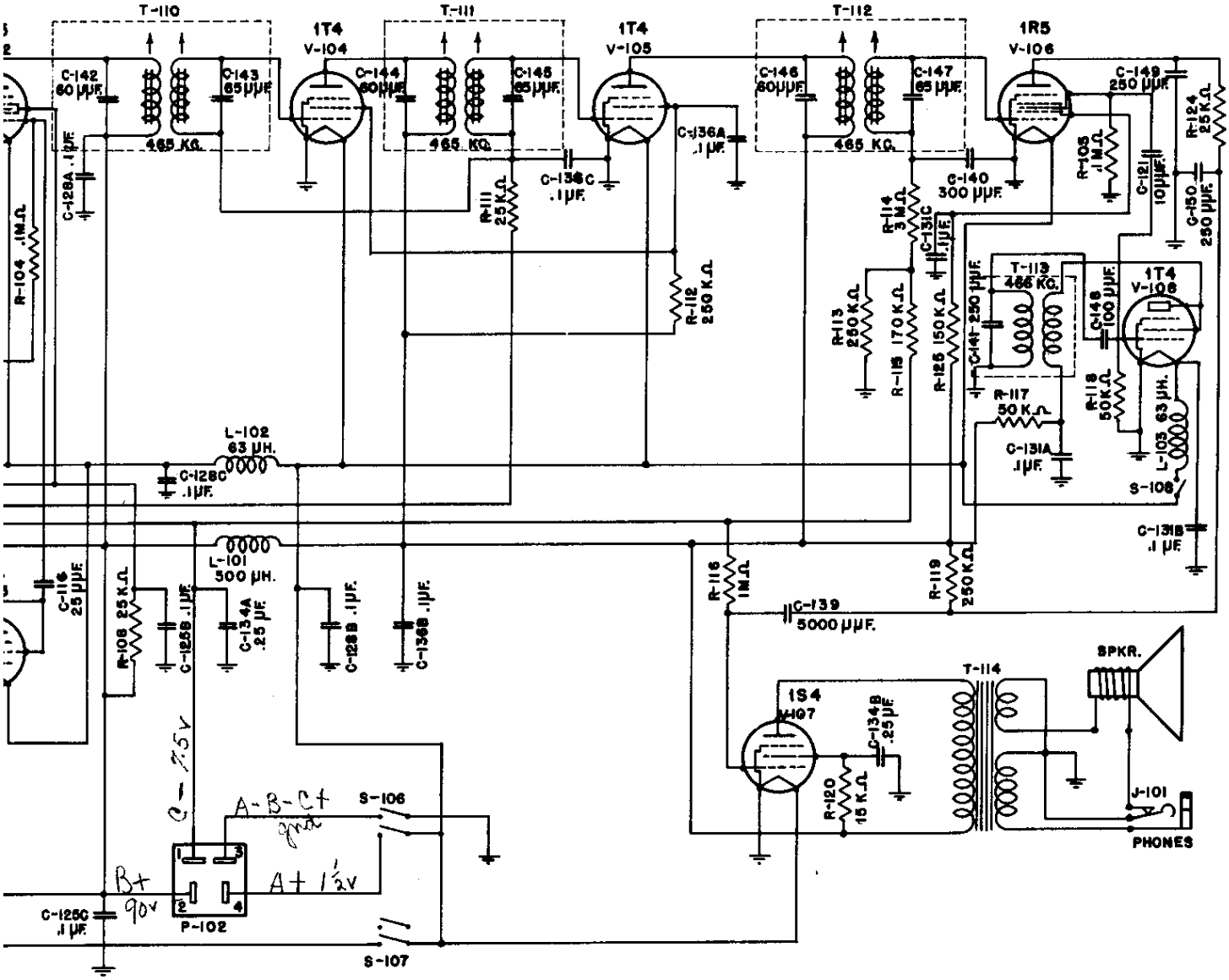


Figure 18, MODEL DAG-1 PORTABLE RADIO DIRECT
TYPE CIA-46174-A RADIO RECEIVER, SCH



PORTABLE RADIO DIRECTION FINDER EQUIPMENT—
74-A RADIO RECEIVER, SCHEMATIC CIRCUIT