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ELECTRONICS INSTALLATION AND MAINTENANCE BOOK

COMMUNICATIONS

DEPARTMENT OF THE NAVY
BUREAU OF SHIPS

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COMMUNICATIONS EQUIPMENT

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PREFACE

The Electronics Installation and Maintenance Book (EIMB), NAVSHIPS 900,000 series, provides subordinate policies and installation and maintenance information for Naval electronic equipment. The information contained in this series is supplementary to equipment technical manuals and related publications and is intended to reduce time-consuming research.

The EIMB is organized into separate handbooks and issued as separate items of supply, each with its own NAVSHIPS decimal number, as follows:

NAVSHIPS	TITLE
900,000.1	Communications
900,000.2	Radar
900,000.3	Sonar
900,000.4	Test Equipment
900,000.5	Radiac
900,000.7	Countermeasures
900,000.100	General
900,000.101	Installation Standards
900,000.102	Electronic Circuits
900,000.103	Test Methods and Practices
900,000.104	Reference Data
900,000.105	RFI Reduction

The Communications Handbook, NAVSHIPS 900,000.1 is intended to provide a convenient source of information and reference for personnel engaged in installation and maintenance of Naval electronics communications equipment. The handbook provides procedures to supplement information contained in electronics equipment technical manuals. The scope of this handbook includes: Section 1, General Information; Section 2, Circuit Applications; Section 3, Field Change Identification Guide (FCIG); Section 4, Service Notes; and Section 5, Reference Data.

The Communications Handbook is in effect upon receipt and replaces all previous data of a corresponding nature in the EIMB.

Suggestions for additions and corrections of errors should be submitted to BuShips Electronics Division, Fleet Electronics Effectiveness Branch (Code 678), Bureau of Ships. Periodic revisions and additions will be made to assure that the material will always reflect the best current data and keep abreast of new developments.

Requisitions for additional copies of this handbook should be submitted to Naval Supply Depot, Philadelphia, Pennsylvania. Activities not already on the distribution list of the EIMB should submit requisitions to Chief, Bureau of Ships (Code 679A2), in order to assure receipt of future revisions.

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SECTION 1

GENERAL

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1-1 INTRODUCTION

PURPOSE.

The purpose of this chapter is to provide general reference material which will aid in maintaining naval communication equipment. Installation data is specific for each equipment and, therefore, is obtained from the appropriate instruction book and the Service Notes section of this chapter.

The equipment described includes all forms of units used for radio communication: transmitters, receivers, teletype and facsimile equipment, terminal equipment for teletype and facsimile equipment, and power supplies and remote control units for all the foregoing.

SCOPE

The material in this chapter takes the form, for each type of equipment, of:

a. A description of the basic principles of operation, which is needed for application of the troubleshooting procedures.

b. A description of the configurations of functions within the equipment.

c. Description and location of adjustments commonly found.

d. A preliminary troubleshooting outline, for use in checking the more easily overlooked causes of trouble and to determine the general area in which the malfunction is located.

e. A troubleshooting procedure for each general area of the equipment and type of complaint.

TROUBLESHOOTING

The electronics technician is urged to analyze each failure to determine its possible causes before attempting to repair a malfunctioning equipment. This step, which should precede removal of the equipment from its cabinet, includes the following:

a. Equipment operation should be tested in all modes and with the use of all functions to permit the malfunction to be described completely.

b. The performance data obtained should be analyzed, with the use of the equipment schematic or block diagram, to determine what specific functions, if impaired, would result in the symptoms noted.

c. Finally, the specific components, which if failed could result in the impairment of the function noted, should be listed.

Many technicians need no instruction to perform these steps, but an outline of the preliminary troubleshooting steps will be useful to the less experienced technician.

More specific troubleshooting procedures are then used to identify the failed component. These, too, might be performed by the experienced technician without specific instructions, but the troubleshooting procedures given will be useful to less experienced technicians. The use of these techniques will save time and money, improve equipment conditions, and improve technical competance.

SAFETY

Hazards encountered in servicing electronic equipment and the precautions to be taken against them are covered thoroughly in electronic technicians training courses, Chapter 1 of the EIMB, and the Navy Safety Manual. These sources should be referred to in case of any doubt about safety precautions to be observed in troubleshooting.

Observance of safety precautions will help keep equipment operating, help your career in the Navy, and possibly determine whether you survive. Follow them!

TYPES OF EMISSION

Understanding the operation and servicing of communication equipment depends to a large extent on understanding the types of radio emissions used. These are tabulated completely in the EIMB appendix; the commonly used emissions are described following.

AM EMISSIONS. A continuous, unmodulated, fixed-frequency radio signal (AO emission) carries no information. The signal must be modulated by another frequency or waveform in order to convey information.

In CW communication, the carrier is present only during coded intervals, as shown in figure 1-1. Such an A1 emission requires a higher degree of operator skill, but uses less complex equipment and is capable of reliable reception over greater distances than other types of emission.

A3 transmission is the radiation of R-F energy which has been amplitude modulated by an audio signal carrying the desired intelligence. A-M voice or "phone" transmissions use this type of emission, as do MCW (A2 or keyed audio-modulated CW), some teletype, and multiplexed voice and/or teletype transmissions.

SINGLE-SIDEBAND EMISSIONS. Although an amplitude-modulated signal is usually pictured as R-F waves within a modulation envelope, as shown in figure 1-1, it is more usefully described in terms of frequency distribution in figure 1-2. This shows the single-tone, amplitude-modulated R-F signal to actually consist of simultaneous transmission of the carrier (f_o), a lower side frequency ($f_o - f_M$), and an upper side frequency ($f_o + f_M$), where f_M is the modulating of the carrier (f_o), a lower side frequency (f_o-f), and an frequency. The beat frequency between the carrier and one or both side frequencies (figure 1-3) is detected and amplified by the receiver to reproduce the audio modulating tone. The carrier frequency can be modulated by more than one audio frequency at a time. Voice-modulation of the R-F signal by frequencies between 100 and 2000 cps, for example, would produce two sidebands rather than two side frequencies. These 1900 cps wide sidebands are shown in figure 1-4. The shape of the sidebands varies from instant to instant with changes in the frequency composition of the modulating voice signal. Conventional A-M phone transmissions result in such frequency distributions.

Two-thirds of the total amplitude-modulated power is in the carrier under perfect conditions, as shown in figures 1-5 and 1-6, and only one-sixth in each side frequency or sideband. However, actual A-M voice transmissions never attain this theoretical efficiency figure (100% modulation).

In practice, each sideband contains perhaps a tenth of the total transmitted power during modulation. The carrier continues at two-thirds of the total maximum power even when no information is being transmitted, such as during pauses between words and sentences.

Single-sideband techniques permit substantial savings in transmitter cost, size, and power consumption for a given information-carrying power. Only one sideband is emitted and only in the presence of a modulating signal. More important, no carrier at all is emitted in SSB transmission. The receiver generates a local frequency which is injected with the sideband signal to take the place of the carrier; the difference frequencies resulting from the heterodyning action are the audio components of the modulation. Such transmissions (A3a emission) occupy less than half the spectrum space of a conventional A-M transmission, relieving the crowded conditions and interference in the radio spectrum.

F-M EMISSIONS. Figure 1-7 shows an R-F waveform which abruptly changes in frequency at regular intervals, while remaining constant in amplitude. This frequency-modulation technique is known as F1 emission; it is used for FSK (frequency-shift keying) transmission of teletype messages.

An R-F emission that is frequency modulated by a single audio tone will produce a single R-F signal varying in frequency. These components and the frequency-modulated R-F output are shown in figure 1-8. Note that the frequency-modulated carrier passes through the center frequency (f_o) twice for each cycle of the modulating signal and that its amplitude is constant. Increasing the frequency of the audio modulating signal, figure 1-8, will increase proportionately the number of times per second that the modulated radio frequency passes through the center frequency, and vice-versa. The effect of decreasing or increasing the amplitude of the modulating signal is to decrease or increase the frequency deviation without affecting the number of frequency excursions per second.

SECTION 2

CIRCUIT APPLICATIONS

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This section is under preparation. When completed, it will contain descriptions of circuit applications related to communications equipment. These descriptions will be supplied in later changes to this handbook.

SECTION 3

FIELD CHANGE IDENTIFICATION GUIDE

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3-1. POLICY

a. The Bureau of Ships Manual, Chapter 67, states the policy for alterations and modifications to electronic equipment. Chapter 67 defines alterations as any change in hull, machinery, fittings, or equipment affecting design, material, number, location or relationship of the component parts of an assembly or system.

b. Only in actual emergencies, will alteration to or modification of electronic equipment under the cognizance of the Bureau of Ships be undertaken, without prior approval of, or direction by, the Bureau. All requests for approval shall be forwarded via the chain of command; state the exact nature of the proposed alteration or modification, reason therefor (also whether for permanent or for special temporary use) and appropriation to which chargeable. Unauthorized alterations to equipment under contractual guarantee may result in the nullification or cancellation of the guarantee and financial loss to the Government, and may result in failure of the equipment to provide the service for which it was installed. If alterations are accomplished under emergency conditions, adequate consideration must be given to safety of personnel and equipment and to the basic performance requirements. The Bureau should be advised at the earliest practicable date of the actual changes made.

c. Field changes are the means by which approved and authorized alterations or modifications are made to the Bureau of Ships electronic equipments. These changes are mandatory and shall be accomplished in accordance with the instructions contained in the field change bulletin.

3-2. DOCUMENTATION

This guide is a revised list of field changes to electronics equipment under the technical control of the Bureau of Ships. It is in effect upon receipt and supersedes the communications portion of Section 4 of the General Handbook, NAVSHIPS 900,000.100, and the communications portion of Change 1 thereto.

3-3. OBJECTIVE

a. The objective of the Field Change Identification Guide (FCIG) is to provide a current list of field changes together with information enabling technical personnel to determine by inspection the applicable field changes that have been accomplished.

b. This guide is published for the information of technical personnel and does not indicate availability of the field change or correction material within the supply system. These items shall not be requisitioned from the supply system until availability notice is published in the EIB or the item is entered in latest revision of NAVSANDA 2002.

3-4. DEFINITIONS

a. Field Change. A field change is any modification or alteration authorized by the Bureau of Ships or agency concerned to be made to an electronics equipment subsequent to delivery to the government.

b. Field Change Kit. A field change kit is the formal means made available to permit accomplishment of a field change. A kit may consist of only published matter or be an assembly of published matter and required material. Kits consisting solely of published matter will not carry a stock number.

c. Classification of Field Change. Field changes shall be of the following types and classes:

(1.) Type designation is defined as follows:

(a) Type 1 - A Type 1 field change includes a publications package and all parts and materials required to accomplish the change to a single equipment and to revise equipment nameplates and manuals.

(b) Type 2 - A Type 2 field change consists only of publications material which provides instructions for accomplishing the change and revising the equipment nameplates and manuals. A Type 2 field change may or may not require that parts be requisitioned.

(c) Type 3 - A Type 3 field change includes a publications package and a portion of the parts and materials required to accomplish the change to a single equipment and to revise equipment nameplates and manuals.

(2) Class designation is added as a hyphenated suffix and has the following meaning with respect to field changes:

(a) Class A - Funding for installation is not required. These field changes are approved for accomplishment by forces afloat or station personnel without further reference to the Bureau of Ships under conditions stated in the field change bulletin. These conditions include cases where equipments affected are identified by serial numbers, group, or application.

(b) Class B - Fleet or shore funding for installation is required. These field changes are approved for accomplishment by Naval shipyards, tenders, repair facilities or shore maintenance authority without further reference to the Bureau of Ships under conditions stated in the field change bulletin when authorized by Type or station commanding officers.

(c) Class C - Bureau of Ships funding for installation is required. To meet urgent operational commitments, the Bureau may approve accomplishment of Class C field changes subject to Type Commander's funding. This class of field change includes, but is not limited to, those changes in operational improvement and is accomplished in the Material Improvement Program's order of priority. These field changes are approved for accomplishment by Naval Shipyards, tenders, repair facilities, or shore maintenance activities under conditions stated in the field change bulletin.

3-5. INSTRUCTIONS REGARDING ACCOMPLISHMENT

a. Background. Accomplishment of applicable field changes is essential to the proper functioning, identity and logistic support of electronics equipments. Effective 1 October 1957, electronics field change kits were transferred from "N" to "F" cognizance. This permits the issue of field changes to ships and activities without charge to their allotments.

b. Recording. The completion of all field changes, alterations, and modification to electronic equipment authorized by the Bureau of Ships shall be recorded on Field Changes Record Card, NAVSHIPS 537 and the Electronic Equipment History Card, NAVSHIPS 536.

c. Reporting. Except as required in Bureau of Ships Instruction 10550.1B Series, accomplishment of field changes should not be reported to the Bureau of Ships. However, the performance and operational reports, required on certain equipments, should list the field changes that have not been accomplished.

3-6. HOW TO USE THIS GUIDE

a. Corrections. Recommendations for correction of errors, and the addition of pertinent information to this guide should be reported to the Electronics Publications Section (Code 679A2), Bureau of Ships and include:

(1) Designation of affected equipment.

(2) Location of error by page and line.

(3) Description of error and indication of what change should be made.

b. Additions. Space has been provided on each page for pen and ink additions or corrections published in the Electronics Information Bulletin (EIB). Periodically, the index will be updated by issuing revised pages.

c. Use. Equipment designations are arranged alphanumerically. A star (*) appearing next to a field change designation indicates that the field change is available for accomplishment by field activities.

(1) Information on each field change is given in the following sequence:

(a) the field change number

(b) the field change title

(c) Correction material-temporary corrections, and revisions to existing equipment publications, complementary technical manuals, and technical manuals accomplishing field change kits.

(d) the type - class (the type and preferred activity to accomplish the field change, i.e., Types 1, 2, and 3, Class A, B, and C.

(e) the modifying activity (i.e. FA-forces afloat, YF - yard forces) and the number of manhours required to accomplish the field change.

(f) The bulletin NAVSHIPS number or other reference

(g) The Federal Stock Number assigned to a particular field change. Suffixes are given to identify various categories and for record purposes. They are as follows:

SUFFIX	MEANING
C	FSN cancelled; material disposed of.
C1	FSN cancelled in accordance with BUSHIPS ltr ser 880-276 of 18 April 1957
C2	FSN cancelled in accordance with BUSHIPS ltr ser 880C-285 of 22 April 1957
C3	FSN cancelled in accordance with BUSHIPS ltr ser 880C-295 of 26 April 1957
C4	FSN cancelled in accordance with BUSHIPS ltr ser 880D-398 of 22 May 1957

Where the word "None" appears, the field change is either a Type 1 kit which was not converted to a Federal Stock Number or a Type 2 kit not requiring a stock number.

(h) the serial numbers or applicable conditions of specific equipments affected by a particular field change. "BUSHIPS" indicates that specific field changes to indicated equipments are as designated by the Bureau of Ships. Accomplishment of these changes should be arranged for in accordance with current instructions.

(i) the identification information applicable to each field change for use in determining its accomplishment.

(2) Reference to field changes should always be by use of the assigned field change number, together with the equipment designation, as follows:

FIELD CHANGE NUMBER EQUIPMENT DESIGNATION AN/SPS-6C

d. Abbreviations. Except for those listed below, the abbreviations used in the FCIG were taken from Standard Abbreviations (JANAP 169), "Military Standard" Abbreviations for Use on Drawings (MIL-STD-12A) and "Military Standard" Abbreviations for Electrical and Electronic Use (MIL-STD-103).

ACU	Antenna control unit
ATDIR	Attack director
AFT	Automatic target follower
ATR	Anti-transmit-receive
BDI	Bearing direction indicator
BKT	Bracket
CCL	Communication control link
CPLR	Coupler
DLVD	Delivered
DPLXR	Duplexer
FC	Field change
FE	Field engineer
FS	Frequency shift
GTT	Generated target training
HYDPH	Hydrophone
IMPED	Impedance
I & S	Installation and Service Bulletin
LSTN	Listening
MAGGY	Magnetron
MCC	Maintenance close contact
MFD	Microfarad
MFI	Multiple feature
MODIF	Modification
MTB	Maintenance true bearing
MTR	Meter
NLM	Noise level monitor
NOR	Norfolk
NRTC	Naval Reserve Training Center
NS	NavShips
N.T.-	Navy type
ODN	Own doppler nullifier
PERFRM	Performance
P/N	Part number
P/O	Part of
RA	Receiver-amplifier
RAI	Receiver-amplifier-indicator
RCG	Reverberation controlled gain
RECVR	Receiver
RHI	Remote height indicator
RIB	Radio Installation Bulletin
RMB	Radio Maintenance Bulletin
RNG	Range
RPPI	Remote plan position indicator
RTRB	Reliable true and relative bearing
SMB	Sonar Maintenance Bulletin
TB	Terminal board
TDC	Torpedo data computer
TDR	Time delay relay
TRB	True and relative bearing
TVG	Time variation of gain
VSWR	Voltage standing wave ratio
WGT	Weight
XDUCER	Transducer
XFMR	Transformer
( )	Series

1-AM-215/U – Tube retaining clips, install
Correction material: T-1 to NS 900,995
A FA-1-1/2 NS98163 F5895-311-2797
SERIAL: All open bridges
IDENTIFY: Channel selector switch does not function.

2-AM-215/U - To electrically remove station selector switch
Correction material:
YF-1 NS98759 None
SERIAL: All installed on open bridges and pilot houses
IDENTITY:

1-AM-215A/U – Same as 2-AM/215/U

1-AM/215B/U – Same as 2-AM-215/U

1-AM-413/G - Replaces the 5Y3 Rectifier Tube V107 with Solid State Rectifiers Type 1N561
2-A NS None
SERIAL: All (Shore)

1-AM-413A/G - Same as 1-AM-413/G

1-AM-413B/G - Same as 1-AM-413/G

1-AM-413C/G - Same as 1-AM-413/G

1-AM-413D/G - Same as 1-AM-413/G

1-AM-420/U - Overload protection, provide
2-A FA-1/2 [illegible] None
SERIAL: All
IDENTITY: 6 amp line fuses F103 & F104 replaced with 2 amp fuses.

2-AM-420/U - Replace capacitor C-123.
Correction material: T-3 to 91517
2-A FA-1/2 NS981235 None
SERIAL: All
IDENTITY: Absence of capacitor C-123, replace by two 300 Kohm capacitors.

1-AM-421/U – Same as 1-AM-420/U

1-AM-1365-URT – Improvement of operation.
Correction material: T-1 to NS93563
2-A FA-½ NS981330 None
SERIAL: 1 thru 306, except 303.
IDENTITY:

1-AM-2289/FSA-17–Installing mounting bracket for connectors J1 and J2.
Correction material: None
1-A FA-1½ NS981307 None
SERIAL: All
IDENTITY:

1-AN/ARC-1 – Dynamotor inter, reduce
Correction material: T-1 to AN16-30ARC1-3, T-1 to AN08-30ARC1-3
A FA-2 NS98778 None
SERIAL: 1-8911
IDENTITY: C-801 changed to 10,000 mmfd. An 8,200 mmfd cap. installed bet. hi-voltage brush terminals and dynamotor "thru" bolt.

2-AN/ARC-1 - Guard reception, modif
Correction material: T-1 to NS 900,145
SERIAL: All
IDENTITY: Several capacitors and one resistor added to G.C. RF amp strip. C-253X added in parallel with C-253 at pin 1 of X-123. Guard channel strip must be removed to identify.

3-AN/ARC-1 - 115vac operation, adatp to AN/ARC- 1X
Correction material: Change 1 to AN16-30ARC1-3
C FA-2 NS98543 F5820-302-5522
SERIAL: BUSHIPS
IDENTITY: PP-1092/U installed

1-AN/ARC-1A – Same as 3-AN/ARC-1 except;
Correction material: Change 1 to AN16-30ARC1-7

2-AN/ARC-1A - Same as 2-AN/ARC-1

1-AN/BRA-4 -
Correction material:
NS98984 None
SERIAL: 2-22
IDENTITY:

1-AN/BRR-3 - Replacing connectors J607, J608, J609 and J610 with connector J618.
Correction material: Change 2 to NS93716, Change 1 to NS93716.61, Change 1 to NS93716.42
1-A FA-2 NS981479 F5820-064-6248
SERIAL: A1 through A9 and B1 through B99
IDENTITY: One nine pin connector replaces four coaxial connectors for the loop antenna cable.

1-AN/CRT-3 – Operating freq, chg
Correction material: T-1 to AN16-30CRT3-2
A FA-1-1/2 NS98393 F5820-302-4110
SERIAL: All on ships
IDENTITY: Switchplate reads new frequency 8364 KC.

1-AN/FCC-3 – Res in recvr, chg
Correction material: T-1 to NS 91901
1-A FA-9 NS98419

SECTION 4

SERVICE NOTES

COMMUNICATIONS

DEPARTMENT OF THE NAVY
BUREAU OF SHIPS

WHAT DOES ANTENNA CURRENT MEAN?

"Meter inoperative, evidently burnt out. 0-5 ampere range seems too low. We find it difficult to keep antenna current this low on most frequencies.__USS____." This report is made frequently. Here is another typical report. "...by changing the length of the antenna, the current was raised from 1 ampere to 2 amperes, thereby increasing our field strength...." This statement is incorrect. The operator merely moved the standing wave relative to the ammeter to bring a high-current part of the standing wave on to the ammeter. The field strength did not necessarily change, and the operator had to record new adjustment settings for his loading circuit due to the altered imput impedance of the antenna. It is believed that the following short discussion will prove helpful to the understanding of the distribution of current in an antenna system.

Figure 1 shows an antenna system with the parts drawn stretched out in a line. Figure 2 shows a standing wave of current of an antenna system. The shape of the loops is supposed to be sinusoidal, but these curves will suffice for discussion purposes. Length in the horizontal direction means "distance along a wire". Height in the vertal direction means "quantity of current in the wire". The curves show the amount of current at any point in the wire. The current in a standing wave is not the same all along the wire, but varies as shown in figure 2. There are several ways to draw a standing wave, but the one shown is one of the best because it shows all current as positive, or above the zero line, which is the only way a thermocouple-ammeter can indicate it. In practice, the standing wave is not as smooth as shown, but is partly irregular due to changes in surge impedance along the length of the antenna system.

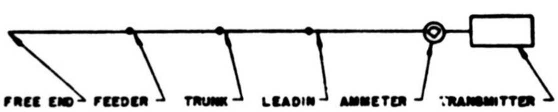

FIGURE 1.--An antenna system

FIGURE 2.--A standing wave of current

Consider a standing wave for a frequency of two megacycles. Its half-wavelength is computed by dividing the frequency in megacycles into 492 feet. The answer in this example is 246 feet which means that there will be 246 feet between the nulls or zero-points of the standing wave (see fig. 3). This distance between nulls is called a half-wavelength. Notice that all points separated by a half-wavelength have the same amount of current in them.

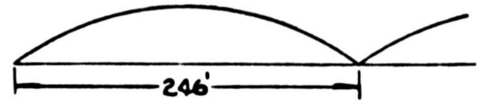

FIGURE 3.--A half-wave at two megacycles

Figure 4 shows how much current the ammeter will indicate for various combinations of antenna length and standing wave. The antenna's length is fixed aboard ship, but the standing wave's length varies with the frequency as described above. Each example has a note beside it giving an estimate of the current. The antennas are drawn spread out like the one in figure 1. Actually each antenna can be of any length, and each standing wave can be of any frequency, provided the standing wave and antenna fit each other as shown in the figure.

The conditions shown in figure 4 will occur when the ammeter is connected between the antenna and the loading reactors of the transmitter- which is usually the connection used. In a very few cases, the transmitter utilizes a different connection, with the ammeter in the loading circuit, and then the readings depend on the tuning as well as the antenna lengths.

The most useful services that the ammeter can perform are:

(1) On frequencies for which the antenna current happens to be large enough at the location of the ammeter to indicate some current, one can be sure that modulation is occurring by watching the ammeter move during speech or mcw transmissions. The meter usually moves slowly and reads only 22.5 percent extra current during 100 percent modulation. (A superior modulation indicator would be a monitor built for the purpose, with which an oscilloscope or headphone indication is used.)

(2) If the ammeter indicates a readable current, then it can be used as a carrier indicator because the current reading will drop if the carrier fails. However, this function is not important as the final plate ammeter and other meters will indicate the same thing. Another excellent carrier indicator consists of a neon bulb loosely coupled to the antenna. This also makes a satisfactory modulation checker.

(3) If the ammeter current is readable and if the antenna (or dummy antenna) input resistance is known, then the power output of the antenna may be computed. In general, the technician does not know the antenna resistance.

(4) If the ammeter current is readable it can be used as a guide for further tuning of any stage in the transmitter. However, the transmitter is usually equipped with other meters for tuning the transmitter correctly.

(5) The antenna ammeter is useful for the indication of accidental changes in the transmitter output or in the antenna impedance (due to grounds, etc.) provided that the correct reading for the frequency in use is recorded and checked frequently. This action is also equally well accomplished by observing the final plate ammeter.

Meter reads ZERO (Half-wave-length antenna)

Meter reads LOW (Antenna very short compared to wavelength in use)

Meter reads ZERO (Antenna equal to wavelength or any whole number of half-wavelengths)

Meter reads VERY HIGH, and may *burn out.* (Antenna length is an odd number of quarter-wavelengths)

Meter reads several amperes (Antenna length is not any of the above cases)

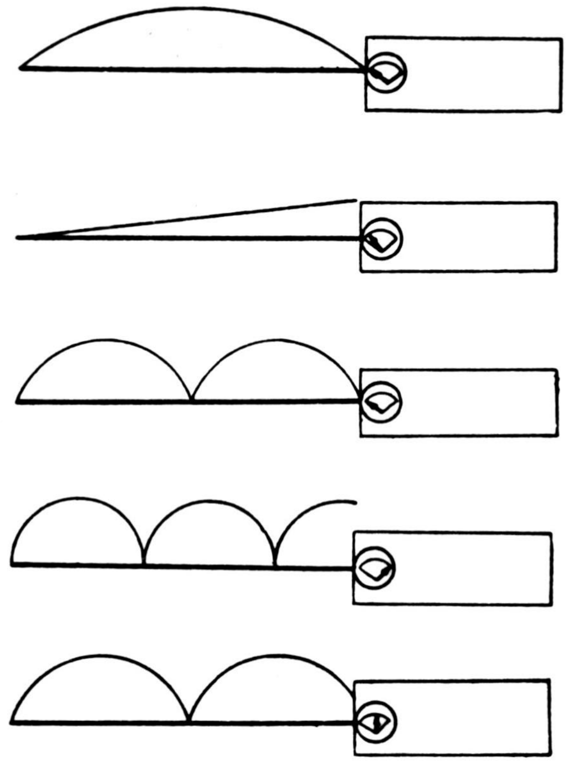

FIGURE 4.--Ammeter readings for various combinations of antennas and frequencies

(6) The antenna ammeter is often useful when reducing the output power, since reducing the antenna current to half its normal value will reduce the radiated power to one quarter its normal value.

It should now be evident that the antenna current meter is useful, but not a necessity, and that in a given installation it can indicate any current from zero to off-scale, the value depending on the frequency as well as on the amount of power fed to the antenna.

What to do when the frequency in use is such that the antenna ammeter indicates zero: NOTHING!! Proper use of the *final plate ammeter* will indicate that power is being fed to the antenna.

What to do when the antenna ammeter is being driven off scale: Try to take action, because the meter may burn out and prevent transmissions until a repair is effected. You may reduce the transmitter power by decreasing the *power fed to the transmitter.*

CONSTRUCTION OF A STANDARD DUMMY ANTENNA

In aligning certain model receivers, such as the RBB/RBC, the instruction book specifies that the signal generator shall be connected to the antenna terminal of the receiver through a standard dummy antenna. This insures that the input circuit of the receiver will function in a normal manner without detuning, etc. (in the RBB/RBC equipments care should be taken that the antenna transfer links are connected in the *antenna* position while aligning).

The standard dummy antenna is made in accordance with specifications laid down by the Institute of Radio Engineers Standards Committee on Radio Receivers. It is furnished as a part of the model LP standard signal generator, but for the information of those who do not have the model LP at hand and wish to construct a standard dummy antenna, the following information is supplied.

The standard dummy antenna is a network of lumped impedances which closely approximates the electrical properties of a standard antenna over a wide frequency range. A standard antenna is defined by the Institute of Radio Engineers booklet "Standards on Radio Receivers, 1938" as "an open single wire antenna (including the lead-in wire) having an effective height of 4 meters and having, at frequencies between 540 and 1600 kilocycles, substantially the same impedance as a series circuit containing a capacitance of 200 micromicrofarads, a self-inductance of 20 microhenries and a resistance of 25 ohms. Its fundamental frequency is approximately 2500 kilocycles. Its characteristic resistance is approximately 550 ohms, and its geometric mean impedance in the frequency range of

ADAPTING RCK AND TDQ FOR CCL SERVICE AT SHORE STATIONS

The following field change is recommended in order to relieve the shortage of the TDG-1 and RBO-1 transmitter and receiver which are presently utilized with the UN (Western Electric Type 42-A-1) Carrier Control System and also in order to fully utilize the capabilities of the Army CF-1 four-channel telephone terminal when utilized alone or when the Type CF-1 terminal is utilized with the Navy Model UF Carrier Telegraph Equipment.

To obtain best use of the Army Type CF-1 telephone terminal the u-h-f transmitter and receiver should have a flat frequency response up to 12 kc. The unmodified TDQ transmitter is down about 16 db at 10 kc and the unmodified RCK receiver is down about 8 db at 10 kc when ban switch is set to "wide."

In their present form the Models TDQ/RCK combination will permit use only of channels one and two of the four channels of the Type CF-1 terminal.

INSTALLATION NOTES COVERING RCK SERIES RECEIVING EQUIPMENTS

The RCK series receiving equipments have been developed for use with the TDQ series transmitting equipments. These receivers are the first of a new series of equipments in which the i-f, audio and power circuits are standardized and the r-f, oscillator and mixer circuits are varied from model to model.

The RCK is a superheterodyne receiver designed to receive signals on any of four crystal controlled frequencies within the range of frequencies covered by the model TDQ transmitter. The model RCK receiver is approximately 11 inches high, 18 inches wide and 18 inches deep and weighs approximately 115 pounds. Power requirements are 106 watts at 110-120-volt, single-phase, 55-65-cycle AC. The tube complement is as follows:

No.	Type	Function
1	956	R-F amplifier
1	717A	Converter
2	717A	Multipliers
1	6N7	Crystal oscillator-multiplier
5	6AB7	I-F amplifiers
1	6H6	Second detector-peak limiter
2	6AB7	Audio amplifiers
1	6V6GT	Audio output amplifier
1	6U4G	Rectifier
1	VR150/30	Voltage regulator

The power output is 15 milliwatts into a 600-ohm load. A single tuning control operates seven tuned circuits. This control has four mechanical detents which are present in accordance with the frequencies of the crystals in use. Change of frequency is rapid and the operating frequency to which the receiver is tuned is indicated by the "lighting up" of one of the four bull's-eyes over the tuning dial.

The receiver chassis is designed to be removed from the cabinet by loosening the thumbscrews on the front panel and sliding the entire chassis assembly forward on the guide strips on each side of the cabinet. The mounting base to which the shock mountings for the receiver are attached is drilled with four holes through which 3/8" bolts of the proper length may be attached to fasten the receiver to a bench or table.

In planning an installation, care must be exercised to provide adequate clearance (minimum ½ 6-1/4") from the back of the receiver to the bulkhead or nearest obstruction to provide access to the power-input plug, antenna-ground plug, speaker plug, silencer plug, and fuses.

The antenna input circuit is unbalanced to ground and is intended to terminate a 50-ohm transmission line. When used with the TDQ series transmitter, the receiver input jack should be connected to the normally open position of the antenna changeover relay in the top chassis section of the transmitter.

Terminals are provided on the rear of the chassis for connection of 600-ohm speaker circuits. Speakers or speaker-amplifiers used in conjunction with the RCK receiver should be operated with taps adjusted on the line side of the matching transformers for optimum impedance match.

Sufficient slack should be left in connecting cables to permit withdrawal of the chassis from the cabinet without necessitating removal of plugs. An angle adapter on the antenna input plug should not be used; it will prevent withdrawal of the chassis without removal of the plug.

Complete instructions regarding the setting of the dial detents, alignment, and adjustment are contained in the instruction books. In conformance with recent practice, the instruction books also contain a complete table of point-to-point voltages and resistance for use in servicing.

OPERATION OF LOUD-SPEAKERS WITH RCK SERIES RECEIVING EQUIPMENTS

The RCK receiving equipment employs two stages of audio-frequency amplification which feed a power-amplifier output stage. The design is such as to impress a constant voltage (within three decibels) across the primary winding of the output transformer. This voltage is independent of changes in load resistance across the secondary terminals of the transformer from 600 to 30 ohms.

The maximum available undistorted output from the equipment is 100 milliwatts for a 600-ohm load. For a 30-ohm load, the power output is 850 milliwatts. The corresponding figures for resonant overload are 150 milliwatts and 1.35 watts. Thus, the RCK is capable of operating a loud-speaker, such as the type 49155, having a 30-ohm impedance and a nominal power input rating of 2 watts. If the RCK is to operate into a 600-ohm load, an amplifier-speaker such as the type 49131 will have to be employed for satisfactory loudspeaker reproduction. The audio-frequency output characteristics of the RCK equipment are approximately the same as the corresponding characteristics of the RBB/RBC receiving equipments and the same treatment would apply to these latter equipments when loud-speaker operation is considered.

RCK C-113 CERAMIC SHAFT

Several reports of breakage of the ceramic shaft of the capacitor, C-113, have been reported. A large number of these failures can be attributed to improper maintenance. In some cases the five screws under the preselector unit which "jig" and secure the dial assembly in place have been replaced improperly. This has resulted in a loose dial assembly causing the ceramic shaft to crack. These screws should not be touched ordinarily and are painted red to call attention to this fact. Removal of the screws during routine removal of the preselector bottom plate places undue strain on the ceramic shafts causing breakage. Therefore—DON'T TOUCH.

INCORRECT VALUE OF RESISTOR R-246 IN RCK EQUIPMENTS

NYMI has reported to the Bureau that resistor R-246 in many new RCK receivers varies from 55,000 to 100,000 ohms. The correct value of this resistor is 47,000 ohms ± 10%, and unless this value is used, it is impossible to adjust the input meter to zero set. Activities experiencing this trouble should check the value of resistor R-246 and replace it if it does not read approximately 47,000 ohms.

PROPER CONNECTIONS BETWEEN RCK EQUIPMENTS AND TYPE 49155 LOUD-SPEAKER UNITS

The design of the audio output circuit of the RCK receiver is such that maximum audio power is available at the speaker jack J-304 when the actual load impedance is much lower than 600 ohms. Therefore, for satisfactory operation of single loud-speaker units of type 49155 with the model RCK, the 30-ohm imput taps on the speaker unit should be connected to the receiver output, even though the latter is designated 600 ohms.

CRYSTAL FAILURES IN RCK AND TDQ SERIES EQUIPMENTS

Reports from the field indicate frequent failures in the crystals supplied with the RCK and TDQ series equipments, resulting in failure of the oscillator circuit. Inability of the crystals to oscillate is due to manufacturing processes in the factory producing these crystals. These processes have been analyzed and corrective measures taken which it is believed will relieve the situation.

The Naval Research Laboratory and the manufacturer of the RCK and TDQ crystals are conducting further investigation in an endeavor to determine other possible causes of crystal failures. In order to carry out these investigations it is requested that all cognizant Naval activities and field personnel assist as follows:

(1) All defective crystals for RCK and TDQ equipments should be immediately returned to the Naval Supply Center, Norfolk, Va., untouched, unopened, and with seals unbroken if sealed.

(2) Failure reports should be submitted to the Bureau for each crystal sent to the NSC, Norfolk, Va. The failure report should state that the crystal has been sent to NSC, Norfolk, Va. Replacement crystals should be requested from the Naval Supply Center in accordance with Chapter 67 of the Bureau of Ships Manual.

RCK ALIGNMENT IN LESS TIME

In order to properly align Radio Receiver RCK, it is necessary that all covers be in place, especially the RF covers. These covers have holes through which an alignment tool may be inserted. It has been brought to the attention of the Bureau that these holes are unmarked, necessitating frequent reference to the pictorial view in the instruction book during alignment procedures.

It has been suggested that these holes be marked with their appropriate designations (such as C-101, E-202) in order to eliminate the need of referring to the instruction book for hole locations. The Bureau concurs that this suggestion will save time in the alignment procedure. A simple method is to type the appropriate designation on a small piece of paper and attach this by means of transparent tape adjacent to the hole corresponding to the symbol number.

REPLACING BROKEN VARIABLE CAPACITOR SHAFTS

Two suggestions have been approved which, because of their interrelation, are combined in this write-up to avoid any confusion which might arise from their separate publication.

The basic suggestion consists of replacing broken ceramic tuning capacitor shafts with shafts fabricated from GMG glass fiber (Melamine) rod.

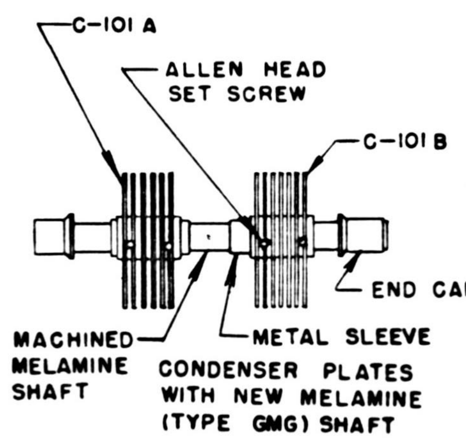

FIGURE 4. Showing New Shaft Installed.

The following is one method for repairing tuning capacitors (C-101 and C-113) in RCK equipments. The new shaft is machined to fit and the original metal sleeves and end caps are remounted (press fitted) on the shaft. Each capacitor plate assembly is secured to its metal sleeve by two Allen Head Set Screws. (See illustration.) This method is satisfactory for repairing these capacitors, which are not available in the electronics supply system.

The following method is for repairing the tuning capacitors in the RF and multiplier sections of RDZ equipments. The 17/64-inch diameter shaft is machined from a 5/16-inch diameter rod. Capacitor rotors must be aligned on the shaft so that proper meshing of rotor and stator plates is obtained. Realignment of the RF and multiplier sections will be necessary after reassembly of the equipment.

Machined surfaces of the new shaft should be coated with Insulating Varnish Compound, **N5970-511-8953** to reduce the effect of humidity.

Repairing the tuning capacitors by installing the new shaft, compared with the former practice of replacing the whole unit, saves material and reduces maintenance costs.

MODEL RCK SERIES TROUBLE SHOOTING NOTES

Difficulty Encountered	Cause and Remedy
No audio output.	Discovered one lead from capacitor C-243, on the side going to the second amplifier grid, was so close to chassis that voltage arced over to ground. However, it did not read "short" when measured to ground with an ohmmeter. Bent lead away from ground and replaced shorted capacitor, from silencer diode to second amplifier grid, with spare capacitor. Operation was again normal.
RCK.--Inability to zero the input meter.	Resistor, R-246, found to be outside 10 percent tolerance limit. Replaced resistor. Normal operation restored.
Receiver had very low sensitivity.	Faulty operation was traced to a defective high-frequency trimmer capacitor C-113. This capacitor is made up with a "slug" type adjustable screw. The "slug" had expanded and would not clear the tubular part of the capacitor. The capacitor was removed and the "slug" sanded down. The capacitor was reinstalled and the receiver operated normally.