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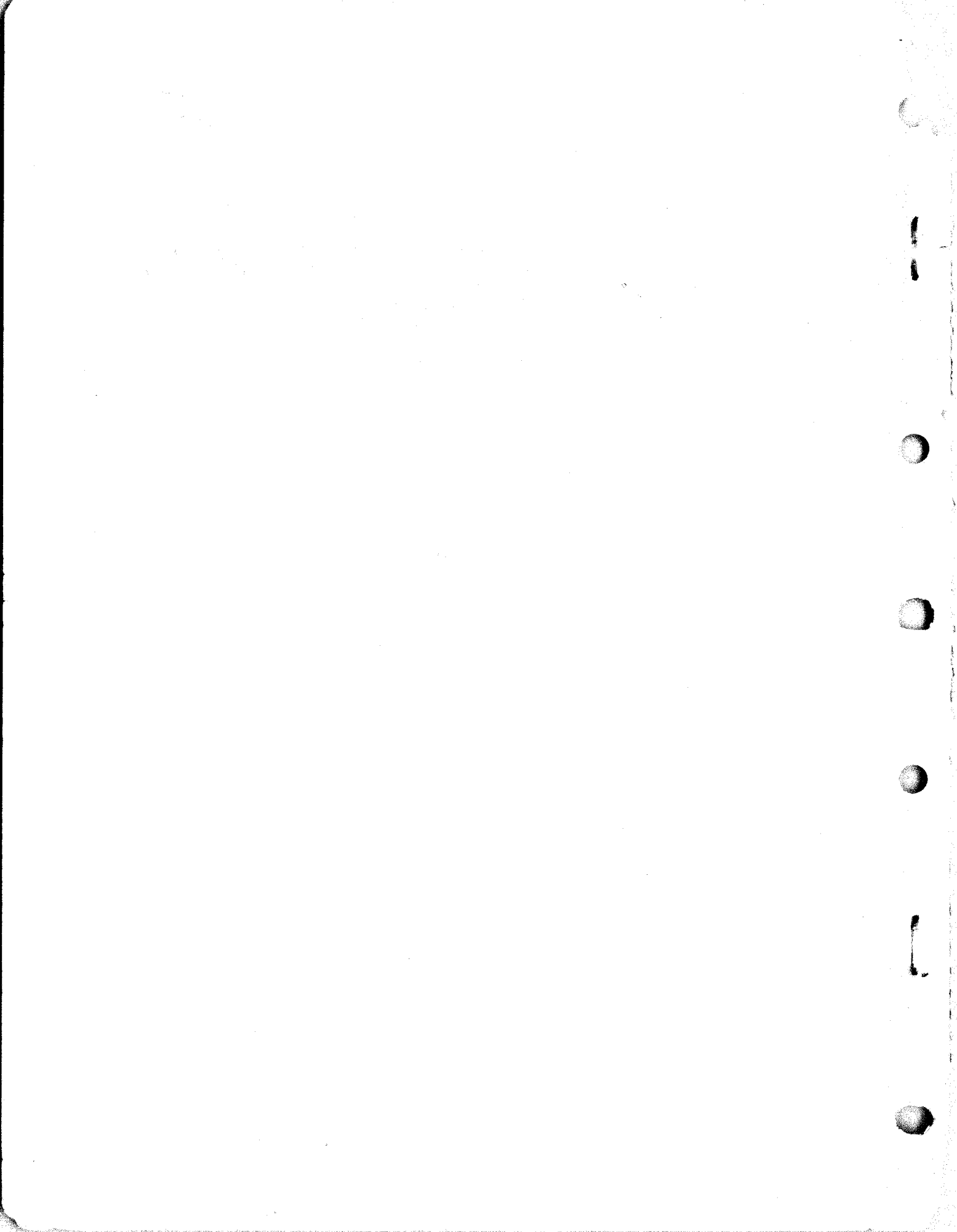
FIELD RADIO AND RADIO RELAY EQUIPMENT



1961

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**MARINE CORPS EDUCATIONAL CENTER
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1. Purpose. To promulgate, in accordance with references (a) and (b), the publication MCS 2-104 "Field Radio and Radio Relay Equipment", for use in instruction conducted by the Marine Corps Educational Center.
2. Cancellation. MCECO P2300.2 - MCS 2-104, "Field Radio and Relay Equipment."
3. Scope. This manual discusses the general characteristics and essential data of field radio and radio relay equipment found in the Fleet Marine Force. Additional information is included on radio equipment under development.
4. Action. Recipients will remove enclosure (1), the last page of this manual, and insert it in the Marine Corps directives file in numerical sequence.

R. K. ROTTET

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SECTION 1

GENERAL

1. Purpose. — The purpose of this manual is to provide information on field radio and radio relay equipment, for instruction within the Marine Corps Educational Center.

2. Scope. — The information contained in this manual covers essential data on representative field radio and radio relay equipment of standard status which is found in Fleet Marine Force units. Additional information is included on the general characteristics of radio equipment, equipment under development and field antenna systems.

3. Use. — Prior to using this manual for study assignments or reference, it is recommended that students review the glossary of terms listed in appendix 1.

SECTION 2

RADIO COMMUNICATION

4. General. — Radio, a means of communication in Fleet Marine Force units, is used for tactical control, fire control, passing of information, administrative purposes, and liaison between and within units whenever necessary. It is especially adapted to rapidly moving situations, amphibious operations, and air-ground communications over impassable terrain or in large areas where wire or other means are impracticable. Radio is the primary means of communication used from ground-to-air and air-to-air.

5. Advantages of Radio.

a. The principal advantage of radio as a means of communication is the speed of installation. Portable and vehicular mounted radios may be made

operational in a matter of seconds.

b. Radio is a flexible means of communication. No fixed circuits are required to be constructed, extended or maintained. Stations may be added to or deleted from a radio net as required. Communications by radio can be maintained while units are mobile. Radio as used in radio relay equipment may be integrated with wire systems. It provides communication across terrain over which it may be impractical to install wire.

6. Disadvantages of Radio. — Radio is the least secure means of communication. It must be assumed that interception takes place every time a message is transmitted. Radio communication is less vulnerable to enemy fire than wire, but it is subject to interference from static, jamming and other radio stations. These disadvantages may be reduced by improving the general techniques of the operator; with particular emphasis on operating procedures, radio telephone procedure and communication security.

SECTION 3

CHARACTERISTICS OF RADIO EQUIPMENT

7. General. — There are several principal characteristics that apply to all radio sets. These characteristics outline the capabilities and limitations of radio equipments. The six principal characteristics of radio sets, as they apply to Fleet Marine Force equipment, are listed in the following paragraphs.

8. Type of sets.

a. Portable sets. — Those that can be carried by an individual and can be operated while moving.

b. Transportable sets. — Those that can be moved from one location to

another location, normally by a team of three men, but cannot be operated while being moved.

c. Vehicular sets. — Those normally installed in a vehicle obtaining their initial power source from the vehicular battery.

d. General use. — This term is used to describe equipment that may be installed for general ground use or may be installed in a vehicle.

9. Type of Modulation. — Although there are several types of modulation, the two that are most commonly used in field radio sets are amplitude modulation (AM) and frequency modulation (FM). Because of technical differences the two radio sets cannot communicate with each other. A principal advantage of FM is that it is less subject to static or atmospheric disturbances. The principal advantages of AM is its comparatively narrow band operation that provides more operating channels within a given frequency coverage.

10. Type of Emission. — Type of emission is described as the signal emitted from a transmitter. Voice emission is the transmission of voice signals. Continuous Wave (CW) and Modulated Continuous Wave (MCW) are used to transmit International Morse Code by means of a key. Frequency Shift Keying (FSK) is used in the transmission of radio teletype signals.

11. Frequency Coverage. — This term is used to describe the range of frequencies to which a particular radio set may be tuned. It may be described by the actual numerical frequencies such as 2 to 12 megacycles or as the band in which the equipment may operate (HF, VHF, etc.).

12. Operating Range. — The rated range of a radio set is a planning fig-

ure. It is the range over which communications may be expected. The power output of the equipment, the type of antenna used and the frequency used will effect the rated range of a specific radio. The type of emission such as CW or voice will also affect the range.

13. Power Sources. — Radios derive their power from various methods. Present equipment used in the field may derive power from dry cell batteries, vehicular batteries, hand generators, gasoline or diesel driven generators.

14. Netting Two Radio Sets. — In order to use two different radio sets in the same radio net, the radio must: be of the same modulation; have at least one common frequency; be capable of detecting the type of emission; and both must be within the range of the shorter range set. In describing the ability of a radio set to net with another, only the first three of these characteristics are considered.

15. Nomenclature System. — The nomenclature system used for describing electronics equipment is the Joint Electronics Type Designation System. It is commonly referred to as the "AN" nomenclature system. All electronic equipment used in the Marine Corps may be identified using the "AN" Nomenclature Chart shown in appendix 2.

SECTION 4

RADIO WAVE PROPAGATION

16. General. — Power is not the sole factor governing the range of a signal generated by a radio transmitter. A basic understanding of wave propagation, its relationship to frequency, power, and antenna configuration, and how, together, they produce different results in terms of the distance a signal will travel, is essential to an understanding of how the

most efficient use can be made of the equipment at hand.

17. Radio Wave Components. — Energy radiated by a transmitting antenna consists essentially of two parts — the ground wave and the sky wave.

a. Sky wave. — Traveling upward into space at all angles with the ground, the sky wave is usually reflected or refracted back to the earth's surface by the ionosphere. This electrically charged (ionized) region of the atmosphere exists at an altitude of 30 to 250 miles. Because of the reflecting or refracting effect of the ionosphere, the sky wave makes long-distance radio communication possible.

(1) Skip zone. — The skip zone of a transmitting station is the gap between the most distant point reached by the ground wave and the point where the sky wave first returns to earth (see figure 1). This is the portion of the earth's surface that is too far from the transmitter for ground wave coverage and too close to the transmitter for sky wave coverage.

(2) Skip distance. — The dis-

tance from a transmitting station to the point where the sky wave first returns to earth is called the skip distance. At a given time, the skip distance of a radio station is largely determined by the operating frequency of the transmitter. The higher the frequency, the greater the skip distance. As shown in figure 2 transmission from station S to point B is possible only when using frequency B. The skip distance with frequency A would be too short; the skip distance with frequency C would be too long. For a given frequency, the skip distance of a transmitting station is greater at night than in the daytime and greater in winter than in summer. Skip distances for various frequencies at certain times of the day and months of the year are predictable. The Army Signal Corps and Navy Communications Electronics Board have prepared charts giving this information for the use of radio facilities throughout the world. Three charts are made up as follows: one for short distance communications (0 to 100 and 100 to 250 miles); another for intermediate distances (250 to 1,500 miles); and the last for long distances (1,500 to 12,000 miles).

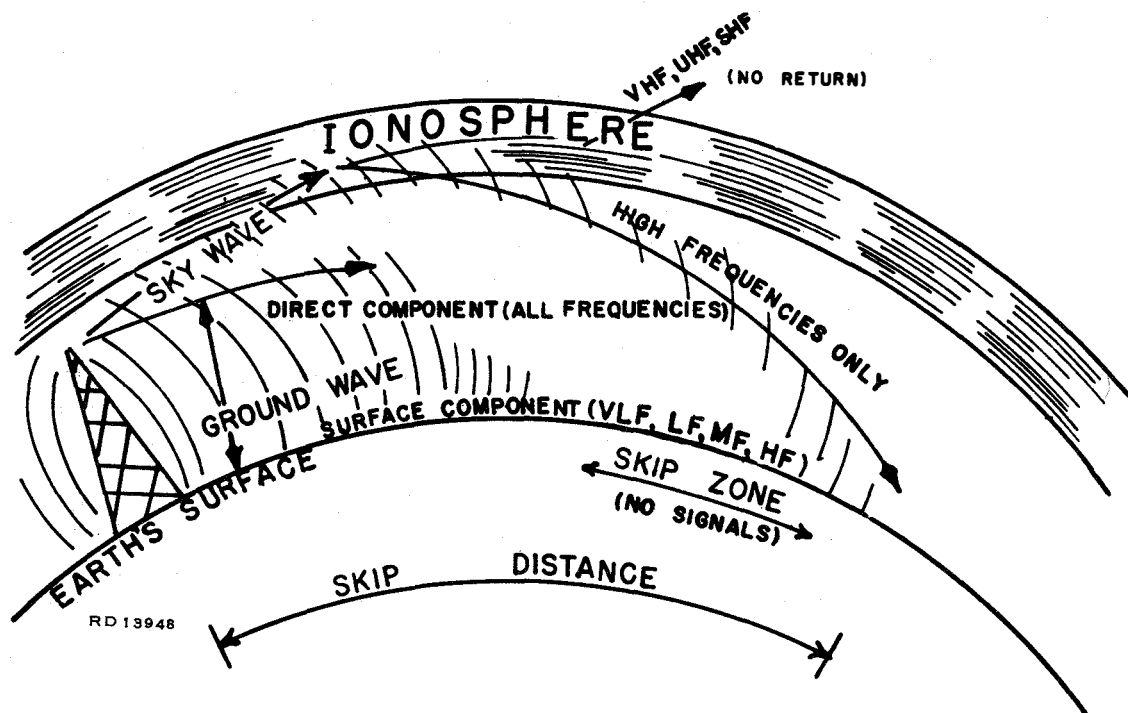


Figure 1. — Illustration of sky wave and ground wave propagation.

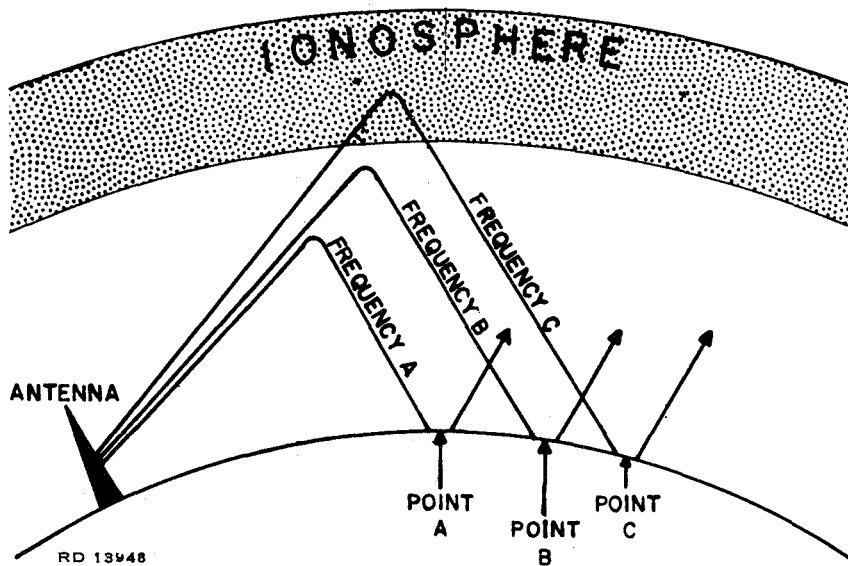


Figure 2. — Effect of frequency on skip distance.

(3) Multihop transmission. — Sky waves returned to earth may bounce back into the ionosphere and again be reflected or refracted back to earth at a more distant point. Many such reflections may take place, but the strength of the sky wave diminishes because of absorption. Often after the first reflection (hop) the signal is too weak to be received. Most long-distance radiocommunication, up to 2,500 miles, is accomplished by single hop transmission, however multiple hop transmissions are generally used for distances greater than 2,500 miles.

b. Ground wave. — Ground wave is the energy radiated by a radio transmitter which travels close to the surface of the earth. It rapidly loses strength because of absorption by the earth. The higher the frequency of the groundwave, the shorter the distance it will travel. At frequencies of about 30 mc, the ground wave is normally limited to line-of-sight distances. Most field radio equipment utilizes the ground wave for normal communication. For convenience, the ground wave is further broken down into a direct component and a surface component.

(1) Direct wave (component). —

These waves travel directly through space between a transmitting antenna and a receiving antenna. Used for line-of-sight transmission, direct waves are influenced little by the electrical characteristics of the earth's surface. However, a certain bending of the waves occurs as they graze the earth's surface or any other intervening obstacle. This phenomenon is called refraction. The bending of the waves occurs at frequencies of 100 mcs or less and results in an increase in range greater than line-of-sight. Direct waves are also used for air-to-ground communication.

(2) Surface waves (component).

— The surface wave follows the curvature of the earth and is that portion of the ground wave that is greatly affected by absorption, thus limiting its range.

c. Other phenomena affecting wave propagation. — Permanent turbulence in the ionosphere and troposphere has the effect of scattering electromagnetic waves of certain wave length in all directions. Use can be made of this effect by beaming high amounts of power at these areas and using highly sensitive receivers to intercept the resulting

radiation returning to the earth's surface. These systems are known as ionospheric scatter and tropospheric scatter and are used in the frequency range of 30 to 150 mcs and in the SHF band, respectively.

18. Relationship of Frequency to Radio Wave Propagation and Its Military Application. — As a general rule, lower frequencies use ground wave propagation almost exclusively, high frequencies use both ground and sky waves, and ultra high frequencies propagate a direct wave on a line-of-sight path.

a. Lower frequency range.

(1) Very low frequency (VLF) below 30 kc. — A very long wave is emitted which hugs the surface of the earth. This type propagation is used mainly for fleet broadcasts to submarines.

(2) Low frequency (LF) 30 kc to 300 kc. — Primarily ground wave, used mainly for aircraft navigation since the direct waves emitted by the transmitter can be detected at great distances by aircraft.

(3) Medium frequency (MF) 300 kc to 3,000 kc. — The ground wave is good for short distances and the sky wave has limited application for intermediate distances.

b. Higher frequency range.

(1) High frequency (HF) 3 mc to 30 mc. — The ground wave is effective for distances up to approximately 50 to 80 miles and the sky wave is reliable for intermediate and long-range communication making transoceanic and world-wide communications possible. Security problems are encountered in these frequencies as signals will frequently be heard well beyond the desired distance due to multiple hopping of the sky wave. Most standard military AM equipment designed for ground-to-ground communications operate within this band.

(2) Very high frequency (VHF) 30 mc to 300 mc. — Good short-range communications by ground wave and direct wave. Use of the sky wave is unreliable. Noncritical line-of-sight; the waves are able to penetrate a limited amount of foliage and can negotiate some variations in terrain.

(3) Ultra high frequency (UHF) 300 mc to 3,000 mc. — Direct wave only; generally used in ground-to-air and air-to-air communications. Use of the sky wave is impossible because it completely penetrates the ionosphere. Critical line-of-sight; the signal is reflected and absorbed by foliage and terrain. Most radar operates in this frequency range.

(4) Super high frequency (SHF) 3,000 to 30,000 mc. — Absolute line-of-sight meaning that nothing can stand in the way of the direct wave. The sky wave penetrates the ionosphere. This is the highest frequency used for communication purposes, primarily radio relay.

(5) Extremely high frequency (EHF) 30,000 mc to 300 kc. — This range of frequencies is too high and critical for field communications application.

19. Effect of Power on Wave Propagation. — The power of a transmitter is its ability to impart a certain strength to the radio signal it emits thus giving it a certain range. The relationship of power to range is not manifested in a direct one-to-one ratio, and the efficiency of power to increase range degenerates rapidly once an optimum output is reached for a certain type radio. For instance, the radio set AN/GRC-9 with hand generator has a rated power output of 3.6 watts for voice transmission with the power switch on the "Hi" position. The range of the ground wave at this output is 10 miles. By increasing the power to 7 watts, the range is not doubled. Continuous increases in power will increase range by smaller increments. In normal AM and FM field radio equipment, it can

readily be seen that limitations of space and requirements for mobility would soon make this an uneconomical way to increase range. This is why an understanding of the other factors that influence range is necessary to effectively communicate in the field. For instance, by using the sky wave, the 3.6 watts of power just discussed might make communications possible over hundreds of miles.

20. Effect of Antenna Construction and Siting on Range and Wave Propagation.

— Most antennas for field radio sets are the vertical whip type which emit an omnidirectional radio wave. This is the most practical for communications while moving and when several units on a net are located in different directions from one another. However, when possible, field expedients can be utilized to increase the range or strength of a signal without increasing the power. Furthermore, the signal can be made directional, to increase security or minimize jamming, at the same time if desired.

a. Antenna construction. — Inverted L, long wire, and rhombic are types of antennas that can be constructed with standard field telephone wire in a short period of time to increase range. Some antennas will also impart a directional impetus to an emitted wave. They are either horizontal or a combination of horizontal and vertical to the ground. By orienting a horizontal antenna for the direction of desired communication, and by cutting the antenna to a certain length (which can be readily determined for the frequency used), the radio wave will cover an area in the shape of two or more lobes and will be highly directional. Spurious signals entering from outside these lobes will be partially repelled. Range is increased as the length of the antenna is increased, lobes of coverage tend to become elongated, and point more and more in the

direction of the long axis of the antenna.

b. Antenna siting. — The general rule is to seek high ground offering a clear path between radio sets. This is especially true of VHF equipment and higher where the signal is greatly attenuated and absorbed by dense foliage and physical obstructions. Greater success is obtained using HF equipment where these conditions exist. There is little that can be said to aid the small unit leader with VHF equipment in overcoming this problem except to recognize its existence and plan accordingly. Some success has been obtained by bouncing direct ground waves off cliffs or the tops of mountains, but the situations where favorable conditions might exist are few and unpredictable.

21. Effect of the Ground on Radio Wave Propagation.

— Radio equipment, as a general rule, should be connected to the earth. The electrical conducting properties of the earth between the transmitting station and the receiving station will have a decided effect on the strength of the signal. Generally speaking, the higher the conductivity of the ground, the stronger the radio wave which will be propagated along its surface. In the event a good ground does not exist in the vicinity of the transmitting and receiving stations (such as in deserts, arid mountains, and frozen terrain), a substitute ground, or counterpoise, must be provided. The counterpoise is a network of wires laid on the surface of the ground beneath the antenna, to which the ground binding post on the radio set is connected. A counterpoise is provided with radio set AN/GRC-9, but in an emergency, an effective counterpoise may be constructed from field telephone wire. The radio's outer metal container, in the case of a man pack radio, and the body of the vehicle, in the case of a vehicular radio, acts as the counterpoise, but even these may be improved upon by adding an additional amount of wire to the case

or vehicle body. The wire need not be stripped; and when a unit is halted for a period of a few hours, the dividends received and simplicity of construction make this field expedient a highly desirable way to improve communications.

SECTION 5

SINGLE SIDEBAND (SSB)

22. General. — Single sideband emission radios such as the AN/TRC-75 and the AN/MRC-83 discussed in section 6 have been adopted by the Marine Corps as standard items of communication equipment and are being phased into the Fleet Marine Force as they become available. It is contemplated that eventually this type equipment will replace many of our present-day field radios. Although single sideband emission is not a new concept, its application is new to the Marine Corps. Single sideband has some limitations for field use and a few very worthwhile capabilities. It will be of value to study briefly the fundamentals of this type equipment, its advantages and disadvantages, and some considerations involving its employment in the field.

23. Theory of Amplitude Modulated and Single Sideband Emission.

a. Amplitude modulation. — Amplitude modulation is the process whereby the size (amplitude) of a carrier wave of energy at a radio frequency (RF) that is generated within a transmitter at a constant rate is altered or varied (modulated) by mixing it with another signal (the voice, for instance) which varies in frequency. Figure 3 shows a typical carrier wave before and after modulation.

(1) Sidebands. — In the process of modulating an RF carrier with a band of lower audio frequencies, an action takes place which causes the creation of two additional bands of frequencies. One of these, called the upper sideband fre-

quency, is the sum of the frequencies of the two mixed or beating signals. The other is the difference between the two beating signals and is called the lower sideband frequency. The sidebands are directly related to the modulating signal. If this signal is removed, the sidebands will no longer be present and only the carrier will remain. It can be said that the sidebands actually contain the intelligence of the modulating signal and the carrier itself contains none of the intelligence. In speaking into the microphone of a transmitter, the band of frequencies created by the voice mixes with the carrier signal; and in the process of modulation, the sideband frequencies are created. The resultant modulated wave is what is emitted by a normal AM transmitter. Figure 4 shows pictorially the signals involved and the resultant modulated wave. One other important fact to remember is that although the two sidebands occupy different positions in the frequency spectrum, they both contain the same information (intelligence of the modulating signal) and are actually mirror images of each other. It can be seen that this method of transmission, called AM double-sideband transmission (DSB), is inefficient since, of the three elements involved in producing a modulated wave, two of them (the sidebands) contain the same intelligence, and the third (the carrier) contains no intelligence.

(2) Power requirements. — In an AM transmitter fully modulated, the power requirements of each sideband are 25% of the carrier's power. Thus, if the carrier output is 100 watts the power in each sideband will be 25 watts, giving a total sideband power of 50 watts and an average transmitter power output rating of 150 watts. Of this 150 watts, only one-third (50 watts) is used to transmit the intelligence-bearing sidebands since the other two-thirds (100-watt carrier) carries no useful intelligence.

(3) Frequency requirements. — AM type emission is inherently wasteful

of the frequency spectrum since a portion of it is required for the carrier and each of the sidebands. Figure 5 shows an example of the bandwidth required for a modulated carrier using a carrier frequency of 100 kc and a modulating voice frequency of from 100-3,000 cycles per second.

b. Single sideband transmission. — A single sideband signal initiates in the same manner as an AM signal. However, once the modulating signal has beat against the carrier and the resultant sidebands have been created, the carrier and one of the sidebands are suppressed before the signal is emitted. By doing this, only one sideband is transmitted. The advantages are as follows:

(1) It is more efficient. — The power required to emit a signal of comparable strength to an AM double sideband signal is cut by five-sixths. Turning the statement around, all the transmitter power is now applied to the one intelligence-bearing sideband increasing the power output five times. Using the example of power in subparagraph a(2), with one sideband suppressed (25 watts) and the carrier suppressed (100 watts), the entire 150 watts is now applied to the one sideband. Therefore, for the same size package, a considerable increase in range is achieved.

(2) It conserves the frequency spectrum. — Only half of the band of frequencies required by the conventional AM double sideband system are necessary. Figure 6 shows an example of this saving.

(3) A better signal-to-noise ratio is achieved. — When weather conditions cause marginal communications due to extraneous noise (static), the single sideband signal will be less affected because it is narrower and will not pick up as much interference as a standard AM double sideband signal.

(4) It is less susceptible to tactical interference (jamming). — Sup-

pression of the carrier frequency makes jamming more difficult. The high power generated also aids by creating a strong signal that requires another piece of high-powered equipment to block or effectively jam it.

c. Limitations of single sideband. — The limitations covered in this paragraph are very real and very important. Only by recognizing its limitations can full advantage be taken of single sideband's greatest single advantage to the ground officer in the field, the ability to communicate reliably over relatively great distances in almost all conditions of weather and terrain.

(1) Requirement for extremely stable circuits. — Because of the narrow frequency band occupied by the SSB wave, transmitter circuits must be extremely stable. The slightest deviation in the carrier frequency will cause distortion of the sidebands. Such stability is not easily or inexpensively produced in field radios. Receivers also require extremely stable circuits because they must accept the narrow signal and reinsert the carrier in order to extract the intelligence and reduce it to an audio frequency that is intelligible when reproduced over the receiving station's loudspeaker or earphones.

(2) Complexity and high cost of equipment. — Because of the close tolerances required, complex circuitry is necessary. This compounds the ever-present problem of maintenance and repair. Skilled technicians with a thorough knowledge of the set are required to calibrate and maintain it. Cost of production is very high compared to the present standard equipment.

(3) Problems of transmission security. — The security problems inherent in the sky wave propagation of HF signals are now experienced in the ground wave propagated by the SSB transmitter. Radio has always been considered the least secure means of communication; now it is even more so.

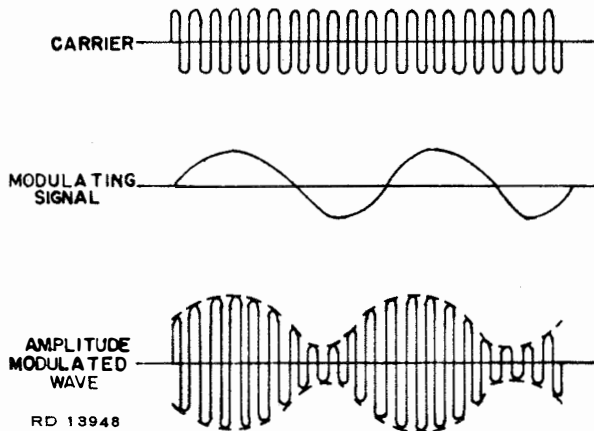


Figure 3.--Illustration of carrier, modulating signal, and amplitude modulated wave.

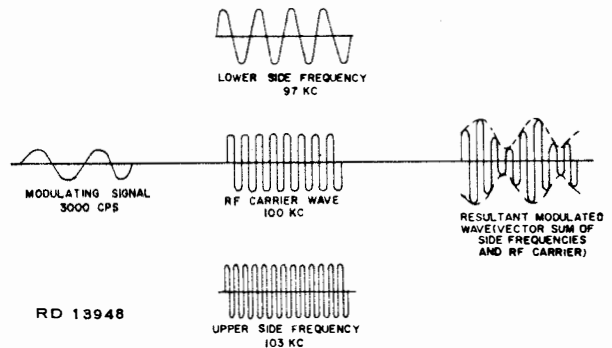


Figure 4.--Sideband frequencies and resultant waveform generated during amplitude modulating process.

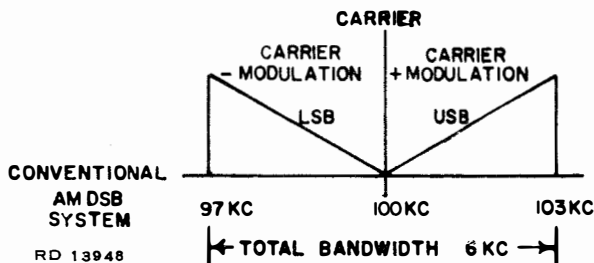


Figure 5.--Bandwidth required for conventional AM double sideband transmission.

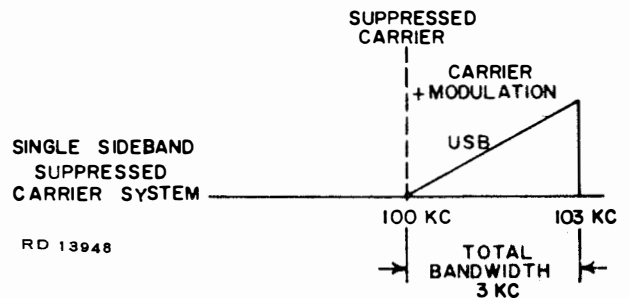


Figure 6.--Bandwidth required for single sideband suppressed carrier transmission.

This is especially true in forward areas where an intercepted transmission that is insecure can be acted upon rapidly. Operator training is still the best solution. Using only the power necessary to do the job is another rule that is especially applicable with SSB.

telephone operation within and between armor, artillery and infantry. Radio set AN/GRC-3 is intended for armored use, radio set AN/GRC-5 for artillery and radio set AN/GRC-7 for infantry. All can be installed and operated in trucks, personnel carriers and other authorized vehicles.

SECTION 6

RADIO EQUIPMENT DATA

24. General. — The radios described in this section are those authorized by the current tables of equipments for use by Fleet Marine Force units.

25. Radio Set AN/GRC-3, -5 and -7 (AN/MRC-36, -37 and -38). — Radio sets AN/GRC-3, -5, and -7 are designed primarily for short range radio-

TECHNICAL CHARACTERISTICS

Frequency coverage. — The frequency coverage of each set includes two bands: One band is covered by set #1 receiver-transmitter and is duplicated by auxiliary receivers; the other band is covered with set #2 receiver-transmitter. Frequency ranges are as follows:

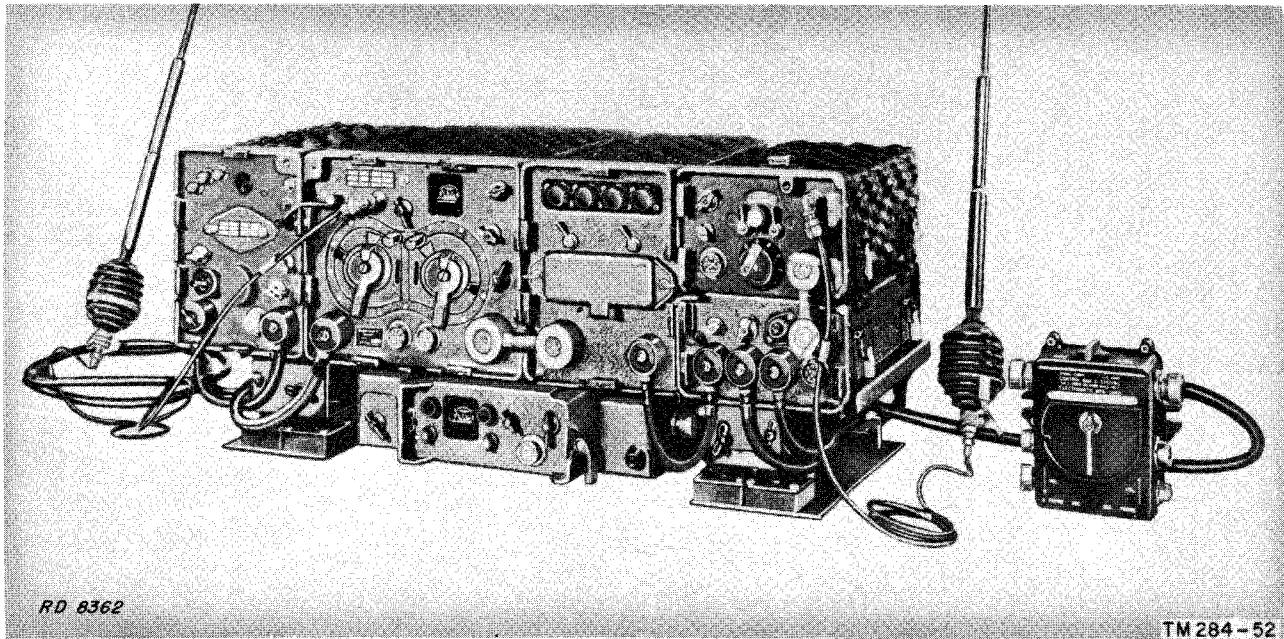


Figure 7. — Radio Set AN/GRC-3.

<u>Radio Set</u>	<u>Set 1</u>	<u>Set 2</u>	<u>Auxiliary Receiver</u>
AN/MRC-36 and AN/GRC-3	20 to 27.9 mc	47 to 58.4 mc	20 to 28 mc
AN/MRC-37 and AN/GRC-5	27 to 38.9 mc	47 to 58.4 mc	27 to 39 mc
AN/MRC-38 and AN/GRC-7	38 to 54.9 mc	47 to 58.4 mc	38 to 55 mc

Type of tuning.

AN/GRC-3, set #1 has continuous FM tuning with two preset channels (3 in auxiliary receiver) and 80 possible channels.

AN/GRC-5, set #1 has continuous FM tuning with two preset channels (3 in auxiliary receiver) and 120 possible channels.

AN/GRC-7, set #1 has continuous FM tuning with two preset channels (3 in auxiliary receiver) and 170 possible channels.

Set #2 in all three radio sets has continuous FM tuning with 2 preset and 115 possible channels.

Type of emission. — Voice.

Antennas. — Set #1 and auxiliary receiver: 10 ft. whip (AN/GRC-3 and

-5); 6 ft. whip (AN/GRC-7). Set #2: 4 ft whip.

Power sources. — 12/24 volts DC (all three sets).

Power output (maximum). — Set #1: LOW power 1 to 2 watts. HIGH power 9 to 16 watts. Set #2: 0.5 watts.

Range (approximate). Set #1 10-15 miles. Set #2 1 mile.

Calibration. Set #2 can be calibrated at every megacycle.

Major components. Shown in figure 8.

26. Radio Set AN/GRC-9Z.

a. Radio set AN/GRC-9Z is a combined radio transmitter and radio receiver which provides voice, continuous and modulated continuous wave communications as a portable, teampack field set. The operating voltages of the radio set may be furnished by either a hand

RADIO SETS

COMPONENT	AN/MRC-36	AN/MRC-37	AN/MRC-38	AN/GRC-3	AN/GRC-5	AN/GRC-7
Receiver-Transmitter RT-66/GRC	1			1		
Receiver-Transmitter RT-67/GRC		1			1	
Receiver-Transmitter RT-68/GRC			1			1
Receiver-Transmitter RT-70/GRC	1	1	1	1	1	1
Radio Receiver R-108/GRC	1			1		
Radio Receiver R-109/GRC		1			1	
Radio Receiver R-110/GRC			1			1
AF Amplifier AM-65/GRC	1	1	1	1	1	1
Power Supply PP-281/GRC or PP-282/GRC	2	2	2	2	2	2
Power Supply PP-109/GR or PP-112/GR	1	1	1	1	1	1
Control Box C-375/VRC	1	1	1	1	1	1
Control Group AN/GRA-6	1	1	1	1	1	1
Control C-435/GRC	1	1	1	1	1	1
Mounting MT-297/GR	1	1	1	1	1	1
Antenna assemblies	3	3	3	2	2	2
Jumper Wire W-142				1	1	1
Technical Manual (TM 11-284)	2	2	2	2	2	2

Reference: TM 11-284

Figure 8. — Table of Components, AN/MRC-36,-37,-38 and AN/GRC-3,-5,-7.

generator or a hand generator and dry cell battery. The radio set may be permanently mounted in a truck, 1/4 ton, 4x4 and power to the radio set furnished by either a vibrator or dyna-

motor power supply. This mobile version is known as the radio set AN/MRC-84.

b. Installation. — Portable team-pack (3 man) radio set. It can be mounted

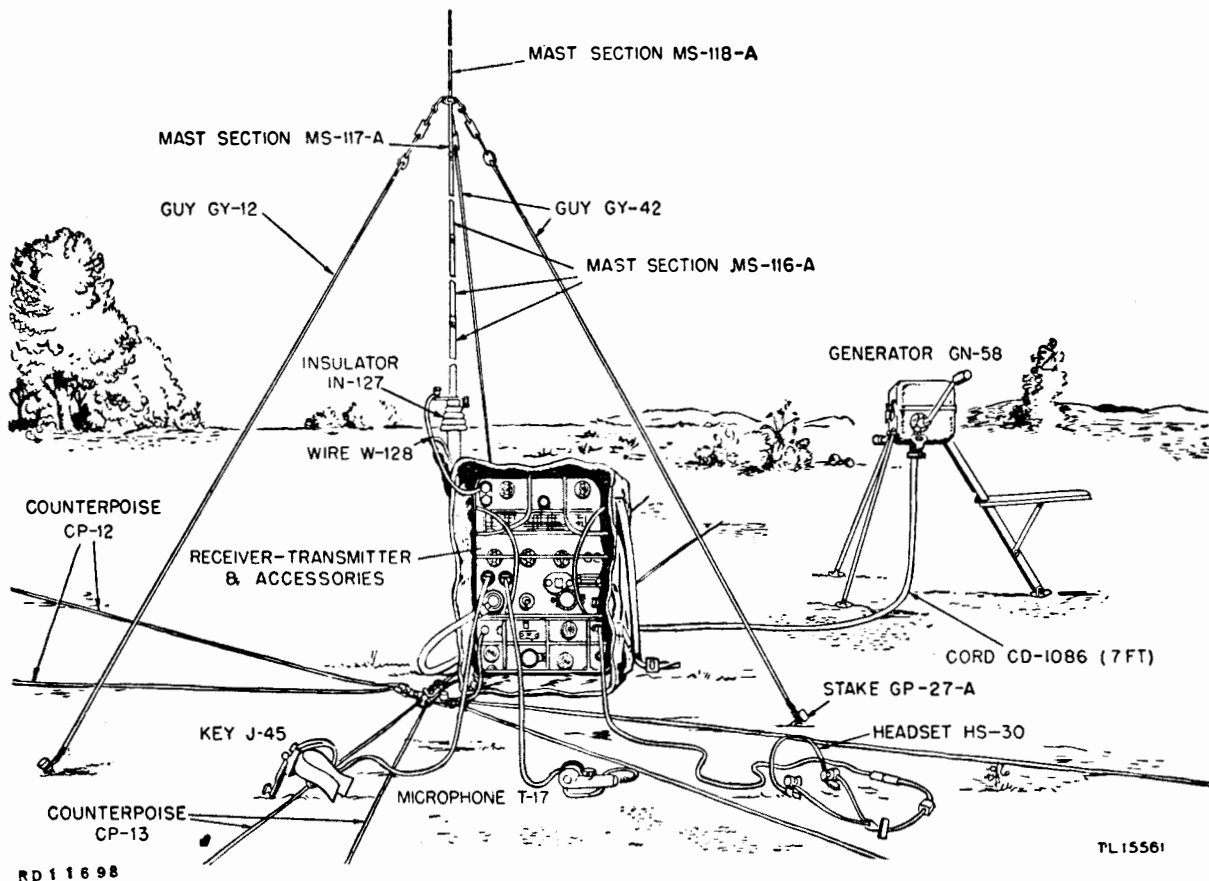


Figure 9. — Radio Set AN/GRC-9.

in and operated from a vehicle with proper auxiliary equipment.

TECHNICAL CHARACTERISTICS

Frequency coverage. — 2 to 12 mc.

Type of tuning. — Continuous.

Type of emission. — CW, MCW and voice (AM).

Antennas. — 15 ft. (whip) or 244.5 ft. (long wire). The whip can be portable or vehicle mounted. The length of the long wire can be adjusted for various operating frequencies at fixed locations.

Power sources. — Portable set:

dry batteries and hand generator. Vehicular set: 24 v battery with Installation Kit-Power Supply MK-365/GRC-9.

Power output (maximum). — Voice: 3.6 watts; CW: 10 watts.

Range (approximate). — Voice: 10 miles; CW: 30 miles; MCW: 20 miles.

Calibration. — Every 200 kc.

Major components.

- Receiver-transmitter RT-77/GRC-9.
- Generator GN-58.
- Microphone T-17.
- Microphone T-45.
- Headset HS-30.
- Roll BG-174 (antenna equipment).
- Bag BG-172 (equipment accessories)

Loudspeaker LS-7.
Key J-45.
Antenna AT-101/GRC-9.
Antenna AT-102/GRC-9.
Counterpoise CP-12 and CP-13.
Spare tubes.
Antenna bracket.

Reference: TM 11-263

27. Radio Set AN/MRC-6C. — Radio set AN/MRC-6 is a vehicular radio set. It is composed of a model TCS radio transmitter and receiver mounted in a 1/4-ton cargo truck, 4x4. Using a whip antenna mounted on the rear of the ve-

hicle, the radio equipment may be operated while the vehicle is in motion as well as from a stationary position.

TECHNICAL CHARACTERISTICS

Frequency coverage.
1.5 to 12.0 mc.

Type of tuning.
Continuous tuning.

Type of emission.
Voice and CW.

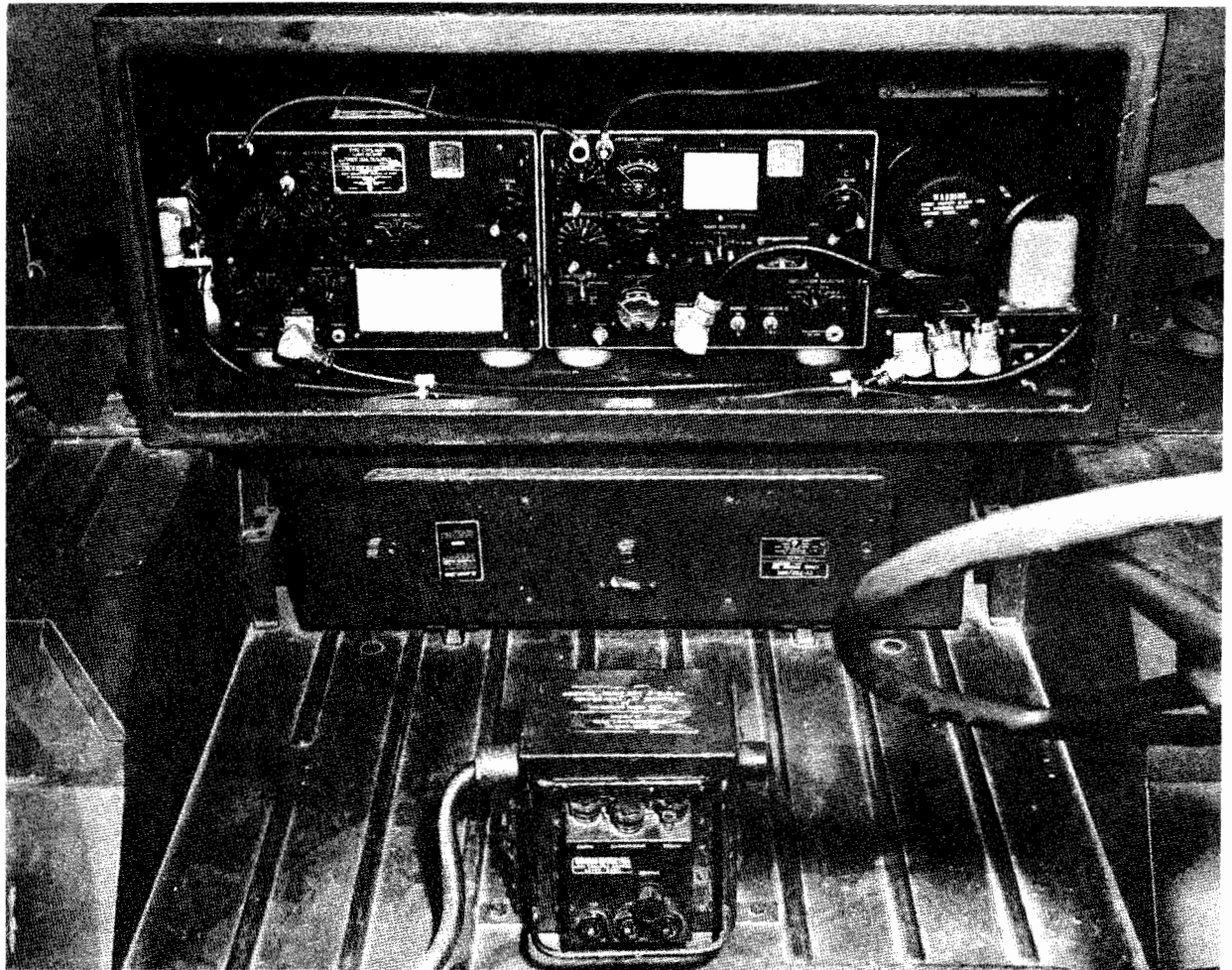


Figure 10. — Radio Set AN/MRC-6.

Antennas.

20 ft. whip antenna.

Power sources.

24 volt driven dynamotor.

Power output (maximum).

Voice: 20 watts; CW: 40 watts.

Range (approximate).

Voice: 15 miles; CW: 30 miles.

Major components.

Receiver-transmitter (TCS radio).

Dynamotor-power unit.

Antenna loading coil.

Audio accessories.

Remote control unit.

Reference: Instruction Book for Navy Model TCS Receiver-Transmitter.

28. Radio Set AN/MRC-30. — Radio set AN/MRC-30 is a mobile high frequency (HF) transmitter and receiver station. It consists of an HF transmitter,

two HF receivers, and their associated equipment. Radio set AN/MRC-30 is not air transportable intact. The shelter must first be removed from the truck. Two R4Q aircraft are required, one to transport the shelter (4,500 pounds), and a generator trailer (4,500 pounds), and the other to transport the 6x6 cargo truck (12,500 pounds). All equipment is housed in Shelter HO-17-A which is mounted on a 2 1/2-ton, 6x6, cargo truck.

TECHNICAL CHARACTERISTICS

Frequency coverage.

Transmitter: 2-18 mc; receivers: 1.5-18 mc.

Type of tuning.

Continuous.

Type of emission.

Voice and CW.

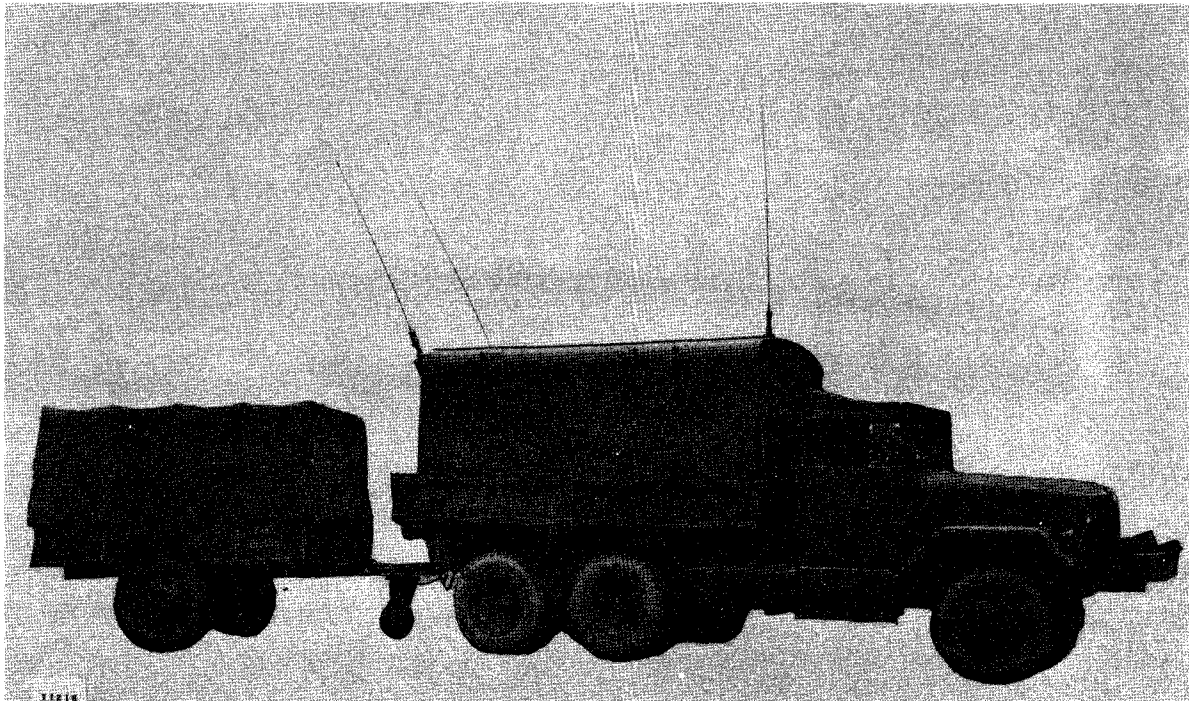


Figure 11. — Radio Set AN/MRC-30.

Antennas.

Antennas are provided for either mobile operation or operation from a semi-fixed location. For mobile operation, three whip antennas are installed on top of the shelter. For operation from a semifixed location, doublets and long wire antennas can be constructed with antenna wire provided with the set.

Power sources.

The primary power supply required is single phase, 115-volt, 60-cycle, alternating current. A generator is not issued as a component of the radio set. However, there is a general allowance of one Generator Set PU-239 for each AN/MRC-30.

Power output (Maximum).

Voice: 300 watts; CW: 400 watts.

Range (approximate).

Voice: 100 miles; CW: 250 miles. Ideal conditions can favor transmissions to 1000 miles.

Major components.

Shelter HO-17-A.
Radio Transmitter BC-610.
Antenna Tuning Unit BC-939.
Radio Receiver BC-342.
Radio Receiver BC-312.
Battery Chest CH-109-A.
Rectifier RA-63.
Speech Amplifier BC-614.
Junction Box JB-70.
Frequency Meter Set SCR-211.

Reference: TM 11-850, TM 11-826.

29. Radio Set AN/MRC-32. — Radio set AN/MRC-32 is a mobile communication set providing facilities for the transmission and reception of CW, voice, and frequency-shift-keying (FSK) teletype signals over a frequency range of 2 to 18 mc. Simultaneous voice and FSK teletype operation is possible. Radio set AN/MRC-32 is not air transportable intact. The shelter must first be removed from

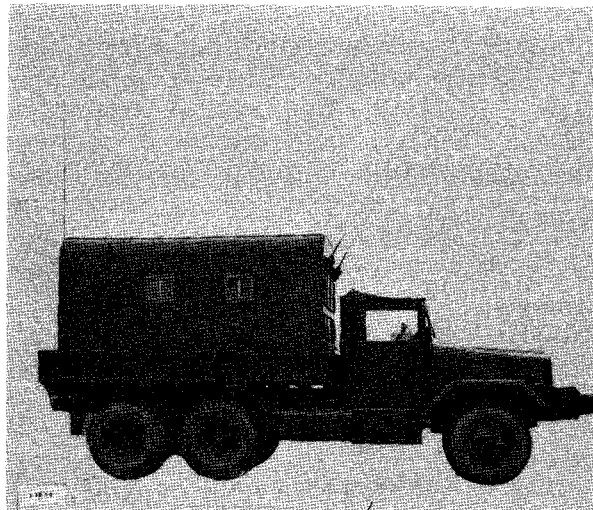


Figure 12. — Radio Set AN/MRC-32.

the truck. Two R4Q type aircraft are required, one to transport the shelter (5,500 pounds) and a generator trailer (4,500 pounds), and the other to transport the 6x6 cargo truck (12,500 pounds). Radio set AN/MRC-32 is similar to Radio set AN/MRC-30 with the additional provision of FSK teletype operation. Many components of the two sets are identical. All components are housed in Shelter S-69/GRC which is mounted on a 2 1/2 ton, 6x6 cargo truck. Mobile operation is possible with both the radio and teletype facilities. However for mobile teletype, only half-duplex operation is recommended and then only under favorable conditions (a hard surface road). For operation at a halt, full-duplex teletype operation is possible.

TECHNICAL CHARACTERISTICS

Frequency coverage.

Transmitter: 2-18 mc; receivers:
.5-30.5 mc.

Type of tuning.

Continuous.

Type of emission.

Voice, CW and FSK.

Antennas.

Antennas are provided for either mobile operation or operation from a semi-fixed location. For mobile operation three whip antennas are used, one for the transmitter and one for each receiver. The antennas can be bowed and held in a horizontal position by insulated guys. For semi-fixed operation, doublets and long wire antennas can be constructed.

Power sources.

The power supply required is single phase, 105-volt, 60-cycle, alternating current. A generator is not issued as a component of the radio set. However, there is a general allowance of one Generator Set PU-239 for each AN/MRC-32.

Power output (maximum).

Voice: 300 watts; CW: 400 watts;
TT: 400 watts.

Range (approximate).

Voice: 100 miles; CW & TT: 250 miles.

Major components.

Shelter S-69/GRC.
Radio Transmitter BC-610.
Antenna Tuning Unit BC-939.
Speech Amplifier BC-614.
Radio Receiver R-388/URR.
Radio Teletypewriter Control C-808/
GRC-26A.
Frequency Shift Exciter O-39B/TRA-7.
Frequency Shift Converter CV-182/GRC
-26A.
Teletypewriter TT-55/MGC.
Teletypewriter TT-56/MGC.
Line Unit BE-77-A.
Antenna (whip and long wire).
Accessories and spare parts.

Reference: TM 11-264.

30. Radio Set AN/MRC-35A. — Radio Set Central AN/MRC-35A has been developed by the Marine Corps to replace



Figure 13. — Radio Set AN/MRC-35A

both Radio Set AN/MRC-13b and Radio Set AN/MRC-19c. It embodies in one vehicle set both high frequency (HF) and ultra high frequency (UHF) radio communication facilities. In addition, low frequency (LF) facilities are available for aircraft homing purposes. This radio set is intended primarily for use by tactical air control parties. Its major components have been used in aircraft for many years and were modified slightly for installation in a 1/4-ton vehicle.

TECHNICAL CHARACTERISTICS

Frequency coverage.

HF transmitter: .2 to .6 mc; 2 to 18.1 mc.
HF receiver: .2 to .5 mc; 1.5 to 18 mc.
UHF transceiver: 225 to 399.9 mc.

Type of tuning.

Continuous HF tuning: 11 preset

transmitter channels.
UHF tuning: 18 preset, 1 guard and
1750 possible channel selections.

Type of emission.

HF: Voice, CW, MCW(AM); UHF:
Voice (AM).

Antennas.

20 ft. whip, long wire 400 ft., for
HF: Ground plane vertical antenna
(bird nest) for UHF.

Power sources.

24 volt DC driven dynamotor.

Power output (maximum).

HF Voice: 60 to 90 watts; HF CW:
100 watts; UHF: 10 watts.

Range (approximate).

HF: 50 miles; UHF: line-of-sight,
120 miles with aircraft at 10,000
ft. plus.

Calibration:

HF: each 10 kc.; UHF: each 100 kc.

Major components.

Antenna.
RF coil.
Load Coil CU-25/ART-13.
Transmitter T-47/ART-13A.
Dynamotor DY-12.
Radio Receiver BC-348.
Terminal box.
Keyer KY 132.
Control panel.
Transmitter-receiver RT-178/ARC-27.
Fuse terminal assembly.
Control C-626/ARC-27.
Antenna AS-390/SCR.

Reference: TM 11-692E, TM 11-5821-
255-().

31. Radio Set AN/MRC-40. — Radio
Set AN/MRC-40 is normally available
only in aviation units for ultra high fre-
quency (UHF) ground to air or ground to

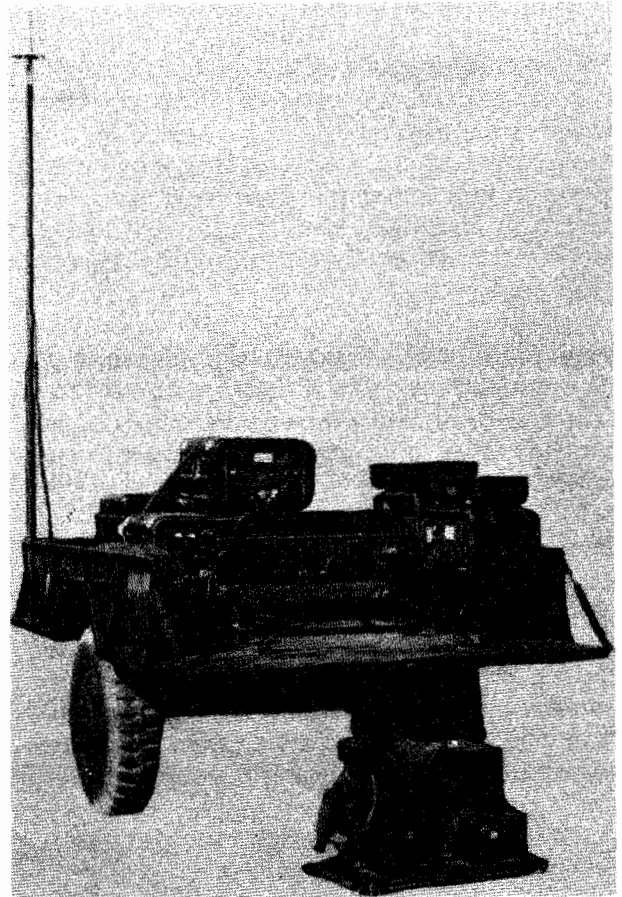


Figure 14. — Radio Set AN/MRC-40.

ground communications in the 225 to
399.9 mc frequency range. Radio Set
AN/MRC-40, mounted in a cargo trailer,
can be rapidly moved in the field and
easily placed into operation again. How-
ever, a prime mover is NOT included
with this radio set. The complete radio
set with trailer and generator weighs
about 3,500 pounds. It can be transported
by large helicopters. When towed by a
truck, mobile operation is possible, if
the radio set is remoted into the truck.
However, mobile operation is not normal
employment for this set.

TECHNICAL
CHARACTERISTICS

Frequency coverage.

225-399.9 mc.

Type of tuning.

Continuous, 11 preset, 1750 possible UHF channels.

Type of emission.

Voice, MCW.

Antennas.

Antenna AS-390/SCR is a modified ground-plane vertical type antenna. It is omni-directional; that is, it radiates and receives signals in a 360 degree circle. The antenna weighs about five pounds.

Power sources.

Power unit PE-75, carried at the rear (near the tail gate) of the trailer and supplies the necessary power for the radio equipment. The generator causes considerable noise and vibration therefore should be removed from the trailer whenever possible. The radio set can also operate on external power source of 115/230 volts, single phase, 60 cycle, alternating current.

Power output (maximum).

100 watts.

Range (approximate).

Line-of-sight.

Major components.

Radio Transmitter T-217A/GR.
Radio Receiver R-278B/GR.
Modulator Power Supply MD-129A/GR.
Radio Set Control C-1335/TRC-32.
Radio Set Control C-1336/TRC-32.
Mast AB-155A/U.
Antenna AS-390/SCR.

Reference: NAVMC ELECT 2003.

32. Radio Set AN/MRC-47.

a. Radio set AN/MRC-47 consists of a transmitter component and a receiver component, each mounted with shelter

on a 2 1/2-ton 6x6 truck. This set is available only in aviation units and is used primarily in air control operations. Ultra high frequency (UHF) and high frequency (HF) communications are possible with this equipment. Two UHF transceivers, two HF transceivers, four HF receivers, and two HF transmitters are provided. The AN/MRC-47 is not intended for mobile operation. Radio set AN/MRC-47 requires four R4Q aircraft to transport it; one plane for each truck (2) and one plane for each shelter and generator trailer (2).

b. Transmitter shelter. — Transmitter Group OA-778/MRC-47 is housed in Shelter S-103. This shelter with equipment weighs about 8,100 pounds. The overall weight of the shelter and truck is about 20,600 pounds.

c. Receiver shelter. — Receiver Group OA-778/MRC-47 is housed in Shelter S-104. This van has four operating positions for controlling the HF radios from both vans and two operating positions for UHF radio. The weight of the shelter with equipment installed is about 6,500 pounds. The overall weight of the shelter and the truck is about 19,000 pounds.

TECHNICAL
CHARACTERISTICS

Frequency coverage.

HF transmitters: 2-18 mc; HF receivers: .5-30.5 mc.

HF transceivers: 1.5-12 mc; UHF transceivers: 225-399.9 mc.

Type of tuning.

Continuous.

Type of emission.

HF: Voice, CW; UHF: Voice, MCW.

Antennas.

An antenna system which consists of

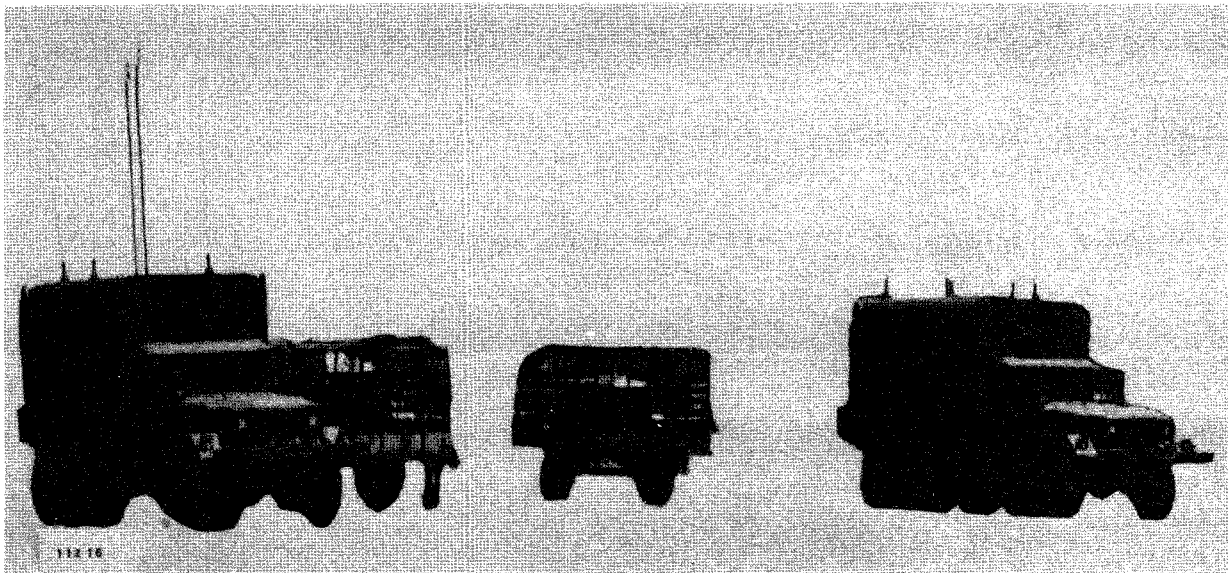


Figure 15. — Radio Set AN/MRC-47.

three 15-foot whip antennas for the HF radios and two Antennas AS-390/SCR for the UHF radios. These antennas are mounted on the roof of the shelter. In addition, two 40-foot Mast Assemblies AB-155A/U are provided to support long antennas and/or Antennas AS-390/SCR. The long wire antennas are connected to the mast base on the shelter and are supported by an antenna mast assembly on the other end. A doublet antenna can be constructed by using both mast assemblies. An antenna mast assembly can simultaneously be used to mount an AS-390/SCR and support one end of a long wire antenna or doublet. Three thousand feet of antenna wire are furnished to construct any combination of these antennas.

Power sources.

The equipment is operated from a single phase, 115 volt, 60 cycle, alternating current power source. Generators are not included as components. However, there is a general allowance of two Generator Sets PU-239 for each AN/MRC-47. Maximum power required at any one time is 10.4 kilowatts for the transmitter van and 2.8 kilowatts

for the receiver van. Three 100-foot power cables are provided as lead-ins to the vans.

Power output (maximum).

HF transmitter: Voice, 100 watts;
CW, 400 watts.

HF transceiver: Voice, 20 watts;
CW, 40 watts.

UHF: 100 watts.

Range (approximate).

HF transmitter: Voice, 75 miles;
CW, 250 miles.

HF transceiver: Voice, 15 miles;
CW, 30 miles.

UHF: line-of-sight.

Major components.

Transmitter Shelter S-103.

Receiver Shelter S-104.

2 HF Radio Transmitter Set TCK-4.

2 UHF Radio Set AN/GRC-27.

2 HF Radio Set TCS.

7 15' whip antennas.

2 Antennas AS-390/SCR.

2 Radio Set Controls C-1335/TRC-32.

4 HF Radio Receiver R-388/URR.

2 Radio Set Control C-1336/TRC-32.

4 Radio Set Control AN/GRA-11.

1 Frequency Meter LM-18.
1 Tube Tester TV-7/U.

Reference: TM 11-854, TM 11-2632, Instruction Book for Navy Model TCS Receiver-Transmitter.

33. Radio Set AN/PRC-6. — Radio Set AN/PRC-6 is a miniature, low-power, battery-operated radio transceiver designed for communications over short distances. The radio is a highly portable handie-talkie intended primarily for combat foot troops on a platoon and company level. A minimum of instruction is required to operate this set. It is self-contained; all operating components necessary for reception and transmission are contained in a two-piece cast-magnesium case. The set may be held in either hand when operating. The microphone and the earphone are fastened to the inside of the case so that the set resembles a hand telephone. An adjustable strap is attached to the case of the set for carrying and for additional support in the operating position. The total weight of the equipment including the battery is approximately 6 1/2 pounds. Provisions are made for the set to accommodate a loop antenna for homing purposes and a handset which can be used when the operator does not wish to hold the equipment or does not want to use the microphone and earphone contained in the set.

TECHNICAL CHARACTERISTICS

Frequency coverage.
47-55.4 mc.

Type of tuning.
1 preset, 43 possible FM channels.

Type of emission.
Voice.

Antenna.

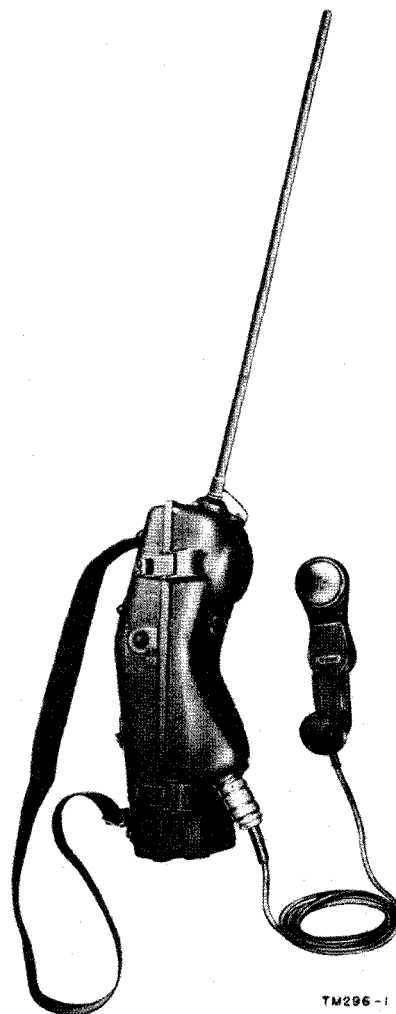


Figure 16. — Radio Set AN/PRC-6.

The antenna used with this equipment is fabricated from several layers of very flexible steel tape, and is of the whip type. When the set is not in operation, the antenna may be disconnected from its mounting and wrapped around the case of the set for ease in handling.

Power sources.
BA-270/U self-contained dry-cell battery.

Power output (maximum).
.25 watts.

Range (approximate).

1 mile over land; 3 miles over water.

Calibration.

200 kc intervals.

Major components.

Receiver-transmitter RT-196/PRC-6.

Antenna.

Handset H-33/PP.

Reference: TM 11-296.

34. Radio Set AN/PRC-8, -9 and -10.

a. Radio Sets AN/PRC-8, -9, and -10 are three portable, frequency-modulated radio sets intended to provide man-pack communications for tank, artillery, and infantry units, respectively. The other equipment with which these sets can communicate are indicated in the frequency spectrum chart, appendix 3.

b. Installation. Man-pack portable, vehicular, aircraft or ground installation.

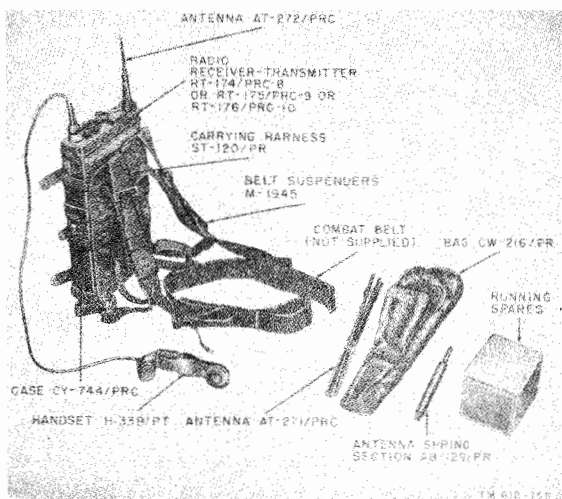


Figure 17. — Radio Set AN/PRC-8, -9, or -10, operating components.

TECHNICAL CHARACTERISTICS

Frequency coverage.

AN/PRC-8: 20.0-27.9 mc (Tank units).

AN/PRC-9: 27.0-38.9 mc (Artillery units).

AN/PRC-10: 38.0-54.9 mc (Infantry units).

Type of tuning.

AN/PRC-8: Continuous tuning, 80 possible FM channels.

AN/PRC-9: Continuous tuning, 120 possible FM channels.

AN/PRC-10: Continuous tuning, 170 possible FM channels.

Type of emission.

Voice (all three sets).

Antennas.

A demountable semi-rigid steel tape antenna, 36 inches long, is used in normal operations. This type antenna is used when the operator is moving about on foot and when the distance between stations is not excessive. The second type antenna used with each set is a 10-foot, multi-section, whip antenna. This antenna is used when maximum range is necessary, such as for two-way unattended relay service or stationary use.

Power sources.

Self-contained dry-cell battery BA-279/U (all three sets).

Power output (maximum).

1 watt (all three sets).

Range (approximate).

3-5 miles (all three sets) depending on type antenna used.

Calibration.

Radio Sets AN/PRC-8, -9 and -10: 1 mc. Radio Sets AN/PRC-8A, -9A and 10A: The crystal controlled frequency calibration check points are 2.15 mc

apart instead of 1 mc. The new check points are indicated by a red mark on the tuning dial.

Major components.

RT-174/PRC-8, RT-175/PRC-9 or RT-176/PRC-10.

Battery BA-279/U in Battery Case CY-744.

Handset H-33B/PT.

Antennas AT-271/PRC and AT-272/PRC.

Antenna Spring Section AB-129/PR.

Belt Suspenders M-1945.

Bag CW-216/PR.

Carrying Harness ST-120/PR.

Reference: TM 11-612.

35. Radio Set AN/TRC-75. — The Radio Set AN/TRC-75 is designed for long range ground-to-ground communications. The radio set uses transceiver principles to operate as both a transmitter and a receiver. It is capable of

transmitting and receiving single side-band voice, amplitude modulated voice, tone-modulated CW or teletypewriter signals in the single-sideband mode of operation. The power source required for the AN/TRC-75 is 115 volts, 400 cps, 3 phase. The Generator Set, Diesel Driven, PU-454 () is the power source issued to the field for this purpose. The AN/TRC-75 mounted in a truck, 1/4-ton, 4x4 has been assigned the nomenclature Radio Set AN/MRC-83. The power for this mobile version is furnished by the vehicle engine and a transistorized power supply. The Communication Central AN/TSC-15 which is presently under development will utilize the radio set AN/TRC-75 as the basic transmitter and receiver.

TECHNICAL CHARACTERISTICS

Frequency coverage.

2.0 to 29.999 mc.

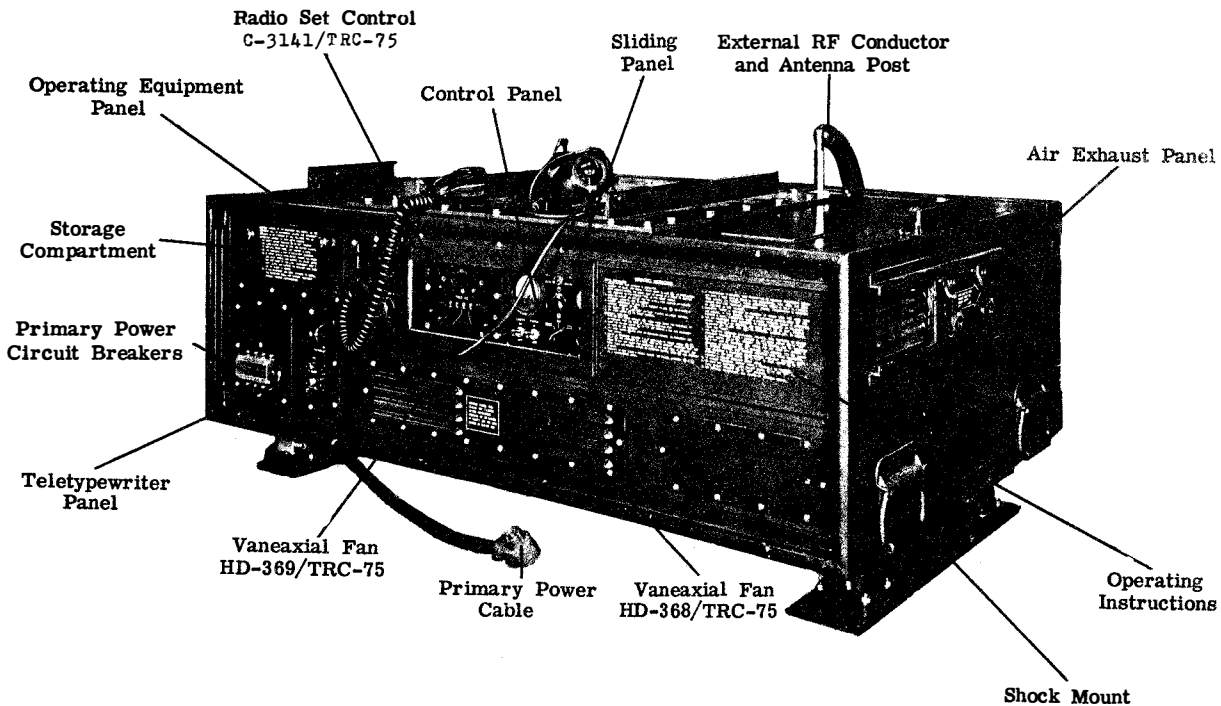


Figure 18. — Radio Set AN/TRC-75, Front View, Cover Removed.

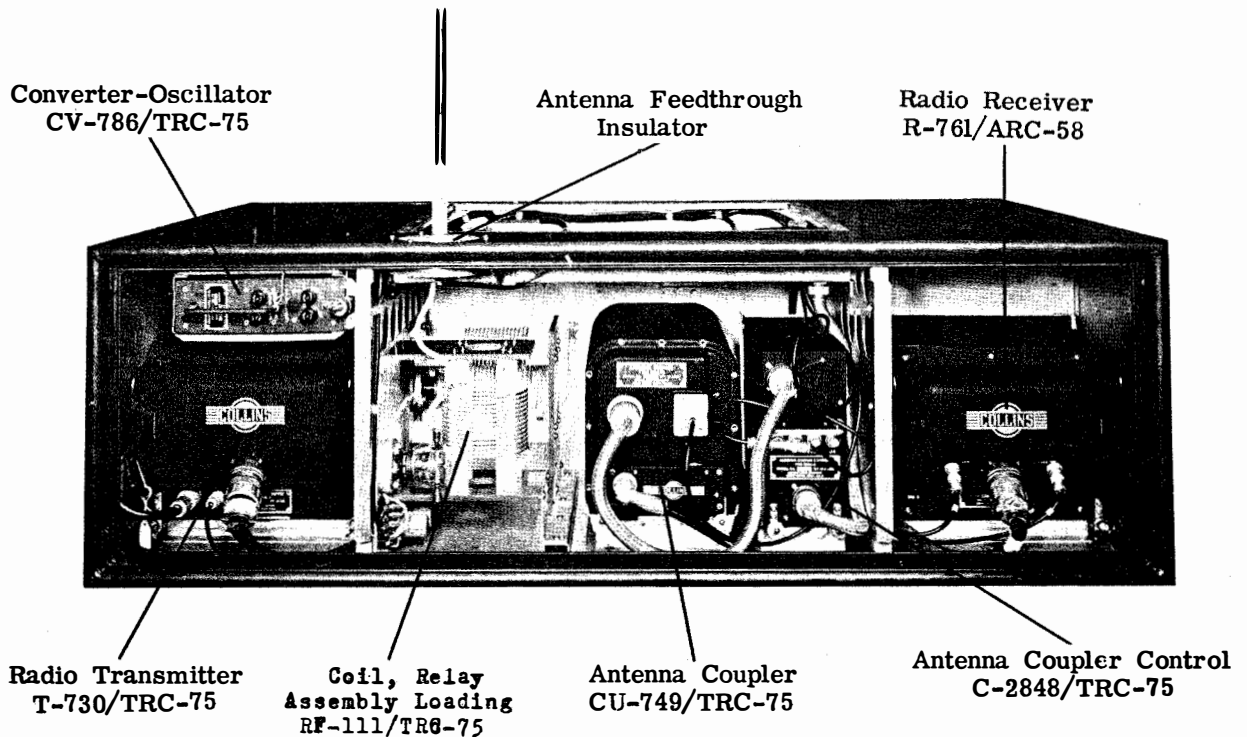


Figure 19. — Radio Set AN/TRC-75, Rear View, Cover Removed.

Type of tuning.

Automatic in 1 kc steps.

Type of emission.

Single-sideband voice, AM voice, MCW or teletypewriter.

Antennas.

15-foot whip for fixed or mobile installations or a long-wire (45 to 95 feet) for fixed site only.

Power sources.

115 volts, 400 cycles, AC.

Power output (maximum).

1 kw.

Range (approximate).

100 miles.

Major components.

Radio Set Case CY-2600/TRC-75.
Radio Receiver R-761/ARC-58

Radio Transmitter T-730/TRC-75.

Radio Set Control C-3141/TRC-75.

Antenna Coupler CU-749/TRC-75.

Antenna Coupler Control C-2848/TRC-75.

Amplifier Assembly AM-2306/TRC-75.

Converter Oscillator CV-786/TRC-75.

Coil, Relay Assembly Loading RF-111/TRC-75.

Installation Kit.

Reference: NAVMC ELECT 2040,
NAVMC ELECT 2041.

36. Radio Set MAY. — Radio Transmitting and Receiving Equipment, Navy Model MAY, is a two-way, battery-operated field set, designed for packboard carry. The equipment is submergence proof, buoyant and is designed to present a low silhouette when carried by a man lying prone. The equipment is used primarily by tactical air control parties to communicate with supporting aircraft.

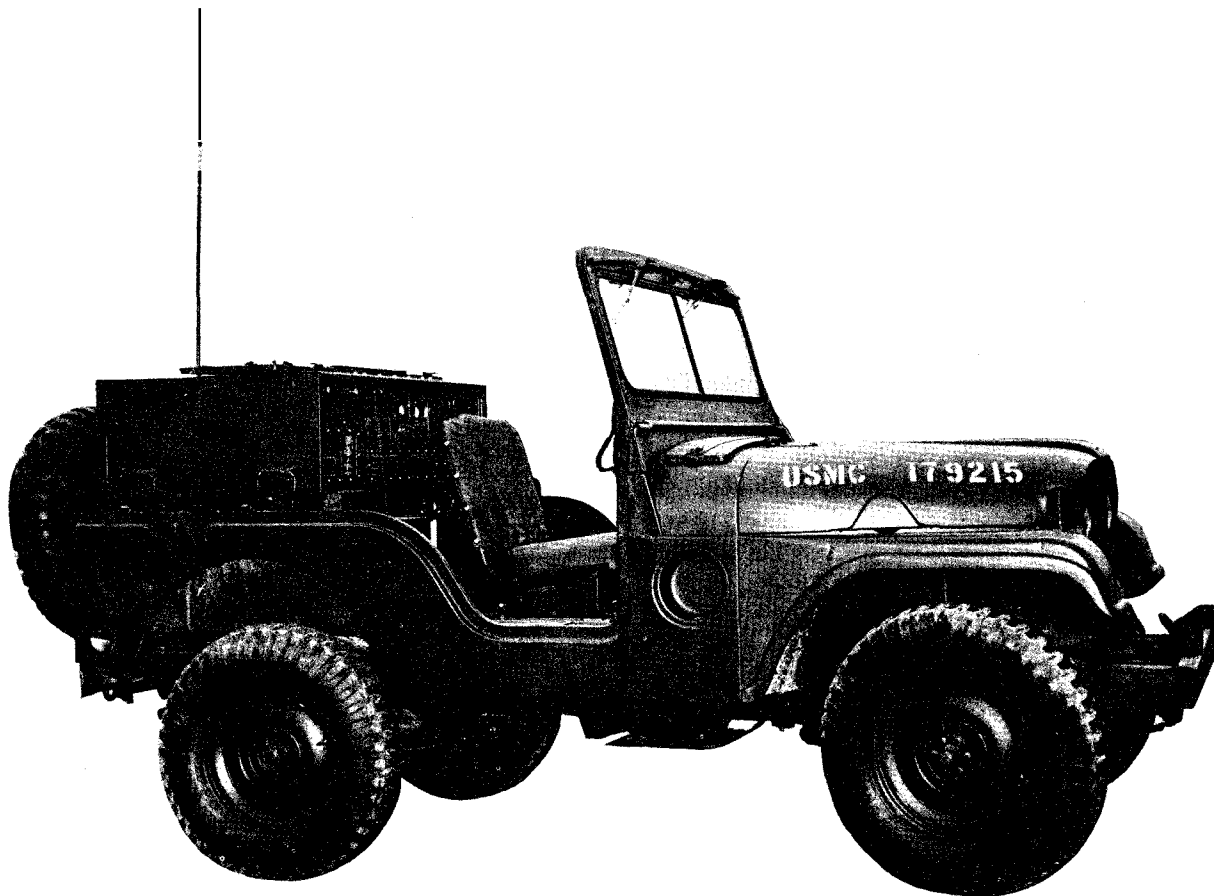


Figure 20. — Radio Set AN/TRC-75, Vehicular Mounted, Designated AN/MRC-83.

Although the equipment is designed primarily for packboard operation it can also be operated in a fixed position or from a vehicle.

TECHNICAL
CHARACTERISTICS

Frequency coverage.
225-390 mc.

Type of tuning.
4 preset channels.

Type of emission.
Voice, MCW.

Antennas.
Discone Antenna - ground-plane type, collapsible broadband. Telescopic whip.

Power sources.
Self-contained 6 volt lead-acid battery.

Power output (maximum).
1 watt.

Range (approximate).
Line-of-sight.

Calibration.
Each 100 kc.

Major components.
Transmitter-receiver CRP-43071.
Discone antenna AS-40810.
Auxiliary battery pack CRP-19062.

Reference: NAVSHIPS 91392.

37. Radio Receiver Set AN/GRR-5. —

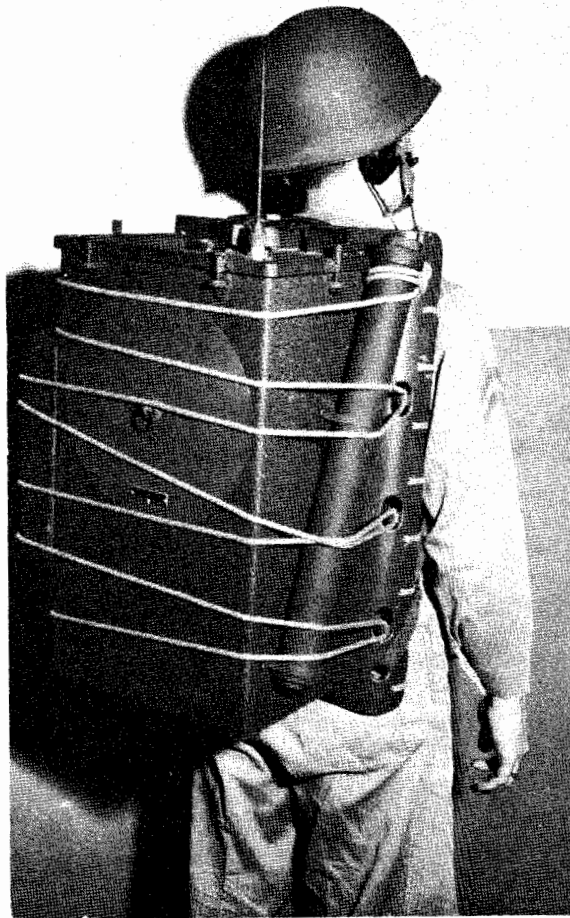


Figure 21. — Packboard operation of Radio Set MAY.

AN/GRR-5 is a radio receiver intended for use in monitoring an alert or broadcast net. It may be used alone or in conjunction with an AM transmitter to form a two-way communication system. The receiver and its power supply are secured together in Electrical Equipment Cabinet CY-615/URR. Front panel markings are phosphorescent to permit operation in the dark. It can be operated as either a field station, mobile, or man-pack.

TECHNICAL CHARACTERISTICS

Frequency coverage.
1.5 to 18 mc (4 bands).

Type of tuning.
Continuous (10 preset freq)

Type of emission.
Voice, CW or MCW.

Antennas.
Whip or other receiving type.

Power sources.
Vehicle: 6, 12 or 24 volt DC.
Pack: 2 each BA-419/U (90 v) plus 1 BA-405/U (1.5 v).
Fixed: 115 v plus/minus 10%, 50 or 60 cycle AC.

Calibration.
Each 200 kc.

Major components.
Radio receiver R-174/URR.
Power supply PP-308/URR.
Antenna sections.

Reference: TM 11-295.

38. Radio Receiver Set R-388/URR — R-388/URR is useful as a general purpose communications receiver but because of exceptional accuracy and stability, it is especially useful for receiving known frequencies without searching and frequency readjustment as well as the reception of radioteletype signals. The R-388/URR is the receiver component of the radio receiving set AN/URR-23A. It can operate as a fixed or mobile station.

TECHNICAL CHARACTERISTICS

Frequency coverage.
.5 mc to 30.5 mc.

Type of tuning.
Continuous.

Type of reception.
Voice, CW, FSK.

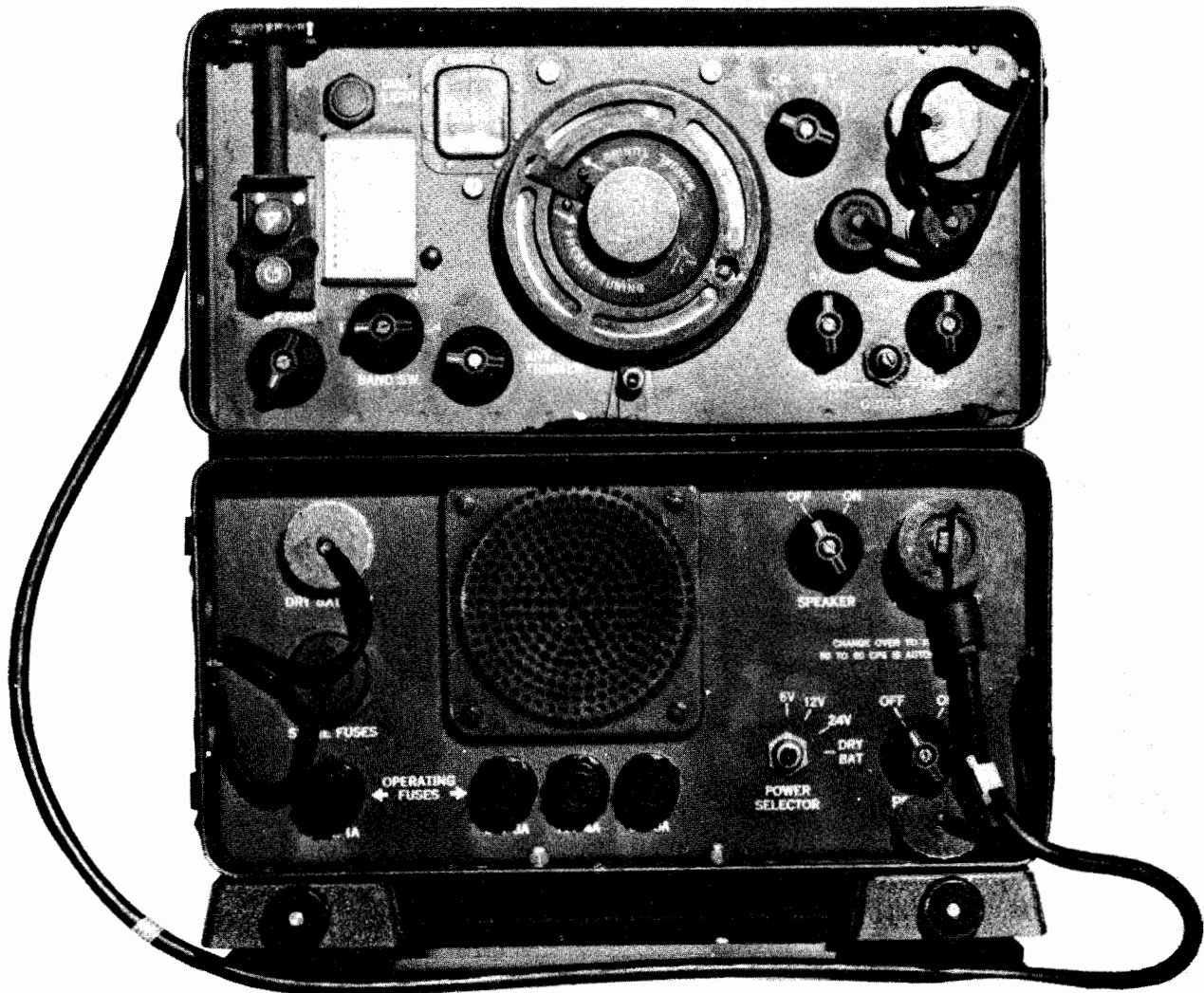


Figure 22. — Radio Receiver AN/GRR-5.

Antennas.

Antenna suitable for the reception of 500 kc to 30.5 mc signals.

Power sources.

115 to 230 volts, 45 to 70 cps, 85 watts.

Calibration.

Each 100 kc.

Reference: TM 11-854.

39. Radio Receiver R-390/URR. — R-390/URR is a high-performance, exceptionally stable, general purpose receiver. It is comprised of several inter-

changeable assemblies including the main frame and seven removable subchassis. These subchassis can be readily removed for maintenance with standard hand tools. It can operate in a fixed or vehicle mount.

TECHNICAL CHARACTERISTICS

Frequency coverage.

.5 to 32 mc.

Type of tuning.

Continuous.

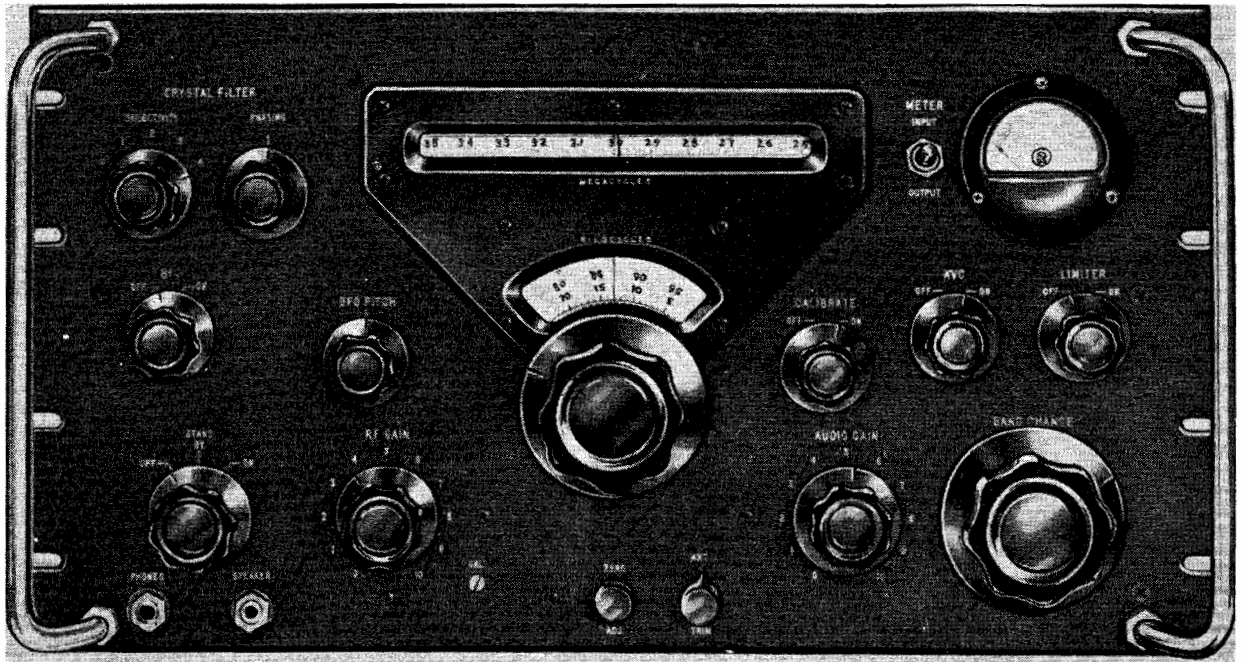
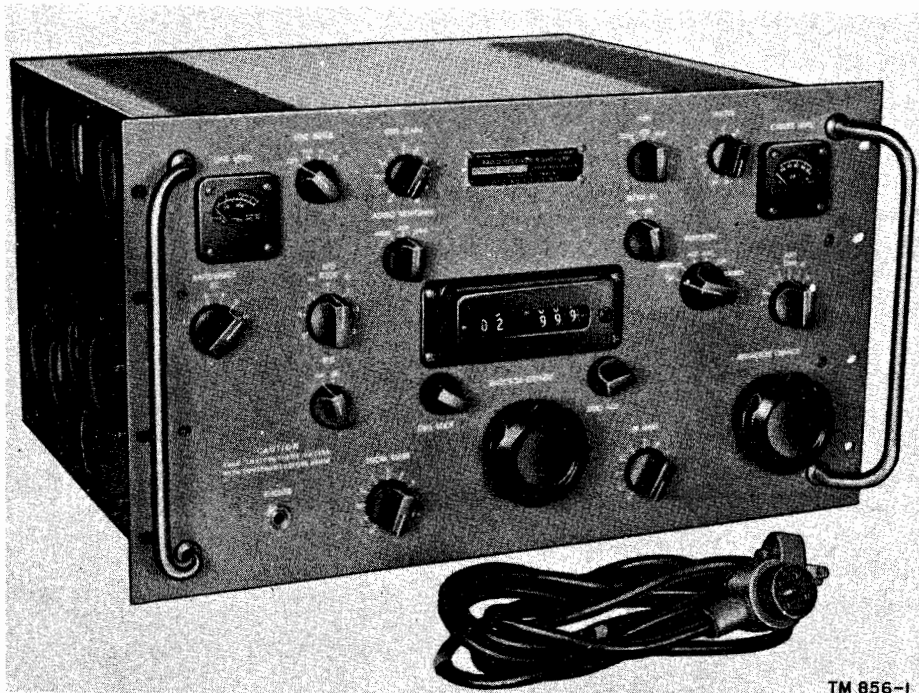


Figure 23. — Radio Receiver R-388/URR.



TM 856-1

Figure 24. — Radio Receiver R-390/URR.

Type of reception.

Voice, CW, MCW and Frequency-shift keyed signals.

Antennas.

Can use doublet or rhombic antennas spaced 600 feet apart or a straight wire or whip type.

Power sources.

Self-contained Power Supply PP-621/URR requiring 115/230 v.

Calibration.

Built-in crystal controlled oscillator for every 100 kc.

Major components.

Radio-receiver R-390/URR.

Power supply PP-621/URR (built-in).

Power cable assembly CX-1358/U.

Reference: TM 11-856.

40. Amplifier Power Supply AM-598/U. — Amplifier Power Supply AM-598/U is a vibrator-type power supply which operates only from a 24-volt direct current source. It supplies the complete power requirements of the radio set AN/PRC-8, -9 or -10. The panel of the unit contains two audio receptacles for connecting an external speaker, headset, microphone, handset, or remote control unit, as desired. No controls are provided. The radio set is operated in the same manner as for pack operation. Any of the three radio sets may be mounted in a vehicle for permanent or semi-permanent operation by using Amplifier Power Supply AM-598/U.

Reference: TM 11-5055.

41. Control Group AN/GRA-6. — Control Group AN/GRA-6 provides means for controlling and operating a radio set using one or two receiver-transmitters, amplifiers or other similar units of the push-to-talk type from a position approximately two miles away from the location of the set. In addition, the control group makes provision for local control of the radio set through a

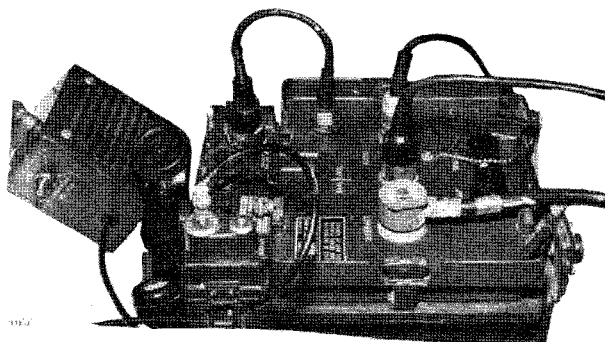


Figure 25. — Radio Set AN/PRC-10A installed with Amplifier Power Supply AM/-598/v.

continuous dc circuit and for two-way telephone (duplex) communication and ringing between the remote and local control operators. Local Control C-434/GRC fits into a compartment in the AN/GRC-3 to -8 sets. Remote Control C-433/GRC can be carried using the shoulder straps issued with the unit. This control group may also be used for remote operation on the portable FM radio equipments.

TECHNICAL CHARACTERISTICS

Power sources.

2 1 1/2-volt batteries BA-30 for each local control unit and remote control unit. 1 45-volt battery BA-414/U.

Range (approximate).

2 miles.

Major components.

The local control position consists of Local Control C-434/GRC while the remote control position consists of Remote Control C-433/GRC. Handset H-33/PT with a connector plug and a push-to-talk switch and Bag CW-189/GR are included as basic components.

Reference: TM 11-5038.

42. Radio Set Control Group AN/GRA-11. — Radio Set Control Group AN/GRA

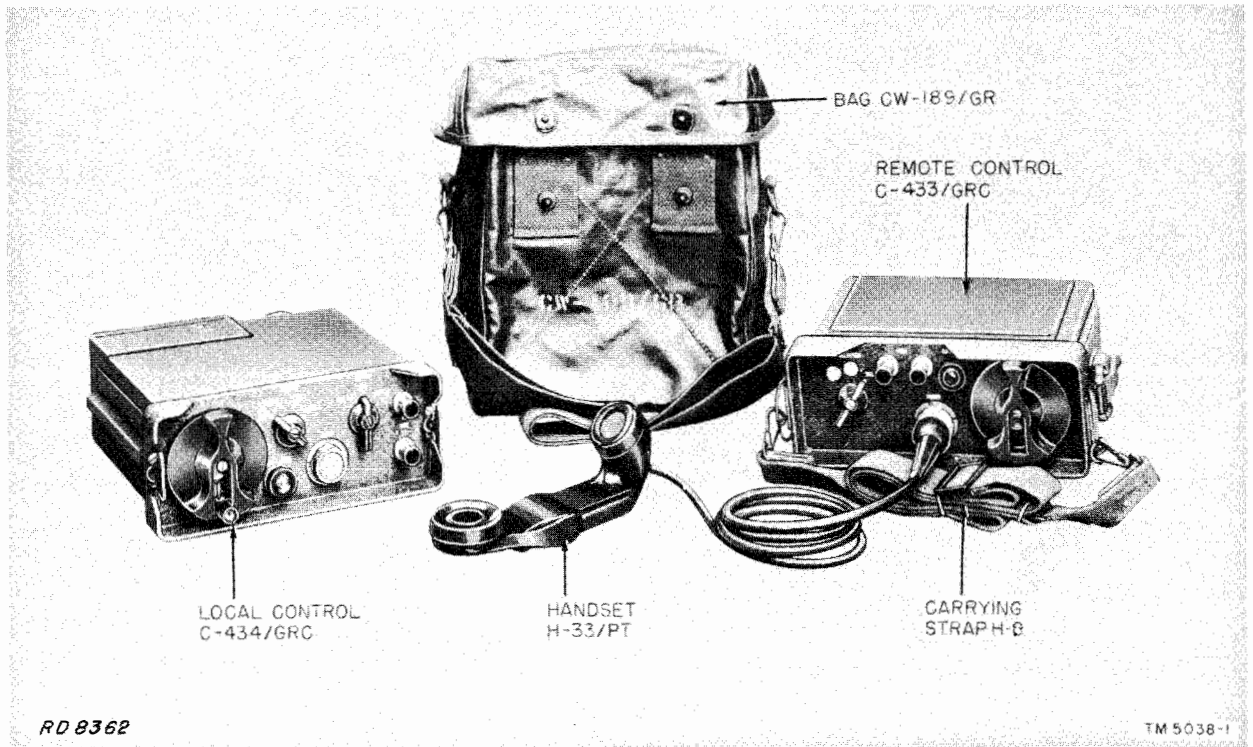


Figure 26. — Control Group AN/GRA-6.

-11 consists of a Local Control RM-53 and Remote Control RM-52. This unit permits push-to-talk operation of a transmitter up to distances of 1 1/2 mile. Preset channels cannot be switched with this control group. It was primarily designed for use with the currently authorized high frequency equipment.

Reference: TM 11-2632.

43. Frequency Meter AN/URM-32. — AN/URM-32 is a self-contained instrument used to measure frequencies in the range from 125 kc to 1000 mc. It is also used as a signal generator which provides a choice of modulated or unmodulated signals for testing and calibrating radio equipment.

TECHNICAL CHARACTERISTICS

Frequency range.

Range A - 125 kc to 2.5 mc.
Range B - 2.5 mc to 65 mc.
Range C - 65 mc to 1000 mc.

Antenna.

AT-564/U.

Power sources.

Power Supply PP-1243/U (not supplied) or dry cell batteries (2 BA-419/U and 1 BA-412/U).

Major components.

Frequency meter AN/URM-32.
Antenna AT-564/U.
Cord CG-409E/U.
Adapter UG-641/U.
Headset HS-33.
Cord CD-307A.

Reference: TM 11-5120.

44. Homing Antenna AT-249/GRC, -340/PRC and -339/PRC. — Homing Antenna AT-340/PRC is a loop type



Figure 27. — Radio Set Control Group AN/GRA-11.

antenna designed for use with Radio Sets AN/PRC-8 and -9 enabling the operator to determine the direction of a transmitted signal and to proceed toward it. It has a frequency range of 20 to 38.9 megacycles. Homing Antenna AT-339/PRC is similar except that it is designed for use with Radio Set AN/PRC-10 and has a frequency range of 38 to 54.9 megacycles. Antenna AT-249/GRD is similar except it is designed for use with Radio Set AN/PRC-6 and has a frequency range of 47 to 55.4 mc. Either loop antenna, when properly connected to its respective radio set, comprises an effective homing device which permits the radio operator to find the direction of a radio transmitter tuned to his frequency, proceed toward it, and eventually reach it. Since highly accurate bearings are not required for homing, an azimuth scale is not provided. When desired, approximate azimuth readings can be obtained by sighting a pocket compass in the direction of the

indicated bearing.

TECHNICAL CHARACTERISTICS

Frequency coverage.

AT-340/PRC covers range from 20 to 38 mc.

AT-339/PRC covers from 38 to 54.9 mc.

AT-249/GRD covers from 47 to 55.4 mc.

Type of tuning.

When used for homing purposes the set would be operated in a manner similar to that of a direction finder. By placing the toggle switch on the antenna controls to the SENSE position and rotating the antenna about a vertical axis until the greatest signal response is heard, the arrow on the antenna frame will point to the direction of the transmitting station. The operator of the set

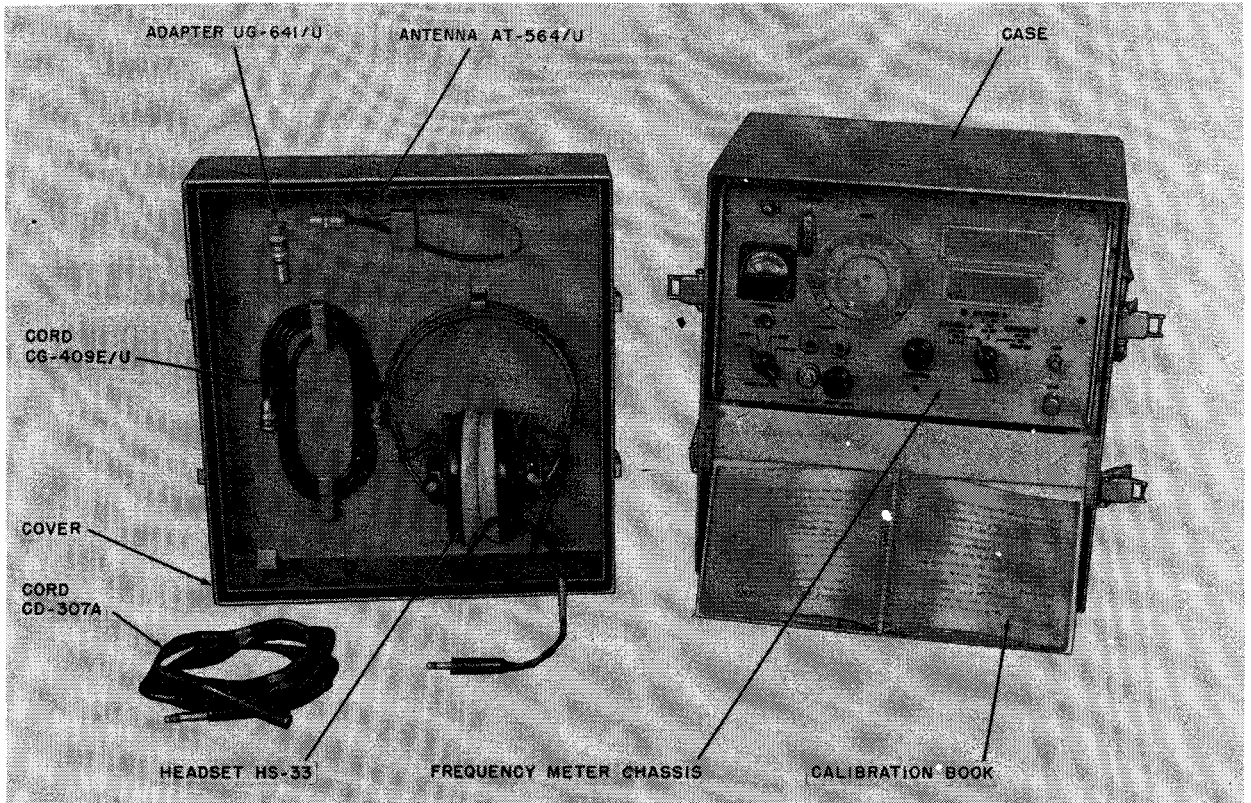


Figure 28. — Frequency Meter AN/URM-32.

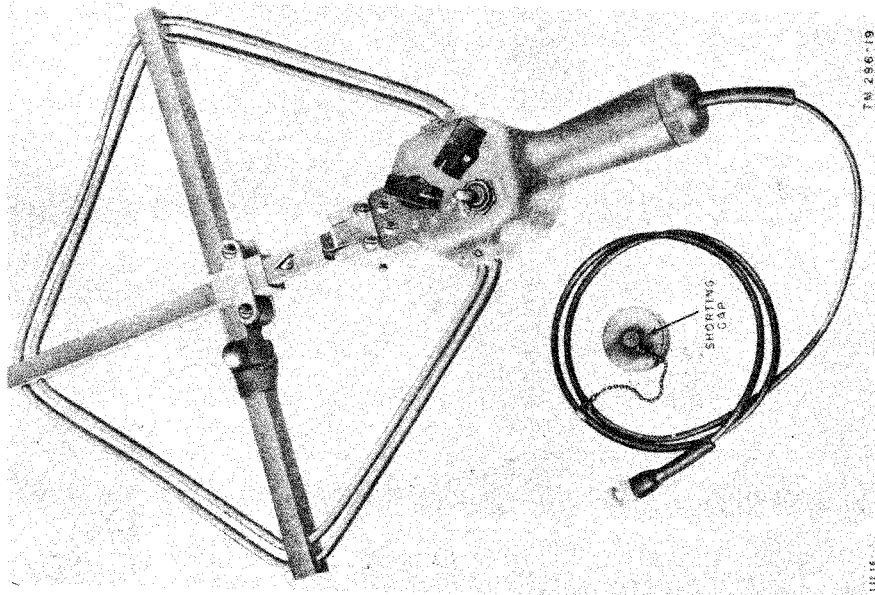
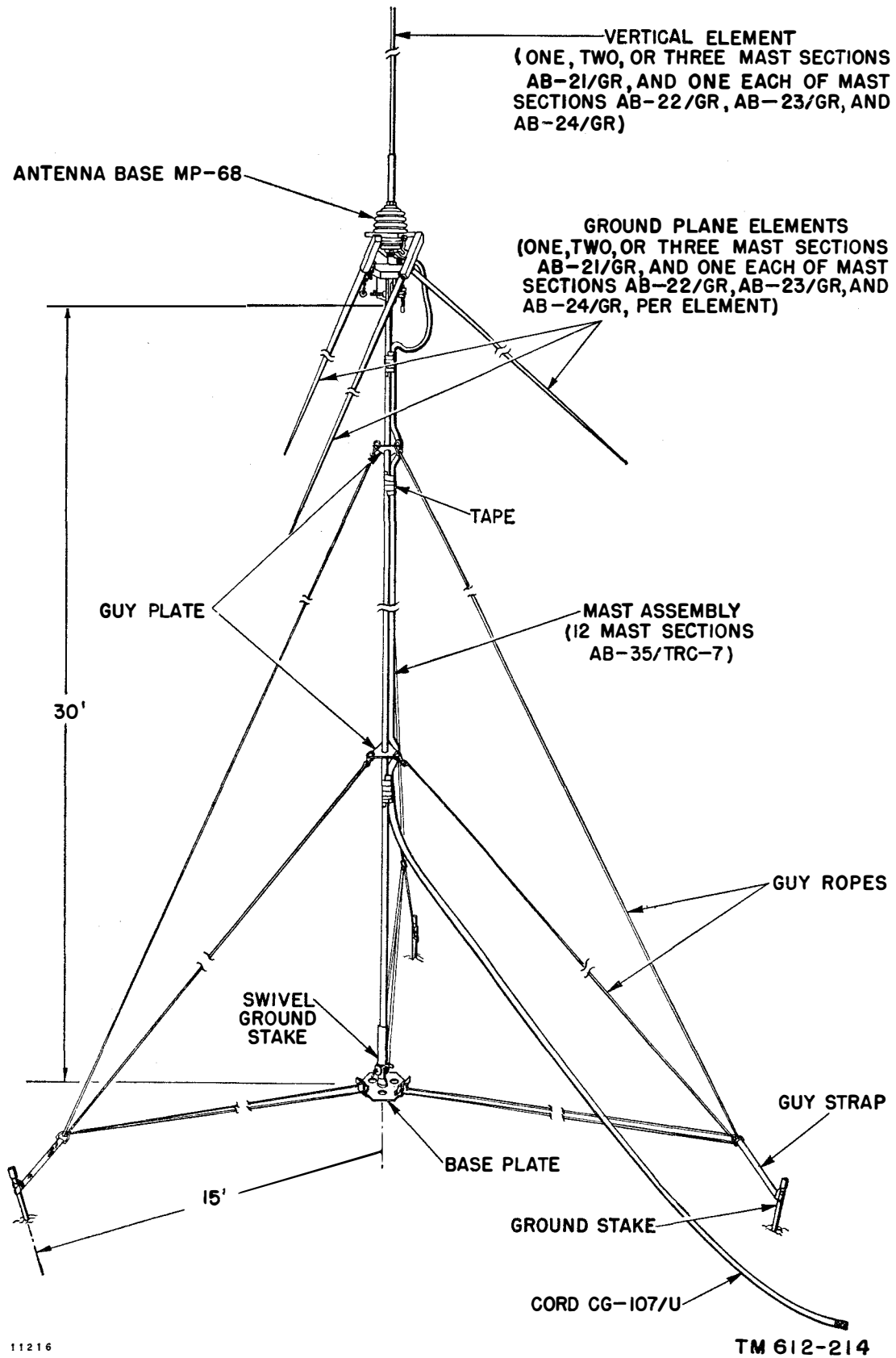


Figure 29. — Homing Antenna AT-249/GRD, -340/PRC, and-399/PRC.



11216

Figure 30. — Antenna Equipment RC-292.

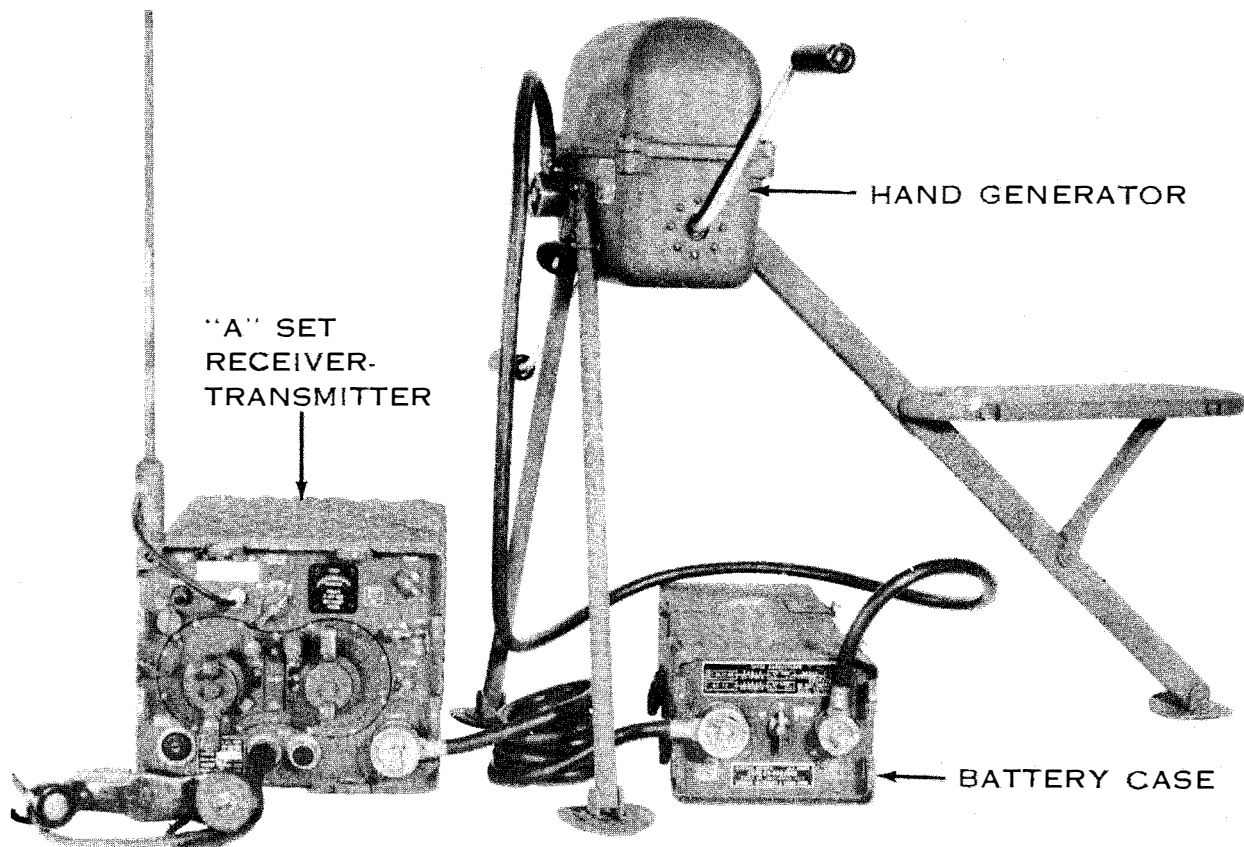


Figure 31. — Modification Kit MX-898/GR.

can then proceed toward the transmitting station along a path in which the signal level remains constant.

Reference: TM 11-612.

45. Antenna Equipment RC-292. — RC-292 is an elevated, wide-band, modified ground-plane antenna which can be used as an auxiliary antenna with frequency-modulated radio sets to increase communication range. A reliable increase of about 10 miles can be expected with most sets. It is used in fixed installations. Antenna elements are adjusted for the various frequency ranges of the equipment used.

Reference: TM 11-5020.

46. Modification Kit MX-898/GR. — MX-898/GR provides the components necessary for temporary operation of an individual receiver-transmitter when it is used in a field location or when vehicular power is not available. It is designed for ground operation of Set #1 or Set #2 of the Radio Sets AN/GRC-3, -5 and -8.

Major components.

Generator G-8/GRC.

Case CY-590/GRC.

Power Cable Assembly CX-1209/U.

Power Cable Assembly CX-1210/U.

Mounting MT-652/GR.

Handset H-33/PT.

Mast Sections AB-22/GR, AB-23/GR and AB-24/GR.

Bag CW-187/GR.
2 Bag CW-188/GR.

Reference: TM 11-284.

SECTION 7

RADIO RELAY

47. General. — Radio relay, a combination of the best features of wire and radio, is the primary means of ground-to-ground communications used by the landing force down to the infantry battalion and artillery battery level, except during the initial ship-to-shore movement and during fast-moving tactical situations. Radio relay equipment is similar in operation to ordinary field radios. It combines the ease of operation and simultaneous two-way conversations of the telephone with the rapidity of installation and flexibility of radio.

There are, however, two major differences: First, the radio relay station transmits on one frequency and receives on another; secondly, the antenna normally used with radio relay equipment is directional. Sending on one frequency and receiving on another provides a circuit which, from the user's standpoint, is basically the same as a telephone circuit connected by wire lines. The conversation takes place without the necessity of switching from send to receive. Radio procedure is not used. The directional antenna used focuses the transmitted signal toward the receiving antenna, making radio relay a point-to-point means of communications.

Such a system enables widely separated commands to establish telephonic and radioteletype communications without a physical link. As such, the installation of communications by radio relay is more efficient than wire since it can bypass enemy occupied territory and terrain which is impassable or inaccessible to wire laying personnel or equipment.

Although this highly directional, point-

to-point characteristic makes radio relay signals more difficult to intercept than radio, it is not considered a secure means of communications. When terrain prevents line-of-sight communications, or when the terminals are beyond the range capabilities of the particular radio relay equipment employed, repeater (automatic retransmission) stations are installed between terminals.

To overcome the limitations of a single radio circuit, units called multiplexers are employed as a part of radio relay equipment to increase its traffic-handling capability. A multiplexer is a device which provides multiple lines of communication over a single transmission circuit. All the lines thus provided can be used simultaneously without mutual interference. Radio relay is used for both voice and teletype transmission. Teletype operation is possible by the addition of telephone-telegraph terminal equipment on any multiplexed line. Lines may be tied to switchboards, or directly to telephones or teletypewriters. The allocation of lines, as to common or private use, must be constantly evaluated to ensure optimum utilization of radio relay facilities. The landing force uses two families of radio relay equipment. One provides four channels of voice communications, the other provides eight channels. These two families have different frequencies, ranges, and power requirements. A critical factor in the efficient operation of radio relay is the siting, or physical placement, of antennas. The frequency range and antenna design of the 8-channel family radio relay equipment makes line-of-sight operation mandatory. When siting antennas, a terrain profile should be taken to ensure line-of-sight operation. Also, the 8-channel family requires that there be no intervening vegetation of any kind. While not as critical as for the 8-channel family, the 4-channel family requires careful siting to avoid hill masses and other obstacles. It is also necessary to ensure that the 4-channel terminal equip-

ment and antennas are emplaced to avoid interference, from either mutual or AM/FM radio sets in the area. Two problems inherent in radio relay systems must be considered. First, effective camouflage is very difficult because of the unique shape of the antennas and the requirement that they be operated on a line-of-sight path. Secondly, their physical security becomes a problem when repeater stations are employed in a radio relay circuit. Thus, they must be erected in areas controlled by friendly forces.

48. Radio Relay Set AN/MRC-62 and -63. — Radio Sets AN/MRC-62 and -63 are intended for use in a radio relay multichannel communication system. The set is vehicular mounted and helicopter transportable less the vehicle.

TECHNICAL CHARACTERISTICS

Frequency coverage.

54 to 70.9 mc.

Type of tuning.

Continuous, 170 possible channels.

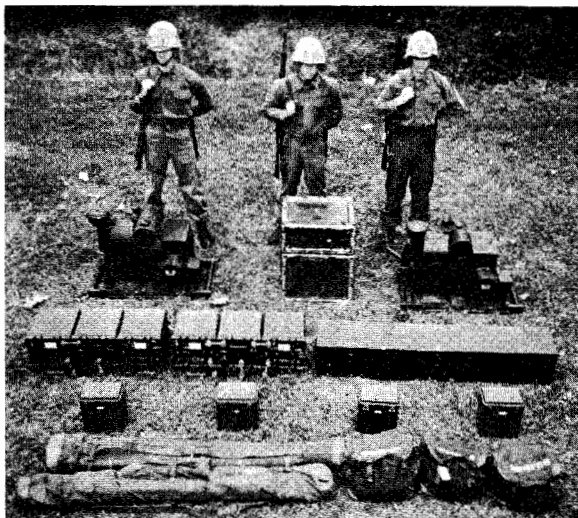


Figure 32. — Radio Relay Set AN/MRC-62, dismantled.

Type of emission.

4 multiplexed channels, 1 order wire, voice frequency TT superimposition.

Antennas.

In a multichannel radio relay system of communications, radio receivers and transmitters operate on separate frequencies to provide full-duplex conversation. This requires two antennas for each AN/GRC-10. The antennas are of Yagi design having director, radiator and reflector elements. The elements are detachable and adjustable for length and spacing in 1 mc increments. The Yagi antenna is a directional antenna and has an effective radiation pattern of about 90 degrees. However, exact orientation of the antenna with the distant station improves transmission and reception.

Power sources.

PE-75. The radio set may be operated from either 115 or 230 volts, 50/60 cycles, alternating current with the power supply equipment or from 26 volts



Figure 33. — Radio Relay AN/MRC-63.

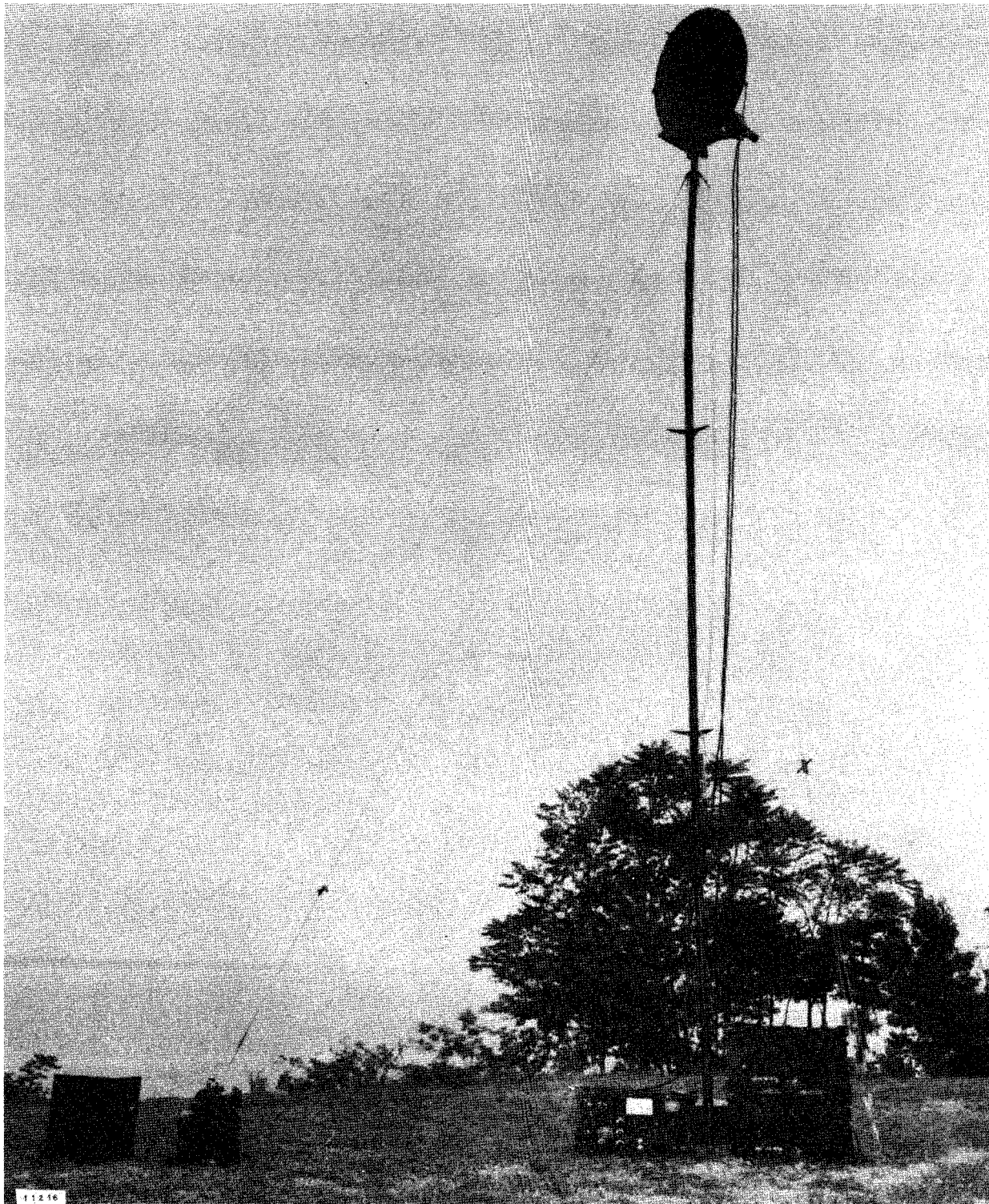


Figure 34. — Radio Set AN/TRC-27.

direct current with the dynamotor.

Power output (maximum).

LG: 10 watts, HI: 40 watts.

Range (approximate).

20-50 miles line-of-sight. Each relay will extend the range by 20-50 miles line-of-sight. Three relays may be used in one link.

Calibration.

Each 100 kc.

Major components.

<u>Components</u>	<u>AN/MRC-62</u>	<u>AN/MRC-63</u>
Radio Set		
AN/GRC-10	2	3
Antenna Group		
OA-249./ GRC-10	1	2
Telephone Terminal AN/TCC-3	1	0
Telegraph-Telephone signal Converter TA-182/U	4	0
Power Unit PE-75	2	2

Reference: TM 11-614

49. Radio Relay Set AN/TRC-27 and AN/MRC-60. — The basic communications system of two AN/TRC-27 terminals provides two-way microwave radio transmission of eight telephone channels. It is designed primarily for operation in a forward area. The AN/MRC-60 consists of the same major units as four AN/TRC-27 sets. The AN/TRC-27 is a five man-pack set, each unit weighing approximately 55 pounds. The AN/MRC-60 is installed in a S-140/MRC-60 shelter on an M37 truck with power units on a separate trailer.

TECHNICAL
CHARACTERISTICS

Frequency coverage.

4400 to 5000 mc.

Type of tuning.

Continuously tunable over entire frequency range.

Type of emission.

Voice or teletype

Antennas.

20 ft. sectionalized mast with parabolic reflector.

Power sources.

Either 115 volt, 400 cycle power or PU-278/TRC-27 for AN/TRC-27. AN/MRC-60 uses PU-392, 2 PU-345/G and 4 PU-278/TRC-27.

Power output (maximum).

1.5 watts.

Range (approximate).

10 miles line-of-sight extendable by relay stations.

Major Components.

Radio Set AN/TRC-27

1 Receiver-Transmitter RT-252/TRC-27.

2 Multiplexers TD-101/TRC-27.

1 Antenna Group OA-1378/GRC.

2 Gasoline Generator PU-278/TRC-27.

Radio Set AN/MRC-60

4 Radio Set AN/TRC-27.

1 Motor Generator PU-392/GRC.

2 Diesel Engine Generator PU-345/G.

4 Gasoline Engine Generator PU-278/TRC-27.

Reference: TM 11-5820-349-15,
NAVSHIPS 93098 (a).

SECTION 8

FIELD EXPEDIENTS

50. General. — Basically a field expedient involves a solution to a specific problem which is not otherwise covered by instructions. In radio operation the primary problem is normally one of poor or of a total lack of communications.

This can be caused by a multitude of adverse factors. The correction or improvement of any one of these factors may be all that is required. In this section a few recommended actions are discussed. However, the actual remedial action taken will depend upon the ability of the personnel involved to analyze the problem, make a decision on what to do, and then to use all available resources to improve the communications system.

51. Equipment Maintenance. — Perhaps before going into the subject of field expedients, it would be wise to review some maintenance techniques. Remember, with good maintenance procedures the need for expedient repairs is decreased. The following listing is a basic outline for all radio equipment. Those items which do not apply to a particular set should be eliminated. If some items are not covered, they should be added.

a. Read the technical manual for the equipment. This gives complete operating and maintenance procedures.

b. Keep the equipment clean and dry.

c. Handle the equipment carefully.

d. Set up routine inspection and check procedures covering the following points:

(1) Plugs and jacks should be clean.

(2) Antenna connections should be tight.

(3) Antenna insulators must be dry and clean.

(4) Power connections must be tight.

(5) Motors, fans, etc., should run freely.

(6) Knobs and controls should operate easily.

(7) Dry batteries should be fresh, and they must be protected from severe climatic extremes.

52. Gasoline Engine Maintenance. — Gasoline engine driven power units are extremely important to the operation of many sets. Since their use is so widespread, listed below is a separate check list for these units. For exact maintenance procedures, refer to the appropriate technical manual.

a. Suggested daily checks:

(1) Battery: For proper water level and protection against terminal corrosion.

(2) Fan belt: For proper tension and fraying.

(3) Radiator: For proper water level.

(4) Oil: For proper level and pressure.

(5) Voltage: As indicated on nameplate.

(6) Frequency: As indicated on nameplate.

(7) Heat: Approximately 180 degrees is normal.

(8) Generator brushes: For wear and arcing.

b. Weekly checks:

(1) Spark-plugs: Clean and adjust.

(2) Distributor points: Clean and adjust.

(3) Oil filter: Change every 256 hours of operation.

(4) Oil: Change approximately every 64 hours of operation.

(5) Relay, start-stop: Clean and adjust contacts.

53. Economy of Equipment. — At any installation it is desirable to have as few operating components as necessary in operation. The remaining components should be kept in good operating condition for use as spares. For example, if one power unit is capable of handling more than one radio set, it should be used to operate as many as it can (without, of course, overloading the unit). In this way the other power

unit can be kept ready for operation when the one in use fails or needs refueling. Also, rotating the power units will equalize the wear on each unit so that greater use can be obtained from these units.

54. General Operating Techniques. —

In some cases, to obtain better communications, a few simple steps can be taken to improve the situation considerably. The following steps will aid in obtaining better communications.

a. If the signal is weak, use a headset in place of a loudspeaker to cut out local noise.

b. Make sure the microphone or handset is in good condition. Speak directly into the microphone; speak slowly and distinctly.

c. If the set is in a vehicle, make sure the battery voltage is up. Keep the engine running to charge the battery.

d. Moving the set and antenna a few feet may improve reception.

e. Use CW in place of voice.

55. Antenna Systems. — With equipment in good operating condition, the cause of poor communications can sometimes be traced to the antenna systems. The following paragraphs describe some improvement that can be made on existing antenna systems.

a. Siting. — The best locations for transmission and reception are hill tops or any high elevations. Flat terrain is also good. As a general rule, transmission over water is better than over land. Valleys, depressions, densely wooded areas, and low places are poor sites. When the set is installed in a vehicle, stay away from bridges, large buildings, power lines, large trees, and heavily traveled roads. Proper siting and the proper antenna are more ef-

fective in maintaining communications than greatly increasing the transmitter power.

b. Whip antennas. — The standard 15-foot whip antenna provides good omnidirectional coverage on the horizontal plane. The distance ranges of the various radio sets listed in this manual consider average terrain. These ranges are reduced in densely wooded areas, mountainous country, or where the locality is very noisy. To overcome this reduction in range, it is necessary to site the set carefully or to change the antenna system.

(1) An increase in the antenna height will usually extend the communications range of a radio set. Operating the set from the top of a vehicle or shelter will increase the range in many cases.

(2) Increasing the antenna length by using additional mast sections or a long piece of wire (if top of this wire can be supported) will usually improve operations. When this is done, it will be necessary to retune the antenna coupling circuit or adjust the antenna lengths until improvement is noted.

c. Whip or rod-type antennas. — Most military radio sets use a whip or rod-type antenna. This is the only type that can be used for vehicles and manpack sets that must operate in motion. Although it is not the best antenna, it serves the purpose better from a tactical standpoint than more elaborate antenna systems. Improved performance can be obtained from the radio equipment under adverse conditions by consulting the technical manual for the particular set, or TM 11-666, 'Antennas and Radio Propagation.'

d. Horizontal antennas. — Using sky-wave propagation, greater ranges can be obtained from radio equipments that normally use ground-wave propagation. The most suitable type of antenna

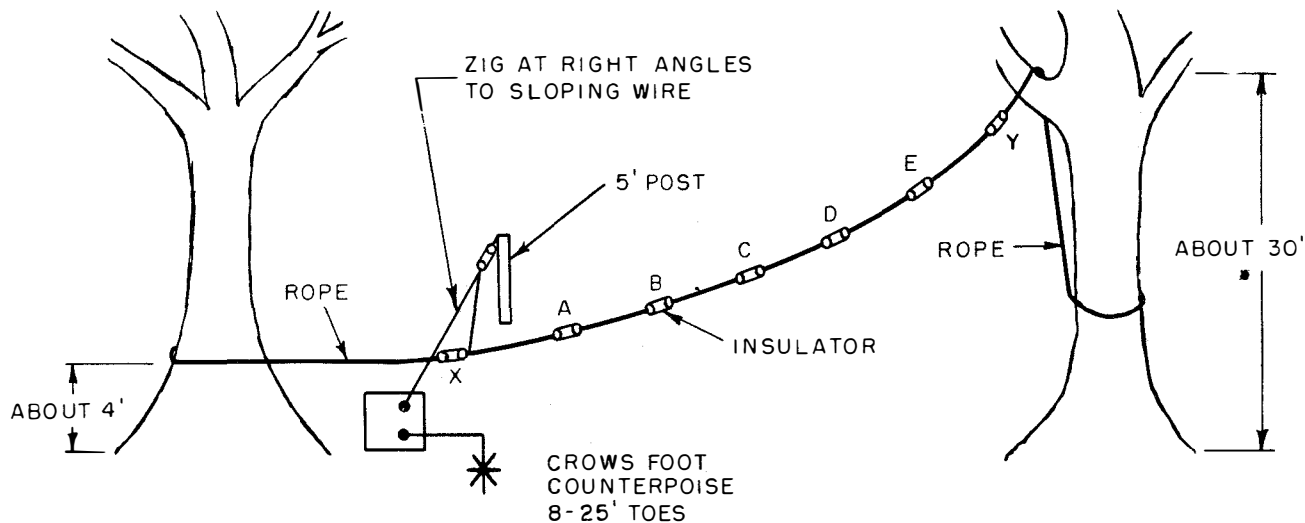


Figure 35. — Improved end-fed antenna.

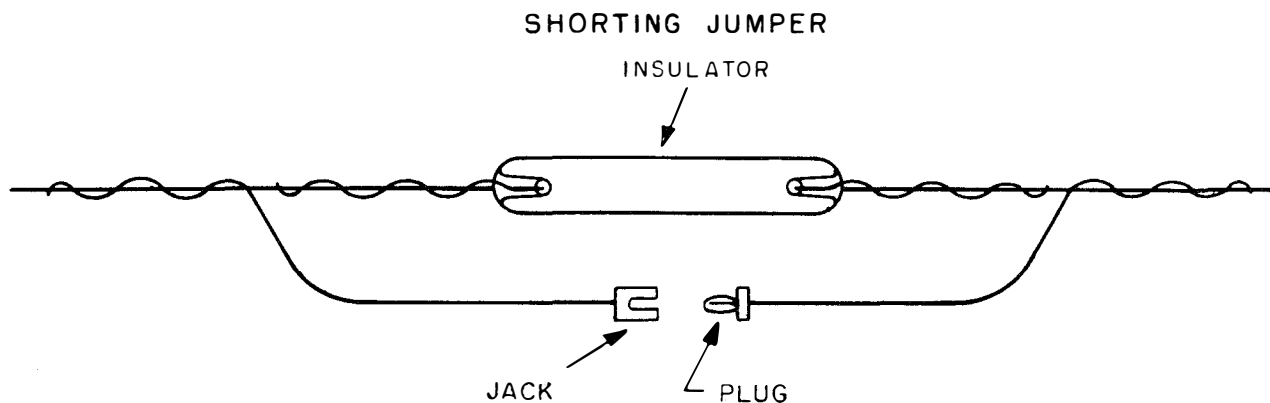


Figure 36. — Shorting jumper detail. (Shorting jumper and insulator appear in figure 35 as item A, B, C, D, and E.)

for sky-wave transmission is the horizontal antenna. When supported above ground between 6 and 30 feet, it will work well for distances of 15 to 200 miles and beyond. These antennas can be end-fed or center-fed. Refer to the intermediate distance sky-wave propagation charts for additional information on antenna performance and frequency selection.

56. Field Expedient antennas.

a. Improvised antennas can be con-

structed from available materials using the method shown in figures 35 and 36. The overall length from X to Y should be 234 feet with insulators placed as follows:

TABLE I. PLACING INSULATORS

Frequency (mc)	Length (ft)	Connections
6.0	78	X to A
5.0	94	X to B
4.0	117	X to C
3.0	156	X to D
2.5	187	X to E
2.0	234	X to Y

NOTE: Improvised insulators can be made of any non-conducting material.

TABLE II. TYPICAL LENGTHS

Frequency (mc)	Antenna Length (ft)	Frequency (mc)	Antenna Length (ft)
2	234	8	59
3	156	9	52
4	117	10	47
5	94	11	43
6	78	12	39
7	67		

NOTE: To determine the proper length (in feet) of a half-wave antenna for any frequency, divide 468 by the frequency in megacycles. The resultant length is given in feet.

b. Expedient antennas can be made from ordinary field wire. These will also improve operation as compared to the whip antennas. Normally, these are made as half-wave antennas, and must

be oriented correctly to insure operation. Using the improvised antenna in figure 37, the best transmission directions are directly (at right angles to the page) into and out of the page, or broadside to the axis of the antenna.

c. Insulated wire, if laid on the ground, or preferably, on bushes or poles a few feet off the ground, will provide a good antenna in some cases. Lengths should be in accordance with Table II.

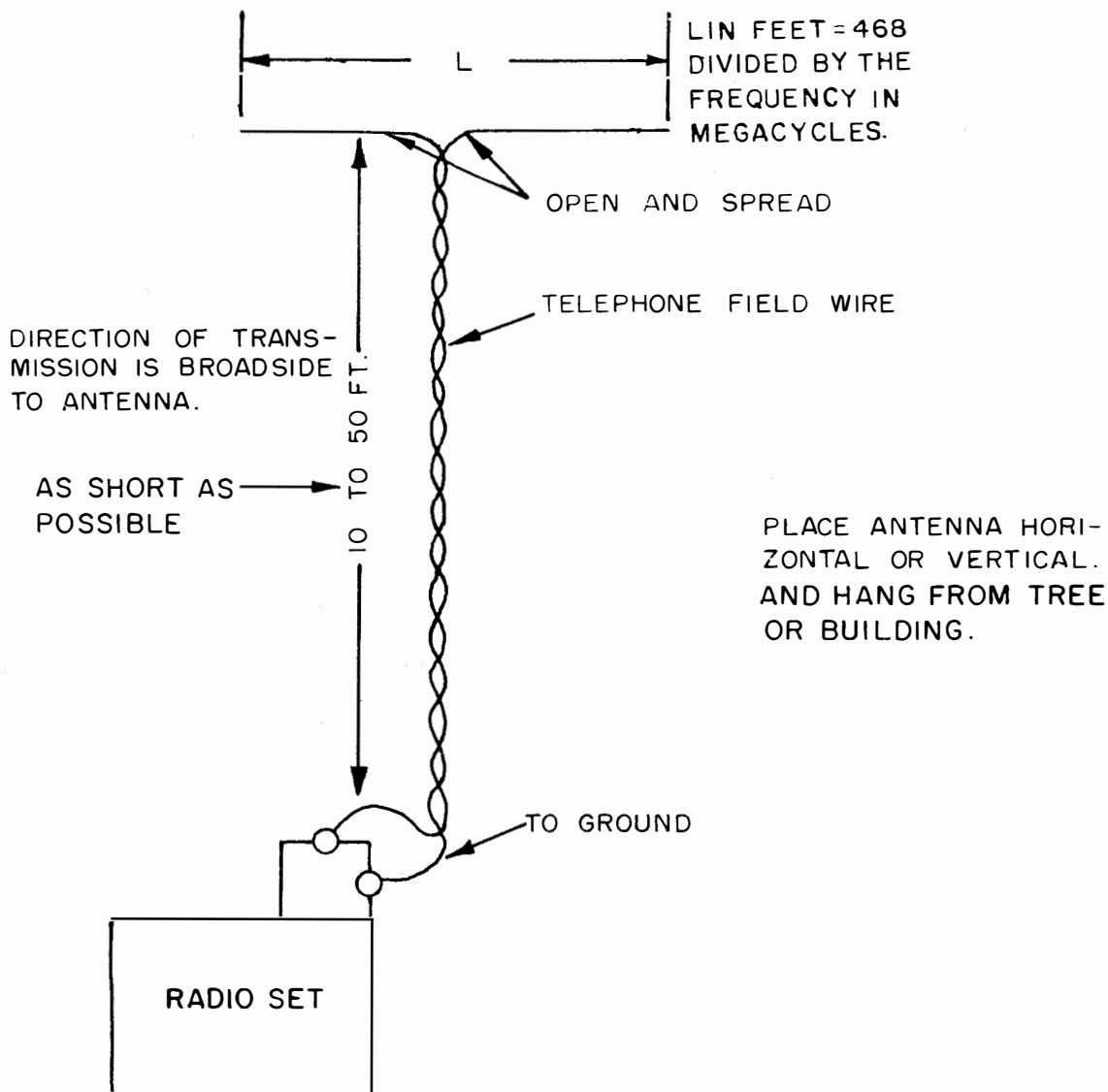


Figure 37. — Improvised Antenna.

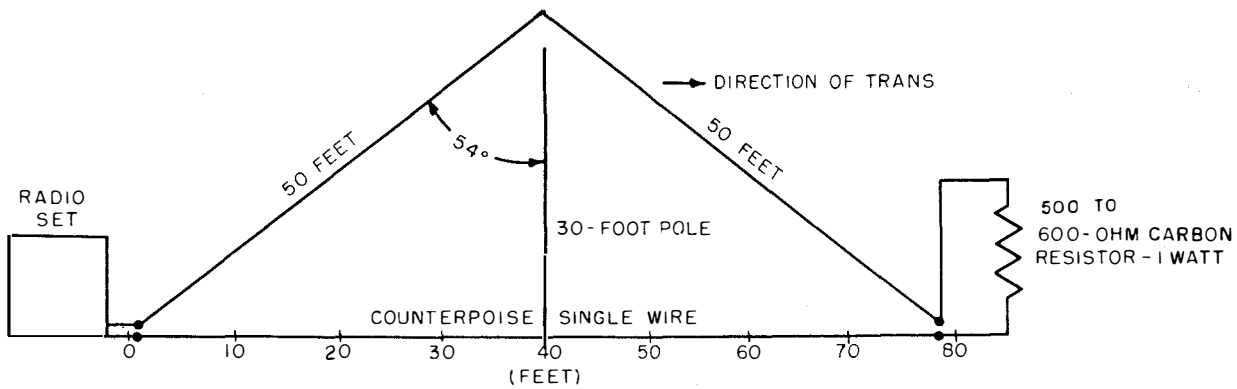


Figure 38. — Vertical half-rhombic for use between 20 and 60 mc.

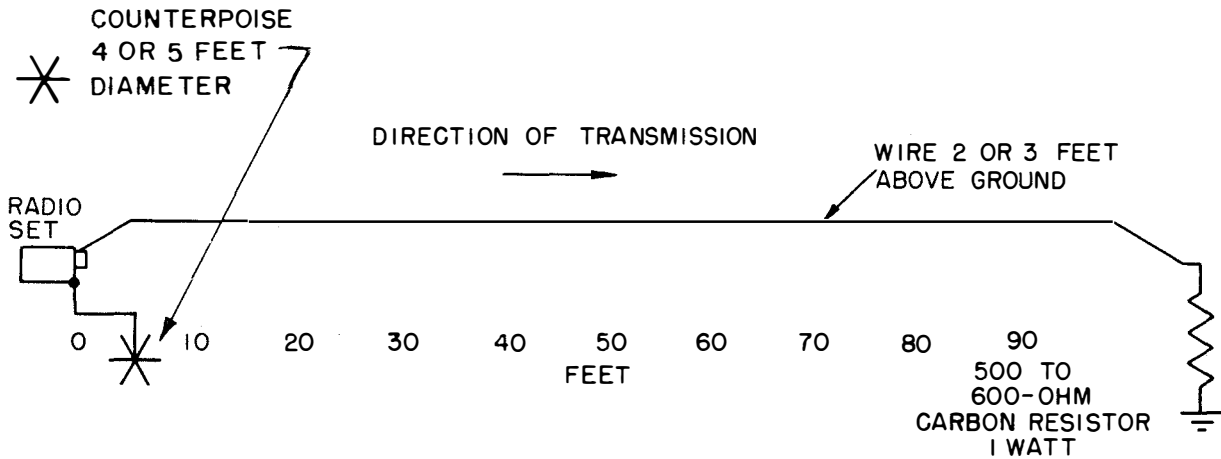


Figure 39. — Vertical polarized wave antenna for use between 20 and 80 mc.

57. Antennas for 20 to 80 mc. — Two field antennas that can be used with the field type HF or VHF sets are the vertical half-rhombic and the wave antenna. These are shown in figures 38 and 39 respectively.

WARNING: When improvised antennas are used, the tuning of the antenna circuits and final amplifier circuits should be checked. It is also important that the precautions in regard to proper siting be observed. If the transmitter loads poorly, try adding to or subtracting from the length of the im-

proved antenna.

SECTION 9

RADIO EQUIPMENT BEING DEVELOPED

58. General. — This section is included to acquaint the student with the radio sets being tested and developed for future use by the Marine Corps. It is emphasized that the equipment described herein may never be adopted or that the final model may have different characteristics. Their discussion

is intended only as advance information of significant developments until instruction on accepted models can be published.

59. Radio Central AN/MRC-87. — Radio Central AN/MRC-87 is an ambulance jeep-mounted version of the AN/TRC-75 with a ultra-high frequency transceiver added. The UHF equipment is the radio set, AN/ARC-55 which operates within the frequency range of 225 megacycles to 399.99 megacycles. This radio central is intended primarily for use by tactical air control parties.

60. Communication Central AN/TSC-15. — The Communication Central AN/TSC-15 consists of the major components of the Radio Set AN/TRC-75, plus an additional receiver-exciter, to allow full-duplex operation. All are mounted in a Shelter S-144 (modified). In addition and associated with the basic radio components and mounted in the shelter, are the following ancillary equipments: Switchboard SB-22; an audio cordless board; teletypewriter set; a four channel teletype multiplexer; teletype d.c. patch panel and two - 2 wire/4 wire telephone terminal units. This equipment will be employed principally to provide long range point-to-point high frequency communication.

61. Radio Set AN/PRC-38. — Radio Set AN/PRC-38 is a man packed, battery operated radio set weighing approx-

imately 35 pounds. This radio set operates single sideband in the frequency range of 30 to 70 megacycles.

62. Radio Set AN/PRC-41. — Radio Set AN/PRC-41 is a man-packed, battery operated radio set weighing approximately 45 pounds. This is an amplitude modulated radio set operating in the frequency range of 225 to 400 megacycles. The AN/PRC-41 is primarily designed for air-to-ground communication. It may be powered from a vehicle or, when stationary, from 115 volts a.c.

63. Radio Set AN/PRC-42. — Radio Set AN/PRC-42 is a single sideband, man-packed, and battery operated radio set. The weight of this equipment is approximately 35 pounds. It operates within the frequency range of 2 to 12 megacycles.

64. Radio Set AN/PRC-47. — Radio Set AN/PRC-47 is a team-packed radio set, battery operated, consisting of two 35 pound loads. It is capable of operating single sideband voice or FSK. It is designed as a displacement radio compatible with the radio set AN/TRC-75. It may be powered from a vehicle or from 115 volts a.c.

65. Radio Set AN/PRC-54. — Radio Set AN/PRC-54 which is presently being designed is a hand-held single sideband radio for small unit use.

APPENDIX 1

GLOSSARY OF COMMUNICATION TERMS

1. Purpose. — To list and define the more common communication terms used in this publication.

2. Presentation.

a. All terms are listed in alphabetical order (based on the primary word in the term), irrespective of subject, to facilitate easy reference.

b. Spaces have been left between each term to facilitate pen and ink insertions of additional terms and definitions by the student to supplement terms in his copy.

A

ALTERNATING CURRENT (AC) — An electric current which reverses its direction of flow at regular intervals.

AMPLIFICATION — The process of increasing the electrical strength of a signal.

AMPLITUDE — The amount of variation of an alternating quantity from its zero value.

AMPLITUDE MODULATION (AM) — A method of modulating a carrier wave to cause it to vary in amplitude corresponding to the amplitude of the original signal.

ANTENNA (ANT) — The portion, usually wires or rods, of a radio transmitter or receiving station, for radiating waves into space or receiving them from space. Also called Aerial.

ANTENNA (Uni-directional) — An antenna which radiates most of its power in one direction.

ANTENNA (Omni-directional) — An antenna which radiates equal power in all directions in a horizontal plane.

AUDIO — A Latin word meaning "I hear." Normally relates to frequencies capable of being heard.

AUDIO FREQUENCY (AF) — A frequency corresponding to a normally audible sound wave; about 20 to 15,000 cycles per second.

AUTOMATIC RETRANSMISSION — The receiving of a signal and automatic relay of that signal on a different frequency between two different stations.

B

BAND - Used as applying to a group of radio channels assigned to a particular

type of radio service. A range of frequencies (cycles per second) within two definite limits.

Very low frequency (VLF) 10-30 kilocycles

Low frequency (LF) 30-300 kilocycles

Medium frequency (MF) 300-3000 kilocycles

High frequency (HF) 3-30 megacycles

Very high frequency (VHF) 30-300 megacycles

Ultra high frequency (UHF) 300-3000 megacycles

Super high frequency (SHF) 3000-30,000 megacycles

BEAM — A directed flow of energy into space. A radio signal directed on a definite path from one fixed station to another.

C

CALIBRATION — The process of comparing an instrument or device with a standard to determine its accuracy.

CALIBRATION, RADIO — The process of correcting the radio dial electrically and mechanically to insure that the dial setting is aligned properly when tuned to an operating frequency.

CARRIER — A wave which may be marked or modulated either by changing its amplitude, frequency or phase so that it may carry "intelligence."

COAXIAL CABLE — A cable in which one conductor is accurately centered inside another. Used primarily for the transmission of telephone, radio and television signals.

CONDUCTOR — A medium capable of carrying an electric current, usually a wire.

CONVERTER —

1. A device or section of a radio receiver that changes the incoming radio frequency to a different or intermediate frequency.
2. An electronic or rotating device changing electrical energy from one form to another. as alternating current to direct or vice versa.

COUNTERPOISE — A conductor used as a substitute for ground in an antenna system.

CRYSTAL — (Abbr: Xtal) A material, usually natural quartz, which vibrates at a fixed frequency, depending on the size to which it has been ground. It is used in radio transmitters to maintain accurate frequency and stability.

D

DEMODULATION — The process of extracting the signal intelligence from a modulated carrier wave. Also called detection.

DIFFRACTION — The effect produced when waves (light, sound or radio) encounter a barrier and bend around it.

DIRECT CURRENT (DC) — Electric current flowing through a circuit in one direction.

DUPLEX — A method of operation of a communication circuit where each end can simultaneously transmit and receive. Ordinary telephones are duplex. When used on a radio circuit duplex operation requires two frequencies.

DYNAMOTOR — A rotating device used to change one DC voltage to a different DC voltage.

E

ELECTRICITY — A fundamental quantity in nature consisting of elementary particles: Electrons (negative) and protons (positive).

ELECTROMAGNETIC FIELD — A magnetic field resulting from the flow of electricity.

ELECTRON — The elementary unit of a negative electrical charge. Electrons are emitted by the cathode of an electron tube.

F

FADING — Variation in the intensity of a received radio signal, usually caused by interference of received waves passing over different transmission paths.

FILTER — A network of reactive elements so arranged as to exhibit frequency discriminating characteristics.

FREQUENCY — The repetition rate of a periodically recurring wave form, commonly stated in cycles, kilocycles or megacycles per second.

FREQUENCY MODULATION (FM) — A method of modulation in which the frequency of the carrier wave is varied according to the signal transmitted.

FREQUENCY SHIFT KEYING (FSK) — A method of transmitting the mark and space elements of a telegraph code by shifting the carrier frequency a small amount.

G

GROUND WAVE — A radio wave which reaches the receiver by propagation along the earth's surface rather than through the earth's upper atmosphere.

H

HARMONIC — A sound wave or electromagnetic wave with a frequency the exact multiple of the fundamental frequency. Harmonics of 60 cycles are 120 cycles, 180 cycles, 240 cycles, etc. Similar to overtones in music.

HETERODYNE FREQUENCY — A frequency which is produced by combining two

other frequencies and which is their numerical sum or difference.

I

IMPEDANCE — That property of an electrical circuit which opposes the flow of current. While a resistance is an impedance, the term is usually reserved for the opposition to current flow offered by inductors, capacitors or combinations of both.

IMPEDANCE MATCHING — A method of minimizing the adverse effects of junctions between dissimilar transmission lines such as cable and open wire. A transformer is used to interconnect the two, or loading coils are used to modify the impedance characteristic of the cable so as to match the open wire.

INSULATION — Nonconducting material used to prevent the leakage of electricity from a conductor; to provide mechanical spacing or support; to protect against accidental contact.

INTERFERENCE — Disturbance in radio reception caused by undesired signals, stray current from electrical apparatus, etc. A current from a foreign source or a second communication line which in some way produces derogatory performance. Interference is sometimes spoken of as the current or power which causes noise in the telephone.

J

JACK — The stationary part of a circuit connector. With its counterpart, a plug, it is used to connect or disconnect electrical circuits.

JUMPER — A short length of conductor bridging two points in a circuit.

JUNCTION BOX — A box enclosing the terminals of wires or cables, in which the latter may be connected as desired.

K

KILO — A prefix meaning one thousand. Example: a kilowatt is 1,000 watts.

KILOCYCLE (KC) — A frequency of one thousand cycles per second.

L

LINE OF SIGHT — The unobstructed or optical path between two points. Also used to describe a radio propagation characteristic.

LOCAL CIRCUIT — A wire circuit connecting a telephone to a switchboard.

M

MARK — In telegraphic communications refers to the closed circuit condition or the signal condition causing the closed or printing condition (opposite: Space).

MASTER OSCILLATOR (MO) — An oscillator which establishes the carrier frequency of a more powerful amplifier. An oscillator which provides or controls modulator drive frequencies for a number of channels or groups of channels.

MEGACYCLE (MC) — One million cycles.

MODULATION — A process by which a carrier wave is varied in frequency, phase or amplitude by the imposition upon it of the frequencies corresponding to the code, control, sound or television signals being transmitted.

MONITOR — To listen to transmissions.

N

NET — (Net Control Station) has technical control of a radio net.

NOISE — Any unintelligible signals in a communication system which tend to interfere with proper reception of the desired signals or speech. More loosely, noise is sometimes used as synonymous with the power which causes noise.

NULL — A minimum or zero value of current in an electrical circuit.

O

OPEN CIRCUIT — An electrical circuit that is broken or interrupted.

Q

QUARTER-WAVE ANTENNA — An antenna whose electrical length is one-quarter the wave length of the signal to be transmitted or received.

R

RADIATOR — That part of an antenna from which radio waves are emitted.

RADIO — Communication by electromagnetic waves transmitted through space.

RADIO CHANNEL — A frequency officially allotted to each station for radio communication or broadcasting purposes.

RADIO FREQUENCY (RF) — A frequency higher in the spectrum than audible frequencies but lower than light or heat frequencies.

RADIO SPECTRUM — The frequencies which may be used for the transmission and reception of radio energy.

RADIOTELEGRAPHY — Radio communication by dot-dash code.

RADIOTELEPHONY — Radio communication by voice.

RADIO WAVE — An electromagnetic wave produced by rapid reversals of current

in a conductor. Such a wave travels through space at approximately the speed of light.

RADIO/WIRE INTEGRATION — A communication technique combining radio channels and wire circuits that terminate in a switching central and are capable of being switched with each other.

RANGE — The approximate distance over which a radio transmitter is useful.

REMOTE CONTROL — The control of a function, as a radio, from a distant point by electrical means.

RETRANSMISSION (RADIO) — A radio installation between any two or more terminal radios that automatically relays the transmitted messages. Also called radio relay.

S

SIDEBANDS — The bands of frequencies on each side of the carrier frequency produced by modulation.

SIGNAL — The intelligence, message or effect conveyed in communications and other electronic applications.

SPACE — In telegraphic communications refers to the open circuit condition or the signal causing the open condition (opposite: mark).

T

TELETYPEWRITER — A teleprinter which prints the messages in page form and can also be used to transmit messages by standard typing methods.

TRANSCEIVER — A radio transmitter and receiver combined in one unit and sometimes containing common components which are switched between the transmitter and the receiver. Generally portable or mobile.

TRANSISTOR — An electronic device utilizing properties of semiconductors, such as germanium, as detectors, amplifiers, and oscillators of electrical currents.

TRANSMITTER — Equipment for generating and sending radio signals.

TUNED — Adjustment of all the circuits of a radio transmitter or receiver for optimum performance at any frequency to which it may be tuned.

V

VOLUME CONTROL — A variable resistor used to vary the loudness of a radio receiver or public-address amplifier.

W

WATT (W) — The unit of electrical power.

WAVE — A single cycle of a periodic disturbance such as in radio or sound.

WAVELENGTH — The distance in meters traveled by a wave during the time interval of one (1) complete cycle. It is equal to the velocity divided by the frequency.

APPENDIX 2

JOINT-ELECTRONICS TYPE DESIGNATION SYSTEM PROCEDURE POLICY ("AN" SYSTEM)

The purpose of the "AN" system of nomenclature for communication equipment is to provide as much information as possible about the equipment by a look at the identifying letter group.

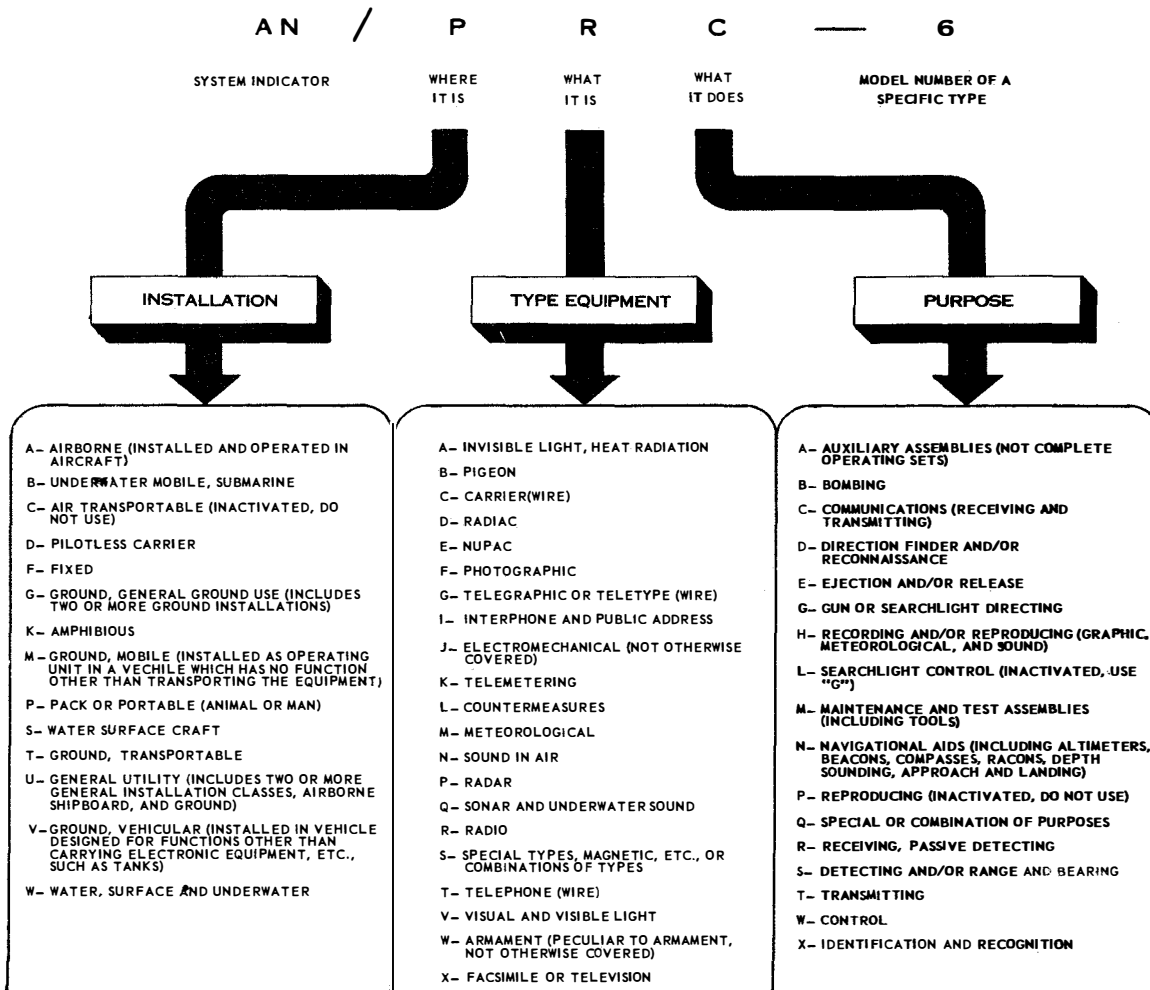
The first two letters, "AN", indicates that it is a major item of equipment, and not a component part of some other equipment. The "AN" is followed by a slant line and three letters. These letters indicate, in this order; (1) where the equipment is used; (2) general type of the equipment; and (3) purpose of the equipment. This establishes the category of the equipment. A number is next added to indicate a specific equipment used for the general purpose shown by the three-letter combination. Thus, "AN/APS-2" is a radar search equipment used in aircraft, as is the "AN/APS-4". The difference in the last number shows that they are entirely different pieces of equipment, differing perhaps in size, shape, weight, frequencies, employment, etc.

If the basic equipment has been modified in some major fashion, such as the addition of two crystals to control the transmitter frequencies, another letter is added after the model number. The "AN/APS-2A", then, is the first major modification of the "AN/APS-2". If it has been found that the "AN/APS-2", designed to operate on 13 volts in the PB4Y airplane, works better in the R4Q on 26 volts, this slight modification is indicated by the suffix letters, X, Y, or Z. "AN/APS-2Z" is the third minor modification of the basic set. It is possible to have both a major and a minor modification to the same set — "AN/APS-2BY".

There are two additional indicators which may be encountered. The letter "T" and a number are used to indicate training sets. "AN/APS-T1" is the set used to train operators for all equipment in the APS series. "AN/APS-2-T2" is the set used to train operators for the APS-2 series of equipments, which differ so much from all the other APS equipments that a special training set is required. The other indicator, in parentheses after the complete set designation, is the letter "X", followed by another letter and number. The "X" shows experimental equipment, the second letter the particular laboratory doing the experiments and the number of the particular set being tested. "AN/APS-2(XB-3)" is the third set of the APS-2 series being tested by the Naval Research Laboratory.

The following chart shows the meaning of the letters and numerals following the AN:

INTERPRETATION OF "AN" NOMENCLATURE SYSTEM



13221 NAVY-MCS QUANTICO VA.

Another phase of AN nomenclature is the identification of component parts. Components carry indicating letters which tell what type of component it is, a number which identifies the particular component, and last, the AN designation of the equipment of which it is a part. A few examples are given to eliminate confusion that might exist if component parts identification were not mentioned.

<u>Comp. Ind</u>	<u>Family Name</u>	<u>Example</u>
AB	Supports, antenna	Antenna mounts, mast bases, mast sections.
CK	Crystal kits	A kit of crystals with holders.
H	Head, hand and chest sets	Includes earphones.
TN	Tuning units	Receivers, transmitter, antenna, etc.

APPENDIX 3 FREQUENCY SPECTRUM (IN MEGACYCLES)

EQUIPMENT	2	5	6	15	20	12	18	19.1	20	27	27.9	30	30.5	32	38	38.9	47	54	54.9	55.4	58.4	70.9	22.5	390	399.9	4100	5500
AN/GRC-9					RT-77/GRC																						
AN/MRC-6					TCS																						
AN/MRC-30					BC-610																						
					BC-312																						
					BC-342																						
AN/MRC-32					BC-610																						
					(2) R-388/URR																						
AN/MRC-35A	T-47/ART-13				T-47/ART-13																			AN/ARC-27			
	BC-348				BC-38																						
AN/MRC-40																									T-217 A/GR		
AN/GRC-48																									(2) R-278B/GR		
AN/MRC-47					(2) TCS																				(2) T-217A/GR		
					(2) TCK-4																				(2) R-278B/GR		
					(4) R-388/URR																						
MAY																								CRP-43071			
AN/PRC-6																											
AN/PRC-8																											
AN/PRC-9																											
AN/PRC-10																											
AN/MRC-36																											
AN/GRC-3																											
AN/URC-20																											
AN/MRC-37																											
AN/GRC-5																											
AN/URC-21																											
AN/MRC-38																											
AN/GRC-7																											
AN/URC-22																											
AN/GRC-10																											
AN/MRC-62																											
AN/MRC-63																											
AN/TRC-27																											
AN/MRC-60																											
AN/TRC-75																											
AN/MRC-83																											

AMPLITUDE - MODULATED EQUIPMENT
 FREQUENCY - MODULATED EQUIPMENT
 PULSE POSITION - MODULATED EQUIPMENT

1219 - F NAVY - MCR QUANTICO, VA.

Amplitude-Modulated Equipment

EQUIPMENT	FREQUENCY RANGE (MEGACYCLES)	MISSION	TRANSMISSION RANGE (MILES)	TUNING	POWER SOURCE	OUTPUT (WATTS)	WEIGHT (POUNDS)	COST	NETS WITH
AN/GRC-9	2-12	VOICE CW MCW	VOICE - 10 CW - 30 MCW - 20	CONTINUOUS	BA-4B HAND GENERATOR -6, -12, -24 VOLTS DC DRIVEN DYNAMOTOR-POWER SUPPLY	VOICE - 3.6 CW - 10	130	1,290	AN/MRC-6, -30, -32, -35, -47, -55
AN/MRC-6	1.5-12	VOICE CW	VOICE - 15 CW - 30	CONTINUOUS	24 VOLTS DC DRIVEN DYNAMOTOR	VOICE - 20 CW - 40	3,100	3,900	AN/GRC-9; AN/MRC-30, -32, -35, -47, -55
AN/MRC-30	BC-610 BC-312 BC-342	VOICE CW	VOICE - 100 CW - 250	CONTINUOUS	115 VOLTS, 60 CYCLES, AC (12 VOLTS, DC, FOR BC-312)	VOICE - 300 CW - 400	17,000	19,920	AN/GRC-9; AN/MRC-6, -32, -35, -47, -55
AN/MRC-32	BC-610 R-388/URR	VOICE CW FSK	VOICE - 100 CW - 250 TT - 250	CONTINUOUS	115 VOLTS, 60 CYCLES, AC	VOICE - 300 CW - 400 TT - 400	18,000	29,530	AN/GRC-9; AN/MRC-6, -30, -35, -47, -55
AN/MRC-35A	T-47/ART-13 BC-34B AN/ARC-27	VOICE CW MCW VOICE	50	CONTINUOUS 11 PRESET CONTINUOUS 18 PRESET 1 GUARD 1750 POSSIBLE	24 VOLTS DC DRIVEN DYNAMOTOR	VOICE - 60-90 CW - 100 10	3,400	8,700	AN/GRC-9; AN/MRC-6, -30, -32, -47, -55 AN/GRC-48; AN/MRC-40, -47; AN/PRC-22; MAY
AN/MRC-40	225-399.9	VOICE MCW	LINE-OF-SIGHT	CONTINUOUS 11 PRESET 1750 POSSIBLE	PE-75 115/230 VOLTS, 60 CYCLES, AC	100	3,500	8,980	AN/GRC-48; AN/MRC-35, -47; AN/PRC-22; MAY
AN/GRC-48	225-399.9	VOICE MCW	LINE-OF-SIGHT	CONTINUOUS 11 PRESET 1750 POSSIBLE	115/230 VOLTS, 60 CYCLES, AC	100	800	6,880	AN/MRC-35, -40, -47, AN/PRC-22; MAY
AN/MRC-47	TCK-4 TCS R-388/URR AN/GRC-27	VOICE CW VOICE MCW	VOICE - 75 * CW - 250 * VOICE - 15 CW - 30 LINE-OF-SIGHT	CONTINUOUS 11 PRESET 1750 POSSIBLE	115 VOLTS, 60 CYCLES, AC	VOICE - 100 CW - 400 VOICE - 20 CW - 40 100	39,600	67,770	AN/GRC-9; AN/MRC-6, -30, -32, -35, -55 AN/GRC-48; AN/MRC-35, -40; AN/PRC-22; MAY
MAY	225-390	VOICE MCW	LINE-OF-SIGHT	4 PRESET	6-VOLT STORAGE BATTERY	1	86	3,190 or 3,300	AN/GRC-48; AN/MRC-35, -40, -47; AN/PRC-22
AN/TRC-75	2-29.999	VOICE, CW/FSK/ (AM or SSB)	100	AUTOMATIC 1-KC STEPS	115v; 400 CYCLES, 3 PHASE, AC	1 KW	325	23,000	OTHER AM or SSB EQUIPMENT

* WHIP ANTENNA

Frequency-Modulated Equipment

AN/PRC-6	47-55.4	VOICE	1	1 PRESET 43 POSSIBLE	BA-270/U	.25	6.5	194	AN/PRC-10; AN/MRC-36, -37, -38; AN/GRC-3, -5, -7; AN/URC-22; AN/GRC-10
AN/PRC-8	20-27.9	VOICE	3-5	CONTINUOUS 80 POSSIBLE	BA-279/U	1	26	510	AN/PRC-9; AN/MRC-36, -37; AN/GRC-3, -5; AN/URC-20, -21
AN/PRC-9	27-38.9	VOICE	3-5	CONTINUOUS 120 POSSIBLE	BA-279/U	1	26	508	AN/PRC-8, -10; AN/MRC-36, -37, -38; AN/GRC-3, -5 AN/URC-20, -21, -22
AN/PRC-10	38-54.9	VOICE	3-5	CONTINUOUS 170 POSSIBLE	BA279/U	1	26	508	AN/PRC-6, -9; AN/MRC-36, -37, -38; AN/GRC-3, -5, -7; AN/URC-21, -22; AN/GRC-10
AN/MRC-36 AND AN/GRC-3	RT-66/GRC R-108/GRC RT-70/GRC	VOICE	10-15	CONTINUOUS 2 PRESET (AUX REC 3) 80 POSSIBLE CONTINUOUS 2 PRESET 115 POSSIBLE	12/24 VOLTS DC	LO 1-2 HI 9-16 .5	MRC 3,100 GRC 270	MRC 4,920 GRC 3,230	AN/PRC-8, -9; AN/MRC-37; AN/GRC-5; AN/URC-20, -21 AN/PRC-6, -10; AN/MRC-37 -38; AN/GRC-3, -5, -7; AN/URC-22; AN/GRC-10
AN/URC-20	20-27.9	VOICE	10-15	CONTINUOUS 2 PRESET 80 POSSIBLE	BA-403/U; BA-419/U HAND GENERATOR (MODIFICATION KIT MX-B9B/GR)	LO 1-2 HI 9-16	102	1,670	AN/PRC-8, -9; AN/MRC-36 -37; AN/GRC-3, -5; AN/URC-21
AN/MRC-37 AND AN/GRC-5	RT-67/GRC R-109/GRC RT-70/GRC	VOICE	10-15	CONTINUOUS 2 PRESET (AUX REC 3) 120 POSSIBLE CONTINUOUS 2 PRESET 115 POSSIBLE	12/24 VOLTS DC	LO 1-2 HI 9-16 .5	MRC 3,100 GRC 270	MRC 5,300 GRC 3,180	AN/PRC-8, -9, -10; AN/MRC-36, -38; AN/GRC-3, -5, -7; AN/URC-20, -21, -22 AN/PRC-6, -10; AN/MRC-36, -38; AN/GRC-3, -5, -7; AN/URC-22; AN/GRC-10
AN/URC-21	27-38.9	VOICE	10-15	CONTINUOUS 2 PRESET 120 POSSIBLE	BA-403/U; BA-419/U HAND GENERATOR (MODIFICATION KIT MX-B9B/_GR)	LO 1-2 HI 9-16	102	1,570	AN/PRC-8, -9, -10; AN/MRC-36, -37, -38; AN/GRC-3, -5, -7; AN/URC-20, -22
AN/MRC-38 AND AN/GRC-7	RT-68/GRC R-110/GRC RT-70/GRC	VOICE	10-15	CONTINUOUS 2 PRESET (AUX REC 3) 170 POSSIBLE CONTINUOUS 2 PRESET 115 POSSIBLE	12/24 VOLTS DC	LO 1-2 HI 9-16 .5	MRC 3,100 GRC 270	MRC 5,530 GRC 3,050	AN/PRC-6, -9, -10; AN/MRC-37; AN/GRC-5; AN/URC-21, -22; AN/GRC-10 AN/MRC-6, -10; AN/MRC-36, -37; AN/GRC-3, -5; AN/URC-22; AN/GRC-10
AN/URC-22	38-54.9	VOICE	10-15	CONTINUOUS 2 PRESET 170 POSSIBLE	BA-403/U; BA-419/U HAND GENERATOR (MODIFICATION KIT MX-B9B/GR)	LO 1-2 HI 9-16	102	1,490	AN/PRC-6, -9, -10; AN/MRC-36, -37, -38; AN/GRC-3, -5, -7; AN/URC-21; AN/GRC-10
AN/GRC-10	54-70.9	VOICE	25	CONTINUOUS 170 POSSIBLE	115/230 VOLTS, 50/60 CYCLES AC 26 VOLTS DC	LO 10 HI 40	170	5,230	AN/PRC-6, -10; AN/MRC-36, -37, -38; AN/GRC-3, -5, -7; AN/URC-22; AN/MRC-62, -63
AN/MRC-62	54-70.9	4 MULTIPLEXED CHANNELS, 1 ORDER WIRE, VF TT SUPER- IMPOSITION	25	CONTINUOUS 170 POSSIBLE	PE-75 115/230 VOLTS, 50/60 CYCLES, AC 26 VOLTS DC	LO 10 HI 40	9,200	22,570	AN/MRC-63
AN/MRC-63	54-70.9	RELAY 4 MULTIPLEXED CHANNELS 1 ORDER WIRE, VF TT SUPER- IMPOSITION	25	CONTINUOUS 170 POSSIBLE	PE-75 115/230 VOLTS, 50/60 CYCLES, AC 26 VOLTS DC	LO-10 HI 40	9,100	20,770	AN/MRC-62

Pulse Position-Modulated Equipment

AN/TRC-27	4400-5000	PULSE 8 MULTIPLEXED CHANNELS VF TT SUPER- IMPOSITION	10	CONTINUOUS	PORTABLE PU-27B CONVERTERS AS REQUIRED 115 VOLTS, 400 CYCLES, AC	2-3	NO SINGLE UNIT MORE THAN 55		AN/MRC-59, -60
AN/MRC-60	4400-5000	PULSE 16 RELAY OR 32 TERMINAL MULTI- PLEXED CHANNELS VF TT SUPER- IMPOSITION		CONTINUOUS	TRAILER MOUNTED GENERATOR 115 VOLTS, 400 CYCLES, AC CONVERTERS AS REQUIRED	2-3			AN/TRC-27; AN/MRC-59