Naval Education and Training Command

NAVEDTRA 12801
August 1994
0502-LP-479-2100

Training Manual (TRAMAN)

Radioman Communications

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Naval Education And Training Program Management Support Activity

RADIOMAN COMMUNICATIONS

NAVEDTRA 12801

1994 Edition Prepared by
RMCS(SW) Kenneth W. Howland

PREFACE

This training manual (TRAMAN) and its associated nonresident training course (NRTC) form a self-study package that will help Radiomen fulfill the requirements of their rating. These requirements include the ability to supervise communications personnel in the performance of their duties, to maintain records, to prepare messages and reports, to establish and maintain communications circuits, and to train other individuals in operating procedures and techniques.

This TRAMAN is designed for individual study, not formal instruction. Subject matter that relates directly to the occupational standards of the Radioman rating is addressed. The NRTC is the standard method for meeting the requirement for completing the TRAMAN. The assignments in the NRTC are designed to lead the student through the TRAMAN while testing the comprehension of the learning objectives listed at the beginning of each TRAMAN chapter.

Scope of revision—Numerous areas of this TRAMAN have been revised. Chapters and areas concerning frequency propagation, satellite communications, message preparation, fleet communications, and security procedures have undergone major revisions and updates. The most comprehensive change is the consolidation of the previous *Radioman 3*, *Radioman 3&2*, and the *Radioman 1&C* TRAMANs into a single, inclusive *RM Communications* TRAMAN.

Names and social security numbers used in this TRAMAN are examples only and do not refer to any person(s) living or dead.

This TRAMAN was prepared by the Naval Education and Training Program Management Support Activity, Pensacola, Florida, for the Chief of Naval Education and Training. Technical and professional assistance was provided by personnel from Naval Computer and Telecommunications Command, Washington, DC.

1994 Edition

Stock Ordering No.
0502-LP-479-2100

Published by
NAVAL EDUCATION AND TRAINING PROGRAM
MANAGEMENT SUPPORT ACTIVITY

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON, D.C.: 1994

THE UNITED STATES NAVY

GUARDIAN OF OUR COUNTRY

The United States Navy is responsible for maintaining control of the sea and is a ready force on watch at home and overseas, capable of strong action to preserve the peace or of instant offensive action to win in war.

It is upon the maintenance of this control that our country's glorious future depends; the United States Navy exists to make it so.

WE SERVE WITH HONOR

Tradition, valor, and victory are the Navy's heritage from the past. To these may be added dedication, discipline, and vigilance as the watchwords of the present and the future.

At home or on distant stations as we serve with pride, confident in the respect of our country, our shipmates, and our families.

Our responsibilities sober us; our adversities strengthen us.

Service to God and Country is our special privilege. We serve with honor.

THE FUTURE OF THE NAVY

The Navy will always employ new weapons, new techniques, and greater power to protect and defend the United States on the sea, under the sea, and in the air.

Now and in the future, control of the sea gives the United States her greatest advantage for the maintenance of peace and for victory in war.

Mobility, surprise, dispersal, and offensive power are the keynotes of the new Navy. The roots of the Navy lie in a strong belief in the future, in continued dedication to our tasks, and in reflection on our heritage from the past.

Never have our opportunities and our responsibilities been greater.

CONTENTS

CHAPTER 1

TRANSMITTER THEORY

CHAPTER LEARNING OBJECTIVES

Upon completing this chapter, you should be able to do the following:

- *Recall common terms and definitions associated with basic transmitters.*
- *Discuss transmitter circuits.*
- *Identify transmitter modes of operation.*
- *Discuss basic communications systems.*

Radiomen are responsible for transmitting and receiving radio signals, and processing all forms of telecommunications through various transmission media. Our communications readiness would be degraded if the operators, such as yourself, do not understand transmitters and associated circuitry. It is, therefore, very important that you understand transmitter and receiver theory.

Your knowledge of communications equipments will increase your professional proficiency and advancement opportunities. As a Radioman, you are not required to be an expert in electronics. However, you must be familiar with the principles of operation and the capabilities of the equipment you operate.

In this chapter, we will discuss the major types of communications transmitters, their functional block diagrams, and associated circuitry. Receivers are discussed in chapter 2.

TERMS AND DEFINITIONS

Before we begin our discussion of transmitters, you should study the following terms and definitions. These terms and their definitions will help you understand the material in this chapter. We suggest that you also study the Navy Electricity and Electronics Training Series (NEETS) modules contained in the Recommended Reading List at the end of this chapter. These modules will enhance your understanding of basic electricity and electronics.

Amplifier—A device that amplifies an input signal. After amplification, the output signal will have some (or all) of the characteristics of the input signal. The amplified output signal is usually larger than the input signal in voltage, current, and/or power.

Amplitude—The size of a signal. When plotted, a graph of the signal is measured from the reference line to the maximum value above or below the line.

Amplitude Modulation (AM)—The method in which the information of the audio signal is imposed on the carrier signal by varying the amplitude of the carrier in accordance with the information to be transmitted.

Audio Frequency (AF)—Any frequency detected by the human ear. The range of AF extends from about 20 to 20,000 hertz (Hz).

Bandwidth—The width of the portion of the frequency spectrum that is occupied by specific signals.

Carrier—The unmodulated signal originally produced in the oscillator section of a transmitter.

Carrier Frequency—The final radio-frequency output without modulation.

Channel—A carrier frequency assignment, usually with a fixed bandwidth.

Complex Wave—A transmitted radio signal composed of more than one frequency.

Cycle—One complete positive and negative alternation of a current or voltage. This concept is usually expressed in hertz (Hz). The number of cycles per second equals the hertz of a given signal.

Frequency—The number of complete cycles per second.

Gain—Any increase in signal strength.

Hertz—The accepted standard unit for frequency, where 1 hertz corresponds to 1 cycle per second.

Modulated Wave—The wave that results after the information from the modulating signal is impressed onto the carrier signal. The modulated wave is what is actually transmitted.

Modulating Wave—An information wave representing intelligence.

Modulation—The impression of intelligence upon a transmission medium (radio waves).

Radio Frequency (RF)—Those frequencies of the electromagnetic spectrum normally associated with radio wave propagation. Frequencies used for radio communications fall between 3 kilohertz (kHz) and 300 gigahertz (GHz).

Waveform—The shape of an electromagnetic wave.

Figure 1-1 shows a cycle of alternating current (ac) over a period of time. A complete cycle consists of a positive and negative alternation. Notice that this wave covers 360°, or two complete alternations. Two alternations represent **one complete cycle**. Therefore, a cycle consists of two complete alternations over a period of time.

One hertz represents 1 complete cycle in 1 second. If 1 cycle per second is 1 Hz, then 100 cycles per second are equal to 100 Hz, and so on. Normally, we use the term "cycle" when no specific time element is involved. We use the term "hertz" when the time element is measured in seconds. Figure 1-1 shows 1 cycle. Figure 1-2 shows 2 cycles per second, or 2 Hz.

When we look at figures 1-1 and 1-2, we see a **waveform**. A waveform is a graphic representation of the shape of a wave that indicates its characteristics (as frequency and amplitude).

Figure 1-3 shows a basic radio communications network. This figure shows the basic elements needed to establish radio communications. To transmit radio waves, we need a transmitter, a transmission line, and a transmitting antenna. To receive radio waves, we need a receiving antenna, a transmission (connecting)

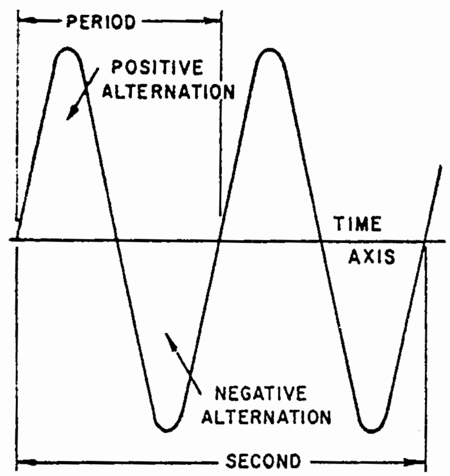


Figure 1-2.—Two cycles per second (cps), or 2 hertz (Hz).

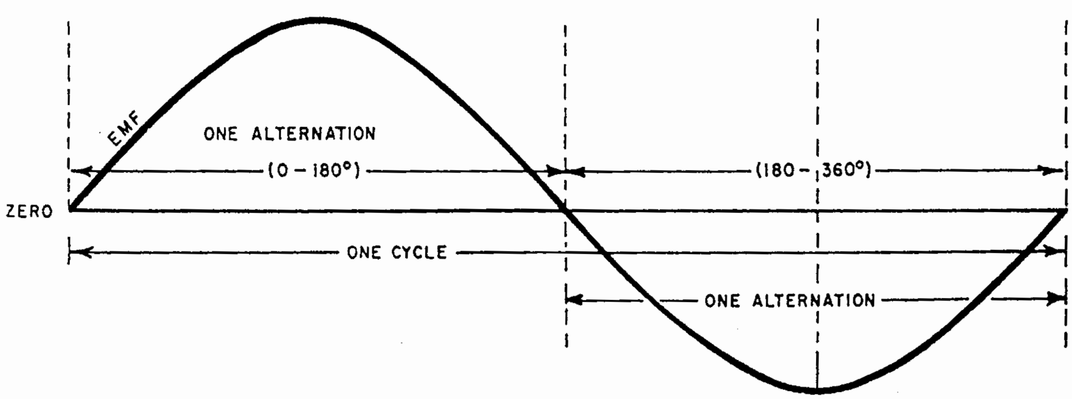


Figure 1-1.—Basic alternating current.

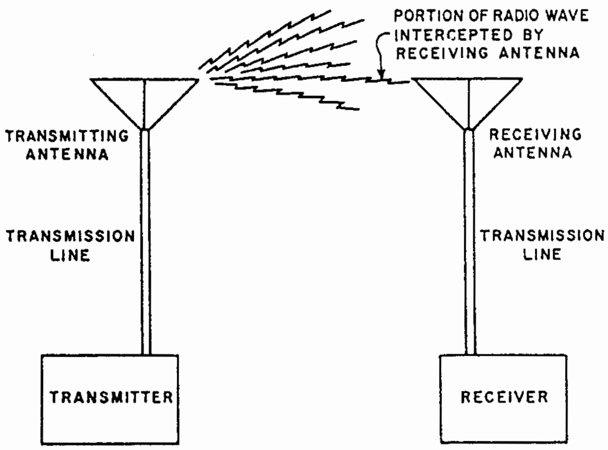


Figure 1-3.—Basic radio communications network.

line, and a receiver. If we took away any one of these components, we could not communicate.

TRANSMITTER CIRCUITS

The overall purpose of a radio transmitter is to produce **radio-frequency** (RF) energy. The transmitter radiates a useful signal using its oscillator, amplifiers, coupler, and antenna. Figure 1-4 shows the basic construction of a typical transmitter. Every transmitter contains these basic circuits. Most transmitters are more complex because of operational requirements. We will discuss each circuit as we progress through this chapter.

OSCILLATOR

As we just mentioned, every transmitter has an oscillator that generates a steady flow of RF energy. The primary function of an oscillator is to generate an ideally stable **signal** at a constant amplitude, at a specific predetermined or preselected frequency. The oscillator must maintain this signal within certain limits.

Most RF oscillators are capable of generating all the frequencies required by their associated equipment. Therefore, the oscillator of a medium-frequency-to-high-frequency (MF/HF) transmitter can generate all the frequencies required in the MF/HF band.

Nearly every piece of equipment that uses an oscillator has two main requirements of the oscillator. They are **amplitude stability** and **frequency stability**.

Amplitude Stability

Amplitude stability is the ability of the oscillator to maintain a constant amplitude output waveform. The less the oscillator deviates from a predetermined amplitude, the better the amplitude stability.

Frequency Stability

Frequency stability is the ability of the oscillator to maintain the desired operating frequency. The less the oscillator drifts from the operating frequency, the better the frequency stability.

RF POWER AMPLIFIERS

The frequency from the oscillator must be amplified before it reaches the antenna. These amplification stages (figure 1-5) are the RF amplifiers, known as the buffer and power amplifiers. The stage connected to the antenna is the final power amplifier (FPA). The stages of amplification between the buffer and the FPA are the intermediate power amplifiers (IPAs).

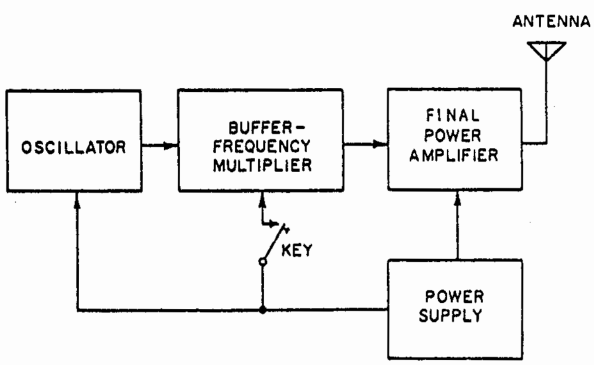


Figure 1-4.—Basic construction of a typical transmitter.

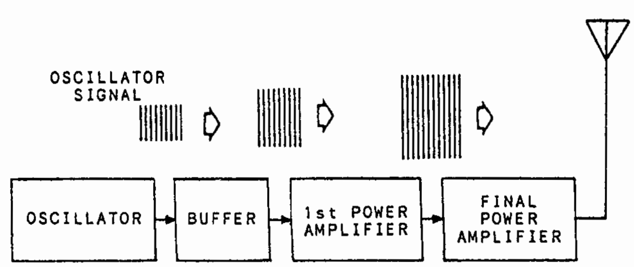


Figure 1-5.—Amplification stages between the oscillator and antenna.

Buffer

The buffer (also called the buffer amplifier) has three basic purposes. Its primary purpose is to isolate the oscillator from the amplifier stages to keep the oscillator output stable. Without the buffer, any changes that occur in the amplifiers could cause a change in the output frequency of the oscillator. It is very important that the oscillator remain highly stable because it determines the carrier frequency of the transmission.

The second purpose of the buffer is to provide the first stage of amplification to the signal from the oscillator. The third purpose is to act as a frequency multiplier. This increases the frequency output of the oscillator to the operating frequency. Figure 1-5 shows the position of the buffer between the oscillator and the PA stages.

Power Amplifiers

The IPAs are located between the buffer and the FPA. The IPAs in figure 1-6 are the stages of RF amplification that build up the RF signal power before the FPA. The main difference between many low- and high-power transmitters is the number of IPAs they contain.

The FPA stage amplifies a generated signal to its largest value by providing the most gain to the signal. Gain is attained when the output signal of an amplifier is higher than the input signal power. The amount of gain provided by the FPA is important because it affects the distance a transmitted signal can travel. Figure 1-6 shows the gain provided by each stage of a typical medium-frequency transmitter.

POWER SUPPLIES

A power supply is any unit that supplies electrical power to a transmitter. It changes ac to dc and maintains a constant voltage output within limits.

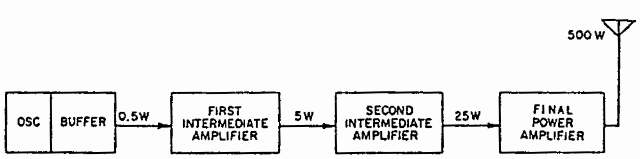


Figure 1-6.—Intermediate power amplifiers (IPAs).

FREQUENCIES

Communications transmitters operate on frequencies ranging from below 3000 Hz to several GHz.

The extremely-low-frequency (ELF) band is below 3 kHz. An ELF signal can travel great distances with low loss. It is also capable of penetrating seawater to considerable depths. For this reason, this frequency band is used for submarine communications.

In the very-low-frequency (VLF) band (3 to 30 kHz), signals can be transmitted over long distances. Signals in this frequency band can also be transmitted through magnetic storms that might blank out the higher bands. This frequency band is used primarily for transmitting time standards, radio navigation, fleet broadcasts, and submarine communications.

In the low-frequency (LF) band (30 to 300 kHz), signals are used for long-range direction finding and medium- and long-range communications. Aeronautical radio navigation and submarine communication frequencies are also in this band.

In the medium-frequency (MF) band (300 to 3000 kHz), relatively long distances can be covered. The international distress frequency, 500 kHz, is in this band. Commercial communication facilities also use this band extensively.

In the high-frequency (HF) band (3 to 30 MHz), maritime communication units are the primary users. The HF band lends itself well to long-range communications and is used extensively as a backup system for UHF and SHF satellite communications.

The very-high-frequency (VHF) band (30 to 300 MHz) is used for aeronautical radio navigation and communications, mobile communications, and by amateur radio operators.

The ultra-high-frequency (UHF) band (300 MHz to 3 GHz) is used for short-range communications and satellite communications.

The super-high-frequency (SHF) band (3 to 30 GHz) is used for point-to-point satellite communications.

This is only a partial listing of the uses of each band. For a complete list of frequencies and their uses, consult the *Spectrum Management Manual*, NTP 6. You will also find further discussion on frequencies in Chapter 4, "Wave Propagation," of this training manual.

TRANSMITTER MODES OF OPERATION

Each transmitter has its own method of producing the signal for which it was designed. The method by which a transmitter accomplishes its particular **mode** or

modes (methods) of operation may sometimes be quite complex. We will not go into the complexities of these methods. We will, however, discuss the major transmitter circuits and their functions.

CONTINUOUS-WAVE MODE OF OPERATION

Continuous wave (CW) is a radio wave of constant amplitude and constant frequency. CW is used primarily in radiotelegraphy in which the wave is turned on and off with a key to form the dots and dashes (dits and dahs) of the Morse code characters. CW was the first type of radio communications used and can be used over long ranges.

Because of technological advancements, the Navy uses CW only as a last resort emergency backup. A CW signal is difficult to jam because of the high signal power, regardless of the frequency. CW uses a narrow bandwidth (discussed later) and has a high degree of intelligibility under severe noise conditions.

AMPLITUDE-MODULATED (AM) MODE OF OPERATION

Having a clear idea of a modulated signal is the first step in understanding what single sideband is all about. Unless you understand amplitude modulation, you may have difficulty in understanding *suppressed carrier*, *single sideband*, or even plain *CW*.

Amplitude Modulation

We call the audio signal that contains the information we want to transmit the **modulating signal**. The higher frequency signal that is to have the information impressed upon it is called the **carrier signal**. **Modulation** is the process of impressing the modulating signal onto the higher frequency signal. This produces the **modulated wave**, which is the wave that is transmitted. Figure 1-7 shows a simplified diagram of the modulation process.

In figure 1-8, you can compare the unmodulated carrier, view A, with the CW signal, view B. As you

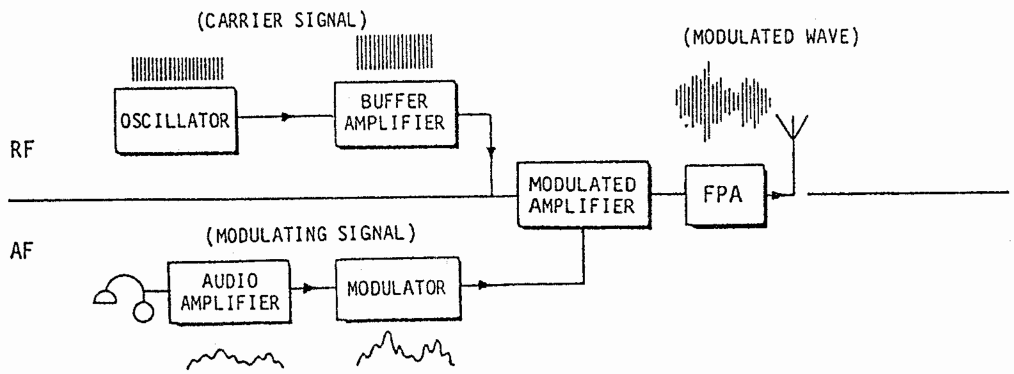


Figure 1-7.—AM transmitter and the modulation process.

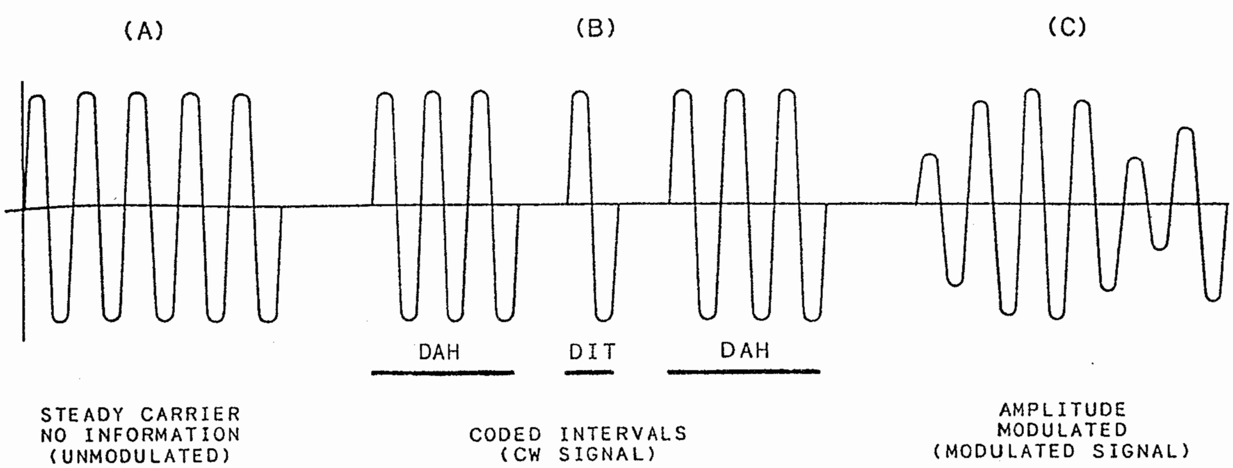


Figure 1-8.—RF signals.

can see, an unmodulated carrier and a CW signal with the key held down are the same. View C is an amplitude-modulated signal.

An AM transmitter can be divided into two major sections: radio-frequency (RF) and audio-frequency (AF) units (figure 1-7). The first section of the transmitter is the RF unit.

In the RF unit, the oscillator generates the RF carrier signal, which is constant in frequency and amplitude. This signal, however, does not convey any intelligence by itself. If you were to patch this carrier signal to a speaker, you would hear a steady tone. The carrier does not have sufficient amplitude to modulate the carrier when it leaves the oscillator. Therefore, the carrier must be amplified in one or more stages (IPAs) before it attains the power required by the final power amplifier. Any information to be transmitted is added to the carrier by the AF circuitry. As we explained earlier, modulation is the process of adding, or impressing, information onto the carrier.

The second section of the transmitter contains the audio circuitry. This section takes a low-power signal from a handset and increases the amplitude of the signal the amount necessary to modulate the carrier.

The last audio stage is the modulator. This is the last stage of audio amplification. The modulator adds its signal to the carrier in the modulated amplifier. This is where the intelligence is impressed onto the carrier. The modulator amplifier can be connected directly to the antenna or to additional stages of RF amplification (as in figure 1-7).

Why do we modulate? The reason is really quite simple. The longer the wavelength of a transmitted signal, the larger the antenna must be. Conversely, the shorter the wavelength of a transmitted signal, the shorter the antenna must be.

Most speech frequencies fall almost entirely below 3 kHz. Since the audio frequencies have longer wavelengths, the length of an antenna required to transmit this frequency band would be impractical. An antenna required for low frequencies would require large amounts of land, be expensive to construct, and consume enormous amounts of power. Obviously, it is impractical to construct antennas for this low-frequency band ashore, and the installation of such antennas on ships would be impossible.

The solution to the problem of long wavelengths is to translate, or transpose, the voice information up into a higher part of the frequency spectrum. Wavelengths in the higher part of the spectrum are shorter and more compatible with practical antenna sizes.

Figure 1-9 shows a basic block diagram of a typical AM transmitter. In the AM transmitter, we are modulating the carrier wave with voice waves created when we speak. These voice waves vary in amplitude at the same rate as our voices vary. When we modulate in AM, we combine voice waves with the carrier. The idea is to cause the amplitude of the output signal from

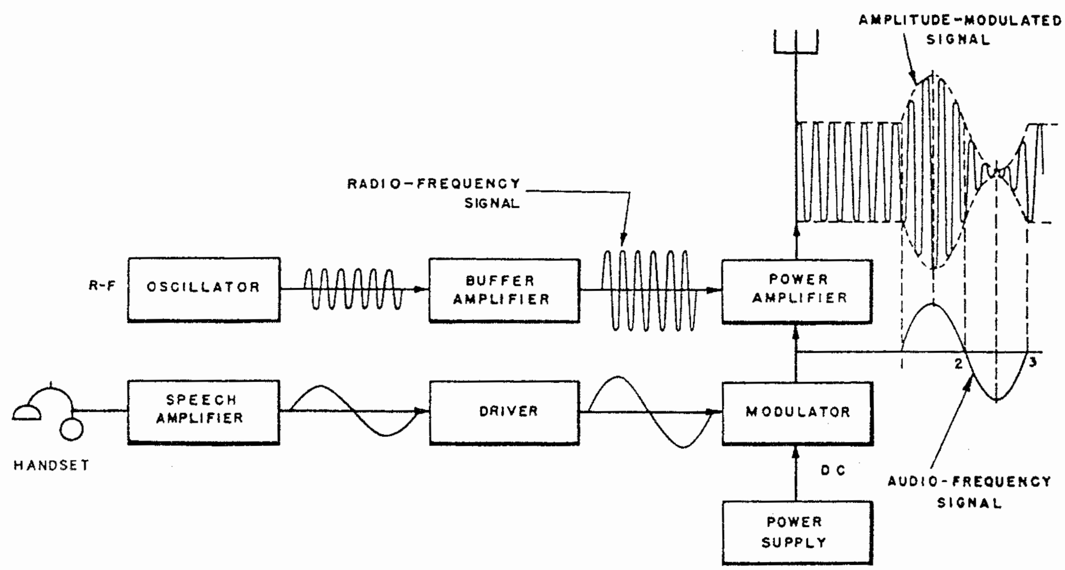


Figure 1-9.—Block diagram of an AM transmitter.

the PA to match the changes in the amplitude of the modulating signal (the voice waves).

The waveforms created by our voices are quite irregular with many high and low points (changes in amplitude). We could see this if we were to look at our voices on the screen of an oscilloscope. (An oscilloscope is a device used to produce a visual representation of waveforms on a screen.)

The desired result of amplitude modulating is to vary the output signal of the transmitter at the same rate that the modulating signal is varying. When an information wave, normally called a modulating wave, is impressed onto a carrier, the result is a **complex wave**. This complex wave is the signal that is transmitted.

View A of figure 1-10 shows a carrier wave, view B shows a modulating wave, and view C shows a complex wave. The complex (modulated) wave is contained inside an **envelope**. This envelope is the total bandwidth and amplitude of the complex wave. Notice that the amplitude of the modulated wave matches the amplitude of the modulating wave and that the frequency of the modulated wave matches the frequency of the carrier wave. This is amplitude modulation—the amplitude of the carrier is varied to match the amplitude of the modulating signal, whereas the carrier frequency remains constant.

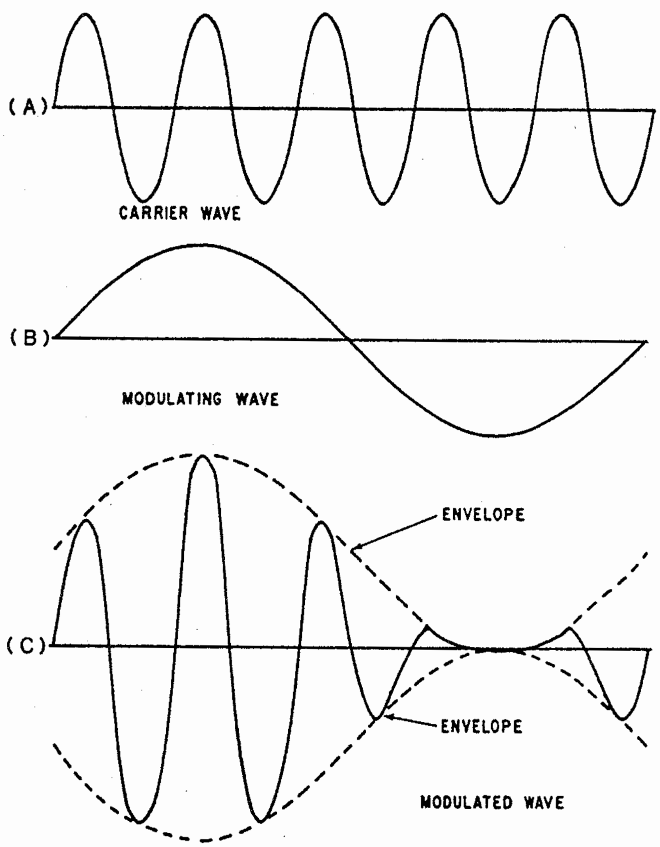


Figure 1-10.—Carrier wave, modulating wave, and amplitude-modulated wave.

We will look again at figure 1-9 and define the various parts of the AM transmitter. As you can see, the oscillator, buffer, and the power amplifier perform the same functions as in the typical transmitter discussed previously. However, we have added a few circuits necessary to accomplish amplitude modulation for us: a handset, speech amplifier (audio amplifier), driver, and modulator.

The handset converts the sound energy into electrical energy. For good quality sound reproduction, the signal from the handset must correspond in frequency to the original sound waves of your voice.

The audio amplifier builds up the signal at the input of the driver stage. The signal is comprised of your voice waves being reproduced by the handset.

Power amplifiers make up the driver stage. The driver does as its name implies. It drives, or amplifies, the signal to a voltage large enough to modulate the carrier.

The modulator stage is connected directly to the power amplifier. It takes the signal from the driver and feeds it to the power amplifier in such a way as to form the modulated wave shown in figure 1-9 at the output of the antenna.

AM Spectrum and Bandwidth

When a single audio modulating frequency modulates an RF carrier, two additional frequencies are produced. One of these frequencies is the **sum** of the RF carrier and the audio frequency. The other is the **difference** between the RF carrier and the audio frequency. We call the sum frequency the **upper sideband** (USB) and the difference frequency the **lower sideband** (LSB).

We call these new frequencies **side frequencies**. These new frequencies appear beside the carrier when the wave is displayed on a spectrum analyzer. (A spectrum analyzer is an electronic device that displays waveforms along a horizontal axis, from left to right, in ascending order of frequency.)

A spectrum analyzer represents each frequency, or waveform, by a vertical line and its amplitude by the height of the line. Figure 1-11 shows the spectrum of an AM wave. The carrier frequency (A) is 5 kHz, and the modulating frequency (B) is 1 kHz. The lower side frequency (C) is 5 kHz minus 1 kHz (4 kHz). The upper side frequency (D) is 5 kHz plus 1 kHz (6 kHz). This is the type of display that you would see on a spectrum analyzer.

Notice that the modulating frequency in figure 1-11 is not part of the spectrum of the modulated wave. It is, however, represented in that spectrum twice: once by the lower sideband, and once by the upper sideband. Notice also that the amplitude of each side frequency is only one-half that of the modulating wave.

In AM, modulating wave power is redistributed equally among the sidebands. This redistributed energy adds to the carrier power and increases the total energy radiated. We call this process of combining two frequencies in such a way as to produce sum and difference frequencies **mixing** or **heterodyne** action.

The space that a carrier and its associated sidebands occupy in the frequency spectrum is the **bandwidth**. The bandwidth of the modulated wave shown in figure 1-11 is 2 kHz. The bandwidth is measured from the location of the lower sideband to the location of the upper sideband.

If the carrier and the modulating signal are constant in amplitude, the sum and difference frequencies will also be constant in amplitude. However, when the carrier and the sidebands are combined and viewed simultaneously with an oscilloscope, the resultant waveform appears as shown in figure 1-12. This resultant wave is the **modulation envelope**.

Spectrum for Multiple Modulation

Multiple modulation simply means modulating a carrier with more than one frequency. Instead of having one upper and lower sideband, we have more than one of each. Simply stated, we have a band of upper and lower sidebands.

Each frequency in the band produces its own pair of side frequencies. This results in a much more complex spectrum. Figure 1-13 shows what you could see on a spectrum analyzer. Notice that the bandwidth is equal to twice the modulating frequency ($BW = 2 \times Highest\ Mod\ Freq$). This is a constant in all modulated waves.

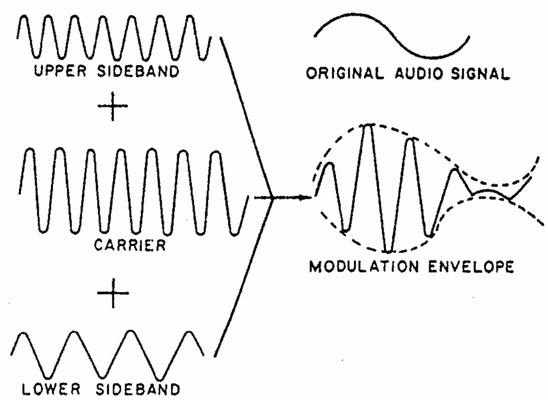


Figure 1-12.—Formation of the modulation envelope.

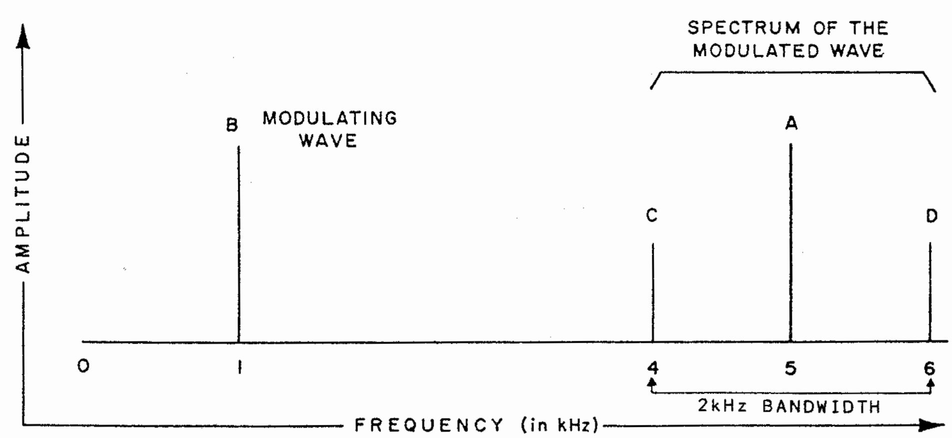


Figure 1-11.—Carrier, modulating wave, and side frequencies.

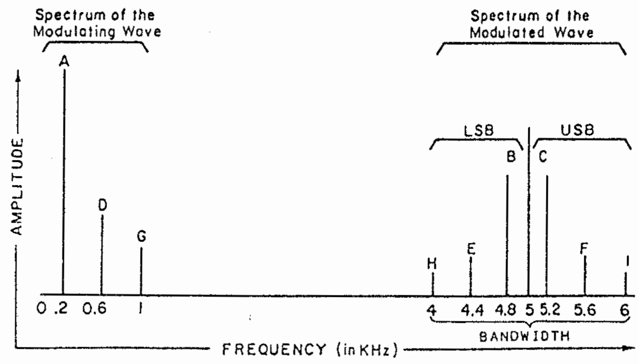


Figure 1-13.—Modulating wave on left, and the resultant modulated wave on right.

You will recall that sidebands are the sum and difference of the carrier and modulating frequencies. In figure 1-13, the lowest frequency of modulating wave (A) is 0.2 kHz, which produces a lower side frequency (B) of 4.8 kHz (difference between 5 kHz and 0.2 kHz) and an upper side frequency (C) of 5.2 kHz (sum of 5 kHz and 0.2 kHz) in the modulated wave. The next highest modulating frequency (D) is 0.6 kHz. Using the same type of calculation as above results in a lower side frequency (E) of 4.4 kHz and an upper side frequency (F) of 5.6 kHz. The highest modulating frequency (G) produces lower and upper side frequencies (H and I) of 4 and 6 kHz, respectively.

Those side frequencies in figure 1-13 that are higher in frequency than the carrier are collectively called the **upper sideband** (USB). You can see that the USB is a replica of the modulating wave. The order and spacing of frequencies are the same as in the modulating wave. Their relative amplitudes are also the same (even though the modulating wave gave only one-half of its amplitude to the USB). We can now say that the information contained in the modulating wave has been translated (or transposed) to a higher part of the frequency spectrum.

Those side frequencies that are lower in frequency than the carrier are collectively called the **lower sideband** (LSB). The LSB is an inverted replica, or mirror image, of both the modulating wave and the USB. The lowest modulating frequency (A) is represented by the highest frequency in the LSB (B). The highest modulating frequency (G) is represented by the lowest frequency in that sideband (H). Despite this frequency inversion, the LSB is a replica of the information contained in the modulating wave being translated to a higher part of the frequency spectrum.

When both the upper and lower sidebands are present and contain identical information, the waveform is known as **double sideband** (DSB). The carrier is removed when a DSB waveform is transmitted.

SINGLE-SIDEBAND (SSB) MODE OF OPERATION

We now know that an AM signal consists of a carrier, an upper sideband, and a lower sideband. In figure 1-11, we saw the spectrum analyzer representation of an RF carrier modulated by a single audio frequency. In figure 1-13, we saw an RF carrier modulated by more than one frequency and learned that this more complex waveform creates more frequencies in the sidebands.

The intelligence carried by an AM signal is contained in both sidebands. None of the intelligence is transmitted in the carrier frequency. Since the intelligence contained in one sideband is a duplicate of the intelligence contained in the other sideband, only one sideband is required for communications. The other sideband can be eliminated by the use of filtering.

Since the carrier contains no intelligence, it, too, can be filtered out. When one sideband and the carrier are both filtered out before transmission, the mode of operation is called a **single-sideband suppressed carrier** (SSBSC) transmission.

Now that we know the basics of SSB, we can look at some of its advantages. One advantage of SSB is that it reduces bandwidth requirements. If a double-sideband signal requires 6 kHz for transmission, we can transmit the same intelligence using 3 kHz by eliminating one sideband. This 50-percent reduction in the bandwidth required is valuable in conserving the overcrowded HF spectrum.

Another advantage of SSB is that there is less noise at the receiver end. Noise is anything other than the signal that we want to receive. Since there is noise on all frequencies, the wider the bandwidth, the more noise pickup. Conversely, the narrower the bandwidth, the less noise pickup. Therefore, a signal that is being washed out by background noise may be detected if all the information is contained in a narrower bandwidth.

A third advantage of using SSB is that it conserves power. In DSB transmissions, about two-thirds of the transmitter output power goes into the carrier and about one-sixth into each sideband. When one sideband is eliminated, the power it would have received can be added to the remaining sideband. This sideband will then contain about one-third of the total power.

The type of signal that results from eliminating one sideband and leaving the carrier undiminished is the **single-sideband full carrier** (SSBFC).

In the transmitter, the main function of the carrier is to allow the frequency of a modulating wave to be changed to a frequency that is high enough for transmission. You will recall that the carrier itself contains none of the information you want to transmit. Therefore, after modulation, the power used by the carrier can be either totally eliminated, as in the single-sideband suppressed carrier mode, or greatly reduced. Reducing carrier power prior to transmission is called the **single-sideband reduced carrier** mode of operation.

As you know, all the information to be transmitted is contained in the sidebands. When the transmitter is operated in the single-sideband suppressed carrier or reduced carrier mode, the power removed from the carrier prior to transmission is added to the power available in the sidebands.

Another mode of transmission is called **independent sideband** (ISB). ISB is created when two different modulating waves are patched to the same transmitter. After the two waves have been modulated with the carrier, the transmitter discards one sideband from each of the two modulated signals, and then transmits the two remaining sidebands, one in the lower sideband position and one in the upper sideband position. The transmitted signal has two sidebands, each containing different information.

When one of the duplicate sidebands of a DSB signal is discarded, a new independent single sideband replaces the discarded sideband. This new sideband is independent from the remaining sideband. In this situation, there are two separate, independent sidebands sharing one carrier. One information source produces the upper sideband. A second information source produces the lower sideband.

We call the transmission of two separate single sidebands sharing one carrier ISB or **double single sideband**. An independent sideband can be transmitted with a full, reduced, or suppressed carrier.

FREQUENCY MODULATION

Intelligence can be superimposed on a carrier in the form of changes in the carrier frequency. This type of modulation is known as frequency modulation (FM). The carrier frequency can be varied a small amount on either side of its average, or assigned value by means of an audio-frequency modulating signal. The amount the carrier is varied depends on the amplitude of the modulating signal. The rate at which the carrier frequency is varied depends on the frequency of the modulating signal. The amplitude of the RF carrier remains constant with or without modulation. Figure 1-14 shows a comparison of amplitude and frequency waves.

The simplest method of establishing FM is to connect a handset into the oscillator circuit of the transmitter. When you speak into the handset circuit at a relatively low frequency, the oscillator frequency changes only a few times per second. If the sound waves are higher, the oscillator frequency changes more times per second. When the sound waves have low amplitude, the extent of the oscillator frequency change is small. Thus, the frequency of the AF signal determines the number of times per second (rate of deviation) that the oscillator frequency changes.

The amplitude of the AF signal determines the extent of the oscillator frequency change (degree of deviation). Figure 1-15 shows a basic block representation of an audio signal being fed into the oscillator input circuits. As you can see at the output, the oscillator frequency is slightly different because of the modulating frequency.

FM Sidebands

The process of frequency modulation produces new frequencies above and below the carrier frequency. These new frequencies are the **sideband frequencies**. These frequencies contain the signal intelligence, as in amplitude modulation. They combine with the unmodulated carrier to produce the modulated carrier previously described.

The significant difference between AM and FM sideband frequencies is the number of sidebands produced. In amplitude modulation, as you will recall, two sidebands are produced for every modulating

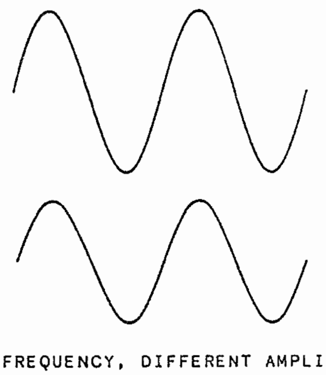


Figure 1-14.—Comparison of amplitude and frequency waves.

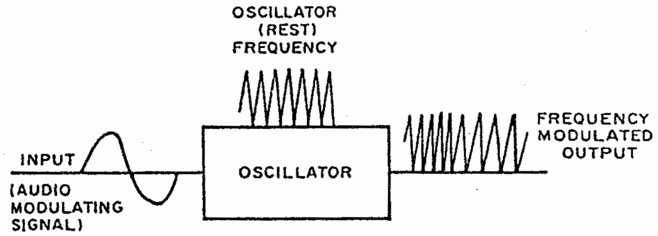


Figure 1-15.—Basic process of frequency modulation (FM).

frequency. One of these sideband frequencies is equal to the sum of the modulating and carrier frequencies and is above the carrier frequency. The other is equal to the difference between the modulating and carrier frequencies and is below the carrier frequency.

In FM, each modulating frequency produces a similar pair of sum and difference sideband frequencies. However, in addition to the basic pair, a theoretically infinite number of additional sideband frequencies are produced. Although, theoretically, these sidebands extend outward from the carrier indefinitely, only a few of them contain enough power to be heard. The farther from the basic frequency that a sideband is, the less power it will have.

In FM, the sidebands derive their power from the carrier. This means that the unmodulated carrier component of an FM wave has less power, or a smaller amplitude, after modulation than it does before modulation. The amount of power removed from the carrier and placed in the sidebands depends on the modulating frequencies and the maximum deviation of the carrier.

It is possible, under certain conditions, for the carrier power to be zero, with all the power contained in the sidebands. This, of course, is the ideal situation since the carrier itself contains no intelligence.

FM Bandwidth

We said that bandwidth meant the entire range of frequencies in a modulated wave. We also said that there are an infinite number of sideband frequencies contained in an FM wave. However, only the significant frequencies (those with amplitudes that can be heard) are included in its bandwidth. The bandwidth of an FM wave is the frequency range between the extreme upper and the extreme lower sideband frequencies whose amplitudes are 1 percent or more of the unmodulated carrier amplitude.

When an FM wave has a very wide bandwidth, it is called **wideband FM**. Such waves require many times the bandwidth of an AM signal carrying similar intelligence. Wideband FM waves are used primarily in the VHF and above bands because of the amount of bandwidth they require. These high frequencies are necessary so that a maximum number of FM waves can be transmitted without interfering with each other. They are not used in the lower bands because of the overcrowding of available frequency space.

It is possible to produce an FM wave having the same bandwidth as an AM wave carrying the same intelligence. This is accomplished by limiting the maximum deviation of the FM carrier. Called **narrowband FM**, this process causes some distortion of the intelligence. However, it allows carrier frequencies to be used that are lower than those required for wideband FM.

The bandwidth of a modulated wave is important for two reasons. First, it determines how much space or room in the radio-frequency spectrum the wave will occupy. Second, it determines the range of frequencies within which the electronic circuits used to receive and process the wave must be capable of operating.

All modulated waves transmitted by radio in a given geographical area must occupy different places in the spectrum; otherwise, these modulated waves would interfere with each other. For example, the lower frequencies of a modulated wave with a 100-MHz carrier and an 8-kHz bandwidth would overlap and interfere with the upper frequencies of a 99-MHz carrier with an 8-kHz bandwidth.

Interference among radio waves can be avoided by reducing bandwidths or by moving carrier frequencies farther apart. However, if bandwidths are too narrow, distortion of the intelligence carried by the wave would result since many of the sidebands that contain the intelligence would be eliminated. On the other hand, if carrier frequencies are too far apart, a smaller number of radio waves would fill the radio spectrum.

BASIC COMMUNICATIONS SYSTEMS

The purpose of any communications system is to efficiently transmit and receive information from one place to another. A communications system is a collection of equipment used together to accomplish a specific requirement.

A requirement may be to send and/or receive voice communications. Another requirement may be to send, receive, or send and receive teleprinter information. You can find block diagrams of all the major systems used in the U.S. Navy in *Strike Warfare (STW), Antisurface Ship Warfare (ASU), Intelligence (INT), Electronic Warfare (ELW), and Command, Control, and Communications (CCC) Exercises (U)*, FXP 3.

Every Navy ship is provided with communications systems based on its mission. Communications systems can vary from the simple to the complex. For instance, a basic radiotelephone system consists of a transmitter, antennas, receiver, and headphones or speaker. A multichannel broadcast system may consist of antennas, receivers, terminal equipment, crypto- graphic equipment, an assortment of printers, patching equipment, and a transmitter at a shore station.

Figure 1-16 is a basic block diagram of a non-secure voice system. You can see how the various equipments are configured (connected) to form a basic communications system. We will use this diagram to illustrate an HF SSB voice system and to explain several of the equipment blocks. In view A of figure 1-16, the system is set up for use as both a receiver and a transmitter. In view B, the system is set up for use as a transceiver.

HF SINGLE-SIDEBAND VOICE (YANKEE) SYSTEM

A typical SSB nonsecure voice system consists of one or more radiotelephone handsets and/or loudspeakers. They are patched to transmitter and receiver equipment or a transceiver via the transmitter transfer switchboard and audio transfer switchboard (switchboards are discussed later). The transmitting and receiving antennas are patched through their associated couplers or multicouplers (discussed in chapter 3) to a transceiver or separate transmitter and receiver.

On the transmit side, the operator's voice generates an audio signal in the handset, which is patched to the transmitter via the transmitter transfer switchboard. To place the transmitter on the air, the operator presses the push-to-talk button on the handset. The keying signal and audio signal are patched to the transmitter via the transmitter transfer switchboard where the audio signal amplitude modulates the RF carrier generated by the transmitter. One of the sidebands and the RF carrier are filtered out, and only the remaining sideband is transmitted. The RF SSB signals are patched to the antenna through an antenna coupler where the signal is radiated.

On the receive side, the SSB signal is received from the transmitting station with a fully suppressed carrier. This RF signal is picked up by the antenna and passed through a multicoupler to the receiver where it is demodulated. The audio signal output from the

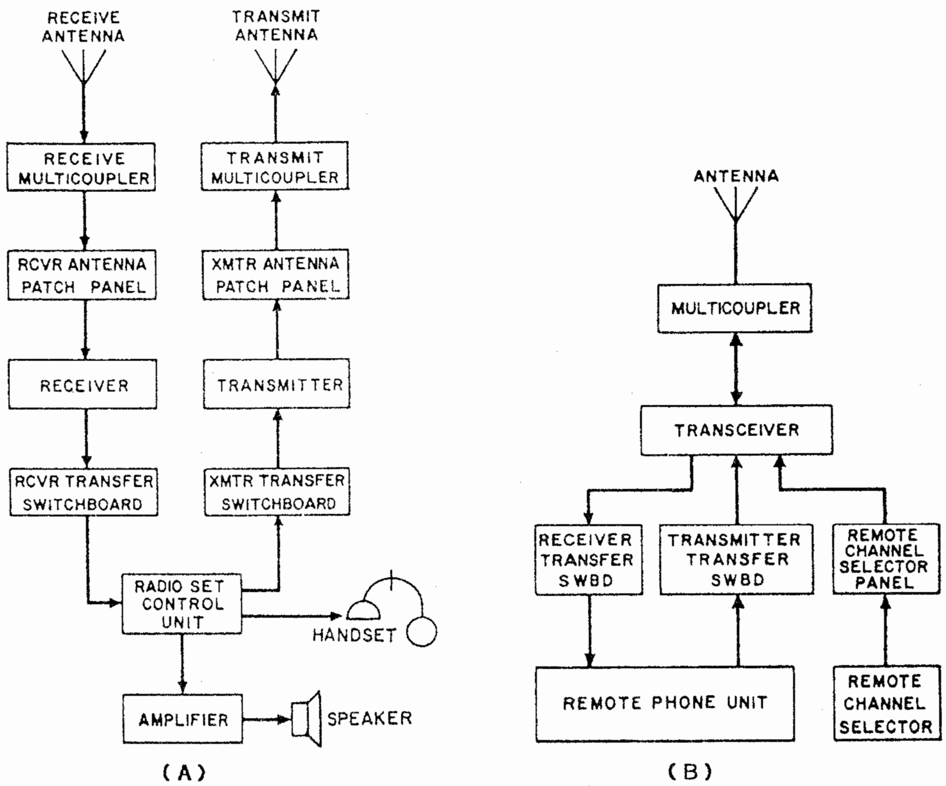


Figure 1-16.—Nonsecure voice system.

receiver is then patched to one or more remote radiotelephone units and/or speakers, via the audio transfer switchboard.

AM/FM VOICE SYSTEM

In an AM/FM voice system, either amplitude or frequency modulation can be used, but all units in a net must use the same mode of transmission. For instance, you cannot communicate on an AM circuit with FM equipment. Regardless of whether the transmission is AM or FM, the same principles apply.

HANDSET

The handset has two functions. One function is to convert acoustical energy (your voice) to electrical energy for use in modulating a radio transmitter. The other is to convert electrical energy to acoustical energy for reproducing the received signal. When the push-to-talk button is pressed on the handset, the direct-current (dc) keying circuit to the transmitter is closed. This places the transmitter on the air. The audio signal and dc keying voltage from the handset are patched to the transmitter or transceiver via the transmitter transfer switchboard. Handsets are normally connected to a radio remote controlunit.

REMOTE CONTROL UNIT

The C-1138 Remote Control Unit in figure 1-17 allows you to remotely control certain radiotelephone

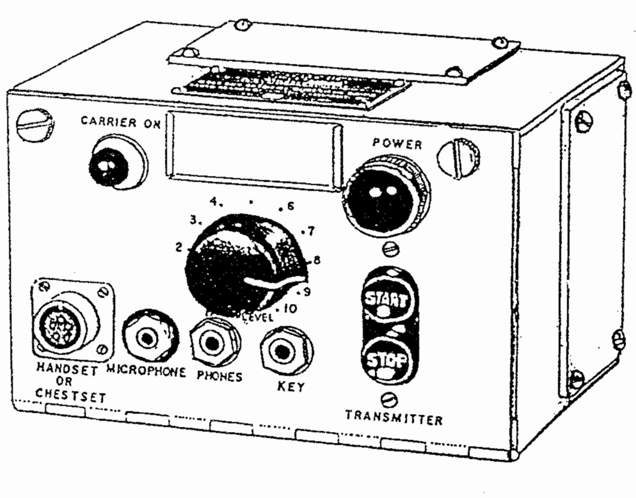


Figure 1-17.—C-1138 Remote Control Unit.

transmitter functions and the receiver output. Some of the controls are used for turning the transmitter on and off. Some are used for voice modulating the transmission (or keying when CW operation is desired). Other controls allow you to control the audio output level of the receiver and silence the receiver when transmitting.

Under standard operating conditions, as many as four C-1138s, or similar units, can be paralleled with a single transmitter and receiver group to provide additional operating positions. You will find setups like this aboard ship where a transmitter and receiver are controlled and operated from several locations, such as the bridge or the combat information center.

TRANSFER SWITCHBOARDS

The transmitter transfer switchboard allows you to selectively transfer remote control station functions and signals to the transmitters. Figure 1-18 shows an SB-988/SRT Transmitter Transfer Switchboard. The SB-988/SRT allows you to selectively transfer any 1 of 10 remote control station functions and signals to any 1 of 6 transmitters. The cabinet has 10 rotary switches, arranged in 2 vertical rows of 5 switches each. Each switch has eight positions. The SB-988/SRT circuitry makes it impossible for you to parallel transmitter control circuits. In other words, you cannot connect more than one transmitter to any remote control station.

Each switch operating knob corresponds to a remote control station. Each rotary switch position (1 through 6) corresponds to a transmitter. One switch position, "X," provides for the transfer of all circuits to additional transmitter transfer switchboards when more than six transmitters are installed in the system. When the rotary switch is in the OFF position, the remote control station is removed from the system.

Let's look at an example of one transfer switchboard application. When remote control station number 2 is to have control of transmitter number 3,

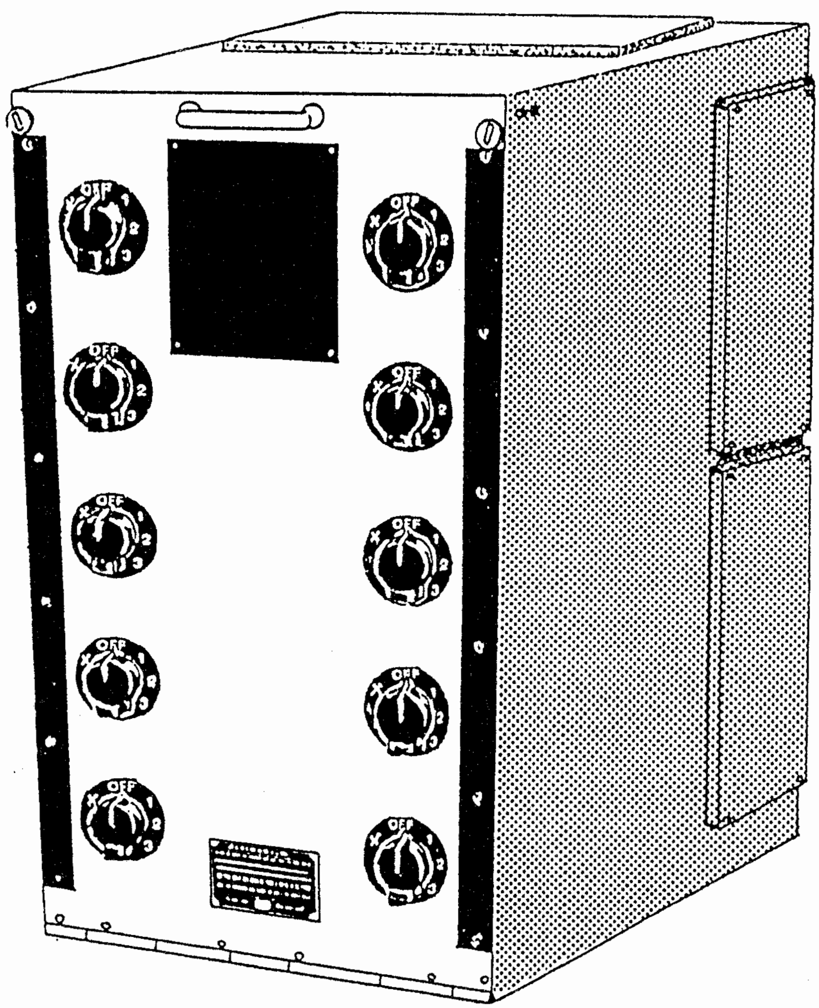


Figure 1-18.—SB-988/SRT Transmitter Transfer Switchboard.

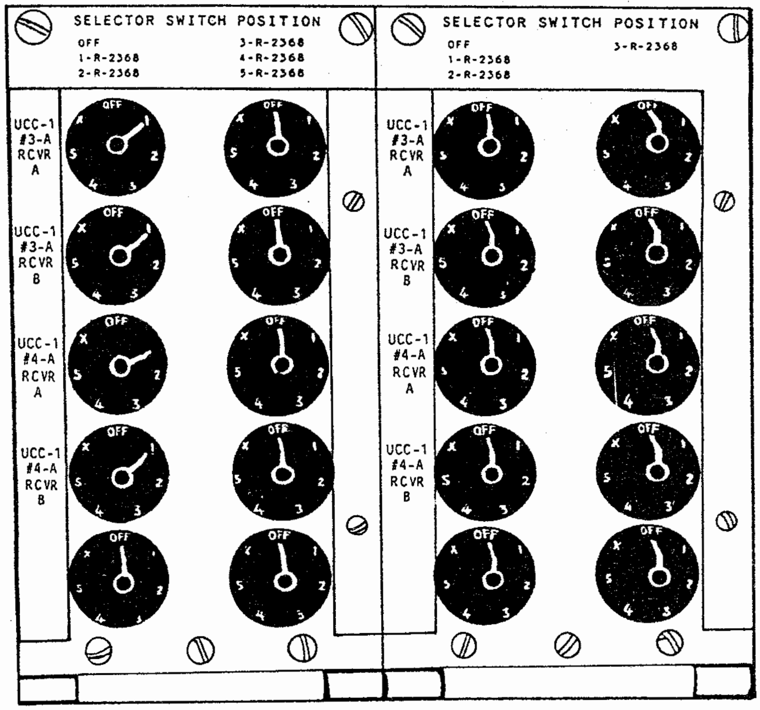


Figure 1-19.—SB-973/SRT Receiver Transfer Switchboards.

switch knob "2" is rotated until its pointer indicates position "3" on its dial plate. Any of the remote stations may thus be connected to control any of the transmitters installed in the system.

The receiver transfer switchboard allows you to transfer the audio output from the receivers to remote control station audio circuits. Figure 1-19 shows two representative SB-973/SRT Receiver Transfer Switchboards. These switchboards contain 10 seven-position switches. Each switch is connected to a remote control station, and each switch position (1 through 5) relates to a receiver.

As mentioned earlier, the position "X" on each switch allows you to transfer the circuits to additional switchboards, as with the transmitter transfer switchboard.

TRANSMITTER

For ease of illustration and example, we will discuss only one radio transmitting set, the AN/URT-23A(V), which is widely used in the Navy. The applications, configuration, and components of this set are typical of most HF transmitter systems used in the Navy.

The AN/URT-23A(V) (figure 1-20) is a medium- and long-range HF radio transmitting set. It is the

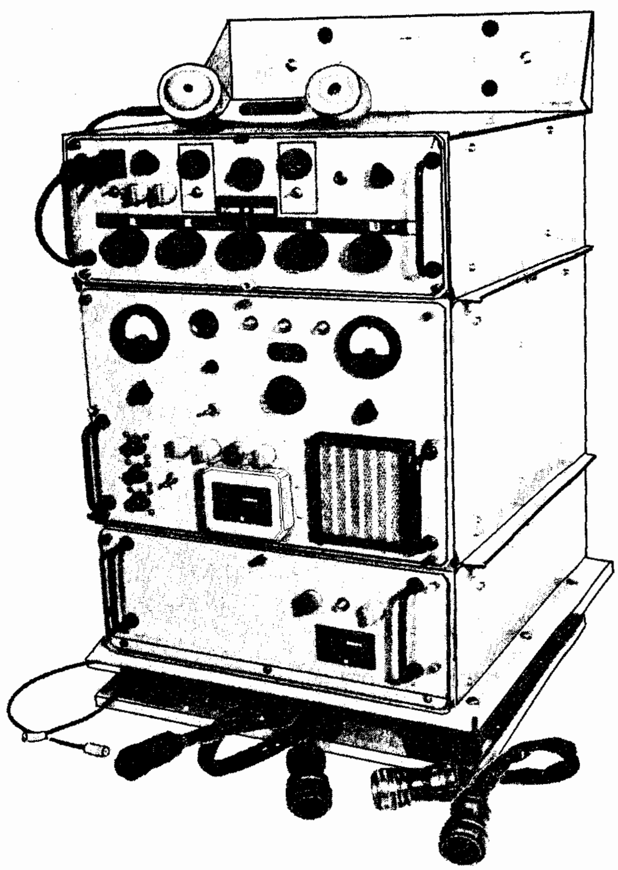


Figure 1-20.—AN/URT-23A(V) Radio Transmitting Set.

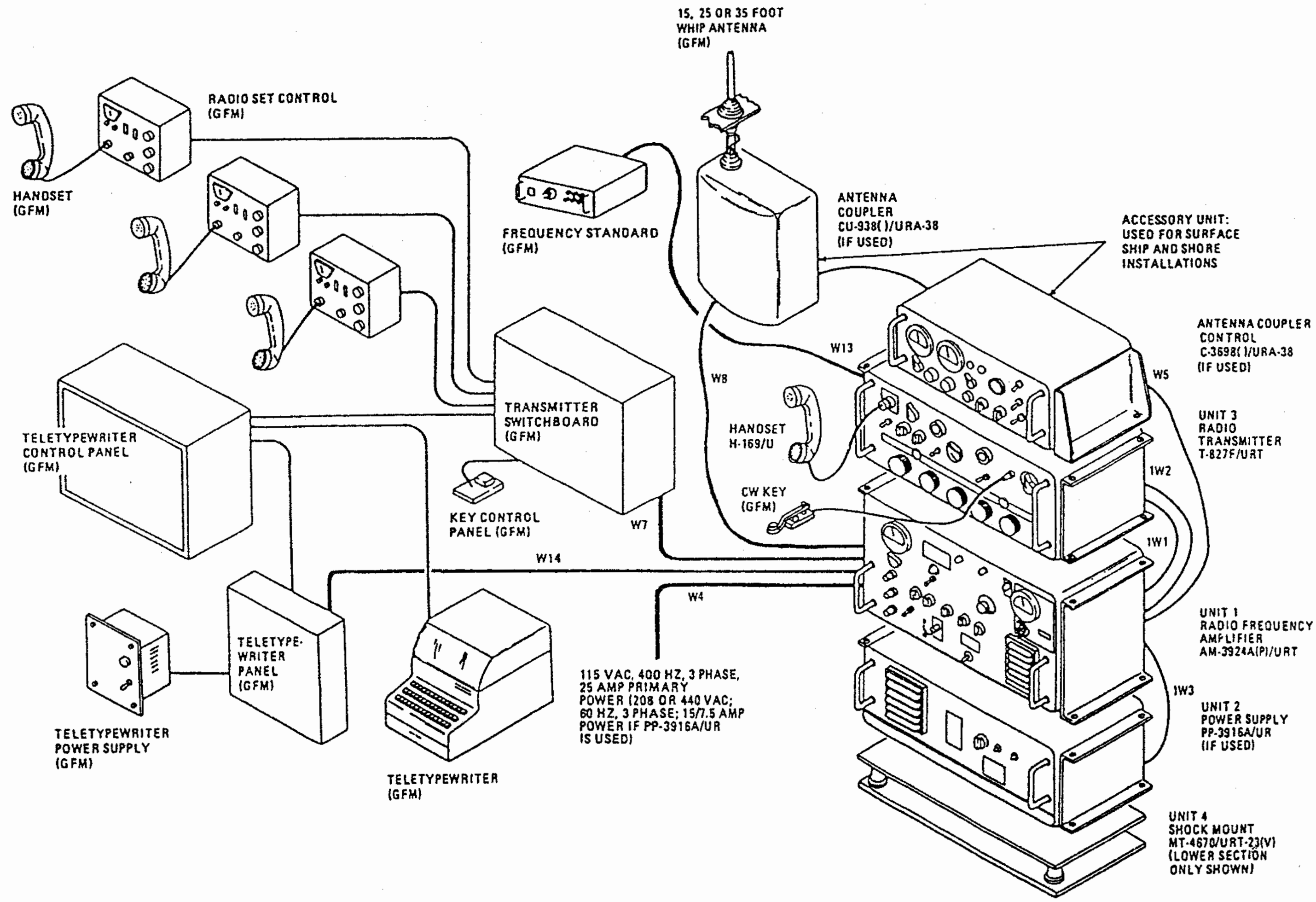


Figure 1-21.—AN/URT-23A(V) Radio Transmitting Set, relationship of units.

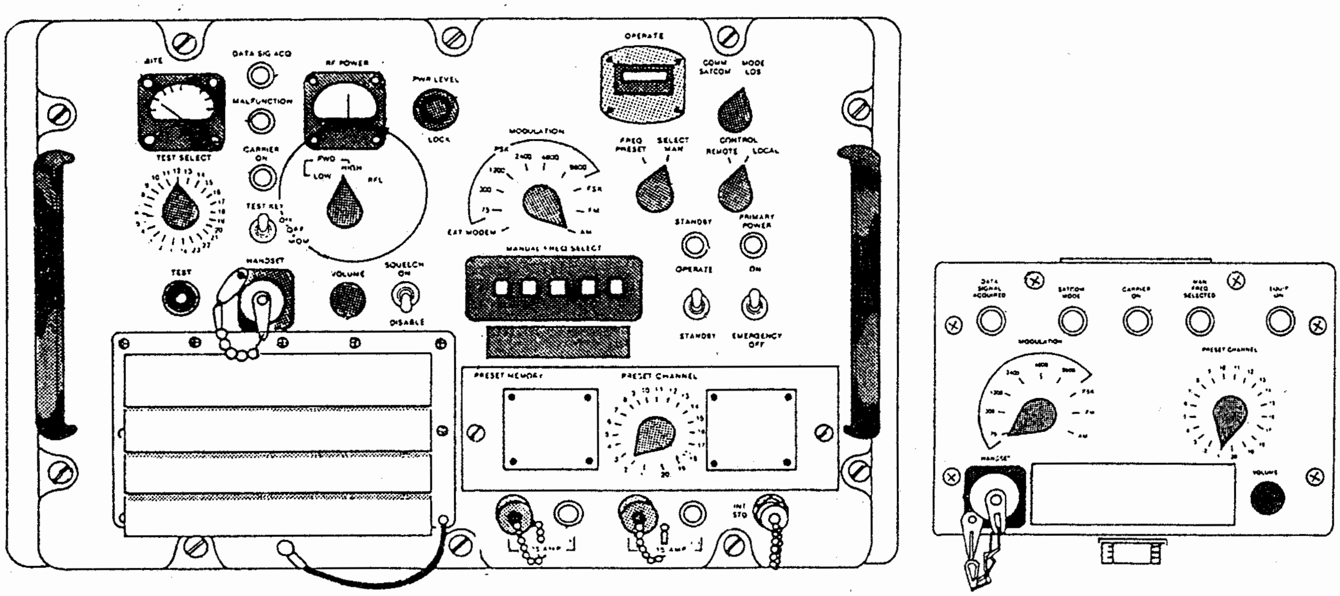


Figure 1-22.—AN/WSC-3 UHF Transceiver and Control Indicator.

most commonly used shipboard HF transmitter. Figure 1-21 shows the four major units that make up the AN/URT-23A(V): Radio Transmitter T-827(F)/URT, Radio-Frequency Amplifier AM-3924A(P)/URT, Power Supply PP-3916A/UR, and Electrical Equipment Shock Mount Base MT-4670/URT-23(V). Figure 1-21 also shows an optional unit, Antenna Coupler Control C-3698()/URA-38, which is used to remotely tune the antenna. These units may be stacked or rack-mounted aboard ship or at shore installations with other ancillary equipment to form a complete communications system (such as that illustrated in figure 1-21).

TRANSCEIVER

One method of obtaining equipment compactness is to combine a transmitter and a receiver into a single unit called a transceiver. A transceiver uses part of the same electronic circuitry for both transmitting and receiving. Therefore, a transceiver cannot transmit and receive simultaneously. Referring back to figure 1-16, view B, you can see that the antenna patch panels and individual multicouplers for the receive and send sides can be eliminated.

The AN/WSC-3 is the standard UHF satellite communications (SATCOM)/line-of-sight (LOS) transceiver. Figure 1-22 shows an AN/WSC-3 unit with a control indicator for use in remote operations. The AN/WSC-3 is used primarily aboard ship and at selected shore installations. It can be operated in either the satellite (SATCOM) (292 to 311 MHz) or line-of-sight (LOS) (225 to 400 MHz) mode. When used in the SATCOM mode, it is used with special ancillary satellite equipment, such as Antenna Group OE-82C/WSC-1(V).

Each AN/WSC-3 is designed for single-channel simplex operation with 20 preset separate channels. The AN/WSC-3 can be used in several configurations, depending on the number of simultaneous channels needed for a particular installation. In some locations, a single AN/WSC-3 transceiver is adequate. Most small ships require two such transceivers. Some large ships, however, require four or more configurations to meet their operational requirements. Figure 1-23 shows a four-channel installation of the AN/WSC-3 transceiver.

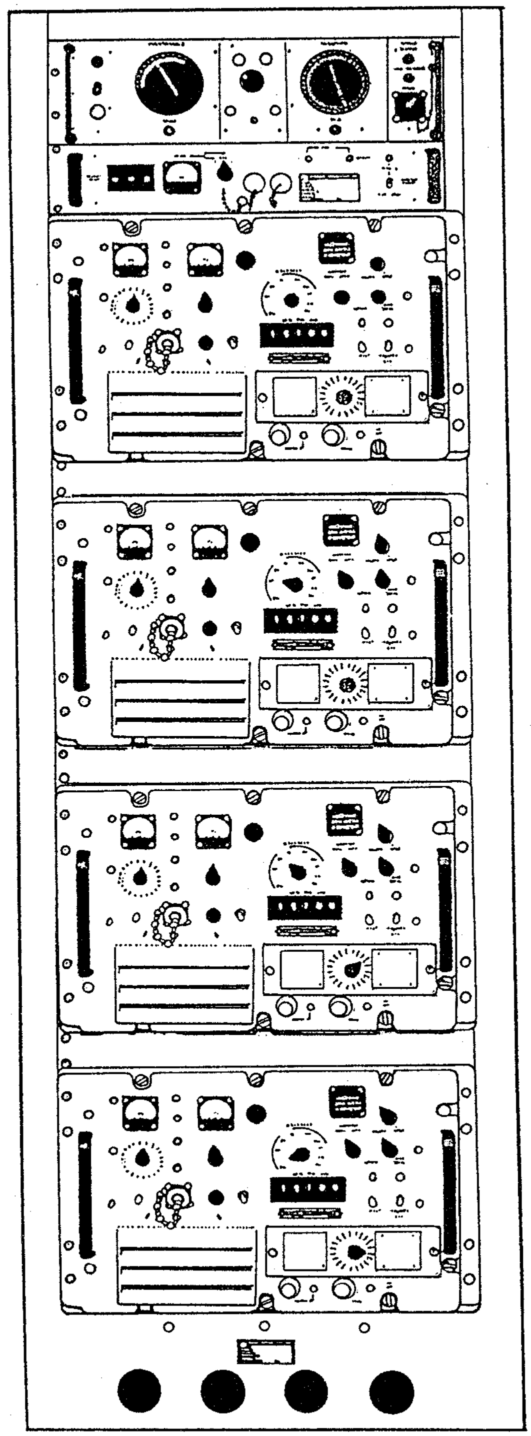


Figure 1-23.—AN/WSC-3 four-channel installation.

Figure 1-23 gives you an idea of how a system can be set up. In chapter 2, we will discuss the receive side of this diagram. In chapter 3, we will discuss the various antennas that are used with communications systems. In chapter 4, we will discuss how the RF signals travel through the atmosphere to complete the communications system diagram. You can find more block diagrams of other systems used in naval communications in *Fleet Communications*, NTP 4, and in FXP 3.

SUMMARY

In this chapter, you have learned some of the terms used in basic transmitters. We covered a basic communications network, the transmitter circuits, and the major types of transmitters, including their block diagrams and associated circuitry. We talked about frequency modulation and its advantages. Depending upon its mission, every U.S. Navy ship has communications systems that can vary from the simple to the complex.

You can learn more about how the various components of communications equipment work by studying the NEETS modules and other publications listed as references at the end of this chapter. A well-rounded knowledge in modern communications equipment is essential if you are to be proficient in performing all your duties.

You should now understand the basics of transmitter theory. In chapters 2, 3, and 4, you will learn the theories of receivers, antennas, and radio wave propagation, respectively. As you study the next three chapters, you will be able to understand how these components work together to form a communications network.

RECOMMENDED READING LIST

NOTE

Although the following references were current when this TRAMAN was published, their continued currency cannot be assured. You therefore need to ensure that you are studying the latest revisions.

Some of the following references were originated by the Naval Education and Training Program Development Center (NETPDC), Pensacola, Fla. Effective 1 September 1986, the title NETPDC was officially changed to Naval Education and Training Program Management Support Activity (NETPMSA), Pensacola, Fla.

Cryptologic Technician Training Series (U), Module 5, *Satellite Communications (U)*, NAVEDTRA A95-05-44-89, NETPMSA, Pensacola, Fla., 1989.

Electronics Installation and Maintenance Book—*Communications,* NAVSEA SE000-00-EIM-010, Naval Sea Systems Command, Washington, D.C., September 1979.

Navy Electricity and Electronics Training Series, Module 1, *Introduction to Matter, Energy, and Direct Current*, NAVEDTRA B72-01-00-92, NETPMSA, Pensacola, Fla., 1992.

Navy Electricity and Electronics Training Series, Module 2, *Introduction to Alternating Current and Transformers*, NAVEDTRA 172-02-00-91, NETPMSA, Pensacola, Fla., 1991.

Navy Electricity and Electronics Training Series, Module 8, *Introduction to Amplifiers*, NAVEDTRA 172-08-00-82, NETPDC, Pensacola, Fla., 1982.

Navy Electricity and Electronics Training Series, Module 9, *Introduction to Wave-Generation and Wave-Shaping Circuits*, NAVEDTRA 172-09-00-83, NETPDC, Pensacola, Fla., 1983.

Navy Electricity and Electronics Training Series, Module 10, *Introduction to Wave Propagation, Transmission Lines, and Antennas*, NAVEDTRA 172-10-00-83, NETPDC, Pensacola, Fla., 1983.

Navy Electricity and Electronics Training Series, Module 12, *Modulation Principles*, NAVEDTRA 172-12-00-83, NETPDC, Pensacola, Fla., 1983.

Navy Electricity and Electronics Training Series, Module 17, *Radio-Frequency Communications Principles*, NAVEDTRA 172-17-00-84, NETPDC, Pensacola, Fla., 1984.

Navy UHF Satellite Communication System Description, FSCS-200-83-1, Commander, Naval Ocean Systems Center, San Diego, Calif., 1991.

CHAPTER 2

RECEIVER THEORY

CHAPTER LEARNING OBJECTIVES

Upon completing this chapter, you should be able to do the following:

- *Explain the origin of receiver input.*
- *Explain the general functions of receivers.*
- *Describe the characteristics of receivers.*
- *Explain the functions of the superheterodyne receiver.*
- *Explain the functions of the single-sideband receiver.*
- *Explain the functions of the R-2368/URR Receiver.*
- *Explain the functions of the AN/SSR-1 Satellite Receiver System.*

As a Radioman, your understanding of receiver theory will help make you a proficient watch stander. You should be capable of recognizing basic trouble symptoms and correcting them before they become major problems.

Just as we must have transmitters to transmit radio waves, we must have receivers to receive these waves. Whether the signal consists of encoded characters and intelligence or is amplitude modulated, we must have a receiver capable of handling that particular type of wave and converting it into a useful output.

ORIGIN OF RECEIVER INPUT

The purpose of a receiver is to convert electromagnetic waves received from a transmitting antenna into usable energy. If the transmission is in AM, the receiver used must be able to convert the received energy into intelligible sound. If the transmitted signal is a fleet teleprinter broadcast, the receiver must be able to convert the received energy into teleprinter functions to print out the desired characters. Whether the receiver is designed for AM, single sideband (SSB), or teleprinter control, the basic circuit functions remain the same.

Before we discuss how a receiver converts energy into a useful output, let's first review the origination of a transmitted wave as presented in chapter 1. For the sake of simplicity, we will use the AM receiver for illustration.

Figure 2-1 is a block diagram of a typical AM transmitter showing the input and output stages of each major section. In AM receivers, the handset converts the sound waves into an electrical signal. This electrical signal varies in frequency and amplitude in proportion to the original sound. Since the signals from the handset are very weak, they are fed to the modulation section, consisting of a speech amplifier, driver, and modulator. This section increases the amplitude to a level suitable as an input into the power amplifier.

The power amplifier in the radio-frequency (RF) unit has two inputs. One input is the audio signal from the modulator; the other is the constant-amplitude RF signal from the oscillator. The output of the oscillator is called the **carrier frequency**. In the power amplifier, the audio signal (intelligence) is impressed on the carrier. The output of the power amplifier is a modulated RF signal. This signal is fed to the antenna.

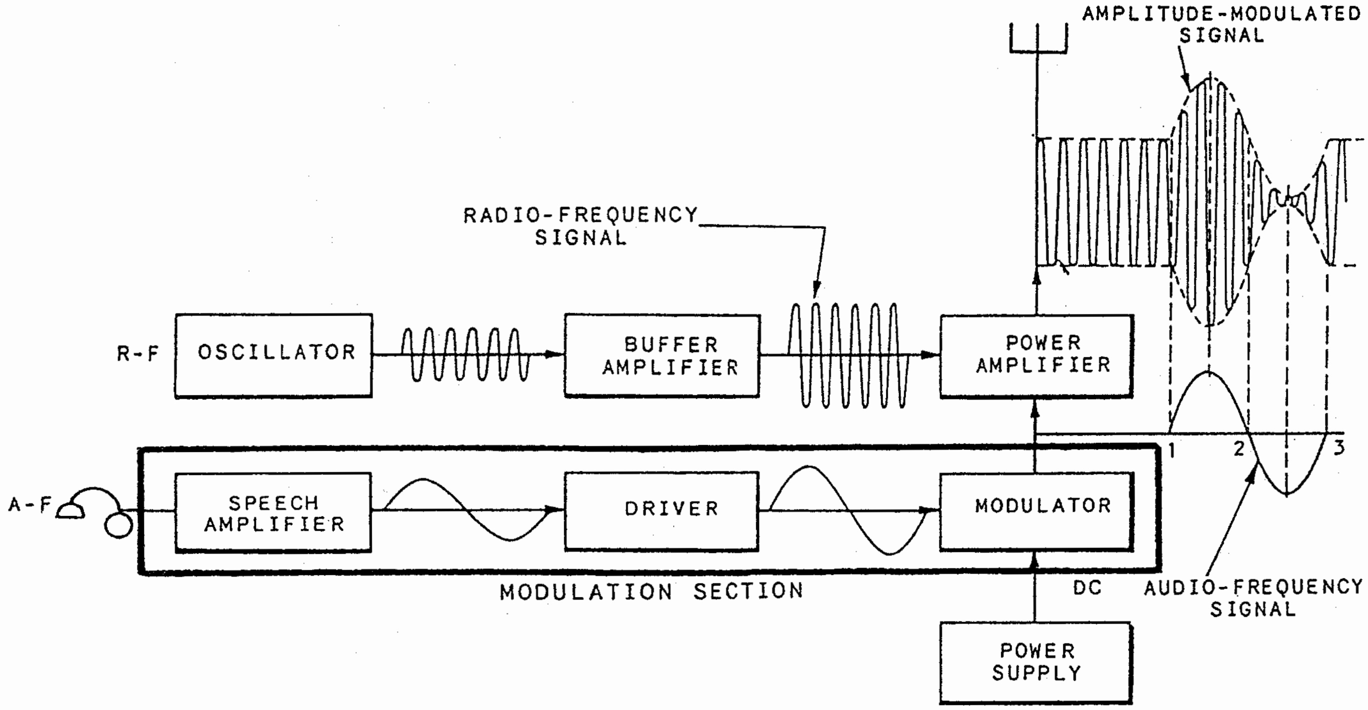


Figure 2-1.—Typical AM radiotelephone transmitter.

The antenna radiates the modulated RF signal in the form of electromagnetic waves. These waves are then used as inputs to the receiver.

RECEIVER FUNCTIONS

An AM receiver processes amplitude-modulated signals received by its antenna and delivers, as an output, a reproduction of the original signal that modulated the RF carrier at the transmitter. The signal can then be applied to some reproducing device, such as a loudspeaker, or to a terminal device, such as a teleprinter. Actual AM receivers vary widely in complexity. Some are very simple; others are quite complex and contain a relatively large number of circuits.

A receiver must perform certain basic functions to be useful. These functions, in order of their performance, are reception, selection, detection, audio-frequency amplification, and reproduction. These terms are more fully explained below.

Reception—The ability of a transmitted electromagnetic wave to pass across the receiver antenna in such a manner as to induce a voltage in the antenna circuits.

Selection—The ability of a receiver to select a particular frequency from all the transmitted signals that happen to be induced in the receiver's antenna at a given time.

Detection—The action of separating the low-frequency intelligence from the high-frequency carrier.

Amplification—The action of increasing (amplifying) low-frequency intelligence to the level required for the operation of the reproducer. "Amplitude" is the term used to describe the size of a signal.

Reproduction—The action of converting electrical signals to sound waves, such as speech or music, so they can be interpreted by the ear.

RECEIVER CHARACTERISTICS

In addition to performing the basic functions just discussed, a receiver must possess four characteristics: sensitivity, selectivity, fidelity, and the ability to reject noise. These terms are more fully explained below.

Sensitivity—The ability of a receiver to reproduce a weak signal. In other words, the weaker a signal that can be applied to a receiver and still achieve the same value of signal output, the better the receiver sensitivity rating.

Selectivity—The ability of a receiver to select and reproduce a desired signal from among several closely spaced stations or from among interfering frequencies. The better a receiver is at differentiating between desired and undesired signals, the better the receiver selectivity rating.

Fidelity—The measure of how well a receiver is able to reproduce the original intelligence signal.

Noise—Sounds created by the various stages in the receiver, antenna, and external sources that generate electrical discharges, such as lightning. Noise generated in the front end of the receiver is amplified in the other stages.

SUPERHETERODYNE RECEIVER

The superheterodyne receiver is the type of receiver with which you are most familiar. The AM/FM radio you use at home is most likely a superheterodyne receiver. We will discuss the basic workings of both AM and FM receivers and their differences.

To help you understand the operation of the superheterodyne receiver, we need to define "heterodyning." We could substitute the word "mixing" for heterodyning and it would mean almost the same thing. The principle or process of combining two or more frequencies is called mixing, modulating, beating, frequency conversion, or heterodyning.

In a superheterodyne receiver, amplifiers preceding the detector stage are tuned to the intermediate frequency (IF). The principle of frequency conversion by heterodyne action is used to convert all frequencies throughout the receiver range to the IF. Because of frequency conversion, the superheterodyne receiver has superior selectivity and sensitivity characteristics.

AMPLITUDE-MODULATED RECEIVER

Figure 2-2 is a basic block diagram of a typical AM superheterodyne receiver. The diagram shows the order in which a signal passes through the receiver. We can also see what the waveforms of the signal are like at the different stages.

When you tune a receiver, you are actually changing the frequency to which the RF amplifier is tuned. The RF signal received by the antenna passes first through an RF amplifier where the amplitude of the signal is increased. The amplified RF signal is then sent to the mixer. The mixer also receives an input from the local oscillator.

Through the process of heterodyning, these two signals are beat together to produce the IF. The IF signal contains all the intelligence or modulation of the original carrier signal. There is always a fixed difference in frequency between the local oscillator

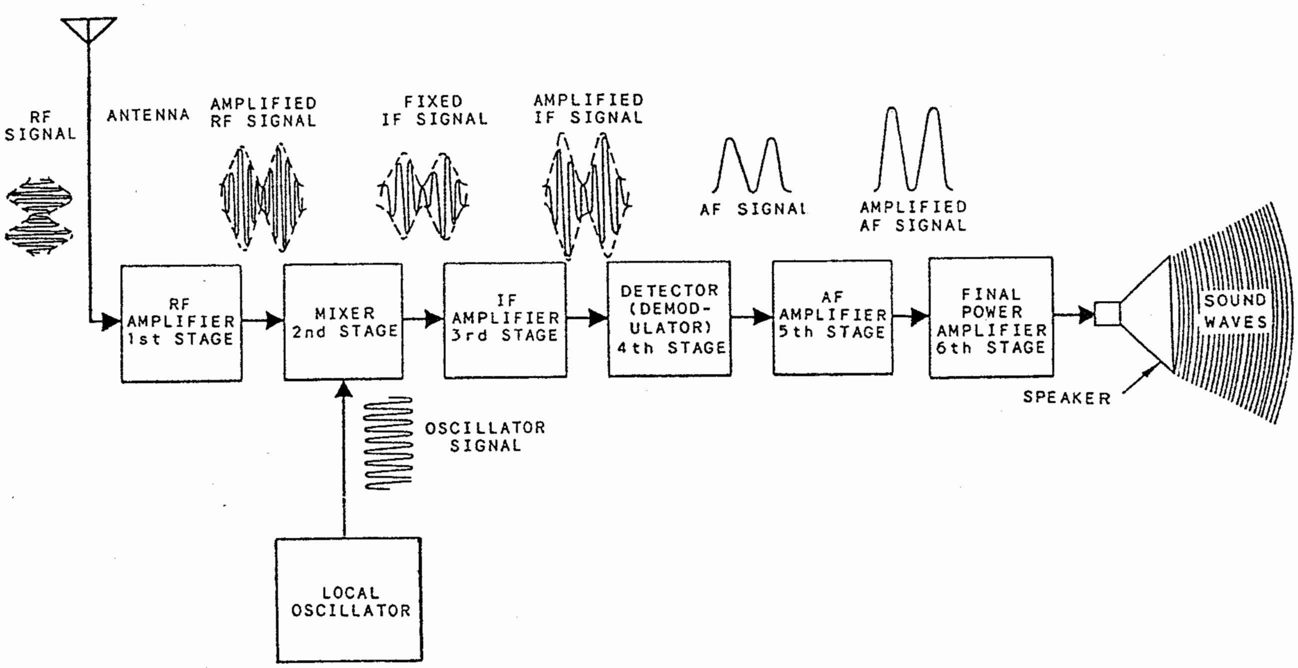


Figure 2-2.—AM superheterodyne receiver, showing signal waveshape.

and the RF amplifier. This fixed difference ensures a constant IF over the frequency range of the receiver.

The IF is then amplified in one or more IF amplifiers and fed to a detector. The detector demodulates the signal (recovers the audio). The output of the detector is the audio component of the input signal. This audio component is then passed through an audio-frequency amplifier. The amplified audio component is sent to a speaker for reproduction, allowing you to hear the signal.

A superheterodyne receiver may have more than one frequency-converting stage and as many amplifiers as needed to obtain the desired power output.

Antenna Section

As you can see in figure 2-2, the antenna section precedes the first RF amplifier. All of the signal processing starts here. The electromagnetic waves propagated from transmitting antennas cut across the receiving antenna and induce very small ac voltages in the antenna. These small voltages are fed to the antenna circuits located at the input of the receiver itself.

Frequency-selection circuits are part of the input antenna circuits located at the input of the receiver. These circuits determine the signal frequency that will be passed on to the RF amplifier circuits to be processed and used.

There are literally millions of different signals present in the atmosphere at any one time. Many of them pass across the receiving antennas at the same time. If it weren't for the frequency-selection circuits located at the input of the receiver, all we would hear on the receiver would be static and a multitude of stations "piled" on top of one another.

The frequency that you select at the front panel of your receiver normally determines the frequency that the selection circuits will allow to pass on to the rest of the circuits for processing.

The transmitted AM signal is actually composed of three distinct frequencies: the carrier frequency and two (upper and lower) sideband frequencies. The separation between the maximum limits of the upper and lower sideband frequencies constitutes the bandwidth of the transmitted signal, while the separation between either sideband and the carrier is equal to the intelligence frequency. To perform its function properly, the frequency-selection circuit must pass both sidebands.

RF Amplifier

Electromagnetic waves sometimes travel long distances before reaching an antenna. These waves are usually weak when the antenna receives them. The function of the RF amplifier (first stage) is to amplify these weak signal voltages. The RF amplifier not only amplifies the received signal but also increases the gain and selectivity of the receiver. A superheterodyne receiver can have more than one RF amplifier to obtain greater sensitivity.

The RF amplifier stage, also called the preselector because it has its own tuning control, is also important in improving the signal-to-noise ratio (SNR) of a receiver. A poor RF amplifier will cause the equipment to respond only to large input signals. Conversely, a good RF amplifier will bring in weak signals above the self-generated receiver noise, permitting reception that would otherwise be impossible.

Self-generated noise is a result of the operation of the various components that make up each circuit within each stage of the receiver. For example, the mixer is a very noisy stage because of the heterodyning taking place within it.

The RF amplifier also isolates the local oscillator from the antenna ground system. If the antenna were connected directly to the mixer stage, part of the local oscillator frequency would be radiated into space.

During periods of radio silence, such radiations could jeopardize ship movements since this signal could enable potential enemies to track the ship via sensitive direction-finding equipment. For this reason and others, Navy superheterodyne receivers are normally provided with at least one RF amplifier stage.

The **selectivity** of the superheterodyne receiver is a measure of its ability to reject unwanted frequencies and pass on the desired frequency. The tuned frequency-selection circuits permit selection of the desired station frequency from among the many present at the antenna. This reduces the reception of **images**. An image is the reception of an unwanted frequency on a selected frequency setting.

The **sensitivity** of the superheterodyne receiver is a measure of its ability to amplify weak signals. The better the sensitivity, the more responsive the receiver is to weak signals. Naturally, this is accomplished primarily in the RF amplifier stage.

The sensitivity of a receiver can be increased by increasing the number of RF amplifiers. We can increase not only sensitivity but also selectivity (to some degree) by increasing the number of RF amplifier stages. Tuned circuits within each RF amplifier stage make these increases possible. These tuned circuits tend to reject unwanted frequencies at each RF amplifier stage. By the time the signal is processed through, say, five stages of RF amplification, most unwanted signals will have been rejected.

The RF amplifier sends an amplified output to the mixer stage for conversion to the intermediate frequency of the receiver.

Mixer and Local Oscillator

The mixer stage and the oscillator stage combine to form the frequency converter. The purpose of a frequency converter is to convert the incoming signals to the intermediate frequency (IF). The mixer is also referred to as a "converter" and sometimes as the "first detector." The input to the mixer consists of two signals: the modulated RF signal coming from the RF amplifier stages and the unmodulated local oscillator signal.

The local oscillator generates an unmodulated RF signal of constant amplitude. This signal is mixed (heterodyned) with the carrier frequency in the mixer stage, producing a fixed IF signal.

In most superheterodyne receivers, the IF frequency is 455 kHz. This is the frequency that the IF circuits are tuned to accept. Therefore, the output of the mixer stage must be 455 kHz to further process the signal properly. The 455 kHz is a result of the mixing action (heterodyning) of the RF frequency being fed in from the RF amplifier and the frequency of the local oscillator.

As a result of this heterodyning, the output of the mixer contains the following four major frequencies:

- The two original signal frequencies;
- The local oscillator frequency;
- The **sum** of the signal frequency and local oscillator frequency; and
- The **difference** of the signal frequency and local oscillator frequency.

Only the difference (or IF frequency) is used from the frequencies present in the output of the mixer stage.

Because the amplitude of the IF leaving the mixer is comparatively weak, it is amplified in one or more IF amplifiers before being fed to the detector stage for recovery of the audio signal.

IF Amplifier

In many ways, the operation of the IF amplifier is similar to that of the RF amplifier. The input signal received from the mixer stage is an amplitude-modulated wave at a frequency lower than the received station signal. The IF amplifier stage produces an amplified reproduction of the mixer output signal (a band of frequencies centered around the IF) and applies it to the detector stage.

Unlike the RF-tuned circuits (whose frequency is tunable over a wide range), the tuned circuits used in IF amplifiers are fixed at a definite resonant frequency. Since they operate at a fixed band of frequencies, IF amplifiers are designed to provide optimum gain and bandwidth characteristics. Almost all the voltage gain and selectivity of the superheterodyne receiver are developed in the IF amplifier.

Superheterodyne receivers use one or more IF amplifiers, depending on design and quality of the receiver. The IF circuits are permanently tuned to the difference frequency between the RF signal and the local oscillator.

As we mentioned earlier, all incoming signals are converted to the same frequency by the mixer, and the IF amplifier operates at only one frequency. The tuned circuits, therefore, are permanently adjusted for maximum signal gain consistent with the desired bandpass and frequency response. Practically all the selectivity of a superheterodyne receiver is determined by the IF stages of amplification, aided by the selectivity already provided by the RF amplifiers.

An additional function of the IF amplifier is to preserve all the original modulating intelligence contained in the carrier. At this stage of signal processing, all the amplitude-modulated intelligence is still contained in the 455-kHz IF signal. All we have done is amplify this signal. The output of the final IF amplifier is fed to the detector or demodulator.

Detector

The detector is considered the heart of the receiver because it separates the audio from the RF carrier. Standing alone, the detector can be considered as a simple receiver. **Detection,** also called **demodulation,** is the process of recreating original modulating frequencies (intelligence) from radio frequencies present in the IF signal.

This same process is carried out in the detector stage of a superheterodyne receiver. This detector is sometimes referred to as the "second detector" because, as we mentioned earlier, the frequency converter or mixer is sometimes called the first detector. The modulated IF of 455 kHz, which has been amplified, is demodulated. All that is left, once the signal is processed through this stage, is the intelligence.

Referring to figure 2-2, you can see that the signal has been reduced to the original modulation as received by the transmitter and is now varying at an audio-frequency (AF) rate. These are the original amplitude modulations created by the voice of the person who originally spoke into the handset at the transmitter. Since this AF is a very small signal, it must be amplified before it can be heard and used.

AF Amplifier

The AF amplifier stage does just as its name implies: It amplifies the audio frequency received from the detector stage. The AF stage is the final stage of the superheterodyne receiver.

From the AF amplifier, the signal goes to the **power amplifier**. Most power amplifiers are used as the final amplifier and control (or drive) the output device. The output device can be speakers, headphones, converters, and so forth. Whatever the device, the power to drive it comes from the final stage of amplification, which is the power amplifier.

FREQUENCY-MODULATED RECEIVER

The function of a frequency-modulated (FM) receiver is the same as that of an amplitude-modulated (AM) superheterodyne receiver. You will find some important differences in component construction and circuit design caused by differences in the modulating technique. Figure 2-3 is a block diagram showing waveforms of a typical FM superheterodyne receiver.

If you compare the block diagrams in figures 2-2 and 2-3, you can see that, in both AM and FM receivers, the amplitude of the incoming signal is increased in the RF stages. The mixer combines the incoming RF with the local oscillator signal to produce the intermediate frequency. This signal is then amplified by one or more IF amplifier stages. Notice also that the FM receiver has a wideband IF amplifier.

The bandwidth for any type of modulation must be wide enough to receive and pass all the side-frequency components of the modulated signal without distortion. The IF amplifier in an FM receiver must have a broader bandpass than an AM receiver.

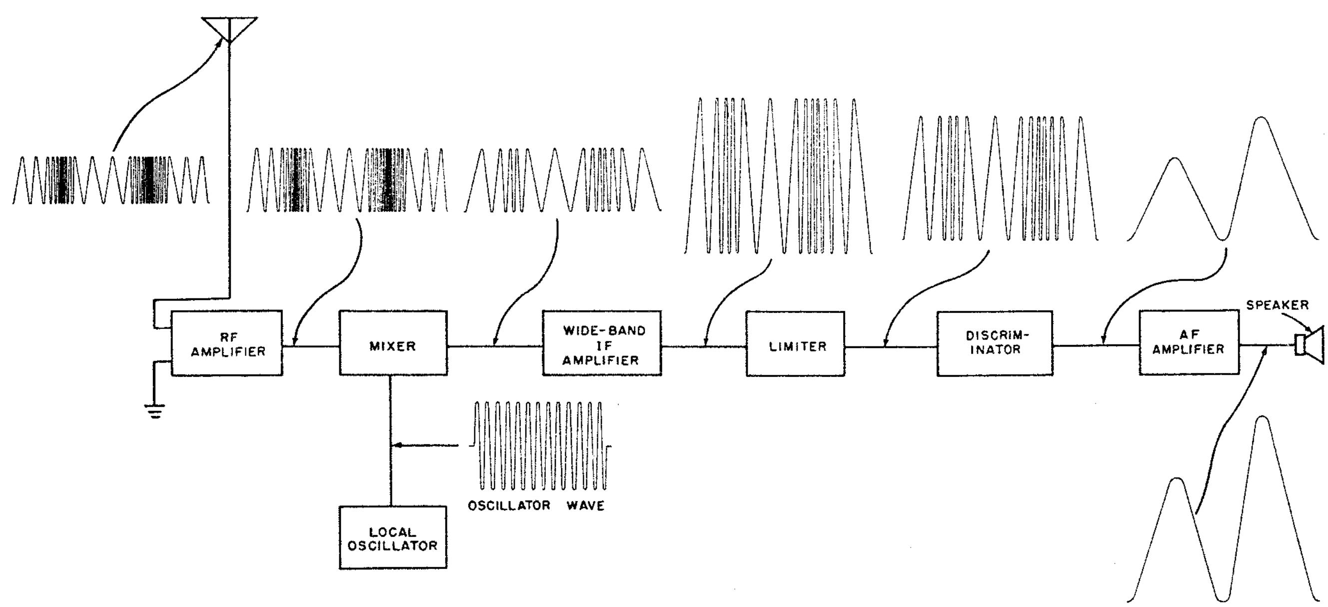


Figure 2-3.—Block diagram of an FM receiver and waveforms.

The sidebands created by FM differ from sidebands created by AM. An AM signal consists of a single set of side frequencies for each RF signal modulated. An FM signal inherently occupies a wider bandwidth than AM because the number of extra sidebands that occur in an FM transmission is directly related to the amplitude and frequency of the audio signal.

There are only two fundamental sections of the FM receiver that are electrically different from the AM receiver. These are the discriminator (detector) and the limiter.

Beyond the IF amplifier stage, the two receivers are markedly different. AM demodulation involves the detection of variations in the amplitude of the signal; FM demodulation is the process of detecting variations in the frequency of the signal.

In FM receivers, a **discriminator** is a circuit designed to respond to frequency-shift variations. A discriminator is preceded by a **limiter** circuit, which limits all signals to the same amplitude level to minimize noise interference. The audio-frequency component is then extracted by the discriminator, amplified in the AF amplifier, and used to drive the speaker.

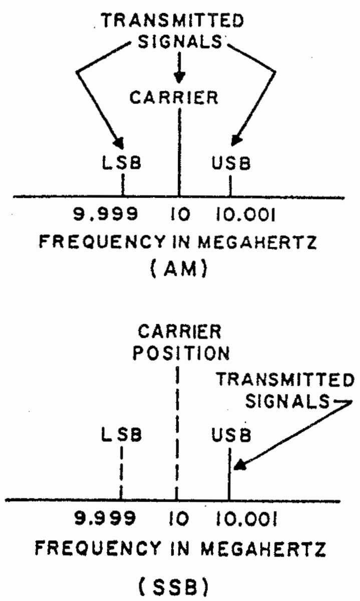


Figure 2-4.—Comparison of AM and SSB transmitted signals.

SINGLE-SIDEBAND RECEIVER

You know from studying the single-sideband (SSB) transmitter in chapter 1 that you can transmit only one sideband of an AM signal and retain the information transmitted. Now, you will see how a single-sideband signal is received.

Figure 2-4 shows the transmitted signal for both AM and SSB. SSB communications have several advantages over AM signals. When you eliminate the carrier and one sideband, all the transmitted power is concentrated in the other sideband. An SSB signal also occupies a smaller portion of the frequency spectrum than an AM signal. This provides two advantages: narrower receiver bandpass and the ability to place more signals in a given portion of the frequency spectrum.

Despite the advantages, SSB communication systems have some drawbacks. The process of producing an SSB signal is somewhat more complicated than simple amplitude modulation, and frequency stability is much more critical in SSB communications.

With SSB communications, we don't have the interference of heterodyning from adjacent signals. However, a weak SSB signal is sometimes completely masked or hidden from the receiving station by a stronger signal. Another disadvantage is that a carrier of proper frequency and amplitude must be reinserted at the receiver because of the direct relationship between the carrier and sidebands.

Figure 2-5 shows a diagram of a basic SSB receiver. It is not significantly different from a

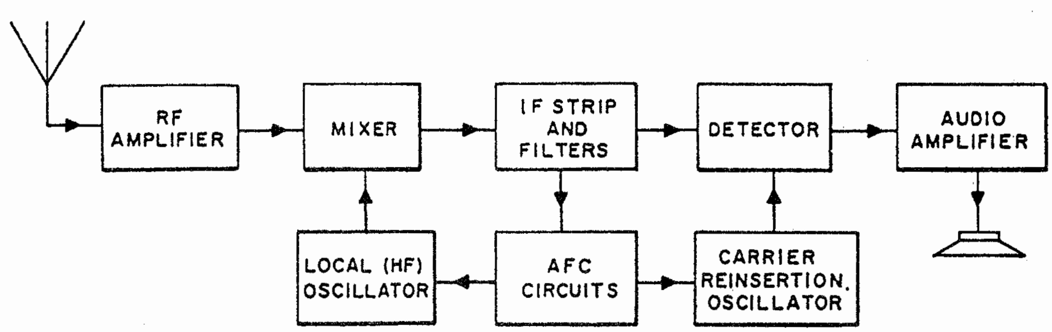


Figure 2-5.—Basic SSB receiver.

conventional superheterodyne AM receiver. However, a special detector and carrier reinsertion oscillator must furnish a carrier to the detector circuit that corresponds almost exactly to the carrier used in producing the original signal.

RF amplifier sections of SSB receivers serve several purposes. SSB signals exist in a narrow portion of the frequency spectrum. Therefore, filters are used to supply the selectivity necessary to adequately receive only one of the signals. These filters help you reject noise and other interference.

R-2368/URR RECEIVER

Figure 2-6 shows the Navy's newest receiver, the R-2368/URR. View A shows the receiver; view B shows the front panel. The R-2368/URR is a digital AM/FM receiver with programmable features for low-, medium-, and high-frequency communications. The R-2368/URR is capable of receiving in the upper sideband (USB), lower sideband (LSB), independent sideband (ISB), AM, FM, and CW modes.

The R-2368/URR has a unique frequency programming mode. It can have up to 100 frequencies programmed into it. The frequencies can be grouped into 9 groups with a maximum of 10 frequencies per group. A keypad is used to enter the frequencies and groups.

The frequency and channel being used, programmed, or scanned are displayed in the frequency display on the front panel. The SCAN mode allows the receiver to scan all programmed channels or a selected group of programmed channels automatically.

Because the R-2368/URR Receiver has improved capabilities, it has replaced older Navy receivers. One improvement is that frequencies are more stable (less drift). The receiver also generates less heat and is compact in size.

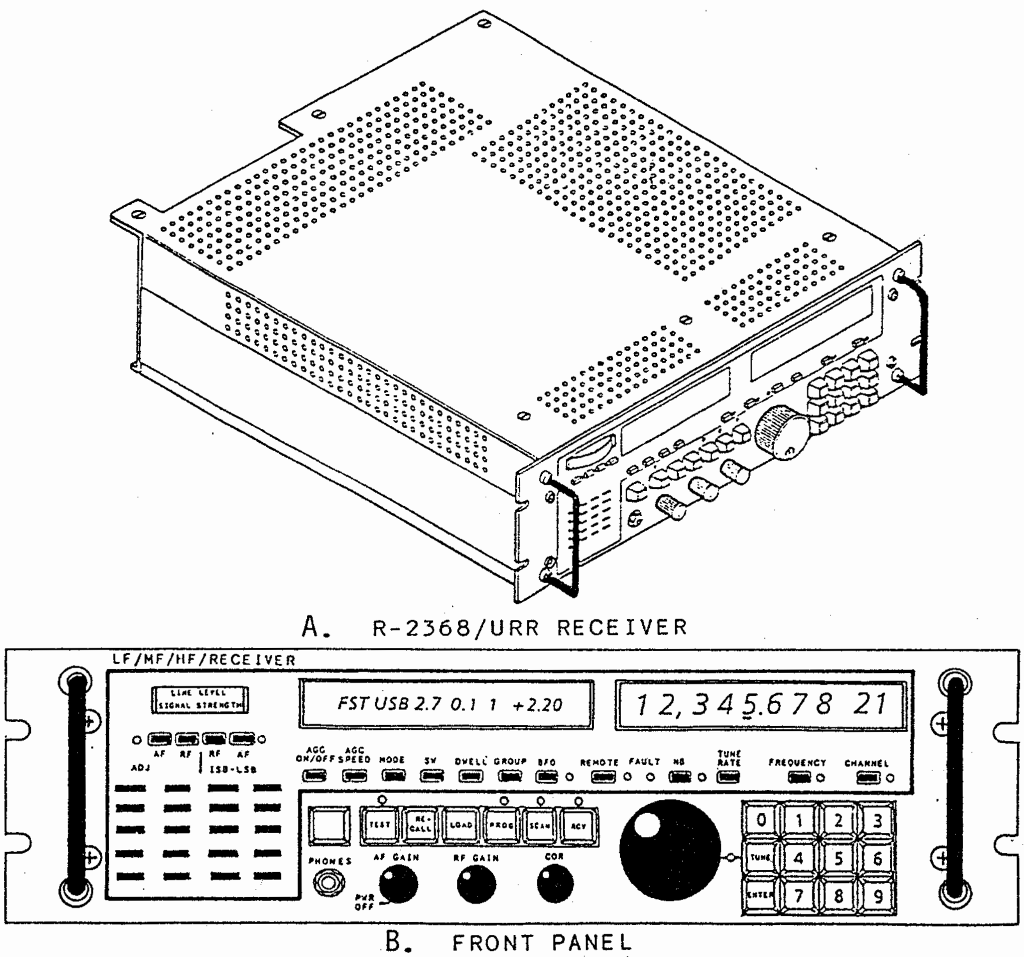


Figure 2-6.—R-2368/URR Receiver.

In the past, communications centers required different types of receivers to handle different frequency ranges, such as the WRR-3(B) for low frequencies, and the R-1051/URR for medium to high frequencies. The R-2368/URR has the capability of receiving in all of these ranges, thereby replacing two receivers.

Operator maintenance of the R-2368/URR is limited to scheduled cleaning, visual inspection, periodic initiating of the self-test routine, and performance-level checks. No special training or equipment is required for visual inspections or cleaning procedures.

The front panel should be checked at least once a day for fault condition displays to ensure that there is no internal circuitry failure. This procedure can be performed without the aid of any special equipment. The technical manual for the R-2368/URR explains how to set up and operate the receiver and provides details on the preventive maintenance required.

AN/SSR-1 SATELLITE RECEIVER SYSTEM

The AN/SSR-1 Satellite Receiver System is found on most naval surface vessels and has the ability to receive fleet satellite broadcast message traffic during both GAPFILLER and FLTSATCOM operations. These operations are discussed in more detail in chapter 11. The relationship of the units that compose the AN/SSR-1 Satellite Receiver System is illustrated in figure 2-7.

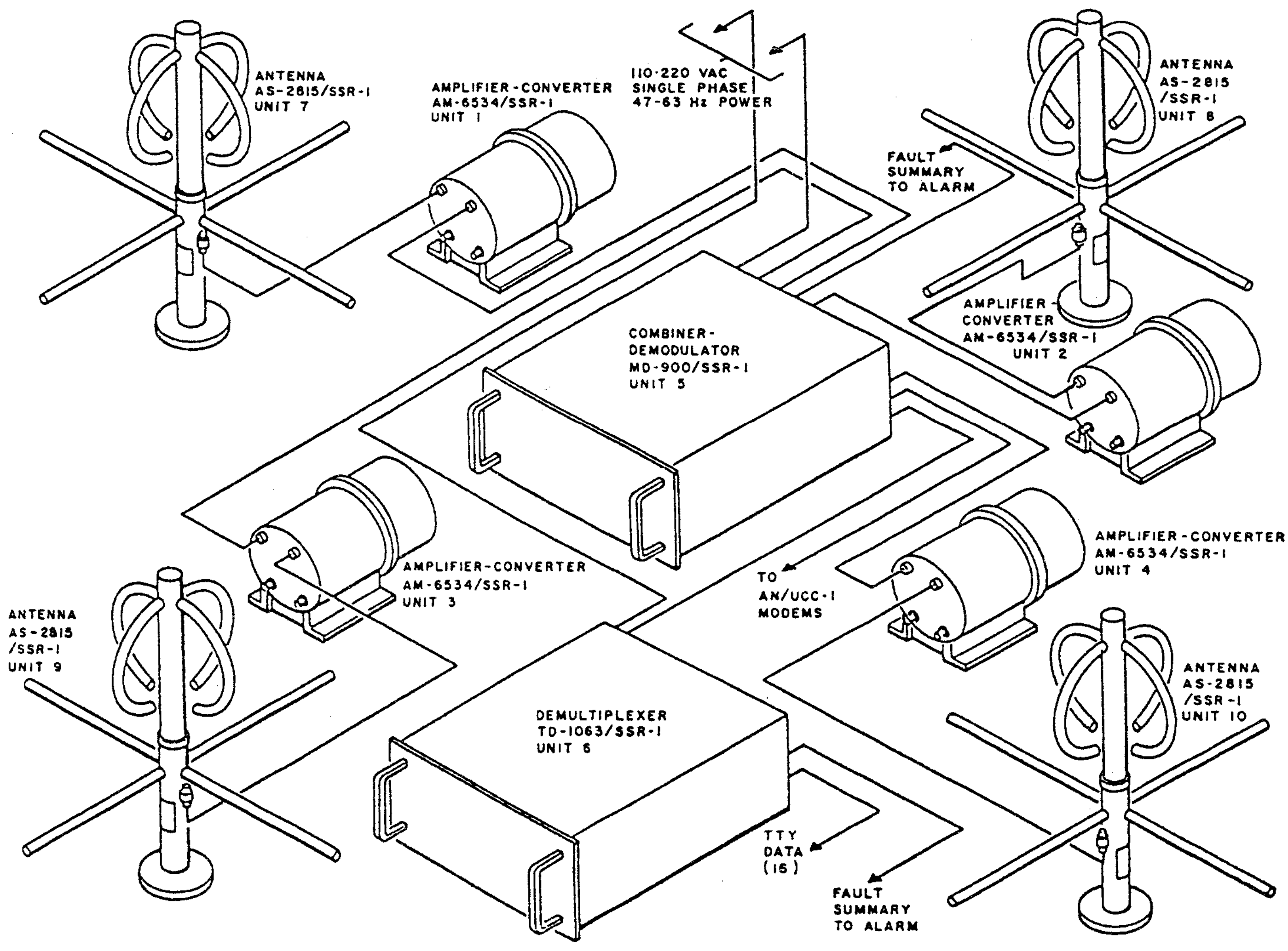


Figure 2-7.—AN/SSR-1 Satellite Receiver System.

A typical shipboard installation includes four AS-2815 Antennas, four AM-6534 Amplifier-Converters, one MD-900 Combiner-Demodulator, and one TD-1063 Demultiplexer. The antennas and antenna converters are mounted above deck so that at least one antenna is always in view of the satellite. The combiner-demodulator and demultiplexer are mounted below deck.

The receiver will accept RF transmissions between 240 and 340 MHz with an FM or PSK modulation. The modulation bandwidth is 25 kHz. The demultiplexer will accept an input of 1,200 bits per second (bps) and will output 15 channels at 75 bps.

The signal received at each antenna is amplified and converted to an intermediate frequency (IF) in its associated amplifier-converter. The output of each amplifier-converter is fed to the combiner-demodulator, which provides compensation for transmission path differences and differences in cable lengths between the combiner-demodulator and the four amplifier-converters. The combiner-demodulator then combines, amplifies, and demodulates the received IF signal.

The applicable demodulation mode is accomplished manually by a switch. Depending on the mode of broadcast operation, the demodulated signal is fed into the TD-1063 Demultiplexer, which performs bit and frame synchronization and demultiplexes the time-division multiplexing – phase-shift keying (TDM-PSK) signal.

SUMMARY

In this chapter, you have learned how a receiver converts a transmitted electromagnetic wave into a useful output through its various stages. You learned that all receivers must perform several basic functions to be useful: reception, selection, detection, amplification, and reproduction. You also learned that besides these basic functions, receivers must possess four characteristics: sensitivity, selectivity, fidelity, and the ability to filter noise.

The more you know about basic receiver theory, the better you will be able to recognize basic trouble symptoms and correct them before they become major problems.

RECOMMENDED READING LIST

NOTE

Although the following references were current when this TRAMAN was published, their continued currency cannot be assured. You therefore need to ensure that you are studying the latest revisions.

Some of the following references were originated by the Naval Education and Training Program Development Center (NETPDC), Pensacola, Fla. Effective 1 September 1986, the title NETPDC was officially changed to Naval Education and Training Program Management Support Activity (NETPMSA), Pensacola, Fla.

Navy Electricity and Electronics Training Series, Module 8, *Introduction to Amplifiers*, NAVEDTRA 172-08-00-82, Naval Education and Training Program Development Center (NETPDC), Pensacola, Fla., 1982.

Navy Electricity and Electronics Training Series, Module 12, *Modulation Principles*, NAVEDTRA 172-12-00-83, NETPDC, Pensacola, Fla., 1983.

Navy Electricity and Electronics Training Series, Module 17, *Radio-Frequency Communications Principles*, NAVEDTRA 172-17-00-84, NETPDC, Pensacola, Fla., 1984.

Technical Manual Operation and Maintenance Instructions with Parts List, Receiver R-2368/URR, EE125-FC-OMI-010/R-2368/URR, Space and Naval Warfare Systems Command, Washington, D.C., 25 May 1989.

CHAPTER 3
ANTENNA THEORY

CHAPTER LEARNING OBJECTIVES

Upon completing this chapter, you should be able to do the following:

- *Recall common terms and definitions associated with antenna theory.*
- *Discuss basic antenna circuits.*
- *Describe antenna characteristics.*
- *Explain antenna tuning procedures.*
- *Define electromagnetic wavelength.*
- *Discuss the two basic types of antennas used in naval communications.*
- *Identify the various types of shipboard antennas.*
- *Explain antenna distribution systems.*

The operation of communications equipment over the entire range of the radio-frequency (RF) spectrum requires many types of antennas. Whether you are stationed aboard a ship or at a communications center ashore, you need to know the basic types of antennas available to you operationally. Your operational training will give you the knowledge necessary to properly use the antennas at your disposal. However, your operational training will not give you the **why's** of antennas; in other words, basic antenna theory.

Besides antenna theory, this chapter will introduce you to some of the various types of antennas used in naval communications today. Before we begin our discussion, we need to review some basic terms and definitions used in association with antenna theory.

TERMS AND DEFINITIONS

An understanding of the following terms and definitions will help you in your study of basic antenna theory:

Antenna—A device used to radiate or receive radio waves.

Antenna Coupler—A device used for impedance matching (tuning) between an antenna and a transmitter or receiver.

Antenna Tuning—The process where an antenna is electrically "matched" to the output frequency and impedance of the transmitter.

Bidirectional Antenna—An antenna that radiates in or receives most of its energy from only two directions.

Directional Antenna—An antenna that radiates or receives radio waves more effectively in some directions than in others.

Dummy Load (Antenna)—A nonradiating device used at the end of a transmission line in place of an antenna for tuning a transmitter. The dummy load converts transmitted energy into heat so that no energy is radiated outward or reflected back.

Electric (E) Field—One of the fields produced as a result of an electric voltage charge on a conductor or antenna.

Electromagnetic Energy—An RF source composed of both an electric and a magnetic field.

Feed Point—The point on an antenna where the RF cable carrying the signal from the transmitter connects to the antenna.

Ground-Plane Antenna—A type of antenna that uses a ground plane (a metallic surface) as a simulated ground to produce low-angle radiation.

Half-Wave Dipole Antenna—A common type of half-wave antenna made from a straight piece of wire cut in half. Each half operates at a quarter of the wavelength. Normally omnidirectional with no gain.

Hertz Antenna—An ungrounded half-wave antenna that is installed some distance above ground and positioned either vertically or horizontally.

Impedance—The total opposition to the flow of an alternating current.

Incident Wave—An electromagnetic wave that travels from the transmitter to the antenna.

Induction Field—The electromagnetic field that is produced around an antenna when current and voltage are present on the antenna.

Magnetic (H) Field—One of the fields produced when voltage flows through a conductor or an antenna.

Marconi Antenna—A quarter-wave antenna that is operated with one end grounded and is positioned perpendicular to the Earth.

Omnidirectional Antenna—An antenna that radiates or receives equally well in all directions (except directly off the ends).

Polarization—The plane (horizontal or vertical) of the electric field radiating from a transmitting antenna.

Radiation Field—The electromagnetic field that radiates from an antenna and travels through space.

Reflected Wave—An electromagnetic wave that travels back toward the transmitter from the antenna because of a mismatch in impedance between the two.

Standing Wave Ratio (SWR)—The ratio of maximum and minimum amplitudes of voltage or current along a transmission line at a given frequency.

Transmission Line—A device designed to guide electrical or electromagnetic energy from one point to another.

Unidirectional Antenna—An antenna that radiates in only one direction.

Wavelength—The distance traveled in feet or meters by a radio wave in one cycle.

We will introduce additional terminology when we discuss the characteristics of antennas.

BASIC ANTENNA CIRCUITS

Figure 3-1 shows a basic transmitting and receiving circuit. The antenna plays an essential part in the propagation and reception of electromagnetic energy and the intelligence that it conveys.

From your study of chapter 1, you learned that the transmitter is an electronic device that generates electrical energy in the form of RF signals. As you can see in figure 3-1, the transmitter modulates the RF signal with the information signal. The modulated signal travels through the antenna coupling coil, which connects the transmitter to the transmission line. The energy continues through the transmission line to the antenna and is then radiated into space as an electromagnetic wave.

The receiving circuit simply reverses the process. The receiving antenna intercepts the electromagnetic energy and converts it into electrical energy. The energy then travels through the transmission line to the input circuits of the receiver where the RF information is recovered.

Before going further, let's discuss the composition of radiated electromagnetic energy. Radiated electromagnetic fields are considered to be waves. A wave is called **electromagnetic** because it is composed of both an electric and a magnetic field. An electric current passing through the antenna produces a magnetic field, and a electric charge on the antenna produces an electric field. Together, both fields form the electromagnetic field. This field is the reason electromagnetic energy can be transmitted and/or received through free space.

The vertical or horizontal direction of an electric field determines the polarization of the wave. (We will discuss wave polarization later in this chapter.) In a vertically polarized wave, the electric force lines are aligned vertically. A horizontally polarized wave has horizontal lines of force. Circular polarization has electric force lines rotating through 360° with every cycle of RF energy. Polarization is important because it determines the type and position of an antenna used in a system. Some antennas are designed to receive vertical waves; others, horizontal waves.

There are two basic fields associated with every antenna: induction and radiation. The induction field is considered a local field and plays no part in the transmission of electromagnetic energy through free space. However, without its presence, no energy would be radiated. The radiation field is responsible for the electromagnetic radiation from the antenna. This field decreases as the distance from the antenna increases.

A radiated electromagnetic wave travels through free space at the speed of light, which is 186,000 miles

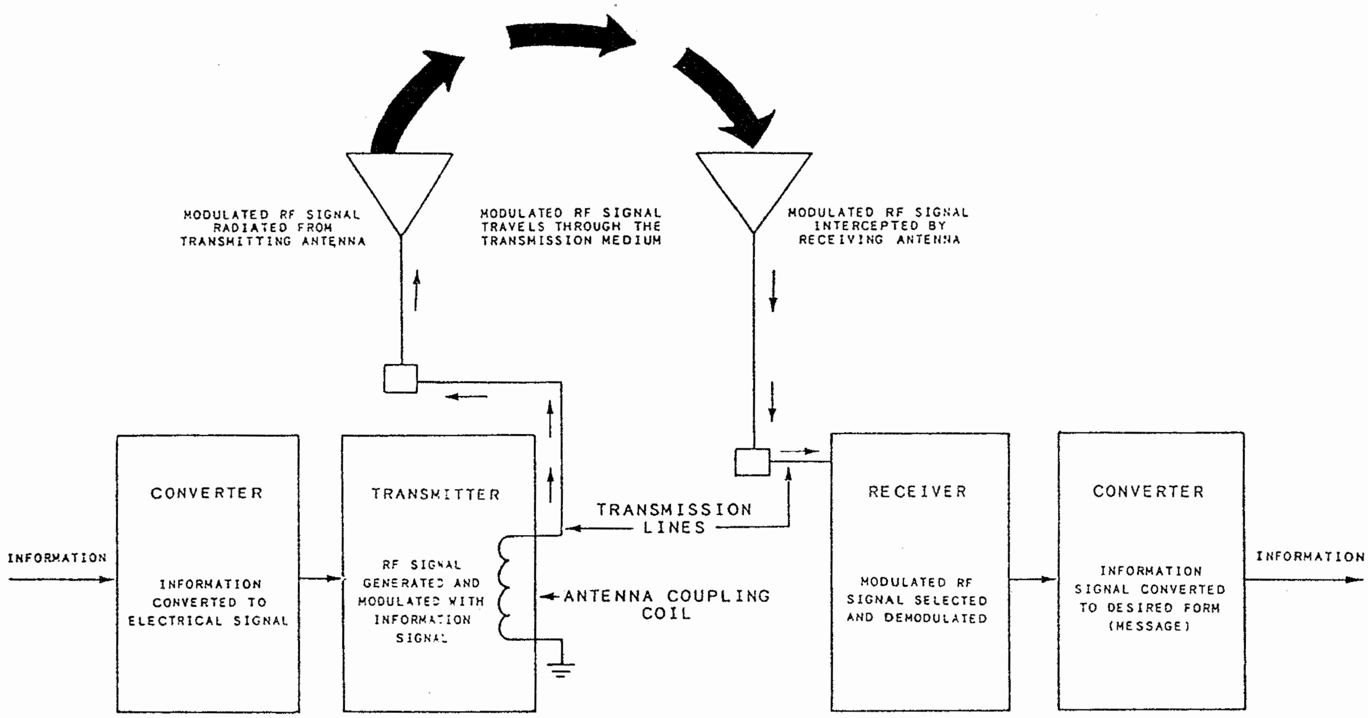


Figure 3-1.—Functions of the basic components of a radio communications system.

per second. The total energy in the radiated wave remains constant in space. However, as the wave advances, the energy spreads out over a greater area and, at any given point, decreases as the distance traveled increases.

ANTENNA CHARACTERISTICS

As you will learn in this section, all antennas exhibit common characteristics. The study of antennas involves the following terms with which you must become familiar:

ANTENNA RECIPROCITY

The ability of an antenna to both transmit and receive electromagnetic energy is known as its **reciprocity**. Antenna reciprocity is possible because antenna characteristics are essentially the same for sending and receiving electromagnetic energy.

Even though an antenna can be used to transmit or receive, it cannot be used for both functions at the same time. The antenna must be connected to either a transmitter or a receiver.

ANTENNA FEED POINT

Feed point is the point on an antenna where the RF cable is attached. If the RF transmission line is attached to the base of an antenna, the antenna is **end-fed**. If the RF transmission line is connected at the center of an antenna, the antenna is **mid-fed** or **center-fed**.

DIRECTIVITY

The **directivity** of an antenna refers to the width of the radiation beam pattern. A directional antenna concentrates its radiation in a relatively narrow beam. If the beam is narrow in either the horizontal or vertical plane, the antenna will have a high degree of directivity in that plane. An antenna can be highly directive in one plane only or in both planes, depending upon its use.

In general, we use three terms to describe the type of directional qualities associated with an antenna: **omnidirectional, bidirectional,** and **unidirectional.** As we mentioned earlier, omnidirectional antennas radiate and receive equally well in all directions, except off the ends. Bidirectional antennas radiate or receive efficiently in only two directions. Unidirectional antennas radiate or receive efficiently in only one direction.

Most antennas used in naval communications are either omnidirectional or unidirectional. Bidirectional antennas are rarely used. Omnidirectional antennas are used to transmit fleet broadcasts and are used aboard ship for medium-to-high frequencies. A parabolic, or dish, antenna (figure 3-2) is an example of a unidirectional antenna. As you can see in the figure, an antenna (normally a half wave) is placed at the "focal" point and radiates the signal back into a large reflecting surface (the dish). The effect is to transmit a very narrow beam of energy that is essentially unidirectional. Figure 3-3 shows a large, unidirectional parabolic antenna. Directional antennas are commonly used at shore installations.

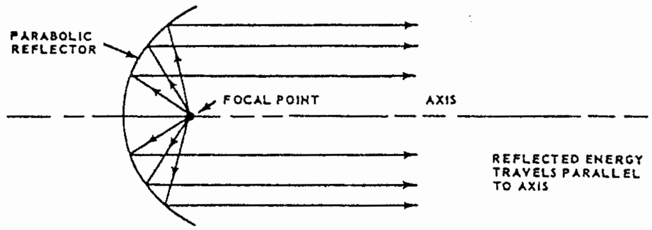


Figure 3-2.—Principle of parabolic reflection.

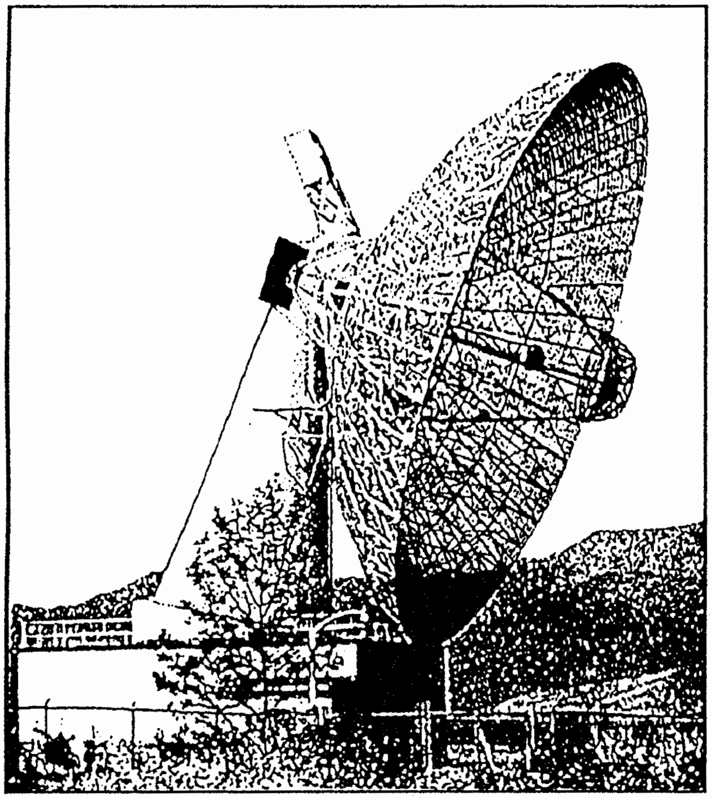


Figure 3-3.—Unidirectional parabolic antenna.

WAVE POLARIZATION

Polarization of a radio wave is a major consideration in the efficient transmission and reception of radio signals. If a single-wire antenna is used to extract energy from a passing radio wave, maximum signal pickup results when the antenna is placed physically in the same direction as the electric field component. For this reason, a vertical antenna is used to receive vertically polarized waves, and a horizontal antenna is used to receive horizontally polarized waves.

At lower frequencies, wave polarization remains fairly constant as it travels through space. At higher frequencies, the polarization usually varies, sometimes quite rapidly. This is because the wave front splits into several components, and these components follow different propagation paths. In Chapter 4, "Wave Propagation," we will discuss the various propagation paths.

When antennas are close to the ground, vertically polarized radio waves yield a stronger signal close to the Earth than do those that are horizontally polarized. When the transmitting and receiving antennas are at least one wavelength above the surface, the two types of polarization are approximately the same in field intensity near the surface of the Earth. When the transmitting antenna is several wavelengths above the surface, horizontally polarized waves result in a stronger signal close to the Earth than is possible with vertical polarization.

Most shipboard communication antennas are vertically polarized. This type of polarization allows the antenna configuration to be more easily accommodated in the limited space allocated to shipboard communications installations. Vertical antenna installations often make use of the topside structure to support the antenna elements. In some cases, to obtain the required impedance match between the antenna base terminal and transmission line, the structure acts as part of the antenna.

VHF and UHF antennas used for ship-to-aircraft communications use both vertical and circular polarization. Because aircraft maneuvers cause cross-polarization effects, circularly polarized shipboard antennas frequently offer considerable signal improvements over vertically polarized antennas.

Circularly polarized antennas are also used for ship-to-satellite communications because these antennas offer the same improvement as VHF/UHF ship-to-aircraft communications operations. Except for the higher altitudes, satellite antenna problems are similar to those experienced with aircraft antenna operations.

ANTENNA TUNING PROCEDURES

It is unrealistic for a ship to have a separate antenna for every frequency that a communications center is capable of radiating. To overcome this, we use a procedure called antenna tuning to electrically lengthen and shorten an antenna to better match the frequency we want to transmit.

OBJECTIVES OF ANTENNA TUNING

There are two objectives of antenna tuning: (1) to tune out the various impedances and (2) to match the length of the antenna to the frequency radiated at its characteristic impedance.

Impedance

Everything exhibits some impedance. Even a straight piece of copper wire 3 inches long will offer some resistance to current flow, however small. The characteristic impedance of this same piece of copper wire is its overall resistance to a signal.

The transmission line between an antenna and a transmitter has a certain amount of characteristic impedance. The antenna also has a certain amount of characteristic impedance. This basic mismatch in impedances between the transmitter and the antenna makes antenna tuning necessary. Naturally, as transmitters, transmission lines, and antennas become more complex, antenna tuning becomes more critical.

Antenna Length Adjustment

When we tune an antenna, we electrically (not physically) lengthen and shorten it. The radiation resistance varies as we vary the frequency of the transmitter and tune the antenna. The radiation resistance is never perfectly proportional to antenna length because of the effects of the antenna height above the ground and its location to nearby objects.

ANTENNA COUPLER

Figure 3-4 shows a diagram of a single-channel antenna coupler group with an antenna coupler, or tuning unit, and an antenna coupler control. The coupler is electrically connected to the antenna and is used to adjust the apparent length of the antenna by electrical means. This simply means that the antenna does not physically change length. The antenna is electrically adapted to the output frequency of the transmitter or receiver and only changes its electrical length.

The RF cable connects the transmitter or receiver to the antenna and carries the RF signal. The control cable connects the antenna coupler control to the antenna and carries the signals from the coupler unit that serve to tune the antenna. Once the antenna is properly tuned to the operating frequency, the antenna is said to be **resonant.** This means that the antenna is matched to the operating frequency.

The couplers may be located at either end, or both ends, of the transmission line. However, the most effective location is at the antenna. When the coupler is located at the antenna, a remote control

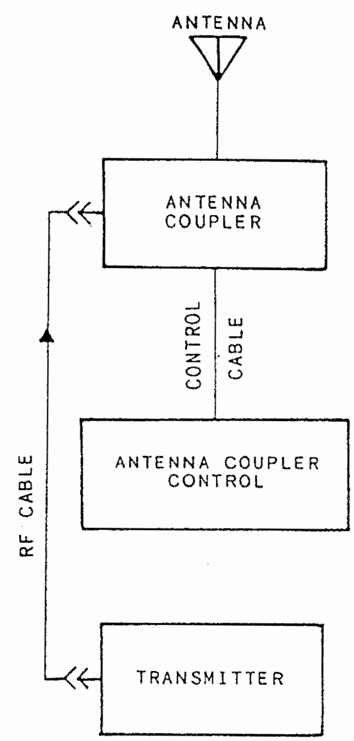


Figure 3-4.—Antenna coupler group.

is required. Figure 3-5 shows a whip antenna mounted on a tuner.

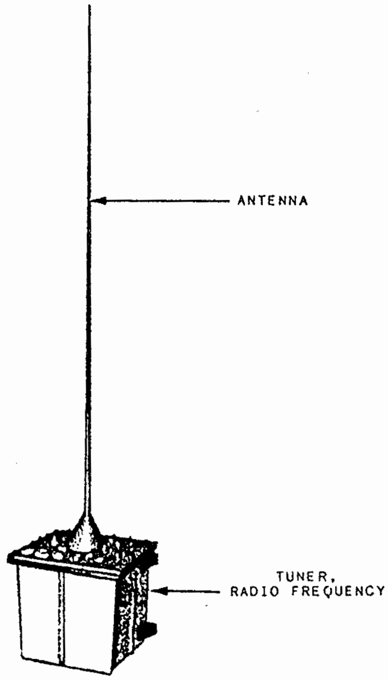


Figure 3-5.—Whip antenna mounted on a tuner.

MULTICOUPLERS

Multicouplers do the same thing as a single-channel antenna coupler. However, multicouplers are capable of coupling several transmitter and/or receiver combinations operating simultaneously into a common antenna. Multicouplers isolate the different channels and frequencies of the various transmitters and receivers. Figure 3-6 shows a block diagram of a multicoupler with transmitter and receiver combinations.

STANDING WAVE RATIO

Another term used in antenna tuning is standing wave ratio (SWR); also called voltage standing wave ratio (VSWR). We defined this term earlier in our list of terms, but a simpler definition could be the "relative degree of resonance" achieved with antenna tuning. When tuning an antenna, you must understand the SWR when expressed numerically.

You will hear SWR expressed numerically in nearly every tuning procedure. For example, you will hear such terms as "three-to-one" or "two-to-one." You will

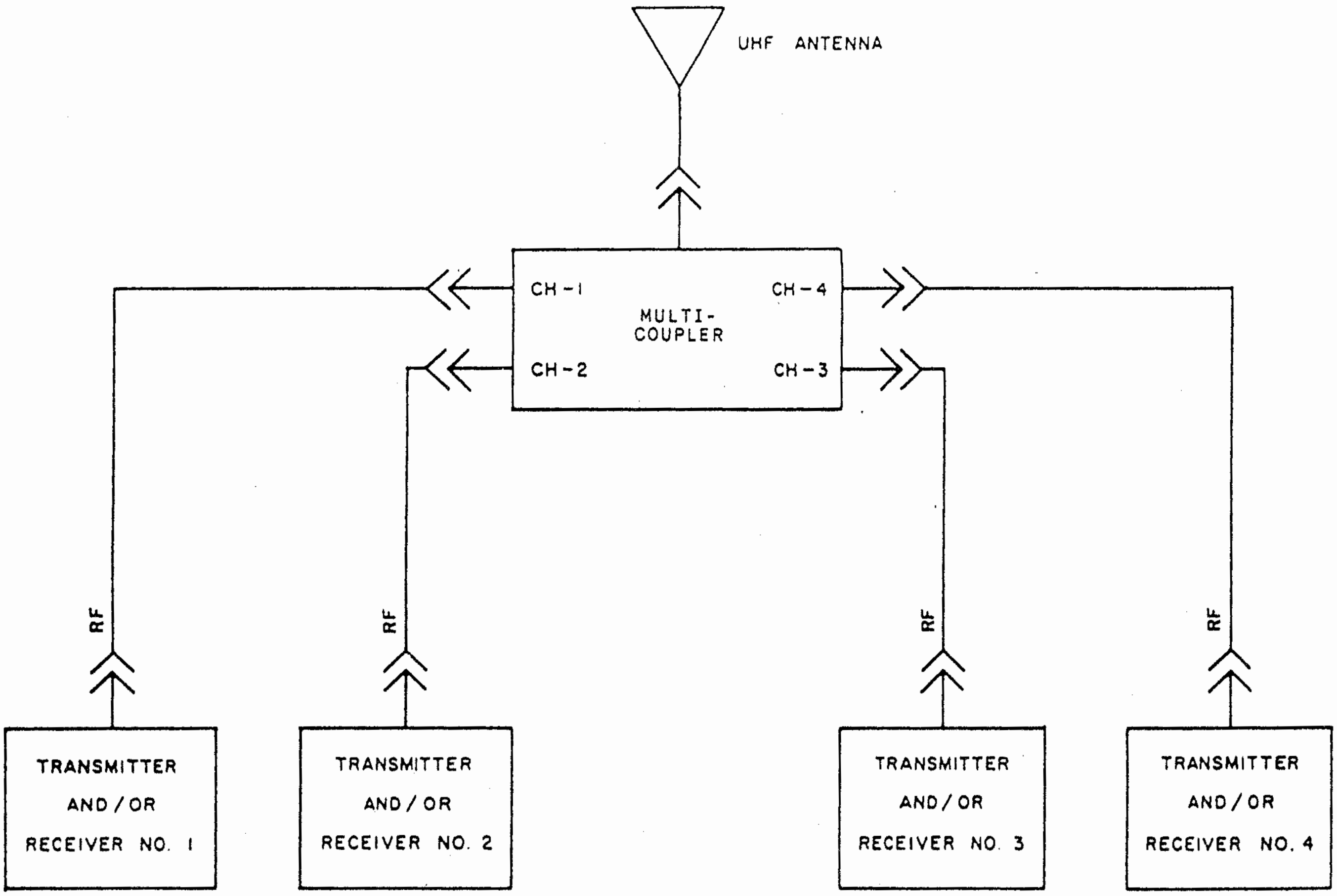


Figure 3-6.—Antenna multicoupler interconnection diagram.

see them written 3:1 SWR, 2:1 SWR, or 1:1 SWR. The **lower** the number ratio is, the **better** the match between the antenna and the transmitter for transmitting RF signals. For example, a 2:1 SWR is better than a 3:1 SWR.

As you approach resonance, you will notice that your SWR figure on the front panel meters will begin to drop to a lower numerical value. A good SWR is considered to be 3 or below, such as 3:1 or 2:1. Anything over 3, such as 4:1, 5:1, or 6:1 is unsatisfactory. The SWR becomes increasingly critical as transmitter output is increased. Where a 3:1 SWR is satisfactory with a 500-watt transmitter, a 2:1 SWR may be considered satisfactory with a 10-kilowatt transmitter.

Most antenna couplers have front panel meters that show a readout of the relative SWR achieved via antenna tuning. Figure 3-7 shows a multicoupler, consisting of four coupling units, with four SWR meters at the top (one for each coupler).

To achieve a perfect standing wave ratio of 1:1 would mean that we have succeeded in tuning out all other impedances and that the antenna is matched perfectly to the transmitted frequency. With such a low SWR, the antenna would now offer only its characteristic impedance. A 1:1 SWR is rarely achieved, of course. There will always be some power loss between the transmitter and the antenna because of natural impedances that exist between the two. Nevertheless, the objective is to achieve the lowest SWR possible. In other words, we want only the characteristic impedance of the antenna remaining.

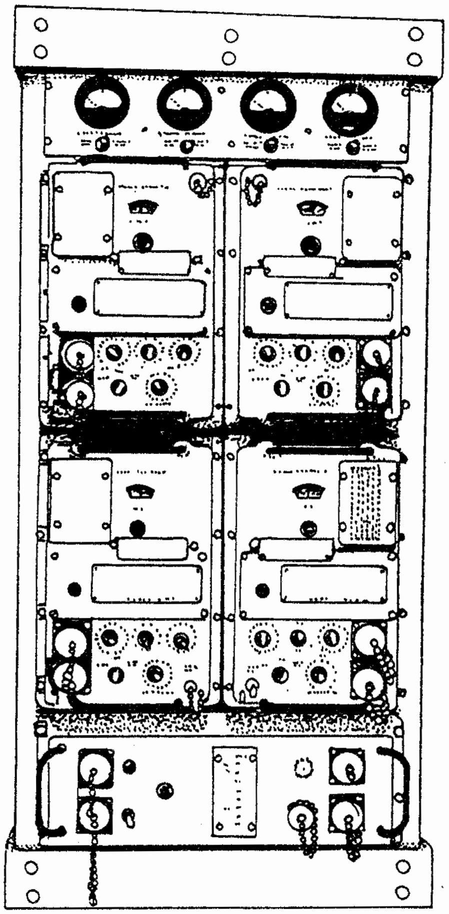


Figure 3-7.—AN/SRA-33 antenna multicoupler.

Incident Waves

Various factors in the antenna circuit affect the radiation of RF energy. When we energize or feed an antenna with an alternating current (ac) signal, waves of energy are created along the length of the antenna. These waves, which travel from a transmitter to the end of the antenna, are the incident waves.

Let's look at figure 3-8. If we feed an ac signal at point A, energy waves will travel along the antenna until they reach the end (point B). Since the B end is free, an open circuit exists and the waves cannot travel farther. This is the **point of high impedance**. The energy waves bounce back (reflect) from this point of high impedance and travel toward the feed point, where they are again reflected.

Reflected Waves

We call the energy reflected back to the feed point the **reflected waves**. The resistance of the wire gradually decreases the energy of the waves in this back-and-forth motion (oscillation). However, each time the waves reach the feed point (point A of figure 3-8), they are reinforced by enough power to replace the lost energy. This results in continuous oscillations of energy along the wire and a high voltage at point A on the end of the wire. These oscillations are applied to the antenna at a rate equal to the frequency of the RF voltage.

In a perfect antenna system, all the energy supplied to the antenna would be radiated into space. In an imperfect system, which we use, some portion of the energy is reflected back to the source with a resultant

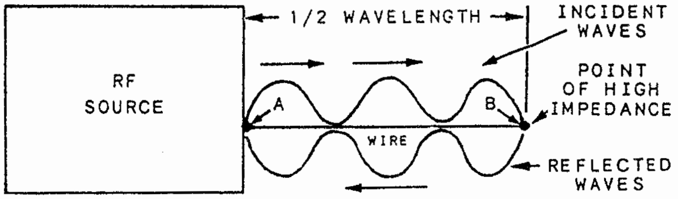


Figure 3-8.—Incident and reflected waves on an antenna.

decrease in radiated energy. The more energy reflected back, the more inefficient the antenna. The condition of most antennas can be determined by measuring the power being supplied to the antenna (forward power) and the power being reflected back to the source (reflected power). These two measurements determine the voltage standing wave ratio (VSWR), which indicates antenna performance.

If an antenna is resonant to the frequency supplied by the transmitter, the reflected waves and the incident waves are in phase along the length of the antenna and tend to reinforce each other. It is at this point that radiation is maximum, and the SWR is best. When the antenna is not resonant at the frequency supplied by the transmitter, the incident and reflected waves are out of phase along the length of the antenna and tend to cancel out each other. These cancellations are called power losses and occur when the SWR is poor, such as 6:1 or 5:1.

Most transmitters have a long productive life and require only periodic adjustment and routine maintenance to provide maximum operating efficiency and reliable communications. Experience has shown that many of the problems associated with unreliable radio communication and transmitter failures can be attributed to high antenna VSWR.

DUMMY LOADS

Under radio silence conditions, placing a carrier on the air during transmitter tuning would give an enemy the opportunity to take direction-finding bearings and determine the location of the ship. Even during normal periods of operation, transmitters should be tuned by methods that do not require radiation from the antenna. This precaution minimizes interference with other stations using the circuit.

A dummy load (also called dummy antenna) can be used to tune a transmitter without causing unwanted radiation. Dummy loads have resistors that dissipate the RF energy in the form of heat and prevent radiation by the transmitter during the tuning operation. The dummy load, instead of the antenna, is connected to the output of the transmitter, and the normal transmitter tuning procedure is followed.

Most Navy transmitters have a built-in dummy load. This permits you to switch between the dummy load or the actual antenna using a switch. For transmitters that do not have such a switch, the transmission line at the transmitter is disconnected and connected to the dummy load (figure 3-9). When transmitter tuning is complete, the dummy load is disconnected and the antenna transmission line is again connected to the transmitter.

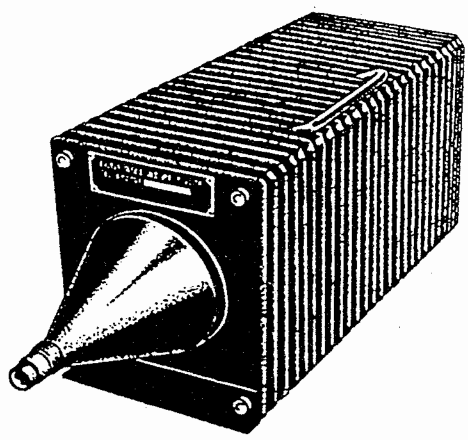


Figure 3-9.—DA-91/U dummy load.

ELECTROMAGNETIC WAVELENGTH

We mentioned earlier that electromagnetic waves travel through free space at 186,000 miles per second. But, because of resistance, the travel rate of these waves along a wire is slightly slower. An antenna must be an appropriate length so that a wave will travel from one end to the other and return to complete one cycle of the RF voltage. A wavelength is the distance traveled by a radio wave in one cycle. This means that wavelength will vary with frequency.

If we increase the frequency, the time required to complete one cycle of alternating current (ac) is naturally less; therefore, the wavelength is less. If we decrease the frequency, the time required to complete one cycle of ac is longer; therefore, the wavelength is longer. Another word for wavelength is LAMBDA (designated by the symbol λ).

The term "wavelength" also refers to the length of an antenna. Antennas are often referred to as **half wave**, **quarter wave**, or **full wave**. These terms describe the relative length of an antenna, whether that length is electrical or physical.

Earlier, we said that when tuning an antenna, we are electrically lengthening or shortening the antenna to achieve resonance at that frequency. We are actually changing the wavelength of the antenna. The electrical length of an antenna may not be the same as its physical length.

You know that RF energy travels through space at the speed of light. However, because of resistance, RF energy on an antenna travels at slightly less than the speed of light. Because of this difference in velocity, the physical length no longer corresponds to the electrical length of an antenna. Therefore, an antenna may be a half-wave antenna electrically, but it is physically somewhat shorter. For information on how to compute wavelengths for different frequencies, consult NEETS, Module 12, *Modulation Principles.*

BASIC ANTENNAS

Many types and variations of antenna design are used in the fleet to achieve a particular directive radiation pattern or a certain vertical radiation angle. However, all antennas are derived from two basic types: the half wave and the quarter wave.

HALF-WAVE THEORY

An antenna that is one-half wavelength long is the shortest antenna that can be used to radiate radio signals into free space. The most widely used antenna is the half-wave antenna, commonly called a dipole, or hertz, antenna. This antenna consists of two lengths of wire rod, or tubing, each one-fourth wavelength long at a certain frequency.

Many complex antennas are constructed from this basic antenna design. This type of antenna will not function efficiently unless its length is one-half wavelength of the frequency radiated or received.

Figure 3-10 shows a theoretical half-wave antenna with a center feed point. Both sections of the antenna are $\lambda/4$ (one-fourth wavelength) at the operating frequency. Together, of course, the effective length of the antenna is $\lambda/2$ (one-half wavelength) at the operating frequency.

One feature of the dipole antenna is that it does not need to be connected to the ground like other antennas. Antennas shorter than a half wavelength must use the ground to achieve half-wave characteristics. The half-wave antenna is already long enough to radiate the signal properly.

Because of sophisticated antenna systems and tuning processes, half-wave antennas can be electrically achieved aboard ship. Therefore, wavelength is becoming less and less the criteria for determining the types of antennas to be used on ships. Dipole antennas can be mounted horizontally or vertically, depending upon the desired polarization, and can be fed at the center or at the ends. Because it is ungrounded, the dipole antenna can be installed above energy-absorbing structures.

QUARTER-WAVE ANTENNA

A quarter-wave antenna is a grounded antenna that is one-fourth wavelength of the transmitted or received frequency. You will hear the quarter-wave antenna referred to as a "Marconi antenna." The quarter-wave antenna is also omnidirectional.

As we mentioned earlier, a half-wave antenna is the shortest practical length that can be effectively used to radiate radio signals into free space. The natural question, then is, "How do we use a quarter-wavelength antenna if a half-wavelength is the shortest length that can be used?" The answer is simple.

Two components make up the total radiation from an antenna. One component is that part of the radiated signal which leaves the antenna directly. The other is a **ground reflection** that appears to come from an underground image of the real antenna (figure 3-11). This image is sometimes called the **mirror image** and is considered to be as far below the ground as the real antenna is above it.

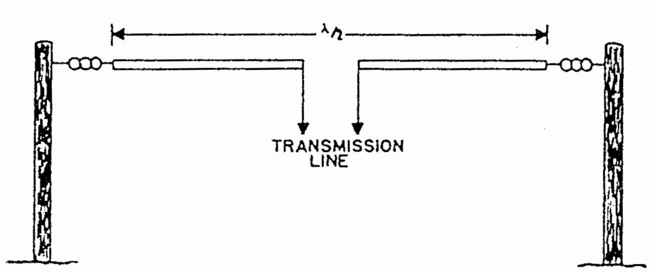


Figure 3-10.—Half-wave antenna with center feed point.

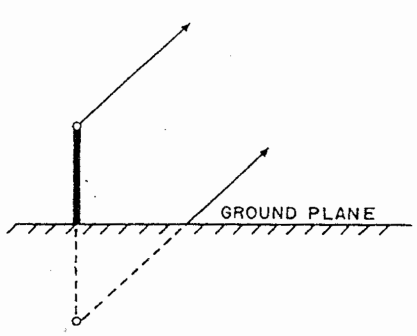


Figure 3-11.—Direct and image signal of a quarter-wave antenna.

Figure 3-12 shows basic current distribution in a real and image antenna. There are certain directions in which the direct wave from the real antenna and the reflected wave from the image are exactly equal in amplitude but opposite in phase. Conversely, there are other directions in which the direct and reflected waves are equal in amplitude and in phase. Therefore, depending on the direction and location of the point at which the field strength is measured, the actual field strength may be (1) twice the field strength from the real antenna alone, (2) zero field strength, or (3) some intermediate value between maximum and minimum. It is this "real" and "image" radiated field that forms the basis for using quarter-wavelength antennas.

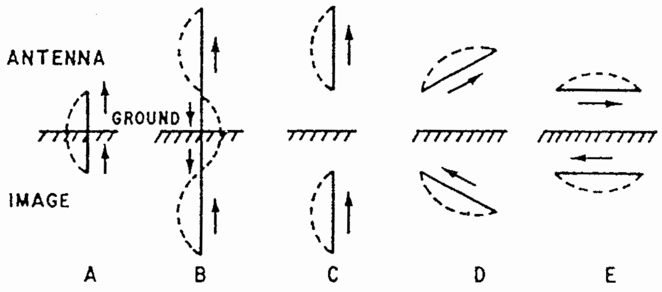


Figure 3-12.—Current distribution in a real antenna and its image.

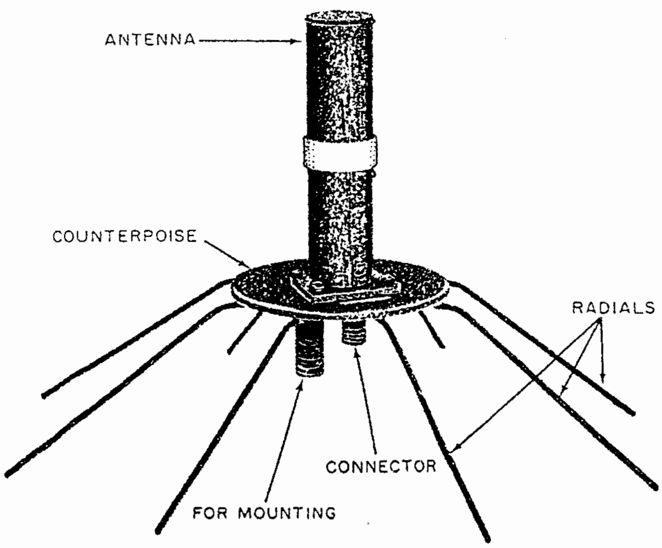


Figure 3-13.—AS-390/SRC UHF antenna with counterpoise, or ground plane.

This reflected-energy principle is very useful in the lower frequency ranges, although ground reflections occur in the high-frequency range as well.

The antenna does not always need to be placed at the Earth's surface to produce an image. Another method of achieving reflected images is through the use of ground planes. This means that a large reflecting metallic surface is used as a substitute for the ground or Earth. This method is frequently used in the VHF/UHF frequency ranges. Figure 3-13 shows a commonly used UHF antenna (AS-390/SRC), which uses this principle. The ground plane is sometimes referred to as a "counterpoise," as shown in the figure. Together, the counterpoise and the radials form the reflecting surface, which provides the reflected image.

TYPES OF SHIPBOARD ANTENNAS

Figure 3-14 shows various shipboard antennas and their placements. The complex structures of modern ships and their operational requirements require the use of many types of antenna. These types include wire rope fans, whips, cages, dipoles, probes, trussed monopoles, and bow stubs. The selection and use of different types is often governed by the limited space available.

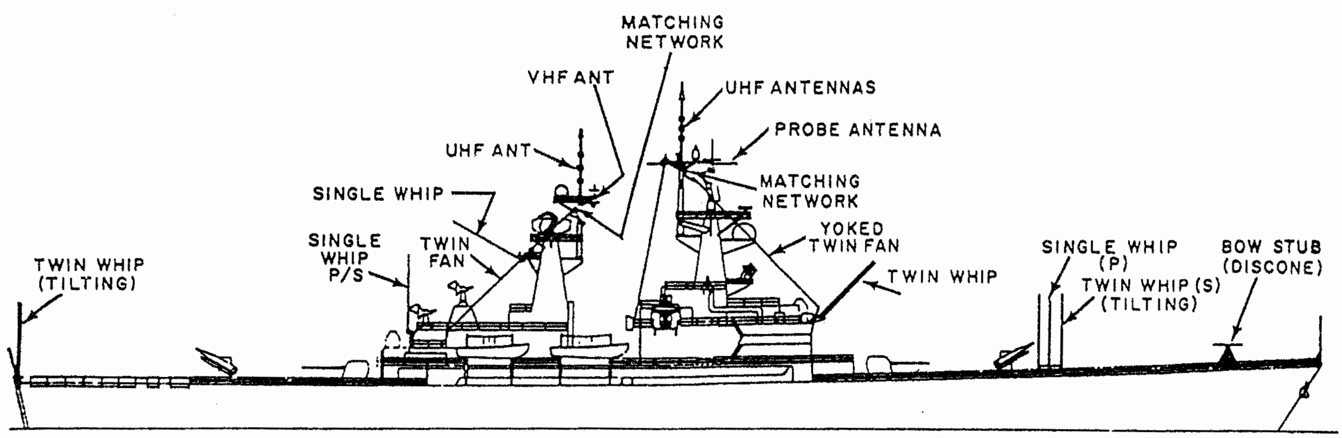


Figure 3-14.—Shipboard antenna systems.

WIRE ROPE ANTENNAS

Wire rope antennas are installed aboard ship for medium- and high-frequency (300 kHz to 30 MHz) coverage. A wire rope antenna (figure 3-15) consists of one or more lengths of flexible wire rigged from two or more points on the ship's superstructure. A wire rope antenna is strung either vertically or horizontally from a yardarm or mast to outriggers, another mast, or to the superstructure. If used for transmitting, the wire antenna is tuned electrically to the desired frequency.

Receiving wire antennas are normally installed forward on the ship, rising nearly vertically from the pilothouse top to brackets on the mast or yardarm. Receiving antennas are located as far as possible from the transmitting antennas so that a minimum of energy is picked up from local transmitters.

Because of the characteristics of the frequency range in which wire antennas are used, the ship's superstructure and other nearby structures become an electronically integral part of the antenna. As a result, wire rope antennas are usually designed or adapted specifically for a particular ship.

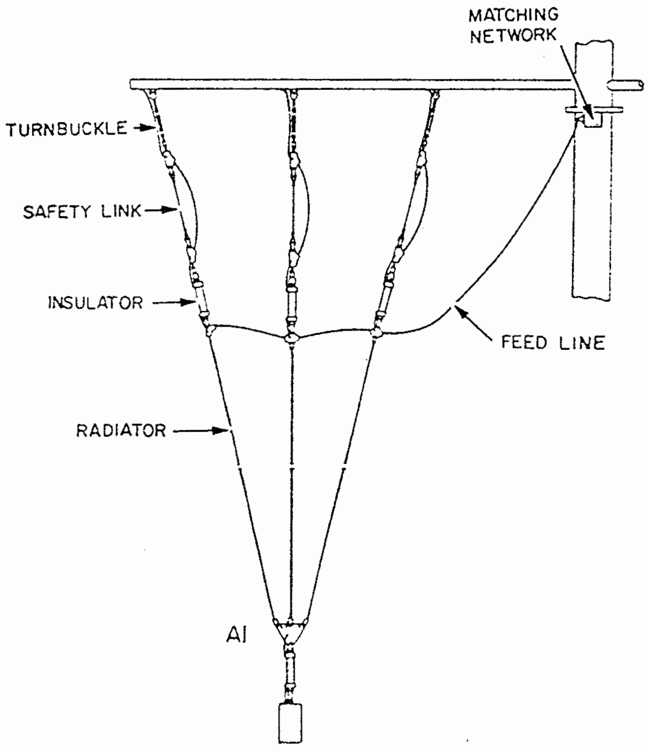


Figure 3-15.—Wire rope fan antenna.

WHIP ANTENNAS

Whip antennas are used for medium- and high-frequency transmitting and receiving systems. For low-frequency systems, whip antennas are used only for receiving. Essentially self-supporting, whip antennas may be deck-mounted or mounted on brackets on the stacks or superstructure. The self-supporting feature of the whip makes it particularly useful where space is limited and in locations not suitable for other types of antennas. Whip antennas can be tilted, a design feature that makes them suited for use along the edges of aircraft carrier flight decks. Aboard submarines, they can be retracted into the sail structure.

Whip antennas commonly used aboard ship are 25, 28, or 35 feet long and consist of several sections. The 35-foot whip is most commonly used. If these antennas are mounted less than 25 feet apart, they are usually connected with a crossbar with the feed point at its center. The twin whip antenna (figure 3-16) is not broadband and is generally equipped with a base tuning unit.

VHF AND UHF ANTENNAS

The physical size of VHF and UHF antennas is relatively small because of the short wavelengths at

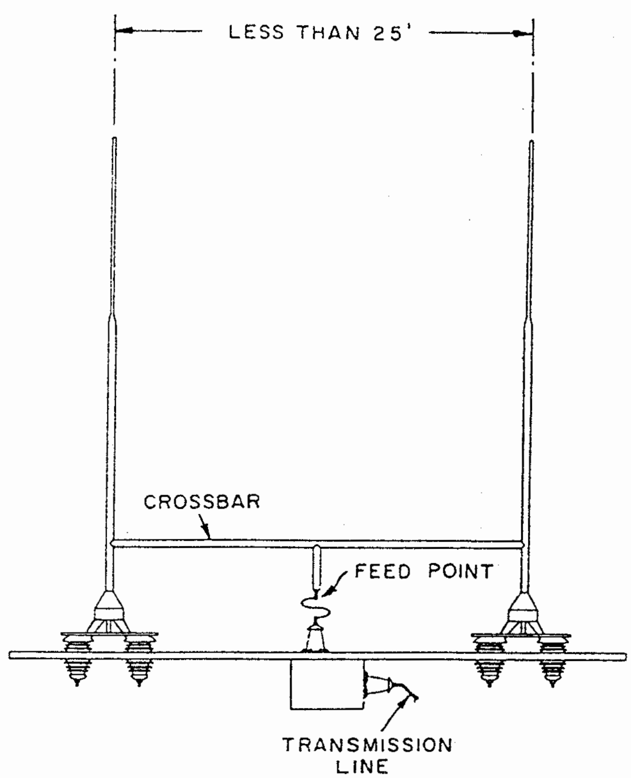


Figure 3-16.—Twin whip antenna with crossbar.

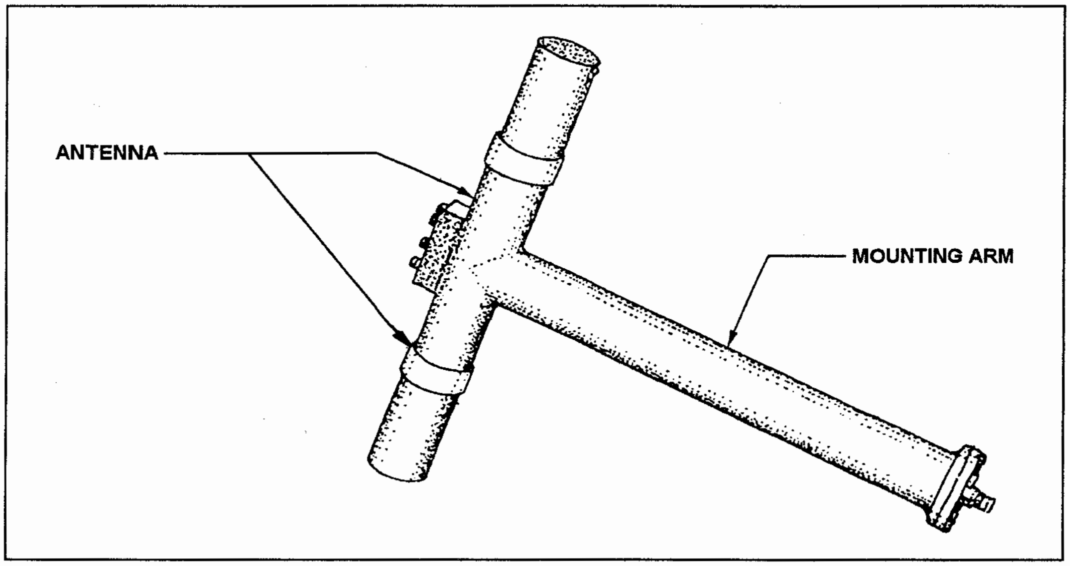


Figure 3-17.—AT-150/SRC UHF antenna.

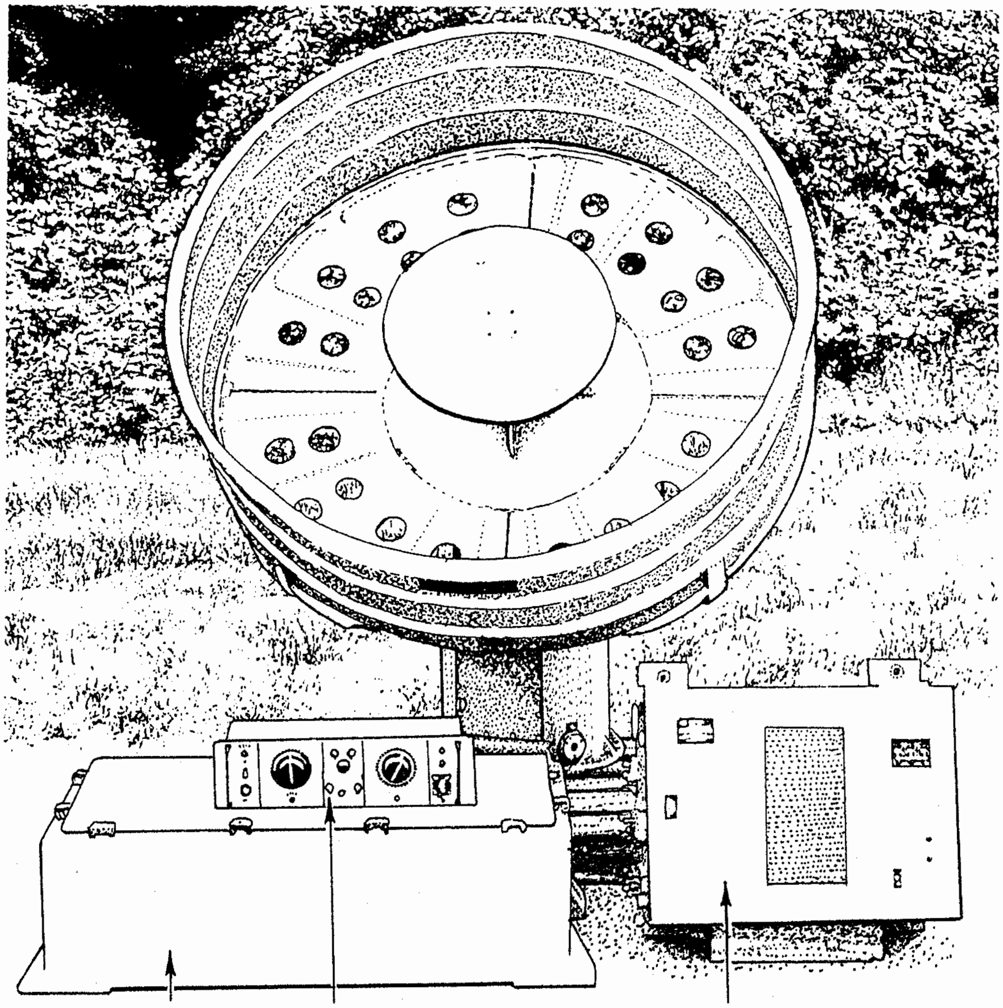


Figure 3-18.—OE-82C/WSC-1(V) antenna group.

these frequencies. Aboard ship, these antennas are installed as high and as much in the clear as possible. Since VHF and UHF antennas are line-of-sight systems, they require a clear area at an optimum height on the ship structure or mast. Unfortunately, this area is also needed for various radars and UHF direction-finding and navigational aid systems.

VHF and UHF antennas are usually installed on stub masts above the foremast and below the UHF direction finder. UHF antennas are often located on the outboard ends of the yardarms and on other structures that offer a clear area.

For best results in the VHF and UHF ranges, both transmitting and receiving antennas must have the same polarization. Vertically polarized antennas are used for all ship-to-ship, ship-to-shore, and ground-to-air VHF/UHF communications. Usually, either a vertical half-wave dipole or a vertical quarter-wave antenna with ground plane is used. An example of a UHF half-wave (dipole) antenna is the AT-150/SRC shown in figure 3-17. This antenna is normally mounted horizontally.

BROADBAND ANTENNAS

Broadband antennas for HF and UHF bands have been developed for use with antenna multicouplers. Therefore, several circuits may be operated with a single antenna. Broadband antennas must be able to transmit or receive over a wide frequency band.

HF broadband antennas include the 35-foot twin and trussed whips, half-cone, cage, and a variety of fan-designed antennas. The AT-150/SRC UHF antenna in figure 3-17 is an example of a broadband antenna.

SATCOMM ANTENNAS

The antennas shown in figures 3-18 and 3-19 are used for satellite communications. The OE-82C/WSC-1(V) antenna (figure 3-18) is used with the AN/WSC-3 transceiver and designed primarily for shipboard installation. Depending upon requirements, one or two antennas may be installed to provide a view of the satellite at all times. The antenna is attached to a pedestal. This permits the antenna to rotate so that it is always in view of the satellite. The frequency band for receiving is 248 to 272 MHz and for transmitting is 292 to 312 MHz.

The AN/SRR-1 receiver system consists of up to four AS-2815/SSR-1 antennas (figure 3-19) with an amplifier-converter AM-6534/SSR-1 for each antenna. The antennas are used to receive satellite fleet broadcasts at frequencies of 240 to 315 MHz. The antenna and converters are mounted above deck so that at least one antenna is always in view of the satellite.

The newer satellite systems use the SHF band. One of the major advantages of these systems is that they use a very small parabolic antenna measuring only 12 inches in diameter.

A satellite antenna must be pointed at the satellite to communicate. We must first determine the azimuth

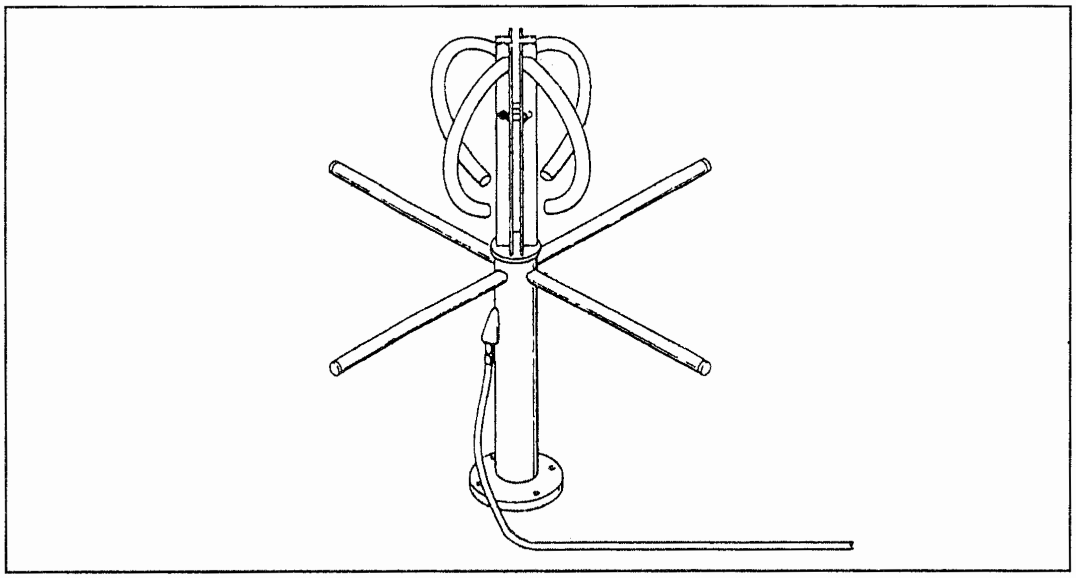


Figure 3-19.—AS-2815/SSR-1 antenna physical configuration.

(AZ) and elevation (EL) angles from a fixed location. Figure 3-20 illustrates how these angles are derived using a pointing guide called the Equatorial Satellite Antenna Pointing Guide. This guide is normally available through the Navy Supply System.

The antenna pointing guide is a clear plastic overlay, which slides across a stationary map. It indicates AZ and EL angles in degrees to the satellite. The values obtained are useful to the operator in setting up the antenna control unit of a satellite system.

To use the guide, observe the following procedures:

1. Center the overlay directly over the desired satellite position on the stationary map.
2. Mark the latitude and longitude of the ship on the plastic antenna pointing guide with a grease pencil.
3. Determine the approximate azimuth angle from the ship to the satellite.
4. Locate the closest dotted line radiating outward from the center of the graph on the overlay in relation to the grease dot representing the ship's location. This dotted line represents degrees of azimuth as printed on the end of the line. Some approximation will be required for ship positions not falling on the dotted line.
5. Determine the degrees of elevation by locating the solid concentric line closest to the ship's marked position. Again, approximation will be required for positions not falling directly on the solid elevation line. Degrees of elevation are marked on each concentric line.

Example: Assume that your ship is located at 30° north and 70° west. You want to access FLTSAT 8 at 23° west. When we apply those procedures discussed above, we can see the example indicates an azimuth value of 115° and an elevation angle of 30°.

RHOMBIC ANTENNA

The rhombic antenna, usually used at receiver sites, is a unidirectional antenna. This antenna consists of four long wires, positioned in a diamond shape. Horizontal rhombic antennas are the most commonly used antennas for point-to-point HF naval communications. The main disadvantage of this antenna is that it requires a relatively large area.

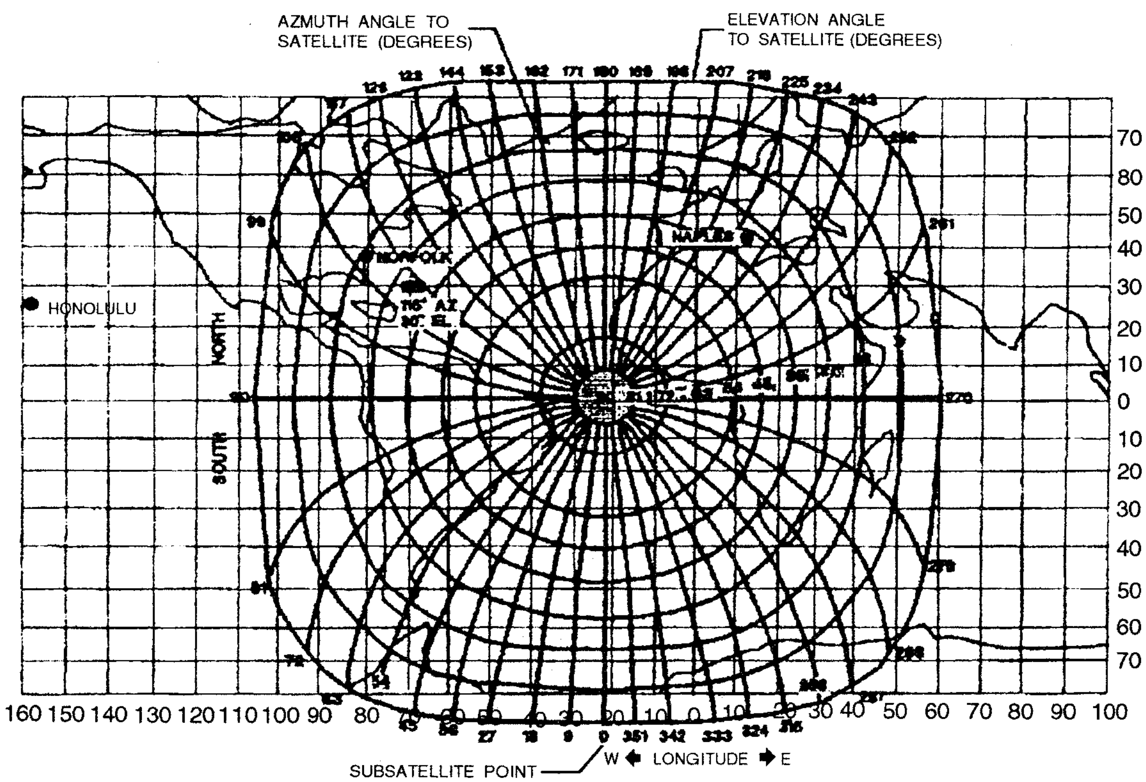


Figure 3-20.—Equatorial Satellite Antenna Pointing Guide.

MULTIWIRE RHOMBIC

A rhombic antenna improves in performance if each leg is made up of more than one wire. An improved antenna, known as a curtain rhombic, uses three wires spaced 5 to 7 feet apart for each leg and connected to a common point (figure 3-21).

SLEEVE ANTENNA

The sleeve antenna is used primarily as a receiving antenna. It is a broadband, vertically polarized, omnidirectional antenna. Its primary uses are in broadcast, ship-to-shore, and ground-to-air communications. Although originally developed for shore stations, there is a modified version for shipboard use. Figure 3-22 shows a sleeve antenna for shore stations.

Sleeve antennas are especially helpful in reducing the total number of conventional narrowband antennas that otherwise would be required to meet the requirements of shore stations. With the use of multicouplers, one sleeve antenna can serve several receivers operating over a wide range of frequencies. This feature also makes the sleeve antenna ideal for small antenna sites.

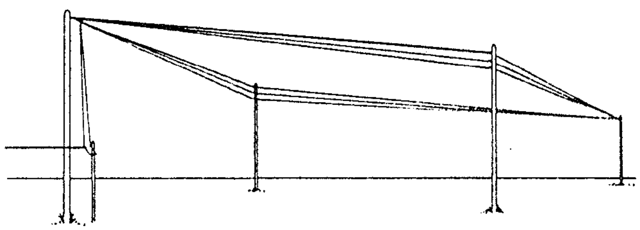


Figure 3-21.—Three-wire rhombic antenna.

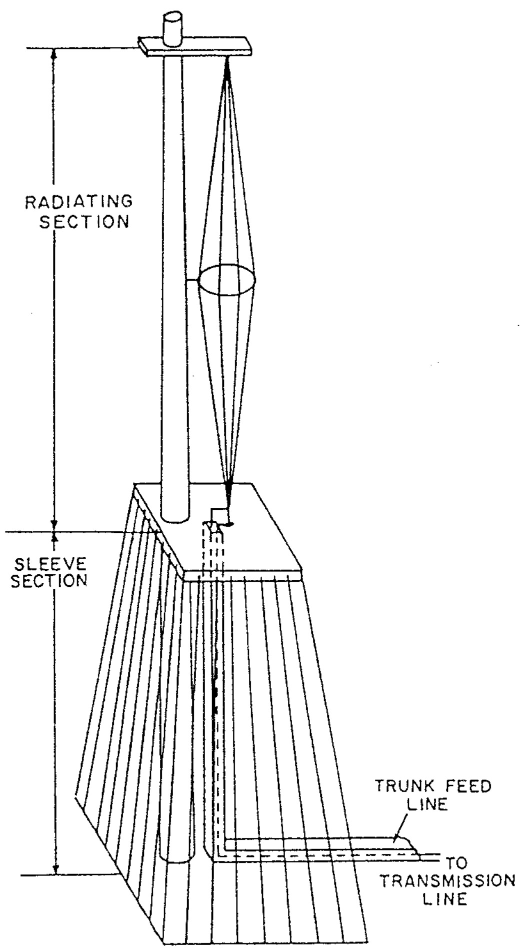


Figure 3-22.—Sleeve antenna (shore stations).

CONICAL MONOPOLE ANTENNA

The conical monopole antenna (figure 3-23) is used in HF communications. It is a broadband, vertically polarized, compact omnidirectional antenna. This antenna is adaptable to ship-to-shore, broadcast, and ground-to-air communications. It is used both ashore and aboard ship.

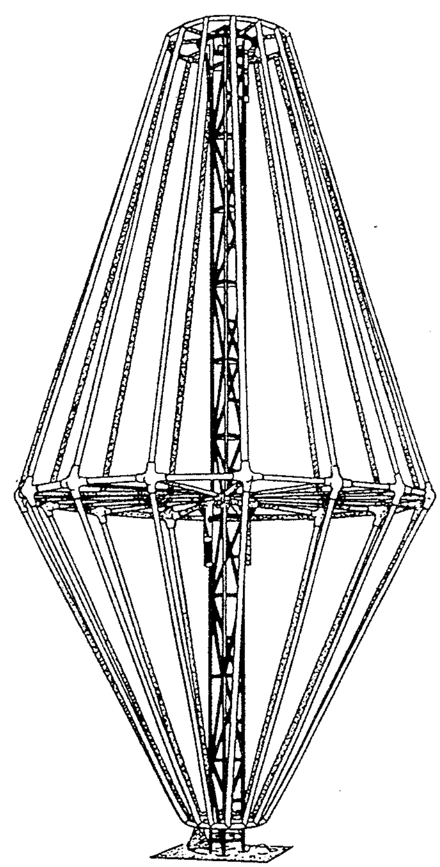


Figure 3-23.—Conical monopole antenna.

When operating at frequencies near the lower limit of the HF band, the conical radiates in much the same manner as a regular vertical antenna. At the higher frequencies, the lower cone section radiates, and the top section pushes the signal out at a low angle as a sky wave (discussed further in Chapter 4, "Wave Propagation"). This low angle of radiation causes the sky wave to return to the Earth at great distances from the antenna. Therefore, this antenna is well suited for long-distance communications in the HF band.

INVERTED CONE ANTENNA

The inverted cone antenna (figure 3-24) is vertically polarized, omnidirectional, and very broadbanded. It is used for HF communications in ship-to-shore, broadcast, and ground-to-air applications. The radial ground plane that forms the ground system for inverted cones is typical of the requirement for vertically polarized, ground-mounted antennas. The radial wires are one-quarter-wavelength long at the lowest designed frequency.

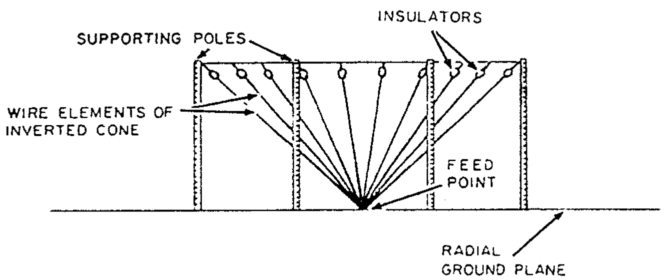


Figure 3-24.—Inverted cone antenna.

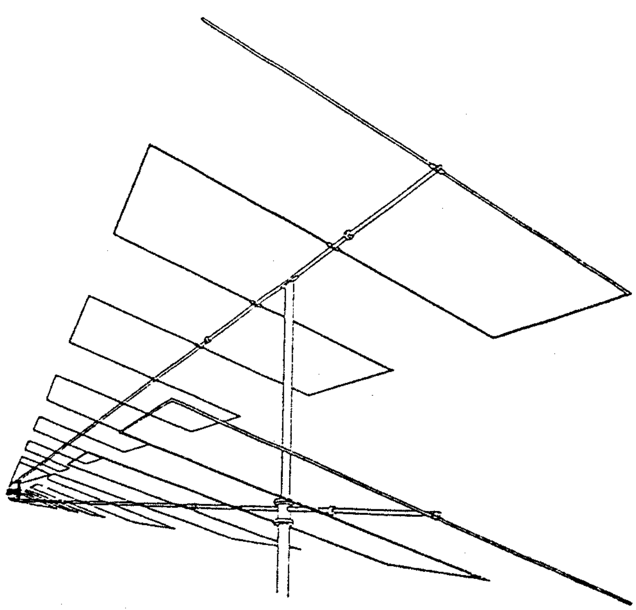


Figure 3-25.—Log-periodic antenna.

LOG-PERIODIC ANTENNA

The log-periodic (LP) antenna operates over an extremely wide frequency range in the HF and VHF bands. Figure 3-25 shows a typical LP antenna designed for extremely broadbanded, VHF communications. The LP antenna can be mounted on steel towers or utility poles that incorporate rotating mechanisms. This antenna is particularly useful where antenna area is limited. A rotatable LP antenna known as an RLP antenna (figure 3-26), possesses essentially the same characteristics as the fixed LP antenna but has a different physical form. The RLP antenna is commonly used in ship-shore-ship and in point-to-point communications.

EMERGENCY ANTENNAS

Damage to an antenna from heavy seas, violent winds, or enemy action can cause serious disruption of communications. Sections of a whip antenna can be carried away, insulators can be damaged, or a wire antenna can snap loose from its moorings or break. If loss or damage should happen when all available equipment is needed, you may have to rig, or assist in rigging, an emergency antenna to temporarily restore communications until the regular antenna can be repaired.

The simplest emergency antenna consists of a length of wire rope to which a high-voltage insulator is attached to one end and a heavy alligator clip, or lug, is soldered to the other. The end with the insulator is hoisted to the nearest structure and secured. The end with the alligator clip (or lug) is attached to the equipment transmission line. To radiate effectively, the antenna must be sufficiently clear of all grounded objects.

ANTENNA DISTRIBUTION SYSTEMS

In figure 3-6, we saw a distribution system with one antenna that can be connected (patched) to one of several receivers or transmitters by way of a multicoupler. In this system, you can patch the antenna to only one receiver or transmitter at a time. However, some distribution systems are more complex, such as the one shown in figure 3-27. In this system, you can patch four antennas to four receivers, or you can patch one antenna to more than one receiver via the multicoupler. In either system, we need a way to

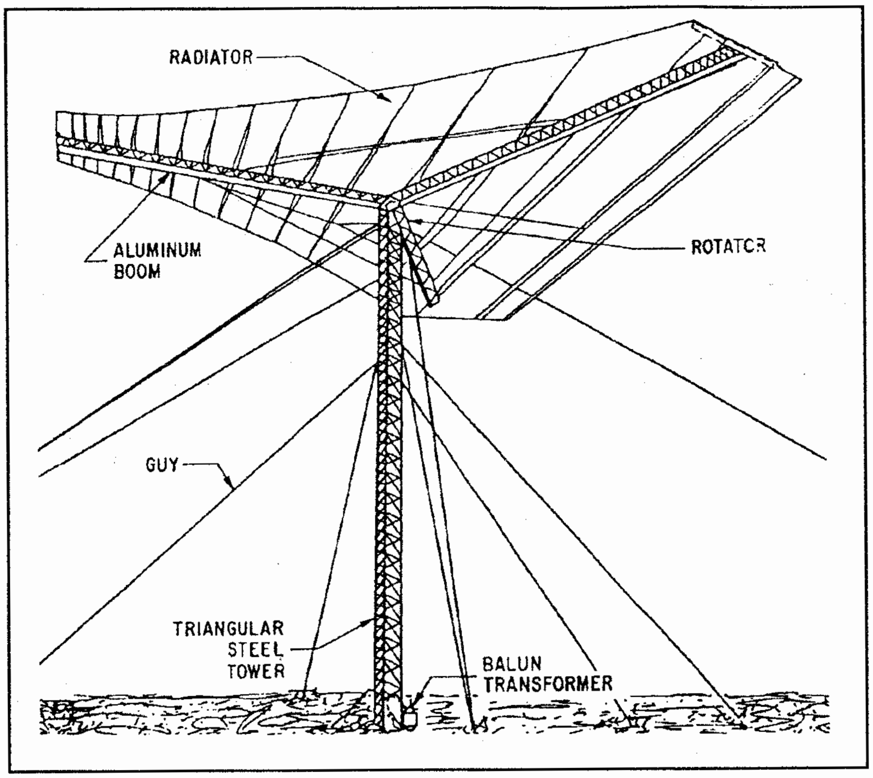


Figure 3-26.—Rotatable log-periodic antenna.

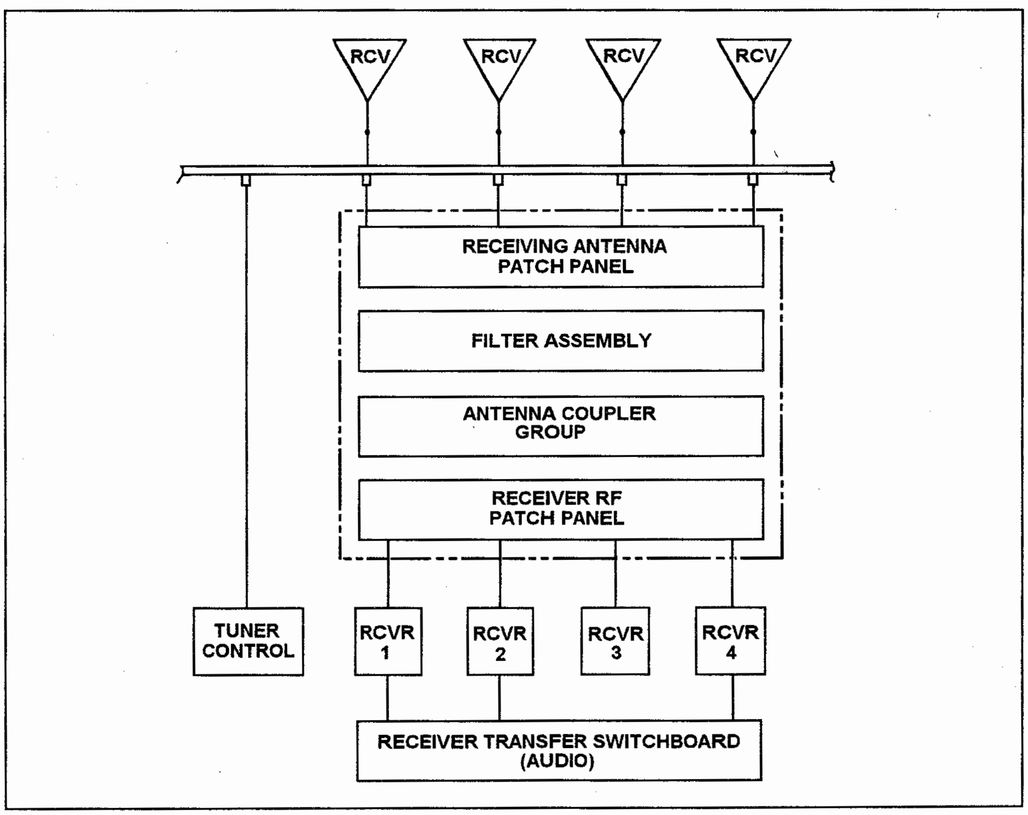


Figure 3-27.—Complex distribution system.

connect the antenna to the receiver or transmitter that we want to use.

Figure 3-28 shows a receiver antenna filter patch panel, AN/SRA-12, with a receiver patch panel. The AN/SRA-12 provides seven radio-frequency channels in the 14-kHz to 32-MHz range. Any or all of these channels can be used independently of any other channel, or they can operate simultaneously.

On the receiver patch panel, a receiver is hardwired to each jack. With the use of patchcords, you can connect a receiver, tuned to a particular frequency, to the antenna by connecting the receiver to the proper jack on the AN/SRA-12. Figure 3-28 shows how the filter assembly is used in combination with other units to pass an RF signal from an antenna to one or more receivers.

NOTE

When patching, **YOU MUST ALWAYS INSERT THE END OF THE ANTENNA PATCH CORD TO THE RECEIVER JACK FIRST. THEN, YOU INSERT THE OTHER END OF THE PATCH CORD INTO THE LOWEST USABLE AN/SRA-12 JACK. TO UNPATCH, ALWAYS REMOVE THE PATCH CORD FROM THE RECEIVER JACK, THEN THE OTHER END FROM THE FREQUENCY FILTER JACK.** An easy way to remember this is always work the patching from the **top down.**

Transmitting antenna distribution systems perform the same functions as receiving distribution systems. Figure 3-29 shows a transmitter patch panel. These transmitter patch panels are interlocked with the transmitter so that no open jack connection can be energized and no energized patch cord can be removed. This provides safety for both personnel and equipment.

SUMMARY

Many types of antennas are used in naval communications. To learn more about the various types of antennas, their uses, and their design configuration, you should study Shipboard Antenna Systems, NAVSHIPS 0967-177-3000 series. This is a five-volume series that will provide you with invaluable information on specific antennas that you will use either aboard ship or at a communications station.

RECOMMENDED READING LIST

NOTE

Although the following references were current when this TRAMAN was published, their continued currency cannot be assured. You therefore need to ensure that you are studying the latest revisions.

Some of the following references were originated by the Naval Education and Training

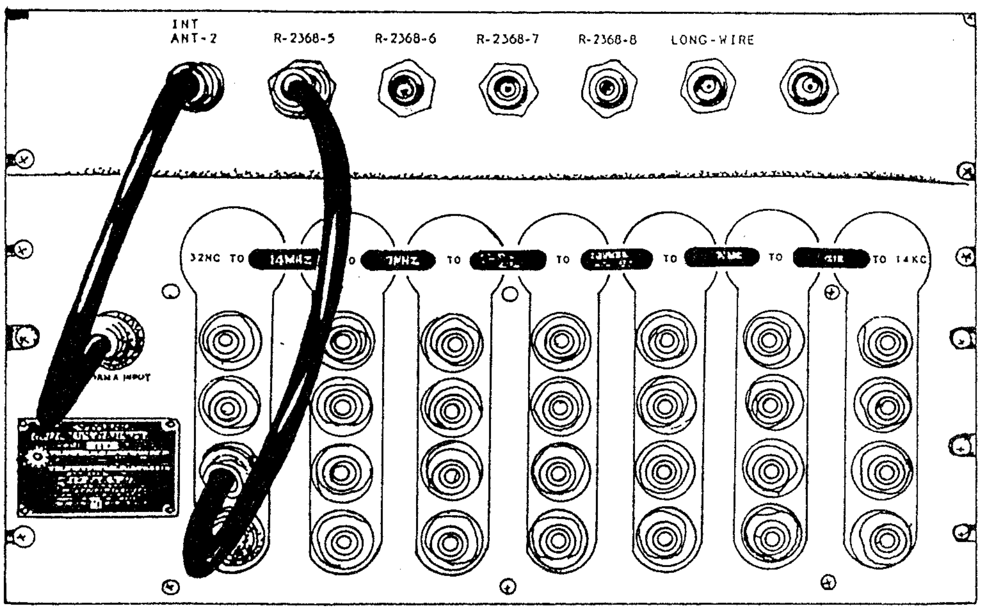


Figure 3-28.—AN/SRA-12 antenna filter patch panel with receiver antenna patch panel.

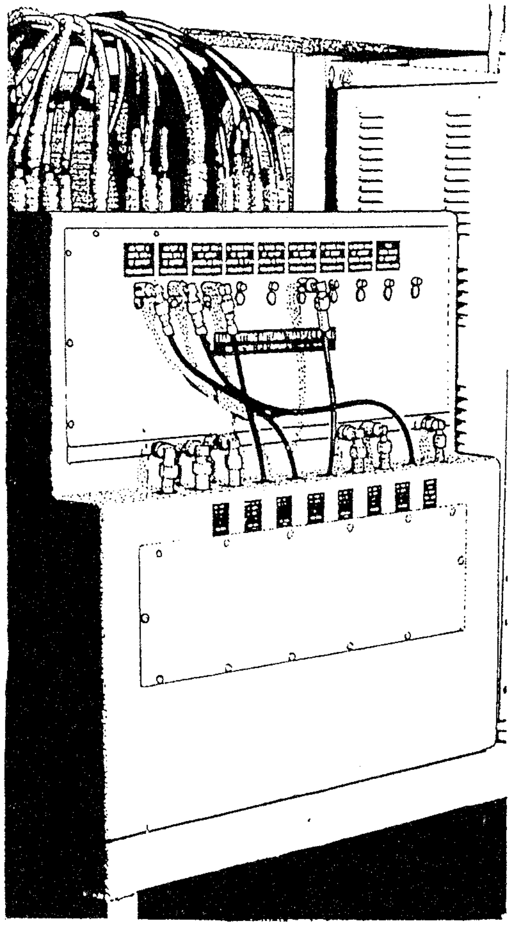


Figure 3-29.—Transmitter antenna patch panel.

Program Development Center (NETPDC), Pensacola, Fla. Effective 1 September 1986, the title NETPDC was officially changed to Naval Education and Training Program Management Support Activity (NETPMSA), Pensacola, Fla.

Navy Electricity and Electronics Training Series, Module 2, *Introduction to Alternating Current and Transformers*, NAVEDTRA 172-02-00-91, Naval Education and Training Program Management Support Activity (NETPMSA), Pensacola, Fla., 1991.

Navy Electricity and Electronics Training Series, Module 10, *Introduction to Wave Propagation, Transmission Lines, and Antennas*, NAVEDTRA 172-10-00-83, Naval Education and Training Program Development Center (NETPDC), Pensacola, Fla., 1983.

Shipboard Antenna Systems, Volume 1, *Communications Antenna Fundamentals*, NAVSHIPS 0967-177-3010, Naval Ship Systems Command, Washington, D.C., September 1972.

Shipboard Antenna Systems, Volume 3, *Antenna Couplers, Communications Antenna Systems*, NAVSHIPS 0967-177-3030, Naval Ship Systems Command, Washington, D.C., January 1973.

Shipboard Antenna Systems, Volume 5, *Antenna Data Sheets*, SPAWAR 0967-LP-177-3050, Space and Naval Warfare Systems Command, Washington, D.C., May 1973.

Navy Ultra High Frequency Satellite Communications (U), NTP 2, Section 2 (E), Naval Computer and Telecommunication Command, Washington, D.C., July 1992.

CHAPTER 4

WAVE PROPAGATION

CHAPTER LEARNING OBJECTIVES

Upon completing this chapter, you should be able to do the following:

- *Recall the terms and definitions used in the study of radio-wave propagation.*
- *Explain the frequency bands and their characteristics.*
- *Describe the composition of the atmosphere.*
- *Discuss diffraction, reflection, and refraction.*
- *Define radio-wave components.*

In chapter 3, you learned how antennas radiate radio-frequency (RF) energy into space as radio waves. In this chapter, we will discuss how the atmosphere affects radio waves and other problems associated with radio-wave propagation. As you will learn shortly, wave propagation is defined as the transmission of RF energy.

Obviously, a radio wave must be propagated from a transmitting antenna to a receiving antenna to establish a useful communications system. From chapter 3, you will remember that in radio communications systems, the transmitter generates power and a transmission line feeds this power to an antenna. The antenna radiates this power into space where it travels at the speed of light. Receiving antennas placed in the path of the traveling radio wave absorb part of the radiated energy. This energy travels from the receiving antenna through a transmission line to a receiver. Figure 4-1 shows a simple radio communications network.

There are two primary paths, or mediums, for radio-wave transmissions: the Earth's surface and the atmosphere surrounding the Earth. By far, the most complex of these two paths is the atmosphere. Because we cannot control the atmosphere, our knowledge of atmospheric changes and their effects on radio waves is important to achieving and maintaining successful communications.

TERMS AND DEFINITIONS

The study of radio-wave propagation involves several terms with which you must become familiar. The following list of terms and their definitions is provided for your reference:

Atmosphere—Gases surrounding the Earth. At altitudes above 350 miles, these gases become extremely thin and eventually disappear altogether. Outer space begins where the Earth's gases cease to exist or exist only in trace amounts. The Earth's

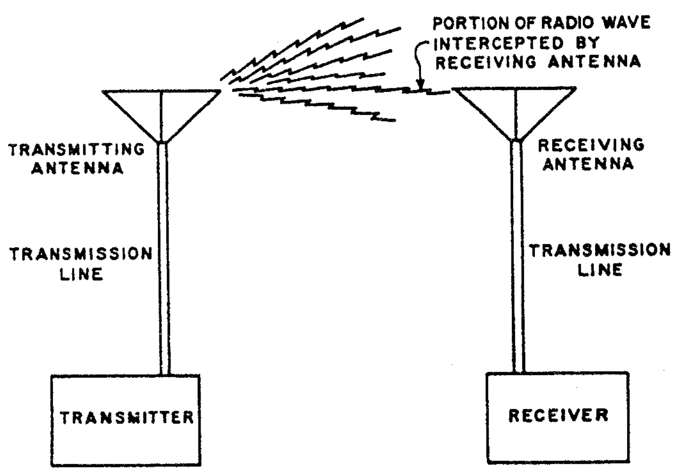


Figure 4-1.—Simple radio communications network.

atmosphere is divided into three basic layers: the troposphere, stratosphere, and ionosphere.

Attenuation—A decrease in radio-wave signal strength.

Conductivity—A measure of the ability of a material to act as a path for electron flow.

Critical Frequency—That frequency below which a radio wave is bent, or refracted, back to Earth by the ionosphere.

Diffraction—The bending of radio waves around the edge(s) of a solid object or dense mass.

Distortion—An undesired change in a signal.

Electromagnetic Waves—Energy produced at the output of a transmitter; also called radio waves.

Fading—Variation in the strength of a received signal.

Frequency of Optimum Transmission (FOT)—The most reliable frequency for propagation at a specific time.

Gigahertz (GHz)—An expression denoting 1,000,000,000 hertz, or 1,000,000,000 complete cycles of a wave form in 1 second. Used to measure frequencies in and above the UHF bands.

Hertz (Hz)—The basic unit used to measure frequency. Hertz denotes the number of complete cycles of a wave form per second.

Ionization—The process of electrically charging atoms or molecules.

Ionosphere—That part of the Earth's atmosphere above the stratosphere where sufficient ionization occurs to affect the propagation of radio waves.

Ions—Atoms or molecules that have been electrically charged.

Kilohertz (kHz)—An expression denoting a frequency of 1000 hertz, or 1000 complete cycles of a wave form in 1 second. Used to designate frequencies in the VLF, LF, and MF frequency bands.

Lowest Usable Frequency (LUF)—The lowest frequency that can be used at a specific time for successful radio communications between two points.

Maximum Usable Frequency (MUF)—The highest frequency that can be used at a specific time for successful radio communications between two points.

Megahertz (MHz)—An expression denoting a frequency of 1,000,000 hertz, or 1,000,000 complete cycles of a wave form in 1 second. Used to designate frequencies in the MF, HF, and UHF bands.

Noise—Any electrical disturbance that interferes with the normal reception of a transmitted signal.

Propagation—The transmission of radio waves from one point to another.

Reflection—When a radio wave strikes the Earth's surface at some distance from the transmitting antenna and is returned upward toward the atmosphere.

Refraction—When a radio wave is bent as a result of passing from one layer in the ionosphere into another layer of different ion density.

RF Energy—Radio-frequency energy. Energy produced at the output of a transmitter.

Skip Distance—Distance from the transmitting antenna to the point where the sky wave is first returned to Earth.

Skip Zone—A specific area that exists between the point at which the ground wave becomes too weak for reception and the point where the sky wave is first returned to Earth. This is the area where a transmitted signal cannot be received.

Sky Wave—A radio wave that is propagated into the ionosphere.

Space Wave—A radio wave that travels either directly from the transmitting antenna to the receiver or is reflected from the ground to the receiver.

Stratosphere—That part of the atmosphere between the troposphere and the ionosphere.

Surface Wave—A radio wave that travels close to the Earth's surface and reaches the receiving antenna without being influenced by the ionosphere.

Troposphere—That part of the atmosphere that lies between the Earth's surface and the stratosphere.

FREQUENCY BANDS AND CHARACTERISTICS

For practical purposes and convenience, we divide radio transmissions into frequency bands and classify communications according to the frequency band used. Table 4-1 lists the frequency ranges, frequency bands, propagation modes, and the typical uses of each band. Although the radio-frequency spectrum is divided into bands, an actual physical distinction between adjoining bands does not exist.

VERY LOW AND LOW FREQUENCIES

Historically, the very-low-frequency (VLF) and the low-frequency (LF) bands have been used for long-range communications where a high degree of reliability is required. These frequencies are particularly

Table 4-1.—Radio-Frequency Characterization

FREQUENCY RANGE	FREQ. BAND	PROPAGATION MODE	APPLICATION-CHARACTERISTICS
3 to 30 kHz	VLF	Earth-ionosphere guided	Shore-based communications, navigation
30 to 300 kHz	LF	Surface wave	Shore-based communications, stable signal
300 kHz to 3 MHz	MF	Surface/sky wave for short/long distance, respectively	Commercial broadcast band, signals subject to fading
3 to 30 MHz	HF	Sky wave, very limited short-distance ground wave	Land and ship-to-shore communications
30 to 300 MHz	VHF	Space wave	Navigation, close to line of sight (LOS) over short distances, broadcast and mobile communications
30 to 60 MHz	VHF	Ionospheric scatter	
300 MHz to 3 GHz	UHF	Space wave	LOS over short distances, broadcast and mobile communications up to 400 MHz, radar and special equipments over 400 MHz
above 300 MHz	UHF	Tropospheric scatter	
3 to 30 GHz	SHF	Space wave	The "workhorse" of the microwave band, LOS, terrestrial and satellite relay links, radar, special equipments
30 to 300 GHz	EHF	Space wave	LOS millimeter wave, space-to-space links, radar, special equipments

valuable as backups to high-frequency circuits. The VLF and LF waves are used because they are not seriously affected during periods of ionospheric disturbances.

In the VLF range, wavelengths are extremely long. If sufficient transmitter power is used, VLF waves can literally be propagated around the world. The Navy has been using VLF to broadcast to ships at sea for many years. The reliability of reception is usually such that confirmation of received messages is not normally required. Currently, the principal use of the Navy VLF communications system is for the fleet broadcasts. Fleet broadcasts serve the submarine fleet and associated ships and activities throughout the world.

The LF band was used in the past to provide ships at sea with communications via continuous-wave (CW) telegraph transmissions. As state-of-the-art communications advanced, the system was converted to single-channel radioteletype transmissions. Today, LF communications also operate as a segment of the Fleet Multichannel Broadcast (MULCAST) system. The MULCAST system provides eight channels of frequency division multiplex teleprinter traffic on each transmission. We will discuss the MULCAST system in greater detail in chapter 11.

MEDIUM FREQUENCIES

Only the upper and lower ends of the medium-frequency (MF) band are used for naval communications. Frequencies in the lower portion of the MF band (300 to 500 kHz) are used mainly for surface wave transmissions. These transmissions cover moderate distances over water and moderate-to-short distances over land.

The commercial broadcast band extends from about 535 to 1605 kHz, which is the middle of the MF band. The Navy uses the upper portion of the MF band (2 to 3 MHz) extensively for short-distance point-to-point communications. The range of communications in the upper portion is generally moderate and dependent upon the type of antenna used. The range of communications is also dependent on the output power of the transmitter.

Because of the rather long antennas required, the MF band is usually used with horizontal wire antennas if antenna space is unrestricted. In mobile applications, whip antennas are normally used for short-distance communications.

HIGH FREQUENCIES

The high-frequency (HF) band (3 to 30 MHz) is used for long-range communications. Until recently, the HF band was the primary frequency range used for Navy ship-to-shore communications circuits.

VERY HIGH AND ULTRA HIGH FREQUENCIES

The very-high-frequency (VHF) and ultra-high-frequency (UHF) bands are used extensively for line-of-sight voice communications. UHF frequencies are also used for U.S. Navy tactical satellite communications.

SUPER HIGH AND EXTREMELY HIGH FREQUENCIES

The super-high-frequency (SHF) and extremely-high-frequency (EHF) bands are used for satellite communications. The Defense Communications Agency (DCA) uses SHF frequencies for the Defense Satellite Communications System (DSCS). Satellite communications, which use EHF frequencies, are currently limited to strategic applications, but the use of EHF is rapidly expanding.

ATMOSPHERIC COMPOSITION

The atmosphere surrounding the Earth is not completely uniform or stable at any given time. Differences in moisture content, temperature, density, and number of ions occur at various heights and geographical locations. Changes in the time of day, season, and year also cause variations in the atmosphere.

As we mentioned earlier, three distinct regions exist in the atmosphere and all affect radio waves. These three regions are the **troposphere, stratosphere,** and **ionosphere**. The troposphere extends from the Earth's surface to a height of approximately 6 to 10 miles. The stratosphere extends from where the troposphere ends to about 50 miles. The ionosphere extends 50 to 250 miles above the Earth. Figure 4-2 is a graphic depiction of these layers.

TEMPERATURE INVERSION

Under normal atmospheric conditions, the warmest air is found near the Earth's surface. The air gradually becomes cooler as altitude increases. At times, however, an unusual situation develops in which layers of warm air are formed above layers of cooler air. This condition is known as a temperature inversion. These temperature inversions cause channels, or ducts, of cool air to be sandwiched between the Earth's surface and a layer of warm air or between two layers of warm air.

If VHF or UHF radio waves enter a duct at a low angle, they may be transmitted far beyond normal line-of-sight distances. When ducts are present, good reception of VHF and UHF signals at points located hundreds of miles from the transmitting station is not unusual. Temperature inversions explain why signals that are normally received only via line of sight can sometimes be received at great distances from the transmitting station.

WEATHER

Weather is an additional factor that affects the propagation of radio waves. Wind, air temperature, and the water content of the atmosphere can combine in many ways to either help or hinder propagation of radio waves. Certain combinations can cause radio signals to be heard hundreds of miles beyond ordinary ranges of radio communications. Conversely, a different combination of factors can cause attenuation (weakening) of the signal. This attenuation can be

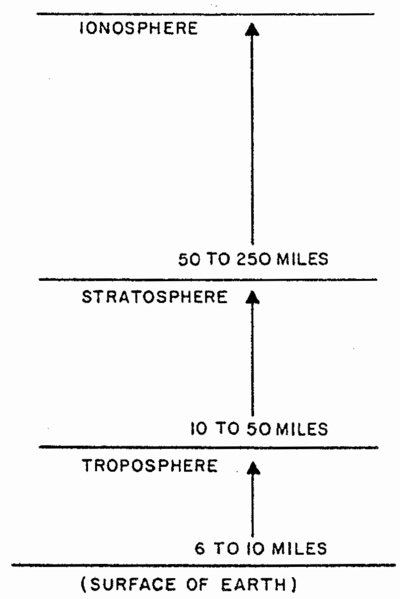


Figure 4-2.—Positions of atmospheric mediums in relation to one another.

such that the signal may not be heard even over a normally satisfactory path.

Unfortunately, there are no hard-and-fast rules concerning the effects of weather on radio transmissions. The effects are different on individual frequencies, and many different variables of weather and signal transmission exist.

Precipitation, either as rain, snow, or fog, has a significant attenuating effect on radio waves with short wavelengths. You will recall from chapter 3 that as frequency increases, wavelength decreases. Therefore, frequencies in and above the VHF band will be most affected by precipitation.

The power in the shorter wavelengths of higher frequencies is easily absorbed by moisture in the atmosphere. This is because the drops of moisture are about the same size as, or even larger than, the wavelength of the radio waves.

Precipitation can also cause scattering of the energy in radio waves. If the size of a raindrop is about the same as the radio wavelength, a large percentage of the energy may be reradiated from the raindrop in many different directions (figure 4-3). At frequencies above 100 MHz (VHF), raindrops cause greater attenuation by scattering than by absorption.

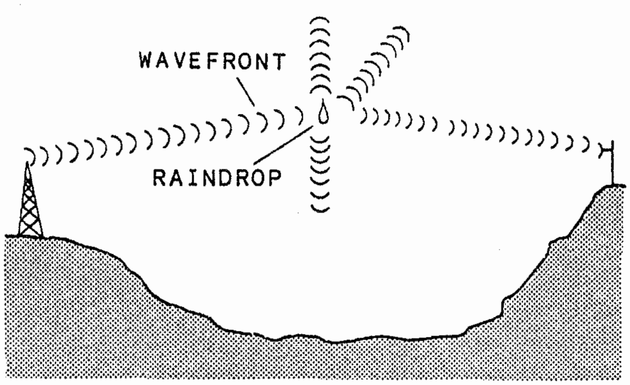


Figure 4-3.—RF energy losses from scattering.

DIFFRACTION, REFLECTION, AND REFRACTION

One of the major problems in the transmission of radio waves is the changeable conditions in the Earth's atmosphere. The effect of these constantly changing conditions on radio waves is very difficult to predict. As we mentioned earlier, atmospheric conditions can help or hinder transmissions.

To communicate effectively, you need to understand how to use the Earth's atmosphere as a transmission medium. However, you must first understand how the atmosphere affects radio waves and how radio waves travel through the atmosphere.

Radio waves travel in one of three ways from a transmitter to a receiver. One way is by **surface waves,** which travel close to the Earth's surface. Another way is by **space waves,** which travel in the troposphere. The third way is by **sky waves,** which travel through the troposphere and into the ionosphere (figure 4-4). We will discuss these three components shortly.

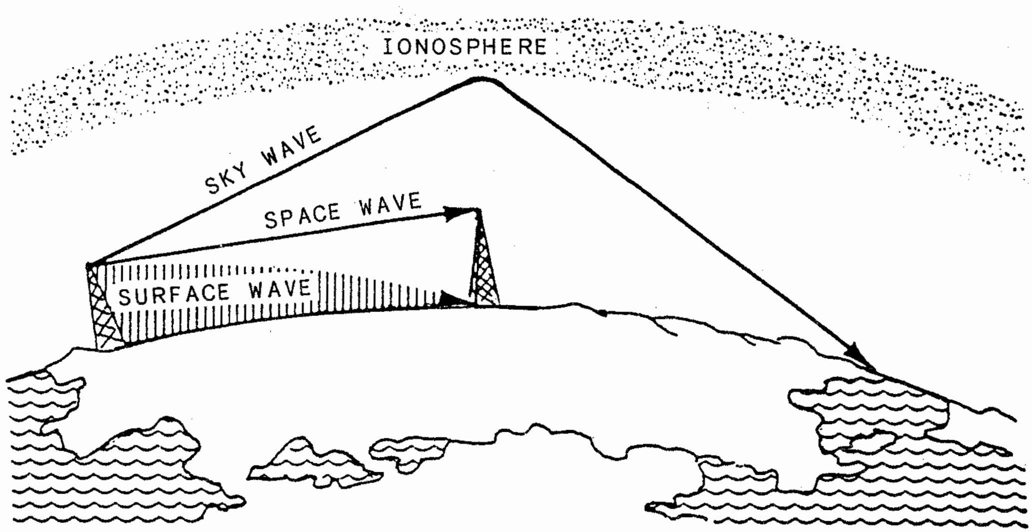


Figure 4-4.—Surface, space, and sky waves.

DIFFRACTION

If you shine a beam of light on the edge of an opaque screen in a dark room, the screen will not cast a perfectly outlined shadow. The edges of the shadow are not sharply outlined because the light rays are bent around the edges of the screen. This causes the size of the shadow to be smaller than the screen itself. This bending is called diffraction and is a phenomenon that also occurs with radio waves.

Radio waves bend, or diffract, when the waves strike a solid or very dense object. The diffraction of radio waves causes the waves to change direction. Figure 4-5 shows the diffraction of radio waves around a solid object. View A of the figure is a top view of the shadow zone; view B shows the shadow zone from a side view.

The frequency of a radio wave determines how much a wave will bend. The lower the frequency, the more the wave will bend, or diffract. Sound waves, which have a very low frequency, diffract more than radio waves, which have higher frequencies.

Diffraction explains why radio waves of proper frequency can be received on the far side of a mountain or in a valley. Diffraction also explains why the range of VHF and UHF line-of-sight communications can extend beyond the horizon.

REFLECTION

Radio waves can also reflect off objects placed in their path. For a radio wave to be reflected, the reflecting object must have a smooth surface. The reflecting object also must have some degree of conductivity and must be physically larger than the wavelength of the radio wave.

If the object is not smooth or is smaller than the wavelength, the energy in the wave will scatter when it strikes the object. Large bodies of water are good reflectors because they are good conductors and generally are fairly smooth. Large, smooth metal surfaces are also efficient reflectors.

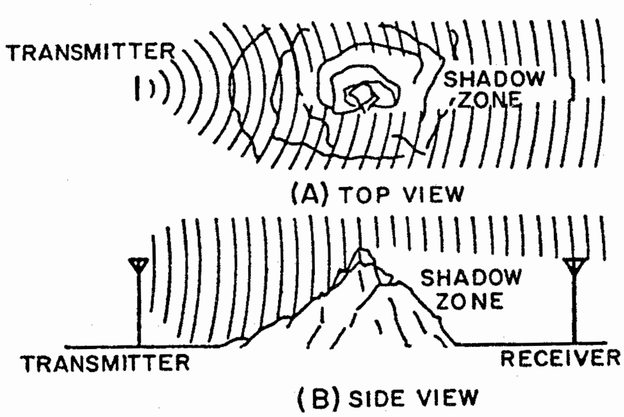


Figure 4-5.—Diffraction of radio waves around a solid object.

REFRACTION

When a radio wave passes from a substance of one density into a substance of a different density, the wave bends to some degree. Figure 4-6 shows a radio wave striking the surface of a body of water. The water, being more dense than air, tends to slow and bend the radio wave downward. The degree that the wave is bent is the **index of refraction**. The more the wave is bent, the higher the index of refraction.

In the ionosphere, layers of varying density exist because of the number of ions found at different heights. The exact ion density varies greatly from moment to moment. When a radio wave passes from a layer of one ion density into a layer of different density, the wave is bent, or refracted.

The direction the wave is refracted depends upon whether the wave is passing into a more-dense layer or into a less-dense layer. A wave that passes into a more-dense layer is refracted downward. Conversely, a radio wave that passes into a less-dense layer is refracted upward.

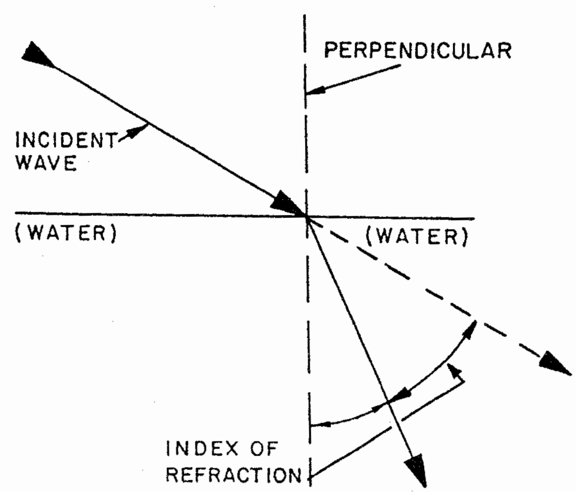


Figure 4-6.—Radio wave striking the surface of a body of water.

Refraction can be more easily understood by the illustration in figure 4-7. As you can see, there is a plowed field in the middle of a parade ground. Now compare the radio wave with a company of recruits marching four abreast at an angle across the parade ground to the plowed field, then crossing the plowed field and coming out on the other side onto the parade ground again. As the recruits march diagonally across the parade ground and begin to cross the boundary onto the plowed field, the front line is slowed down. Because the recruits arrive at the boundary at different times, they will begin to slow down at different times (number 1 slows down first and number 4 slows down last in each line). The net effect is a bending action. When the recruits leave the plowed field and reenter the parade ground, the reverse action takes place.

The index of refraction depends primarily upon the following four elements:

- The number of ions present. (We will discuss the effect of ions on radio-wave transmissions later.)
- The frequency of the radio wave.
- The power of the transmitter.
- The angle at which the wave is transmitted into the atmosphere.

The frequency and the transmitter power are variable and can be selected by the radio operator. However, the angle of transmission is usually fixed and is determined by the physical installation of the transmitting antenna. Most antennas are installed to achieve a specific angle of transmission, which the radio operator cannot change.

The effects of frequency and power on refraction are basically the same. Higher frequencies in and above the UHF range normally are not refracted by the ionosphere, regardless of the angle of transmission. High-power transmissions also may not be refracted by the ionosphere if the angle of transmission is too great. However, antennas used for transmissions that depend upon refraction for effective communications (HF antennas) are generally installed to allow for maximum transmitter power.

One of the biggest problems with radio communications is transmissions over great distances. The difficulty arises because the curvature of the Earth prevents most radio waves from traveling directly from the transmitting antenna to the receiving antenna. To overcome this problem, we use the

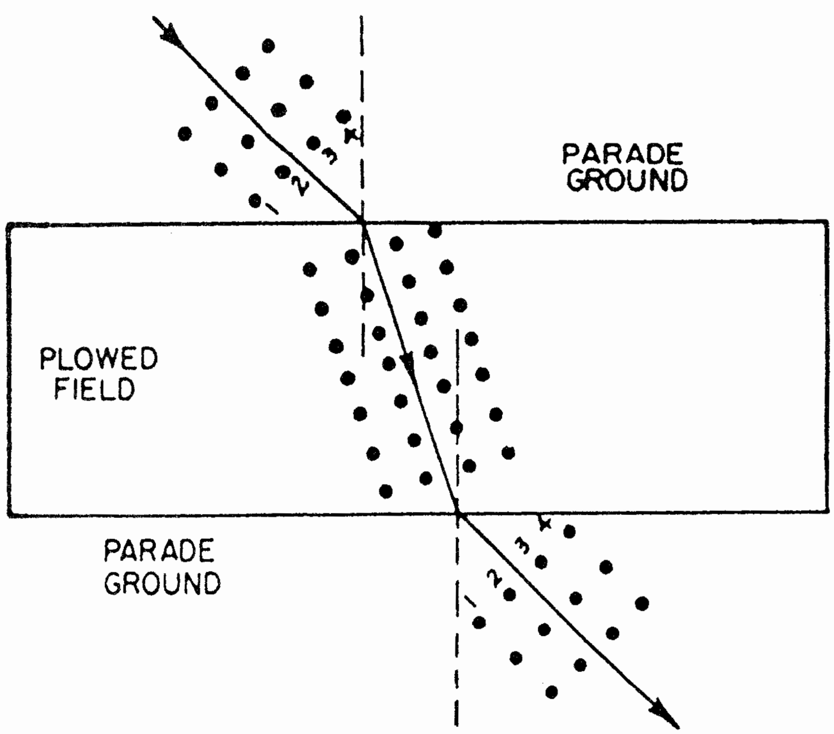


Figure 4-7.—Analogy of refraction.

ionosphere to refract radio waves back to the Earth's surface.

Figure 4-8 shows how the ionosphere is used to refract radio waves. In figure 4-8, waves (A), (B), and (C) represent three separate radio-wave transmissions. Wave (A) was transmitted almost straight up into the Earth's atmosphere. Waves (B) and (C) were transmitted at smaller angles in reference to the Earth.

Wave (A) travels through the troposphere and is refracted only slightly as it passes into the ion dense layers of both the stratosphere and the ionosphere. Notice that once the wave passes through the ion layers present in the ionosphere and into outer space where little ionization occurs, the wave is refracted again and continues away from the Earth.

Wave (B) represents a radio wave that is transmitted at the proper angle to accomplish long-range communications. The frequency, transmitter power, and the angle of transmission of wave (B) combine to create a proper index of refraction to return the radio wave back to the Earth's surface.

Wave (C) is transmitted at too low an angle to permit wave refraction to return it to the surface of the Earth. Note that while the ionosphere refracts wave (C), the index of refraction is too small to return the radio wave back to the Earth.

Using the ionosphere to refract radio waves presents a whole set of problems in itself. This is because the atmosphere is in a constant state of change, as we discussed in the previous section. We will discuss these problems in the section on basic ionospheric propagation.

RADIO-WAVE COMPONENTS

As we mentioned earlier, radio-wave transmissions can have as many as three major components: surface waves, space waves, and sky waves. The components that are present in any particular transmission depend primarily upon the type and position of the transmitting antenna.

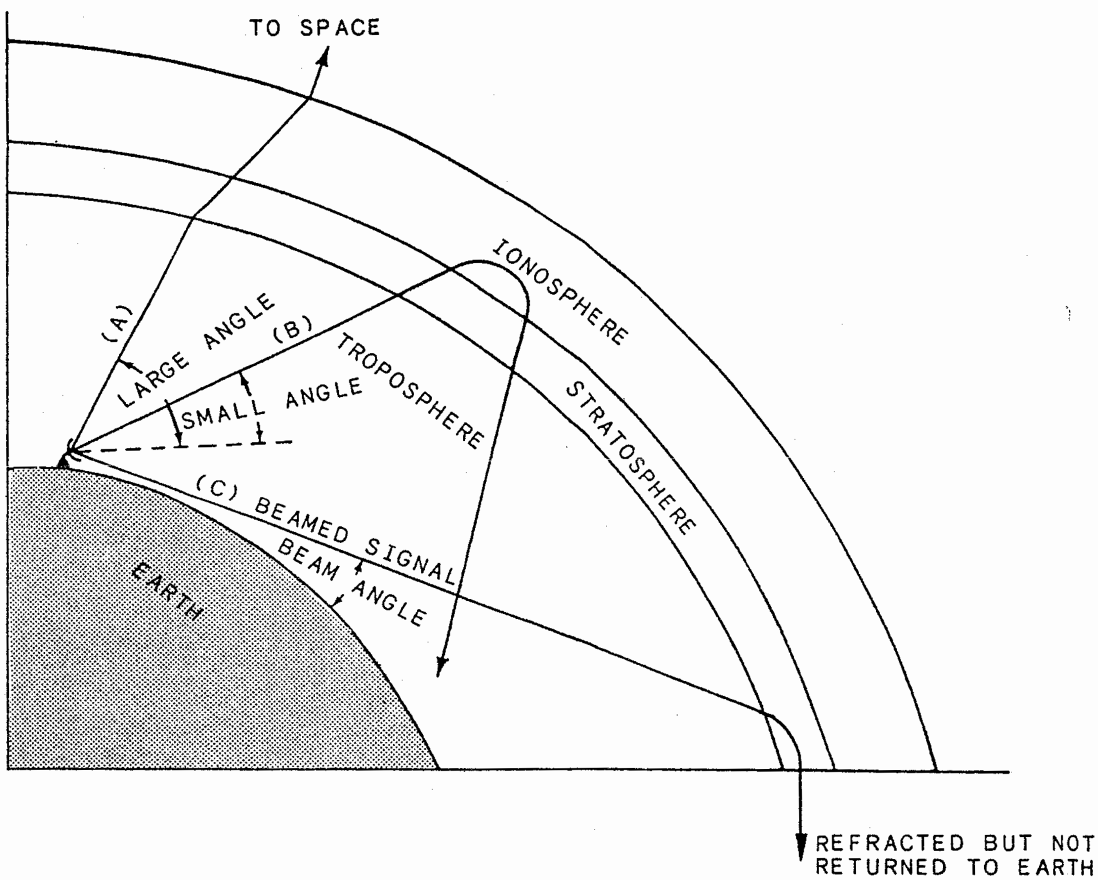


Figure 4-8.—Refraction of radio waves in atmosphere.

SURFACE WAVES

Surface waves occur in most communications, regardless of the type and position of the antenna. Transmitted surface waves follow the curvature of the Earth and are gradually attenuated by the Earth's surface.

The amount of attenuation depends on the electrical properties of the terrain over which the wave must travel and the strength of the signal. For example, water obviously is a much better conductor of electricity than rocky terrain. So, a surface wave passing over water would travel farther and be less attenuated than a wave of equal power passing over rocky terrain. Table 4-2 shows the relative conductivity of various terrain.

Generally, LF, VLF, and ELF communications rely on surface waves as a form of propagation. These communication methods use the good propagation characteristics of the ocean surface to achieve the long-distance coverage of fleet broadcasts transmitted in these low-frequency ranges.

SPACE WAVES

Space waves travel directly from the transmit antenna to the receive antenna and are called line-of-sight (LOS) communications. In LOS communications, no sky wave component is present. VHF and UHF communications are propagated via LOS as space waves in the troposphere. Weather and other atmospheric conditions directly affect LOS communications.

The effective distance of LOS communications is from the transmitter to the horizon plus a small added distance achieved by diffraction of the wave around the Earth's curvature. The effective distance of LOS communications can be extended by elevating either or both the transmitting and receiving antennas. However, as we mentioned earlier, the angle of transmission of most antennas is usually fixed during installation and cannot be moved by the radio operator.

SKY WAVES

Two methods of communications use sky waves for propagation. The first is high-frequency (HF) communications. In HF communications, the frequency, transmitted power, and angle of transmission are set so that the radio wave will be properly refracted in the ionosphere and returned to Earth. HF communications rely on the conditions that exist in the ionosphere for effective communications to be achieved. Any changes in the ionosphere can directly impact HF communications.

The second method of communications that use sky waves is satellite communications. Satellite communications use super and extremely high frequencies (SHF and EHF) and an angle of transmission that causes the radio wave to pass directly through the ionosphere with little or no refraction. These radio waves continue into outer space where they are

Table 4-2.—Relative Conductivity of Earth's Terrain

TYPES OF SURFACE	RELATIVE CONDUCTIVITY
Seawater	Good
Large bodies of fresh water	Fair
Wet soil	Fair
Flat, loamy soil	Fair
Dry, rocky terrain	Poor
Desert	Poor
Jungle	Unusable

eventually received by a satellite. Changes in the ionosphere usually have little impact on satellite communications.

Figure 4-9 shows some of the many possible paths that radio waves of various frequencies can take between a transmitter and a receiving station. Notice that some of the waves pass through the ionosphere and are lost into space. These waves have either too high of a frequency or the angle of transmission is too large to allow for enough refraction.

Figure 4-9 also shows the skip zone and the skip distance of a transmitted signal. The skip zone is the area between the end of the surface wave range and the point where the sky wave first returns to Earth. The skip distance is the distance from the transmitting antenna to the nearest point at which the refracted waves return to Earth.

The skip zone depends upon how much power is radiated in the surface wave and the amount the wave is attenuated by the terrain it must pass over. The skip distance depends upon the density of the ionosphere and the frequency, transmitted power, and angle of the radio wave.

A receiving station located within the skip zone will not be able to receive the radiated signal. If communications with that station are desired, another method, such as LOS or satellite communications, must be used.

BASIC IONOSPHERIC PROPAGATION

The ionosphere begins approximately 50 miles above the Earth. This layer differs from other atmospheric layers in that it contains a much higher number of positive and negative gas ions. These ions are formed when gas atoms are exposed to ultraviolet and infrared radiation from the Sun and from cosmic rays. Exposure to radiation dislodges electrons from gas atoms, causing the atoms to become ions. The result of this ionization is a large number of gas ions and free electrons that are not attached to any atom.

In outer space, gas atoms are too sparse to provide significant numbers of ionized atoms. Significant ionization occurs in the upper atmosphere where gas atoms are much more abundant. As solar ultraviolet radiation passes through the upper ionosphere, it is absorbed in the process of ionization. Below an altitude of about 40 miles, most of the ultraviolet

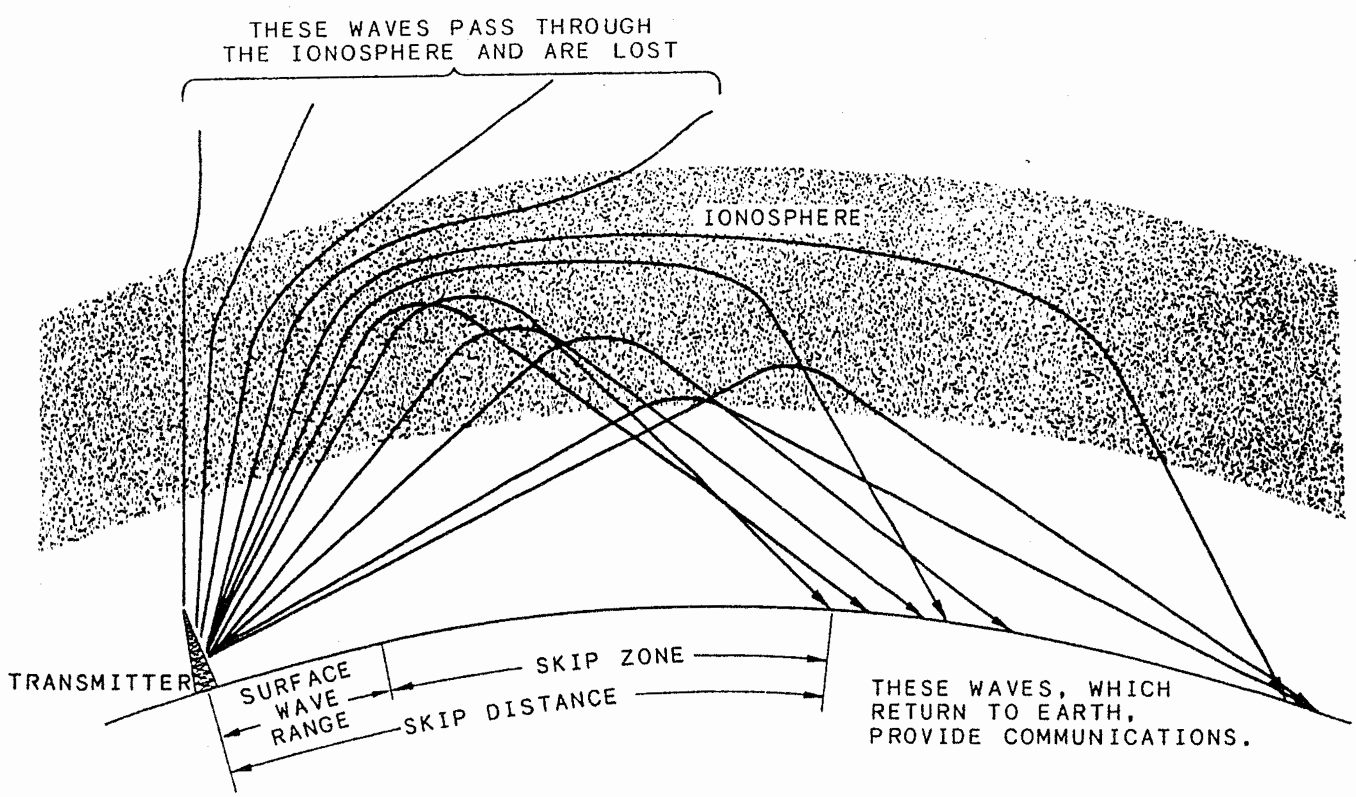


Figure 4-9.—Possible paths for radio waves.

radiation has been absorbed. Therefore, very little ionization occurs in the lower portions of the atmosphere. The result is that the ions needed to refract radio waves exist in large numbers only in the ionosphere. Ions rapidly decrease in numbers as altitude decreases.

At various times, the ionosphere can consist of up to four distinct layers. The layers are designated D, E, F1, and F2. The lowest level is the D layer; the highest layer is the F2 layer. The presence or absence of these layers and their thickness varies with the strength of the solar radiation. At high noon, solar radiation is greatest, while at night it is at a minimum. At night, the distinction between the F1 and F2 layers becomes negligible, and the D layer disappears altogether. During the day when the amount of radiation is highest, all four layers are present. Figure 4-10 shows the various layers that exist in the ionosphere at night and during the day.

D Layer

The D layer exists in the ionosphere at an altitude between 40 and 50 miles and is present only during the day. The D layer begins to disappear at sunset. The number of ions existing in the D layer is relatively low. Therefore, its ability to refract radio waves is limited to low-power, low-frequency transmissions.

E Layer

The E layer exists in the ionosphere at an altitude between 50 and 90 miles. The E layer is a well-defined layer with the greatest ion density about 70 miles up. This layer is strongest during daylight hours and is also present, but much weaker, at night.

The maximum density of the E layer occurs about midday. This is when the ionization of the E layer is sometimes sufficient to refract frequencies in the lower HF band back to Earth. Effective HF communications at distances up to 1,500 miles can be accomplished using the E layer, providing the proper combination of power and frequency can be found.

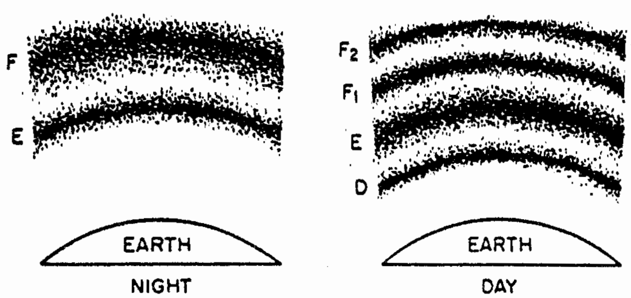


Figure 4-10.—Ionospheric layers at night and during the day.

F Layer

The F layer extends from about the 90-mile level to the upper limits of the ionosphere. During daylight hours, both F1 and F2 layers exist. At night, these layers combine to become the F layer. The ionization in the F1 and F2 layers is quite high and varies widely from moment to moment. This portion of the atmosphere is closest to the Sun, and at noon the degree of ionization is maximum. Although ionization is low at night, the F layer still has the most ions of any layer in the atmosphere.

At sunset, ionization begins to decrease, and the F1 and F2 layers begin to combine and eventually become the F layer. At sunrise, ionization increases, and the F layer expands into the F1 and F2 layers. Effectively, this means that during the hours of sunrise and sunset, the F layers are rapidly changing and can greatly affect radio-wave transmissions. During these hours, HF communications must be closely monitored. Changing frequencies and power levels may be necessary to maintain effective communications.

Sporadic E

Erratic patches of ionized gases appear in the E layer much in the same way that clouds appear in the sky. These patches are in addition to the normal ionization presence in the E layer. These patches are sporadic-E ionization and may appear in considerable strength. Sporadic-E ionization can severely disrupt HF communications.

USABLE FREQUENCIES

Because the ionosphere is constantly changing, the frequency necessary to establish and maintain optimum HF communications at any given time may be difficult to determine. Frequency tables are issued to help radio operators predict the **maximum usable frequency** (MUF) for every hour of the day.

These frequency tables are prepared from data collected continually from radio stations around the world. Other frequency selection guidelines are found in Naval Computer and Telecommunications Area

Master Station Communications Information Bulletins (CIBs) and communications advisories. You will also find frequency selection guidelines in *Recommended Frequency Bands and Frequency Guide*, NTP 6 SUPP-1.

IONOSPHERIC ABSORPTION

As radio waves pass into the ionosphere, they lose some of their energy to the free electrons and ions present there. This loss of energy is called absorption. Absorption of radio energy accounts for the majority of the energy lost during transmission and occurs when the radio wave collides with the electrons and ions in the ionosphere.

IONOSPHERIC VARIATIONS

Since the ionosphere exists primarily because of solar radiation, any variation in the strength of the radiation will cause the ion density to change. Some of the changes in the ion density of the ionosphere are periodic and can be predicted to occur on a regular basis. Other changes are unpredictable and can be severe enough to radically affect HF communications.

Despite the damaging effects of these unpredictable changes, one of your primary jobs as an HF radio operator will be to find the best and most reliable frequencies. You must also constantly monitor the circuits to ensure that adverse effects are noticed and corrected promptly.

PERIODIC VARIATIONS

Daily variations of ionization are caused by the 24-hour rotation of the Earth. As we mentioned earlier, ionization is higher during the day than at night. When selecting frequencies for HF communications, a radio operator usually should use lower frequencies at night and higher frequencies during the day.

Seasonal variations also occur as the intensity of the solar radiation changes with the position of the Earth in its orbit around the Sun. Seasonal variations differ, depending upon where you are in the world at any given time of the year. The closer you are to the Equator, the less the seasonal variation. As you move away from the Equator, either north or south, seasonal variations become more pronounced. Although these variations do exist, they usually do not have a significant effect on the selection and use of HF frequencies.

Sunspot activity varies in an 11-year cycle. Sunspots, which appear when violent solar eruptions occur, are seen as dark spots on the Sun's surface. During periods of high sunspot activity, ionization of the layers in the atmosphere is greater than normal and higher than normal frequencies may become usable. However, higher energy absorption may also occur in the D and E layers during sunspot activity.

As a radio operator, you must be aware of when sunspot activity is expected. The exact effect sunspots will have on your particular circuits is unpredictable. You must be ready to monitor communications circuits, find alternate frequencies, and quickly restore communications if outages occur.

FADING

Fading is a variation in the strength of a radio signal at the receiving end of a transmission. Fading occurs for several reasons. The major cause of fading is multipath fading. Multipath fading occurs when the transmitted signal is received at the same time from two or more different paths.

Fading also occurs when radio waves are refracted in the ionosphere or reflected from the Earth's surface. Random variations in polarization of the signal may occur. These variations can cause changes in the received signal level because the receiving antenna is set to receive a signal that is polarized in one specific direction.

Another reason for fading is that the operating frequency selected is too close to the MUF. If this is the case, any slight change in the ionosphere might cause a change in signal strength.

Fading also results from absorption of the signal energy in the ionosphere. Absorption fading occurs for a longer period of time than other types of fading. This phenomenon is the result of the length of time required for an ionized layer to change ion density.

Multipath Fading

Figure 4-11 shows some of the various paths a signal can use to travel between two stations. One signal, the surface wave, followed path XYZ. Another signal, refracted from the F layer, followed path XFZ. At point Z, the received signal is a combination of the surface wave and the sky wave. If these two waves are received out of phase, they will produce a weak or fading signal. If the waves are received in phase, they will produce a strong signal.

Because VHF transmissions travel along the Earth's surface and through the troposphere, they are highly susceptible to multipath fading.

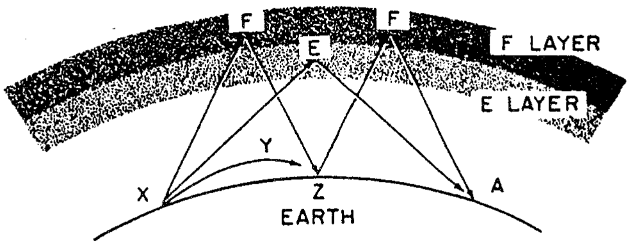


Figure 4-11.—Various paths a signal may travel.

Selective Fading

When a wide band of frequencies, such as a multichannel broadcast tone pack, is used to transmit, the amount of fading the various frequencies in the tone pack experience can be different for each frequency. Some of the frequencies may not fade at all, whereas others may fade radically. This type of fading is called selective fading and can cause severe distortion of various channels in the tone pack.

TACTICAL FREQUENCY MANAGEMENT SYSTEM

Communications equipment that operates in the high-frequency (HF) range depends on conditions in the ionosphere for good propagation. Frequencies selected from this range must propagate well and be relatively interference free. The CHIRPSOUNDER Tactical Frequency Management System (TFMS) allows us to choose those frequencies.

The AN/TRQ-35 CHIRPSOUNDER system consists of three unique pieces of equipment. Normally, the shore station has the TCS-4B transmitter, whereas the ship has both the RCS-4B receiver and the RSS-4B spectrum monitor.

The TCS-4B transmitter emits a continuous-wave signal that sweeps upward through the HF spectrum. The RCS-4B receiver works in synchronization with the transmitter and tunes upward at the same rate. The radio waves reflected by the ionosphere are received and analyzed by the RSS-4B spectrum monitor. The monitor then stores and can display, upon request, clear and interference-free channels.

The TFMS is a stand-alone communications system that must be managed. Widespread use calls for close coordination to prevent redundancy and interference from other installed systems. Unified commanders are responsible for sounder operations and policy within their areas of responsibility. Additional information on the AN/TRQ-35 CHIRPSOUNDER Tactical Frequency Management System is available in NTP 6(C).

SUMMARY

As you have learned from this chapter, radio-wave communications are very complex and require considerable knowledge and skill. As a radio operator, your goal is to establish and maintain effective communications, regardless of atmospheric conditions. To meet this goal, you must know and understand how radio waves are propagated and the various effects the atmosphere can have on communications. You must also know how to deal with those effects as they arise.

RECOMMENDED READING LIST

NOTE

Although the following references were current when this TRAMAN was published, their continued currency cannot be assured. You therefore need to ensure that you are studying the latest revisions.

Fleet Communications (U), NTP 4(C), Commander, Naval Telecommunications Command, Washington, D.C., 1988.

Naval Telecommunications Procedures, Recommended Frequency Bands and Frequency Guide, NTP 6 Supp-1(S), Commander, Naval Telecommunications Command, Washington, D.C., 1993.

Naval Telecommunications Procedures, Spectrum Management Manual, NTP 6(C), Commander, Naval Telecommunications Command, Washington, D.C., November 1988.

Navy Electricity and Electronics Training Series (NEETS), Module 10, *Introduction to Wave Propagation, Transmission Lines, and Antennas*, NAVEDTRA 172-10-00-83, Naval Education and Training Program Development Center (NETPDC*), Pensacola, Fla., 1983.

*Effective 1 September 1986, the preceding title NETPDC was officially changed to Naval Education and Training Program Management Support Activity (NETPMSA).

CHAPTER 5

COMMUNICATIONS ORGANIZATION, ADMINISTRATION, AND PUBLICATIONS

CHAPTER LEARNING OBJECTIVES

Upon completing this chapter, you should be able to do the following:

- *Discuss the national and defense communications systems.*
- *Discuss the Defense Information Systems Agency (DISA).*
- *Define the mission and policy of naval communications.*
- *Discuss the naval telecommunications system.*
- *Explain naval communications management.*
- *Identify the role of the naval warfare publications library.*
- *Identify the objectives of naval communications planning.*

"Naval communications" is the term assigned to the entire communications effort of the Department of the Navy, both afloat and ashore. The naval communications complex is the total of all Navy-operated communications installations and services. The communications complex provides, operates, and maintains tactical communications, including fleet broadcast, ship to shore, and air to ground. The operating forces and all commands and activities ashore depend on this complex for reliable transmission and receipt of information.

In this chapter, we will give you a broad overview of how naval communications is organized at shore commands and aboard ship. We will also discuss the various publications used in naval communications. These publications provide standard guidance for all phases of naval communications, such as basic communications doctrines, message preparation, and proper circuit discipline.

NATIONAL COMMUNICATIONS SYSTEM

The National Communications System (NCS) was established to achieve a cohesive effort in the event of war. The NCS provides a unified governmental system that links together the communications facilities and components of the various Federal agencies. Essentially, all branches of the Federal Government, both civilian and military, are part of the NCS. Each department and branch, however, has its individual organization, methods, and procedures.

DEFENSE COMMUNICATIONS SYSTEM

The Defense Communications System (DCS) exists to support the three military departments (Navy, Army, Air Force) and other Department of Defense activities. The circuits that make up the DCS are government-owned or leased and are point-to-point circuits that are long-haul and worldwide. The DCS combines many of the communication elements of the three military forces into a single communications system.

Although the Naval Telecommunications System (NTS) and the DCS are two different communications systems (fleet and ashore, respectively), they are constantly intermixed. For example, as often happens, a naval message originated aboard ship and destined for a shore activity leaves the ship over the NTS, but final routing is accomplished over the DCS circuits. The interface between the NTS and DCS is always provided by the shore communications facility.

DEFENSE INFORMATION SYSTEMS AGENCY

The Defense Information Systems Agency (DISA) gives operational direction to the DCS. With reference to the DCS, the DISA must ensure that the system is operated and improved so as to meet the continual long-haul, point-to-point requirements that arise.

The DISA functions under the management of a director who is appointed by the Secretary of Defense. The director is a flag-rank officer and is responsible for coordinating the combined communications elements of the three military departments.

MISSION OF NAVAL COMMUNICATIONS

The mission of naval communications is to provide and maintain reliable, secure, and rapid communications, based on war requirements, to meet the needs of naval operating forces. Naval communications must also satisfy the requirements of the Defense Communications System (DCS) and the National Communications System (NCS).

Naval communications must always be ready to shift to the requirements of wartime. Our peacetime organization and training must be capable of making this shift rapidly and with a minimum of changes. Without this capability, our forces would be severely handicapped, and vital defense information would never reach its destination. For this reason, we have a well-defined communications structure, with responsibilities assigned to each element, from the Chief of Naval Operations (CNO) down to individual fleet units.

POLICY OF NAVAL COMMUNICATIONS

The policy of naval communications is to:

- Establish and maintain effective communications within the Department of the Navy;
- Encourage at all levels of command an effort to improve techniques, procedures, and efficiency;
- Cooperate with the military services, Defense Information Systems Agency (DISA), and other departments and agencies of the U.S. Government and allied nations;
- Encourage development of the amateur and commercial communications activities of the United States to enhance their military value and to safeguard the interests of the nation; and
- Promote the safety of life at sea and in the air by maintaining communications facilities with the U.S. Merchant Marine, aircraft over sea, and appropriate U.S. and foreign communication stations.

NAVAL TELECOMMUNICATIONS SYSTEM

The word "telecommunications" includes all types of information systems in which electric or electromagnetic signals are used to transmit information between or among points. The Naval Telecommunications System (NTS) is comprised of all the end terminal processing equipment, transmission, switching, cryptographic, and control devices used to transmit operational information in the Navy.

The NTS provides electrical and optical communications from the commander in chief and naval commanders down to all naval forces under their command. You should remember that the NTS is used primarily to exercise command and control over the naval operating forces; not the shore establishment. Most shore establishments are served through the Defense Communications System (DCS). Naturally, there are overlapping portions of each system where necessary.

Operational direction and management control of the assigned elements of the NTS are the responsibility of the Commander, Naval Computer and Telecommunications Command (COMNAVCOMTELCOM).

In naval communications, COMNAVCOMTELCOM determines the responsibilities of each of the various commanders, whether a fleet commander or the commanding officer of a ship. For example, direction and control of all naval fleet broadcasts, ship-shore, air-ground, and other direct fleet-support telecommunications are assigned to the fleet commanders in chief. That is to say all Pacific Fleet naval broadcasts are under the operational direction and control of the Commander in Chief, Pacific Fleet (CINCPACFLT). The same applies to Atlantic Fleet naval broadcasts. These broadcasts are under the operational direction and control of the Commander in Chief, Atlantic Fleet (CINCLANTFLT).

Fleet commanders in chief are responsible for the adequacy of communications to satisfy the needs of their respective fleets. They, in turn, assign broad communications responsibilities in the form of fleet operation orders (OPORDs). OPORDs are to be complied with at every level down through individual commanding officers of operating ships.

The commanding officers use only those portions of the fleet commander's communications OPORD that affect them. In this simple, yet direct, manner, the NTS is administered at every operational level in the fleet, according to that ship's mission and communication needs. We will talk more about OPORDs later in this chapter.

The Naval Telecommunications Command is composed of the following elements:

- Commander, Naval Computer and Telecommunications Command (NAVCOMTELCOM);
- Naval Computer and Telecommunications Area Master Stations (NCTAMSs);
- Naval Computer and Telecommunications Stations (NAVCOMTELSTAs, sometimes referred to as NCTSs);
- Naval Communications Detachments (NAVCOMTEL DETs, also abbreviated NCTDs);
- Naval Data Automation Commands (NAVDACs);
- Naval Security Group Departments (NAVSECGRUDEPTs) of NAVCOMTELSTAs; and
- Navy-Marine Corps Military Affiliate Radio System (MARS).

COMMANDER, NAVAL COMPUTER AND TELECOMMUNICATIONS COMMAND

With the merging of automatic data processing (ADP) and telecommunications, the mission and responsibilities of COMNAVCOMTELCOM have greatly increased. For the remaining 1990s, you will see COMNAVCOMTELCOM continue to change and grow as telecommunications technology advances into the 21st century.

There have already been changes in the makeup of the COMNAVCOMTELCOM claimancy as communications stations have merged with Naval Regional Data Automated Centers (NARDACs). Those communications stations that do not merge with an ADP activity will become Naval Computer and Telecommunications Stations (NCTSs) or Naval Computer and Telecommunications Detachments (NCTDs).

Although not all-inclusive, COMNAVCOMTELCOM's responsibilities include the following:

- Integrates and consolidates Navy common-user ashore communications and information resources (IR) (including personnel) into the NAVCOMTELCOM claimancy, and implements Navy IR management policy within the claimancy;
- Advises the Director, Naval Space and Warfare Command of validated communications requirements that may demand development or modification of satellite communications systems;
- Formulates policy on and exercises authoritative control over the Navy Communications Security Material System (CMS), and reviews or initiates action in cases of loss or compromise of CMS material;
- Serves as Department of the Navy (DON) manager of leased portions of Navy-dedicated and common-user information transmission systems;
- Manages the Navy and Marine Corps Military Affiliate Radio System (MARS) and coordinates Navy participation in amateur radio matters;
- Establishes, implements, and maintains the Fleet Operational Telecommunications Program;
- Manages International Maritime Satellite (INMARSAT) communications ground interfaces to naval communications for the DON and handles any other commercial telecommunications authorized by law or treaty;
- Operates and maintains the NCTSs, NARDACs, and assigned elements of the Defense Communications System (DCS);
- Serves as technical advisor to CNO for communications/enlisted ratings (RM, DP, ET, DS), and assists in career development and training for these ratings; and
- Serves as central design agency for communications in the DON, and performs life-cycle

management on Navy Standard Communications Software components.

NAVAL COMPUTER AND TELECOMMUNICATIONS AREA MASTER STATIONS (NCTAMSs)

As we mentioned earlier, there have been changes in the claimancy of NAVCOMTELCOM. As a result, each of the former NAVCAMS has been redesignated as a NCTAMS, and has merged with a NARDAC. The four NCTAMSs are NCTAMS EASTPAC, Honolulu, Hawaii; NCTAMS LANT, Norfolk, Virginia; NCTAMS WESTPAC, Guam; and NCTAMS MED, Naples, Italy.

The world is divided into four Naval Communications Areas (NAVCOMMAREAs): Western Pacific (WESTPAC), Eastern Pacific (EASTPAC), Atlantic (LANT), and Mediterranean (MED) (figure 5-1). All communications activities within any of these geographical areas are organized to operate under the operational control of a NCTAMS. These master stations are the major sites in a COMMAREA and are the primary keying stations for that area. They are the entry points for Navy Tactical Satellite Systems and also operate and maintain one or more Defense Satellite Communications System (DSCS) terminals.

The NCTAMSs have, as part of their organization, a fleet telecommunications operations center (FTOC). This is the focal point for fleet communications support.

To support the operating forces of each fleet commander in chief (FLTCINC), the authority to exercise operational direction over all NAVTELCOMs is delegated on an area basis to the commanding officers of the master stations. Operational direction is decentralized down to the commanding officers of the NCTAMSs. These commanding officers report to and are immediately responsible to the FLTCINC. COMNAVCOMTELCOM, however, exercises overall operational direction to assure integration of the worldwide system, taking into consideration the requirements and priorities of other FLTCINCs and/or higher authority. You should refer to the appropriate Fleet Operational Telecommunications Program (FOTP) manual for further information.

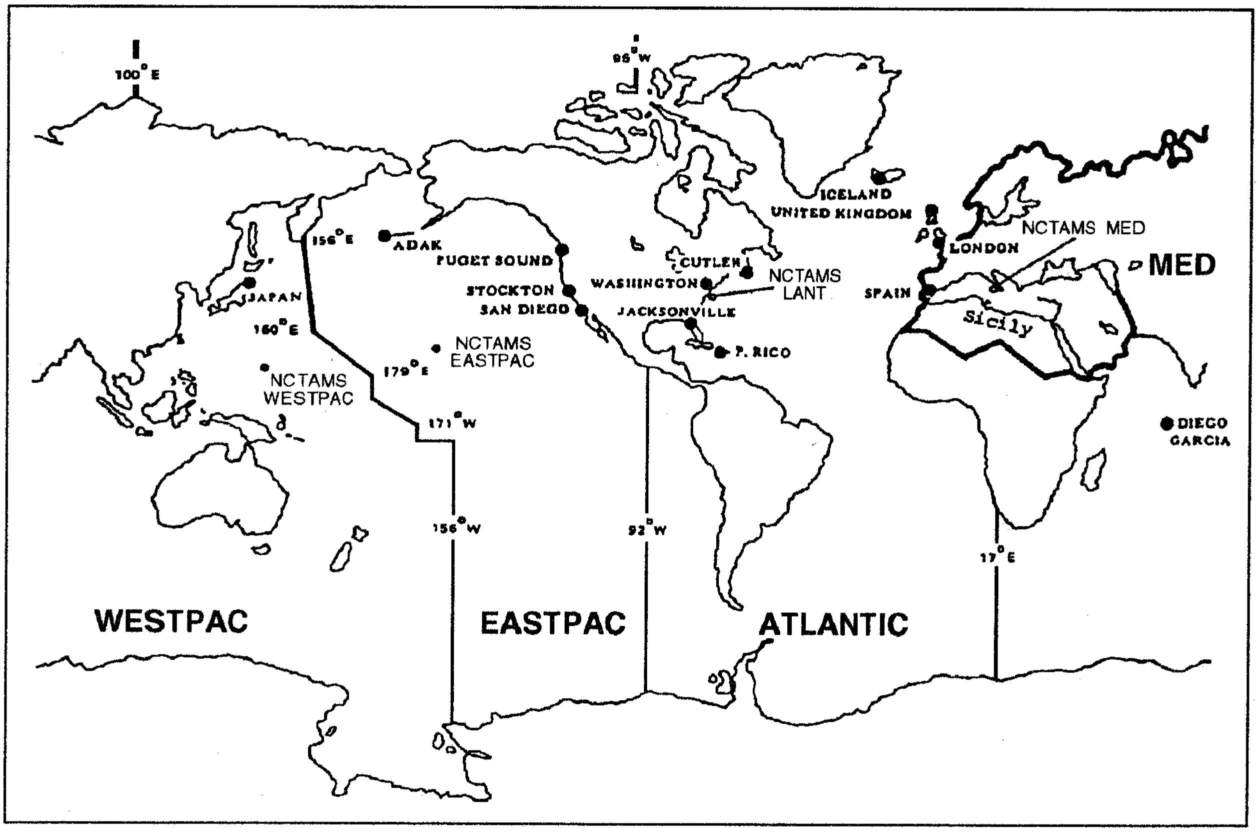


Figure 5-1.—Naval communications areas.

Within the various NAVCOMMAREAs are alternate NCTAMSs. They coordinate control of communications under the direction of the primary NCTAMSs.

NAVAL COMPUTER AND TELECOMMUNICATIONS STATION

A Naval Computer and Telecommunications Station (NAVCOMTELSTA) is a communications station with the primary responsibility for communications in a large specific area. This responsibility includes all communications facilities and equipment required to provide essential fleet support and fixed communications services. For example, NAVCOMTELSTA, Diego Garcia, serves a large geographical area of the Pacific and Indian oceans. It also includes facilities and equipments necessary to interface with all other NAVCOMTELSTAs or communications detachments on all naval communications matters. It also provides Naval Industrial Fund (NIF) ADP services to Navy customers.

NAVAL COMPUTER AND TELECOMMUNICATIONS DETACHMENT

A Naval Computer and Telecommunications Detachment (NAVCOMTEL DET) is a small telecommunications facility that is assigned a limited, or specialized, mission and has a limited number of personnel and facilities.

NAVAL DATA AUTOMATION FACILITY

A Naval Data Automation Facility (NAVDAF) comes under the control of an NCTS or a NARDAC. NAVDAFs provide ADP services in areas where no NARDACs are located. The workload of a NAVDAF is normally less than that of a NARDAC.

NAVAL SECURITY GROUP DEPARTMENTS

The Naval Security Group Departments (NAVSECGRUDEPTs) come under the authority of Commander, Naval Security Group Command (COMNAVSECGRU) and are responsible for the cryptologic and related functions of the Navy. NAVSECGRUDEPTs may be part of a NCTAMS or a NAVCOMTELSTA. As such, COMNAVSECGRU exercises technical control over the cryptologic operations, whereas COMNAVCOMTELCOM has overall responsibility for the management and operating efficiency of the NAVSECGRUDEPTs.

NAVY-MARINE CORPS MILITARY AFFILIATE RADIO SYSTEM (MARS)

A function of the Navy-Marine Corps Military Affiliate Radio System (MARS) is to provide auxiliary communications to military, civil, and/or disaster officials during periods of emergency. The Navy encourages amateur radio operators to affiliate with MARS. Many of the operators have earned their amateur radio licenses from the Federal Communications Commission.

The amateur radio operators, using their amateur stations on Navy radio frequencies, receive training in naval communications procedures and practices. Besides assisting in emergency situations, MARS operators also create interest and furnish a means of training members in naval communications. You can find detailed information about the MARS program in *U.S. Navy-Marine Corps Military Affiliate Radio System (MARS) Communications Instructions*, NTP 8.

NAVAL COMMUNICATIONS MANAGEMENT

As radiomen advance, they can expect to assume additional authority and responsibility. A first class or chief will most likely be placed in charge as a watch supervisor, leading petty officer or chief, or even as a division officer. These are only a few of the many leadership positions to which they might be assigned. In summary, eventually a career Radioman is going to be a manager.

The Navy has conducted extensive studies to pinpoint problems in the area of communications organization and management. These were done to allow communications personnel to take corrective action on the problem areas. Use of sound managerial principles helps us accomplish our mission.

All levels of management require an evaluation standard. Managers are then able to properly evaluate specific communication systems or components. Such an evaluation provides a basis for comparison of equipment, personnel, and even complete facilities. This evaluation forms the basis for establishing additional standards and guidelines. A continuing evaluation requires data collection via a system of feedback reports from all managerial levels.

EVALUATING PERFORMANCE

Effectiveness of naval communications is the first consideration in the management of any communications facility. The overall capability must be viewed in relation to each functional unit. Standards of performance can be established and control elements determined. An evaluation of the entire system must be completed by the highest level of command. Each operational unit must be scrutinized by the chief or first class in charge.

Establishing Standards

Standards of performance must be established to determine the effectiveness of operations and service provided against customer requirements and system capability. Standards must be established for internal functions as well as for overall system performance. After performance standards are established, the control elements and manner of control can be determined.

It is most important that performance standards be established in the general areas of reliability, speed, security, and economy. These areas can be broken down into standards for internal operation, equipment, personnel, maintenance, supply, and so forth.

Realistic standards of performance must be established. This allows maximum use of resources without overcommitment. The standards must be compatible with command requirements and within resource capability. The standards must also be flexible enough to allow for changing operating conditions. Skill levels and manning levels change constantly. Equipment status and configurations are never stable. Operating conditions and commitments change from day to day. Therefore, each communications facility manager must establish flexible standards to accommodate changing requirements and situations.

Management Responsibilities

Midmanagement radiomen must realize the need for progressively improving standards. The following points may assist midmanagement radiomen in improving standards within their division:

- **Overcoming Resistance**—The practice of relying on past performance as a basis for establishing standards is often sound. With an organized effort, however, conditions can be changed to improve performance. If the personnel responsible for better performances participate in the organized effort, the problem of resistance to higher standards is often eliminated.

- **Improving Conditions**—Owing to the rapid growth and change in the character of communications systems, considerable managerial effort must be devoted to improving the effectiveness of operations and service. The essential approach to this type of problem can be summarized in a sequence of three stages:

  —Discovery of the problems; that is, what part of an existing condition needs improving;

  —Diagnosis to determine what changes are needed to bring about the needed improvement; and

  —Remedial action; that is, implementing the necessary changes.

- **Responsibility**—Responsibilities must be established in accordance with the organizational structure and be clearly defined.

- **Organizational Considerations**—Leading radiomen must realize that the existing organizational structure may be a contributing factor to poor personnel performance. In such instances, recommendations to realign the organizational structure must be seriously considered.

- **Conservation of Personnel Resources**—The communications facilities manager must be constantly aware of the need to conserve personnel resources at all levels. Conservation of personnel resources is accomplished by evaluating personnel requirements properly and by using available personnel effectively through proper training and assignment.

GENERAL ADMINISTRATION

A communications facility should function effectively and efficiently. This is normally the result of the senior supervisor's ability to set up and manage the organization.

Good supervisors retain open minds. They recognize the need for change and implement those changes as required. They acquire a thorough knowledge of the functions performed by their area of responsibility and understand how it relates to the overall mission. Only then can they plan a rational approach to correct a problem or make positive changes.

Although the current structure and methods may meet the objectives of the division, a periodic review should still be conducted. The goal is to develop more efficient office methods, techniques, and routines. Procurement of state-of-the-art equipment may require a complete evaluation and reorganization of divisional workflow and workspace layout. To plan properly, the supervisor must know the following information:

- **WHAT** work is to be done;
- **WHY** the work is to be performed;
- **WHEN** the work is to be performed;
- **HOW** the work is to be accomplished;
- **WHERE** the work is to be performed; and
- **WHO** is responsible for completing the work.

PERSONNEL MANAGEMENT

Good managerial traits and supervisory abilities are prerequisites for the first class or chief petty officer who is required to function as a front line supervisor and manager. The RM1 or RMC will normally be the RM supervisor and will have many managerial and supervisory responsibilities added to those present at the junior petty officer level.

Supervision involves working with people, and a major responsibility of a supervisor is production. A good supervisor knows how to get a job done by getting the most out of personnel. However, the desire to attain an acceptable production level must not be at the expense of personnel assets. People have the right to be treated as individuals and respected as such. If treated in any other manner, no amount of pressure will create a permanent increase in production levels. While you want to achieve a high level of production, you also want your personnel to produce willingly and be interested in their work.

OFFICE MANAGEMENT

The physical location of a communications office is normally predetermined by higher authority. Furthermore, the space allotted to the various sections is usually determined by competent engineers based on available space. After discussing the matter with the senior petty officers in the division, the division officer or division chief usually determines the physical location of furniture and equipment.

When the office layout is being planned, primary consideration must be given to proper flow of paper and work, the physical location of workspaces, and the internal communications of the division.

Secondary factors to be considered are the number of personnel to be accommodated, safety standards, security of classified material, structural location of electrical outlets, and physical locations of bulkheads and passageways.

Paper and Work Flow

Good paper flow is the smooth movement of paperwork from one desk or individual to another. As much as possible, the paperwork should flow in one direction through various sections with no reversals or crisscrossing. Figure 5-2 shows the ideal communications space layout with sequential workflow. Placing related tasks in adjacent spaces reduces distance and increases efficiency of operations. This ultimately increases the work accomplished.

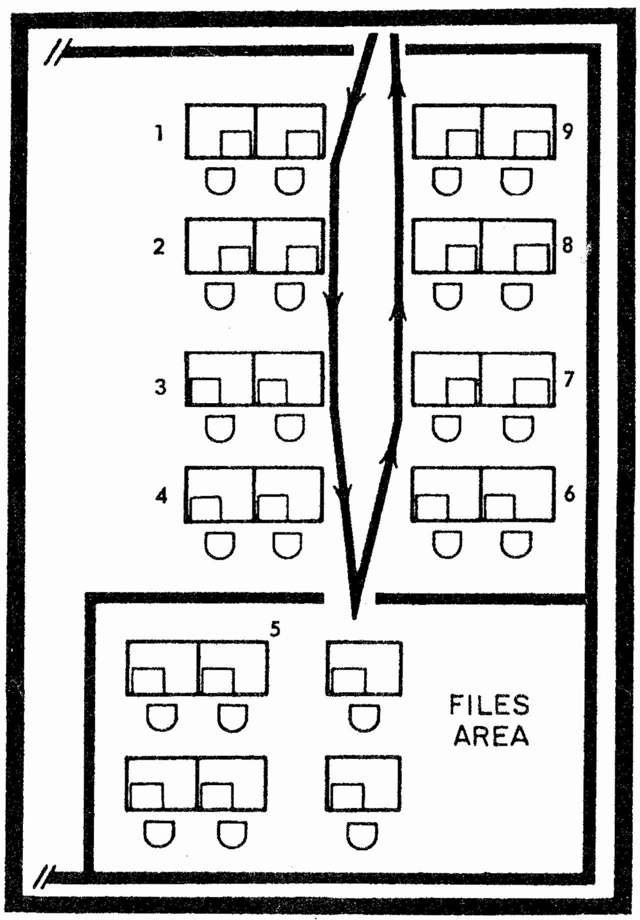


Figure 5-2.—Ideal communications space layout.

Workflow affects the placement of sections within the division and the location of desks, files, and other equipment. Changes should only be made to improve workflow. Deviations from approved methods can result in loss of time and motion and cause delays in completion of work assignments.

Physical Factors

The physical layout of workspaces should be reviewed when:

- There is evidence of improper workflow;
- The number of personnel or office procedures change;
- The volume of work increases or decreases;
- New equipment is ordered or is to be installed; or
- There is a change in allotted space.

Before actually moving personnel or equipment, it is a good idea to draw a scale model of the anticipated layout. You can then evaluate the idea and judge its effectiveness.

In evaluating an office layout, you should consider the following factors:

- Office congestion;
- Personnel supervision;
- Use of space;
- Volume of work versus people; and
- Office appearance.

Internal Communications

A large portion of communications office work consists of receiving, distributing, and filing communications, reports, instructions, and records. Another major portion of the work is the disposition of correspondence. When handling correspondence, the supervisor must establish standard procedures. Once decided, these procedures should be conveyed both vertically and horizontally. Vertical communications are routed up and down the chain of command. Horizontal communications are routed to other divisions and departments.

Vertical communications can be either formal or informal. Formal information usually consists of office procedures, watches, schedules, job instructions, and written orders. Formal communications are handled to ensure wide dissemination and accuracy of information, to avoid distortions, and to provide a permanent record. Informal information is usually passed orally and provides guidance and instructions on work assignments.

Horizontal communications can be either formal or informal. Personnel holding parallel positions (two watch supervisors for instance) can sometimes resolve problems through informal communications without involving higher authority. On the other hand, formal communications must be used when the subject requires approval through the chain of command. Formal communications may be in the form of station directives, administrative procedures, or station watch bills.

COMMAND COMMUNICATIONS ORGANIZATION

The structure of the communications organization of a command depends on command size and whether the command is ship- or shore-based. Not all Navy ships have a communications department. *Basic Operational Communications Doctrine (U)*, NWP 4, designates the types of ship that should have a communications department. In ships that are not so designated, communications personnel are assigned to the operations department, but the communications functions are the same as those for ships with a communications department. Future organization may structure communication and automated systems into a combined information systems department.

Senior enlisted personnel may be assigned communications duties normally assigned to officers if there are insufficient officers to fill communications billets. Figure 5-3 shows a normal shipboard communications organization. Key billets are further discussed in this chapter.

Commanding Officer

The commanding officer of a ship or a shore command is responsible for the communications of that command. The only exception to this is when a flag officer is embarked aboard a ship, making that vessel the flagship. In such cases, the embarked commander assumes control of flagship communications. The commanding officer is still responsible for the proper handling of message traffic within the ship.

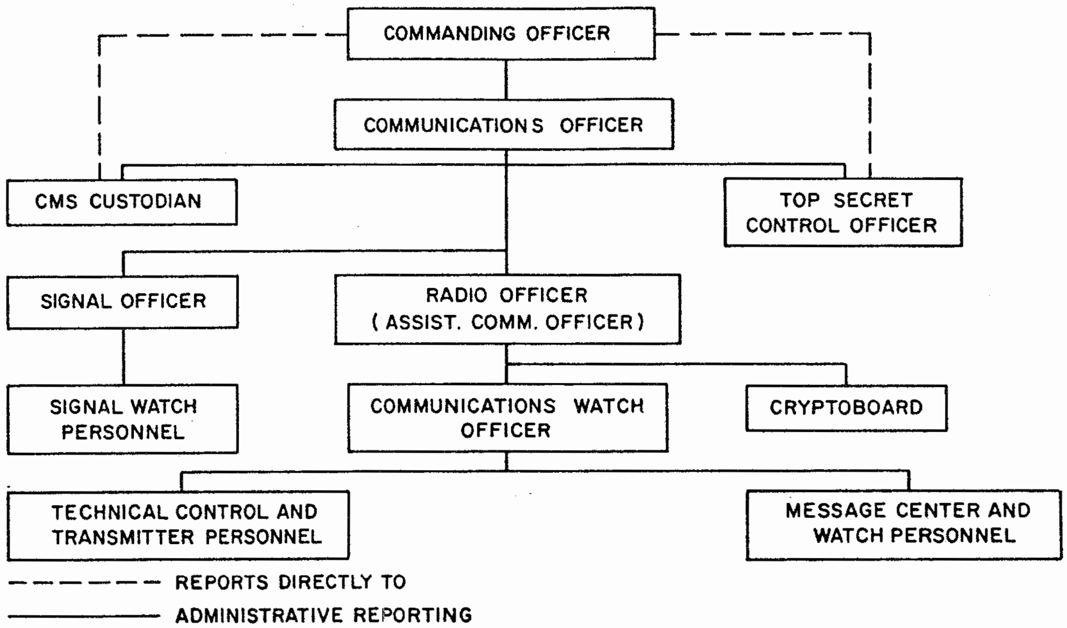


Figure 5-3.—Communications organization.

Communications Officer

The communications officer (COMM officer) is responsible for the organization, supervision, and coordination of the command's exterior communications. At shore stations, the COMM officer is the department head. Aboard ship, the COMM officer may be assigned as a department head or may be assigned under the operations officer. Aboard ship, the COMM officer is also responsible for the management of related internal communications systems.

Radio Officer

The radio officer is in charge of the communications center. This officer is responsible for organizing and supervising assigned personnel to ensure accurate, secure, and rapid communications. The radio officer is responsible to the communications officer for:

- Preparing the command's communications plan;
- Monitoring the proper allocation of equipment for operations;
- Preparing and maintaining the communications watch, quarter, and station bill;
- Conducting the communications training program; and
- Preparing standard operating procedures (SOPs) for the communications center. On small ships, the communications officer and the radio officer may be the same person.

Communications Security Material System (CMS) Custodian

The CMS custodian is responsible to the commanding officer for:

- Managing the CMS account in accordance with the instructions contained in the *Communications Security Material System (CMS) Policy and Procedures Manual*, CMS 1;
- Advising the commanding officer on matters concerning the physical security and handling of CMS publications and materials;
- Stowage of CMS publications and materials, as well as the drawing, correcting, and authorized destruction; and
- Submitting all reports concerning the accountability and issuance of CMS publications and materials.

Watch Section Personnel

The functions of the operational organization of a communications command consist of:

- Message processing, circuit operation, technical control, data processing, and operation; and

- Control of voice circuits and the operation of satellite circuits, where installed.

The combined efforts of the operational organization are performed in various spaces simultaneously. In the next section, we will discuss the duties and responsibilities of some of the key billets within this organization.

COMMUNICATIONS WATCH OFFICER (CWO).—The CWO is responsible to the communications officer for:

- Ensuring that communications capabilities are accomplished in accordance with the command's mission;
- Incoming and outgoing traffic, ensuring that all messages, transmitted or received, are handled rapidly and accurately in accordance with existing regulations; and
- Ensuring compliance with existing communications directives and monitoring the performance of on-watch personnel and spaces.

Fleet Communications (U), NTP 4, contains a detailed listing of the duties of the CWO.

SENIOR WATCH SUPERVISOR (SWS).—When assigned, the SWS is the senior enlisted person on watch in communications spaces and is responsible to the CWO for:

- The proper handling of all communications;
- Notifying the CWO on all matters of an urgent or unusual nature;
- Examining operational logs and monitoring equipment alignment and operation; and
- Directing action necessary to prevent or overcome message backlogs.

In addition to the duties listed in NTP 4, the SWS is also responsible for any other duties as may be assigned by the CWO.

COMMUNICATIONS CENTER SUPERVISOR.—The communications center supervisor is responsible to the CWO and SWS for:

- Supervising message processing and circuit operations;
- Directly supervising all radiomen on watch in the message processing center; and
- Notifying the CWO and SWS on all matters of an unusual or urgent nature.

TECHNICAL CONTROL SUPERVISOR.—The technical control ("tech control") supervisor is responsible to the CWO for:

- Establishing and maintaining required circuits, and initiating action to restore or bypass failed equipment;
- Ensuring that quality monitoring and control procedures are used on all systems;
- Maintaining the status board showing pertinent information on all equipment, nets, and circuits in use; and
- Directly supervising all personnel assigned to technical control and transmitter room spaces.

Command Ship Communications

The term "flagship" is sometimes used instead of "command ship" but means the same thing. Either term means that a group, squadron, or division commander is embarked on board, thereby making that vessel the flagship, or command ship. We mentioned earlier that, in flagships, the embarked commander assumes responsibility for communications functions. The flag communications officer is responsible for ship and flag communications requirements. However, the internal routing of message traffic remains the responsibility of the commanding officer of the ship in which the flag is embarked.

When a flag officer is embarked, the ship's communications officer, communications watch officers, and enlisted communications personnel may be ordered to additional duty in the flag communications division. These personnel are directly responsible to the flag communications officer for the operation of the flag communications functions. The ship's communications officer reports to the flag communications officer and is the contact officer for matters pertaining to the handling of ship and staff message traffic. Figure 5-4 illustrates a standard watch organization aboard a ship with a flag embarked.

By now, you should have a basic idea of how naval communications is organized at shore commands and aboard ship. Remember that there are variations in all organizations. The size, scope of operations, and personnel assets are just a few of the factors that affect the structure of the communications organization.

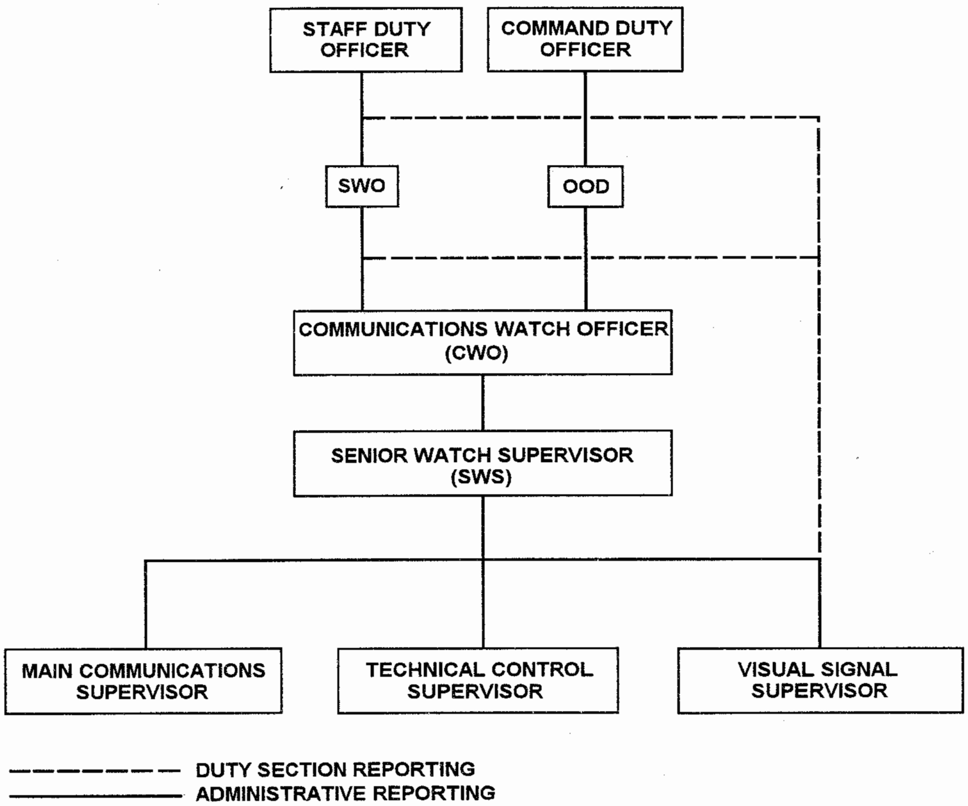


Figure 5-4.—Communications watch organization.

OPERATION ORDERS

Operation orders (OPORDs) are directives issued by naval commanders to subordinates for the purpose of effecting coordinated execution of an operation. Operation orders are prepared in accordance with a standing format, as set forth in *Naval Operational Planning*, NWP 11.

An OPORD is an operations plan made up of the heading, body, and ending. The basic plan, contained in the body of the OPORD, is concise and contains minimum detail. More detailed information on various ship departments is contained in enclosures (called annexes and appendixes).

The annex of most concern to radiomen is the communications annex. The communications annex, along with its appendixes and tabs, discusses the many details to be considered in planning communications for a particular operation. In this annex, you can find such information as the applicable circuits, equipment, and frequencies that will be used in the upcoming operation.

STANDARD OPERATING PROCEDURES

In addition to the OPORDs, you should also become familiar with the standard operating procedures (SOPs) used by your division and department. SOPs should be sufficiently complete and detailed to advise personnel of routine practices. The detail depends upon such variables as the state of training, the complexity of the instructions, and the size of the command.

Staff sections, divisions, and departments often find it convenient to establish their own SOPs for operating their respective areas and for guiding their personnel in routine matters. Some examples of communications SOPs are:

- Procedures for persons going aloft;
- Handling of visitors in radio spaces; and
- MINIMIZE procedures.

Communications SOPs are written to meet an objective. SOPs may vary from command to command and may differ according to their objectives. Your job will be to recommend changes or maybe even write the objectives. In any event, a complete set of SOPs will enable you and your shipmates to perform your duties in a responsible, professional, and safe manner.

NAVAL WARFARE PUBLICATIONS LIBRARY

The naval warfare publications library (NWPL) is the designation assigned to that group of communications and operational publications designated as part of the publication allowance for the command. These publications contain required procedures, signals, and other information of an operational or mission-essential nature. They may also include information involving safety. The NWPL provides for the central administration and maintenance of communications and operational publications. These publications include, but are not limited to:

- Naval telecommunications publications (NTPs);
- Naval warfare publications (NWPs);
- Fleet exercise publications (FXPs);
- Allied tactical publications (ATPs);
- Allied exercise publications (AXPs);
- USN addenda to allied publications; and
- Miscellaneous allied publications.

The objective of central administration of naval warfare publications (NWPs) is to ensure that these publications are correct and readily available for their intended use. Some NWPs contain information that is necessary for the proper performance of individual duties and is important for individual professional development. Therefore, NWPs must be readily available for use by individuals with a duty-related need or a general professional need for the information.

NAVAL WARFARE PUBLICATIONS CUSTODIAN

The responsibility for managing the NWPL is assigned to an officer or senior petty officer who is responsible to the executive officer, department head, or division officer. This assignment is a collateral duty, and the person assigned is known as the naval warfare publications custodian (NWPC). This person is responsible for the overall administration and security of the NWPL in accordance with the *Naval Warfare Documentation Guide*, NWP 0.

NAVAL WARFARE PUBLICATIONS LIBRARY (NWPL) CLERK

The NWPL clerk is a person assigned by the NWPC. The clerk is responsible for the upkeep and maintenance of the library. The NWPL clerk maintains all records and receipts in the central file, orders all necessary publications and changes thereto, and enters all changes and amendments to publications physically held in the NWPL. The clerk reports all matters of concern to the library custodian.

NWPL ADMINISTRATION

The NWPL custodian issues publications to holders and short-term users. A holder is a person who has permanent subcustody of a publication under the central control of the NWPL. The holder is responsible for maintaining the publication, entering all changes and amendments, and providing adequate security. A user is a person who checks out a publication for temporary or short-term custody.

Signature custody and disclosure records for classified material are maintained as required by the *Department of the Navy Information and Personnel Security Program Regulation*, OPNAVINST 5510.1. This book is also known as the *Security Manual*. Signature custody of unclassified publications is not required. However, the records of the NWPL should provide an up-to-date location of publications that have been issued to holders or checked out to users. Where signature custody is not required, a locator card may be used in place of a catalog card to check out publications to users.

NWPL MAINTENANCE

Several basic files are used in maintaining the NWPL. One is the custody file, which contains a NWPL Catalog Card, OPNAV Form 5070-11 (figure 5-5), for each naval warfare publication on allowance or on board. The purpose of this file is to maintain an up-to-date record of the holder and location of each publication. This record also helps keep track of entries and changes to the publication. The catalog card can also be used as a custody card and as a destruction record. When used as a record for security purposes, it must be retained as required by the *Security Manual*.

The administrative file, sometimes called the transaction file, contains designation letters for custodian, local allowance/inventory sheets, the directives file, responsibility acknowledgment forms,

SHORT TITLE	COPY NUMBERS ON HAND	CLASSIFICATION OF PUBLICATION
NTP 4( )	m 1, p 2, 3, 4, 5, 6	
LONG TITLE		EFFECTIVE DATE

CHANGE OR CORRECTION	DATE OF ENTRY BY COPY NUMBER									
	1	2	3	4	5	6	7	8	9	10
CHG #1										
CHG #2										
MSG CORR 1/1										

NOTES: MSG CORR entered into a microfiche copy of a publication will be placed into the envelope with the copy and annotated on the envelope.

ENTRY DATE will be written into each column for each copy of the publication receiving change or correction.

OPNAV FORM 5070-11 (11-57) BACK

DISPOSITION OF PUBLICATION						
COPY NO.	HOLDER (Signature)	LOCATION	REC'D. DATE	RETURN DATE	DESTRUCTION DATE	DESTRUCTION AUTHORITY
1&2	NWPL Custodian's Sig	NWPL	*1		*5	*6
1	Subcustodian's Sig	RADIO CENTRAL	*2	*3		
1	NWPL Clerk's Sig	NWPL	*4			

NOTES:
*1. Date copy received into library.
*2. Date subcustodian received copy.
*3. Date subcustodian returned copy to library. (Signature of clerk witnessed by subcustodian)
*4. Date publication received by library.
*5. Date copy destroyed.
*6. Authority cited for destruction of copy.

Figure 5-5.—NWPL Catalog Card.

CHANGE ENTRY CERTIFICATION
OPNAV 5070/12 (REV. 6-75)

RETURN TO NAVAL WARFARE PUBLICATIONS LIBRARY

SHORT TITLE	COPY NO.	CHANGE	EFFECTIVE DATE

REMARKS:

I certify that the above change or correction has been entered and the list of effective pages was checked against the contents of the basic publication, and the superseded pages and residue of the change were returned to the Naval Warfare Publications Library.

NOTE: *Missing pages or other defects should be reported in the REMARKS space above.*

SIGNATURE	ENTRY DATE

PART 2 S/N 0107-LF-050-7061

SHORT TITLE	COPY NO.	CHANGE	EFFECTIVE DATE

REMARKS:

I acknowledge receipt of the above change and certify that this change will be entered upon the effective date/immediately and that the superseded pages will be returned to the Naval Warfare Publications Library within five (5) working days thereafter.

SIGNATURE	DATE

PART 1 S/N 0107-LF-050-7061 C-3500

Figure 5-6.—Change Entry Certification form.

publication notice route slips, destruction records, inspection documentation letters, and copies of all correspondence pertaining to naval warfare publications. Included in the administrative file is the Change Entry Certification form, OPNAV 5070/12, shown in figure 5-6. This form is filled out by the holder of the applicable publication. Material in the administrative file must be retained for 2 years.

NWPL BINDERS

Binders for U.S. naval warfare publications are color-coded according to their security classification. The color codes are RED for Secret, YELLOW for Confidential, and BLUE for unclassified. Allied/NATO publications have white binders regardless of security classification.

ENTRY OF CHANGES

The timely and accurate entry of changes to NWPL publications is necessary to ensure accurate, up-to-date information as well as information continuity. The NWPL clerk is responsible for making changes or corrections to NWPL publications or ensuring that holders receive and make the changes in a timely manner.

Changes are often so numerous that all communications personnel may become involved in making them. The NWPL clerk is responsible for ensuring that all personnel making changes or corrections to NWPL publications know the proper procedures for making these changes. These procedures are a follows:

- Check the Foreword or Letter of Promulgation of the change for the effective date of the change/correction to ensure that the publication to be corrected is effective.
- Read all the specific instructions contained in the change or correction before making the entry.
- Use any dark ink EXCEPT RED for pen-and-ink entries. Red is not visible under red night lights used aboard ship.
- Type lengthy pen-and-ink corrections on a paste-in cutout. All superseded matter must be deleted in ink prior to inserting the cutout.
- Use flaps when no room exists for a cutout. When used, flaps should be attached to the binder side of the page.
- Use rubber cement or mucilage for pasting instead of glue or gummed tape.
- Make a notation in the margin adjacent to the entry after making pen-and-ink corrections, citing the source of the correction; for example, ALCOM 007/94.

After page changes are entered, a page check must be conducted and the page change and page check recorded on the Record of Changes and Corrections sheet.

Corrections to NWPL publications are issued by message when the material requires rapid dissemination. These numerical message corrections (NMCs) are normally sent as general messages. NMCs are assigned a two-number designation separated by a slant sign. The first number indicates the sequential number of the message correction to the original or revised publication. The last number is the printed change that incorporates the material. For example, NMC 7/3 is the 7th message correction and is incorporated into the publication by change 3.

PUBLICATION NOTICE

A publication notice gives a brief summary of a new publication or change. The notice is included with each hardback copy and is furnished solely for routing by the NWPC. These notices keep all cognizant personnel informed of the changes to naval warfare publications. The notices are destroyed when no longer useful.

WATCH-TO-WATCH INVENTORY

To ensure positive control of NWPL publications, a watch-to-watch inventory should be conducted. At the change of each watch, the watches jointly conduct a visual inventory of every publication held by the watch section. Those loose-leaf publications requiring a page check at the end of the watch will be indicated on the inventory sheet.

The signing of the watch-to-watch inventory by the relieving watch certifies that the publications were sighted, the required page checks were conducted, and that the relieving watch stander is responsible for them. Any discrepancies should be resolved prior to the relieving of the watch.

All signatures in the watch-to-watch inventory must be in ink. The inventory may be destroyed after 30 days if it is no longer needed for local reference. If watch-to-watch inventories are not required aboard ship, a daily inventory is required.

EXTRACTS

Naval warfare publications may be extracted/reproduced for use in training or operations of U.S. forces. All extracts must be properly marked with the security classification and safeguarded in accordance with the *Security Manual.*

The classification assigned to an extract is the highest classification assigned to any article, paragraph, page, or pages from which the information is taken. Guidance for allied (NATO) publications is found in their NATO letters of promulgation.

RECEIVING NEW OR REVISED PUBLICATIONS

When new or revised publications are received, you should check the Foreword and the U.S. Letter of Promulgation for the effective status of the publication. The Foreword shows the effective status of the publication for allied usage; the U.S. Letter of Promulgation for U.S. use.

A revision to a publication can be issued that is effective for U.S. use but not for allied use. Particular care should be taken not to destroy the previous edition until the new revision is effective for allied use as well.

ALLIED COMMUNICATIONS PUBLICATIONS

With worldwide cooperation among friendly nations and the United States, the need arose for coordinated and standardized communications. To meet this need, the allied communications publications (ACPs) were developed. The ACP series provides communication instructions and procedures essential to conducting combined military operations and communications in which two or more allied nations are involved. A Radioman's work often requires familiarity with ACPs.

JOINT ARMY-NAVY-AIR FORCE PUBLICATIONS

Joint Army-Navy-Air Force publications (JANAPs) were developed to coordinate and standardize communications among the U.S. military services. The publication *Status of Noncryptographic JANAPs and ACPs*, JANAP 201, lists the short and long titles, content of each publication, and the current edition of JANAPs and ACPs.

NAVAL TELECOMMUNICATIONS PUBLICATIONS

Naval telecommunications publications (NTPs) are the main communication publications in use by the U.S. Navy, Coast Guard, and Marine Corps. The NTPs include information and guidance from basic communication information (NTP 4), to frequency spectrum management (NTP 6), and commercial traffic (NTP 9), just to name a few areas of communications.

NAVAL WARFARE PUBLICATIONS

Naval warfare publications (NWPs) incorporate the results of fleet tactical development and evaluation programs and fleet and allied (NATO) experience. NWPs also provide information about the tactical capabilities and limitations of equipment and systems. NWP 0 provides guidance for the management of the NWPL and lists the publications contained in the library.

FLEET TELECOMMUNICATIONS PUBLICATIONS

Fleet telecommunications publications (FTPs) are the guiding doctrine of a NCTAMS for the communications area under its jurisdiction. To provide optimum communications responsiveness to fleet requirements, FTPs incorporate the unique communications procedures for the COMMAREA into a standardized fleet-oriented procedural document. FTPs are based on the NTP series.

COMMUNICATIONS INFORMATION BULLETINS

Communications information bulletins (CIBs) are developed by each NCTAMS to provide reference information on specific tactical communications subjects. CIBs also provide communications operating personnel with communications procedural information applicable to a specific COMMAREA. NTP 4 lists the CIBs and their contents.

COMMUNICATIONS PLANNING

The primary objectives of communications planning are:

- To provide for effective connectivity to support the exercise of command and the exchange of essential information; and
- To advise the commander of the implications of communication capabilities and limitations for the operation plan and its execution.

The communications plan has to consider reliability, security, and speed. The communications planner chooses facilities and methods that will best satisfy operational requirements. The plan provides for the command and control capability by which the operation will be controlled and directed.

To be effective, the communications planner needs comprehensive knowledge of the organizational structure established for the operation and the capabilities and limitations of the communications and command center facilities available to the force.

COMMUNICATIONS REQUIREMENTS

The operational tasks assigned to various units require radio nets that link units engaged in the same activity or task. Communication circuits follow the command lines of the task unit or contribute to its tactical effectiveness by providing for essential information exchange. These considerations provide the essential elements for determining communications requirements.

PROTECTION OF COMMUNICATIONS

Enemy interception and disruption of communications are of primary concern to any communications planner. Every facet of communications facilities, methods, and procedures needs to be examined in terms of security, vulnerability to deception, and the electronic counter-countermeasures (ECCM) required for maximum protection.

Communications Security

Security is the safeguarding of information. As it pertains to communications, security is usually referred to in terms of communications security (COMSEC) and signal security (SIGSEC). Security will be discussed in more depth in chapter 7. Various devices and procedures are used to increase security, including:

- **Authentication**—A security measure designed to protect communications systems against acceptance of false transmissions or simulations by establishing the validity of a transmission, message, or originator.
- **Codes**—Any system of communication in which arbitrary groups of symbols represent units of plain text. Codes are often used for brevity and/or security.
- **Ciphers**—Any cryptologic system in which arbitrary symbols or groups of symbols represent units of plain text.
- **Radio Silence**—A condition in which all or certain radio equipment is kept inoperative (frequency band and/or types of equipment are specified).
- **Monitoring**—The act of listening, carrying out surveillance on, and/or recording the emissions of one's own or allied forces for the purpose of maintaining and improving procedural standards and security.
- **Identification Friend or Foe (IFF)**—A system using electromagnetic transmissions to which equipment carried by friendly forces automatically responds. For example, by emitting predetermined IFF pulses, friendly forces can distinguish themselves from enemy forces.

Communications Deception

Communications deception, part of the field of tactical deception, is the use of devices, operations, and techniques with the intent of confusing or misleading the user of a communications link or a navigation system.

ECM and ECCM

Electronic countermeasures (ECM) is that division of electronic warfare (EW) involving actions taken to prevent or reduce an enemy's effective use of the electromagnetic spectrum. Enemy ECM concerns the communications planner because overcoming enemy jamming and deception imposes certain restrictions on general communications operations procedures.

Electronic counter-countermeasures (ECCM) is that division of EW involving actions taken to ensure friendly effective use of the electromagnetic spectrum despite an enemy's use of electronic warfare. The planner must be aware of ECCM capabilities available.

THE COMMUNICATIONS PLAN

The communications plan satisfies the communications requirements of an operation. It specifies circuits, channels, and facilities to be used and stipulates the policies and procedures that are applicable. The plan is, in effect, an assignment of communications tasks to be performed by subordinate commanders or by supporting commands.

The planner first establishes requirements for communications and then determines the best means for satisfying them. This process may reveal shortages or inadequacies in what is available. If inadequacies are identified, it may become necessary to share circuits or facilities, as well as merging or consolidating requirements. All possibilities should be considered to support valid operational requirements.

In planning communications, the planner must evaluate such factors as the performance, capabilities, and capacities of systems, facilities, and personnel. These factors are merely guides and averages. They represent the sum result of experience in previous similar situations, and are considered only after any local factors are determined. These factors change from time to time and must all be available for final determination of communications requirements.

TELECOMMUNICATIONS SERVICE REQUEST (TSR)

When a command requires additions, deletions, or changes in existing Defense Communications System (DCS) circuits, it must initiate a TSR. The submission of a TSR is not a simple process and requires research and planning. The Defense Information Systems Agency (DISA) publishes a publication called *Submission of Telecommunications Service Request*, DISA CIRCULAR 310-130-1, that provides instructions for preparing and submitting TSRs. New, increased, or updated services are expensive and require substantial justification.

The increasingly high cost of telecommunications support, especially leased services, has resulted in the high visibility of communications programs at all levels of government. This fact underscores the need for managerial awareness and improved life cycle documentation of telecommunications resources.

Planning and developing a responsive naval telecommunications system requires early identification and consideration of user requirements. Programming is required to obtain necessary resources. Normally, these requirements should be defined and submitted at least 2 years in advance to permit timely system planning and programming.

TELECOMMUNICATIONS SERVICE ORDER (TSO)

The TSO is the authorization to start, change, or discontinue circuits, trunks, links, or systems. It is used to amend previously issued TSOs and to effect administrative changes.

The basic circuit design information for all new or changed circuits will be provided by the TSO. The TSO may also be used as the authority to procure specific devices and ancillary equipment necessary to install the circuit or services designated.

FREQUENCY MANAGEMENT

Over the last quarter century, electronics has pervaded virtually every facet of our life. High-tech electronic devices, especially those that radiate, make constant use of the electromagnetic spectrum.

The term "electromagnetic spectrum" refers to the natural vibrations that occur when a force is applied to a substance. These vibrations occur with various speeds and intensities. The speed at which they occur is called frequency, and the distance between each vibration is called wavelength. Frequency and wavelengths were discussed in earlier chapters.

Spectrum Management

A great invention in the 19th century ultimately led to the need for spectrum or frequency management. This invention was the wireless or, as we know it today, the radio. At first, there were only two radio frequencies—50 kilohertz (kHz) and 1000 kHz. Today, the spectrum is recognized by international treaty to extend up to 3000 gigahertz (GHz). The development of radar, satellites, and other technologically advanced systems and their subsequent demands on the frequency spectrum have contributed to the need for frequency management.

Frequency Allocation

The Department of the Navy will obligate no funds for equipment until a frequency allocation has been obtained. This means that all actions necessary to establish a frequency band for a specific item must be completed and approved prior to budgeting funds.

The allocation approval authority considers the type of service the item will provide and the classification of the emission. This authority also enforces rules and regulations and compliance with technical standards. The approval authority also ensures the compatibility of emerging equipment with other equipment operating in the same electromagnetic environment.

Interservice frequency coordination is another important consideration. It reduces the potential for harmful interference if more than one service develops similar items that will operate in the same band. The coordination is the responsibility of the Chief of Naval Operations (CNO), working through the Military Communications Electronics Board.

Frequency Assignment

Frequency assignment is the process of authorizing a system or equipment to operate on a discrete frequency (or frequencies) and within a specified set of constraints. Examples of constraints are power, emission bandwidth, location of antennas, and operating time.

Authority for using radio frequencies by Navy and Marine Corps activities within the United States and Possessions (US&P) is obtained from the Administrator, National Telecommunications and Information Administration (NTIA), Washington, D.C.

The CNO establishes overall policy for spectrum management within the Department of the Navy. Authority for using radio frequencies by Navy and Marine Corps activities within the area of responsibility of a unified or specified commander is obtained from the Joint Chiefs of Staff through the United States Military Communications Electronics Board (USMCEB). Within the Department of the Navy, the Naval Electromagnetic Spectrum Center (NAVEMSCEN) authorizes frequency assignment applications and ensures all prerequisites are completed.

SUMMARY

As you have learned from this chapter, the naval communications establishment is quite complex. We communicate not only with other U.S. naval commands, both at sea and ashore, but also with other U.S. military services and allied nations. Before the messages that you send reach their destinations, they may travel through other networks in the Defense Communications System.

The various publications that you, as a communicator, rely on are continually being updated. Communications is an area that is constantly changing in areas of equipment and procedures. Therefore, it is important that you become thoroughly familiar with all the publications and current changes that pertain to your communications area.

RECOMMENDED READING LIST

NOTE

Although the following references were current when this TRAMAN was published, their continued currency cannot be assured. You therefore need to ensure that you are studying the latest revisions.

Basic Operational Communications Doctrine (U), NWP 4 (Rev. B), Chief of Naval Operations, Washington, D.C., September 1989.

Fleet Communications (U), NTP 4(C), Commander, Naval Telecommunications Command, Washington, D.C., June 1988.

Fleet Telecommunications Procedures for Atlantic and Mediterranean Naval Communications Areas, NCTAMS LANT/MEDINST C2300.1, Naval Computer and Telecommunications Area Master Station LANT/Naval Computer and Telecommunications Area Master Station MED, September 1993.

Fleet Telecommunications Procedures for the Pacific and Indian Ocean Naval Communication Areas, NCTAMS EASTPAC/NCTAMS WESTPACINST C2000.3D, Naval Computer and Telecommunications Area Master Station EASTPAC/Naval Computer and Telecommunications Area WESTPAC, 10 August 1992.

Naval Warfare Documentation Guide, NWP 0 (Rev. P), Chief of Naval Operations, Washington, D.C., January 1990.

CHAPTER 6

MESSAGE CONTENT AND FORMAT

CHAPTER LEARNING OBJECTIVES

Upon completing this chapter, you should be able to do the following:

- *Discuss common message elements and format.*
- *Identify the classes and types of naval messages.*
- *Explain the concept of message and routing addressees.*
- *Explain the concept of plaindress and abbreviated plaindress messages.*
- *Explain the purpose of codress messages.*
- *Identify the significance of prosigns.*
- *Explain the use of operating signals.*
- *Identify the responsibilities of the message user.*
- *Summarize message verification procedures.*
- *Explain message readdressal procedures.*

The overall objective of this chapter is to introduce you to basic message formats and modes of telecommunications. A variety of message formats are used in telecommunications. The format used depends upon the method and mode of operation. For example, Automatic Digital Network (AUTODIN) message procedures and formats differ from those used in radiotelephone (R/T) and manual teleprinter communications. Although there are many types and modes of communications, the basic naval message must conform to a standard format with few exceptions. As a Radioman, you need to be familiar with all of them.

COMMON MESSAGE ELEMENTS

Before covering the basic format of military messages, we will first discuss the time system, precedence categories, and speed-of-service objectives used in naval communications.

TIME

Time is one of the most important elements in communications. Messages are normally identified and filed by either date-time group or Julian date, depending on the method of transmission.

Date-Time Group

The date-time group (DTG) is assigned for identification and file purposes only. The DTG consists of six digits. The first two digits represent the date, the second two digits represent the hour, and the third two digits represent the minutes. For example, 221327Z AUG 94 means the 22nd day of August plus the time in Greenwich mean time (GMT). The dates from the first to the ninth of the month are preceded by a zero. We will talk more about the GMT system shortly.

This designation is followed by a zone suffix and the month and year. The month is expressed by its first three letters and the year, by the last two digits of year of origin; for example, 081050Z AUG 94. The zone suffix ZULU (Z), for Greenwich mean time, is used as the universal time for all messages. The exception is where theater or area commanders prescribe the use of local time for local tactical situations. Radiomen never use 2400Z and 0000Z as the DTG of a message. The correct time would be either 2359Z or 0001Z, as appropriate.

GREENWICH MEAN TIME.—In naval communications, the date-time group is computed from a common worldwide standard. To meet the need for worldwide time standardization, the international Greenwich mean time (GMT) system was developed. The GMT system uses a 24-hour clock instead of the two 12-hour cycles used in the normal civilian world.

In the GMT system, the Earth is divided into 24 zones. Zone zero lies between 7 1/2° east and 7 1/2° west of the 0° meridian. The 0° meridian passes through Greenwich, England. The time in this zone (zone zero) is called Greenwich mean time (GMT). The military more commonly refers to this as **ZULU** time. Both names refer to the same standard.

Each time zone extends through 15° of longitude. Zones located east of zone zero are numbered 1 through 12 and are designated minus. To obtain Greenwich mean time, you must **subtract** the zone number in which you are located from local time.

Zones located west of zone zero are also numbered 1 through 12 but are designated plus. These zones must be **added** to the local zone time to obtain GMT. As we will discuss shortly, the 12th zone is divided by the 180th meridian, which is the international date line.

Each zone is further designated by a letter. Letters A through M (J is omitted) designate the eastern, or minus, zones. Letters N through Y designate the western, or plus, zones. The designating letter for GMT is Z (ZULU). The zone number, prefixed by a plus or minus sign, constitutes the zone description. Zones crossing land areas often follow boundaries, natural features, or regional demarcations to keep similar or closely related areas within the same zone.

CONVERTING GMT AND LOCAL TIMES.—Most countries have adopted the GMT system. As a Radioman, you will need to be able to convert local time to GMT. To do this, you must understand the GMT system. Figure 6-1 is a chart showing the time zones of the world. Refer to the chart as you study the material in the next paragraphs.

To illustrate converting local time to GMT, assume that we are in zone R and the local time is 1000R (10 a.m.). Referring to the time chart in figure 6-1, you can see that zone R lies west in longitude from zone zero, and is designated plus 5. Therefore, we add 5 hours to the local time, 1000, to find that GMT is 1500Z. To convert GMT to local time, we reverse the process and subtract 5 hours from the GMT (1500Z) to obtain 1000R.

The U.S. military services use the 24-hour system to express time in four-digit groups. The first two digits of a group denote the hour and the second two digits, the minutes. Thus, 6:30 a.m. becomes 0630; noon is 1200; and 6:30 p.m. is 1830. Midnight is expressed as 0000 (never as 2400), and 1 minute past midnight becomes 0001. Remember, never use 0000Z or 2400Z as the date-time group of a message to eliminate any possible confusion. The correct time would be either 2359Z or 0001Z.

We mentioned earlier that the 12th zone is divided by the 180th meridian. This meridian is the international date line (IDL) (figure 6-1). This is where each worldwide day begins and ends. A westbound ship crossing the line loses a day, whereas an eastbound ship gains a day. This time zone is divided into literal zones MIKE and YANKEE. The eastern half of zone 12 is designated MIKE (-12), and the western half is designated YANKEE (+12).

Now we come to a very important point in our discussion. Since MIKE and YANKEE are two parts of a single zone, the time in MIKE and YANKEE is always the same. When the IDL is crossed from either direction, the day must change. Since we have already established that there is a 1-hour difference between each of the 24 time zones, it is clear that there is always a situation where it is a day earlier or later in one part of the world than it is in another. The primary point to remember about this zone is that it is always the same time in zone MIKE as it is in zone YANKEE, but it is never the same day! You can find more information on time zones in *Communication Instructions General (U)*, ACP 121.

Julian Date

The Julian date consists of seven digits. The first three digits represent the day, and the last four digits represent the hour and minutes. The first day of the calendar year is Julian 001, and each day is numbered consecutively thereafter. For example, in Julian 0311315, 031 is the 31st day of the calendar year (January 31), and 1315 is the filing time.

PRECEDENCE

The message drafter indicates the desired writer-to-reader delivery time through the assignment of a message precedence. Although the drafter determines the precedence, the releaser should either confirm or

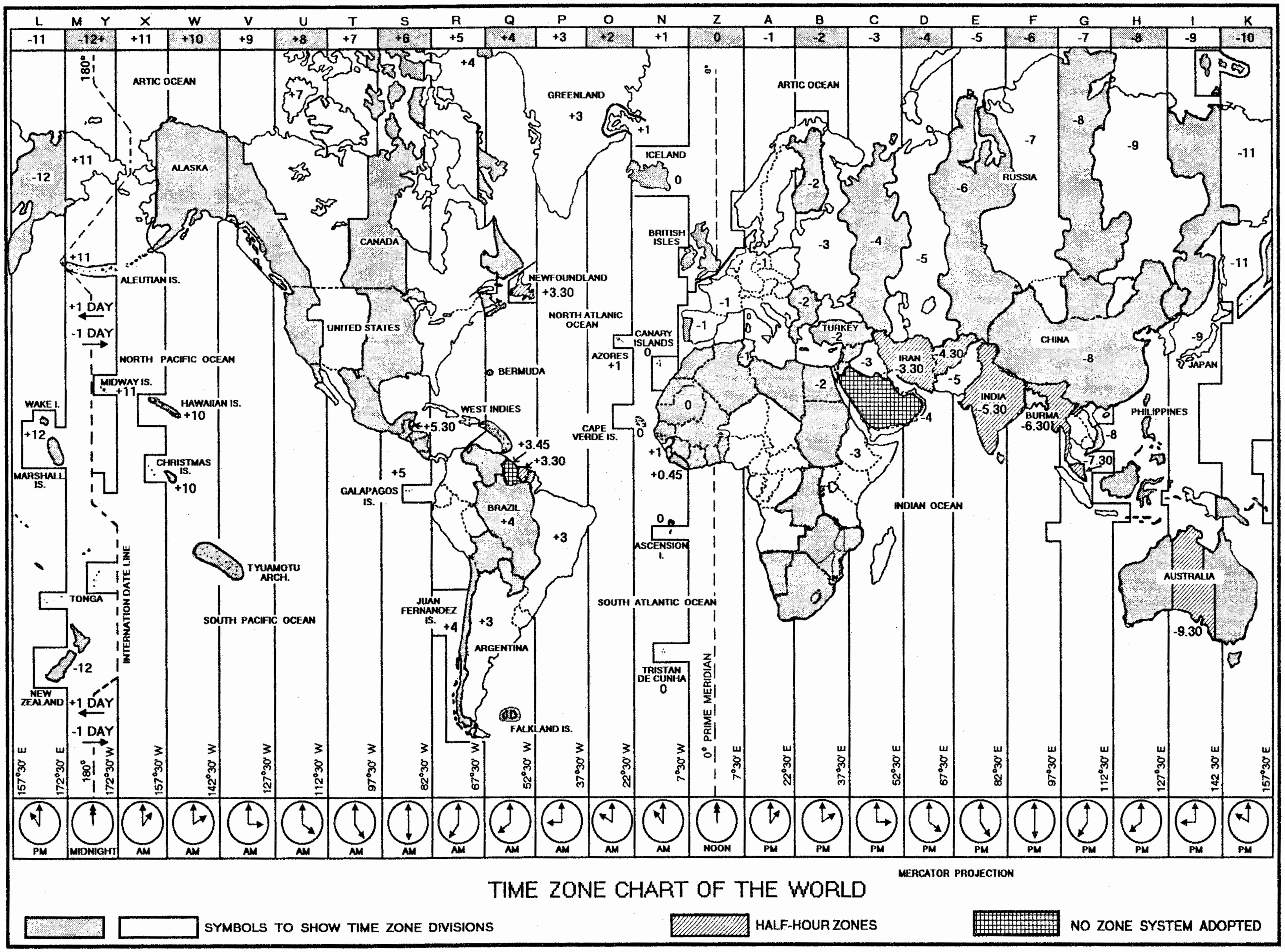


Figure 6-1.—Time zone chart of the world.

change it. (We will talk more about the responsibilities of the drafter, originator, and releaser later in this chapter.)

Precedence is assigned according to urgency, based solely on writer-to-reader time, not according to the importance of the subject matter or the text. For example, an unclassified message may be assigned an IMMEDIATE precedence, whereas a Secret message may be assigned a ROUTINE precedence. In this situation, the unclassified message requires fast action or response, whereas the Secret message may not require any action at all.

The following paragraphs list the various precedence categories, their indicators, and basic definitions:

ROUTINE (R)—This category is assigned to all types of traffic that justify electrical transmission but which are not of sufficient urgency to require a higher precedence.

PRIORITY (P)—This category is reserved for messages that furnish essential information for the conduct of operations in progress. This is the highest precedence normally authorized for administrative messages.

IMMEDIATE (O)—This category is reserved for messages relating to situations that gravely affect the national forces or populace and which require immediate delivery to addressees.

FLASH (Z)—This category is reserved for initial enemy contact reports or operational combat messages of extreme urgency; message brevity is mandatory.

YANKEE (Y)—In addition to the four major precedence categories, an EMERGENCY COMMAND PRECEDENCE (ECP) is used within the AUTODIN system. This ECP is identified by the precedence prosign Y and is limited to designated emergency action command and control messages.

SPEED-OF-SERVICE OBJECTIVES

Many factors affect writer-to-reader delivery time. These factors include the types of facilities and systems used, traffic volume, relay requirements, message length, the number of addressees, and circuit conditions. The speed-of-service objectives in table 6-1 provide general guidance. However, message traffic must be handled as rapidly as possible, consistent with reliability and security.

BASIC FORMAT OF MILITARY MESSAGES

Messages processed through the Defense Communications System (DCS), of which the Naval Telecommunications System (NTS) is an integral part, vary in format. Depending upon the level of processing required and ultimate destination of the message, the format will be either ACP 126, modified ACP 126, or ACP 127 for teleprinter procedures. The ACP 126 and the modified ACP 126 message formats are used within the U.S. communications networks. The ACP 127 message format is used over NATO circuits.

For messages processed through the Automatic Digital Network (AUTODIN) system, message format lines 1 and 2 must follow the JANAP 128 procedures. The major differences between these message formats appear in the first three format lines of the message heading. These formats are similar with only minor variation from format lines 4 through 16. These format lines are also used in voice communications and must follow the ACP 125 voice procedures.

The message format is divided into three distinct parts: (1) heading, (2) text, and (3) ending. There are 16 format lines that make up these three parts. Each format line corresponds to a particular type of information and places the contents of a message in standard sequential order.

Referring to table 6-2, you can see which format lines make up the three major parts of a message. They bear no relationship to the number of typed lines

Table 6-1.—Speed-of-Service Objectives

PRECEDENCE	PROSIGN	SPEED-OF-SERVICE OBJECTIVES
FLASH	Z	As fast as possible with an objective of less than 10 minutes
IMMEDIATE	O	30 minutes
PRIORITY	P	3 hours
ROUTINE	R	6 hours

Table 6-2.—Basic Message Format

BASIC MESSAGE PART	FORMAT LINES CONTAINED	GENERAL FORMAT-LINE CONTENT
HEADING	1	Used in automated systems and TTY relay
	2	Station(s) called and exempted station(s)
	3	Prosign DE (or from) and calling station
	4	Instructions; for example, T (relay)
	5	Precedence and DTG
	6	Prosign FM (the originator of this message is) and originator
	7	Prosign TO and action addressees
	8	Prosign INFO and the information addressees
	9	Prosign XMT and the exempted addressees
	10	Accounting symbol, group count, SVC (service), and PDC
Separation	11	Prosign BT (Break)
TEXT	12	Basic idea of originator
Separation	13	Prosign BT (Break)
ENDING	14	Time group (where appropriate)
	15	Final instructions (where appropriate); for example, Prosign B more to follow
	16	Ending sign; for example, K or AR

contained in each format line. For example, format line 4 is used for relaying instructions. These instructions may total several lines on a typewritten message. Format lines play a crucial role in the accountability, identification, and processing of a message.

Heading

The majority of the format lines (1 through 10) are contained in the heading. The heading of a message is a message part, and its associated lines are called format lines (F/Ls). In addition to these, we also have message components. Components are placed in a simple, logical order for clarity. There are a total of six components in a naval message, four of which are in the heading. The remaining two, text and ending, are discussed later in this chapter. The four components that make up the heading are as follows:

- Beginning procedure;
- Preamble;
- Address; and
- Prefix.

Table 6-3 shows the message heading, associated components, and their format lines.

BEGINNING PROCEDURE.—The beginning procedure component contains format lines 1 through 4. Since there are different methods of transmission, the basic construction of the beginning procedure will vary. For example, when communicating by teleprinter, you use plain language address (PLA) designators and AUTODIN routing indicators (discussed later). When communicating on a radiotelephone (R/T) circuit, you use spoken call signs that correspond to the stations you are in communications with.

Format line 1 contains handling instructions, the station/channel designator, and the channel sequence number. This format line is used only in teleprinter relay and the AUTODIN system. In the AUTODIN system, format line 1 is computer-generated.

Format line 2 contains the called station(s), both action and information addressees, and any necessary exempted stations. These are on a voice circuit and teleprinter point-to-point circuit. The following examples show how format lines 1 and 2 may look for the AUTODIN and the modified ACP formats:

AUTODIN JANAP 128 FORMAT:

(F/L 1) VZCZCABC123

(F/L 2) RTTCZYUW RULYNMU5678 1841235-CCCC—RULYUSA RULYJFK.

MODIFIED ACP 126 FORMAT:

(F/L 1) VZCZCABC123

(F/L 2) RTTCZYUW RULYNMU5678 1841235-CCCC—RULYSUU.

As you can see in the first example, there are two called stations, RULYUSA and RULYJFK. The AUTODIN system requires routing indicators for each addressee in format lines 7 and 8. Therefore, these routing indicators must be listed in format line 2, as in the first example.

In the second example, RULYSUU serves as a called station for all addressees in format lines 7 and 8. U.S. Navy mobile units route message traffic to serving Naval Communications Processing and Routing

Table 6-3.—Heading and Components

PART	COMPONENT	FORMAT LINE
HEADING	Beginning procedure	1 2 3 4
	Preamble	5
	Address	6 7 8 9
	Prefix	10

Systems (NAVCOMPARS) and Local Digital Message Exchange (LDMX) sites. These units enter the NAVCOMPARS/LDMX system by using the first four letters of the NAVCOMPARS/LDMX site plus the suffix SUU for automatic routing indicator assignment. Format lines 1 and 2 for automated systems are discussed further in Chapter 10, "Automated Systems," of this TRAMAN.

Format line 3 contains the identification of the calling station. The calling station precedes its calling designation with the prosign DE (which means "from") on a teleprinter point-to-point circuit or with the spoken words THIS IS on an R/T circuit. For example, you are operating an R/T circuit, and your voice call sign is HORNE. You want to communicate with a station whose voice call sign is LEYTE GULF. Using format lines 2 and 3, you would say:

LEYTE GULF (format line 2)

THIS IS HORNE (format line 3)

and then continue to the next part of your transmission.

Format line 4, when used, contains transmission instructions. Transmission instructions tell the called station (format line 2) what to do or what action to take with reference to the handling or forwarding of the message. For example, the operating prosign T means "Transmit this message to all addressees or to the addressee designations immediately following." When using teleprinter procedures, you write the prosign T as is. However, in R/T procedures, you use the spoken words RELAY TO instead. To expound on the example already used, your transmission could be:

LEYTE GULF (format line 2)

THIS IS HORNE (format line 3)

RELAY TO JOHN RODGERS (format line 4)

You then continue to the next part of your transmission.

Format line 4 could contain any of a number of operating signals or prosigns that tell the called station what particular action to take with the received message. Prosigns consist of letters or combinations of letters that are used to convey frequently sent orders or instructions in a standard form. Prosigns are covered later in this chapter. Operating signals are contained in *Communication Instructions—Operating Signals*, ACP 131.

You will find detailed instructions for preparing format line 4 for each type of transmission media in the appropriate procedure publications (ACPs, NTPs, and JANAPs).

PREAMBLE COMPONENT.—Format line 5 contains the entire preamble component. The preamble contains the following three elements:

- **Precedence**—Indicated by the appropriate prosign, Z, O, P, or R, as assigned by the originator.
- **Date-time group**—Suffixed by the letter Z to indicate Greenwich mean time. For example, the DTG of O 121314Z AUG 94 indicates that the message is an IMMEDIATE (Prosign O) and was originated on the 12th day, 13th hour, 14th minute Greenwich mean time in the month of August, in the year 1994.
- **Message instructions**—Expresses specific handling or delivery instructions desired by the communications center of the originator. These instructions are in the form of operating signals.

You must not confuse the message instruction line with format line 4, which contains transmission instructions for the called station. The message instructions contained in format line 5 are not necessarily for the called station alone. These instructions may pertain to any and all stations that handle the message.

Format line 5 also contains execute instructions when the Executive Method of communications is used. The Executive Method is used when it is necessary to execute a tactical message at a given instant. In other words, this method is used when two or more ships or units must take action at the same time. The Executive Method is used only in the abbreviated plaindress format. Chapter 8, "Radiotelephone (R/T) Procedures," contains further information on the Executive Method.

ADDRESS COMPONENT.—The address component consists of format lines 6 and 7 and, when required, 8 and 9 (table 6-3). The lines correspond to originator, action addressee(s), information addressee(s), and exempted addressee(s).

Format line 6 is the originator element. It is identified by the originator prosign FM (meaning "from") and contains the designation of the originating station.

Format line 7 is the action element. It is identified by the action prosign TO and contains the designation(s) of the action addressee(s), if any.

Format line 8 is the information element. It is identified by the prosign INFO and contains the designation(s) of the information addressee(s), if any.

Format line 9 is the exempt element. It is identified by the prosign XMT. This line contains the designation(s) of the exempted addressee(s), if any. For example, the action element may be a collective call sign (discussed later) that encompasses many stations. The originator of the message may want all but two of the stations in the collective call sign to receive the message. Therefore, the originator would place the names of the two stations to be exempted from receiving the message in format line 9.

An entire address might look something like that shown in table 6-4.

Addressee designations in the address component may be call signs, address groups, plain language designators, or a combination of routing indicators and plain language designators, depending on the method of transmission.

PREFIX COMPONENT.—Format line 10 is called the prefix component and contains either the message group count or accounting information.

The accounting information is a combination of letters called an accounting symbol. The accounting symbol indicates the agency having financial responsibility when a message is commercially refiled or when the message is originated by an agency of the Department of Defense (DOD) and destined for a non-DOD agency. For example, a message indicating that the Navy has financial responsibility would contain the word "NAVY" in format line 10. Commercial communications are discussed further in Chapter 14, "Commercial Traffic."

The group count is designated by the prosign GR, followed by a number. The number indicates the number of words in the text. For example, a text containing 15 words would contain the prosign GR15 in format line 10. A numerical group count is required for all coded group messages. When an accounting symbol is used, either the group count must be used or the prosign GRNC (groups not counted) must be included as part of format line 10.

Separation

Format lines 11 and 13 contain only the separation sign BT, meaning "break." Its purpose is to provide a distinct separation between the heading and the text and between the text and the ending. Remember, the separation is not a message part or component; however, it is an essential format line.

Text

The text is the part of the message that contains the thought or idea that the drafter desires to communicate. Regardless of the number of lines written or typed by

Table 6-4.—Address Format Lines

ACP 126 TTY	VOICE
(F/L 6) FM USS HORNE	FROM HORNE
(F/L 7) TO USS LEYTE GULF	TO LEYTE GULF
(F/L 8) INFO USS JOHN RODGERS	INFO JOHN RODGERS
USS BELKNAP	BELKNAP
AIG 62	AIG 62
(F/L 9) XMT USS FIFE	EXEMPT FIFE
USS PATTERSON	PATTERSON

the drafter, the text uses only one format line, format line 12 (table 6-2).

In drafting the text for transmission, the drafter should strive for brevity through the proper choice of words and good writing technique. However, brevity must never be achieved at the expense of accuracy or clarity. Uncommon phrases and modes of expression can render the meaning of a message ambiguous or obscure.

The text must be worded so that it unmistakably expresses the thoughts to be conveyed. All abbreviations must be limited to those meanings that are self-evident or those that are recognizable by virtue of long established use. We will now discuss some of the more important requirements concerning the text of a message.

CLASSIFICATION LINE.—The classification line is the first line of the text and immediately follows the BT that separates the heading and text. This line indicates the message classification and, when applicable, special-handling markings, codes, or flag words. This line also provides the Standard Subject Identification Code (SSIC) (these are all discussed later).

For United States use, the three security classification designators are Confidential, Secret, and Top Secret. The acronyms FOUO (For Official Use Only) and EFTO (Encrypt For Transmission Only) are not classification designators. They are used with the designation UNCLAS in the classification line.

"Restricted Data" and "Formerly Restricted Data" (discussed later) are similar except that they are used with classification designators. Figure 6-2 shows the proper spelling and spacing of classification designators. You can find information concerning the criteria and handling of FOUO and EFTO messages in the *Telecommunications Users Manual*, NTP 3.

```
UNCLAS
UNCLAS E F T O
UNCLAS E F T O FOUO
C O N F I D E N T I A L
S E C R E T
T O P S E C R E T
```

Figure 6-2.—Classification spelling and spacing.

SPECIAL-HANDLING MARKINGS.—Certain types of messages require special handling in addition to that provided by the security classification. These special markings are placed in the classification line immediately following the classification. Some of the more common special-handling markings that you will see are:

- SPECAT (Special Category);
- LIMDIS (Limited Distribution); and
- PERSONAL FOR.

SPECAT messages come in two variations. One type includes both the general SPECAT and the SPECAT Single Integrated Operational Plan—Extremely Sensitive Information (SPECAT SIOP-ESI). This type of SPECAT message is associated with code words or projects. For example, a Secret message whose subject matter deals with a special project entitled "TACAMO" would have a classification line reading SECRET SPECAT TACAMO. SPECAT SIOP-ESI messages are always classified Top Secret. SPECAT (less SIOP-ESI) messages must be classified at least Confidential.

The other type of SPECAT message is SPECAT EXCLUSIVE FOR (SEF). SEF is used only within the naval community for highly sensitive matters, high-level policy, or when politically sensitive information is to be passed only to a particular individual. The classification line would then contain the name of that individual. For example, a Secret message destined exclusively for Admiral W. T. Door would read:

SECRET SPECAT EXCLUSIVE FOR ADM W.T. DOOR //N00000//

SEF messages are reserved for use by flag officers and officers in a command status. These messages are not intended for use in operational matters, and they may not be readdressed nor referenced in other narrative messages.

SPECAT messages are handled only by those personnel who are authorized to view them as approved in writing by the commanding officer.

LIMDIS messages are associated with special projects, cover names, or specific subjects. These messages require limited distribution within the addressed activity to those personnel with a need to know and who are specifically authorized by the command to have access to the information. Only classified messages qualify for the special-handling marking LIMDIS. However, the classification is still assigned according to the subject matter. The classification line of a Secret LIMDIS message would read SECRET LIMDIS.

PERSONAL FOR messages may be unclassified or classified and are reserved for flag rank and command status officers. Distribution of these messages is limited to the named recipient (who may direct further distribution). In PERSONAL FOR messages, the classification line always shows the name or title of the intended recipient and may show the name or title of the originator. For example:

C O N F I D E N T I A L PERSONAL FOR ADM W. T. DOOR //N00000//
or UNCLAS PERSONAL FOR ADM W. T. DOOR FROM ADM J. R. FROST //N00000//

PERSONAL FOR messages are used only by and addressed only to Navy commands.

STANDARD SUBJECT IDENTIFICATION CODE.—The Standard Subject Identification Code (SSIC) identifies the subject matter of the message. The SSIC is preceded and followed by two slant signs; for example, UNCLAS E F T O FOUO //N02000//. The SSIC always contains five digits corresponding to the particular subject matter, preceded by the letter N. With few exceptions, an SSIC is required on all naval messages. Those messages without SSICs are normally returned to the drafter. Many automated systems route message traffic by the SSIC. Messages that do not require SSICs include:

- Tactical messages handled on tactical circuits;
- Messages using code or flag words exclusively to identify the subject—for example, exercise messages;
- Messages transmitted on dedicated or closed networks;
- Casualty report (CASREP), movement report (MOVREP), and Status of Resources and Training System (SORTS) messages and messages containing the Navy's portion of the Joint Reporting System (JRS);
- Messages addressed only to commercial firms or individuals via commercial refile; and
- Pro forma messages, which are automatically processed without human intervention.

The SSIC //N00000// may be assigned to high-precedence messages if determining the proper SSIC will delay the message. This SSIC is assigned to service messages and those messages that contain special-handling markings.

SSICs are contained in *Department of the Navy File Maintenance Procedures and Standard Subject Identification Codes,* SECNAVINST 5210.11.

PASSING AND DELIVERY INSTRUCTIONS.—The majority of naval automated message processing systems rely on specific elements at the beginning of the text. These elements may be flag words, code words, subject lines, and outgoing/incoming message references. These elements serve as guides and assist the automated internal routing of messages. Special delivery instructions, such as FOR, FROM, PASS TO _____, are additional means of indicating that the text of the message is to receive the attention of the indicated individual or office without necessarily limiting the normal distribution.

Special delivery instructions, when used, follow the SSIC. These instructions are used for exceptional cases not covered by use of office codes in the address (discussed later). Passing instructions must not be separated into an individual paragraph of the text. They should follow the SSIC and can continue on the line immediately following the classification and SSIC.

SUBJECT LINE.—The subject line indicates the basic contents of the message. Internal message routers and Navy automated message processing systems key on the subject to determine internal message distribution. Therefore, messages containing similar information should be assigned a standard subject whenever possible to facilitate message identification and internal distribution.

The subject line of a message begins at the left-hand margin immediately following the classification line with the characters "SUBJ." The following list contains the only instances when the subject line may be omitted:

- When it would classify an otherwise unclassified message;
- When it would noticeably increase the length of a short message; and

- When the subject is readily apparent in the first line of the text.

If a message meets one of these criteria, the characters "SUBJ" will start at the left margin with the remainder of the subject text left blank.

REFERENCE LINES.—Reference lines are used to avoid repeating lengthy quotations or references within the text of a message. A reference may be any message, document, correspondence, or telephone conversation that is pertinent to the message. Each reference starts at the left margin using the format contained in NTP 3. For example, the following references would be listed as shown:

```
REF/A/GENADMIN/COMSUBGRU
SIX/092042ZAUG94/-/NOTAL//

REF/B/LTR/CNO WASHINGTON DC/930827//

REF/C/TEL/COMSUBLANT/27AUG94//

AMPN/TELCON BETWEEN NETPMSA/RMC BRUSH
AND CSL/CDR BOAT ON MTF PROCEDURES//
```

When one of the above references is referred to in the text, it would be called REF (A), REF (B), or REF (C), as applicable.

In a multiple-address message, sometimes not all addressees are required to have all the references listed in the message. References that may not be held by all addressees are indicated by the acronyms NOTAL (not to or needed by all) and PASEP (passed separately). As you can see in REF set A in the example above, these acronyms, when used, are added after the reference. These two acronyms may also be used together for the same reference.

INDENTING.—The classification, subject, and reference set lines always begin at the left-hand margin. Textual material may be indented a maximum of 20 spaces for clarity.

The RMKS (remarks) set begins the actual text. The message may contain several subjects or several aspects of one subject. For this reason, textual material is divided into paragraphs and subparagraphs (numbered and lettered consecutively).

CLASSIFICATION AND PARAGRAPH MARKINGS.—When a message is classified, the subject line, all paragraphs, and subparagraphs are marked with the appropriate classification symbol. This eliminates any doubt in the reader's mind as to the classification of a particular paragraph. Figure 6-3 shows the proper classification markings of the subject line and paragraphs comprising the text

The first line of the text, the classification line, will have the overall classification of the message. For example, if a message contains both Secret and Confidential paragraphs, the classification line would be SECRET. When a message is prepared for transmission, the letters of the security classification in the subject line are separated by spaces; for example, S E C R E T. The *Department of the Navy Information and Personnel Security Program Regulation*, OPNAVINST 5510.1, hereinafter called the *Security Manual*, requires all electrically transmitted messages to be paragraph marked.

RESTRICTED DATA AND FORMERLY RESTRICTED DATA MARKINGS.—Some types of information are defined as Restricted or Formerly Restricted Data. This means that the information falls into one of the several categories of nuclear-oriented subject matter under the Atomic Energy Act of 1954.

When such information appears in the text of a message, the symbols RD or FRD are added to the classification markings. For example, if a paragraph of

```
P 271420Z AUG 94

FM COMNAVCOMTELCOM WASHINGTON DC//N12//

TO NETPMSA PENSACOLA FL//N31//

BT

S E C R E T PERSONAL FOR RADM PISTOL//N02300//

SUBJ: TRAINING MATERIAL (U)

MSGID/GENADMIN/COMNAVCOMTELCOM//

REF/A/RMG/NETPMSA PENSACOLA/191530ZAUG94

AMPN/REQUESTING MATERIAL (U)//

RMKS/1. (U) REQUEST FOR TRAINING MATERIALS
IN REF A APPROVED.

2. (S) MATERIAL FORWARDED BY REG MAIL NR
541662 ON 27 AUG 94//

DECL/OADR//


(SECRET FOR TRAINING, OTHERWISE
UNCLASSIFIED)
```

Figure 6-3.—Example of classification markings of subject line and paragraphs.

a message is classified Secret and is also Restricted Data, the paragraph must be marked S-RD. If the paragraph is classified Confidential and is also Formerly Restricted Data, it would be marked C-FRD. These markings are spelled out after the security classification in the subject line.

PUNCTUATION.—Punctuation is used within the text of a message when essential for clarity. Authorized abbreviations are used when the method of transmission does not permit the use of the punctuation marks. Punctuation marks are transmitted exactly as drafted. Otherwise, communications personnel must substitute authorized abbreviations for the punctuation marks in accordance with the governing publication for the type of transmission media used. Let's use a period as an example. On a voice circuit, you would say, PERIOD or FULL STOP. However, on a teleprinter circuit or for automated equipment, you would use the symbol "." or the abbreviation "PD."

MINIMIZE CONSIDERED.—During an actual or simulated emergency, it may become necessary to reduce the volume of record and/or voice communications ordinarily transmitted over U.S. military telecommunications circuits. This action, known as MINIMIZE, is designed to clear communications networks of messages that are not considered urgent. Only those messages that affect the accomplishment of a mission or safety of life are considered essential and, therefore, require electronic transmission during minimize.

The releasing officer must review messages that have not been released during minimize periods. The releasing officer must determine if a message can be sent via another means or if it must be sent electrically via telecommunications circuits. If the releasing officer releases a message for transmission, the words "MINIMIZE CONSIDERED" and "RELEASED BY" must by included.

In a pro forma message, these words are placed in the **RMKS** set and in a narrative message as the last line of text (we discuss minimize and pro forma messages later in this chapter). The releaser's name and rank must be included in the RELEASED BY line.

Messages that are determined not to require electrical transmission during the minimize period should be returned to the office of origin with the reason for their return.

DOWNGRADING INSTRUCTIONS.—All classified messages must contain a downgrading or declassification instruction with the exception of Restricted Data and Formerly Restricted Data messages. There are three authorized downgrading or declassification markings that may be used by the originator. These markings are shown below.

DECL/__//	The date, month, and year are inserted for declassification; for example, DECL/27AUG96//
DECL/OADR//	If a specific date or event cannot be determined for declassification purposes, then Originating Agency's Determination Required (OADR) is used
DECL/DG/_/_//	After Downgrade (DG), insert S (Secret) or C (Confidential), as appropriate, and specific date of event; for example, DECL/DG/C/15JUN96//

Ending

The ending is the third and last part of a message. It is also another changeable portion. It contains the ending procedure and uses format lines 14, 15, and 16.

Format line 14 is the time-group element (table 6-2). When used, this element contains the time group, expressed in hours and minutes, and the zone suffix. For example, 0830R indicates the time in hours and minutes in the time zone ROMEO.

Format line 15 is called the final instructions. The communications operator may use this line to correct transmission errors, indicate a pause, or to execute a message. The operator may also use this line to indicate more traffic for a specific station by the use of prosigns, operating signals, and station designators, as required. Remember, format lines 14 and 15 may not be used at all, depending upon the situation.

Format line 16 is called the ending sign. For voice transmissions, this is the proword OVER or OUT. For continuous-wave (CW) or teleprinter transmissions, the prosign K or AR is used. This format line is used to indicate the end of a transmission.

CLASSES AND TYPES OF NAVAL MESSAGES

As a Radioman, you will handle and process various classes and types of naval message. It is therefore essential that you know the various categories of messages. How you handle and process a message depends upon its type and classification. For example, messages designated as SPECAT require that only those personnel designated by the commanding officer be allowed to process them.

CLASSES OF NAVAL MESSAGES

Messages are placed in different classes to aid in administration and accounting, especially where tolls and charges are involved. In general, there are five classes of message: A, B, C, D, and E. Of the five classes, A, B, and C are U.S. Government messages. Classes D and E are non-U.S. Government (private) messages.

Class A messages make up the largest volume of message traffic handled by the Navy. Messages of this class are originated by Department of Defense (DOD) activities and sent to DOD activities. This includes the Coast Guard when it is operating as a part of the Navy.

Class B traffic includes official messages originated by and destined for U.S. Government agencies other than the DOD. When the Coast Guard is not operating as a part of the Navy, Coast Guard traffic falls into the class B category.

Class C messages consist of broadcast traffic in special forms and available to ships of all nationalities; for example, hydrographic data, weather, time signals, and so forth.

Class D messages are private messages for which the Navy collects tolls. This group includes radiotelegrams and press messages sent by correspondents aboard ship.

Class E messages are personal messages sent to and from naval personnel, handled free of charge over naval circuits. Charges are collected from the sender only when a commercial communications company, such as Western Union, handles the message over part of its route. The class E message privilege is used mainly to enhance morale. It provides a means of communicating urgent personal matters for personnel at sea. This privilege is not available between points on shore within the United States.

TYPES OF MESSAGES

Naval communications enable naval commanders to make their wills known and, as such, are the voice of command. Naval messages speak for and with the authority of the commander who originated them.

All official messages, whether classified or not, contain privileged information. No person is entitled to knowledge or possession of either classified or unclassified communications solely by virtue of grade, position, office, or clearance. There must be a need to know before a person can have knowledge of the contents or possession of a message. The contents of all personal and commercial messages handled by naval communications are revealed only to the person(s) to whom they are addressed and to the communications personnel who must handle them.

Commercial messages concerning emergencies, such as death, serious illness, and injury, must be processed with adequate precautions to prevent their contents from being disclosed to the addressee in a rash manner. Normally, local instructions clarify these particular methods.

You must remember that there are many types or categories of naval message. Each type or category receives different treatment with reference to internal routing and distribution. However, there are certain categories of message traffic that are common in communications. These message categories are usually similar in format and are easily recognizable. When not similar in format, they are usually recognizable by content. Although space precludes a total discussion of all the various message categories, the following is a discussion of the most common.

General Messages

General messages provide a standard distribution to a large group of addressees and are identified by a repetitive short title (for example, ALNAV, NAVOP, JAFPUB). General message types, from whom they originate, and distribution are contained in *Basic Operational Communications Doctrine (U)*, NWP 4.

All commands to whom general messages are distributed are action addressees. However, each command receiving a general message is responsible for determining what action, if any, it needs to take on the message.

Although general messages have a wide, standardized distribution, all addressees may not need to take action. However, commands are required to keep a continuous numerical file of all general messages for which they are on the distribution list and receive. Consequently, the general message files should contain every general message received during the calendar year, in numerical order. The general message files are separate from all other files and are subdivided according to identifying title or type. Figure 6-4 shows a typical heading of a general message.

In this example, the line immediately prior to the subject line is used to inform the reader that this is the 26th ALCOM message of 1994. The designation ALCOM indicates the message is intended for wide distribution throughout the Navy.

General messages are canceled in the following ways:

- The first general message of a calendar year lists those messages of the previous year(s) (by number) that remain in effect. Messages not listed are automatically canceled. If necessary, interim cancellation messages may be sent at other times during the year.
- An individual general message may include its own cancellation date within the text. Additionally, a subsequent message of the same general message series may cancel a message.
- General messages that do not have a yearly cancellation message and are not assigned particular cancellation dates are automatically canceled 90 days from the DTG.

American Red Cross Messages

The American Red Cross (AMCROSS) may use the facilities of naval communications, free of charge, for sending and receiving emergency and administrative traffic as prescribed in *U.S. Navy Regulations*, 1990. However, in each case, this privilege is subject to the approval of the commanding officer who may refuse to extend this service if it would interfere with naval administration or operations.

```
P 171731Z MAY 94
FM CNO WASHINGTON DC//094//
TO ALCOM
BT
UNCLAS //NO2300//
ALCOM 026/94
SUBJ: GENERAL ADMINISTRATIVE (GENADMIN)
MESSAGE TEXT FORMAT (MTF)
```

Figure 6-4.—Typical heading of a general message.

Red Cross messages are handled as class B traffic and are normally in plain text. Most Red Cross messages are assigned a precedence of ROUTINE; however, critically important ones may be assigned up to IMMEDIATE precedence over naval circuits. When the Red Cross is assisting during a civilian disaster, message traffic may be given equal precedence with military traffic (over naval circuits) at the discretion of the senior officer present at the scene of the disaster.

As a rule, Red Cross traffic is not accepted if it cannot be handled entirely over naval or Defense Communications System (DCS) circuits. The exception to this rule is traffic that is related to emergencies or disasters involving relief.

Since AMCROSS messages contain information that is very personal to the recipient, communications personnel are not to discuss the contents of the message with anyone. Distribution of AMCROSS messages is limited to the executive officer or appointed alternate only. Local command policy dictates filing and handling procedures for AMCROSS messages.

Commercial Messages

Sometimes a class A or B message must be sent over commercial communications circuits. When a commercial communications company is involved in a portion of the handling or in the final delivery of a class A or B message, the company is paid for the charges incurred out of government funds. NTP 9 provides detailed information on handling commercial messages.

Pro Forma Messages

Pro forma messages are messages whose subject matter and sequence of textual content are preset and cannot be changed by the originator. Figure 6-5 is an example of a pro forma message used to update a previously reported electronics casualty report (CASREP). Notice that the textual sequence of information follows a preset format and that it does not have a subject line. Also notice that classification markings are not applied to paragraphs or subparagraphs. The message assumes the overall classification as given in the classification line.

```
        P 010914Z JUN 94
        FM    USS KITTY HAWK
(1)     TO    COMSECONDFLT
              CTG TWO ZERO PT TWO
              COMNAVAIRLANT NORFOLK VA//00//01//31//
              NAVSSES PHILADELPHIA PA//46//48//03P//
        INFO  AIG SIX EIGHT FOUR THREE
              NUSC NEWPORT RI//JJJ//
              COMSPAWARSYSCOM WASHINGTON DC//02//31//32//34//38//
              NAVSHIPWPNSYSENGSTA PORT HUENEME CA//JJJ//
              NAVSHIPWPNSYSENGSTA NORFOLK VA//00//01//02//63//67//

        BT
        C O N F I D E N T I A L
(2)     MSGID/CASREP/CV 63 KITTY HAWK/29//
(3)     POSIT/PHILADELPHIA/010800ZJUN94//
(4)     REF/CASUALTY/SARATOGA/131744ZMAY94//
(5)     CASUALTY/CORRECT-86012/NO. 1 OXYGEN ANAL/EIC:F300/CAT:2//
(6)     AMPN/TEN HOUR DELAY IN RECEIPT OF PARTS. 138 MANHOURS
        EXPENDED TO CORRECT. 2100 HOURS SINCE LAST FAILURE-
        CONTINUOUS USE. PARTS RECEIVED LIST: DLO1 132044ZMAY94
        DL02 132044ZMAY94 DL03 142230ZMAY94 DL04 142230ZMAY94
(7)     DWNGRADE/DECL 01DEC94//
        BT(CONFIDENTIAL FOR TRAINING, OTHERWISE UNCLASSIFIED)
```

Figure 6-5.—Example of a pro forma message.

Pro forma messages enhance the standardization of repetitive message subject matter and ensure less ambiguity in these areas. They encompass a large variety of messages, such as publication change recommendations, hydrographic information, and movement reports. Pro forma messages reduce the chance of error through interpretation. This is important, especially in movement reporting where misinterpreted information could mean an at-sea collision or result in communications personnel copying the wrong broadcast, thereby missing their traffic.

Many pro forma messages are computer-generated and computer-processed. A number of automated systems, such as the Worldwide Military Command and Control System (WWMCCS) and those used in Tactical Support Centers (TSCs), are capable of automatically generating messages with varying degrees of required message formats. These types of messages are normally destined for a communications central processor designed to accommodate and route such traffic. They may also simply be processed directly into normal communications channels.

Minimize Messages

Military telecommunications systems tend to become overloaded during an emergency. Naturally, it becomes necessary to reduce unnecessary traffic volume to clear user circuits for essential traffic. This reduction in traffic is accomplished by use (usually by message) of the word "MINIMIZE." Minimize means **"It is now mandatory that normal message and telephone traffic be reduced drastically so that vital messages connected with the situation indicated will not be delayed."**

A message ordering minimize consists of the word "MINIMIZE," followed by the area affected (scope), reason, and duration of the minimize condition (when known). Minimize messages must be brought to the immediate attention of the leading communications petty officer (LPO) and the communications officer.

The Chief of Naval Operations (CNO), fleet commanders in chief, and area coordinators are authorized to impose minimize conditions on users of naval communications systems. Subordinate commanders may impose minimize over elements of their commands only with prior permission from one of the three authorities just mentioned.

During minimize conditions, FLASH and IMMEDIATE traffic should be restricted to a maximum of 100 and 200 words, respectively. Message releasers are also kept to a minimum and must be specifically designated in writing. NWP 4 contains information pertaining to the types of normal, environmental, and supply traffic that may be sent over normal channels and circuits during minimize.

Service Messages

Service messages are short, concise messages between communications personnel. These messages have the authority of an official communication and must receive prompt attention. If the action requested in a service message cannot be accomplished within a reasonable time, the station originating the service message should be notified. Service messages are normally assigned a precedence equal to the message being serviced.

Service messages deal with many topics. You will find that most deal with corrections, repetitions, broadcast reruns, and misrouted or missent messages. You must remember that a service message should be promptly dealt with and retained until all actions concerning it have been completed. Once action is complete, it is good practice to attach a copy of the service message to the serviced message when it is filed, or mark it with the DTG of the service(s).

Requests for information through service messages should be as brief, concise, and accurate as possible. Careful attention to detail and the use of proper operating techniques by communications and crypto personnel will reduce the number of service messages required.

Service messages are normally prepared in abbreviated plaindress format and may be assigned sequential reference numbers. (We discuss plaindress messages later in this chapter.) The service message number immediately follows the abbreviation "SVC" in the message text. If used, sequential service reference numbers may continue throughout the calendar year. When you reply to a service message received with a reference number, the text of the reply should refer to the number. For example:

```
UNCLAS SVC //N00000// ZUI SVC 0245
RUEDCSA1234 1921600
```

This example is a service message inviting attention (ZUI) to a previous service message with a reference number of 0245. Occasionally, you will see the acronym COSIR in a service message text, which means "Cite Our Service in Reply." Authorized operating signals are used to the greatest extent possible in service messages, but clarity must not be sacrificed for brevity.

The security classification is the first word of text in all service messages. This is followed by the abbreviation "SVC." If the service message requires special handling, the special-handling designator follows the security classification. For example:

```
UNCLAS SVC or SECRET SPECAT SIOP ESI SVC
```

A service message may quote the textual content of a classified message or refer to the classified message in a manner that reveals textual content. In this case, the service message must be assigned the same classification as the classified message being serviced. You can find detailed information on service messages in *Automatic Digital Network (AUTODIN) Operating Procedures*, JANAP 128.

Tracer Messages

Tracer messages are special types of service message. Tracers are sent to determine the reason for excessive delay or nondelivery of a message previously sent. Normally, tracer requests are initiated by a message originator or addressee. However, a situation may dictate that tracer action be initiated by the originating communications station, the relay station, or the communications station of the addressee.

Tracer action continues on a station-to-station basis until the cause of delay has been determined. Upon receipt of a tracer, a station should examine its records for the time of receipt and transmission of the message being traced. This information is compiled and transmitted with the tracer action to the preceding station(s) and to the station that originated the tracer. The station that caused the delay or nondelivery must cite the reason and provide a summary of corrective action in the report.

Tracer action requests must be initiated as soon as the discrepancy is discovered. Action must be initiated no later than 4 days after the original time of transmission for a tactical addressee. For nontactical addressees, action must be initiated no later than 30 days from the original time of transmission. In-station records, files, logs, and tapes must be retained beyond the required retention limit if tracer action is in progress prior to the expiration date. You can find detailed information concerning tracer action in JANAP 128.

Termination Request Messages

Ships send termination request messages to establish circuits with a NCTAMS or NAVCOMTELSTA on a limited or full-time basis. A termination request message must be sent to the cognizant NCTAMS at least 48 hours prior to activating the requested termination. If the ship has a requirement for a full-time termination, it will be assigned a routing indicator by the cognizant NCTAMS. NTP 4 contains detailed information pertaining to termination requests and formats.

Communications Guard Shift Messages

Communications guard shift (COMMSHIFT) messages are required when a command shifts its guard from one broadcast or servicing communications center to another. When possible, the shift takes effect at 0001Z of the new radio day. When broadcasts are shifted, an overlap period before and after the effective time is observed to ensure continuity of traffic. The command guards both broadcasts during the overlap period.

COMMSHIFT messages are sent to the NCTAMS of the communication areas from which the old and the new broadcasts originate. COMMSHIFT messages are necessary because of operational considerations or changes in the deployment schedule of a ship. These messages are necessary when a command needs to effect a shift at a time other than that indicated by its movement report. Detailed information concerning communications guard shift messages and formats is contained in NTP 4.

Broadcast Screen Requests

Broadcast screen requests (BSRs) are service messages to request the rerun (ZDK) of missed or garbled messages. BSRs are sent to the Broadcast Keying Station (BKS) or to the designated broadcast screen ship that is responsible for the broadcast channel. NTP 4 provides detailed information and prescribes proper format for drafting a BSR.

COMMSPOT Reports

COMMSPOT reports are used to advise of any situation that might cause significant disruption of tactical communications. These reports are submitted by all ships and nonterminated units when unusual communications difficulties are encountered. COMMSPOT reports must be submitted as soon as unusual communications difficulties are experienced to minimize further deterioration of the communications situation.

JCS Emergency Action Messages

Joint Chiefs of Staff (JCS) Emergency Action Messages (EAMs) contain key instructions or information from high-level authority and have predetermined formats (pro forma). Such messages are transmitted by various communications systems and normally carry FLASH (Z) precedence. They are vital messages of an extremely time-sensitive nature, and rapid processing is mandatory to achieve the fast reaction required by their content. Usage and handling procedures are issued by the JCS to those who have a need to know.

Movement Reports

Many naval ships are deployed at any one time. For command and administrative purposes, it is necessary to have up-to-the-hour information on unit locations. The dissemination of movement report information is the function of the Movement Report (MOVREP) system. The MOVREP system provides the Worldwide Military Command and Control System (WWMCCS) with ship location information.

The controlling agency of the MOVREP system is the Navy WWMCCS Data Control Center located in Washington, D.C. The agency is designated NWDCC WASHINGTON DC. There are two movement reporting centers (MRCs): CINCLANTFLT Headquarters (MRC NORFOLK VA) and CINCPACFLT Headquarters (MRC PEARL HARBOR HI).

MRCs coordinate the MOVREP system within their assigned geographic areas, monitor reports submitted for timeliness and accuracy, and issue corrective messages as necessary. They also act as contact point for all matters concerning the reporting of the location of U.S. Navy forces.

A U.S. Navy vessel sends a MOVREP message 24 to 48 hours prior to getting under way. These messages state the time of departure, destination, route, speed of advance, and any other significant information.

The message enters the system through the MRC controlling the area in which the ship is located. The MRC then disseminates the ship's movement information to those commands that have a need to know. Such activities include other MRCs that a ship will pass en route, supply centers, fleet post offices, NCTAMS, and fleet weather facilities. Movement reports are prepared in accordance with *Operational Reports*, NWP 10-1-10.

Q Messages

Allied nations have navigational warning systems that are used primarily during wartime. Certain portions of these systems are used to distribute classified information of a sensitive nature. An example would be information concerning minefields and open channels. Classified portions of allied navigational warning messages are identified as "Q" messages. Detailed information on this subject is found in *Allied Navigational Information in Time of War—"Q" System*, AHP 1. Occasionally, the Q system is used in peacetime fleet exercises at the discretion of the officer conducting the exercise (OCE).

Submarine Check Reports

Submarine check reports (figure 6-6) are used to ensure the safety and accountability of submarines.

```
0 190810Z DEC 94
FM    USS FRANCIS SCOTT KEY
TO    COMSUBRON EIGHTEEN
INFO  COMSUBGRU SIX
      COMSUBLANT NORFOLK VA


BT
UNCLAS
CHECK TWO FOUR SUBMARINE
FRANCIS SCOTT KEY.
BT
```

Figure 6-6.—Example of a submarine check report.

Check reports are unclassified and are assigned an IMMEDIATE precedence. These reports can be identified by the word "CHECK" as the first word of the text. When check reports are received, they are given proper and expedient handling. Delays and nondelivery of these reports can result in the initiation of SUBMISS/SUBSUNK procedures. The words "TWO FOUR" contained in the text of the message in figure 6-6 indicate that the submarine is on a 24-hour check schedule.

Notices to Airmen

Notices to airmen (NOTAMs) messages are originated by military activities and civil agencies concerned with the safety of aircraft. The NOTAMs concern aerological facilities, services, and hazards.

Hydrographic Messages

Hydrographic messages provide navigational warnings to ships. These message reports may include such information as casualties to various types of navigational aids; marine, air, or submarine disasters; and searches for survivors. They may also include selected exercises and hazardous operations conducted by units of the Armed Forces. Hydrographic messages are identified as "HYDROLANT" or "HYDROPAC," followed by a serial number.

Message Cancellations

In naval communications, many types of messages have self-contained cancellation dates. Others, such as those in the Navy directives system, are automatically canceled after 30 days except when:

- The text provides for an earlier cancellation;
- A subsequent message extends the cancellation date; and/or
- The directive is reissued by the originator in standard format within 30 days of the release date.

In all cases, you should remember that only the originator has the authority to cancel a message. To do this, the originator drafts and releases an entirely separate message that refers to the message to be canceled. Messages can NOT be canceled by service messages.

When a message contains information that becomes obsolete by a certain time, it is indicated by the statement THIS MESSAGE IS CANCELED AT (TIME/DATE).

MESSAGE AND ROUTING ADDRESSEES

Most messages have at least one addressee responsible for taking action on the contents and for originating any necessary reply. Addressees who have an official concern in the subject of the message, but who do not have primary responsibility for acting on it, receive the message for information. Although information addressees are usually concerned only indirectly with a message, they occasionally must take action of some kind within their own commands. Some messages contain only information addressees.

Messages may be divided into types, according to the way they are addressed, as follows:

Single-Address—A message that has only one addressee, which may be either for action or information.

Multiple-Address—A message that has two or more addressees, which may be either action or information and where each addressee is informed of all other recipients.

Book—A message destined for two or more addressees but where the drafter considers it unnecessary that each addressee be informed of other addressee(s). Book messages are routed according to each addressee's relay station. All unnecessary addressees are deleted from the face of the message before being sent to the addressee(s) served by that particular relay station.

General Message—A message that has a wide, predetermined, standard distribution. General messages are normally titled with a sequential number for the current year; for example, ALCOM 28/94, NAVOP 30/94. The title indicates distribution and serves as the address designator.

ADDRESS GROUPS

Address groups are four-letter groups assigned to represent a command, activity, or unit. In military communications, address groups can be used in the same manner as call signs to establish and maintain communications. Generally speaking, the Navy uses address groups the same way as call signs. Address groups never start with the letter N; hence, they are easily distinguishable from naval radio call signs. Address groups, however, follow no distinctive pattern, and the arrangement of the four letters that constitute them conveys no significance whatsoever.

Afloat commands (except individual ships) and shore-based commands or activities not served by their own communications facilities are assigned address groups. For example:

- Senior commands and commanders ashore, such as the Secretary of Defense and the Secretary of the Navy;
- Navy bureaus, systems commands, and district commandants; and
- Elements of the shore establishment having a need for direct addressing and receipt of message traffic (such as weather centrals).

Among other uses, address groups facilitate delivery of message traffic when a communications center serves so many activities that its own call sign is insufficient to identify the addressee. Address groups are contained in *Allied Call Sign and Address Group System—Instructions and Assignments*, ACP 100, and in *U.S. Call Sign & Address Group System Instructions & Assignments (U.S. Supplement No. 1)*, ACP 100 U.S. SUPP-1. Like call signs, address groups are divided into the following types:

- Individual activity;
- Collective;

- Conjunctive;
- Geographic;
- Address indicating; and
- Special operating.

Individual Activity Address Groups

Individual activity address groups are representative of a single command or unit, either afloat or ashore. For example:

DTCI—COMNAVSURFLANT; and

SSMA—CHIEF OF NAVAL OPERATIONS (CNO).

Collective Address Groups

Collective address groups represent two or more commands or activities. Included in this group are commanders and their subordinate commanders. For example:

JTBC—DESRON 6; and

YQHV—SUBRON 16.

Conjunctive and Geographic Address Groups

Conjunctive and geographic address groups are discussed together because they are interrelated in their usage.

Conjunctive address groups have incomplete meanings and must have geographic address groups added to them to denote a specific command or location. For this reason, conjunctive address groups are used only with one or more geographic address groups. For example, the conjunctive address group XZKW means "All ships present at _________." To complete the meaning, it must be followed by a geographic address group.

Geographic address groups are the equivalent of geographical locations or areas. They are always preceded by conjunctive address groups. For example, the address group DEXL could represent Newport, R.I. Therefore, all ships present at Newport would be addressed XZKW DEXL.

Address Indicating Groups

Address indicating groups (AIGs) represent 16 or more specific and frequently recurring combinations of action and/or information addressees. The purpose of AIGs is to increase the speed-of-traffic handling. They shorten the message address by providing a single address group to represent a large number of addressees. This eliminates individual designators for each address used in the heading.

Messages that are repetitively addressed to a constant group of 16 or more addressees can effectively be processed by an AIG address designator. For example, let's assume that a hypothetical AIG (AIG 31) is used to address SUBMISS/SUBSUNK message traffic by COMSUBLANT to 30 action addressees and 35 information addressees. Since a single AIG (AIG 31) is used, 65 call signs and address groups are eliminated from the heading of the message.

AIGs are normally created when particular types of message traffic become repetitive enough (at least 12 times a year) and are addressed to enough of the same addressees to warrant it. Among such message traffic are:

- Alerts, air defense warnings, operational or emergency actions, and so forth;
- Destructive weather warnings, such as hurricanes and typhoons;
- Logistical transactions and reports;
- Intelligence summaries;
- Movement reports, such as aircraft, ships, and personnel; and
- Notices to airmen (NOTAMs).

A point for you to remember is that an AIG will not be established for groups of addressees numbering less than 16. A complete listing of AIGs by number, cognizant authority, and purpose is contained in *U.S. Navy Address Indicating Group (AIG) and Collective Address Designator (CAD) Handbook*, NTP 3 SUPP-1. A partial listing of AIGs, along with specific action and information addressees, can be found in ACP 100 U.S. SUPP 1.

Special Operating Groups

Special operating groups (SOGs) are four-letter groups that are identical in appearance to address groups. SOGs are provided for use in the headings of messages to give special instructions. However, SOGs are not used unless specifically authorized by CNO. They must always be encrypted. SOGs may be used singly or with encrypted or unencrypted call signs or address groups.

COLLECTIVE ADDRESS DESIGNATOR

The collective address designator (CAD) is a single-address group that represents a set of four or more activities, including the cognizant authority, linked by an operational or administrative chain of command. Examples of CADs, their cognizant authorities, and purposes are shown in table 6-5.

CALL SIGNS

Call signs are made up of letters, letter-number combinations, or one or more pronounceable words. Call signs are used to identify communication activities and to establish and maintain communications. They are used in both military and civil communications and are divided into several categories, with some call signs belonging to more than one category.

International Call Signs

International call signs are assigned to radio stations of all countries, both civilian and military, afloat and ashore. These call signs are assigned according to international agreement. The United States is assigned the first half of the A block (A through ALZ) and all the K, W, and N blocks. The call signs are assigned as follows:

A block	Army and Air Force;
K and W blocks ...	Commercial and private stations, merchant ships;
N block	Navy, Marine Corps, Coast Guard.

Naval shore communication stations have three-letter N calls. For example, NAM is the call sign for NCTAMS LANT Norfolk. The exception to the three-letter N calls for naval shore communication stations is NAVCOMTELSTA Spain (AOK).

Call signs for fixed and land radio stations are listed in ACP 100 and in the U.S. Supplement 1 thereto. International call signs assigned to U.S. Navy ships are four-letter N calls and are used for all nonmilitary international communications. For example, NJFK is the call sign for the USS *John F. Kennedy* (CV 67).

International call signs for USN, USMC, and USCG aircraft are composed of N, NM, and NC, respectively. These letters are followed by the last four digits of the serial or systems command number of the aircraft.

Military Call Signs

Most ships of allied nations are assigned military call signs in addition to their international call signs. When used to address messages, military call signs are always encrypted. Both international and military call signs are listed in *Call Sign Book for Ships*, ACP 113.

Collective Call Signs

Collective call signs pertain to two or more facilities, commands, or units. For example, NIMK . . . All U.S. submarines copying this broadcast. Collective calls are listed in ACP 113 and in ACP 100 series.

ROUTING INDICATORS

Routing indicators identify stations in a communications relay network and are comprised of from four to seven letters. It is easy to distinguish routing indicators from call signs and address groups. Routing indicators always begin with the letter R. Chapter 10, "Automated Systems," has more detailed information on routing indicators.

MESSAGE ADDRESSES

Absolute consistency in the format and spelling of plain language address (PLA) was not critical prior to

Table 6-5.—Collective Address Designators

CAD	AUTHORITY	PURPOSE
ALL SSBNs PAC	COMSUBPAC, PEARL HARBOR HI	Promulgate information of an operational/general nature to all SSBNs PAC
ALL AFLOAT UNITS ATLANTIC COMMAREA	NCTAMS LANT, NORFOLK	Promulgate communications matters to afloat units

the implementation of automated message-processing systems. Because communications personnel processed all messages, deviations in address spelling were tolerated. This is no longer true. Message drafters must now verify the PLA for each addressee in the *Message Address Directory* (MAD) and not rely on memory or copy PLAs from incoming messages.

Message Address Directory

The MAD contains authorized message addresses and is divided into sections: Joint Department of Defense (JDOD PLAD), U.S. Military Communications—Electronics Board Publication (MCEB Pub 6), Army, Air Force, and Navy. The Navy section, "U.S. Navy Plain Language Address Directory (USN PLAD 1)," includes message addresses for Marine Corps and Coast Guard activities. MAD UPDATEs are published four times a year to ensure that all addresses are current.

Plain Language Addresses

The plain language addresses (PLAs) listed in USN PLAD 1 are the only designators authorized for use in message addressing to Navy, Marine Corps, and Coast Guard activities. Deviation from USN PLAD 1 in spelling, spacing, or formatting cannot be tolerated because automated message-processing systems are keyed to USN PLAD 1 entries. These systems will reject (for operator intervention) any message that contains an address designation in format lines 7 and 8 not constructed according to USN PLAD 1.

Plain Language Address Spelling

The MAD lists the authorized command short titles and geographical locations in message addressing. NTP 3 and the MAD contain the basic rules for proper spelling of numbers and geographical locations in message addresses. Some of the basic rules are:

- The use of any punctuation or other extraneous characters is prohibited.
- The numbers 10 through 19 are written as one word; for example, COMSUBRON SIXTEEN. Numbers 20 and above are spelled out digit for digit; for example, AIG SIX FOUR.
- The names of cities and towns are not abbreviated. States and country abbreviations are contained in the MAD.
- When the words "SAINT," "MOUNT," "POINT," or "FORT" are used as a part of a geographic location, they are abbreviated as ST, MT, PT, and FT, respectively. When these same four words are used as a part of an activity short title, they are not abbreviated; for example, USS MOUNT HOOD. The word "POINT," when used as part of a task organization's PLA, will be abbreviated; for example, CTG SEVEN ONE PT ONE.

Use of an ADMIN PLA

The word "ADMIN" is normally used in message traffic between flag rank commanders who are temporarily detached from their headquarters location and their staff. For example, when the flag rank commander is temporarily detached from the headquarters location, the FROM line of a message addressed to the staff would show the commander's complete plain language address (PLA). The TO line would show the word "ADMIN" followed by the commander's complete PLA, as in the following example:

```
FM COMSUBLANT NORFOLK VA
TO ADMIN COMSUBLANT NORFOLK VA
```

When the commander is absent, the commander's staff may use the proword ADMIN in the FROM line of messages originated by the staff and destined to the activity maintaining the commander's communications guard with appropriate special delivery instructions. The following example illustrates the use of ADMIN:

```
FM ADMIN COMSUBLANT NORFOLK VA
TO CNO WASHINGTON DC
UNCLAS //N02310//CNO NOT AN ADDEE, PASS TO
ADM BOAT FOR ACTION
```

USN PLAD 1 provides procedures for establishing an ADMIN PLA.

Office Codes

Office codes are required for all Navy shore activity PLAs. Office codes follow the PLA and are enclosed in double slants; for example, CNO WASHINGTON DC//094//. There is no limit on the number of office codes that can be used with a PLA. When multiple office codes are used with a PLA, the first code is the action code. A single slant separates multiple codes; for example, CNO WASHINGTON DC//094/611//. If an office code is not known, the code //JJJ// is used after the PLA. Office codes are not used with AIGs, CADs, or PLAs in pro forma messages. NTP 3 has further information concerning office codes used with PLAs.

PLAINDRESS AND ABBREVIATED PLAINDRESS MESSAGES

A plaindress message is one in which the originator and addressee designations appear externally in the address component. The plaindress message is the most commonly used format over naval circuits. Basically, the plaindress format contains all the components of the basic message except that the group count may be omitted. Referring back to table 6-2, you can see that this is format line 10 of the basic message.

Anytime the text is encrypted, the group count prosign GR and group count must be included in the prefix component. Messages requiring commercial refile that are transmitted by a military communications center to the commercial refile center must also have format line 10. Format line 10 contains the accounting prosign ACCT with the appropriate accounting symbol, the group count prosign, and the group count when applicable. It also contains the appropriate program designator code (PDC).

The following is an example of how a plaindress message might look if you were operating a ship-to-ship teleprinter circuit:

Example 1:

Format Line(s)	Transmission
2 & 3	NRMR DE NDRS
4	T
5	R 270907Z AUG 94
6	FM USS CLARK
7	TO USS CONQUEST
8	INFO USS LA SALLE
11	BT
12	TEXT (PLAIN LANGUAGE)
13	BT

You should note that the text is in plain language and no accounting data is required; therefore, the prefix component is omitted.

Where operational requirements are of such a nature that handling speed is of prime importance, the plaindress message may be abbreviated. The abbreviated plaindress format is used extensively in voice communications, although it may be used in other formats as well.

In the abbreviated plaindress format, the initial call serves as the address. For example, if your initial callup is VINCENNES THIS IS NIMITZ on an R/T circuit, format lines 6, 7, 8, and 9 need not appear in the heading. However, to have the call serve as the address, you must be in direct communication with the station or stations for which the message is intended. This eliminates the need for format lines 6 through 9.

Also included in the elements that may be omitted in abbreviated plaindress procedure are the precedence, date, DTG, and group count. The following is an example of an abbreviated plaindress message as it might appear on an R/T net:

Example 2:

Format Line(s)	Transmission
2 & 3	VINCENNES
11	BREAK
12	TEXT (PLAIN LANGUAGE)
13	BREAK
14	TIME GROUP
16	OVER

In example 2, the originator (*Nimitz*) is in direct communications with the addressee (*Vincennes*). Therefore, the call serves as the address. Notice there is no DTG. However, format line 14 (time group) is used only in abbreviated plaindress messages when a time group replaces a date-time group in format line 5.

CODRESS MESSAGES

A codress message is one sent in encrypted form. Since a codress message is encrypted, it always contains a numerical group count in the prefix. A codress message contains all the components of the basic message **except the address component**. The entire address component is included within the encrypted text. This makes the codress message a valuable security measure, which the originator may use when it is desirable to conceal the identity of the addressees. In so doing, we deny an enemy the luxury of being able to make inferences from originator/addressee traffic patterns that would otherwise be revealed by an external address.

The address component of a codress message is encrypted within its text unless address indicating groups (AIGs) are used. The requirement to handle these messages visually within the U.S. Navy is almost nonexistent because of the crypto systems in use. There may, however, be an occasional requirement to relay a codress message between allied ships using procedures contained in ACP 129.

PROSIGNS

Procedural signs, or prosigns, are letters or combinations of letters that convey frequently sent orders or instructions in a simple, standard format. Although some prosigns may seem to be abbreviations of their assigned meanings, prosigns are never referred to as abbreviations. Whether you are operating communications equipment on a circuit aboard ship or ashore, it is helpful to have a complete command of the prosigns. A recommended method of learning them is to prepare cards with the prosign on the front and their meaning on the back, and use them for self-drill. The following is a complete list of authorized prosigns:

- Precedence Prosigns:

  Z . . . . FLASH
  O . . . . IMMEDIATE
  P . . . . PRIORITY
  R . . . . ROUTINE

- Prosigns that identify portions of a transmission:

  AA . . . . All after
  AB . . . . All before
  WA . . . . Word after
  WB . . . . Word before

- Ending prosigns:

  K . . . . Go ahead; or, this is the end of my transmission to you and a response is invited.
  AR . . . . End of transmission; no receipt required.

- Pause prosigns:

  AS . . . . I must pause for a few seconds.
  AS AR . . . . I must pause longer than a few seconds; will call you back.

- Separation prosigns:

  BT . . . . Break. (Separates text of message from heading and ending.)
  II . . . . (Written in messages as a short dash.) Separative sign. (Used to separate certain elements of message headings. Not to be used as punctuation to represent a hyphen or dash in message texts.) Used in CW.

- Prosigns always followed by one or more call signs and/or address groups:

DE	From (in call).
FM	Originator's sign.
TO	The addressee designations immediately following are addressed for action.
INFO	The addressee designations immediately following are addressed for information.
XMT	Exempt. (Used to exempt addressees from a collective call or address.)

- Prosigns used in transmission instructions of a message:

T	Transmit this message to all addressees or to the addressee designations immediately following.
G	Repeat this entire transmission back to me exactly as received.
F	Do not answer.

- Group count prosigns:

GR (plus numerals)	Group count.
GRNC	The groups in this message have not been counted.

- Prosigns used with the Executive Method:

IX	Action on the message or signal that follows is to be carried out upon receipt of "EXECUTE."
IX Plus 5-second dash.	"EXECUTE"—Carry out the direction of the message or signal to which this applies.

- General:

AA	Unknown station.
B	More to follow.
C	Correct.
E E E E E E E E	Error (At least eight Es).
E E E E E E E E AR	This transmission is in error. Disregard it.
HM HM HM	Emergency silence sign.
IMI	Repeat.
INT	Interrogative.
J	Verify with originator and repeat.
NR	Station serial number.
R	I received your last transmission satisfactorily.

OPERATING SIGNALS

Like prosigns, operating signals provide communications operators with a brief signal that conveys a much longer expression and would require greater circuit time if sent in its longer form. However, in some respects, operating signals differ from prosigns.

FORMAT OF OPERATING SIGNALS

Operating signals, unlike prosigns, are comprised of three letters and begin with either Q or Z. In R/T, PROWORDS are used instead. An exception to this rule is made when a message containing an operating signal is relayed by R/T. In this case, the operator will transmit the group phonetically.

ACP 131 contains a listing of all Q and Z signals authorized for use by naval communications operators. Operating signals ZYA to ZZZ in *Communication Instructions—Operating Signals*, ACP 131 U.S. SUPP-1, are reserved for use by the U.S. Navy only. You should study these instructions carefully so that you, as a communications operator, can become familiar with those operating signals that may be used when communicating with civilian stations, allied nations, other naval ships, and so forth.

Generally speaking, Q signals are used between civil aviation units or civil international units. Z signals are used primarily between allied military units. Naturally, all Q and Z signals may be used between U.S. naval units because all naval units should hold ACP 131 as a basic part of their shipboard communication publication allowance. However, if you have a choice of using either a Q signal or a Z signal, which has the same meaning, such as QRK and ZBZ, you should use the Z signal.

USE OF OPERATING SIGNALS

An operating signal may be used in one of two ways: as a question or as a statement. The prosign INT means interrogative. Placing INT before an operating signal places it in the form of a question. For example, let's assume that USS *Nimitz* is having trouble communicating with USS *Vincennes* and inquires as to whether *Vincennes* is being interfered with.

NIMITZ asks: NVIN DE NMTZ INT QRM K?

VINCENNES answers: NMTZ DE NVIN QRM K.

In the preceding example, by using the operating signals INT QRM, NMTZ asked NVIN, ARE YOU BEING INTERFERED WITH? NVIN, by using QRM by itself, answered, I AM BEING INTERFERED WITH.

Some signals must be accompanied by a numerical suffix that completes, amplifies, or varies the basic meaning. For example, an operator may want to know the strength of the transmitted signals at the receiving station. To find out, the following transmission could be sent between *Nimitz* and *Vincennes*:

NIMITZ asks: NVIN DE NMTZ INT QSA K?

VINCENNES answers: NMTZ DE NVIN QSA5 K.

In the above example, NMTZ sent INT QSA, which means "What is the strength of my signals?" NVIN answered QSA5, which means "The strength of your signals is very good."

When communicating with nonmilitary stations, use the prosign IMI after the Q signal instead of INT before the Q signal to give an interrogatory meaning. You'll recall that IMI means "REPEAT" when used with military stations.

Unless encrypted, operating signals have no security and must be regarded as the equivalent of plain language. Operating signals sent on approved and properly cleared wire circuits are considered to have been encrypted and are not considered compromising.

MESSAGE USER RESPONSIBILITIES

A message user is any individual authorized to draft, release, and/or process electronically transmitted messages. There are certain responsibilities associated with the origination of a message. These responsibilities are separate and distinct and concern the following parties:

- Originator;
- Drafter; and
- Releaser.

Occasionally, the responsibilities may overlap, especially if one person is serving a dual capacity. For example, communications officers may occasionally draft and release messages, thus making them both drafters and releasers.

ORIGINATOR

The originator is the authority (command or activity) in whose name the message is sent. The originator is presumed to be the commanding officer of the command or activity. Most often, the originator and the releaser are one and the same.

In some cases, the drafter, releaser, and originator are all the same person. For example, if the commanding officer drafts a message for transmission, he or she is the drafter as well as the releasing authority for the activity in whose name the message is sent.

DRAFTER

The drafter is the person who actually composes the message. In accordance with NTP 3, the drafter is responsible for:

- Proper addressing and using PLAs correctly;

- Clear, concise composition;
- Selecting the precedence;
- Ensuring the proper format;
- Assigning the proper classification; and
- Ensuring the application of proper downgrading and declassification instructions to classified messages, except those containing Restricted Data or Formerly Restricted Data.

RELEASER

The releaser is a properly designated individual authorized to release messages for transmission in the name of the command or activity. The releasing individual ensures that the drafter has complied with the requirements contained in NTP 3. In addition to validating the contents of the message, the signature of the releaser affirms compliance with message-drafting instructions. The signature of the releaser authorizes the message for transmission.

After a message has been properly released, it is delivered to the telecommunications center (TCC) for transmission. The DTG is normally assigned here. Proper transmission, receipting, and filing procedures are done by the communications personnel.

An important point that you should remember about the DTG is that it is assigned for identification and file purposes only. It is not used to compute message processing time.

VERIFICATION OF MESSAGES

When accepting an outgoing message, you must check the message for completeness and accuracy and ensure that it has been properly released. During minimize, you must screen all messages to ensure that the words "MINIMIZE CONSIDERED" are on those messages destined for an area under minimize. You must ensure that the PLAs are in accordance with the MAD and that classified messages have downgrading instructions at the end of the text. Finally, you need to check the precedence and determine if any special-handling procedures are required.

MESSAGE FORMAT

General administrative (GENADMIN) is the format used for most narrative messages. The exceptions are those narrative messages for which a publication, instruction, or other directive requires a different format. In our discussion, we will be using the GENADMIN format.

There are other formats for special-purpose messages. These messages include casualty reports (CASREPs), movement reports (MOVREPs), and Status of Resources and Training System (SORTS). Instructions for preparing these messages are found in appropriate publications or instructions, such as naval warfare publications (NWPs).

MESSAGE TEXT FORMAT (MTF)

The unique message identifier (MSGID), GENADMIN, distinguishes this message format from all other formatted messages. This distinction cues computer processing to the prescribed sequence and repetition of allowable *sets* within the message. Figure 6-7 shows the basic GENADMIN message format.

A **set** is an ordered collection of information specifically arranged to be both human readable and machine processable. A set always begins with a set identifier, which is a word, an acronym, or abbreviation. The set identifier cues the human reader or automated processor as to the set content. MSGID is a set, which means "message identification."

A **field** is a discrete block of information within a set. Each field within a set begins with a field marker (/) and may contain only that information specified by **a set map**. Each set map is identified by its set identifier (MSGID, for example) and prescribes field arrangement and content.

There are two kinds of sets in the GENADMIN message: **linear** and **free text**. Figure 6-8 shows an example of a linear set.

A linear set consists of a set identifier and one or more data fields presented in a horizontal manner. A set identifier begins the set at the left margin and is a word, an abbreviation, or acronym that is descriptive of the information contained in the set.

A free-text set consists of a set identifier, such as AMPN, followed by a field marker and a single unformatted narrative data field. This type of set is used to explain or amplify formatted information contained in one or more of the linear sets in the message; for example:

AMPN/.....// (Info about preceding set only)

NARR/.....// (Info about two or more preceding sets)

RMKS/.....// (Info about the entire message)

AMPN/REF IS LETTER FROM USCINCEAST 18AUG94

RMKS/REQUEST IMMEDIATE REPLY

```
UNCLAS (or appropriate classification)
SUBJ: ..............................................
MSGID/GENADMIN/COMNAVCOMTELCOM//
RMKS/
1.   (U)
  . .  FREE ........................................
  . . . . . . TEXT .................................
  . . . . . . . . . . AS ...........................
2.   (U) . . . . . .  MUCH .........................
  . . . . . . . . . . . . . . . AS .................
  . . . . . . . . . . . . . . . . YOU ..............
3.   (U) . . . . . . . . . . . . .  NEED ......... //
DECL/OADR//   (or other DECL instruction for classified messages)

NOTES:
• DECL/   SET NOT USED FOR UNCLAS MESSAGE
• WHEN YOU REFERENCE USMTFs, USE THE MESSAGE ID TYPE "SHORT TITLE" (MSGID)
  OF THE MESSAGE, for example;

  REF/A/RRI/J6J/xxxxxxZxxx94
```

Figure 6-7.—Basic GENADMIN message format.

A data field is the basic element of reported information and may be formatted or unformatted. All data fields in a linear set are formatted.

Field markers (slant symbol [/]) mark the start of each field. The set identifier is separated from the first data field by a field marker, and subsequent data fields are separated from each other by field markers. Field markers are NEVER used before a set identifier, after the last field on a line, or after the final field in a set. Nor can they be used within a linear data field. Since field markers have particular significance in the automatic processing of messages, they cannot be used within formatted data fields.

REFERENCES

A reference may be any message (voice or record), document, correspondence, meeting, or telephone conversation that is pertinent to the text of the message. Figure 6-9 shows examples of various types of references using the reference (REF) set. We can follow the "map" of the REF set (figure 6-8) using the RECORD MESSAGES example in figure 6-9 in the below example:

```
       Field 1      Field 2     Field 3      Field 4
REF/serial letter/identification/originator/date-time group
REF/    A   /       RMG        /JCS J3 (JOD)/
                               240700ZMAR94//
        Field 5            Field 6        Field 7
/message serial number/special notation/NASIS code//
```

As you can see, fields 1 through 4 were filled in as required by the shaded portions in figure 6-8. If there are two or more references in a GENADMIN message, each reference uses an individual REF set and is serialized alphabetically.

REF	REFERENCED MESSAGE INFORMATION	REF

	1		2		3		4
REF	/ 1A		/ 1-20ANBS		/ 1-20ANBS		/ 6-12AN
	SERIAL LETTER		MESSAGE or COMM TYPE		ORIGINATOR		DATE-TIME of REF

5	6	7	
/ 1-7ANBS	/ 5A	/ 3A	//
SERIAL NUMBER	SPECIAL NOTATION	NASIS CODE	

NOTE: SHADED FIELDS ARE MANDATORY

The Referenced Message Information(REF) set indicates pertinent references. If the referenced message is a USMTF message, the type and originator must be exactly as shown in the MSGID set of the referenced message.

FIELD NO.	NAME	USE	EXPLANATION(ALLOWED FORMATS)
1	Serial Letter	M	Enter a sequential alphabetic character indentifying an individual reference, e.g., A, B, C. (1A)
2		M	Indicate the reference type using one of the following methods:
	Message Type, or		Enter the referenced message indentifier(name), e.g., MARREP, GENADMIN, AIRLIFTREQ. Non-USMTF message names, e.g., CASREP, LOGREQ, may also be entered. An AMPN set may be used, but is not required, to amplify a single REF set, or the last reference in a group of REF sets. A NARR set may be used, but is not required, to amplify a group of REF sets. (1-20ANBS), or
	Communications Type		Enter one of the other communications codes listed below. The "RMG" code is used when referencing a message having no unique indentifier (name). The reference must be amplified by an AMPN or a NARR set. Use an AMPN set if this is a single REF set or the last reference in a group of REF sets. Use a NARR set if multiple REF sets are listed and any one of these references(unless it is the last reference) and message contains a code from the list below: (3A)

COMMUNICATIONS	CODE
Conference/Meeting	CON
Document	DOC
Letter	LTR
Record Message	RMG
Telephone Conversation	TEL
Voice Message	VMG

FIELD NO.	NAME	USE	EXPLANATION(ALLOWED FORMATS)
3	Originator	M	Enter the originator of a message. Enter the unit name, squadron type and number, abbreviated ship name, or abbreviated task organization. Fleet commanders may use their command short title, e.g.,CTG 72.5, ENTERPRISE, PATRON FOUR SIX, CINCPACFLT, COMSIXTHFLT, COMNAVSURFGRU FOUR, PERRY OH. (1-20ANBS)
4		M	Enter the time of the reference using one of the following methods:
	Date-Time Group, or		Enter the Date-Time Group, e.g., 260600ZFEB94.(12AN), or
	Date-Time of Reference, or		Enter Date,Time, and Time Zone, e.g., 260600Z (7AN), or
	Alpha Date of Reference, or		Enter the Date-Alphamonth-Year, e.g., 26FEB94. (7AN), or
	Date of reference		Enter the Year-Month-Date, e.g., 940226. (6N)
5	Serial Number	O	Enter the message serial number exactly as found in the referenced message. (1-7ANBS)
6	Special Notation	O	A caveat that indicates special actions or restrictions: Enter "NOTAL" (Not to all) or "PASEP" (Passed separately). (5A)
7	NASIS Code	O,R	Enter the NATO Subject Indicator System (NASIS) alphatic code which indicates the subject matter contained in a particular message, e.g., GBL, ATU. Used only in USMTF messages that have a NATO addee. (3A)

Figure 6-8.—Example of a linear set.

CONFERENCE

REF/A/**CON**/CDR 82ND AB DIV/20SEP94

AMPN/AIRBORNE COMMANDERS CONFERENCE, FT BENNING GA//

MEETING

REF/A/**CON**/COMNAVWEPS CTR/02NOV93//

AMPN/JOINT ORDNANCE WORKING GROUP MEETING, DAHLGREN VA//

DISCUSSION/CONVERSATION (other than telephone)

REF/A/**CON**/CINCFOR/11MAR94

AMPN/BETWEEN MAJ SMITH CINCFOR(FCJ3J) AND CDR JONES CINCLANT(J36)//

TELEPHONE

REF/A/**TEL**/SPAWARS/08DEC93

AMPN/REF/A IS TELCON BETWEEN SPAWARS/LCDR SMITH AND CNO/CDR JONES//

DOCUMENT (Pub, Instruction, Reg., and so forth.)

REF/A/**DOC**/JCS J7/15APR94//

AMPN/JCS PUB 1-01 CHAP II, PARA 3.//REF/A/**DOC**/DOD/01SEP94

AMPN/DIR 5000.1, SUBJECT: MAJOR AND NON-MAJOR DEFENSE

ACQUISITION PROGRAMS, PG 3, PARA D.3.//

REF/A/**DOC**/JCS/07JAN93//

AMPN/JCS MOP 160, PG 6, PARA D (1)//

LETTER (For example, correspondence, memo, NAVGRAMs)

REF/A/**LTR**/JCS J7/18JUN94//

AMPN/TASKING LETTER TO GPO, SUBJ: PRINTING SERVICES SER J7/178//

REF/A/**LTR**/JCS J3/25SEP94//

AMPN/MEMO FOR DISTRIBUTION SER J3-202-93//

REF/A/**LTR**/JCS J6/19AUG94//

AMPN/MEMO FOR DIRECTOR, JTC3A. SUBJ: C3 INITIATIVES SER J6-568-88//

RECORD MESSAGES (other than USMTF messages)

REF/A/**RMG**/JCS J3(JOD)/240700ZMAR94//

AMPN/ALERT ORDER: OPERATION FULL BORE (U)//

REF/A/**RMG**/JCS J7-JETD/071818ZDEC94//00194//

REF/B/**RMG**/JCS J7-JETD/071326ZJAN94//00294//

NARR/REFS ARE PREVIOUS INTELLIGENCE SITUATION MSGS FOR EXERCISE

PROUD SCOUT 93 (U)//

VOICE MESSAGE (other than USMTF voice messages)

REF/A/**VMG**/PC188/181800ZMAY94//

AMPN/AIRCRAFT POSITION REPORT TO LOS ANGELES CENTER//REF/A/**VMG**/PAN AM 845/050615ZMAR94//

AMPN/MAYDAY RECEIVED BY USS ENTERPRISE ON 121.5 MHZ//

Figure 6-9.—Examples of references.

The AMPN (amplification) line further explains one reference and immediately follows the REF set. The NARR (narrative) line further explains more than one reference and immediately follows the last REF set.

The RMKS (remarks) set (figure 6-7) is the main body of the free text portion of a GENADMIN message.

Textual paragraphs are numbered consecutively, and each number is followed by a period. No line of text can exceed 69 characters.

SUBJECT LINE MARKINGS

The subject line of a classified message must be marked with the appropriate classification symbol if the subject line contains classified information. If the subject line itself is unclassified, it must be so marked. For both cases, the appropriate symbol is enclosed by parentheses (table 6-6) and follows the subject line.

PARAGRAPH MARKINGS

The *Security Manual* requires that each paragraph or subparagraph of classified messages be marked to show the level of classification. If unclassified, the paragraph or subparagraph should be so marked.

DOWNGRADING AND DECLASSIFICATION MARKINGS

Downgrading and declassification markings are required on all classified messages except those containing Restricted Data (RD) or Formerly Restricted Data (FRD).

MESSAGE READDRESSALS

If you receive or send a message and later determine that another activity may need to act on or know about the information in the message, you can readdress the original message to that activity. If you receive a copy of a message as an "information addressee," you can only readdress the original for information purposes.

Use a short form or long form, depending on how long ago the original message was sent. For both the short form and long form, you must:

- Fully identify the message you are readdressing.
- Enter the new addressee(s).
- Enter the original message originator.
- Include the original date-time group.
- Use the Process Sequence Number (PSN), if contained in the original message.

If the original message was sent within the last 60 days, use the short form to readdress it. Messages are held in the message center file for up to 60 days. On the short form, enter the *from, to,* and *information addressees* in the fields provided. Send the short form to the message center where it will be combined with the text of the original and then sent.

The short form readdressal is always unclassified. However, it must state the classification of the readdressed message.

Messages over 60 days old are routinely deleted from the message center files. If the original message to be readdressed is more than 60 days old, use the long form. Enter the *from, to,* and *information addressees* in the fields provided. Unlike the short form, you retype

Table 6-6.—Classification Marking Symbols

CLASSIFICATION	MARKING SYMBOL
Unclassified	(U)
For Official Use Only	(FOUO)
Confidential	(C)
Secret	(S)
Top Secret	(TS)
Restricted Data	(RD)
Formerly Restricted Data	(FRD)
NOFORN	(NF)

the entire message. Classify the long form the same as the original message.

When a sectionalized message is readdressed, each section of the message must be readdressed separately. The headerlines and addressees must be the same on each readdressal. The PSN must match that of the section being readdressed, but the respective section number is omitted. Each section of the readdressed message should have the same date-time group.

The precedence of the readdressal message may be lower, the same as, or of a higher precedence than the original message when deemed operationally imperative by the readdressal authority. General formatting instructions and preparation guidance are available in NTP 3. Message readdressal procedures may vary slightly at different TCCs. The required procedure may be verified through the local TCC.

SUMMARY

This chapter has introduced you to the various message formats and the modes of communication in which they are used. You have learned that the basic message format has three parts: heading, text, and ending. There are 16 format lines that make up these 3 parts, but not all format lines may be used, depending upon the mode of communication you are using. This chapter also presented the different types and classes of naval messages and the different types of addressee.

Finally, we discussed message preparation using MTF and GENADMIN message format. You were introduced to message readdressals and given information essential to their use and construction.

RECOMMENDED READING LIST

NOTE

Although the following references were current when this TRAMAN was published, their continued currency cannot be assured. You therefore need to ensure that you are studying the latest revisions.

Allied Call Sign and Address Group System—Instructions and Assignments, ACP 100(F), Joint Chiefs of Staff, Washington, D.C., March 1984.

Automatic Digital Network (AUTODIN) Operating Procedures, JANAP 128(J), Joint Chiefs of Staff, Washington, D.C., July 1993.

Basic Operational Communications Doctrine (U), NWP 4(B), Chief of Naval Operations, Washington, D.C., September 1989.

Communication Instructions—General (U), ACP 121(F), Joint Chiefs of Staff, Washington, D.C., April 1983.

Communications Instructions—General, ACP 121 US SUPP-1(F), Joint Chiefs of Staff, Washington, D.C., June 1981.

Communication Instructions—Operating Signals, ACP 131(D), Joint Chiefs of Staff, Washington, D.C., May 1986.

Communications Instructions—Tape Relay Procedures, ACP 127(G), Joint Chiefs of Staff, Washington, D.C., November 1988.

Communications Instructions—Teletypewriter (Teleprinter) Procedures, ACP 126(C), Joint Chiefs of Staff, Washington, D.C., May 1989.

Fleet Communications (U), NTP 4(C), Commander, Naval Telecommunications Command, Washington, D.C., June 1988.

Message Address Directory, Joint Chiefs of Staff, Washington, D.C., June 1990.

Operational Reports, NWP 10-1-10, Chief of Naval Operations, Washington, D.C., November 1987.

Telecommunications Users Manual, NTP 3(I), Commander, Naval Telecommunications Command, Washington, D.C., January 1990.

U.S. Call Sign & Address Group System Instructions & Assignments, ACP 100 U.S. SUPP-1(N), Joint Chiefs of Staff, Washington, D.C., June 1989.

U.S. Navy Address Indicating Group (AIG) and Collective Address Designator (CAD) Handbook, NTP 3 SUPP-1(K), Commander, Naval Telecommunications Command, Washington, D.C., August 1986.

CHAPTER 7

SECURITY

CHAPTER LEARNING OBJECTIVES

Upon completing this chapter, you should be able to do the following:

- *Summarize physical security as applied to classified materials.*
- *Discuss communications security (COMSEC).*
- *Discuss transmission security as related to COMSEC equipment and communications interference.*
- *Discuss emissions security, including TEMPEST and EMCON.*
- *Explain personal security censorship.*

Your duties as a Radioman will require that you handle considerable classified information. You should be able to recognize classified matter and know what to do—or not do—with it. Security is as basic a part of your assignment as operating telecommunications equipment. Safeguarding classified information is an integral part of your everyday duties.

In the first part of this chapter, we will discuss physical security. Later, we will cover communications security, its definition, and how it differs from physical security.

PHYSICAL SECURITY

The security of the United States in general, and of naval operations in particular, depends upon the safeguarding of classified information. As a Radioman, you will learn information of vital importance to both the military and the nation. Vast amounts of classified message information will pass through your hands at times.

You must be security conscious to the point that you automatically exercise proper discretion in the discharge of your duties. In this way, security of classified information becomes a natural element of every task and not an additionally imposed burden.

NEED FOR SECURITY

Most nations, even in peacetime, maintain espionage organizations to gain information on known or potential enemies. The activities of these organizations have always been among the greatest hazards to security.

You must remember that cost, time, and effort are no obstacles to a foreign government determined to get vital national defense information. Trained agents may be sent to areas near military installations where they may spend weeks, months, or even years becoming friendly with military personnel.

SECURITY CONTROL AND RESPONSIBILITY

The Secretary of the Navy has made the Chief of Naval Operations (CNO) responsible for information and personnel security. The CNO has delegated to the Commander, Naval Security Group Command (COMNAVSECGRU) the authority for administering the Navy communications security program.

The CNO has issued instructions for the proper administration of the security system. These instructions are contained in the Department of the Navy Information and Personnel Security Program Regulation, OPNAVINST 5510.1, hereinafter called the *Security Manual*. These instructions provide for the proper indoctrination of all personnel charged with safeguarding classified matter.

SECURITY CLASSIFICATION CATEGORIES

Information that requires protection against unauthorized disclosure in the interests of national security must be classified. The three classification categories are Top Secret, Secret, and Confidential. The level of classification depends on the degree of its significance to national security. Definitions and examples of each of the three categories are covered in the next paragraphs.

Top Secret

The Top Secret designation refers to defense information or material requiring the highest degree of protection. It is applied to information the unauthorized disclosure of which could reasonably be expected to cause **EXCEPTIONALLY GRAVE DAMAGE** to the national security. Examples include:

- Armed hostilities against the United States or its allies;
- Compromise of vital national defense plans; and
- Compromise of complex cryptologic and communications intelligence systems.

Secret

The Secret designation refers to defense information or material the unauthorized disclosure of which could reasonably be expected to cause **SERIOUS DAMAGE** to the national security, such as:

- The compromise of significant scientific or technological developments relating to national security;
- Significant impairment of a program or policy directly related to national security; and
- Disclosure of significant military plans or intelligence operations.

Confidential

Confidential is the designation applied only to information or material the unauthorized disclosure of which could reasonably be expected to cause **DAMAGE** to the national security. Examples include:

- Information indicating strength of ground, air, and naval forces; and
- Performance characteristics, test data, design, and production data on U.S. weapon systems and munitions.

SPECIAL-HANDLING MARKINGS

In addition to the three security classification categories just discussed, other markings also appear on some documents and messages. Among these markings are such designations as Restricted Data (RD), Formerly Restricted Data (FRD), NOFORN, LIMDIS, FOUO, EFTO, SPECAT, PERSONAL FOR, NATO RESTRICTED, and ALLIED RESTRICTED.

Restricted Data and Formerly Restricted Data

The marking "Restricted Data" (RD) is applied to all data concerned with the design, manufacture, or use of nuclear weapons. Also included in this category is the special nuclear material used in energy production.

The marking "Formerly Restricted Data" (FRD) pertains to defense information that has been removed from the RD category but must still be safeguarded as classified defense information. FRD material cannot be released to foreign nationals except under specific international agreement.

NOFORN Designation

The NOFORN marking is used to identify intelligence that may not be released in any form to foreign governments, foreign nationals, or non-U.S. citizens without permission of the originator. The abbreviation "NOFORN," or "NF," is used with a security classification and means "Not Releasable to Foreign Nationals." The absence of this designation on intelligence material is not to be construed as authorization to disseminate the information to foreign nationals.

LIMDIS (Limited Distribution)

The LIMDIS designator is applied only to classified messages which, because of the subject matter, require limited distribution within the addressed activity.

For Official Use Only (FOUO)

FOUO is the designation used on official information not requiring a security classification but which must be withheld and protected from public release. Unclassified messages containing FOUO information must have the abbreviation "FOUO" after the designation "UNCLAS."

Encrypt for Transmission Only (EFTO)

Certain categories of unclassified messages may be identified as having potential value if subject to analysis, but do not meet the criteria for security classification. The special designation "EFTO" was established to protect these unclassified messages during electrical transmission.

EFTO is not required on unclassified messages addressed exclusively among Navy, Marine Corps, and Coast Guard commands. EFTO is authorized for use within the Department of Defense, including the National Security Agency. However, EFTO is required on FOUO messages addressed to DOD activities outside the continental United States. Bear in mind, however, that just because information is FOUO, it is not automatically EFTO, and vice versa.

As we mentioned earlier, EFTO is a transmission marking for unclassified messages. FOUO markings, however, define a certain category of information requiring special handling. Neither FOUO nor EFTO markings are security classifications; both are special-handling designations. You can find detailed information on EFTO and FOUO markings in *Basic Operational Communications Doctrine (U)*, NWP 4.

SPECAT

The SPECAT marking means special category. SPECAT messages are classified messages identified with a special project or subject. SPECAT messages require special-handling procedures in addition to the handling procedures for the security classification of the message. There are four SPECAT categories:

- SPECAT;
- SPECAT EXCLUSIVE FOR (SEF);
- SPECAT Single Integrated Operational Plan-Extremely Sensitive Information (SIOP-ESI); and
- PSEUDO-SPECAT.

SPECAT and SPECAT EXCLUSIVE FOR messages must be at least Confidential. SPECAT SIOP-ESI messages are always Top Secret. PSEUDO-SPECAT messages are normally unclassified messages that require limited distribution. Examples of PSEUDO-SPECAT messages include AMCROSS messages, urinalysis test results, and HIV test results.

SPECAT messages are handled only by those personnel who are authorized by the commanding officer in writing to view them. The types of information assigned SPECAT and handling procedures can be found in NWP 4 and in *Fleet Communications (U)*, NTP 4, respectively.

PERSONAL FOR

PERSONAL FOR is the marking applied when message distribution must be limited to the named recipient. Only flag officers, officers in a command status, or their designated representatives may originate PERSONAL FOR messages.

NATO RESTRICTED

The United States does not have a security classification equivalent to NATO RESTRICTED. NATO messages classified as restricted must be safeguarded in a manner similar to FOUO messages. Messages originated by NATO must be handled in accordance with *NATO Security Procedures (U)*, OPNAVINST C5510.101.

ALLIED RESTRICTED

The United States does not have a security classification equivalent to ALLIED RESTRICTED. However, these messages must be handled in the same manner as Confidential messages. U.S.-originated messages containing ALLIED RESTRICTED information are marked as "Confidential" immediately following the security classification.

GENERAL MARKING REQUIREMENTS

Classified documents and material must be clearly and conspicuously marked. Special markings, such as NOFORN, LIMDIS, and Restricted Data, are normally placed near the classification markings. These markings inform and warn recipients of the classification assigned and indicate the level of protection required. These markings also identify the information that must be withheld from unauthorized persons.

Top Secret, Secret, and Confidential classification markings must be stamped, printed, or written in capital letters larger than those used in the text of the document. These security markings should be red in color, when practicable, and be placed at the top and bottom center of each page.

All reproductions or copies of classified materials, regardless of form, must bear clearly legible security classification markings and notations in the same manner as on the copied or reproduced material. Copying equipment does not always clearly reproduce all colors of ink or marginal images. If the reproduction process does not clearly reproduce the security markings appearing on the original copy, all copies must be marked in the same positions and size as on the original.

Paragraph markings are required for classified documents. The appropriate security markings are placed at the beginning of the classified paragraph. The symbols used to indicate paragraph classification are (TS) for Top Secret, (S) for Secret, (C) for Confidential, and (U) for Unclassified.

It is not uncommon to see foreign-originated classified information in U.S. messages and documents. Paragraphs that contain foreign-originated classified information must be properly marked; for example, "U.K.(C)" or "NATO(S)."

At the beginning of Restricted Data and Formerly Restricted Data paragraphs, use the appropriate classification symbol with the abbreviation "RD" or "FRD," such as "(S-RD)," "(C-FRD)." For the intelligence control marking "NOFORN," use the abbreviation "NF" along with the classification symbol, such as "(S-NF)."

Titles and subjects are classified according to their content, regardless of the overall classification of the document. Normally, the symbols indicating the classification assigned to a title or subject are placed in parentheses immediately following the item, as in the following example:

Subj: BASIC OPERATIONAL COMMUNICATIONS DOCTRINE (U)

The *Security Manual* contains complete information on paragraph, subparagraph, and document markings.

SECURITY AREAS

Different spaces aboard ship and different areas within a shore activity usually have varying degrees of security importance. The degree of security of each area depends upon its purpose and the nature of the work, information, equipment, or materials concerned. Access to security areas must be controlled in a manner consistent with the security level.

Restricted Areas

Designating security spaces as restricted areas provides an effective and efficient means for a command to restrict access and control movement. In restricted areas, only those personnel whose duties actually require access and who have been granted appropriate security clearance are allowed freedom of movement within the area.

Persons who have not been cleared for access to the information contained within the area may, with appropriate approval, be admitted into the area. While in these spaces, however, uncleared persons must be escorted, or other security procedures implemented to prevent any unauthorized disclosure of classified information.

All designated restricted areas must have warning signs posted at all entrances and exits. These areas must have clearly defined perimeters and, if appropriate, Restricted Area warning signs posted on fences and barriers.

Access to Spaces

The commanding officer or the officer in charge over security spaces is responsible for controlling access to these areas. Procedures should limit access to security spaces only to those persons who have a need to know. No one has a right to have access to classified information or spaces based solely on clearance, rank, or position.

Each command establishes a pass or badge identification system to restrict access and to help control movement. Control of movement within the area is normally accomplished by requiring the display or presentation of the pass or badge for that particular area.

Access List

Admission of visitors to communications spaces is a topic of major concern to radiomen since access to communications spaces under operating conditions usually permits viewing of classified traffic and equipment. A security badge does not automatically mean that visitors have a "need to know" or that they should be granted access. Admission to communication spaces is granted only to personnel whose names, rates/ranks, and clearance level appear on the official access list.

Access lists, which must be signed and approved by the commanding officer, should be posted at each entrance to a communications space. Admission of persons other than those on the access list is subject to the specific approval of the commanding officer or his or her designated representative.

Personnel not on the access list nor specifically granted permission by the commanding officer for entry must be escorted or supervised at all times while in communications spaces.

Communications Center Visitors Log

A communications center visitors log (or register) is used to record the arrival and departure of authorized personnel whose names do not appear on the access list. NTP 4 recommends the following column headings for visitors logs:

- Date;
- Visitor's printed name;
- Organization the visitor is representing;
- Purpose of visit;
- Visitor's signature;
- Officer authorizing access to restricted area(s);
- Escort's name;
- Time in; and
- Time out.

Access to Classified NATO Messages

Only those personnel who hold a security clearance equal to or greater than the clearance required for U.S. material may have access to NATO messages. NATO messages and documents belong to NATO and must not be passed outside the NATO organization. OPNAVINST C5510.101 is the authority for the proper handling, storage, accounting, classification, and clearances of NATO material.

The final responsibility for determining whether a person is granted access to a security area rests upon the individual who has the authorized possession, knowledge, or control of the information involved and not upon the prospective recipient. No number of written rules or governing statutes can replace individual initiative and common sense. As we mentioned earlier, no one has a right to access based solely upon security clearance, rank, or position.

COMPROMISE

Compromise is the disclosure of classified information to a person who is not authorized access. The unauthorized disclosure may have occurred knowingly, willfully, or through negligence. Compromise is considered confirmed or suspected under the following circumstances:

- Confirmed when conclusive evidence exists that classified information has been disclosed to an unauthorized person.
- Suspected when some evidence exists that classified information has been subjected to unauthorized disclosure.

HANDLING AND STORAGE OF CLASSIFIED MATERIAL

Classified messages must be provided accounting and control that corresponds to their assigned classification. Accounting and control of classified messages serve the following functions:

- Limit dissemination;
- Prevent unnecessary reproduction; and
- Determine the office or person normally responsible for the security of the material.

With Top Secret messages, it is also important to keep a current record of who has the information and who has seen it.

Since distinctions are made among the three levels of classification, distinctions are also made in the degree of accountability and control. Within each command, specific control and accountability procedures are established to ensure that classified material is properly controlled and that access is limited only to cleared personnel.

Security Personnel

To control classified information with maximum efficiency, the commanding officer designates a security manager, usually an officer. The security manager is responsible for the command's overall security program, which includes the security of classified information, personnel security, and the command's security education program.

In addition, the commanding officer usually appoints a Top Secret Control Officer (TSCO). The TSCO is responsible for the receipt, custody, accounting, and disposition of Top Secret material in the command. The TSCO is normally subordinate to the security manager. If a separate person is not designated as the TSCO, the security manager may be designated as TSCO. The duties of the security manager and the TSCO are outlined in the *Security Manual*.

Besides the security manager and the TSCO, every command involved in processing data in an automated system must designate an ADP security officer. The ADP security officer is responsible to the security manager for the protection of classified information processed in the automated system.

Handling Top Secret Material

Although administrative records are maintained for each classification category, the strictest control system is required for Top Secret material.

Except for publications containing a distribution list by copy number, all Top Secret documents and each item of Top Secret equipment must be serially numbered at the time of origination. Also, each document must be marked to indicate its copy number (for example, Copy No.____of____Copies).

Each page of a Top Secret document not containing a list of effective pages (LOEP) must be individually numbered (for example, Page____of____pages). Top Secret documents are required to have a list of effective pages and a page-check page. Top Secret documents may be reproduced only with the permission of the originator or higher authority.

A continuous chain of receipts for Top Secret material must be maintained. Moreover, a Record of Disclosure, OPNAV form 5511/13, for Top Secret material is attached to each document that circulates within a command or activity. Each person having knowledge of the contents of a Top Secret document must sign the attached Record of Disclosure. Top Secret messages, documents, and publications must be stored in a security container separate from those classified Secret and below.

Handling Secret Material

Every command is required to establish administrative procedures for recording all Secret material originated and received. These administrative procedures, as a minimum, must include a system of accountability for Secret matter distributed or routed within the command, such as a communications log. Accounting of Secret material may or may not be centralized.

Unlike Top Secret material, Secret material does not require signed receipts distributed or routed within the command. However, it is extremely important that you ensure that the person who is receiving Secret messages or material is properly cleared and his or her name appears on an access list released by the commanding officer.

Handling Confidential Material

Procedures for handling Confidential material are less stringent than those for Secret. There is no requirement to maintain records of receipt, distribution, or disposition of Confidential material. However, Confidential material must still be protected from unauthorized disclosure by access control and compliance with regulations on marking, storage, transmission, and destruction.

Handling Classified ADP Material

Classified ADP storage media and output must be controlled and safeguarded in accordance with its security classification. When handling decks of classified ADP cards, you must handle each deck as a single message with the first and last cards carrying the classification markings. Specific procedures on security requirements for handling and storing ADP material are found in the *Department of the Navy Automatic Data Processing Security Program*, OPNAVINST 5239.1.

Custody of Classified Material

An individual who has possession of or is charged with the responsibility for safeguarding and accounting for classified material or information is the "custodian" of that material or information. As a

Radioman, you are constantly in possession of classified material, including messages, publications, and equipment. Therefore, you are a custodian of classified material as long as the material is in your possession.

As custodian of classified material, you are responsible for protecting and accounting for the material at all times. You must ensure that the material is protected from disclosure to uncleared personnel, such as a visitor being escorted through your working spaces. If working outside of normal communication spaces, you must ensure that classified material is locked in an approved security container when the material is not in use or under direct supervision.

CARE DURING WORKING HOURS.—Every Radioman must take the necessary precautions to prevent access to classified information by unauthorized persons. These precautions include:

- When removed from storage for working purposes, classified documents must be kept under constant surveillance or face down or covered when not in use.
- Preliminary drafts, carbon sheets, plates, stencils, notes, work sheets, and all similar items containing classified information require special precautions. They must be either destroyed immediately after they have served their purpose or given the same classification and safeguarded in the same manner as the classified material produced from them.
- Typewriter ribbons used in typing classified material must be protected in the same manner as the highest level of classification for which they have been used. Fabric typewriter ribbons may be considered as unclassified when both the upper and lower sections have been recycled through the machine five times in the course of regular typing. Those ribbons that are classified must be destroyed as classified waste.

CARE AFTER WORKING HOURS.—At the close of each watch or working day, all classified material that is passed from watch to watch must be properly inventoried. Custody is then transferred to the relieving watch supervisor. All other classified material must be locked in an approved security container. A system of security checks at the close of each working day is the best method to ensure that all classified material held is properly protected. Whether your watch section is being relieved by the oncoming watch or you are securing an office space, you should make an inspection to ensure as a minimum that:

- All classified material is properly stored;
- Burn bags are properly stored or destroyed;
- Wastebaskets do not contain classified material; and
- Classified notes, carbon paper, carbon and plastic typewriter ribbons, rough drafts, and similar papers have been properly stored or destroyed. As a matter of routine, such items should be placed in burn bags immediately after they have served their purpose.
- When classified material is secured in security containers, the dial of combination locks should be rotated at least four complete turns in the same direction.

Storage of Classified Material

All classified matter not in actual use must be stored in a manner that will guarantee its protection. The degree of protection necessary depends on the classification category, quantity, and scope of the material involved. Normally, the type and extent of physical protection required are determined before an activity begins its day-to-day or watch-to-watch routine.

It is very likely that an appropriate physical security program is already in effect when you report aboard. Details concerning physical security standards and requirements for classified information are contained in the *Security Manual.*

UNATTENDED CONTAINERS.—If you find an open and unattended container or cabinet containing classified matter, you should report it to the senior duty officer. Do not touch the container or contents, but guard them until the duty officer arrives. The duty officer then assumes responsibility for such further actions as locking the security container, recalling the responsible person or persons, and reporting the security violation to the commanding officer. The custodian must conduct an immediate inventory of the contents of the security container and report any loss to the commanding officer.

COMBINATIONS.—Combinations to security containers containing classified material are made available only to those persons whose duties require access to them. The combinations of security containers containing classified information must be changed at least every 12 months, unless more frequent change is dictated by the type material stored within. Combinations must also be changed under the following circumstances:

- When an individual knowing the combination no longer requires access;
- When the combination has been subject to possible compromise or the security container has been discovered unlocked and unattended; and
- When the container is taken out of service.

The combination of a security container used for the storage of classified material is assigned a security classification equal to the highest category of classified material authorized to be stored in the container. Records of combinations are sealed in an envelope (Standard Form 700) and kept on file in a central location designated by the commanding officer.

DESTRUCTION OF CLASSIFIED MATERIAL

Classified material that is no longer required should not be allowed to accumulate. Destruction of superseded and obsolete classified materials that have served their purpose is termed "routine destruction."

Routine Destruction

There are specific directives that authorize the routine destruction of publications, message files, and cryptomaterials (we discuss crypto later in this chapter). As a Radioman, you should carefully study these directives so that you may properly comply with them. Additionally, the letter of promulgation of publications often sets forth disposition instructions about destruction requirements for that publication. Other materials, such as classified rough drafts, work sheets, and similar items, are periodically destroyed to prevent their accumulation.

Top Secret, Secret, and Confidential material may be destroyed by burning, pulping, pulverizing, or shredding. Destruction must be complete and reconstruction of material impossible. The most efficient method of destroying combustible material is by burning.

Destruction Procedures and Reports

Top Secret material will be destroyed by two witnessing officials. Persons performing any destruction must have a clearance level equal to or higher than the material being destroyed. Destruction will be recorded on a record that provides for complete identification of the material being destroyed. Destruction records must include number of copies destroyed, date of destruction, and personnel completing destruction. These records are maintained for 2 years.

Secret messages must be destroyed following the two-person rule, without a record of destruction. Alternatively, one person may destroy Secret messages if a record of destruction is made. The commanding officer may impose additional controls for Secret messages if warranted and if they reasonably balance security against operational efficiency.

Confidential material and classified waste are destroyed by authorized means. Personnel performing destruction will hold an appropriate clearance and are not required to record destruction.

If the material has been placed in burn bags for central disposal, the destruction record is signed by the witnessing officials at the time the material is placed in the burn bags. Records of destruction must be retained for 2 years.

All burn bags must be given the same protection as the highest classification of material in them until they are destroyed. Since several burn bags may accumulate for burning, it is important to keep an accurate record of the number of bags to be burned. Burn bags must be serially numbered and a record kept of all subsequent handling until destroyed.

BURNING.—As a Radioman, you will probably assist in the burning of classified material. Every member of a burn detail must know exactly what is to be burned and should double-check burn material against an inventory list before the material is burned.

To provide for accountability of the burn bags, the supervisor of a burn detail must be sure that the bags are numbered (or counted) before they are removed from the workspaces. The supervisor of a burn detail must have either a log or checkoff list that lists the number of bags to be burned. At the destruction site, each bag is checked off the list as it is destroyed in the presence of the witnessing officials (witnessing officials are discussed later in this chapter).

To ensure the complete destruction of bound publications, the pages must be torn apart and crumpled before they are placed in bags. All material must be watched until it is completely consumed. The ashes must be broken up and scattered so that no scraps escape destruction.

SHREDDING.—Crosscut shredding machines are relatively quiet and may be used aboard ships where incinerator facilities are not available. Crosscut shredders are replacing incinerators in many areas where burning is not allowed because of the Clean Air Act. Crosscut shredding machines must reduce classified material to shreds no greater than 3/64 inch wide by 1/2 inch long. Crosscut shredding suffices as complete destruction of classified material, and the residue may be handled as unclassified material with the exception of some COMSEC material. Not all crosscut shredders are suitable for destroying microfiche, so make sure the one you are using has that capability before attempting to shred microfiche.

PULVERIZING AND DISINTEGRATING.—Pulverizers and disintegrators designed for destroying classified material are usually too noisy and dusty for office use unless installed in a noise- and dust-proof enclosure. Some pulverizers and disintegrators are designed to destroy paper products only. Others are designed to destroy film, typewriter ribbons, photographs, and other material.

JETTISONING OR SINKING.—Material to be jettisoned during emergency destruction must be placed in weighted bags. The sea depth should be 1,000 fathoms or more. However, if water depth is less that 1,000 fathoms, the material should still be jettisoned to prevent easy recovery.

Emergency Plans

Emergency plans provide for the protection, removal, or destruction of classified material. Commands holding classified material must develop an emergency plan to fit their needs. The primary requirement of an emergency plan is that it adequately provide for the rapid and complete destruction of the classified material. Emergency plans must cover three areas of emergencies:

- Natural disasters, such as hurricanes;
- Civil disturbances, such as rioting; and
- Enemy action.

Emergency plans should provide for the protection of classified material in such a manner as to minimize the risk of loss of life or injury to personnel.

For destruction, the command's emergency plan must do the following:

- Emphasize procedures and methods of destruction, including place and destruction equipment required;
- Clearly identify the exact location of all classified material;
- Prioritize material for destruction; and
- Assign personnel by billet, areas of responsibility for destruction.

PRIORITIES.—When the emergency plan is implemented, priority of destruction is based on the potential effect on national security should the material fall into hostile hands. COMSEC material is destroyed first. The priorities for emergency destruction are as follows:

- **FIRST PRIORITY**—Top Secret COMSEC material and classified components of equipment and all other Top Secret material;
- **SECOND PRIORITY**—Secret COMSEC material and all other Secret material;
- **THIRD PRIORITY**—Confidential COMSEC material and all other Confidential material.

After you have destroyed the classified for which you are responsible, you should destroy any unclassified equipment that could be of use to an enemy. You should also destroy pertinent technical, descriptive, and operating instructions.

FIRE PLANS.—In addition to an emergency plan, a plan of action in the event of fire is also required. As with an emergency plan, it is important that all communications personnel familiarize themselves with their command fire plan. Normally, the fire plan provides for the following:

- Local fire-fighting apparatus and personnel to operate the equipment;
- Evacuation of the area, including a decision whether to store classified material or remove it from the area; and
- Admitting outside fire fighters into the area.

PRECAUTIONARY ACTIONS.—Precautionary destruction reduces the amount of classified material on hand in case emergency destruction later becomes necessary. Destruction priorities remain the same during precautionary destruction. However, when precautionary destruction is held, material essential to communications must not be destroyed. For example, communications operating procedures and publications that are to become effective in the near future would not be destroyed. Communications operating procedures that are already effective, necessary, and being used would also not be destroyed.

The following actions should be taken daily:

- All superseded material should be destroyed in accordance with its prescribed time frame.
- Unneeded material should be returned to the issuing agencies.
- Material should be stored in such a way as to make it readily accessible for removal during destruction.

Contrary to widespread opinion, there is no security policy requiring destruction of unclassified messages. However, some message centers with high volumes of classified and unclassified message traffic may find it more efficient to destroy all messages and intermingled files as though they were classified. Under some circumstances, units operating in foreign ports or waters and commands situated in foreign countries may take additional precautions in disposing of unclassified material.

COMMUNICATIONS SECURITY (COMSEC)

As a Radioman, you will often deal with sensitive subject matter that requires special security handling. It is for this reason that we have communications security (COMSEC). Within the framework of COMSEC, we have directives and requirements that deal specifically with communications material.

COMSEC involves all the protective measures taken to deny unauthorized persons information derived from the possession and study of telecommunications relating to national security. COMSEC also consists of the measures taken to ensure the authenticity of our communications. COMSEC includes the following:

- Cryptosecurity, which results from measures taken to provide technically sound cryptosystems and their proper use;
- Physical security, which results from physical measures taken to safeguard COMSEC material and information;
- Transmission security, which results from measures designed to protect transmissions from interception and exploitation by means other than cryptoanalysis; and
- Emission security, which results from measures taken to deny unauthorized persons information derived from the interception and analysis of emanations from crypto and telecommunications equipments.

The first part of this chapter discussed physical security procedures, which apply to all persons handling classified material. In the discussion that follows, we will see how the other three elements of COMSEC—cryptosecurity, transmission security, and emission security—are unique to the duties of a Radioman.

CRYPTOSECURITY/COMMUNICATIONS SECURITY MATERIAL SYSTEM (CMS)

The Navy has instituted a unique distribution system to achieve technically sound cryptosystems. The Navy has also developed strict accountability and control procedures to ensure proper use of cryptosystems.

The CMS is designed to ensure the proper distribution, handling, and control of COMSEC material and to maintain the cryptographic security of communications. Procedures governing the CMS can be found in *Communications Security Material System (CMS) Policy and Procedures Manual*, CMS 1.

CMS Account

Every command with a CMS account is assigned an account number by the Director, Communications Security Material System (DCMS). A command or activity with a CMS account number receives its COMSEC material directly from national and Navy sources. A CMS account command may also be responsible for COMSEC material transferred to other commands. The command assigns a CMS custodian and alternates the responsibility for the overall management of the CMS account.

CMS Custodian and Alternate Custodians

The CMS custodian is the person designated in writing by the commanding officer to maintain the CMS account for the command. The alternate custodians are also designated in writing by the commanding officer and assist the CMS custodian.

In the custodian's absence, the alternates assume the duties of the custodian. Their duties include receiving, inventorying, destroying, and issuing COMSEC material and equipment to authorized users and local holders. They are also responsible for training all personnel involved in CMS and submitting required COMSEC reports to the proper authority in a timely manner. CMS 1 provides details on the responsibilities of the CMS custodian and alternates.

CMS Local Holder

A CMS local holder is a command or activity that receives its COMSEC material support from a CMS account command. The local holder command has a designated CMS custodian and alternates who are responsible to their commanding officer for the proper handling of COMSEC material and training of personnel involved. For example, if a ship drew all of its COMSEC material from a central account maintained by the squadron commander, the ship would have to be a local holder. Local holders must draw all of their material from only one CMS account and may not be local holders to two or more accounts.

CMS User

A CMS user is an individual who requires COMSEC material to accomplish an assigned duty or who needs COMSEC material for advancement study or training purposes. A CMS user must be properly cleared and authorized by the commanding officer to handle CMS material. As a Radioman, you will most likely become a user of COMSEC material.

CMS Witness

There may be times when you will be assigned as a CMS witness. You will be responsible to assist a custodian or user in performing routine administrative tasks related to the handling of COMSEC material. As a witness, you must be familiar with applicable CMS procedures and command directives.

CMS Responsibilities

Whether you are a CMS user or a witness, you are responsible for the proper security, control, accountability, and destruction of CMS material in your workspace. Everyone involved with CMS material must comply with the procedures in CMS 1-related administrative and procedural publications. You must also comply with the CMS instructions of the command and higher authority.

CMS Training Requirements

The CMS custodian and alternates are responsible for training all personnel involved with COMSEC material in the proper handling, security, accounting, and destruction of COMSEC material. The CMS custodian may use the Personnel Qualifications Standards (PQS) for CMS as a training tool. All personnel who become involved with CMS should complete the PQS training course.

CMS Storage Requirements

COMSEC material must be stored separately from non-COMSEC material. This helps ensure separate control for COMSEC material and makes emergency destruction of COMSEC material easier. COMSEC material of different security classifications may be stored in the same security container drawer. COMSEC material, however, must be segregated according to classification so that it can be destroyed in a timely manner in an emergency.

Storage requirements for COMSEC keying material are more stringent than for nonkeying material. All COMSEC keying material requiring two-person integrity (TPI) must be stored in such a manner that a single person, including the CMS custodian, cannot obtain access. CMS 1 lists the storage requirements for COMSEC keying material.

CMS Inventory

Each time a watch section changes, the oncoming watch supervisor and a witness must inventory all COMSEC material held at a watch station. Two-person integrity must be maintained at all times during the inventory. When you inventory COMSEC material, you must do the following:

- Account for all keying material and page-check open keying packages;

- Visually inventory all COMSEC equipment and account for equipment by quantity; and
- Page-check all COMSEC publications.

The inventory sheet must list COMSEC material by short title, edition, and accounting number (if any). Both persons must sign the inventory sheet. CMS 1 outlines the requirements for inventorying COMSEC material.

CMS Destruction

As a Radioman, you may very well be involved with the routine destruction of COMSEC material. The destruction methods that we discussed earlier are also used for COMSEC material. CMS 1 gives complete details on priority of destruction of CMS materials.

ROUTINE DESTRUCTION.—Superseded COMSEC material must be destroyed as soon as possible after supersession. Keying material marked "CRYPTO" must be destroyed no later than 12 hours after supersession. Superseded authentication publications and documents must be destroyed no later than 5 days after supersession.

EMERGENCY DESTRUCTION.—COMSEC material that must be destroyed in an emergency is divided into three categories:

- Keying material;
- COMSEC documents; and
- COMSEC equipment.

As we mentioned earlier, an emergency plan consists of both precautionary destruction and complete destruction.

PRECAUTIONARY DESTRUCTION.—When precautionary destruction is ordered, COMSEC material must be destroyed as follows:

- **Keying Material**—Superseded keying material must be destroyed first, then keying material that becomes effective in 1 or 2 months.
- **Nonessential Classified COMSEC Documents**—This material includes maintenance, operating, and administrative manuals.

COMPLETE DESTRUCTION.—When complete destruction is ordered, COMSEC material must be destroyed as follows:

- **Keying Material**—Keying material is always destroyed first in the following order: superseded, effective, then reserve.

Superseded keying material that has been used to encrypt traffic is the <u>most</u> sensitive of the three categories. If superseded keying material falls into enemy hands, all past intercepted traffic is subject to compromise and analysis. Superseded keying material must be destroyed within 12 hours after supersession.

Effective keying material is destroyed after superseded keying material. Reserve keying material is keying material that will become effective within the next 30 days. Reserve keying material is destroyed after effective keying material.

Keying material must be stored in priority order for destruction. Top Secret material must be destroyed ahead of Secret material, and Secret material destroyed ahead of Confidential material. This applies to all categories of keying material.

- **COMSEC Documents**—COMSEC documents are destroyed next. COMSEC documents include cryptoequipment maintenance manuals, operating instructions, general publications, status publications, CMS-holder lists and directories. COMSEC documents contain information on the types of cryptoequipments we use, the level of technology we have attained, and the way our COMSEC operations are organized and conducted.
- **COMSEC Equipment**—COMSEC equipment is destroyed last. In emergencies, the immediate goal regarding cryptoequipment is to render the equipment unusable and unrepairable. The operating and technical manuals for cryptoequipments provide details on the techniques for rapid and effective destruction.

The destruction plan itself is contained in the overall emergency plan. The emergency plan should always provide for securing, removing, or destroying the material, depending on the situation.

The appropriate course of action and timing should be stated in the overall destruction plan. For example, if there is a local civil uprising that appears to be short-lived, destroying all material would probably not be necessary. In this situation, a partial destruction of the more sensitive superseded material might be made, some of the remaining material removed, and the rest secured.

The commanding officer will normally implement the emergency plan. Should the situation prevent contact with the commanding officer, other individuals, such as the COMSEC officer or COMSEC custodian, are usually authorized to implement the plan. During an emergency, personnel safety overrides the destruction priority.

TWO-PERSON INTEGRITY

Two-person integrity (TPI) is the security measure taken to prevent single-person access to COMSEC keying material and cryptographic maintenance manuals. TPI is accomplished as follows:

- The constant presence of two authorized persons when COMSEC material is being handled;
- The use of two combination locks on security containers used to store COMSEC material; and
- The use of two locking devices and a physical barrier for the equipment.

At no time can one person have in his or her possession the combinations or keys to gain lone access to a security container or cryptographic equipment containing COMSEC material. Neither can one person have sole possession of COMSEC material that requires TPI security.

CRYPTOGRAPHIC OPERATIONS AND OPERATOR REQUIREMENTS

As a Radioman, you will be required to learn and understand the more detailed procedures and processes involving cryptographic operations. Cryptographic procedures and associated equipments are governed by many strict rules and standards. To understand cryptographic operations and their importance, you must understand the following terminology:

- **CRYPTO**—The marking "CRYPTO" is not a security classification. This marking is used on all keying material and associated equipment to protect or authenticate national security-related information. All material and equipment marked "CRYPTO" require special consideration with respect to access, storage, and handling.
- **CRYPTOMATERIAL**—The term "cryptomaterial" refers to all material, such as documents, devices, or apparatus, that contain cryptoinformation. Furthermore, the material must be essential to the encryption, decryption, or authentication of telecommunications. Cryptomaterial is always classified and is normally marked "CRYPTO."

Cryptomaterial that supplies equipment settings and arrangements or that is used directly in the encryption and decryption process is called keying material. Keying material is afforded the highest protection and handling precautions of all information and material within a cryptosystem. Keying material is always given priority when an emergency plan is implemented.

- **CRYPTO INFORMATION**—Cryptoinformation is always classified. This type of information normally concerns the encryption or decryption process of a cryptosystem. It is normally identified by the marking "CRYPTO" and is subject to all the special safeguards required by that marking.
- **CRYPTO-RELATED INFORMATION**—Crypto-related information may be classified or unclassified. It is normally associated with cryptomaterial but is not significantly descriptive of it. In other words, it does not describe a technique or process, a system, or equipment functions and capabilities. Crypto-related information is not marked "CRYPTO" and is not subject to the special safeguards normally associated with cryptoinformation.
- **CRYPTOSYSTEM**—The term "cryptosystem" encompasses all the associated items of cryptomaterial that are used together to provide a single means of encryption and decryption.

All items of a related nature that combine to form a system must be given the strictest security. Any failure, equipment, or operator that adversely affects the security of a cryptosystem is called crypto-insecurity.

- **GENERAL AND SPECIFIC CRYPTOSYSTEMS**—During your cryptographic duties, you will sometimes hear the terms "general" and "specific" applied to some cryptosystems. A general cryptosystem consists of a basic principle and method of operation regardless of the cryptomaterials used. In other words, regardless of the types of materials or elements used, the method of operation will always be the same, whether encrypting, decrypting, or authenticating.

A specific cryptosystem is one within a general system that is necessary and confined to actual encryption, decryption, or authentication. These systems are identified by the short and long titles of their variables.

- **CRYPTOVARIABLES**—A cryptovariable is an element of a cryptosystem that directly affects the encryption and decryption process. These variables are divided into two types: primary and secondary.

A primary cryptovariable is the most readily and frequently changed element of a cryptosystem. A secondary cryptovariable is one that permits change of circuit operation without altering the basic equipment. A secondary cryptovariable must also be used in conjunction with appropriate primary variables.

The commanding officer is responsible for ensuring that personnel are thoroughly trained and certified for cryptographic duties. This training may be formal or on-the-job training. The CMS custodian is responsible for ensuring that cryptographic operators receive the training necessary to perform these duties and that they meet the following minimum qualifications:

- Be properly cleared for access to the material with which they will be working;
- Be authorized by the commanding officer to perform cryptoduties; and
- Be familiar with local cryptoprocedures.

TRANSMISSION SECURITY

Transmission security results from measures designed to protect transmission from interception and exploitation by means other than cryptographic analysis. In the next paragraphs, we will discuss specific methods of transmission security.

COMMUNICATIONS SECURITY (COMSEC) EQUIPMENT

There are numerous types of cryptographic equipment used throughout the Navy. However, they all perform the same basic function—to encipher or decipher a communications signal.

During secure transmission, the cryptoequipment accepts a "plain text" teleprinter or data signal containing classified information from the classified (red) patch panel and adds a "key" (randomly chosen bits generated internally). This composite signal is relayed as an encrypted signal.

Following this encryption, the signal is fed to the unclassified (black) patch panel where it is patched directly to a converter. This converted audio signal is then routed to the transmitter for transmission.

Over-the-Air Rekey/Transfer (OTAR/OTAT)

Many of the new cryptosystems that use the 128-bit electronic key (ANDVT, KY-58, KG-84A/C, and KY-75) are now capable of obtaining new or updated key via the circuit they protect or other secure communications circuits. This process is known as *over-the-air rekey* (OTAR) or *over-the-air transfer* (OTAT). The use of OTAR or OTAT drastically reduces the distribution of physical keying material and the physical process of loading cryptoequipments with key tapes.

A station may have nothing to do with actual physical CRYPTO changeovers on a day-to-day basis. All an operator would have to do is observe the alarm indications and ensure the alarm indicator returns to operate. The electronic key would normally come from the Net Control Station (NCS).

The added feature of OTAT is that the key can be extracted from an OTAT-capable cryptosystem using a KYK-13 or KYX-15/KYX-15A. The key is then loaded into another cyptosystem as needed. More detailed information on OTAR/OTAT is available in the *Procedures Manual for Over-the-Air Transfer (OTAT) and Over-the-Air Rekey (OTAR)* and *Field Generation and Over-the-Air Distribution of Tactical Electronic Key*, NAG-16C/TSEC.

Authentication

Authentication is a security measure designed to protect a communications or command system against fraudulent transmissions or simulation. Authenticating systems have instructions specifying the method of use and transmission procedures. By using an authenticating system properly, an operator can distinguish between genuine and fraudulent stations or transmissions. A station may include authentication in a transmitted message. This security measure is called transmission authentication. The types of authentication are:

- **Challenge and Reply**—This is a prearranged system whereby one station requests authentication of another station (the challenge). By a proper response, the latter station establishes its authenticity (the reply).
- **Transmission Authentication**—A station establishes the authenticity of its own transmission by either a message- or a self-authentication method. A message authentication is a procedure that a station uses to include an authenticator in the transmitted message. Self-authentication is a procedure that a station uses to establish its own authenticity and the called station is not required to challenge the calling station.

The following examples are instances when authentication is mandatory:

- A station suspects intrusion on a circuit;
- A station is challenged or requested to authenticate;
- A station directs radio silence or requires another station to break an imposed radio silence; and
- A station transmits operating instructions that affect communications, such as closing down a station, shifting frequency, or establishing a special circuit.

You can find further information on authentication in *Communications Instructions—Security (U)*, ACP 122, and in *Voice Communications*, NTP 5.

MEACONING, INTRUSION, JAMMING, AND INTERFERENCE (MIJI)

MIJI is a term used to describe four types of interference that you are likely to experience in a given situation.

Meaconing is the interception and rebroadcast of navigation signals. These signals are rebroadcast on the received frequency to confuse enemy navigation. Consequently, aircraft or ground stations are given inaccurate bearings. Meaconing is more of a concern to personnel in navigation ratings than to you as a Radioman. However, communications transmitters are often used to transmit navigation signals. Since communications personnel operate the transmitters, they must know how to deal with any communications problems resulting from meaconing.

Intrusion is defined as any attempt by an enemy to enter U.S. or allied communications systems and simulate our traffic to confuse and deceive. An example of intrusion is an unauthorized radio transmission by an unfriendly source pretending to be part of an air traffic control service and giving false instructions to a pilot.

Jamming is the deliberate radiation, reradiation, or reflection of electromagnetic signals to disrupt enemy use of electronic devices, equipment, or systems. In jamming operations, the signals produced are intended to obliterate or obscure the signals that an enemy is attempting to receive. Some common forms of jamming include:

- Several carriers adjusted to the victim frequency;
- Random noise amplitude-modulated carriers;
- Simulated traffic handling on the victim frequency;
- Random noise frequency-modulated carriers;
- Continuous-wave carrier (keyed or steady); and
- Several audio tones used in rapid sequence to amplitude modulate a carrier (called bagpipe from its characteristic sound).

Interference is normally a nondeliberate intrusion upon a circuit. It unintentionally degrades, disrupts, obstructs, or limits the effective performance of electronic or electrical equipment. Interference usually results from spurious emissions and responses or from intermodulation products. Sometimes, however, interference may be induced intentionally as in some forms of electronic warfare. An example of interference is the interruption of military transmissions by a civilian radio broadcast.

The more effective methods of dealing with MIJI are contained in NTP 4 and in *Reporting Meaconing, Intrusion, Jamming, and Interference of Electromagnetic Systems,* OPNAVINST 3430.18.

EMISSION SECURITY

We stated earlier that emission security results from measures taken to deny unauthorized persons information of value that might be derived from compromising emanations from cryptoequipment and telecommunications. Several methods of emission security are discussed below.

CONTROL OF COMPROMISING EMANATIONS (TEMPEST)

Compromising emanations (CE), referred to as "TEMPEST," are unintentional data-related or intelligence-bearing signals. If these signals are intercepted and analyzed, they could disclose the information transmitted, received, handled, or otherwise processed by electrical information-processing equipment or systems. Any electrical information-processing device, whether an ordinary electric typewriter or a large complex data processor, may emit compromising emanations.

Tempest Vulnerability Assessment (TVA)

The vulnerability of a ship, aircraft, shore station, transportable equipment, or a contractor facility is determined by a TEMPEST Vulnerability Assessment. This assessment includes each of the following factors, which, together, create vulnerability:

- **Susceptibility**—The probability that TEMPEST signals exist and are open to exploitation.
- **Environment**—The primary environmental considerations are the geolocation of a ship, aircraft, shore station, or contractor facility; physically and electrically controlled spaces; adherence to approved installation criteria; and the use of TEMPEST-approved equipment or systems.
- **Threat**—The capability and motivation of an enemy to exploit the TEMPEST signal.

The interaction of all of these factors determines the vulnerability. From this assessment and considering the category, classification, or sensitivity of the information involved, a determination will be made. An Instrumented TEMPEST Survey (ITS) will be scheduled, or the requestor will be placed in the "acceptable risk" category.

Tempest Vulnerability Assessment Request (TVAR)

A TVAR must be submitted prior to processing classified data. This request should be sent to the Naval Criminal Investigative Service, Washington D.C., with a copy to CO, NAVELEXSECCEN and other commands as appropriate. The list of required information is available in *Navy Implementation of National Policy on Control of Compromising Emanations (U)*, OPNAVINST C5510.93E.

Some ships are identified by CNO as high TEMPEST risk platforms. Those which are likely to be the target of hostile TEMPEST collection efforts will be scheduled for an Instrumented TEMPEST Survey (ITS). No TVAR is required from any ship.

EMISSION CONTROL (EMCON)

EMCON is used to prevent an enemy from detecting, identifying, and locating friendly forces. It is also used to minimize electromagnetic interference among friendly systems. EMCON is normally imposed by a commander to control all electromagnetic radiations. Once EMCON is imposed, general or specific restrictions may be added to the EMCON order, depending on the operational, intelligence, or technical factors for the area affected.

For radiomen, EMCON usually means either full radio silence or HF EMCON. The most secure communications methods during EMCON reduce, but do not eliminate, the possibility of identification. It is assumed that any electromagnetic radiation will be immediately detected and the position of the transmitting ship will be fixed by an enemy. You will find detailed information on the implementation of EMCON and its degree of adjustment in *Electronic Warfare Coordination*, NWP 10-1-40.

SUMMARY

Security violations result from bad personal habits, security indifference, occupational fatigue, or ignorance of established regulations. When security violations occur in installations located in foreign countries, the violations become more serious because of an activity's greater vulnerability to hostile exploitation. With respect to COMSEC, security violations could prove costly.

You should immediately report any security violation or compromise to your immediate superior or other person in authority. Failure to do so may further the damage done, especially if the compromised material is in the hands of hostile forces.

There is no way of knowing how many violations have actually occurred, but were not reported. An example would be when a person leaves a classified document on the top of a desk overnight. Another example is when a security container is left open overnight or unattended for long periods during the day. Still another example is when classified information is discussed over the telephone using so-called "double talk." It is for this reason that security training programs are administered.

Security should be second nature insofar as the practice of personal habits is concerned. However, second nature does not mean "without thinking." It behooves all of us to take security seriously and practice sound security habits in the interests of naval operations and our overall national security.

As a Radioman, you have a two-fold job concerning security. The first, of course, is to properly perform your duties within general security guidelines. Security guidelines pertain to everyone in every official capacity. Second, you must also perform your duties in such a manner as to protect the integrity and overall value of secure communications.

Security precautions mentioned in this chapter do not guarantee complete protection nor do they attempt to meet every conceivable situation. Anyone who adopts a commonsense outlook can, however, solve most security problems and gain a knowledge of basic security regulations. For information on local security rules, study your command's security regulations and the publications listed at the end of the chapter.

RECOMMENDED READING LIST

NOTE

Although the following references were current when this TRAMAN was published, their continued currency cannot be assured. You therefore need to ensure that you are studying the latest revisions.

Basic Operational Communications Doctrine (U), NWP 4(B), Chief of Naval Operations, Washington, D.C., September 1989.

Communications Instructions—Security (U), ACP 122, Joint Chiefs of Staff, Washington, D.C., 1981.

Communications Security Material System (CMS) Policy and Procedures Manual, CMS 1, Department of the Navy, Washington, D.C., March 1993.

Department of the Navy Information and Personnel Security Program Regulation, OPNAVINST 5510.1H, Chief of Naval Operations, Washington, D.C., April 1988.

Fleet Communications (U), NTP 4(C), Commander, Naval Telecommunications Command, Washington, D.C., June 1988.

Telecommunications Users Manual, NTP 3, Commander, Naval Telecommunications Command, Washington, D.C., January 1990.

CHAPTER 8

RADIOTELEPHONE PROCEDURES

CHAPTER LEARNING OBJECTIVES

Upon completing this chapter, you should be able to do the following:

- *Explain radiotelephone circuit procedures.*
- *Discuss radiotelephone security.*
- *Discuss radiotelephone voice procedures.*
- *Discuss radiotelephone format.*
- *Explain radiotelephone call signs.*
- *Identify radiotelephone circuits.*
- *Summarize the Executive Method for radiotelephone.*
- *Explain authentication procedures.*
- *Discuss enemy contact reporting.*
- *Discuss code and cipher messages.*
- *Explain the importance of radiotelephone circuit logs.*

Whether you are ashore or at sea, your professional duties as a Radioman will include radiotelephone (R/T) communications. You should understand that uncovered (nonsecure) radio transmissions are the least secure means of communications, and that R/T voice communications are the least secure of all radio communications. Despite these drawbacks, R/T communications play an important part in our day-to-day fleet operations and in the control of coastal and harbor shipping.

R/T is the easiest, most convenient method of relaying real-world situation traffic from ship to ship, ship to shore, or shore to ship. All that is necessary is that you pick up a transmitter handset and speak into it.

Unless using secure voice communications equipment, you must assume that everything you say when using R/T is being intercepted. The inherent dangers of interception can be significantly reduced by adhering to the principles of strict circuit discipline.

Circuit discipline is achieved through the proper use of radio equipment, adherence to prescribed frequencies and operating procedures, proper training, and monitoring. The lack of circuit discipline, as well as basic negligence, inaccuracy, and laxity, is responsible for violations that endanger the integrity and security of R/T transmissions.

CIRCUIT PROCEDURES

A radiotelephone circuit would quickly become unusable if everyone on the circuit failed to follow the same rules and procedures. Much of what is accomplished over an R/T circuit involves proper techniques and training, coupled with common sense and experience. It is impossible to cover every conceivable situation that may arise when using voice communications. There are many simple R/T procedures that apply to these circuits. It is these procedures, along with their operating rules, that we will discuss throughout this chapter.

CIRCUIT DISCIPLINE

R/T transmissions should be as short and concise as possible without sacrificing clarity. It is important that all personnel using voice communications be instructed in the proper use of the handset and R/T equipment. They must also be cautioned on the likelihood of transmission intercept.

Adherence to prescribed operating procedures is mandatory! Deviations from these procedures create confusion, reduce reliability and speed, and tend to nullify security precautions. Once you know the proper operating procedures, you can use your initiative and common sense to satisfy specific operating requirements.

Although circuit discipline is discussed here with respect to its connection with R/T procedures, you must understand that the requirement for circuit discipline applies to all communications circuits—not just R/T circuits. Every operator must recognize and avoid the following malpractices, which could endanger communications security:

- Linkage or compromise of classified call signs and address groups by plain language or association with unclassified call signs;
- Linkage or compromise of encrypted call signs and address groups by association with other call signs, address groups, or plain language (for example, use of encrypted call signs in the call and unencrypted call signs in the message address);
- Misuse and confusion of call signs, routing indicators, address groups, and address indicating groups (AIGs) (which could result in the nondelivery of an important message, a compromise, or the linking of classified and unclassified call signs and address groups);
- Violation of emission control (EMCON) conditions;
- Unofficial conversation between operators;
- Transmitting on a directed net without permission;
- Transmitting the operator's personal sign;
- Excessive repetition of prowords;
- Use of plain language in place of applicable prowords;
- Unnecessary transmissions;
- Incorrect and unauthorized procedures;
- Identification of unit locations;
- Excessively long calls (when a station is called and does not answer within a reasonable time, presumably because a condition of radio silence prevails, the message may be transmitted in the blind or by some other method);
- Use of profane, indecent, or obscene language; and
- Failure to maintain radio watches on designated frequencies and at prescribed times.

CIRCUIT TECHNIQUES

You should use the following guide in developing good voice circuit techniques. To enhance your proficiency, you should practice the techniques on a training net. Remember, though, that nothing can take the place of good common sense.

DO:

- Listen before transmitting. Unauthorized break-in causes confusion and often blocks a transmission in progress to the extent that neither transmission gets through.
- Speak clearly and distinctly. Both slurred syllables and clipped speech are hard to understand. A widespread error among untrained operators is failure to emphasize vowels sufficiently.
- Speak slowly. Give the receiving operator a chance to get your message down. This can save time and repetitions.
- Avoid extremes of pitch. A high-pitched voice cuts through interference best, but is shrill and unpleasant if too high. A lower pitch is easier on the ear, but is difficult to understand through background noises if too low.
- Be natural. Maintain a normal speaking rhythm. Group words in a natural manner. Send your message phrase for phrase instead of word for word.
- Use standard pronunciation. Talkers who use the almost standard pronunciation of a broadcast network announcer are easiest to understand.

- Speak in a moderately strong voice in order to override unavoidable background noises and to prevent dropouts.
- Keep correct distance between lips and handset. A distance of about 2 inches is correct for most handsets. If the distance is too great, speech becomes inaudible and background noises interfere. If the distance is too small, blaring and blasting result.
- Give an accurate evaluation in response to a request for a radio check. A transmission with feedback or a high level of background noise is not "loud and clear," even though the message can be understood.
- Pause momentarily after each normal phrase, and interrupt your carrier. This allows any other station with higher precedence traffic to break in.
- Adhere strictly to prescribed procedures. Up-to-date R/T procedures are found in *Radiotelephone Procedure*, ACP 125.
- Transact your business and get off the air. Excessive preliminary calls waste time.

DO NOT:

- Transmit while surrounded by others loudly discussing the next maneuver or event. It confuses the receiving stations and could be a serious security violation.
- Hold the handset button in the push-to-talk position until absolutely ready to transmit. Your carrier will block other communications on the net.
- Hold a handset in such a position that there is a possibility of having feedback from the earphone added to other background noises.
- Hold a handset loosely. A firm pressure on the push-to-talk button prevents unintentional release and consequent signal dropout.
- Tie up a circuit with test signals. Usually, 10 seconds is sufficient for testing.

PHONETIC ALPHABET

Some letters of the alphabet have similar sounds; therefore, it is easy to confuse the sounds of these letters. For this reason, the standard phonetic equivalents of the letters of the alphabet are used in R/T communications. Using the phonetic alphabet saves many corrections and constant repetitions that would otherwise be necessary. Table 8-1 contains the alphabet with a list of its phonetic and spoken equivalents. The bolded portions of the spoken equivalents are the parts of the word that should be given the greatest emphasis when spoken.

Table 8-1.—Phonetic Alphabet

LETTER	PHONETIC	SPOKEN AS
A	ALFA	**AL** FAH
B	BRAVO	**BRAH** VOH
C	CHARLIE	**CHAR** LEE or **SHAR** LEE
D	DELTA	**DEL** TAH
E	ECHO	**ECK** OH
F	FOXTROT	**FOKS** TROT
G	GOLF	GOLF
H	HOTEL	HOH **TELL**
I	INDIA	**IN** DEE AH
J	JULIETT	**JEW** LEE **ETT**
K	KILO	**KEY** LOH
L	LIMA	**LEE** MAH
M	MIKE	MIKE
N	NOVEMBER	NO **VEM** BER
O	OSCAR	**OSS** CAH
P	PAPA	PAH **PAH**
Q	QUEBEC	KEY **BACK**
R	ROMEO	**ROW** ME OH
S	SIERRA	SEE **AIR** RAH
T	TANGO	**TANG** GO
U	UNIFORM	**YOU** NEE FORM or **OO** NEE FORM
V	VICTOR	**VIC** TAH
W	WHISKEY	**WISS** KEY
X	X-RAY	**ECKS** RAY
Y	YANKEE	**YANG** KEY
Z	ZULU	**ZOO** LOO

When signals from naval signal books are transmitted by voice, names of flags (ALFA, BRAVO, and so on) are used since they appear in the signal books. Difficult words within the text of plain text messages may be phonetically spelled, using the phonetic alphabet, preceded by the proword I SPELL. When the operator can pronounce the word to be spelled, he or she does so before and after the spelling of the word to be identified. For example, a phrase in a plain text message might contain the words "Kisatchie Reservation." Upon reaching these two words, the operator would say, ". . . Kisatchie, I SPELL, KILO, INDIA, SIERRA, ALFA, TANGO, CHARLIE, HOTEL, INDIA, ECHO, Kisatchie, Reservation . . ." (rest of text).

When a text is composed of pronounceable words, the words are spoken as such. When a text is encrypted, the groups are transmitted by the phonetic equivalents of the individual letters and without the proword I SPELL. For example, the encrypted group DRSRM is spoken "DELTA, ROMEO, SIERRA, ROMEO, MIKE" and is counted as one group.

PRONUNCIATION OF NUMERALS

You must use care in distinguishing numerals from similarly pronounced words. When transmitting numerals, you may use the proword FIGURES preceding such numbers. For example, the text of an R/T message contains the phrase "From Ten Companies." There is a possibility that the phrase would sound like "From Tin Companies" if spoken as it is written. An operator, therefore, could use the proword FIGURES when this phrase is reached in the text by saying "From FIGURES One Zero Companies." The operator could also use the proword I SPELL here. For example, upon reaching the same phrase in the text of the message, an operator could transmit "From Ten, I SPELL, TANGO, ECHO, NOVEMBER, Ten, Companies."

When numerals are transmitted, their correct pronunciation is as follows:

Numeral	Pronounced
0	Ze ro
1	Wun
2	Too
3	Tree
4	Fo wer
5	Fife
6	Six
7	SE ven
8	Ait
9	NIN er

The numeral 0 is always spoken as "zero," never as "oh." Decimal points are spoken as "day-see-mal."

Numbers are transmitted digit for digit except that exact multiples of thousands are spoken as such. There are, however, special cases, such as antiair warfare reporting procedures, when the normal pronunciation of numerals is prescribed and digit-for-digit transmission does not apply. For example, in the case given, the number 17 is pronounced "seventeen"; not "one seven." The following is a list of numbers and their normal R/T pronunciation:

Number	Pronounced
11	Wun Wun
55	Fife Fife
1000	Wun Tou-zand
1920	Wun Niner Too Zero
34,000	Tree Fower Tou-zand
349,204	Tree Fower Niner Too Zero Fower

DECIMALS, DATES, AND ABBREVIATIONS

As we mentioned earlier, the decimal point is spoken as "day-see-mal." For example, 920.4 would be spoken as "Niner Too Zero Day-see-mal Fower."

Dates are spoken digit for digit, with the months spoken in full. For example, the date 20 September is spoken as "Too Zero September."

There are some rules that you should remember concerning abbreviations in the text of an R/T message. For example, initials are spoken phonetically when used alone or with short titles. The phrase "Para A" is spoken as "Para Alfa." The initials "ACP" would be spoken as "Alfa Charlie Papa."

Personal initials are spoken phonetically, prefixed by the proword INITIALS. For example, the name "W. T. DOOR" would be spoken as "INITIALS Whiskey Tango Door."

Familiar abbreviations that are frequently used in normal speech may be transmitted in abbreviated form on R/T. For example, the word "NATO" is spoken as "NATO." The ship "USS *Canopus*" is spoken as "USS Canopus."

PUNCTUATION

When punctuation is necessary in an R/T message, the punctuation is pronounced as follows:

Punctuation	Spoken
Comma	COMMA
Period	FULL STOP or PERIOD
Parentheses	PAREN/UNPAREN or OPEN BRACKETS/ CLOSE BRACKETS
Oblique Stroke	SLANT
Quotation Marks	QUOTE/UNQUOTE
Hyphen	HYPHEN
Colon	COLON
Semicolon	SEMICOLON
Dash	DASH

Roman numerals, when used, are transmitted in the same manner as the corresponding Arabic numerals and preceded by the word "ROMAN." For example, the Roman numeral III is pronounced "ROMAN Tree."

USE OF PROWORDS

Table 8-2 contains a list of authorized prowords for general use. Prowords are used to expedite message handling on circuits where R/T procedures are used. In no case may a proword or combination of prowords be substituted for the textual component of a message. Between units of different nationalities,

Table 8-2.—Radiotelephone Prowords, Equivalent Prosigns, and Operating Signals

PROWORD	EXPLANATION	EQUIVALENT TO
ACKNOWLEDGE (ACK)	An instruction to the addressee that the message must be acknowledged	ZEV
ADDRESS GROUP	The group that follows is an address group	
ALL AFTER	The portion of the message to which I have reference is all that which follows ________	AA
ALL BEFORE	The portion of the message to which I have reference is all that which precedes ________	AB
AUTHENTICATE	The station called is to reply to the challenge which follows	INT ZNB
AUTHENTICATION IS	The transmission authentication of this message is________	ZNB
BREAK	I hearby indicate the separation of the text from other portions of the message	BT
BROADCAST YOUR NET	Link the two nets under your control for automatic rebroadcast	
CALL SIGN	The group that follows is a call sign	
CORRECT	You are correct, or what you have transmitted is correct	C
CORRECTION	An error has been made in this transmission. Transmission will continue with the last word correctly transmitted An error has been made in this transmission (or message indicated). The correct version is ________ That which follows is a corrected version in answer to your request for verification	EEEEEEEE C C
DISREGARD THIS TRANSMISSION—OUT	This transmission is in error. Disregard it. This proword must not be used to cancel any message that has been completely transmitted and for which receipt or acknowledgment has been received	EEEEEEEE AR

Table 8-2.—Radiotelephone Prowords, Equivalent Prosigns, and Operating Signals—Continued

PROWORD	EXPLANATION	EQUIVALENT TO
DO NOT ANSWER	Stations called are not to answer this call, receipt for this message, or otherwise to transmit in connection with this transmission. When this proword is used, the transmission must be ended with the proword OUT	F
EXECUTE	Carry out the purport of the message or signal to which this applies. To be used only with the Executive Method	IX
EXECUTE TO FOLLOW	Action on the message or signal that follows is to be carried out upon receipt of the proword EXECUTE. To be used only with the Delayed Executive Method	IX
EXEMPT	The addressees immediately following are exempted from the collective call	XMT
FIGURES	Numerals or numbers follow	
FLASH	Precedence FLASH	Z
FROM	The originator of this message is indicated by the address designator immediately following	FM
GROUPS	This message contains the number of groups indicated by the numeral following	GR
GROUP NO COUNT	The groups in this message have not been counted	GRNC
I AUTHENTICATE	The group that follows is the reply to your challenge to authenticate	ZNB
IMMEDIATE	Precedence IMMEDIATE	O
IMMEDIATE EXECUTE	Action on the message or signal following is to be carried out on receipt of the word "EXECUTE." To be used only with the Immediate Executive Method	IX
INFO	The addressees immediately following are addressed for information	INFO
I READ BACK	The following is my response to your instructions to read back	
I SAY AGAIN	I am repeating transmission or portion indicated	IMI
I SPELL	I will spell the next word phonetically	
I VERIFY	That which follows has been verified at your request and is repeated. To be used only as a reply to VERIFY	C
MESSAGE	A message that requires recording is about to follow. Transmitted immediately after the call. (This proword is not used on nets primarily employed for conveying messages. It is intended for use when messages are passed on tactical or reporting nets)	ZBO
MORE TO FOLLOW	Transmitting station has additional traffic for the receiving station	B
NET NOW	All stations are to net their radios on the unmodulated carrier wave that I am about to transmit	ZRC2
NUMBER	Station Serial Number	NR

Table 8-2.—Radiotelephone Prowords, Equivalent Prosigns, and Operating Signals—Continued

PROWORD	EXPLANATION	EQUIVALENT TO
OUT	This is the end of my transmission to you and no answer is required or expected	AR
OVER	This is the end of my transmission to you and a response is necessary. Go ahead; transmit	K
PRIORITY	Precedence PRIORITY	P
READ BACK	Repeat this entire transmission back to me exactly as received	G
RELAY (TO)	Transmit this message to all addressees (or addressees immediately following this proword). The address component is mandatory when this proword is used	T or ZOF
ROGER	I have received your last transmission satisfactorily	R
ROUTINE	Precedence ROUTINE	R
SAY AGAIN	Repeat all of your last transmission. Followed by identification data means "Repeat _______ (portion indicated)"	IMI
SERVICE	The message that follows is a SERVICE message	SVC
SIGNALS	The groups that follow are taken from a signal book. (This proword is not used on nets primarily employed for conveying signals. It is intended for use when tactical signals are passed on nontactical nets)	
SILENCE (Repeated three or more times)	Cease transmission on this net immediately. Silence will be maintained until lifted. (When an authentication system is in force, the transmission imposing silence is to be authenticated)	HM HM HM
SILENCE LIFTED	Silence is lifted. (When an authentication system is in force, the transmission lifting silence is to be authenticated)	ZUG HM HM HM
SPEAK SLOWER	Your transmission is at too fast a speed. Reduce speed of transmission	QRS
STOP REBROADCASTING	Cut the automatic link between the two nets that are being rebroadcast and revert to normal working	
THIS IS	This transmission is from the station whose designator immediately follows	DE
TIME	That which immediately follows is the time or date-time group of the message	QTR
TO	The addressees immediately following are addressed for action	TO
UNKNOWN STATION	The identity of the station with whom I am attempting to establish communication is unknown	AA
VERIFY	Verify entire message (or portion indicated) with the originator and send correct version. To be used only at the discretion of or by the addressee to which the questioned message was directed	J
WAIT	I must pause for a few seconds	AS

Table 8-2.—Radiotelephone Prowords, Equivalent Prosigns, and Operating Signals—Continued

PROWORD	EXPLANATION	EQUIVALENT TO
WAIT-OUT	I must pause longer than a few seconds	AS AR
WILCO	I have received your signal, understand it, and will comply. To be used only by the addressee. Since the meaning of ROGER is included in that of WILCO, the two prowords are never used together	
WORD AFTER	The word of the message to which I have referenced is that which follows _____	WA
WORD BEFORE	The word of the message to which I have referenced is that which precedes _____	WB
WORDS TWICE	Communication is difficult. Transmit(ting) each phrase (or each code group) twice. This proword may be used as an order, request, or as information	QSZ
WRONG	Your last transmission was incorrect. The correct version is_______	ZWF

prowords may be replaced by their equivalent prosigns where these exist. These should be spelled out using the authorized phonetic equivalents.

USE OF OPERATING SIGNALS

Operating signals are not designed for R/T transmissions. In R/T procedures, operating information is normally conveyed in concise phrases. However, in two circumstances it is permissible to use operating signals contained in *Communication Instructions, Operating Signals*, ACP 131, instead of standard R/T phrases. These circumstances are where there are language difficulties and where practical if there is no risk of confusion.

In such instances, operating signals must be preceded by the word "PROSIGN" or "OPERATING SIGNAL." Prosigns and operating signals are transmitted using only authorized phonetic equivalents. The prosign INT is transmitted in its prosign equivalent; that is, INTERROGATIVE. The prowords I SPELL and FIGURES are not used. Examples of prosigns and operating signals are:

QRM—OPERATING SIGNAL QUEBEC ROMEO MIKE

XMT—PROSIGN X-RAY MIKE TANGO

INT ZKA—OPERATING SIGNAL INTERROGATIVE ZULU KILO ALFA

RADIOTELEPHONE SECURITY

In addition to adhering to circuit discipline, all users are responsible for observing proper security precautions on R/T nets. For example, many units at sea use classified call signs on tactical nets. If the operator does not know the operating situation, the classified call could be linked to the unclassified call sign for that ship. Such unauthorized disclosures are why BEADWINDOW procedures have been introduced into the R/T process.

BEADWINDOW

BEADWINDOW is a real-time procedure used to alert circuit operators that an unauthorized disclosure has occurred over a nonsecured circuit. BEADWINDOW also warns other operators on the net of the disclosure. This serves as an educational aid. The long-term benefits of the BEADWINDOW procedure include an increased awareness of the proper use of voice circuits throughout the fleet and better security of uncovered Navy voice communications.

BEADWINDOW procedures deal with Essential Elements of Friendly Information (EEFIs). EEFIs are established by operational commanders. EEFIs identify specific items of information which, if revealed and correlated with other information, would degrade the security of military operations, projects, or missions in the applicable areas. EEFIs can therefore vary from operation to operation or from area to area. Table 8-3 contains an EEFI key number and key word definition list.

BEADWINDOW CODE WORDS

The BEADWINDOW procedure uses the code word "BEADWINDOW" and a number combination (from the EEFI list) that is transmitted immediately to the unit disclosing an EEFI. The code word notifies the unit that it has committed the disclosure, and the number combination provides specific identity of the item disclosed. For example, when any station of the net commits a disclosure of an EEFI, net control (or any station observing the disclosure) calls the violator with a normal call-up. The calling station then says the word "BEADWINDOW," followed by the number of the EEFI the violator disclosed.

The only authorized reply to the BEADWINDOW message is "ROGER—OUT." This method allows the reported unit to take immediate action to correct the insecure practice. In this particular situation, if the call sign of the net control is "Control" and the call sign of

Table 8-3.—Essential Elements of Friendly Information (EEFIs)

01 Position	Friendly or enemy position, movement or intended movement: position, course, speed, altitude or destination of any air, sea, or ground element unit or force
02 Capabilities	Friendly or enemy capabilities or limitation: force composition or identity capabilities, limitations or significant casualties to special equipment, weapon systems, sensors, units, or personnel. Percentages of fuel or ammunition remaining
03 Operations	Friendly or enemy operations, intentions, progress or results: operational or logistic intentions; assault objectives; mission participants; flying programs, mission situation reports; results of friendly or enemy operations
04 Electronic Warfare (EW)	Friendly or enemy EW/EMCON intentions, progress or results: intention to employ ECM; results of friendly or enemy ECM objectives of ECM; results of friendly or enemy ECCM; results of ESM; present or intended EMCON policy; equipment affected by EMCON policy; equipment affected by EMCON policy
05 Personnel	Friendly or enemy key personnel: movement or identity of friendly or enemy flag officers: distinguished visitors; unit commanders; movements of key maintenance personnel indicating equipment limitations
06 COMSEC	Friendly or enemy COMSEC locations: linkage of codes or code words with plain language; compromise of changing frequencies or linkage with line numbers, circuit designators linkage of changing call signs with previous call signs or units; compromise of encrypted/classified call signs; incorrect authentication procedure
07 Wrong Circuit	Inappropriate transmission: information requested, transmitted or about to be transmitted which should not be passed on the subject circuit because it either requires greater security protection or is not appropriate to the purpose for which the circuit is provided
08	For NATO assignment, as required
09	For NATO assignment, as required
10	For NATO assignment, as required
11-29	Reserved for CINCUSNAVEUR
30-49	Reserved for CINCLANTFLT
50-69	Reserved for CINCPACFLT

the violator is USS *Frances Scott Key*, Control's report would be:

"Key, THIS IS Control, BEADWINDOW Three, OVER."

The violator would reply:

"Control, THIS IS Key, ROGER, OUT."

The EEFI list should be posted in clear sight of the operator at all nonsecure voice positions for quick reference. You should remember that procedural violations are not security violations; therefore, they don't fall in the BEADWINDOW category.

IMPORTANCE OF RADIOTELEPHONE VOICE PROCEDURES

Poor voice communications can create confusion, reduce reliability and speed, and nullify security precautions. Poor procedures can ultimately have an adverse affect on the mission of a ship.

A commanding officer, regardless of the mission of the ship, has only one real-time means of communicating with his commander and other units of a force—radiotelephone. Your ship may be required to guard (monitor) 10 or more voice circuits, each having a specific purpose and specific procedures. Few of these circuits are operated from communications spaces except on small ships, such as submarines or destroyers. On larger ships, the circuits are handled from the bridge and the combat information center (CIC).

As an operator, you are responsible for providing reliable transmitter and receiver services to these remote operating positions. This entails establishing communications on a net or circuit before making that net or circuit available to the remote operators. If you do not know the various nets that are guarded by your ship and the purpose of these nets, the overall communications of the ship can be degraded. This could impede the progress of the entire operation.

Modern, high-speed naval operations make the elimination of confused R/T operations an absolute necessity. For example, a hunter-killer force searching for an enemy submarine is not permitted the luxury of a 5- or 10-minute delay in executing a screening signal. An unnecessary delay such as this could defeat the purpose (speed) of the officer in tactical command (OTC) when using R/T. A 1-minute delay by an aircraft carrier pilot in executing a vectoring signal because he did not understand the message could easily result in the pilot's death.

During shakedown operations, a submarine could risk collision with its escort vessel during emergency surfacing procedures if voice communications are not clearly understood.

When possible, you must use only standard phraseology, authorized prowords, and brevity code words. Standard procedures enhance reliability and clarity. Moreover, variations from standard circuit procedures provide an ideal situation for enemy imitative deception.

BASIC RADIOTELEPHONE MESSAGE FORMAT

Radiotelephone uses a 16-line message format (table 8-4) that is comparable to formats in teleprinter communications. Radiotelephone messages also have the same three military message forms: plaindress, abbreviated plaindress, and codress.

By far, the most common message form in R/T traffic is the abbreviated plaindress. In fact, the abbreviated plaindress message is sometimes so abbreviated that it closely resembles the basic message format. The three major message parts—heading, text, and ending—are there, however. Each of these major parts is reduced to components and elements.

All format lines do not necessarily appear in every message. When a line is used, it must be placed in the message in the order shown in table 8-4. An abbreviated plaindress message may omit any or all of the following: precedence, date, date-time group (DTG), and/or group count. A codress message is one in which the entire address is encrypted within the text. The heading of a codress message contains only information necessary to enable communications personnel to handle it properly.

Notice that the order of components and parts shown in table 8-4 corresponds to the order of the basic message shown in Chapter 7, "Message Content and Format." Notice also that prowords, not prosigns, are used in voice communications. Because prowords are spoken, it is important that you, as the operator, be completely familiar with them. Refer to table 8-2 for a list of many of the commonly used prowords, their explanations, and their equivalent prosigns. Throughout this chapter, prowords are shown in all capital letters.

Table 8-4.—Radiotelephone Message Format

PARTS/ COMPONENTS		ELEMENTS	FORMAT LINE	CONTENTS
HEADING	Procedure		1	Not used
		a. Call	2 & 3	Stations called—Proword EXEMPT, exempted calls Proword THIS IS—station calling
		b. Message follows		Proword MESSAGE
		c. Transmission Identification		Proword NUMBER and station serial number
		d. Transmission Instructions	4	Prowords RELAY TO; READ BACK; DO NOT ANSWER; WORDS TWICE; Operating signals; Address Groups; Call Signs; Plain Language designators
	Preamble	a. Precedence; date-time group; message instructions	5	Precedence designation; Proword TIME: date and time expressed in digits, and zone suffix followed by month indicated by the first three letters and, if required by national authorities, the year indicated by the last two digits; operating signals and proword EXECUTE TO FOLLOW
	Address	a. Originator's Sign; Originator	6	Proword FROM. Originator's address designator
		b. Action Addressee Sign	7	Proword TO. Action addressee designator
		c. Information Addressee Sign; Information Addressee	8	Proword INFO. Information addressees designators
		d. Exempted Addressee Sign; Exempted Addressee	9	Proword EXEMPT. Exempted addressee designators
	Prefix	a. Accounting Information, group count	10	Accounting symbol; group count; Proword GROUPS (GROUP NO COUNT)
SEPARATION			11	Proword BREAK
TEXT	Text	a. Subject Matter	12	CLEAR, UNCLASSIFIED, proword SERVICE, and/or internal instructions as appropriate; thoughts or ideas as expressed by the originator
SEPARATION			13	Proword BREAK
ENDING	Procedure	a. Time Group	14	Proword TIME. Hours and minutes expressed in digits and zone suffix, when appropriate
		b. Final Instructions	15	Prowords WAIT, CORRECTION, AUTHENTICATION IS, MORE TO FOLLOW, Station designators.
		c. Ending Sign	16	Prowords OVER, OUT

In the following paragraphs, we will discuss the format lines used in the R/T message format. Refer to table 8-4.

FORMAT LINES 1, 2, 3, AND 4

Format line 1 is not used in R/T procedures. Format lines 2 and 3 contain the call sign, the proword MESSAGE, and the transmission identification.

The call may take one of the following forms:

Full Call

"Kamehameha (station called),

THIS IS

Vallejo" (station calling)

Abbreviated Call

"THIS IS

Vallejo" (station calling).

Normally, a full call is used when first establishing a net and when reporting into a previously established net. A full call is also used in the transmission instructions and address components when a message is required to be relayed to a station on a different net.

Once communications are established and no confusion will result, an abbreviated call may be used. To further expedite voice communications, the receiving station may omit the proword THIS IS when the station is responding to a call and communications are good. Additionally, the call may be omitted entirely when two stations are in continuous communication or the net is not shared by a third station.

When a collective call sign is used and some of the addressees are to be exempted, you do so in the call by using the proword EXEMPT, followed by the call sign(s) of the station(s) exempted. For example:

"Edison (collective call)

EXEMPT

Tecumseh (station exempted),

THIS IS

Vallejo" (station calling).

Notice that only one station is exempted in this call-up. If there had been more than one station, each station would have been spoken before the proword THIS IS.

After the call, transmit the proword MESSAGE if you wish to indicate that a message you are about to transmit requires recording. For example:

"Vallejo (station called),

THIS IS

Kamehameha (station calling)

MESSAGE" (message is to follow).

The transmission identification is normally a station serial number used mostly in teleprinter procedures. When used in voice communications, the transmission identification is the last element of format lines 2 and 3 consisting of the station serial number preceded by the proword NUMBER.

Format line 4 contains the transmission instructions, which may consist of the prowords RELAY TO, WORDS TWICE, DO NOT ANSWER, or READ BACK. The use of these prowords is explained later.

FORMAT LINE 5

Format line 5 contains the precedence, DTG, and any necessary message instructions. The precedence is the first element of format line 5. In the case of a dual-precedence message, the higher precedence is transmitted first; for example, "PRIORITY ROUTINE." The DTG is preceded by the proword TIME. An example of this format line is as follows:

"Vallejo, THIS IS Polk, RELAY TO Key, PRIORITY, TIME, Tree Zero Wun Fower Fower Fife Zulu."

Message instructions are not normally required in R/T messages. When included, they consist of short and concise instructions that indicate the status of the message. Message instructions remain with the message until the message reaches its destined station. For example, if the message is a suspected duplicate, the phrase "This Message Is A Suspected Duplicate" immediately follows the DTG.

FORMAT LINES 6, 7, 8, AND 9

Format lines 6, 7, 8, and 9 form the address of the message and are recognized by the prowords FROM, TO, INFO, and EXEMPT, respectively. When the originator and the addressee are in direct communication, the call may serve as the address. Figure 8-1 is an example of an R/T transmission

Transmission	
F/L 2&3	LINCOLN (Collective Call) THIS IS POLK MESSAGE
F/L 5	PRIORITY TIME THREE ZERO ONE FIVE ONE ZERO ZULU
F/L 6	FROM POLK
F/L 7	TO LINCOLN
F/L 8	INFO KEY
F/L 9	EXEMPT EDISON (Exempted addressee from Collective Call)

Figure 8-1.—R/T message showing all possible elements of the address components.

showing elements of the heading components (format lines 2 through 9).

FORMAT LINE 10

Format line 10 is identified by the proword GROUPS, followed by the number of groups, or "GROUP NO COUNT." This line may contain an accounting symbol in addition to the group designation. Accounting symbols are seldom used on R/T circuits. However, they may appear on messages received for relay from circuits using other procedures. Accounting symbols are a combination of letters used to indicate the agency, service, or activity that assumes financial responsibility for the message.

Since R/T messages are usually short, a group count is seldom used. However, if a group count is sent, the number of groups is preceded by the proword GROUPS and appears in the message prefix. When a message is transmitted before the group count is determined, the proword GROUP NO COUNT is used in lieu of the group count. The actual group count may then be transmitted in the final instructions and be inserted in the message prefix by the receiving operator. The proword GROUP NO COUNT is included in messages bearing an accounting symbol when groups are not counted.

FORMAT LINES 11 THROUGH 16

Format line 11 contains the proword BREAK. This line separates the heading from the text. The use of this proword is not required except where confusion may be possible between the heading and text.

Format line 12 is the text of the message and expresses the idea of the originator. The primary difference between R/T text and other types of communication is that R/T text must be spoken. Therefore, it is important that new operators thoroughly familiarize themselves with the proper phrases and prowords that are commonly used in communications texts.

Format line 13 contains the proword BREAK. This line separates the text from the ending. Like format line 11, this proword should be used when confusion may occur between the text and the ending.

Format line 14 is used only in abbreviated plaindress messages when a time group is transmitted here. When used, it takes the place of a DTG in format line 5. For example, a DTG may not be determined prior to transmission. In such cases, it may be omitted in format line 5 and be sent as a time group in format line 14. When used, format line 14 consists of the proword TIME, followed by the time group plus the zone suffix. For example, you are in time zone B and you are sending a time group of 310850 in format line 14. You would transmit the time group as:

"TIME Three One Zero Eight Five Zero Bravo."

Format line 15 contains any final instructions. When used, this line may contain prowords (such as WAIT, CORRECTION, MORE TO FOLLOW, AUTHENTICATION IS), operating signals, address groups, call signs, and plain language designators.

Format line 16 is identified by the proword OVER or OUT. Every transmission ends with either OVER or OUT. However, the proword OVER may be omitted when two stations are in continuous communication with each other on a circuit not shared with a third station. In transmissions where the proword DO NOT ANSWER is used, the transmissions must end with the proword OUT.

RADIOTELEPHONE CALL SIGNS

Call signs used in radiotelephone are commonly known as voice call signs. They consist of spoken words, which can be transmitted and understood more rapidly and more effectively than actual names of ships and afloat commands, or phonetic equivalents of international radio call signs. Under certain circumstances, however, the phonetically spelled international call sign is used in R/T for station identification. At other times, a ship's name serves as the call sign.

R/T call signs may be assigned by an operation order (OPORD), a tactical communication plan (COMMPLAN), or permanently by commonly held communications publications. R/T call signs may be either permanent or temporary, and they may be internationally usable or locally issued. In any event, call signs are used to identify the station and to establish communications. A station's call sign can be any of the following:

- The name of the ship or aircraft tail number;
- A voice call sign listed in *Joint Voice Call Sign Book*, JANAP 119;
- An allied voice call sign listed in *Tactical Call Sign Book (U)*, ACP 110; and/or
- A call sign for ships listed in *Call Sign Book for Ships*, ACP 113.

Voice Communications, NTP 5, lists publications that contain encrypted and daily changing call signs.

A ship must use its call sign when first establishing a net or when reporting into a previously established net. After this initial contact, an abbreviated form of communications may be used as discussed earlier.

If call sign encryption is in effect and a ship or unit name appears in the text, the name should be replaced by the encrypted call sign or address group of the ship or unit. When used in this manner, the call sign or address group may be preceded by the proword CALL SIGN or ADDRESS GROUP, as applicable.

ACP 113 CALL SIGNS

ACP 113 lists the international call signs and hull numbers for ships under military control. The call signs in this publication are unclassified. International call signs are used for all nonmilitary communications and military communications using unencrypted call signs.

JANAP 119 VOICE CALL SIGNS

Voice call signs contained in JANAP 119 are pronounceable words. They are for tactical use and are designed to facilitate speed on tactical radio circuits. Secure voice call signs can be achieved only by a conscientiously applied system for changing call signs on a frequent and periodic basis.

CALL SIGNS ON LOCAL HARBOR CIRCUITS

JANAP 119 does not assign voice call signs to administrative shore activities. Consequently, a ship cannot use a tactical call on administrative ship-shore circuits. When operating on ship-shore R/T circuits, a ship may use its international call sign. Operators must speak the call sign phonetically. For example, you would speak the international call sign NOKB as "November Oscar Kilo Bravo." The procedure described in the next paragraph may also be used.

In U.S. ports and U.S.-controlled ports overseas, the name of the ship serves as the voice call sign. As a rule, the USS prefix, hull designation and number, or the first name or initials of the ship need not be included in the voice call unless essential for clarity. This procedure also applies to shore activities on administrative nets. Each activity may use its administrative title in an abbreviated form, consistent with clarity. For example, Mobile Technical Unit 2 may have a voice call of MOTU on an administrative circuit.

Port authorities that control local harbor voice circuits are identified by the word "CONTROL." For example, let's say that the *Key* is entering port in New London, Conn. *Key's* initial call to New London Control to check into the local harbor net would be:

"Control, THIS IS Key, OVER."

If *Key* were to call Fuel Control, its call would be:

"Fuel Control, THIS IS Key, OVER."

You must remember that the simplified type of call is authorized only in U.S. ports or U.S.-controlled ports. If a ship is in a port not under U.S. control, it must conform to the international practice of using phoneticized international call signs on R/T circuits.

RADIOTELEPHONE CIRCUITS

Voice communications requirements are grouped into two basic categories: operational or tactical and administrative.

OPERATIONAL OR TACTICAL CIRCUITS

Most voice circuits used at sea are operational or tactical nets; some circuits, however, are often used to pass administrative traffic. These circuits are subcategorized into two distinct types: short and long range.

Short-range operational communications normally use the UHF frequency spectrum (225 to 400 MHz) and low-power, line-of-sight equipment. Because of these frequency and equipment characteristics, the maximum effective range is usually 20 to 25 miles. This limited UHF range offers no security, and transmissions are always subject to enemy interception. However, since these transmissions are limited somewhat to the local geographic area, interception by an enemy would be difficult. On the other hand, the range of UHF communications may be extended through the proper use of relay procedures.

More and more, our modern and high-speed ships must report to OTCs from longer distances than the older ships they replaced. Long-range frequencies in the medium- and high-frequency spectrum (2 to 32 MHz) are therefore used. From your study of chapter 4, you will remember that the propagation characteristics of these frequencies make them desirable for long-range communications. To further increase the range capabilities of long-range communications, we use single-sideband (SSB) methods (previously discussed in chapter 1 of your text).

ADMINISTRATIVE CIRCUITS

Administrative circuits are normally used only in port and may include both short- and long-range communications. Voice circuits that are neither operational nor tactical are included in the administrative category. Seldom is there such a circuit in at-sea communication plans.

Harbor common circuits and tug control nets are two examples of administrative nets. Naturally, these nets assume an operational function during situations requiring emergency procedures, such as natural disasters and civil uprisings. Circuit requirements vary from port to port as established by the senior officer present afloat (SOPA). Both the UHF and MF/HF circuits may be used for administrative nets.

TYPES OF NETS

There are two types of R/T nets: directed and free. The type of net to be used is determined by the operational situation. Regardless of the type of net used, a Net Control Station (NECOS) is assigned to monitor the circuit or circuits and enforce circuit discipline.

NECOS is the senior net member or designated authority. The NECOS is responsible for implementing operational procedures and enforcing discipline and security on the net. Enforcement of circuit discipline, however, is not the only reason for having a NECOS. Sometimes there are so many stations sharing a common circuit that a NECOS is necessary to facilitate the handling and passing of R/T traffic.

Directed Net

On a directed net, stations must obtain permission from the NECOS before communicating with other stations on the net. The exception to this rule is when a station has FLASH traffic to send. Also, transmissions on the directed net may be accomplished with a predetermined schedule.

Free Net

On the free net, member stations don't need NECOS permission to transmit. Net members must ensure that the net is not in use before initiating a call-up. A free net, however, does not relieve the NECOS of the responsibility for enforcing operational procedures and maintaining proper circuit discipline.

Both free and directed nets normally use collective call signs. Figure 8-2 diagrams an R/T net that consists of the following stations: USS *Key*, USS *Mariano G. Vallejo*, USS *James K. Polk*, USS *Kamehameha*, and USS *Tecumseh*. In this example, we will assume that the NECOS is *Key*. Notice that the collective call sign for the entire net is Poseidon.

OPENING THE NET

The responsibility for opening the net for the first time or reopening the net after it has been temporarily secured belongs to *Key*. To accomplish this on a free net, *Key* would transmit:

"Poseidon, THIS IS Key, OVER."

After the transmission, all stations answer in alphabetical order:

"Key, THIS IS Kamehameha, OVER,"

"Key, THIS IS Polk, OVER," (and so on until all stations have responded).

After all stations on the net have answered, *Key* then sends:

"Poseidon, THIS IS Key, OUT."

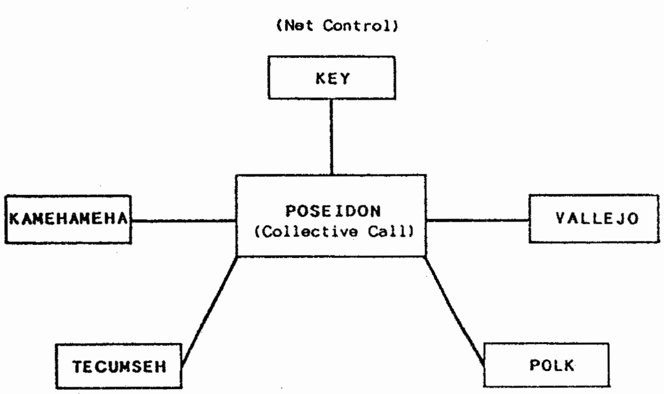


Figure 8-2.—Radiotelephone net.

This last message from *Key* informs all stations that their transmissions were heard and there is no traffic for them at the time.

If a station does not reply to the collective call within 5 seconds, the next station answers in proper sequence. Barring any difficulties the station may have, the delinquent station answers last. If the delinquent station is having difficulty that prevents an answer to the call, it reports in to the net as soon as possible with the transmission:

"Key, THIS IS (name of station).

Reporting In To Net, OVER."

At this time on the free net, and following a preliminary call, the stations concerned would start transmitting traffic to each other. For example, if *Vallejo* has traffic for *Kamehameha*, it would let *Kamehameha* know this with the call:

"Kamehameha, THIS IS Vallejo, OVER."

Kamehameha would acknowledge with:

"Vallejo, THIS IS Kamehameha, OVER."

Vallejo would then send its traffic.

On the directed net, when all communications over the net are controlled by the NECOS, *Key* would call the member stations and announce that the net is directed. In this initial transmission, *Key* would request information on the status of any outstanding messages. For example:

"Poseidon, THIS IS Key, This Is A Directed Net, Of What Precedence And For Whom Are Your Messages, OVER."

Each subordinate station then answers in alphabetical order, indicating its traffic on hand. For example:

"Key, THIS IS Polk, I Have One IMMEDIATE And One PRIORITY For You, OVER."

"Key, THIS IS Vallejo, No Traffic, OVER." (Other stations respond.)

After all stations have checked into the net, *Key* would ROGER for the transmissions and commence to clear traffic in the order of priority. For example:

"Poseidon, THIS IS Key, ROGER, Polk Send Your IMMEDIATE, OVER."

After *Polk* has sent its transmission and obtained a receipt, net control then gives permission to transmit to the station with the next higher precedence traffic.

After the initial traffic is cleared, stations having messages to transmit to other stations on the net must first obtain permission from net control. For example:

"Key, THIS IS Tecumseh, I Have One ROUTINE For Polk, OVER."

Net control then answers:

"THIS IS Key, Send Your Message, OVER."

As you can see from our examples, circuit discipline is essential. Regardless of whether a single ship is entering port or several ships are engaged in a major fleet exercise, voice communications are required. The number of necessary circuits and nets increases with the complexity of the task and the number of units participating.

Whether the net is free or directed, the Net Control Station has the primary responsibility for expediting message traffic. Each station is responsible for assisting net control in the proper passing of traffic. Adherence to proper operating procedures and communications standards is essential in keeping a net free of backlogs and tie-ups.

ESTABLISHING COMMUNICATIONS

We have already discussed the procedure for calling and answering on free and directed nets. There will also be times when you will need to establish communications with a ship or station on a temporary basis to pass message traffic. This consists of nothing more than a simple call-up to initiate contact and to determine whether communications conditions are good. For example, if the USS *Ohio* wants to contact the USS *Alabama* on a commonly guarded frequency, *Ohio*'s initial call would be:

"Alabama, THIS IS Ohio, OVER."

Upon hearing the initial call, *Alabama* would reply:

"Ohio, THIS IS Alabama, OVER."

At this point, *Ohio* would initiate another call-up and indicate that it has traffic to pass to *Alabama*.

To use the circuit more efficiently, the operator should observe the following procedures:

- Write down all messages or their substance prior to transmission, including those that must be delivered by the receiving operator to another person and those that are preceded by the proword MESSAGE.
- Listen to make sure that the circuit is clear before initiating a transmission.
- Speak in a clear, natural voice and pause after each natural phrase.
- If technically practical, during the transmission of a message, the operator should pause after each natural phrase and momentarily interrupt his transmission (carrier). This will allow another station to break in if necessary.

Sometimes the operator must initiate test signals for the adjustment of either a transmitter or a receiver. Such signals should not exceed 10 seconds and should be composed of spoken numerals (1, 2, 3, and so on), followed by the call sign of the station transmitting the signals.

SEQUENCE OF CALL SIGNS

Call signs or address groups in message headings should be arranged alphabetically in the order in which they are to be transmitted, whether plain or encrypted. For this purpose, the slant sign (/) and numerals 1 through 0 are considered the 27th through the 37th letters of the alphabet. When abbreviated call signs are used on a net, the sequence of answering a collective call should be the same as if full call signs were used. This will prevent confusion when these call signs are changed from full to abbreviated.

SIGNAL STRENGTH AND READABILITY

A station is presumed to have good signal strength and readability unless the operator is notified otherwise. Queries concerning signal strength and readability should not be exchanged unless one station cannot clearly hear another station. The proword RADIO CHECK is the standard phrase used in a call-up that questions signal strength and readability. For example, let's assume that USS *Alabama* initiates a call to USS *Ohio* and wishes to know the status of communications conditions. *Alabama*'s initial call would be:

"Ohio, THIS IS Alabama, RADIO CHECK, OVER."

Upon hearing this transmission satisfactorily and determining that communications conditions are clear, *Ohio* would then answer:

"Alabama, THIS IS Ohio, ROGER, OVER."

The omission of comment on signal strength and readability is understood by *Alabama* to mean that the reception is loud and clear. If any adverse conditions existed that were impeding *Ohio*'s ability to maintain satisfactory communications, *Ohio* would have used one of the phrases (considered prowords) in table 8-5.

For example, if *Ohio* did not consider the transmission satisfactory, *Ohio* might reply:

"Alabama, THIS IS Ohio, WEAK And DISTORTED, OVER."

A station that wishes to inform another station of signal strength and readability does so by means of a short report of actual reception. A short report may be "Weak but readable" or "Weak with interference." Such reports as "Five by" or "Four by four" are not authorized and are not indicative of signal strength and quality of reception.

COMMUNICATIONS CONDITIONS

Situations exist where atmospheric conditions and interference do not present problems to successful communications. During good conditions, message parts need only be transmitted once, and, depending upon the operational situation, preliminary calls are sometimes optional.

At other times, conditions are anything but ideal and can present problems to even an experienced operator. Normal operating procedure requires an operator to transmit all call signs twice when communications conditions are bad. During bad conditions, phrases, words, or groups to be transmitted

Table 8-5.—Prowords Concerning Signal Strength and Readability

(1) **General:** RADIO CHECK	What is my signal strength and readability; that is, how do you hear me?
ROGER	I have received your last transmission satisfactorily. The omission of comment on signal strength and readability is understood to mean that reception is loud and clear. If reception is other than loud and clear, it must be described with the prowords in the below paragraphs
NOTHING HEARD	To be used when no reply is received from a called station
(2) **Report of Signal Strength:** LOUD	Your signal is very strong
GOOD	Your signal strength is good
WEAK	Your signal strength is weak
VERY WEAK	Your signal strength is very weak
FADING	At times, your signal strength fades to such an extent that continuous reception cannot be relied upon
(3) **Report of Readability:** CLEAR	Excellent quality
READABLE	Quality is satisfactory
UNREADABLE	The quality of your transmission is so bad that I cannot read you
DISTORTED	Having trouble reading you because your signal is distorted
WITH INTERFERENCE	Having trouble reading you due to interference
INTERMITTENT	Having trouble reading you because your signal is intermittent

twice are indicated by the use of the proword WORDS TWICE. Reception may be verified by use of the proword READ BACK. For example, if bad communications conditions exist and *Tecumseh* has a message for *Kamehameha* that reads "Moor Starboard Side Tender," the transmission would be:

> "Kamehameha, Kamehameha, THIS IS, Tecumseh, Tecumseh, WORDS TWICE, WORDS TWICE, Moor Starboard Side Tender Moor Starboard Side Tender, OVER."

Upon receipt of the message, *Kamehameha* would ROGER for it. To ensure reception during bad communications conditions, *Tecumseh* could have ended the above transmission with the proword READ BACK, sent twice. This would require *Kamehameha* to read back the message verbatim in WORDS TWICE form, thus ensuring that the message was properly received.

Another method of using the READ BACK procedure is to do so without using WORDS TWICE. If *Tecumseh* wanted *Kamehameha* to read back the message to ensure reception but did not want to use the WORDS TWICE procedure, *Tecumseh*'s transmission would be:

> "Kamehameha, THIS IS Tecumseh, READ BACK Text, BREAK, Moor Starboard Side Tender, OVER."

Kamehameha would then answer:

> "Tecumseh, THIS IS Kamehameha, I READ BACK Text, Moor Starboard Side Tender, OVER."

Satisfied that *Kamehameha* has properly received the message, *Tecumseh* would then send:

> "Kamehameha, THIS IS Tecumseh, That Is Correct, OUT."

If *Kamehameha* repeated back the message incorrectly, *Tecumseh* would have used the proword WRONG, followed by the correct version. *Kamehameha* would then repeat back the necessary portions until the entire message was correctly received.

When using the WORDS TWICE or READ BACK procedure, you should remember several rules. First, the prowords THIS IS and OVER are not repeated twice when using the WORDS TWICE procedure. These prowords are not spoken twice in the original transmission nor in the repeat back version. Second, the proword ROGER is not necessary to indicate receipt of the message in the READ BACK procedure. If the message is correct in its repeated back version, you would use the phrase "THAT IS CORRECT, OUT."

In a collective call where only some of the stations represented are to read back, those stations should be specified by transmitting their appropriate call signs preceding the proword READ BACK. When the order to read back is given, only those stations directed to do so will read back. The remaining stations called will keep silent unless directed by the calling station to receipt. When not preceded by identifying call signs, the proword READ BACK means that all stations are to read back if the call is a collective one.

CORRECTIONS

When a transmitting operator makes an error, the operator uses the proword CORRECTION to correct it. The operator then repeats the last word, group, proword, or phrase correctly sent, corrects the error, and proceeds with the message. For example, let's assume that *Tecumseh* made a mistake in the message to *Kamehameha*. The method *Tecumseh* uses to correct that mistake is:

> "Kamehameha, THIS IS Tecumseh, Moor Outboard Side, CORRECTION, Moor Starboard Side Tender, OVER."

If an error in a message is not discovered until the operator is some distance beyond the error, the operator may make the correction at the end of the message. Let's assume that *Key* is communicating with *Polk*. During *Key*'s transmission, *Key* makes a mistake in the time group but the mistake is not discovered until near the end of the transmission. The procedure *Key* would make to correct the mistake is:

> "Polk, THIS IS Key, TIME Zero Eight Two Four Zulu, BREAK, Request Status Deep Dive, BREAK, CORRECTION, TIME Zero Eight Two Five Zulu, OVER."

REPETITIONS

When words are missed or cannot be determined, stations may request repetitions before receipting for the message. The prowords most often used for obtaining repetitions are SAY AGAIN, ALL BEFORE, ALL AFTER, WORD BEFORE, WORD AFTER, and TO. For example, in the previous message from *Key* to *Polk*, assume that *Polk* missed the entire message after the word "Request." *Polk*'s request for a repetition for that portion of the message would be:

> "Key, THIS IS Polk, SAY AGAIN ALL AFTER Request, OVER."

Key would then reply:

"THIS IS Key, I SAY AGAIN ALL AFTER Request—Status Deep Dive, BREAK, OVER."

Upon satisfactory receipt, *Polk* would send:

"THIS IS Polk, ROGER, OUT."

This same procedure applies for the proword ALL BEFORE.

The repetition procedure is also used when a station requests that a particular word be repeated. This is done by using either of the prowords WORD AFTER or WORD BEFORE. For example:

"Key, THIS IS Polk, SAY AGAIN WORD AFTER Status, OVER."

Key then replies:

"THIS IS Key, I SAY AGAIN WORD AFTER Status—Deep, OVER."

The WORD BEFORE procedure would be accomplished in the same way by simply substituting the prowords.

The use of the proword TO is as follows:

"Key, THIS IS Polk, SAY AGAIN Request TO Dive, OVER."

Key would then reply:

"THIS IS Key, I SAY AGAIN Request TO Dive—Request Status Deep Dive, OVER."

Upon satisfactory receipt, *Polk* would reply:

"THIS IS Polk, ROGER, OUT."

An important rule to remember is that when you request repetitions in the heading of an R/T message containing FROM, TO, INFO, or EXEMPT addressees, the prowords are the key to the repetition procedures. Repetitions may be requested for all of that portion of the heading preceding or following a proword or that portion between any two prowords. For example, *Key* sends the following message to *Polk*:

"Polk, THIS IS Key, MESSAGE, PRIORITY, TIME, Zero Eight Zero Nine Three Zero Zulu, FROM Key, TO Polk, INFO Tecumseh, BREAK, Proceed Naval Underwater Sound Laboratories, Rendezvous SAQAD, I SPELL, Sierra, Alfa, Quebec, Alfa, Delta, SAQAD, Representative, BREAK, OVER."

Polk misses the portion of the message before the address and sends:

"Key, THIS IS Polk, SAY AGAIN ALL BEFORE FROM, OVER."

Key then sends:

"Polk, THIS IS Key, I SAY AGAIN ALL BEFORE FROM—Polk, THIS IS Key, MESSAGE, PRIORITY, TIME, Zero Eight Zero Nine Three Zero Zulu, OVER."

Upon understanding the missing portion, *Polk* sends:

"Key, THIS IS Polk, ROGER, OUT."

This same procedure can be applied to all repetition prowords. An important point for you to remember is that requests for repetition must include those portions of the heading before, after, or between the applicable prowords.

CANCELING MESSAGES

Before the ending proword OVER or OUT is sent, a station can cancel a message transmission by using the proword DISREGARD THIS TRANSMISSION, OUT. For example, if *Key* should realize, while sending a message, that the message is being sent in error, *Key* would cancel the transmission as follows:

". . . Proceed Underwater Sound Laboratories, DISREGARD THIS TRANSMISSION, OUT."

After a message has been completely transmitted, it can be canceled only by another message. For example:

"Polk, THIS IS Key, Cancel My Zero Eight Zero Nine Three Zero Zulu, TIME Zero Nine Five Zero Zulu, OVER."

Polk transmits:

"Key, THIS IS Polk, ROGER, OUT."

RECEIPT OF A MESSAGE

No message is considered delivered on an R/T circuit until the transmitting station receives a receipt. A receipt is effected by the use of the proword ROGER. The receiving station can transmit a receipt after each message or after a string of messages if there is more than one message to be receipted for.

In a collective net, the transmitting station may determine that speed of handling should be the primary consideration. In this case, one station in the net may be directed to receipt for the message or messages and no other station may answer until instructed to do so. This, however, does not prohibit any station in the net from requesting repetition.

ACKNOWLEDGMENT OF R/T MESSAGES

You should not confuse an acknowledgment with a reply or receipt. An acknowledgment is a reply from an addressee indicating that a certain message was received, understood, and can be complied with. A receipt means only that the message was received satisfactorily. Only the commanding officer or his or her authorized representative can authorize communications personnel to send an acknowledgment.

A request for acknowledgment is accomplished by use of the word "acknowledge" (not a proword) as the final word of the text. The reply is the proword WILCO. If the commanding officer can acknowledge at once, the communications operator may receipt for the message with WILCO because the meaning of ROGER is contained in WILCO. If the acknowledgment cannot be returned immediately, the communications operator receipts for the message with ROGER, and replies with WILCO later. The return transmission to a request for an acknowledgment is either ROGER or WILCO; never both. For example, *Polk* receives the following transmission from *Key*:

> "Polk, THIS IS Key, Request Special Communications Training, Acknowledge, OVER."

The commanding officer wishes to consider the request before acknowledging; the operator sends:

> "Key, THIS IS Polk, ROGER, OUT."

After consideration, the commanding officer of *Polk* understands and can comply with the message. The operator then transmits:

> "Key, THIS IS Polk, WILCO, OUT."

VERIFICATION OF R/T MESSAGES

When a receiving station requests verification of an R/T message, the originating station verifies the message with the originating person, checks the cryptography (if the message is encrypted), and sends the correct version. For example:

> "Key, THIS IS Polk, VERIFY your Zero Eight Zero Nine Three Zero Zulu—SAY AGAIN FROM TO INFO, OVER."

Key then transmits:

> "THIS IS Key, ROGER, OUT."

After checking with the originating officer, *Key* determines that the portion to be verified is correct as transmitted previously and sends:

> "Polk, THIS IS Key, I VERIFY My Zero Eight Zero Nine Three Zero Zulu, I SAY AGAIN, FROM TO INFO—FROM Key, TO Polk, INFO, OVER."

Polk receipts for the transmission:

> "THIS IS Polk, ROGER, OUT."

BREAK-IN PROCEDURES

A station having a message of higher precedence than the transmission in progress may break in and suspend that transmission in the following manner:

FLASH message—The station should break in at once and transmit the message.

IMMEDIATE message—The station may break in at once and pass the message. The station may make a preliminary call before transmitting the message, if necessary. On a directed net, the station must obtain control approval before transmitting the message.

PRIORITY message—The station should use the same procedure as for IMMEDIATE, except that only long ROUTINE messages should be interrupted.

You should be aware that the break-in procedure is not to be used during the transmission of a tactical message except to report an enemy contact. The precedence of the message spoken three times means to cease transmissions immediately. Silence must be maintained until the station breaking in has passed the message. In the following example, assume that *Tecumseh* is transmitting a message to *Kamehameha* on a free net and *Key* has a FLASH message for *Polk*. *Key* breaks in with the following transmission:

> "FLASH, FLASH, FLASH, Polk, THIS IS Key, FLASH, OVER."

Polk replies:

> "THIS IS Polk, ROGER, OVER."

Key then proceeds with the FLASH traffic and obtains a proper ROGER, thus freeing the net for further transmissions. After hearing "ROGER," *Kamehameha* recontacts *Tecumseh* for the remainder of the traffic that was being sent before the break-in:

"Tecumseh, THIS IS Kamehameha, ALL AFTER . . . ."

On a directed net, the station wishing to break in would first obtain permission from net control. For example, referring to figure 8-2, assume that *Vallejo* is transmitting a message to *Kamehameha* and *Polk* has FLASH traffic for *Tecumseh. Polk* notifies *Key* (net control):

"FLASH, FLASH, FLASH, Key, THIS IS Polk, FLASH For Tecumseh, OVER."

Key then answers:

"Polk, THIS IS Key, Send Your FLASH, OVER."

Upon hearing the authorization, *Tecumseh* transmits:

"THIS IS Tecumseh, OVER."

Polk proceeds:

"Tecumseh, THIS IS Polk, FLASH (sends message), OVER."

The preceding transmission would conclude after *Polk* had received a proper ROGER for the FLASH traffic. The two stations that were broken (*Vallejo* and *Kamehameha*) would reestablish communications using proper R/T procedures.

EMERGENCY SILENCE

Emergency silence may be imposed on an R/T net only by competent authority. If an authentication system is in effect, a station must always authenticate a transmission that:

- Imposes emergency silence;
- Lifts emergency silence; and
- Calls stations during periods of emergency silence. When emergency silence is imposed, no receipt or answer for such transmissions is required.

To impose emergency silence, the NECOS speaks the proword SILENCE three times. For example, refer to figure 8-2 and assume that *Key* (net control) was authorized to impose emergency silence. *Key* would transmit:

"Poseidon, THIS IS Key, SILENCE, SILENCE, SILENCE, TIME One Four Four Zero Zulu, OUT."

To impose emergency silence on a particular frequency but not on all frequencies used in the net, *Key* would use the proword SILENCE (spoken three times), followed by a frequency or the frequency designator to be silenced. SILENCE (spoken three times), followed by the words "all nets," means to cease transmissions immediately on all nets. All transmissions end with the proword OUT.

To lift emergency silence, *Key* would send the following transmission:

"Poseidon, THIS IS Key, SILENCE LIFTED, TIME One Five One Zero Zulu, OUT."

EXECUTIVE METHOD FOR RADIOTELEPHONE

The Executive Method for R/T is used to execute a tactical message at a given instant. This method is used to ensure that two or more units make simultaneous maneuvers. Abbreviated plaindress format is normally used for Executive Method messages. These messages never have a time group included in the message ending. There are two variations of the Executive Method: delayed and executive.

DELAYED EXECUTIVE METHOD

A tactical message sent by the Delayed Executive Method must carry the warning proword EXECUTE TO FOLLOW in the message instructions immediately preceding the text. The executive signal is sent later in the form of "standby—EXECUTE," the latter word being the instant of execution. For example, referring to figure 8-2, assume that *Key* sends the following message by the Delayed Executive Method to the collective call Poseidon:

"Poseidon, THIS IS Key, EXECUTE TO FOLLOW, Fire One Water Slug, OVER."

All stations respond in alphabetical order of full call signs:

"THIS IS Kamehameha, ROGER, OUT."

"THIS IS Polk, ROGER, OUT."

"THIS IS Tecumseh, ROGER, OUT."

"THIS IS Vallejo, ROGER, OUT."

When ready to execute, *Key* transmits:

"Poseidon, THIS IS Key, Standby, EXECUTE, OVER."

The stations then respond in alphabetical order of full call signs with:

"THIS IS (station), ROGER, OUT."

If communications conditions are good, *Key* can designate only one station to receipt for everyone to ensure that the transmission is heard. As part of the execute signal, *Key* could have transmitted:

"Poseidon, THIS IS Key, Standby, EXECUTE, Polk, OVER."

Polk would then ROGER with:

"THIS IS Polk, ROGER, OUT."

When considerable time has elapsed between the EXECUTE TO FOLLOW message and the actual execution message, the text to be executed should be repeated prior to the words "Standby—EXECUTE." The text should also be repeated when it is only a portion of a message or one of several outstanding "EXECUTE TO FOLLOW" messages.

IMMEDIATE EXECUTIVE METHOD

In cases of urgency, the execute signal may be transmitted in the final instructions element of the message to which it refers. The use of the Immediate Executive Method does not allow stations to obtain verifications, repetitions, acknowledgments, or cancellations before the message is executed. These messages should be in plain language or limited to basic TURN, CORPEN, and SPEED signals.

The Immediate Executive Method uses the warning proword IMMEDIATE EXECUTE in the message instructions instead of the proword EXECUTE TO FOLLOW. The text of the signal is transmitted twice, separated by the proword I SAY AGAIN. The execute signal is transmitted in the final instructions. For example:

"Poseidon, THIS IS Key, IMMEDIATE EXECUTE, BREAK, Shift Your Rudder, I SAY AGAIN, Shift Your Rudder, STANDBY, EXECUTE, Polk, Vallejo, OVER."

Notice that *Key* includes both *Polk* and *Vallejo* as ROGER addressees. Again, this is done to ensure that the transmission is received by everyone involved, provided communications are good. However, if communications are bad, all stations in the net must ROGER the execution. Upon hearing their calls, *Polk* and *Vallejo* would answer:

"Key, THIS IS Polk, ROGER, OUT"

"Key, THIS IS Vallejo, ROGER, OUT."

AUTHENTICATION

Authentication is a security measure designed to protect a communications system against fraudulent transmissions. There are specific times when you will have to use authentication procedures. Several types of authentication systems are in use, and the method of authentication will vary with the system that you are using. Authentication systems are accompanied by specific instructions outlining the method of use. You can find more information about the types of authentications and specific reasons when and why to use the authentication process in *Communications Instructions—Security (U)*, ACP 122, and in NTP 5.

ENEMY CONTACT REPORTING

Enemy contact reports are normally made only once when you are in direct communications with the officer in tactical command (OTC), a higher authority, or a shore radio station. Enemy contact reports are signaled using basic R/T procedures as modified by chapter 6 of ACP 125. Details of enemy contact reporting are contained in *Allied Maritime Tactical Instructions and Procedures*, ATP 1, Volume I. There are two conditions under which enemy contact reports are to be made more than once:

- When DO NOT ANSWER procedures are used (texts are transmitted twice in this procedure).
- When the text consists of emergency alarm signals. In this case, the text is transmitted twice, separated by the proword I SAY AGAIN, with a time group in the ending.

When required, authentication is used in contact reports. Lack of proper authentication, however, should not prevent retransmission or relay of the message to higher authority.

There are two types of contact reports: initial and amplifying. As you would expect, initial reports are used to report initial contact or sightings. These reports should be sent as expeditiously as possible with immediate, pertinent information (type vessel, location, basic track, and so forth). The amplifying reports contain all necessary amplifying information to be fully analyzed by higher authority or command.

CODE AND CIPHER MESSAGES

Code words, such as VERDIN in the text EXECUTE PLAN VERDIN, are sent as plain language words. Encrypted groups, such as DRSRM, are spelled phonetically: DELTA, ROMEO, SIERRA, ROMEO, MIKE.

The phonetic alphabet is used for the names of signal flags as well as for spelling words, letter groups, and so on. Signal flags are combined into code groups that have meanings of their own. DELTA ROMEO ONE, for example, might mean "prepare to hover." Signal flag A is ALFA, flag B is BRAVO, and so on. Meanings of such code groups are given in appropriate signal publications.

Because flag signals are also sent by R/T, you must be able to differentiate between the two uses of the phonetic letters when you hear them. Here is the way—if the phonetic alphabet is used, the proword I SPELL precedes it and each phonetic letter is recorded as a letter. If you hear I SPELL, followed by DELTA OSCAR, write it as DO. On administrative nets, the proword SIGNALS, followed by DELTA OSCAR, means the groups have been taken from a signal book and should be recorded as such. Prowords are not used on nets used primarily for conveying signals. Therefore, you may assume that alphabet flags are intended.

The duties of an R/T operator require a knowledge of the special language developed for tactical maneuvering, air control, antiair warfare, naval gunfire support, electronic countermeasures, antisubmarine warfare, and other specialized uses. Words, phrases, and abbreviations used in R/T for these specialized uses are called operational brevity codes. A complete list of operational brevity code words is found in *Operational Brevity Codes*, ACP 165.

You should understand that the words and phrases of the brevity code provide no communications security. The purposes of the codes are to:

- Standardize the vocabulary;
- Improve the accuracy of the transmission; and
- Shorten transmission time.

RADIOTELEPHONE CIRCUIT LOGS

R/T circuit logs must be maintained on all R/T nets or circuits unless otherwise directed. The circuit log shows a complete and continuous record of all transmitted and received traffic, as well as the operating condition on that radio day. Circuit logs contain the following information:

- Times of opening and closing by individual stations;
- Causes of any delays on the circuit;
- Frequency adjustments and changes;
- Unusual occurrences, such as procedural and security violations; and
- Changing of the watch.

NTP 5 contains the complete list of data required in an R/T circuit log.

When operating conditions permit and when there are no instructions to the contrary, an operator should record every transmission heard, regardless of the source or completeness. This rule applies to all tactical, command, and reporting nets. On other nets, a modified log may be kept.

Some nets may require only a modified log for ready reference. However, on nets or circuits that require complete logs, automatic recording devices should be used to ensure a total record. Time should be automatically or manually recorded at intervals not to exceed 5 minutes.

When a message is addressed to or is to be relayed by the receiving station, the message must be written in full on a message blank. Only details needed to identify the message are inserted in the radio log. If the message does not need to be recorded in full on a message blank, the transmission should be recorded as completely as feasible in the circuit log.

When opening a new circuit or starting a log for a new day, the operator writes or types in his or her name and rank/rate or grade in full. Upon being relieved or closing the circuit, the operator must sign the log. The oncoming operator then writes or types his or her name and rank/rate or grade in full in the log.

Log entries are never erased. Any necessary changes are made by drawing a neat single line through the original entry and indicating the changed version adjacent to the lined out entry. When using the typewriter, the operator may use the slant key to delete erroneous entries. All changes must be initialed by the operator making the change.

SUMMARY

SECURITY CONSCIOUSNESS must be a priority with all voice operators. As we mentioned at the beginning of this chapter, R/T communications are the least secure of all radio communications and everything you say can be intercepted. You and other users must be alert to avoid disclosure of classified information when transmitting on R/T circuits. You should carefully study the rules and guidelines presented in this chapter and practice them on a training net. A training net provides experience without the pitfalls of serious operational mistakes made by a nervous or inexperienced operator.

To further enhance your proficiency, you should study ACP 125 and ACP 165, in addition to this chapter. You should also study the references at the end of the chapter and those portions of ATP 1 (Vol. 1) that deal with contact reporting. Remember, if a situation arises in which the operational situation is critical and requires quick action, you will not have time to refer to the applicable publications for proper procedures and security precautions.

RECOMMENDED READING LIST

NOTE

Although the following references were current when this TRAMAN was published, their continued currency cannot be assured. You therefore need to ensure that you are studying the latest revisions.

Call Sign Book for Ships, ACP 113(AC), Joint Chiefs of Staff, Washington, D.C., April 1986.

Communication Instructions, General, ACP 121(F), Joint Chiefs of Staff, Washington, D.C., April 1983.

Joint Voice Call Sign Book, JANAP 119, Joint Chiefs of Staff, Washington, D.C., January 1984.

Radiotelephone Procedure, ACP 125(E), Joint Chiefs of Staff, Washington, D.C., August 1987.

Voice Communications, NTP 5(B), Naval Telecommunications Command, Washington, D.C., August 1984.

CHAPTER 9

MANUAL TELEPRINTER PROCEDURES

CHAPTER LEARNING OBJECTIVES

Upon completing this chapter, you should be able to do the following:

- *Discuss Navy teleprinter equipment.*
- *Discuss the AN/UGC-143A(V) Navy Standard Teleprinter.*
- *Explain message alignment.*
- *Recognize proper message punctuation.*
- *Identify proper message format.*
- *Outline basic teleprinter operating instructions.*

The new Navy Standard Teleprinters (NSTs) used in Navy communications are more than electrically operated typewriters. The prefix "tele" comes from the Greek word "teleos," which means "at a distance." "Tele," when combined with the word "typewriter," forms a new word, which means "typewriting at a distance."

By operating the keyboard, the operator sends signals that cause the teleprinter to print selected characters (letters, figures, and symbols) in printed page form. When on-line in a circuit, the characters appear, with a slight delay, at both sending and receiving sites as a printed copy. During operation, one teleprinter will actuate all connected machines.

In this chapter, we discuss basic machine functions, operating instructions, and procedures associated with manual operation. You will find detailed information concerning these areas in Communications Instructions, Teletypewriter (Teleprinter) Procedures, ACP 126.

TELEPRINTER EQUIPMENT

Communications equipment is constantly changing to keep up with the changing needs of Navy communications requirements. You are probably using the new Navy Standard Teleprinters (NSTs) that have come on-line and replaced the old Model 28 family of teletypes. We will therefore discuss only the new NSTs (AN/UGC-143A[V]).

AN/UGC-143A(V) NAVY STANDARD TELEPRINTER

AN/UGC-143A(V) Navy Standard Teleprinters (NSTs) are new electronic teleprinters that have replaced Model 28 teletypewriters. The replacements, completed in the early 1990s, were through attrition during modernizations and improvements. The NST was designed for shipboard (surface and subsurface) and shore station use. The NST fulfills most Navy operational circuit needs, including coordination, netted, broadcast, ship-shore, and ship-ship record communications circuits.

NST OVERVIEW

An NST is an electronic teleprinter made up of several units selectively connected to form various configurations (discussed shortly). Modern microcircuits ensure NST reliability, performance, and maintainability. The NST uses multiple microprocessor units to distribute tasks among the units. Microprocessors provide the advantage of better maintainability. This advantage comes from three levels of programmed built-in test (BIT) features, greater reliability, and discrete logic components performing similar functions.

Microprocessors also provide easy NST operation through the use of English prompting during setup, operation, and testing. The NST is designed as either a table-top or slide-mounted unit that can be used in standard equipment racks. The NST printer prints 12 times faster than the Model 28. The NST provides a soft copy, one-line visual display designed to assist operators in preparing and correcting messages.

The NST can permanently store formatted and composed information. This storage capability, along with its various interface capabilities, provides an alternative method for satisfying paper tape reader/punch functions.

MODULES

There are various NST configurations. These include combinations of the electronic module, printer module, keyboard module, keyboard/display module, and/or the bulk storage module. Depending on the configuration, each module may contain different components (figure 9-1).

Electronic Module

The electronic module controls the functional operations of the NST and provides a temporary storage of all input, output, and internal NST information. This module contains up-to-date information on the specific configuration of the NST as well as the operational/nonoperational status of each of the connected modules.

The electronic module contains a message buffer memory, message segmentation logic, message routing logic, communication port, cryptoport, and power supply. Depending upon its configuration, the electronic module may also contain a punch port, a bulk storage port, or a reader/punch port.

Printer Module

The printer module automatically prints all information received via the communications line without the need for operator intervention. Additionally, all information released to the send communications line is automatically printed after it has been sent. The operator can interrupt the printing mode without losing information and print other data as desired.

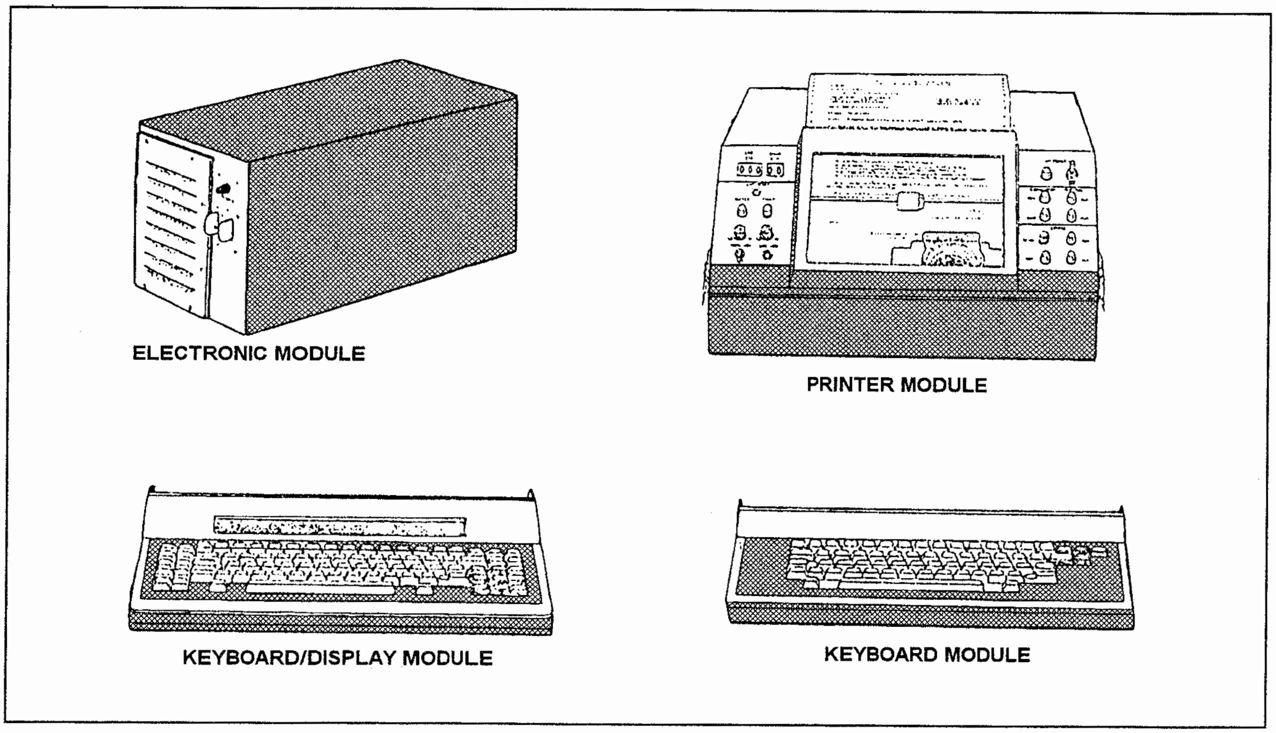


Figure 9-1.—AN/UGC-143A(V) modules.

The printer consists of a dot matrix mechanism capable of printing line lengths up to 80 characters in American Standard Code for Information Exchange (ASCII) or Baudot (communications or weather information). Operator-selectable single- or double-line spacing modes are available. The standard configuration of this printer includes the friction feed (roll type) paper feed mechanism for use with fanfold-type paper. The printer is capable of accommodating up to three-ply paper. The quality of the third copy is such that it can be reproduced on a shipboard copy machine.

Using character-type symbols, the printer prints at 120 characters per second. The majority of the NST interfaces/visual indicators are character and line counters, send-and-receive indicators, fault indicators, paper advance switches, send and phase initiate switches, and character and line counter reset switches.

The printer module contains the printer mechanism, printer electronics, printer buffer, status indicator, system setup switches, and power supply.

Keyboard Module

The keyboard module contains the basic complement of keys needed to send characters, release tape reader input, and perform tape editing.

Keyboard/Display Module

The keyboard/display module is simply an enhanced keyboard. The additional features include a one-line (80-character) display, tape edit keys, message edit keys, and the editing buffer memory.

Bulk Storage Module

The bulk storage module automatically stores all received and transmitted messages on a removable data cartridge. This module maintains an archive directory listing (table of contents) of all messages stored. The operator can have the table of contents printed or displayed on the screen (figure 9-2). The table of contents lists the messages in date-time group

MESSAGES RECEIVED - AWAITING PRINT OR ARCHIVE

PENDING	MN	SRC	TIME	MONTH	ORIGINATOR	PSN

MESSAGES IN EDIT BUFFER

PENDING	MN	SRC	TIME	MONTH	ORIGINATOR	PSN
A	1637.10	E	221230Z	APR	Fm ORIGINATOR #40	000000A40

BULK STORAGE UNT DIRECTORY REPORT TAPE ID: UGC143

TIME	MONTH	ORIGINATOR	PSN	SRC	MN
221230Z	APR	ORIGINATOR #3	000000A03	E	1636.02
221230Z	APR	ORIGINATOR #7	000000A07	E	1636.03
221230Z	APR	ORIGINATOR #7	000000A07	E	1637.01
221230Z	APR	ORIGINATOR #40	000000A040	E	1637.02
221230Z	APR	ORIGINATOR #40	000000A040	E	1636.03
221230Z	APR	ORIGINATOR #40	000000A040	E	1636.04
221230Z	APR	ORIGINATOR #40	000000A040	E	1636.05
221230Z	APR	ORIGINATOR #40	000000A040	E	1636.06
221230Z	APR	ORIGINATOR #40	000000A040	E	1636.07
221230Z	APR	ORIGINATOR #40	000000A040	E	1636.08
221230Z	APR	ORIGINATOR #40	000000A040	E	1636.09
221230Z	APR	ORIGINATOR #40	000000A040	E	1636.10
				R	1630
				R	1631
				R	1632
				R	1633
				R	1634
				R	1635

END OF REPORT

Figure 9-2.—Table of contents report.

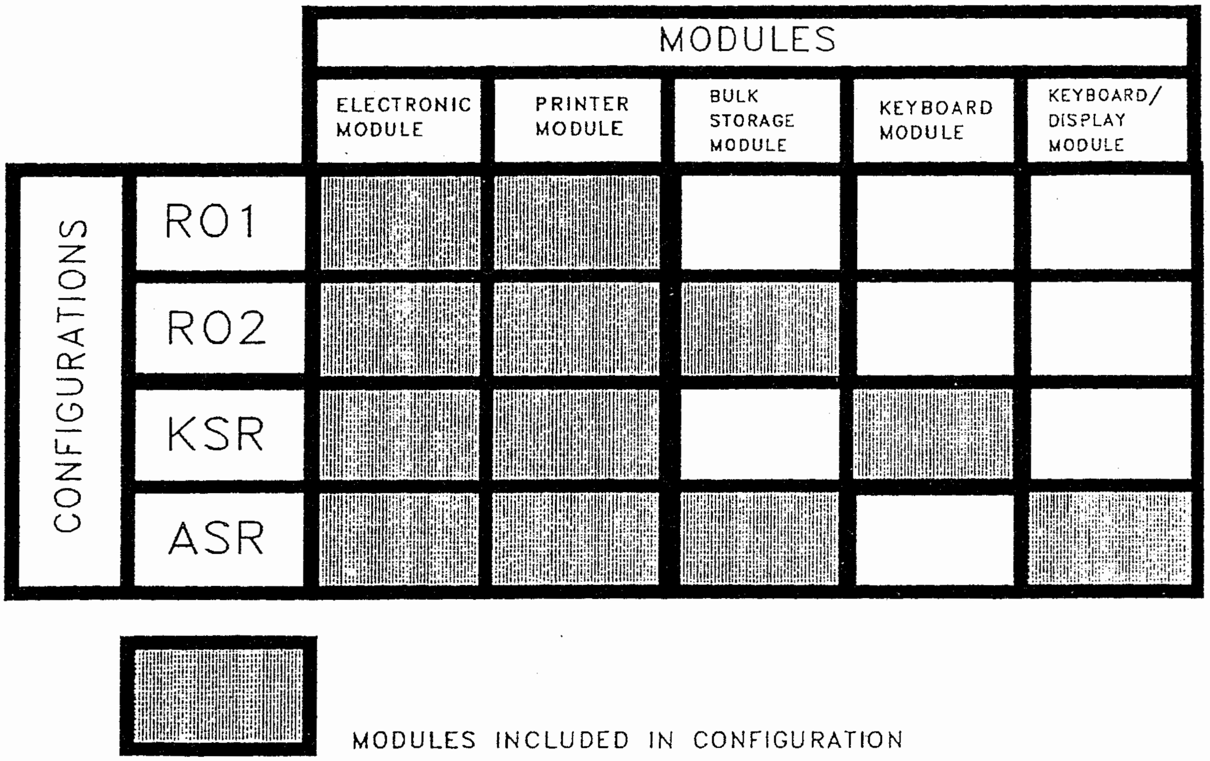


Figure 9-3.—AN/UGC-143A(V) teleprinter configurations.

order and includes the originator, NAVCOMPARS processing sequence number (PSN), and an access number by which the operator can recall the message from storage.

A data cartridge can store up to 1,344 messages of 2,000 characters each. Maximum recall time for operator access to a stored message is 90 seconds. When a message is recalled, the NST starts searching from the beginning of the data cartridge and works its way to the end.

The bulk storage module contains the tape drive, drive electronics, message file logic, bulk storage buffer, function control switches, and power supply.

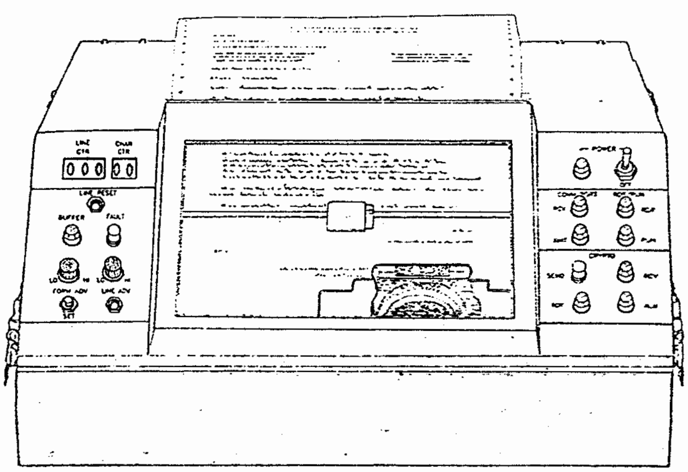


Figure 9-4.—AN/UGC-143A(V)1 or 2, Receive-Only (RO) teleprinter.

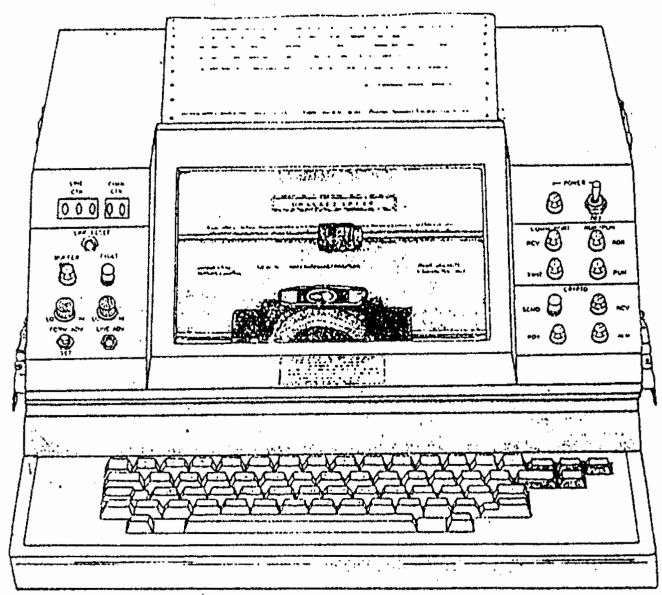


Figure 9-5.—AN/UGC-143A(V)3 Keyboard Send-Receive (KSR) teleprinter.

CONFIGURATIONS

There are four versions of the AN/UGC-143A(V) teleprinter: Receive Only-1 (RO1), Receive Only-2 (RO2), Keyboard Send-Receive (KSR), and Automatic Send-Receive (ASR). Figure 9-3 is a graphic display of modules used in each of the four configurations.

Receive-Only (RO) Teleprinters

The RO teleprinter (figure 9-4) has all the features needed to process/print incoming messages. This teleprinter is compatible with most common cryptographic and paper tape/punch devices. The RO teleprinter design allows it to be stacked three high in a rack while providing visibility of all printouts.

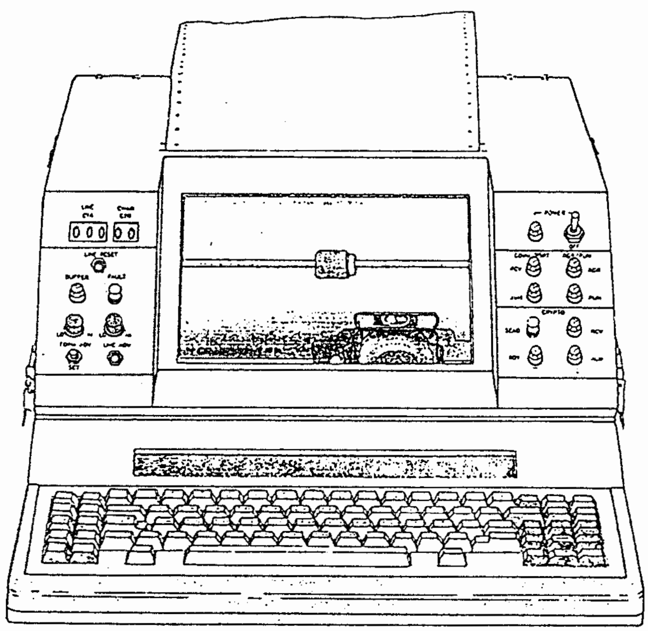


Figure 9-6.—AN/UGC-143A(V)4 Automatic Send-Receive (ASR) teleprinter.

RECEIVE ONLY-1 (RO1) TELEPRINTER.— The RO1 consists of electronic and printer modules. The RO1 receives messages via the communications port and prints them as they are received. If messages are received faster than the printer can print, the incoming messages are stored (buffered) up to the 120,000 character limit of the buffer memory. The printer continues to print as long as there is data in this buffer memory.

RECEIVE ONLY-2 (RO2) TELEPRINTER.— The RO2 has the same electronic and printer modules as the RO1. The RO2 also has a bulk storage module. The bulk storage module automatically stores all formatted messages onto magnetic tape and prepares an archive directory listing (table of contents).

Keyboard Send-Receive (KSR) Teleprinter

The KSR (figure 9-5) expands the RO1 by the addition of a keyboard module. The KSR has direct keyboard on-line (order-wire operations) capabilities. The KSR also uses the reader/punch port to interact with paper tape readers or punches.

Automatic Send-Receive (ASR) Teleprinter

The ASR (figure 9-6) expands the RO2 by the addition of a keyboard/display module. The ASR provides the capabilities of all the other three configurations. The ASR also provides simple message preparation and correction features using the one-line display and specialized function keys.

AN/UGC-143A(V) TELEPRINTER KEYBOARDS

Two different keyboards are used with the AN/UGC-143A(V). Figure 9-7 shows the keyboard

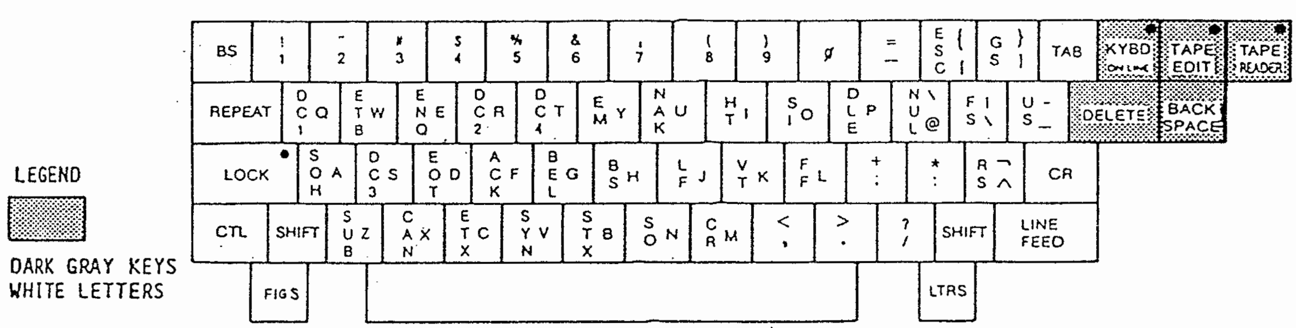


Figure 9-7.—AN/UGC-143A(V)3 KSR keyboard.

for the KSR version. Figure 9-8 shows the keyboard for the ASR version. As you can see, there are many more functions and keys on the teleprinter keyboard than are on the old teletype keyboard. Operators can select a variety of characters or functions by pressing one or more keys.

Because there are so many functions on the NSTs, we cannot discuss all of them in this chapter. We will, however, discuss the most important. Refer to figure 9-8 as you study the following AN/UGC-143A(V)4 keyboard functions:

EDIT Key

Pressing the EDIT key causes the teleprinter to enter or exit the edit mode. In the edit mode, the operator can edit the contents of existing messages. The LED indicator inset into the key is on when the teleprinter is in the edit mode.

CMP (Composition) Key

Pressing the CMP key causes the teleprinter to enter or exit the message composition mode. This mode allows the operator to compose a new message.

CONT CHAR (Control Characters) Key

The CONT CHAR key is used only during message composition and edit modes. This key allows the operator to turn the control characters on or off at the display readout on the ASR teleprinter. The indicator in the key comes on when the character line is filled.

BULK Key

The operator uses the BULK key to transfer messages to the magnetic tape cartridge in the bulk storage unit. Pressing both the BULK key and the SHIFT key allows the operator to delete messages stored on the tape cartridge. The operator presses both the BULK key and the CTL key to assign a new tape identification number and delete all messages stored on the tape cartridge.

CAN (Cancel) Key

The operator can use the CAN key to cancel or delete messages from the buffer. The operator can then compose or edit a different message. Pressing both the CAN key and the SHIFT key deletes messages stored by the teleprinter.

RPT (Report) Key

When the RPT key is pressed, the table of contents report is printed. When the RPT and SHIFT keys are pressed, a status report of messages is generated.

RTV (Retrieve) Key

The RTV key retrieves messages stored by the teleprinter. The operator can have the messages printed by the printer unit or punched by the paper tape

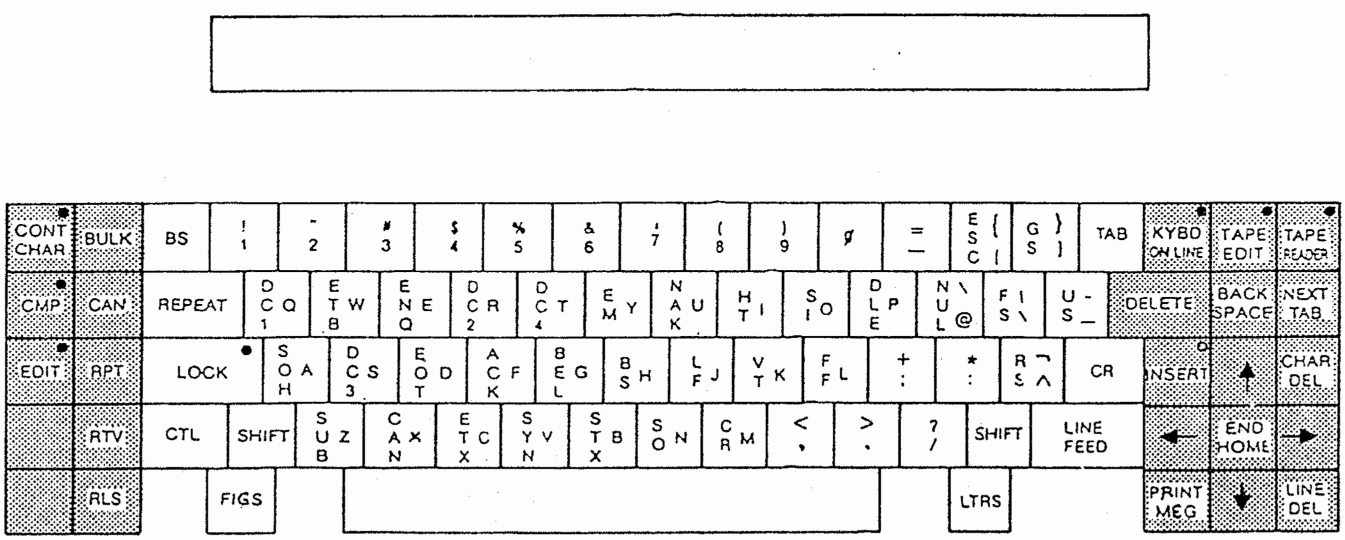


Figure 9-8.—AN/UGC-143A(V)4 ASR keyboard.

punch. The operator can retrieve up to eight sequentially or randomly numbered messages. To cancel the retrieval operation, the operator presses the CAN key.

RLS (Release) Key

Pressing the RLS key releases up to eight sequentially or randomly numbered messages for transmission to remote communications equipment.

KYBD ON LINE Key

Pressing the KYBD ON LINE key places the teleprinter in character-by-character status. This mode sends messages directly to the communications port for transmission to remote equipment or for order-wire operation. Table 9-1 contains the control command code abbreviations found on the keys.

MESSAGE ALIGNMENT

Specific machine functions in manual teleprinter procedures are necessary to facilitate the handling of messages and to align the receiving teleprinters. Likewise, specific message alignment functions are necessary for the continuity of operation. These basic alignment functions are:

- All message transmissions must be preceded by five spaces, two carriage returns, and one line feed (5SP, 2CR, 1LF). If two or more messages appear on one tape (called a string of messages) for transmission, the five spaces, two carriage returns, and one line feed must precede each message.
- Each typed line within a message must end with an end-of-line function (two carriage returns and one line feed).

Table 9-1.—Control Command Code Abbreviations and Definitions

ABBREVIATION	DEFINITION	ABBREVIATION	DEFINITION
ACK	Acknowledge	FF	Form Feed
BEL	Bell	FS	File Separator
BS	Backspace	GS	Group Separator
CAN	Cancel	HT	Horizontal Tabulation
CR	Carriage Return	LF	Line Feed
DC1	Device Control 1	NAK	Negative Acknowledge
DC2	Device Control 2	NUL	Null
DC3	Device Control 3	RS	Record Separator
DC4	Device Control 4	SI	Shift In
DLE	Data Link Escape	SO	Shift Out
EM	End of Medium	SOH	Start of Heading
ENQ	Enquiry	STX	Start of Text
EOT	End of Transmission	SUB	Substitute
ESC	Escape	SYN	Synchronous Idle
ETB	End of Transmission Block	US	Unit Separator
ETX	End of Text	VT	Vertical Tabulation

- Between pages of a long message (for example, PAGE 1 of 2 PAGES), the separative function is two carriage returns and four line feeds.

- The end-of-message (EOM) function is 2 carriage returns, 8 line feeds, the letter N repeated 4 times, and the LTRS key 12 times (2CR, 8LF, NNNN, 12LTRS). When authorized by separate service instructions, the EOM function may be altered to require 2 carriage returns and 12 line feeds.

- No line may exceed 69 characters, including spaces, except when authorized by separate service instructions.

MESSAGE PUNCTUATION

All punctuation and symbols available on U.S. military teleprinter equipment may be used over U.S. networks. However, instructions contained in *Communications Instructions, Tape Relay Procedures*, ACP 127, apply when a message contains other than U.S. routing indicators in format line 2.

Table 9-2 lists the authorized abbreviations and symbols that may be used if messages are being transmitted to non-U.S. military commands. The letter X may be used instead of punctuation when exact punctuation is not essential, but some separation in the text is necessary for clarity. However, the use of X can be used only in cases when it is not ambiguous. The written phonetic spelling (X-RAY) of the letter X should not be used for this purpose.

MESSAGE FORMAT

Messages that are processed and handled by teleprinter are prepared for transmission in either plaindress, abbreviated plaindress, or codress form except when a commercial form is authorized. In AUTODIN procedures, there are also certain formatting requirements that must be maintained. These special requirements are discussed in Chapter 10, "Automated Systems." With the exception of format line 1, manual teleprinter procedures are the same as those used in the basic message format covered in chapter 6.

Table 9-3 shows the sequence of basic manual teleprinter message format lines and an explanation of each line. As you can see, basic message format, radiotelephone (R/T) format, and manual teleprinter format are all similar. In each area of formatting, the lines are essentially the same and the order remains unchanged. Before going any further, however, we need to touch on a topic that has not been discussed previously in message formatting: format line 1.

Format line 1 is used in tape relay procedures as well as in several modes of AUTODIN operation. The various uses for format line 1 include:

- For "pilots" (message-handling instructions) when necessary;

- For transmission identification (TI), normally in the form of channel numbers;

- For start-of-message (SOM) indicators, when necessary;

Table 9-2.—Abbreviations and Symbols for Message Punctuation

PUNCTUATION	ABBREVIATION	SYMBOL
Question Mark	QUES	?
Hyphen		-
Colon	CLN	:
Parentheses/Brackets	PAREN	( )
Period/Full Stop	PD	.
Comma	CMM	,
Slant/Oblique Stroke	SLANT	/
Paragraph	PARA	NONE
Quotation Marks	QUOTE-UNQUOTE	NONE

Table 9-3.—Teleprinter Message Format

	FORMAT LINE	EXPLANATION	
Call	2	Designation of station(s) called; (prosign XMT, exempted calls)	Contains description of the station(s) called; the prosign XMT and designation of exempted station(s). Line 2 may also contain the repeated precedence prosign. (Lines 2 and 3 may appear as a single typed line)
	3	Prosign DE; designation of station calling; transmission identification (station serial number)	The prosign DE; the designation of the calling station and the transmission identification (station serial number). (Lines 2 and 3 may appear as a single typed line)
Transmission instructions	4	Prosign T; operating signals; address designations; routing indicators	Contains the transmission instructions and will be identified by the appearance of the prosign T, operating signals, address designations; routing indicators as required
Precedence: date-time group; message instructions	5	Procedence prosign; date and time expressed in digits, and zone suffix followed by month indicated by the first three letters, and, if required, by national authorities, the year indicated by the last two digits; operating signal(s)	Will contain the appropriate procedence prosign once and, in the case of dual precedence, both will be shown separated by a space, the originator's date-time group and message instructions in the form of operating signals as necessary
Originator's sign; originator	6	Prosign FM; originator's designation	Is identified by the appearance of the prosign FM and contains the designation of the originator, which may be indicated by plain language, call sign, or address group
Action addressee sign; action addressee	7	Prosign TO; address designation(s)	Is identified by the appearance of the prosign TO and contains the designation of the action addressee(s) in the form of plain language, address group(s), call sign(s); or routing indicators
Information addressee sign; information addressee	8	Prosign INFO; address designation(s)	Is identified by the appearance of the prosign INFO and contains the designation of the information addressee(s) in the form of plain language, address group(s), call sign(s); or routing indicators. A collective designation or an Address Indicating Group (AIG) in format line 7 may include information addressees

Table 9-3.—Teleprinter Message Format—Continued

	FORMAT LINE	EXPLANATION	
Exempted addressee	9	Prosign XMT; address designation(s)	Is identified by the prosign XMT and contains the designation of the addressee(s) who is/are exempted from the collective address designation, when such designation is employed in lines 7 and 8 or an AIG is used in format line 7
Accounting information; group designation	10	Accounting symbol; group count; program designator code (PDC)	Is identified by the appearance of the group count prosign, accounting symbols (as required), which precede the group count prosign, and the appropriate PDC
	11	Prosign BT	Separates the heading of the message from the text
Subject matter	12	Internal instructions; thought or idea expressed by the originator	Is the text of the message and may contain internal instructions as well as the thought or idea expressed by the originator
	13	Prosign BT	Separates the text from the ending of the message
Time group	14	Hours and minutes expressed in digits and zone suffix	May contain a time group expressed in digits plus the zone suffix
Confirmation (as required)		Prosign CFN; confirmatory material	May contain the prosign CFN and confirmed portions of the message as necessary
Corrections filing time; final instructions	15	Prosigns, operating signals; necessary corrections; date separated by slant from hours and minutes expressed in digits; plus zone suffix	Is identified by the appearance of prosign C, operating signals, and corrections as required; may contain the date and time message was filed with the communications center; final instructions in the form of prosigns B; AS; and station designation(s)
Ending sign	16	Prosign K; AR	Is identified by the prosign K or AR as appropriate

- For "pilot cards" containing special-handling instructions in data communications; and
- For use in several AUTODIN modes of operation in accordance with *Automatic Digital Network (AUTODIN) Operating Procedures*, JANAP 128.

An example of a correctly prepared transmission identification line (format line 1) may appear as:

VZCZCJTA(FIGS)123(LTRS) (2CR, 1LF)

The letter V ensures that the first character of following intelligence is not lost or garbled. The letters ZCZC indicate the start of the message. The letters JTA are the station/channel designator, and the three-digit number is the sequential number of the transmission. Notice that no spaces are allowed in format line 1, and this line must be error-free.

For tape relay procedures in the AUTODIN system, instructions in format line 1 are contained in JANAP 128. You can also find detailed usages of format line 1 concerning tape relay procedures in *Communications Instruction, Tape Relay Procedures,* ACP 127.

BASIC TELEPRINTER OPERATING INSTRUCTIONS

Basic manual teleprinter procedures are similar to basic R/T procedures or to CW procedures to those who send CW. The main difference between R/T and teleprinter procedures is the use of abbreviated equivalents of prowords, operating signals, and separative functions. For example, instead of using the proword INTERROGATIVE, you would type INT. Instead of using the expression THIS IS, you would type DE.

You should remember that manual teleprinter procedures are exactly that—manual. We will assume that you are operating a teleprinter keyboard that is transmitting traffic to receiving stations. Just as in radiotelephone, radioteleprinters have certain procedures and requirements that are necessary for proper circuit discipline and security. In the next paragraphs, we will discuss the basic operating instructions that are essential to proper manual communications.

MANUAL CALLING AND ANSWERING

Establishing communications on a teleprinter normally requires a preliminary call. Preliminary calls may be single, collective, or multiple. A ship or station may also use radio call signs, international call signs, tactical call signs, collective call signs, net call signs, address groups, or theater routing indicators.

Net Control Station

Just as there is a Net Control Station (NECOS) in a radiotelephone net, teleprinter nets also have a NECOS to ensure positive and continuous circuit discipline. The most senior command or unit is normally NECOS. On ship-shore circuits, the NCTAMS or NAVCOMMTELSTA assumes the duties as NECOS. Some of the responsibilities NECOS is charged with are:

- Expediting traffic flow on the net;
- Maintaining circuit discipline;
- Limiting transmissions to the essential minimum;
- Resolving disputes incident to message handling;
- Determining procedural discrepancies and initiating corrective action; and
- Conducting a roll call of stations after each frequency shift.

NECOS opens the net with the initial transmission of:

- ALL STATIONS THIS NET (YAPD);
- Identification of NECOS (DE ZKA);
- Net operation (free or directed) (ZKB);
- Order for answering—turn number (ZGB);
- Any other special instructions (ZWC);
- Querying units for number and precedence of messages they need to send (INT ZBO); and
- Assigning turns to each unit with messages to transmit in order of precedences (QRY ___).

Calling

The most common type of call is the single call, usually made on a ship-to-ship or ship-to-shore ORESTES net. A single call consists of the identification of a single station or a collective call sign representing more than one station. The identification or collective call sign of the station is followed by the prosign DE, the call sign of the station calling, and the prosign K. Both a single and a collective call are shown in examples A and B as follows:

Example A: (Single Station)

(5SP, 2CR, 1LF)

NNBD DE NFSK K (2CR, 1LF)

Example B: (Collective Call) In this example, the call sign HZDQ represents a collective of several stations. The prosign XMT may be used with a collective call sign as follows:

(5SP, 2CR, 1LF)

HZDQ XMT NJFK NMNU DE NFSK K (2CR, 1LF)

Those stations that are a part of HZDQ and not exempted would then answer in alphabetical order just as in R/T procedures.

A multiple call consists of the transmission identification of the stations called, the prosign DE, the identification of the station calling, and the prosign K. The station designations preceding the prosign DE are arranged alphabetically in the order in which they are to answer.

The station designations of a multiple call should also be arranged in proper procedural form. Because of this, the "/" (slash) is considered to be the 27th letter of the alphabet. Arabic numerals 1 through 0 are considered to be the 28th through the 37th letters of the alphabet.

When making multiple calls, you must use care to avoid separating groups of related call signs or conjunctive address groups that are interdependent. The following example is a call that is NOT interdependent:

(5SP, 2CR, 1LF)

NFSK NNBD NOKB DE NJFK K (2CR, 1LF)

The stations would then answer in the order called.

When multiple calls are made in which there are both action and information addressees, the information addressees must be indicated. This is done with the operating signal ZFH2, followed by the designation of the information addressees. For example:

(5SP, 2CR, 1LF)

NFSK NNBD NOKB DE NJFK (2CR, 1LF)

ZFH2 NNBD NOKB (2CR, 1LF)

When all addressees are information, the procedure is as follows:

(5SP, 2CR, 1LF)

NFSK NNBD NOKB DE NKFK (2CR, 1LF)

ZFH2 (2CR, 1LF)

Answering

In answering a preliminary call, the called stations answer by transmitting the identification of the calling station, the prosign DE, the called station's identification, and the prosign K. For example, NOKB calls NFSK:

(5SP, 2CR, 1LF)

NFSK DE NOKB K (2CR, 1LF)

NFSK then answers:

(5SP, 2CR, 1LF)

NOKB DE NFSK K (2CR, 1LF)

After the preliminary calls and answers have been completed, remember that the transmitting station must send 2CR and 8LF prior to transmitting a message. You should also be aware that, as in radiotelephone procedures, abbreviated calls may be made if no confusion will result or if two stations are in direct contact with each other. For example, NFSK may have responded:

(5SP, 2CR, 1LF)

DE NFSK K (2CR, 1LF)

If a station fails to answer in proper sequence when a collective or multiple call is used, the next station waits 5 seconds and then answers. The station that failed to answer must then wait to answer until all other stations have answered or have had time to answer.

When a station fails to answer in sequence and then fails to answer within 5 seconds after all other stations have answered, the calling station should initiate a separate call to the delinquent station. When any station included in a collective or multiple call is specifically directed to answer, no other station included in that call may answer until instructed to do so.

CIRCUIT TEST

If a circuit is experiencing communications difficulties or has just been opened, a test may be transmitted as follows:

(5SP, 2CR, 1LF)

NOKB DE NNBD (2CR, 1LF)

TEST THE QUICK BROWN FOX
JUMPS OVER THE LAZY DOG
1234567890 (2CR, 1LF)

RYRYRYRYRYRYRYRYRYRYRY
RYRYRYRYRY (2CR, 1LF)

K (2CR, 8LF)

The called station (NOKB) would then respond with an answer that includes an appropriate operating signal to indicate the quality of reception. For example:

(5SP, 2CR, 1LF)

DE NOKB QRK 5 K (2CR, 1LF)

TRANSMISSION ENDING

Every transmission must end with the prosign K or AR. (AR means "Nothing further for you, out.") When a transmission ends with the prosign AR, the transmitting station is telling the called station(s) that no response is expected. However, depending upon the situation, this does not preclude a request for repetitions or verifications, if needed.

In duplex operation, the transmitting station should not interrupt a message being transmitted except to respond to received messages of IMMEDIATE precedence or higher. In this case, the precedence must be higher than that of the message being transmitted.

Sometimes a station may have two or more messages to send. The station operator may elect to send the messages one after another without pausing. As we mentioned earlier, messages grouped in one transmission is called a string of messages. The receiving station should attempt to respond (receipt, request retransmission, and so forth) to each message as it is received.

MESSAGE PRECEDENCE

You will recall that the message originator is responsible for assigning the message precedence. The originator determines the message precedence by the subject matter of the text and the time factor within which the message must be handled. Precedence designations indicate to communications personnel and addressees the priority in which messages should be handled.

As you learned in chapter 6, the appropriate precedence prosign (Z, O, P, R) indicates message precedence. The precedence designator is the first element of format line 5. Precedence prosigns indicate the following:

- To the originator—The required speed of delivery to the addressee;
- To communications personnel—The order of message handling and delivery; and
- To the addressee—The order in which the message should be handled.

As you know, messages having both action and information addressees may be assigned two precedences. In dual-precedence messages, the higher precedence for the action addressees appears first in format line 5. The lower precedence for the information addressees follows the first precedence separated by a space. For example, NFSK has a dual-precedence message for NOKB and NNBD:

```
(5SP, 2CR, 1LF)
NOKB NNBD DE NFSK          (2CR, 1LF)
O P 101010Z NOV 93         (2CR, 1LF)
FM NJFK                    (2CR, 1LF)
TO NOKB                    (2CR, 1LF)
INFO NNBD                  (2CR, 1LF)
(Rest of message)          (2CR, 8LF)
NNNN (12LTRS)
```

In this example, format line 5 indicates that the message is IMMEDIATE traffic for NOKB and PRIORITY traffic for NNBD.

Precedence may be included in the preliminary call by including the appropriate precedence prosign before the ending prosign. For example, NFSK calls NNBD:

```
(5SP, 2CR, 1LF)
NNBD DE NFSK O K           (2CR, 1LF)
```

This example indicates that NFSK has IMMEDIATE traffic for NNBD. You should remember that the bell signal is always transmitted before and after the FLASH precedence prosign in a preliminary call, followed by the prosign K. For example, NOKB has FLASH traffic for NFSK:

```
(5SP, 2CR, 1LF)
NFSK DE NOKB (FIGS) JJJJJSSSSS
(LTRS) Z (FIGS) JJJJJSSSSS
(LTRS) K                   (2CR, 1LF)
```

A sending station may want to send a string of messages that are of different precedences. The station may use the operating signal (OPSIG) ZBO in the initial call, followed by the number of messages and their precedence. The OPSIG ZBO means "I have (or __ has) __ message(s) of __ precedence(s) for you (or for . . .). (We discuss OPSIGs later in this chapter.) For example, let's assume that NOKB has three messages of different precedences to send to NFSK. NOKB's preliminary call to NFSK would be as follows:

```
(5SP, 2CR, 1LF)
NFSK DE NOKB ZBO3 O P R K  (2CR, 1LF)
```

This preliminary call indicates to NFSK that NOKB has three messages that are outstanding (ZBO3) and their precedences are IMMEDIATE (O), PRIORITY (P), and

ROUTINE (R). NOKB then sends the string of messages in the order of precedence.

BREAK-IN PROCEDURE

Sometimes it is necessary for a receiving station to use the break-in procedure to interrupt the transmitting station. When the receiving station breaks in, it is because the station has a higher precedence message to send or because of equipment or receiving difficulties.

You should remember that FLASH and IMMEDIATE traffic may interrupt traffic of lower precedence. PRIORITY traffic, however, should not interrupt ROUTINE traffic unless the ROUTINE traffic is of excessive length. All precedences are transmitted in the order received, and, of course, higher precedence traffic is transmitted ahead of lower precedence traffic.

On simplex circuits where only one station can talk at a time, to stop the transmitting station, the break-in station transmits a series of hyphens as follows:

(FIGS) A (FIGS) A (FIGS) A . . . and so on

On the keyboard, the hyphen key is the upper case of the letter A key. Pressing the FIGS key shifts the keyboard to the upper case.

The transmitting station must be informed of the reason for the interruption, if practicable. For example, if the break-in station has higher precedence traffic, the station notifies the transmitting station, then sends the higher precedence traffic. After the interruption, the transmitting station should resume transmission at the beginning of the line of copy where the interruption was made. If necessary, the transmitting station may retransmit the entire message.

CORRECTIONS

To prevent extreme delays in the receipt of traffic, an operator must have a thorough knowledge of proper correction techniques. There are several methods of correcting errors that an operator can use during manual transmission. The location of the error determines the correct method. For instance, if an operator makes an error in the text of a message, the operator sends the error prosign EEEEEEEE (eight Es) after the incorrect word. The operator then resumes transmission by repeating the last word or group transmitted correctly. For example, "CHECK TWO FOUR SUBRAEEEEEEEE FOUR SUBMARINE FRANCIS SCOTT KEY." Notice there are no spaces between the Es when used to correct any part of a message.

If the operator makes an error in the message heading, the operator sends the error prosign followed by the last prosign or OPSIG correctly sent. For example, assume that the operator makes an error in format line 8 (INFO addee):

	(2CR, 1LF)
TO COMSUBRON SIXTEEN	(2CR, 1LF)
IFNOEEEEEEEE	(2CR, 1LF)
TO COMSUBRON SIXTEEN	(2CR, 1LF)
INFO COMSUBFLOT EIGHT	(2CR, 1LF)
(Rest of message)	(2CR, 8LF)
NNNN (12LTRS)	

When errors are made in preparing tape, the operator corrects them by backspacing the tape and "lettering out" the errors using the LTRS key. The LTRS key punches all five-character columns on the cut tape. This action prevents a letter or number from printing when the letter functions pass through the transmitter-distributor (TD).

When errors are made in the heading of a message while cutting a tape for transmission, the operator must prepare a new tape. This is necessary because error-free and sequence-perfect headings are mandatory so that the tape can be passed through automatic relay systems.

End-of-Message Corrections

If you discover that an error was made earlier in the transmission but not corrected, you can correct the error at the end of the message. The correction is made in format line 15 after the final BT. The prosign C is the first element in this format line. The procedure is similar to the "word after" and "word before" procedures you learned in Chapter 8, "Radiotelephone Procedures." For example, let's assume that while transmitting a message, the operator discovers an error in the text and wishes to correct it at the end of the message. The operator makes the correction as follows:

(. . . text of message . . . .)	(2CR, 1LF)
BT	(2CR, 1LF)
C WA SUBMARINE-FORCE	(2CR, 1LF)
K	(2CR, 8LF)
NNNN (12LTRS)	

In this example, the transmitting operator corrected the word after (WA) "submarine" to read "force," and sent the equivalent of phonetic "over" (K). The operator ended the transmission with the proper ending procedure of 2 carriage returns, 8 line feeds, 4 Ns, and 12 LTRS. The receiving operator would then either "Roger" for the message (R AR) or request further disposition by using the appropriate operating signal.

Corrections to Multiple-Page Messages

To correct a multiple-page message, the operator transmits the corrections at the end of the page where the errors appear. At this point, the operator sends (2CR, 1LF), uses the prosign C, then transmits the correction, as in our last example. After transmitting the corrections, the operator sends the end of the page functions (2CR, 4LF). The operator then sends the next page of the message.

After sending the last page of a multiple-page message, the operator ends the transmission with the normal message ending and machine functions. When the operator does not discover an error prior to transmitting another page, the error should be corrected at the end of the message.

Requests for Repetitions

When receiving stations request repetitions or corrections, they must provide sufficient transmission identification. For example, if a word or group occurring more than once in a message is used to identify a part of a correction request, the transmitting station will assume that the first occurrence of that word or group is implied.

If the first occurrence is not intended, the requesting station must include amplifying data, such as adjacent words or groups. For example, assume that "COMSUBLANT" is used frequently throughout the text of a message. The receiving operator discovers that the word following one usage of COMSUBLANT is garbled and the next readable word is TRIDENT. If the operator simply asks for the word after (WA) COMSUBLANT, the transmitting operator would not know which COMSUBLANT was referenced. The transmitting operator would, therefore, send the word after the first appearance of COMSUBLANT in the text. The receiving operator's request would be better served in the following form:

(5SP, 2CR, 1LF)

NOKB DE NFSK IMI WB TRIDENT K (2CR, 1LF)

In this example, NFSK is asking NOKB to repeat (IMI) the word before (WB) TRIDENT in the text of the message. The receiving operator saved time by requesting the word before TRIDENT rather than having to amplify further a "word after" COMSUBLANT request.

Notice the usage of the operating signal IMI in the preceding example. IMI means "repeat" and is used when a station desires a repetition of a particular message part. If NFSK desired a repetition of the TO to INFO message components, the repetition request would be as follows:

(5SP, 2CR, 1LF)

NOKB DE NFSK IMI TO TO INFO K (2CR, 1LF)

If NFSK wanted to request a repetition of the eighth group of an encrypted message, the request would be as follows:

(5SP, 2CR, 1LF)

NOKB DE NFSK IMI 8 K (2CR, 1LF)

If NFSK wanted to request a repetition of the entire encrypted message after the eighth group, the request would be as follows:

(5SP, 2CR, 1LF)

NOKB DE NFSK IMI AA 8 K (2CR, 1LF)

Repetitions Involving BT

You should remember that the separative sign "BT" appears twice in the format of a normal message. It is assumed, therefore, that repetition requests involving BT usually refer to the first BT. For example, assume that NFSK sends the following transmission:

(5SP, 2CR, 1LF)

NOKB DE NFSK IMI AB BT K (2CR, 1LF)

In this example, NOKB may assume that NFSK is requesting repetition all before (AB) the first BT. NOKB would then retransmit the entire heading to NFSK.

If NFSK wanted the entire text repeated, the transmission would be as follows:

(5SP, 2CR, 1LF)

NOKB DE NFSK IMI BT TO BT K (2CR, 1LF)

This would indicate to NOKB that NFSK wanted the text only (format line 12) and needed no information that might have been sent after the second BT (format lines 14, 15, and 16). If NFSK wanted both the text and the substance of format lines 14, 15, and 16, the transmission would be as follows:

(5SP, 2CR, 1LF)

NOKB DE NFSK IMI AA BT K (2CR, 1LF)

NOKB would then retransmit everything after the first BT. A situation such as this could arise when there are so many garbles in the received copy that it would be more time consuming to use the "word after" or "word before" procedure than to simply repeat the entire text and remaining format lines.

Subject to Correction (SUBCOR) Messages

Occasionally, corrections and repetitions cannot be obtained immediately. Messages received with missing portions or portions of doubtful accuracy should be delivered or forwarded subject to correction (SUBCOR) if the precedence is IMMEDIATE or higher or the operational situation dictates.

In local delivery and routing, the missing or doubtful portions should be indicated by appropriate notation on the face of the message. You must use discretion when forwarding or delivering transmissions that are so garbled as to be of no value. The station delivering or forwarding a message that is subject to correction is responsible for obtaining and forwarding corrections.

Verifications

Verification requests should be initiated only by addressees and may be in the form of a service or regular message. New messages or service messages requesting verification are sent only if the message in question has already been receipted for. On a manual TTY circuit, verifications can be requested on a real-time basis as the need arises. The prosign J (verify with the originator and repeat) can be used in much the same way as the prosign C or the operating signal IMI. For example, assume that NFSK wants a verification of the words "SUBNOTE REQUEST" from a line in the text that reads: "COMSUBLANT REQUESTS SUBNOTE REQUEST PROCEDURES BE IMPLEMENTED." The request for verification would be as follows:

(5SP, 2CR, 1LF)

NOKB DE NFSK J REQUESTS TO
PROCEDURES K (2CR, 1LF)

After checking with the originator and verifying that the textual words in question are correct as previously transmitted, NOKB would send:

(5SP, 2CR, 1LF)

NFSK DE NOKB J REQUESTS
TO PROCEDURES SUBNOTE
REQUEST K (2CR, 1LF)

NFSK would then end the exchange with:

(5SP, 2CR, 1LF)

NOKB DE NFSK R AR (2CR, 1LF)

CANCELLATIONS

A transmission, whether it be a message or direct communications with a station, can be canceled by using the error prosign E E E E E E E E (eight spaced Es) and the ending prosign AR. For example, if you are transmitting a message and discover that the transmission is in error, the proper method of cancellation is as follows:

AND PROCEED TO POINT (2CR, 1LF)

E E E E E E E E AR (2CR, 1LF)

The error prosign and AR cannot be used to cancel a transmission after a receipt has been given. For this purpose, a class A message containing appropriate operating signals must be used. A station canceling a transmission is responsible for any further action necessary in connection with the message involved.

COUNTING AND CHECKING GROUPS

Confusion often results if an operator is not familiar with the basic rules concerning the counting of message groups. The basic rules are as follows:

- Count text groups only.
- Punctuation and symbols are not counted unless spelled out or abbreviated.
- A sequence of characters that are not separated by a space is counted as one group.
- The letter X is counted as one group when used instead of punctuation.
- The proper names of countries, cities, or streets consisting of two or more separate words may be written and counted as one group. For example, NEWLONDON, SANDIEGO, SALTLAKECITY, but when the words are written separately, they should be transmitted and counted as separate groups.

The following example text is counted as 20 groups:

SHIPMENT MARKED TWENTY HYPHEN ONE SHOULD HAVE BEENMARKEDTWENTY-ONE. FUTURESHIPMENTSFORPAREN SANDIEGO PAREN SHOULD BE MARKED (SANDIEGO)PERIOD.

Here is how the above example text is counted:

	Group Count
TWENTY HYPHEN ONE	3
TWENTY-ONE	1
(SANDIEGO)PERIOD	1

All the other words in the text are counted separately for a total group count of 20.

Checking Group Count

There are several methods of checking the group count of a message. One method is by using the operating signal IMI, which, as we stated earlier, means "repeat." For example, if an operator wants the ninth group of a message repeated, the request would be as follows:

(5SP, 2CR, 1LF)

(Station called) DE (Station calling)

IMI GR9 K (2CR, 1LF)

In this example, the calling station is requesting that the ninth group be repeated.

Another method is by using the operating signal INT preceding the group symbol GR. When a calling station uses this format, the exchange is assumed to be in the form of a question, meaning "Is the number of groups correct as indicated?" For example, NFSK would verify the group count received as follows:

(5SP, 2CR, 1LF)

NOKB DE NFSK INT GR9 K (2CR, 1LF)

If NOKB checks and finds the group count correct as transmitted, the prosign C would be used as follows:

(5SP, 2CR, 1LF)

NFSK DE NOKB C K (2CR, 1LF)

For another example, assume that NOKB transmits a message with a group count as GR9 (meaning that the message has nine textual groups). Upon receiving the message, NFSK finds that the number of groups received does not correspond to the group count transmitted. NFSK would question the validity of the group count with the following transmission:

(5SP, 2CR, 1LF)

NOKB DE NFSK INT GR10 K (2CR, 1LF)

In this case, NOKB rechecks the message it transmitted and finds that the NFSK check of the group count is correct. NOKB uses the prosign C to verify the NFSK group count:

(5SP, 2CR, 1LF)

NFSK DE NOKB C K (2CR, 1LF)

Essentially, NFSK asked NOKB, "Is the group count correct as received?" NOKB responded, saying "That is correct." The primary difference between the operating signals IMI and INT is that IMI asks for a repeat, whereas INT makes the entry in the form of a question. Verification of groups is important, since errors can be made at both ends.

Checking Messages under 50 Groups

For plain language and encrypted text messages under 50 groups, the transmitting station (NOKB) repeats the original group count and the first character of each word or groups in the text when responding to an INT. For example, assume that NOKB makes the following transmission to NFSK:

(5SP, 2CR, 1LF)

NFSK DE NOKB (2CR, 1LF)

R 151015Z NOV 93 (2CR, 1LF)

GR9 (2CR, 1LF)

BT (2CR, 1LF)

YOUR SORTIE REQUEST
APPROVED IAW COMSUBLANT
OPORD APPLICABLE ANNEX (2CR, 1LF)

BT (2CR, 1LF)

K (2CR, 8LF)

NNNN (12LTRS)

NFSK then questions the group count:

(5SP, 2CR, 1LF)

NOKB DE NFSK INT GR8 K (2CR, 1LF)

NOKB checks and finds the group count to be correct as transmitted, then transmits:

(5SP, 2CR, 1LF)

NFSK DE NOKB GR9 BT
Y S R A I C O A A BT K (2CR, 1LF)

Checking Messages over 50 Groups

For group count checks on plain text messages of over 50 groups, the procedure is the same as that discussed for messages of under 50 groups. For encrypted text messages with a group count of over 50 groups, however, the transmitting station repeats the original group count and repeats the first letter of the 1st, 11th, and every 10th group following them. For example, assume that NFSK sends the following INT request to NOKB after NOKB has completed transmitting a 76-group encrypted message:

(5SP, 2CR, 1LF)

NOKB DE NFSK INT GR76 K (2CR, 1LF)

NOKB checks and finds the group count to be correct as transmitted, then transmits:

(5SP, 2CR, 1LF)

NFSK DE NOKB GR76 BT 1-R
11-M21-C 31-S 41-S 51-S 61-D
71-R BT K (2CR, 1LF)

Using the preceding method, the receiving station can check to see if the sequence of groups has been received correctly. After transmitting the 1st, 11th, and subsequent group letters, the receiving station can then find where the error lies and can send a request for repetition of the 10 groups in which there has been a miscount during reception. For example:

(5SP, 2CR, 1LF)

NOKB DE NFSK IMI 30 to 40 K (2CR, 1LF)

An important point to remember is that the group count of the transmitting station is final.

TRANSMISSION OF MESSAGES

As you know, messages should be sent exactly as intended by the originator. When a message is transmitted, abbreviations should not be substituted for full words or full words for abbreviations without the approval of the originator.

A station receiving a message for transmission is responsible for the message until a receipt is obtained from another station or local delivery is accomplished. Messages forwarded by the broadcast services are considered received when transmitted.

You should remember that the number of characters and spaces typed on one line must not exceed 69. Sending operators should type the message in such a manner that a long word falling at the end of a line will not be hyphenated. To prevent hyphenating a word at the end of a line, you must pay strict attention to the end-of-line indicators (warning light or margin bell).

Multiple-Page Messages

Messages containing more than 20 lines of heading and text are divided into pages for transmission as follows:

- The message text in any transmission cannot exceed five pages. A page consisting of part heading and part text does not count as a textual page.
- The first page must consist of not more than 20 lines beginning with format line 5 of the message heading, and continue for a total of 20 lines.
- All succeeding pages should contain 20 lines of text, except the last page, which may contain less. (Note the similarity between TTY paging and DD-173 paging.)
- Correction (C) procedures may be used at the end of each page as necessary.
- The machine functions between pages should be (2CR, 4LF).

You should remember this important point concerning the proper paging of messages: **A page consisting of part heading and part text does not count as a textual page.** For example, the initial page contains the heading and, unless there is a long list of action and information addressees, a few lines of text. This initial page does not count as one of the textual pages because it contains both heading and textual lines. Therefore, the first textual page is the page that contains 20 typed lines of text, and does not include any element of the heading.

Long Messages

Messages that exceed five textual pages are considered long messages and, therefore, are divided into transmission sections. A transmission section cannot exceed five textual pages.

Long messages can monopolize circuit time when transmitted in their entirety. It is sometimes advisable to separate such messages into transmission sections even though they may be less than the prescribed length. Normally, messages are separated at a convenient point so as not to destroy the continuity of the message but not beyond the maximum number of five textual pages.

Each section of a sectionalized message is identified by the marking "SECTION ___ OF ___" at the beginning of the text following the security classification or the abbreviation UNCLAS, and special-handling designators, if used. The message heading is the same on each section. However, each section has a different station serial number and group count (if any) for that particular section. The final section is identified by "FINAL SECTION OF ___ ." For example, when a message is divided into two sections, the first section is identified as "SECTION 1 OF 2," and the second section is identified as "FINAL SECTION OF 2."

The second and succeeding pages of a sectionalized message are identified by the page number, the routing indicator of the station of origin, the station serial number, and the security classification. This page identification line is not counted as a line of text.

The following is an example of the correct method of numbering pages and transmission sections of a 1,600-group message:

(5SP, 2CR, 1LF)	
NBA DE NFSK NR1	(2CR, 1LF)
T	(2CR, 1LF)
O 171510Z NOV 93	(2CR, 1LF)
FM USS FRANCIS SCOTT KEY	(2CR, 1LF)
TO COMSUBGRU SIX	(2CR, 1LF)
COMSUBRON SIXTEEN	(2CR, 1LF)
COMSUBRON FOURTEEN	(2CR, 1LF)
INFO COMSUBRON EIGHTEEN	(2CR, 1LF)
GR750	(2CR, 1LF)
BT	(2CR, 1LF)
SECTION ONE OF TWO	(2CR, 1LF)
(20 lines of heading and text)	(2CR, 4LF)
PAGE TWO NFSK NR1	(2CR, 1LF)
(20 lines of text)	(2CR, 4LF)

NOTE

Succeeding pages of this transmission should follow the format shown in the preceding example. The final page is shown next.

PAGE FIVE NFSK NR1	(2CR, 1LF)
(Final lines of text)	(2CR, 1LF)
SECTION ONE	(2CR, 1LF)
BT	(2CR, 8LF)
NNNN (12LTRS)	

The second and final transmission section would appear as follows:

(5SP, 2CR, 1LF)	
NBA DE NFSK NR2	(2CR, 1LF)
T	(2CR, 1LF)
O 171510Z NOV 93	(2CR, 1LF)
FM USS FRANCIS SCOTT KEY	(2CR, 1LF)
TO COMSUBGRU SIX	(2CR, 1LF)
COMSUBRON SIXTEEN	(2CR, 1LF)
COMSUBRON FOURTEEN	(2CR, 1LF)
INFO COMSUBRON EIGHTEEN	(2CR, 1LF)
GR850	(2CR, 1LF)
BT	(2CR, 1LF)
FINAL SECTION OF TWO	(2CR, 1LF)
(20 lines of heading and text)	(2CR, 4LF)
PAGE TWO NFSK NR2	(2CR, 1LF)
(20 lines of text)	(2CR, 1LF)

NOTE

The succeeding pages of this transmission section should appear in the manner just shown. The final page is shown below.

PAGE FIVE NFSK NR2	(2CR, 1LF)
(Final lines of text)	(2CR, 1LF)
SECTION TWO	(2CR, 1LF)
BT	(2CR, 1LF)
K	(2CR, 8LF)
NNNN (12LTRS)	

In the above example, notice that the text was conveniently broken down into 750 and 850 groups, respectively. Notice also that each transmission section has a separate station serial number, although the date-time group and addressees remained the same.

USE OF OPERATING SIGNALS

Operating signals (OPSIGs) are three-letter groups, sometimes followed by a numeral, which begins with the letter Q or Z. OPSIGs are used as brevity codes to express various common phrases used in communications. Any of the signals in the series QAA to QNZ and QRA to QUZ and the series ZAA to ZXZ may be used in service messages required for tape relay operations. Because they perform essential triggering functions in automatic equipment, only Z OPSIGs may be used in format line 1. Table 9-4 lists a few common OPSIGs, along with prosigns, used in teleprinter communications.

Communications Instructions, Operating Signals, ACP 131, and *Communications Instructions, Operating Signals,* ACP 131 US SUPP-1, list all the authorized OPSIGs and their meanings.

USE OF COMMON PROSIGNS

Proper usage of common prosigns saves circuit time and expedites traffic-handling procedures. This makes it important for TTY operators to have a good knowledge of the most frequently used prosigns and their definitions.

Prosigns AA, AB, and AS

The prosign AA (all after) identifies requested portions of a message. It is normally used after the prosigns IMI, C, and J. For example:

(5SP, 2CR, 1LF)	
DE NFSK IMI AA BT K	(2CR, 1LF)

The prosign AB (all before) is used in the same manner as AA.

The prosign AS (wait) may be used alone or with the ending prosign AR. When used alone, AS indicates a short pause from the transmitting operator. AS, followed by AR, means "You are to wait" or "I am obliged to wait," as applicable. An example of the prosign AS used alone is:

(5SP, 2CR, 1LF)	
NOKB DE NFSK	(2CR, 1LF)
R 221035Z NOV 93	(2CR, 1LF)
GR15	(2CR, 1LF)
BT	(2CR, 1LF)
MOOR PORT SIDE	(2CR, 1LF)
AS	(2CR, 1LF)

In this example, since AS is used without an ending prosign, this tells the receiving operator that there will be a short pause before the next transmission. If, however, this transmission ended with an AS AR, it would tell the receiving operator that the wait will be longer than a short pause. In any event, the receiving station is to wait for either a K or an AR before transmitting. An exception to this rule applies anytime the receiving station has a message of higher precedence to transmit. In this case, the receiving station should use the break-in procedure.

Prosign B (More to Follow)

The prosign B means there is more traffic to follow. For example:

(5SP, 2CR, 1LF)	
NOKB DE NFSK	(2CR, 1LF)
R 221330Z NOV 93	(2CR, 1LF)
FM USS FRANCIS SCOTT KEY	(2CR, 1LF)
TO USS ABRAHAM LINCOLN	(2CR, 1LF)
BT	(2CR, 1LF)
(Text)	(2CR, 1LF)
BT	(2CR, 1LF)
B	(2CR, 1LF)
K	(2CR, 8LF)
NNNN (12LTRS)	

In this example, NFSK uses the prosign B to indicate that it has more traffic to send.

Let's assume that NFSK has traffic to send to NOKB. Using our example above, NFSK receipts for the message and indicates to NOKB that it has priority traffic to send by using the prosign B as follows:

(5SP, 2CR, 1LF)	
NOKB DE NFSK R B P K	(2CR, 4LF)

In this situation, a precedence prosign (except the prosign R) may be used.

The prosign B, followed by a numeral, means "More to follow, total number of groups transmitted thus far is as indicated." For example, if NFSK were transmitting a 190-group message to NOKB, the procedure would be as follows:

(5SP, 2CR, 1LF)	
NOKB DE NFSK	(2CR, 1LF)
R 221345Z NOV 93	(2CR, 1LF)
GR190	(2CR, 1LF)
BT	(2CR, 1LF)
(First 100 groups)	(2CR, 1LF)
B 100	(2CR, 1LF)
K	(2CR, 4LF)

In this example, NFSK indicates to NOKB that the number of groups sent thus far is 100 and that there is more to follow. The K indicates that NOKB must respond either by receipting for the message or by requesting repetitions. It is standard circuit procedure to pause at the end of each 100 groups to allow the receiving station time to request repeats, corrections, and so forth.

Table 9-4.—Prosigns and Operating Signals

PROSIGN	OPSIG	EXPLANATION
—	QSL	Acknowledge receipt of messages
—	ZEV	Acknowledge transmission
AA		All after
AB		All before
—	ZGO	Answer After—"You are to answer after call sign ____when answering transmissions"
—	ZKD	Assume control—"You are to assume control of this net until further notice"
—	INT ZNB	Authenticate—"You are to reply to the challenge which follows"
—	ZNB	Authentication is—"The transmission authentication of this message is ____"
AR		End of transmission—"This is the end of my transmission to you and no response is required or expected"
AS	ZUJ	Wait— 1. AS made during a transmission and without an ending sign indicates a pause for a few seconds. 2. AS followed by AR indicates "You are to wait" or "I am obliged to wait," as applicable
B		More to follow
BT		Long break—Indicates the separation of the text from other portions of the message or portions indicated
C		1. "C" alone means "You are correct." 2. "C" followed by identification data means "This is a correct version of the message or portions indicated." 3. Always used when replying to prosign J
CFN		Confirmation—"The following confirms a portion of the text"
DE		From—"This transmission is from the station whose designation follows"
EEEEEEEE		1. Error—A succession of eight E's indicates that an error has been made. This error sign will be followed by the last word, group or prosign that was correctly transmitted. 2. Disregard this transmission—A succession of eight E's with spaces between. This prosign must not be used to cancel any message that has been completely transmitted and for which receipt or acknowledgement has been received
F		Do not answer—"Stations called are not to answer this call or receipt for this message or otherwise transmit in connection with this transmission"
FM		Originator's sign—"The originator of this message is indicated by the designation immediately following"
G		Repeat Back—"Repeat this entire transmission back to me exactly as received"

Table 9-4.—Prosigns and Operating Signals—Continued

PROSIGN	OPSIG	EXPLANATION
GR		Groups—GR followed by numeral(s) means "This message contains the number of groups indicated"
GRNC		Group Not Counted—"The groups in this message have not been counted"
HM HM HM		(HM made three times.) Emergency silence sign. "Silence"
—	ZKA	I am assuming—"I am assuming control of this net until further notice"
IMI		Repeat
INFO		Information addressee sign
INT		Interrogatory—Preceding OPSIGs and prosigns, indicates that the matter to follow is in the form of a question. INT preceding a portion of a message means "Is my reception of this correct?"
IX		"Action on the message or signal that follows is to be carried out upon receipt of Execute"
J		Verify and repeat—"Verify the entire message (or portion indicated) with the originator and send correct version"
K		Go ahead—"This is the end of my transmission to you and a response is necessary. Go ahead; transmit"
—	ZBO	"I have (number of) (precedence) message(s) for you"
NR		Number
O		Immediate—"The precedence of this message is IMMEDIATE"
—	ZGN	Nothing heard—"Nothing heard from you (or) (since)"
P		Priority—"The precedence of this message is PRIORITY"
R		Roger—"I have received your last transmission (or messages indicated) satisfactorily"
—	ZOK	Relay—"Relay your message through call sign ____"
R		Routine—"The precedence of this message is ROUTINE"
—	QRT	Stop sending
T	ZOF	Transmit—"Transmit this message to all addressee(s) immediately following this prosign/OPSIG"
TO		Action addressee
WA		Word after
WB		Word before
XMT		Exempt—"Addressees indicated by designation immediately following are exempted from the collective call or address designation"
Z		Flash—"The precedence of this message is FLASH"

Prosign GRNC (Groups Not Counted)

The prosign GRNC means "The groups in this message have not been counted." GRNC is included in the prefix if it is necessary to indicate that the groups have not been counted. GRNC must also be included in the prefix of messages bearing an accounting symbol when groups are not counted. An accounting symbol is used to affix financial responsibility when charges are incurred. Accounting symbols are discussed in detail in *Commercial Communications Instructions*, NTP 9.

When a group count has not been determined prior to transmission, the prosign GRNC is used in the message heading and the actual group count transmitted in the final instructions.

Prosign HM (Emergency Silence Sign)

Emergency silence may be imposed or lifted by a station only when authorized by proper authority. The prosign HM, transmitted three times, means "Cease transmissions immediately; silence will be maintained until directed to resume."

The silence transmission HM HM HM after a call means "Station(s) addressed cease all transmissions on this net immediately." After a call, HM HM HM, followed by a frequency or frequency designator, means "Station(s) addressed cease all transmissions immediately on that frequency or that indicated by a frequency designator." For example:

(5SP, 2CR, 1LF)

NSFK DE NOKB	(2CR, 1LF)
HM HM HM ZNB _______	(2CR, 4LF)

The operating signal (OPSIG) ZNB means "Authentication is _______."

Emergency silence is lifted by addressing the station(s) concerned and transmitting the operating signal meaning "negative" (ZUG) followed by HM HM HM. For example:

(5SP, 2CR, 1LF)

NFSK DE NOKB	(2CR, 1LF)
ZUG HM HM HM ZNB _______ AR	(2CR, 1LF)

Prosign T (Transmit To)

The prosign T, when used, appears in the transmission instructions. T alone means "Station called transmit this message to all addressees in the address component." (Also referred to as TARE instructions.) For example:

(5SP, 2CR, 1LF)

NOKB DE NFSK	(2CR, 1LF)
T	(2CR, 1LF)
P 221405Z NOV 93	(2CR, 1LF)
FM NFSK	(2CR, 1LF)
TO NJFK	(2CR, 1LF)
(Rest of message)	(2CR, 8LF)
NNNN (12LTRS)	

In this example, the placement of T in the transmission instructions tells NOKB to transmit the message to NJFK.

The prosign T, followed by (an) address designation(s), means "Station called transmit this message to the addressee(s) whose address designation(s) follow(s)." For example:

(5SP, 2CR, 1LF)

NOKB DE NFSK	(2CR, 1LF)
T NNBD	(2CR, 1LF)
P 221410Z NOV 93	(2CR, 1LF)
FM NFSK	(2CR, 1LF)
TO NNBD	(2CR, 1LF)
INFO NJFK	(2CR, 1LF)
(Rest of message)	(2CR, 8LF)
NNNN (12LTRS)	

In this example, NFSK is telling NOKB to transmit the message to NNBD only.

The prosign T, preceded by a call sign and followed by (an) address designation(s), means "Station whose call sign precedes T transmit this message to the addressee(s) whose address designation(s) follow(s) T." For example:

(5SP, 2CR, 1LF)

NOKB NNBD DE NFSK	(2CR, 1LF)
NNBD T NDRS	(2CR, 1LF)
NOKB T NRMC	(2CR, 1LF)
P 221430Z NOV 93	(2CR, 1LF)
(Rest of message)	(2CR, 8LF)
NNNN (12LTRS)	

In this example, NFSK is instructing NNBD and NOKB to transmit the message to NDRS and NRMC, respectively. A point to remember is that when more than one station is called and directed to relay a message, the transmission instructions for each station must appear on a separate line.

Prosign T instructions may be modified by use of the OPSIG ZWL. This signal denotes that no forwarding action is required to the addressee designation(s) that immediately follow(s) ZWL. For example:

(5SP, 2CR, 1LF)	
NOKB DE NFSK	(2CR, 1LF)
T ZWL NDRS	(2CR, 1LF)
P 221445Z NOV 93	(2CR, 1LF)
FM NFSK	(2CR, 1LF)
TO NRMC	(2CR, 1LF)
NMFO	(2CR, 1LF)
NDRS	(2CR, 1LF)
NBIB	(2CR, 1LF)
(Rest of message)	(2CR, 8LF)
NNNN (12LTRS)	

In this example, NFSK is directing NOKB to relay the message to all the addressees, except NDRS, by using the OPSIG ZWL after T and before the call sign to be exempted.

There are many uses of the various operating signals and prosigns. It would be difficult to foresee each circumstance in which they would be used. A thorough understanding of the basic rules regarding the use of these prosigns and operating signals is essential to the operators. Of course, experience is the best teacher on the proper use of prosigns and OPSIGs. It is recommended that you thoroughly read and understand ACP 126 as well as the applicable procedures outlined in fleet and force commanders' directives.

MANUAL SWITCHING SYSTEMS

Establishing and terminating connections in manual switching systems require a different procedure from that required for other methods of manual teleprinter operation. However, the procedure for handling messages through switching centrals is the same.

The differences in switchboard and teleprinter equipment used by various nations preclude a combined manual switching procedure. The manual switching procedures used by each nation are contained in the National Annex to ACP 126. When working with foreign countries, calling stations must make local arrangements to use the applicable calling and operating procedures prescribed by the nation to whose switchboard that station is connected.

There are several special abbreviations that should be understood by teleprinter operators who are part of a manual switching system. These abbreviations are as follows:

- BKD (Booked)—"Your call has been booked." Used by switchboards after "BOOK" has been requested.
- BOOK—"It is requested that this call be booked." The precedence of the message awaiting transmission should be included in the book request.
- ENGD (Engaged)—"The station called is engaged." If the called station is engaged, the calling station may then transmit "BOOK," followed by the precedence of the message awaiting transmission.
- OOO (Out of Order)—"The circuit(s) to the station called is (are) out of order."

Manual switching systems are engineered in such a manner that each station connected to a switching central switchboard can communicate with other stations connected to the same switchboard by manual cross connection or patching.

Placing Calls

A station operator calls the switchboard operator by pressing the BREAK switch for 2 seconds. When an answer is received from the switchboard operator, the originating station transmits a preliminary call indicating the station(s) with which communication is desired. This call consists of the identification of the called station(s), the prosign DE, the identification of the station initiating the call, the precedence prosign, and the prosign K. If the precedence is FLASH, five bells are sounded after the prosign K.

After the switchboard operator has completed the connection between the calling and called station(s), repeated the preliminary call, and an answer has been received by the station initiating the call, transmission of traffic will begin. Traffic is transmitted in the same manner as if there were no switchboards involved.

Recalling and Disconnection

During a connection, the switchboard operator may be recalled by pressing the BREAK switch for 2 seconds. When an answer is received from the switchboard, the recalling station should immediately transmit the reason for the recall.

When the station that initiated the call is ready to terminate the connection, the station recalls the switchboard by transmitting a 2-second break. To terminate the connection, the calling station transmits the prosign DE, the station identification, and the prosign AR.

Occasionally, switching arrangements cannot be made through existing trunk connections or are not considered practicable for further switching. In this event, the message(s) is (are) "tabled out," that is, passed to a local repreforator or teleprinter for onward transmission.

SUMMARY

It is essential that operators be well trained in communications procedures, competent in their responsibilities, and able to maintain circuit discipline. A manual teleprinter net is similar to a radiotelephone net in that chaos usually results when proper operating procedures are not followed. Reliability, security, and speed are reduced when prescribed procedures are not maintained.

RECOMMENDED READING LIST

NOTE

Although the following references were current when this TRAMAN was published, their continued currency cannot be assured. You therefore need to ensure that you are studying the latest revisions.

Communications Instructions, Tape Relay Procedures, ACP 127(G), Joint Chiefs of Staff, Washington, D.C., November 1988.

Communications Instructions, Tape Relay Procedures, ACP 127 US SUPP-1(H), Joint Chiefs of Staff, Washington, D.C., May 1984.

Communications Instructions, Teletypewriter (Teleprinter) Procedures, ACP 126(C), Joint Chiefs of Staff, Washington, D.C., May 1989.

Navy Training Plan, Navy Standard Teleprinter AN/UGC-143A(V), NTP E-70-8409A, Chief of Naval Operations, Washington, D.C.

Teleprinter Set AN/UGC-143A(V), Commander, Space and Naval Warfare Systems Command, Washington, D.C., March 1989.

CHAPTER 10

AUTOMATED SYSTEMS

CHAPTER LEARNING OBJECTIVES

Upon completing this chapter, you should be able to do the following:

- *Discuss ashore automated telecommunications systems.*
- *Describe fleet communications systems.*
- *Explain automated voice communications systems.*

Telecommunications capabilities are continually advancing as technology improves. Because of advances in technology, we are seeing great improvements in the quality and speed of communications, and an increase in our information transfer capabilities. The Navy's modern automated systems greatly reduce writer-to-reader times in message handling, and the volume of messages that can be processed is steadily increasing.

In the first part of this chapter, we will discuss the automated systems used at shore stations. Next, we will cover the automated systems used aboard afloat commands. Finally, we will address automated voice communications.

ASHORE AUTOMATED TELECOMMUNICATIONS SYSTEMS

Two new shore command systems that are coming on-line in the 1990s are the Navy Standard Teleprinter Ashore (NSTA) and the Manual Relay Center Modernization Program (MARCEMP). We will discuss these two new systems as well as the other in-place automated shore systems and their interface components.

NAVY STANDARD TELEPRINTER ASHORE

With the introduction of the Navy Standard Teleprinter (NST) at afloat commands, there was a need to replace antiquated communications systems ashore with a system compatible with the NSTs. To meet this need, the Navy has developed the Navy Standard Teleprinter Ashore (NSTA) program.

The heart of the NSTA program is the Personal Computer Message Terminal (PCMT) and its associated software. The PCMT (figure 10-1) is a PC-based microcomputer that has replaced the shore-based teletypewriters (TTYs), card readers/punches, paper tape readers/punches, and the optical character readers (OCRs). The PCMT is a major step toward modernizing the entire Naval Telecommunications System.

PERSONAL COMPUTER MESSAGE TERMINAL

The Personal Computer Message Terminal (PCMT) is a remarkable military message-processing software package that runs on a combination of IBM-compatible PC- or AT-class desktop microcomputers and input/output devices called bus

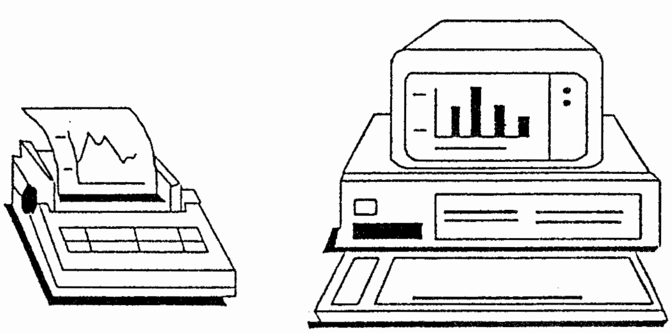


Figure 10-1.—Personal Computer Message Terminal (PCMT) with printer.

interface units (BIUs). The PCMT has the following advantages:

- For sites having a message relay requirement, the PCMT system eliminates handling torn paper tape.
- For small naval telecommunications centers (NTCs), the PCMT provides a sophisticated, easy-to-use automated message-handling system. The system is an ideal replacement candidate for sites currently operating as Automatic Digital Network (AUTODIN) Mode V terminals or those served by DCT 2000 or small Standard Remote Terminal/Remote Information Exchange Terminal (SRT/RIXT) systems.
- For Local Digital Message Exchange (LDMX) or Naval Communications Processing and Routing System (NAVCOMPARS) subscribers that must be served remotely, the PCMT can provide an excellent, low-cost remote terminal capability. Received traffic can be reviewed at a terminal and selected messages shifted to a printer when a hard copy is needed. The system will allow the operator to compose and save any number of partially completed pro forma messages. Subsequently, these messages can quickly and easily be retrieved, completed, and sent whenever needed.
- The PCMT allows messages to be exchanged via diskette media. For users who wish to exchange AUTODIN message traffic with their own PC-based systems, the PCMT provides an excellent vehicle for doing so.

PCMT SYSTEM

The PCMT message-processing system is a store-and-forward system that provides full accountability for all messages transmitted and received. The PCMT consists of a microcomputer configured with an 84-key keyboard, monitor, hard disk, and one or two floppy diskette drives. The PCMT also includes a medium-speed printer for printing message logs and hard-copy messages when required. Bus interface units (BIUs) are required to interface between the PCMT and the automated shore systems.

The PCMT microprocessor has 640K (minimum) of random-access memory (RAM) and uses the Microsoft Disk Operating System (MS/DOS). The PCMT has a 5 1/4- and 3 1/2-inch disk drive capability. The minimum hard disk has a capacity of 10 million bytes. The hard disk varies based on software and user storage requirements. The PCMT may have either a nonremovable or removable drive, depending upon the user's security requirements.

The MS/DOS software is designed for a single workstation operation with operator-entered commands controlling the workstation. Powerful, easy-to-use message edit software will help the operator correct errors in input data from diskettes and generate messages. The monitors are monochrome except where the software has been coded to display pertinent information in color. In the next paragraphs, we will describe some of the capabilities of the PCMT.

The PCMT system assigns a message accountability number (MAN) to each complete or partial message processed. Once a MAN is assigned, the system reports each step in the processing of that message. This is done by automatically generated and on-demand log entries and on-demand message accountability reports. Message accountability reports identify all processing activity completed or pending for each message processed by the system.

The system also generates a log entry each time a complete or partial message is received, transmitted, or canceled. All messages received from or delivered to a diskette are further identified in the log entries and message accountability reports by the appropriate diskette volume identification.

The PCMT can be used to recall a specific message from the hard disk, which can be printed on an output device. The operator can recall a message by providing a message accountability number (MAN), a component identification number (CIN), or a channel service number (CSN). The operator can also recall a message with an originating station routing indicator (OSRI), station serial number (SSN), or time of file (TOF).

The PCMT also provides significant paper reduction since information on receipt and delivery of message traffic is recorded on diskettes instead of paper. The PCMT stores messages on the hard disk until the operator requests delivery. The PCMT then outputs messages to a diskette, thereby reducing manual processing steps.

The PCMT system is set up so that narrative and data pattern (card image) traffic received from the serving LDMX and NAVCOMPARS can be delivered to the printer and/or diskettes. Data pattern traffic is usually delivered only to diskettes. Messages delivered to diskettes are segregated by routing indicators so that message centers receive only those messages addressed to them.

An operator can use the PCMT to enter a narrative or card image message, or create a new message using a simple keyboard/display screen editor. The terminal allows the operator to save a partially completed message on a diskette, recall it, and continue to edit it. At some communications centers, the operator can enter narrative or card image data pattern traffic prepared elsewhere.

Simple PC-based application programs that can be used in an office environment to review and prepare both narrative and card image messages are being developed. Once a day, the PCMT system will generate a summary report that identifies all traffic processed by the terminal during the previous 24-hour period.

The PCMT is the outgrowth of a program begun by COMNAVTELCOM (now COMNAVCOMTELCOM) in 1982 to provide automation support for fleet message relay centers. The Navy had a continuing requirement to exchange message traffic over HF radio channels terminated at a relay site. Unfortunately, such channels impressed transmission garbles on any message they carried.

Since NAVCOMPARS required that message data presented by a TTY circuit be letter-perfect, NAVCOMPARS could not terminate such circuits directly. In the past, a message received on these circuits had to be punched out onto paper tape and printed simultaneously. The fleet center operator would then examine the printed copy and, if there were no errors, feed the paper tape into a reader that was on-line to NAVCOMPARS. If there was an error, either the ship would have to resend the message or the operator would have to recut the message's paper tape on a Model 28 TTY.

The process was slow, manpower intensive, and error prone. The system built in response to this need is now what we call the Manual Relay Center Modernization Program (MARCEMP).

MANUAL RELAY CENTER MODERNIZATION PROGRAM

The Manual Relay Center Modernization Program (MARCEMP) was first certified for operational use in 1988 as part of the NSTA program. However, even before certification, it was recognized that the system could serve as the basis for a much more generalized low-cost message-processing system. The typical MARCEMP system is a PCMT configuration.

The MARCEMP provides significant automation support for all aspects of HF message relay operations within the fleet. Since all HF full-period termination and primary ship-shore traffic circuits have been terminated directly into a state-of-the-art computer-based system, the need to handle torn paper tape has been completely eliminated.

The MARCEMP system automatically checks formal messages for errors and sends them on when no errors are found. The system also makes available to a fleet center operator an advanced, full-screen computer terminal editor. The operator can use the terminal editor to correct format errors in the message that occur due to transmission garbles. The terminal editor can also be used to carry on an operator-to-operator dialogue with afloat communications personnel to coordinate corrective action.

The system provides a complete message audit trail and detailed accountability reports, which help ensure that all traffic is properly handled. Its modular and flexible design permits it to be easily tailored to meet the varying individual needs of the large or small fleet center. MARCEMP can handle up to 24 send and 24 receive circuits simultaneously. MARCEMP can also process approximately 3,500 narrative or operator-to-operator dialogue messages daily.

A number of significant enhancements have been added to the MARCEMP version 1.0 baseline system. These enhancements have resulted in the PCMT version 2.0 as another configuration of the NSTA program. This version is configured as a single workstation. Version 3.0 can be configured as a multiple workstation or single workstation PCMT system to replace both the earlier version 1.0 MARCEMP and version 2.0 PCMT. The PCMT version 3.0 can do everything MARCEMP and PCMT version 2.0 can do—and much more.

GATEGUARD SUBSYSTEM

The GateGuard subsystem is an Automatic Digital Network (AUTODIN) Interface Terminal (AIT) that provides user office automation systems (OAS) a gateway to the AUTODIN system. (AUTODIN is discussed later.) GateGuard also acts as a security guard device; hence, the name GateGuard. The GateGuard subsystem will eventually allow commands (subscribers) to interface directly with the AUTODIN system. This direct interface eliminates the manual handling of messages by the servicing telecommunications center (TCC).

Currently, a servicing TCC processes (transmit and receive) message traffic from the AUTODIN system for its subscribers. The GateGuard subsystem will eventually eliminate the need for TCCs because subscribers will be able to process their own messages through GateGuard. Subscribers will also be able to route messages via their local area networks (LANs) using desktop computers.

The GateGuard system is comprised of three elements:

- An AUTODIN Gateway Terminal (AGT);
- A gateway communications link to an Automated Information System (AIS); and
- A Guard Device (GD).

The AGT functions as a RIXT look-alike send-and-receive terminal connected to one of the AUTODIN subscriber terminals, such as the LDMX, NAVCOMPARS, or PCMT. The AGT serves as the primary AUTODIN interface point for a single organization.

The AGT has software that will operate on microcomputer systems designed to be operated by organization admin personnel. For example, in a small command, the AGT is located in the commanding officer's outer office and is operated by the Yeoman or secretary.

The communications link connecting the AUTODIN Subscriber Terminal (AST) with the AGT passes through the Guard Device (GD). The main purpose of the GD is to assist in enforcing system security policy. Specifically, the GD serves to isolate sensitive data in the serving AST from data processed by the AGT. It does so by ensuring that each message processed has been properly encapsulated and assigned a security code that the AGT is cleared to process.

The serving AST provides long-term archive storage for all messages sent to or received from the AGT. When the AGT is served by an LDMX, an operator at the AGT is able to recall messages from that system automatically. The operator is also able to identify the desired message by its originator and date-time group, originating station routing indicator, station serial number, time of file, or by the processing sequence number assigned to the message by that system.

The following is a simplified description of how the GateGuard subsystem works:

Various offices in a command have desktop computers that are interconnected by the command's LAN. Messages drafted on any computer in the system can be stored in a central computer. These messages can be accessed by any computer in the LAN. The messages can then be reviewed and checked for accuracy in format and content. When a message is released, the command sends it to the AUTODIN system via the GateGuard subsystem. At no time does the message leave the computer channels.

When messages are sent to subscribers via the AUTODIN system, the GateGuard subsystem will be able to identify messages for the various subscribers by plain language addresses (PLAs) or routing indicators (RIs). In some cases, GateGuard will use a key word or phrase in the message text to identify the subscriber for which the message is intended.

GateGuard will examine each message for which it accepts delivery responsibility, determine message completeness, and determine if it contains internally consistent security labels. If GateGuard detects any discrepancies, the software will not allow the message to be forwarded or delivered to a diskette. However, the message can still be routed to a local printer connected to the GateGuard subsystem.

AUTOMATIC DIGITAL NETWORK

The Automatic Digital Network (AUTODIN) is a worldwide computerized communications system. AUTODIN provides for the transmission of narrative and data pattern traffic on a store-and-forward basis.

AUTODIN provides reliable, secure, and efficient communications. AUTODIN also incorporates error detection and contains the highest speed transmission equipment currently available. AUTODIN is part of the Defense Communications System (DCS) and is managed by the Defense Communications Agency (DCA).

Interface equipments translate all AUTODIN inputs into common machine language, making AUTODIN compatible with many computer codes, speeds, and media, such as cards and tapes. Because of this, communications equipment within the NTS can be integrated into the AUTODIN system.

AUTODIN Switching Centers

The backbone of the AUTODIN system is the Automatic Switching Center (ASC). There are eight ASCs in the continental United States and five ASCs overseas (Europe and the Pacific).

The ASCs are interconnected into a digital network by trunk lines. Each center has local lines that link it to each subscriber (communications center) terminal. Messages entering the AUTODIN system at any of the subscriber terminals are forwarded through their respective switching centers. The ASCs accept messages from subscribers, determine the classifications and precedence of the messages, and relay the messages to the addressed subscribers.

AUTODIN Operational Modes

There are five AUTODIN system operational modes. These modes provide variation of speed and operation capabilities based on the equipment configurations of the message center subscribers. The following paragraphs describe each mode:

- **Mode I**—A duplex operation with automatic error and channel controls. Mode I operation allows independent and simultaneous two-way operation between two stations. The channel control characters acknowledge receipt of valid line blocks and messages or allow return of error information to the subscriber. The terminal (switching center) responds automatically to these characters by continuing or stopping transmission and displaying action information to the operator. A magnetic tape terminal is an example of terminal equipment using mode I.

- **Mode II**—A duplex operation normally associated with TTY or teleprinter equipments with independent and simultaneous two-way operation capability. There are no automatic error and channel controls in mode II operation. Message accountability is maintained through channel sequence numbers and service message actions.

- **Mode III**—A duplex operation with automatic error and channel controls but only one-way transmission capability. The return is used only for error control and channel coordination response. The mode III channel is reversible on a message basis. Control characters are used in the same manner as in mode I.

- **Mode IV**—A unidirectional operation (send only or receive only) without error control and channel coordination. The mode IV channel is nonreversible and is equivalent to half-duplex operation of mode II.

- **Mode V**—A duplex operation, normally associated with TTY or teleprinter equipment, with independent and simultaneous two-way transmission. Control characters acknowledge receipt of messages and display limited information to the operator. Message accountability is maintained through the use of channel sequence numbers.

Input and output (I/O) devices, such as teleprinters, provide the central AUTODIN computer with the necessary means to communicate with the user. Output devices provide the means for changing the computer-processed data into a form specified by or intelligible to the users. The selection of I/O devices depends on the specific use for which a computer is intended.

Generally, I/O devices must meet several basic requirements. First, they must be able to modify all data so that it is acceptable to the computer during the input phase of the operation. The devices must also be able to present data in usable form during the output phase and operate quickly and efficiently with the computer.

I/O devices use coded languages. These languages are:

- **ASCII Code**—American Standard Code for Information Interchange, eight-level paper tape; and

- **ITA #2 Code**—American version of international TTY alphabet, five-level paper tape.

Message Header Programming

At the beginning of each AUTODIN message is a header (format line 2) containing pertinent information on the destination of the message. The originator can address a message either to a single addressee or to multiple addressees. This system saves time and requires fewer communications facilities since only one message is prepared by the originator and sent to the switching center.

The timing system contained in AUTODIN equipment briefly connects a switching center to each subscriber terminal in turn. Computer memories act as reservoirs for the incoming messages of each subscriber terminal. The computer is programmed to connect each terminal in turn during a cycle. Messages received in their entirety are scheduled for output to the addressees' channels as their turns arrive in the cycle.

AUTODIN has built-in safeguards that can detect almost any type of hardware or format error. Additionally, a complete (reference) copy of all relayed messages is kept on AUTODIN computer tape. A separate (journal) copy is made of only the addressee(s). Using this journal copy as an index enables the system to locate the reference copy of any message.

AUTODIN Tape Messages

The AUTODIN system is programmed to accept properly cut tapes and route them through the various switching centers and terminals en route to their ultimate destination. The system is then able to produce a tape and hard copy for the designated addressee(s).

When preparing a message tape for the AUTODIN system, you must adhere to certain tape-cutting procedures. For example, format lines 1, 2, and 4 must not deviate; otherwise, the ASC will reject the message. The next paragraphs discuss the most important points on proper preparation of tape messages for transmission in the AUTODIN system.

ROUTING INDICATORS.—Within the AUTODIN network, a message tape is routed through the AUTODIN system to the addressee(s) by a routing indicator. Routing indicators are combinations of not less than four nor more than seven letters.

A routing indicator begins with the letter R or Q. The letter R indicates that the routing indicator is part of the worldwide tape relay system. The letter Q indicates that the routing indicator is within a self-contained network within a command or theater.

The second letter of the routing indicator identifies the nation or international alliance to which the indicator belongs. For example, the letter U refers to the United States. Therefore, RU indicates that the message tape is part of the worldwide network and is destined to a station in the United States.

The third letter of the routing indicator identifies the geographical area in which a particular station is located or from which it is served. This is necessary for relay purposes because the second letter may indicate a large nation within which there are a number of subdivisions or stations. For example, many stations in the United States are designated by the third letter C. Therefore, the first three letters of "RUC" indicate that the tape is part of the worldwide network, destined for the United States, and to a certain geographical area within the United States.

The fourth and subsequent letters of a routing indicator designate relay and tributary stations within the tape relay network. Like the first three letters, the fourth and subsequent letters may vary, depending upon location, area, and other factors.

TRANSMISSION IDENTIFICATION (FORMAT LINE 1).—As a means of maintaining traffic continuity, TTY terminals (modes II, IV, and V) must prefix each message header with a message transmission identification (TI). The ASC validates the elements in the TI. Modes I and III do not require format line 1. The TI is constructed without spaces and must be accurately prepared without corrections. For example, a correctly prepared TI might appear as follows:

```
VZCZCJTA(FIGS)123(LTRS)(2CR 1LF)
```

The elements of the TI and their meanings are as follows:

- **V**—Ensures that the first character of intelligence is not lost or garbled;
- **ZCZC**—Indicates the start of the message;
- **JTA**—Station/channel designator letters;
- **xxx**—Three-digit number indicating the sequential number of transmissions.

The station/channel designators vary for each channel and are determined by the status of the originating station. For example, if a minor relay or tributary station originates a TI to a major relay station, the first two characters consist of the fifth and sixth letters of the station routing indicator. The third character identifies the channel. Channel designators start with the letter A, progress alphabetically, and are assigned to all connected channels. For example, a tributary station having the routing indicator RUWTABA would use the designator "ABA" for the first outgoing channel and "ABB," "ABC," and so on, for additional outgoing channels.

MESSAGE HEADER (FORMAT LINE 2).—The message header is a basic 43-position header (figure 10-2). The message header is the starting point for the operator who is preparing the message tape. When preparing the header, the operator must remember that it must be letter-perfect.

The following paragraphs describe each position of the header:

Position 1 (Precedence)—The prosign Z (FLASH), O (IMMEDIATE), P (PRIORITY), or R (ROUTINE) is the first element. The prosign Y (YANKEE) is an emergency command precedence (ECP) and is assigned to emergency action messages (EAMs). The prosign Y indicates that a message has FLASH preemption capability. EAMs are processed ahead of all other traffic and interrupt lower precedence traffic already in processing within the AUTODIN system.

Positions 2 and 3 (Language and Media Format)—The language and media format (LMF)

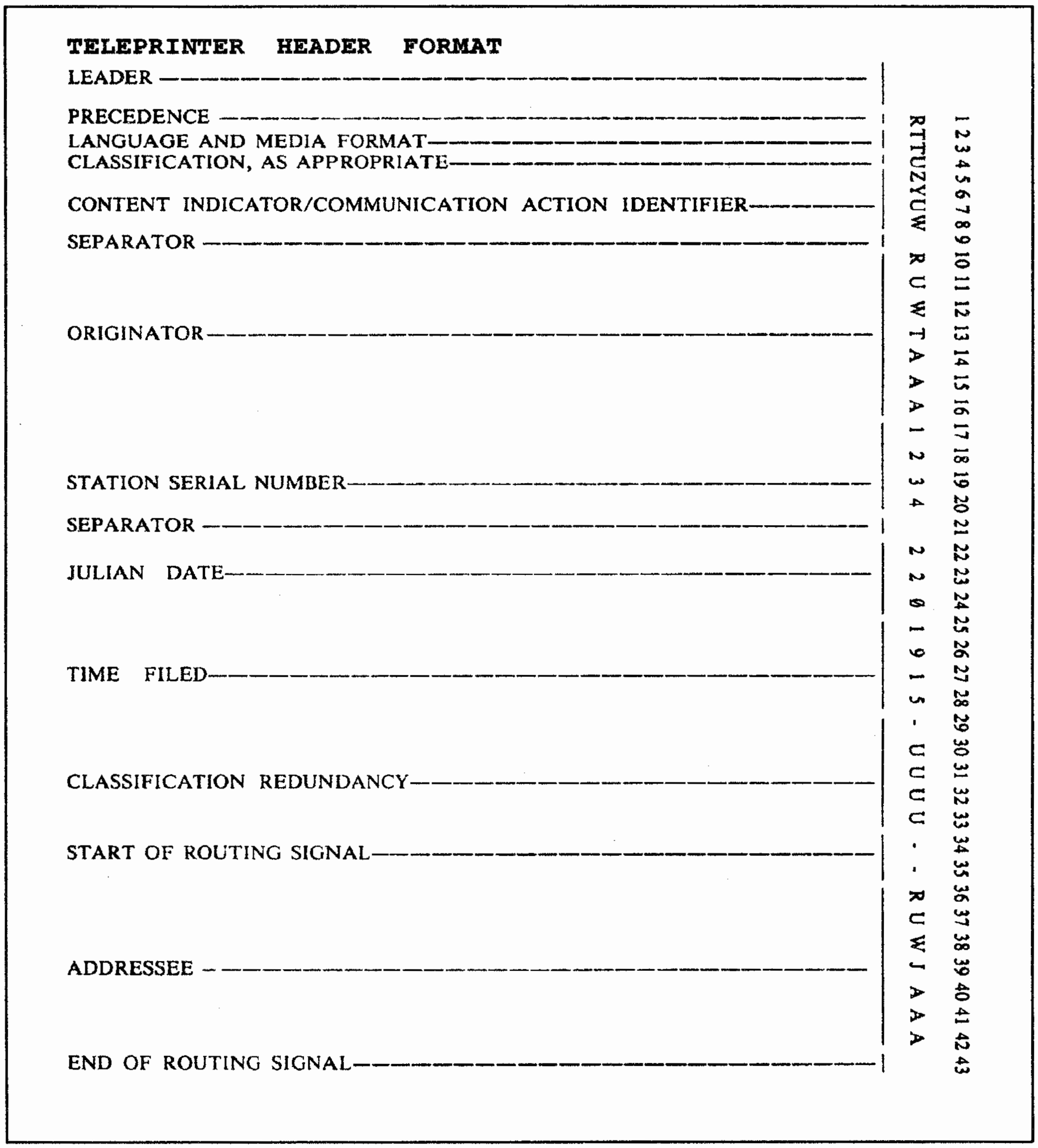


Figure 10-2.—Message header (format line 2).

consists of two alphabetical characters. The LMF is the mode used to insert a message into the AUTODIN system. The LMF of the originating station is placed in position 2, and the LMF of the preferred output device of the addressee is placed in position 3. For example, in figure 10-2, positions 2 and 3 have the character T. The character T in position 2 indicates that the originator's transmitting mode is paper tape (TTY/teleprinter) (five-level ITA2 code). The character T in position 3 indicates that the output device at the receiving end will be paper tape (TTY) (five-level ITA2 code). If the character C was used in position 3, this would indicate that the message was prepared and transmitted on paper tape and the output device at the receiving message center would be magnetic tape. *Automated Digital Network (AUTODIN) Operating Procedures*, JANAP 128, lists the LMFs used in the AUTODIN system.

Position 4 (Classification)—The letters authorized to indicate the message classification or special handling in this position are:

A	Special Category (SPECAT)
T	Top Secret
S	Secret
C	Confidential
E	Unclassified EFTO
U	Unclassified

Positions 5 through 8 (Content Indicator Code [CIC]/Communication Action Identifier [CAI])—These positions of the header are a combination of either four letters or three letters and one number. These combinations are used to indicate message content and to provide identification for communications handling. For example, in figure 10-2, the CAI in positions 5 through 8 is ZYUW. This identifies the message as a narrative message. A CAI of ZFH2 would mean that the message is being forwarded to the addressee for information only. A CAI of ZYVW would indicate that the message is a service message. A complete listing of these codes is found in JANAP 128.

Position 9 (Separator)—At this point in the header, the operator must press the space bar to insert the TTY code equivalent for space on the message tape.

Positions 10 through 16 (Originator)—The appropriate routing indicator of the originating station is placed in these positions.

Positions 17 through 20 (Station Serial Number)—The station serial number (SSN) of the sending station is inserted here. The SSN serves two specific purposes. First, when used in combination with the originator's routing indicator, it provides positive identification for each transmission. Second, in the end of message (EOM) validation (discussed later in this section), the SSN appearing in format line 15 provides a means by which the ASCs can check for the existence of straggler messages.

The SSN is expressed in four numeric characters beginning with 0001 and continuing consecutively through 9999. A new series begins when the number 9999 is reached. Operating stations may use SSNs to identify local activities, channels, or positions within a station by assigning each activity a specific block of numbers. For example, one station may be assigned numbers 0001 to 2000, the next station 2001 to 4000, and so on.

Position 21 (Separator)—This position requires the same information as that for position 9.

Positions 22 through 24 (Julian Date)—The Julian date is the date that the message was received from the originator for transmission by the communications center. The first day of the calendar year is Julian 001 and each day is numbered consecutively thereafter.

Positions 25 through 28 (Time Filed)—The time filed is the time that the message was received from the originator by the communications center for transmission. Each filing time is expressed in Greenwich mean time (GMT) and must contain four numerical characters.

Positions 29 through 33 (Classification Redundancy)—For security reasons, the classification designator used in position 4 is repeated here. Position 29 is filled with a hyphen as a sentinel. The classification designator in position 4 is repeated in positions 30 through 33.

Position 34 through end-of-routing signal (start-of-routing signal and addressees)—The positions reserved for routing are made up of two sections: start-of-routing signal and the addressees' routing indicators. The start-of-routing signal consists of two consecutive hyphens and will always precede the first addressee routing indicator. Addressee routing indicators are listed immediately following the start-of-routing signal. A message can have a maximum of 500 routing indicators in these positions. If a message contains 501 or more routing indicators, the message will require two separate transmissions. In this case, all routing indicators that have the same first four letters should be in one transmission.

End-of-Routing Signal—The end-of-routing signal consists of a period (.) and is inserted in the position immediately following the last addressee routing indicator.

SECURITY WARNING (FORMAT LINE 4).—A security warning is the first component of format line 4. The appropriate operating signal (ZNR or ZNY) will always be followed by a classification character repeated five times. The operating signal and classification characters are as follows:

ZNR UUUUU—For off-line encrypted messages and classified messages transmitted in the clear;

ZNY EEEEE—For unclassified EFTO messages; and

ZNY, followed by CCCCC, SSSSS, or TTTTT—For Confidential, Secret, or Top Secret messages, respectively.

For SPECAT and SPECAT SIOP-ESI messages, the five redundant security characters are followed by an oblique (/) and AAAAA for SIOP-ESI or BBBBB for all other SPECAT messages. For example, format line 4 for a Top Secret SPECAT message would be:

ZNY TTTTT/AAAAA (2CR, 1LF)

END OF MESSAGE (EOM) (FORMAT LINES 15 AND 16).—Format line 15 is the EOM validation line that is used to inhibit suspected straggler messages. Format line 15 consists of the SSN in format line 2 preceded by the number sign (#). Format line 16 consists of the EOM functions. The EOM functions consist of normal TTY ending procedure when five-level Baudot code is used (2CR, 8LF, 4Ns, 12LTRS). However, for ASCII, 12 delete functions are used (12DEL). The EOM for the message with format line 2 shown in figure 10-2 would be as follows:

TEXT	(2CR, 1LF)
BT	2CR, 1LF)

(1FIGS)#1234(1LTRS)

(2CR, 8LF)NNNN(12LTRS)

Format lines 1, 2, 4, and 5 must all be accurately prepared. Backspacing, lettering out, double-spacing, or using two or more FIGURES and LETTERS functions in sequence will cause the ASC to reject the message during attempted transmission from the originating station. The EOM validation appearing in format line 15 and the EOM function in format line 16 must be prepared in uninterrupted sequence, be letter-perfect, and be without corrections.

General Teleprinter Rules

A leader must precede the header to ensure acceptance and transmission of the first character of the message header. The leader for the five-level Baudot code (most common) consists of at least six blanks and six letter functions. The leader for the ASCII (eight-level Baudot code) consists of at least six nulls and six delete functions. This will ensure acceptance and transmission of the first character of the message header.

When a message is assigned dual precedence, the higher precedence is shown in format line 2 (position 1). Both precedences are shown in format line 5.

Communications personnel of tributary stations must ensure that a record is made of the time of file (TOF) and the time available for delivery (TAD). These times are used to determine message-processing times.

Message Lengths

Messages cannot exceed more than 20 lines of heading and text, beginning with format line 5. Messages that exceed the 20-line limit must be divided into pages for transmission. The second and succeeding pages of a message are identified by the page number, the routing indicator of the station of origin, and the SSN. The security classification of classified messages follows the page identification. After the first letter of the classification, you must separate each letter by one space from the previous letter. For example:

PAGE 2 RUEDABA0123 C O N F I D E N T I A L (2CR, 1LF)

On unclassified messages, "UNCLAS" is placed after the page identification with no spaces separating the letters.

When a message exceeds five textual pages, the message must be divided into transmission sections.

The message should be separated at a convenient point on the last permissible page of a transmission section. This normally will be at the end of a sentence or cryptopart. Each section must be numbered in plain language at the beginning of the text following the classification or abbreviation "UNCLAS." For example:

UNCLAS SECTION 1 OF 2

In long encrypted messages, when a transmission section starts with a new cryptopart, the designation of the cryptopart follows the designation of the transmission section. Also, when a numerical group count is associated with an off-line encrypted message and is indicated in format line 10, the count must indicate the number of groups in the textual section being transmitted—not the number in the complete message. Cryptopart identification is included in the group count; the page identification and transmission section are not.

Statistical and meteorological messages can have up to 100 lines of text without paging when the inclusion of paging information would disrupt processing by the user. However, you should divide these types of messages into transmission sections if they exceed 100 lines of text.

Misrouted and Missent Messages

A misrouted message is one that contains an incorrect routing instruction. This normally occurs when the originating communications center assigns an incorrect routing indicator during message header preparation. Misrouted messages are usually not discovered until they reach the communications center of the called routing indicator. Communications personnel of a tributary station in receipt of a misrouted message must take the following actions:

- Obtain the correct routing indicator, if possible;
- Apply a header change to the misrouted message and retransmit it to the correct routing indicator; and
- Originate a service message to the originating station advising of the reroute action and the correct routing indicator.

A missent message is one that contains a correct routing indicator but is transmitted to a station other than the one represented by the routing indicator. Missent messages can be caused by an equipment malfunction, incorrect switching, or operator error. Communications personnel of a tributary station in receipt of a missent message must take the following actions:

- Reintroduce the message into the AUTODIN system as a suspected duplicate (SUSDUPE) after applying a header change; and
- Forward a routine service message to the connected ASC citing the complete header and time of receipt (TOR) and advising that the message has been protected.

Suspected Duplicates

When a station suspects that a message may have been previously transmitted, but definite proof or prior transmission cannot be determined, the message should be forwarded as a suspected duplicate (SUSDUPE) by applying a header change. However, if a station receives a message that is already marked "SUSDUPE," the station should file the message if the message was previously received and delivered to the addressee. If there is no indication that the message was previously received and delivered, it should be forwarded.

Stations receiving unmarked duplicate transmissions should immediately forward a routine service message to the originating station. This service message should cite the complete header format of the duplicated message, including the TOR of the original and duplicate transmissions. If the initial copy was delivered to the addressee, the station should file the message.

Upon receipt of service messages concerning duplicates, communications personnel at the originating station must take the following actions:

- Check transmission records to determine the validity of the duplication report;
- Ensure that in-station procedures are adequate to guide operating personnel in the retransmission of SUSDUPE messages;
- Have maintenance personnel perform equipment checks if an equipment malfunction is suspected to be the cause of duplication; and
- Advise the connected ASC by routine service message if only one transmission can be accounted for.

An ASC receiving notification of a duplicate transmission should search its records to determine if the message was received in duplicate. If the message was not received in duplicate, it must be traced on a station-to-station basis to determine the point of duplication.

Magnetic Tape Messages

Magnetic tape is one of the principal media used in electronic data processing equipments (EDPEs). Magnetic tape terminal stations (MTTSs) in the AUTODIN provide for the rapid exchange of large volumes of data in a relatively short period of time. The basic mode of MTTS operation with other AUTODIN tributary stations is either full duplex or on a store-and-forward basis.

In the continental United States, terminals that have compatible equipment and circuit speeds and are connected to the same ASC may communicate directly by Hybrid AUTODIN Red Patch Service (HARPS). HARPS provides a direct subscriber-to-subscriber encrypted circuit. HARPS uses the same circuit and equipment normally used in the message-switching component of the network. Communications centers not serviced by HARPS communicate by normal message switching, which automatically performs the necessary speed, format, and code conversions.

Operating Rules

All received tape reels must be periodically dismounted and made available for delivery as scheduled by a receiving activity and system manager. A magnetic tape reel accepted by a communications facility for transmission is screened and arranged for transmission according to majority message precedence levels contained on the reel. Establishment of transmission schedules is the responsibility of the commands concerned. Prior coordination is necessary to provide for efficient use of the equipment and circuit time. Schedules are limited to 30 minutes per period.

Most facilities establish their own procedures for maintaining reel accountability and ensuring that message transmission has been accomplished. Message header and EOT printouts are furnished by the message originator with each reel of tape to be transmitted. If a message cannot be transmitted, the MTTS operator returns the reel to the originator, identifying the message (or messages) that could not be sent. The originator is also provided the reason for the nontransmission, if known.

Terminal equipment should not be used to change message media format for customer convenience; for example, changing from magnetic tape to narrative records.

Operating Precautions

Communications station master records, such as history tapes and journal records, remain with the communications facility until destroyed. History tapes are labeled to prevent them from being inadvertently delivered to addressees with live traffic tapes.

Recorded information is very close to the edge of the tape. Tape-edge indentations, caused by careless tape handling, will seriously affect the accuracy of magnetic tape recordings. You should be aware that tape splices are not permitted in reels of tape used for traffic.

Message Formats

Message formats used within the AUTODIN require that each message contain a message heading, text, and EOT record. The textual material on magnetic tapes may consist of a wide variety of information recorded in either structured or nonstructured formats, depending upon the type of system.

EOT is either a single N or four consecutive Ns. The header, text, and EOT cards of magnetic tape messages are always transmitted in the AUTODIN common language code (ASCII). This is accomplished by automatic code conversion logic provided in the magnetic tape terminal.

The text of magnetic tape messages can be prepared by the EDPE system in 80-character data images, series record images, or by variable-length record images. The length of data records to be transmitted by AUTODIN may vary according to user requirements. For general transmission of data throughout the system, computerized terminals must be capable of transmitting records that contain from 18 to 1,200 characters.

Subscribers desiring to transmit messages that contain fewer than 18 or more than 1,200 characters must ensure that the addressee is capable of receiving such records prior to transmission. Typical line formats of magnetic tape message records are described in JANAP 128.

Magnetic tape messages prepared for transmission are limited to a maximum of 40,000 characters (five hundred 80-character data records) that include the header, text, and EOT records. The preparation of magnetic tape messages, formats, routing, contents, and sequence on tape is the responsibility of the message originator.

Message and Tape Reel Accountability

Each tape reel given to the MTTS operator for transmission must bear a tape label containing the following information:

- Reel number;
- Number of messages recorded on tape;
- Highest precedence used;
- Highest security classification;
- Date and time filed;
- Tape density;
- LMF used;
- Beginning and ending SSNs; and
- Time delivered to the MTTS operator.

Each blank reel of tape furnished to the MTTS operator for mounting on the receive tape transport contains a tape label with the following information recorded in the sequence of handling:

- A statement that the reel is blank;
- Reel number;
- Highest classification ever recorded;
- Time the reel is mounted on the receive transport;
- Time the reel is removed from the receive transport;
- Time the reel is delivered to the addressee; and
- Number and types of message on the reel and other applicable reel information.

All originated tape reels must be retained for at least 10 days. The header and EOT printouts furnished the MTTS operator for both originated and terminated traffic are maintained as a station communications record for at least 30 days. Other logs recommended for MTTS operation are the master station log and the reel delivery log.

The master station log reflects the current operation status of the terminal equipments and circuits. This log should also reflect equipment and circuit outages, causes of the outages, and the corrective actions initiated.

The reel delivery log should indicate the reel number and the time the reel was delivered to the transmitting operator or the addressee.

AUTODIN Security

Required security protection must be extended to all classified traffic transmitted through the AUTODIN. The ASC automatically checks and compares the security classification stated in the header of the message against the authorized security level of the incoming circuit. Transmission of a message with a higher security level than authorized will result in the message being rejected by the ASC.

In addition, an automatic system-generated service will be transmitted by the ASC to the originating station. The purpose of this service is to advise the originating station of possible security compromises. Also, the ASC automatically checks and compares the security classification contained in the header of each message against the security classification of each destination. A security mismatch occurs for each destination that does not indicate a matching security level.

In the event of a security mismatch, the ASC takes the following actions:

- In a single-address message, the ASC rejects the message and alarms appear at the originating terminal indicating that the message needs retransmission.
- In a multiple-address message with at least one deliverable destination, the ASC accepts the message and delivers it to all valid destinations. For invalid routing indicators, an automatically generated service retransmits the message to the originating routing indicator and advises that the message needs retransmission.

In-station operating procedures should be carefully planned and rigidly enforced to prevent inadvertent transmission of classified messages to unauthorized stations or agencies. Complete security precautions and operating rules are contained in JANAP 128.

NAVAL COMMUNICATIONS PROCESSING AND ROUTING SYSTEM

The Naval Communications Processing and Routing System (NAVCOMPARS) is an automated system that serves as the interface between AUTODIN or other networks ashore and operational units of the Navy. There are five NAVCOMPARS sites: NCTAMS EASTPAC, NCTAMS WESTPAC, NCTAMS MED, NCTAMS LANT, and NAVCOMMTELSTA Stockton, California. The primary purpose of NAVCOMPARS is to provide security, speed, and systems compatibility for the Naval Telecommunications System (NTS). The NAVCOMPARS system provides the following services:

- On-line communications with AUTODIN switching centers;
- On-line communications with tactical and dedicated circuits;
- Off-line communications interface capabilities;
- Processing of JANAP 128-formatted messages;
- Conversion of modified ACP 126-formatted messages to JANAP 128 format;
- Filing, retrieving, and accountability of messages;
- Local delivery analysis;
- Distribution assignment;
- Message store-and-forward capability to fleet units;
- Fleet support through broadcast management or full-period terminations and primary ship-shore circuits;
- Broadcast keying and screening;
- On-line communications with the Worldwide Military Command and Control System (WWMCCS); and
- On-line communications with Common User Digital Information Exchange System (CUDIXS). (CUDIXS is discussed later.)

Automation of these functions and services eliminates manual processing and minimizes related delays and errors. Automation also improves originator-to-addressee delivery time and allows the timely exchange of information critical to the command and control of forces afloat.

LOCAL DIGITAL MESSAGE EXCHANGE

The Local Digital Message Exchange (LDMX) provides automatic outgoing message routing and reformatting for Navy activities ashore. It simultaneously transmits and receives messages over the AUTODIN and other remote terminal circuits. The LDMX system provides high-speed processing, system reliability, secure communications, flexibility, statistical information, and accounting data.

High-Speed Processing

The LDMX system provides high-speed communications processing. On-line to AUTODIN and other circuits, the LDMX system automatically receives, identifies, and files traffic for processing and future reference. Incoming messages are automatically arranged by precedence then processed, edited, and printed on reproducible mats for delivery.

Outgoing traffic is entered by magnetic or paper tape. The system formats the outgoing message, creates a header, and validates the message identifiers, precedence, and classification. The LDMX system also searches system files to assign the correct routing indicator and arranges the message by precedence for automatic transmission. Operating at full capacity, the system can process up to 7,500 messages per day.

System Reliability

Message-processing reliability has been greatly improved by automatic message identification and header preparation and by system look-up files instead of manual files. The elimination of most manual functions and validation of those remaining greatly reduce misroutes and nondeliveries. The system continues to operate in either a semiautomatic or manual mode if a major component becomes inoperable.

Secure Communications

All message security fields are validated. If a mismatch is detected in the LDMX system, the message will be displayed to an inrouter or an outrouter for review and action. Depending on user requirements, video display terminal (VDT) operators may be prevented from displaying or recalling Top Secret and SPECAT messages. The purpose of this precaution is to reduce the possibility of a security violation.

Flexibility

The LDMX system eliminates most manual processing without imposing stringent limitations on the user. Tailored to meet the unique situations at each command, the LDMX can be responsive to individual command requirements and variances.

Statistical and Management Reports

A significant feature of the LDMX system is the natural accumulation of statistical information and accounting data. This provides accurate verification of the reliability and performance of the system. Message-processing data is summarized in a series of statistical analysis summaries that include the following:

- A bar chart providing an hourly volume of incoming or outgoing messages;
- A summary report showing the number and average length of incoming or outgoing messages, the number of messages delivered to a remote printer, and the number of classifications and precedences;
- A listing of service messages sent and received;
- A listing of duplicated, misrouted, and missent messages; and
- A speed-of-service report, giving maximum, average, and minimum processing times (by precedence, classification, or selected originator).

STANDARD REMOTE TERMINAL SYSTEM

The Standard Remote Terminal (SRT) (figure 10-3) functions as a remote communications terminal that is capable of interfacing with the AUTODIN and LDMX systems. The SRT can process all types of data communications in the form of AUTODIN message structures at speeds up to 19,200 bits per second. In this system, message security and accountability are maximized through automatic detection and error-correction capabilities.

The nucleus of the SRT peripheral equipments is the line control unit (LCU) shown in figure 10-3. The LCU features high internal processing speeds, random-access memory (RAM), read-only memory (ROM), and direct memory access (DMA) for high-speed data circuits. The SRT operates with either 40K or 56K of memory. The memory incorporated in each SRT system is unique to each site configuration.

The three basic configurations of the SRT are as follows:

SRT I—The SRT I is the most basic configuration for low-volume message users. The SRT I contains the LCU and peripheral devices. These peripheral devices include a high- or medium-speed line printer, paper tape punch and reader, optical scan unit, storage module disk drive, and magnetic tape units.

SRT II—The SRT II is the most common configuration for average-volume message users. The SRT II contains the LCU, high- or medium-speed line printer, and tape reader/tape punch.

SRT V—The SRT V configuration is for high-message-volume sites or unique-requirement sites. In addition to the peripherals contained in the other SRT sites, SRT V sites also have magnetic tape units (MTUs).

All SRT configurations can accommodate the optical scan unit (OSU). Another device available for use with any SRT configuration is the storage module disk drive (SMDD). The SMDD is not considered a user peripheral but may be added to the SRT for message review. The major operator functions that can be performed with the SRT are discussed in the next paragraphs.

Message Reception

The message-reception program is automatically loaded when the LCU is initialized. This program operates continuously and receives top priority for message-processing time.

Message Transmission

The message-transmission program is selected and started by the operator and receives second

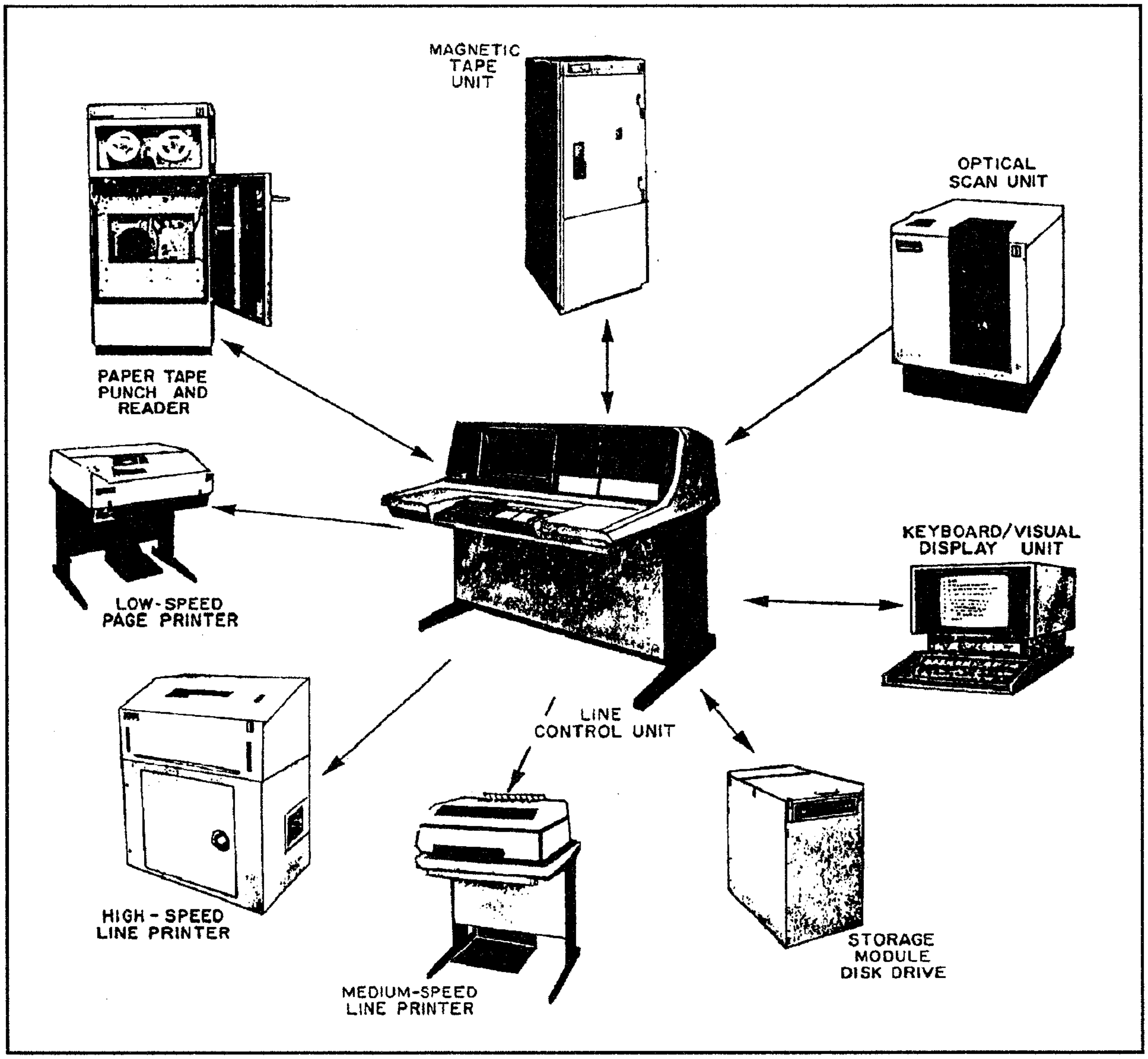


Figure 10-3.—Standard Remote Terminal System.

priority for processing time. This program can accept narrative text and data from the peripherals, format text or data into blocks, and transmit the blocks to the receiving station.

Message Preparation

The message-preparation program is loaded by the operator. This allows messages to be originated at the visual display unit (VDU) and released for transmission.

Device-to-Device Transfer

Device-to-device transfer allows the operator to transfer data from any send peripheral to any receive peripheral. Any data translation required can be performed by the SRT system.

Self-Test Program

The self-test program permits the operator to send messages from the message transmit program and loop them back to the message-reception program.

FLEET COMMUNICATIONS SYSTEMS

The systems for afloat units are compatible with those used ashore. In the next paragraphs, we will discuss the types of automated systems used afloat.

NAVAL MODULAR AUTOMATED COMMUNICATIONS SYSTEM

The Naval Modular Automated Communications System (NAVMACS) is a shipboard message-processing system developed to meet command missions. The NAVMACS provides accurate, secure, and expedient communications for various classes of ships and flagships. The hardware, software, and functional capabilities of the NAVMACS are based on the needs of individual ships and commands.

The current versions of NAVMACS are (V)1, (V)2, (V)2-MPD (message-preparation device), (V)3, and (V)5/(V)5A. NAVMACS capabilities are augmented in a building-block manner from the most basic system (V)1, through (V)5/(V)5A, the most sophisticated system.

NAVMACS (V)1

The NAVMACS (V)1 configuration provides automation for the receipt and processing of up to four channels of incoming broadcast message traffic. This configuration provides one channel of incoming and outgoing high-speed satellite link message traffic from and to the CUDIXS (discussed shortly). The system incorporates the equipments and computer program necessary to perform the automatic address screening and management functions required in the processing of incoming messages. It also incorporates the storage, formatting, and accountability functions used in the ship-to-shore delivery of messages transmitted via satellite and the shore-to-ship delivery of messages received via broadcast and satellite.

NAVMACS (V)2

The NAVMACS (V)2 configuration provides the same message processing and delivery functions used in the (V)1 configuration for up to four channels of incoming broadcast message traffic. It provides one channel of incoming and outgoing high-speed satellite link message traffic from and to CUDIXS. The NAVMACS (V)2 configuration upgrades the (V)1 system in the following ways:

- Adds automatic MILSTRIP paper tape message processing;
- Adds message output to medium-speed printers instead of low-speed printers; and
- Uses magnetic tape program loading instead of paper tape loading.

NAVMACS (V)2-MPD

The NAVMACS (V)2-MPD configuration has the same capabilities as the NAVMACS (V)2 version but uses a different program for operator language and system printouts. The MPD program provides an additional capability for on-line message composition and editing ability, and outgoing message error analysis (before transmission). It also provides a proof copy with paper tape for off-ship transmission. The (V)2-MPD system consists of the same equipments as the (V)2 system with the addition of MPD units, which are modified video displays.

NAVMACS (V)3

The NAVMACS (V)3 configuration automates certain processing functions required in the handling of narrative messages. It serves as an afloat terminal within those communications networks using broadcast and point-to-point modes of operation on both conventional and satellite transmission paths.

The (V)3 configuration interfaces with up to four channels of fleet broadcast, and up to four channels of full-period termination send-and-receive circuits. It also interfaces with one channel of incoming and outgoing high-speed satellite link message traffic to and from CUDIXS.

The (V)3 configuration also interfaces with off-line torn tape and manual transmit/receive circuits of any type. The (V)3 system provides the capability of on-line message composition and on-line message retrieval from magnetic tape.

NAVMACS (V)5/(V)5A

The NAVMACS (V)5/(V)5A system is an automated communications processing system capable of interfacing a mix of input/output channels. This system is enhanced with the addition of remote terminals for message input. It includes up to four incoming broadcast channels and eight itinerant, netted, and fully dedicated communication network channels. It also includes one incoming/outgoing high-speed satellite link with CUDIXS and onboard peripheral devices.

The (V)5/(V)5A system includes a remote terminal capability for direct input/output of narrative and data pattern messages to high-volume onboard user areas. Remote terminals consist of a medium-speed printer, video display, and paper tape reader/punch, or a combination thereof—depending on the unique requirements of the various remote terminals.

COMMON USER DIGITAL INFORMATION EXCHANGE SYSTEM

The Common User Digital Information Exchange System (CUDIXS) provides a bidirectional, ship-to-shore-to-ship, high-speed digital data communications link between a ship and a NCTAMS or NAVCOMMTELSTA. Subscriber stations use the NAVMACS as their terminal. The link consists of a single Fleet Satellite Communications (FLTSATCOM) half-duplex channel. The link is dedicated to synchronous communications between the CUDIXS shore station (Net Control Station [NCS]) and the subscribers afloat. Each CUDIXS communications link can operate with up to 60 subscribers. There are two types of subscribers, special and primary.

Special subscribers are those ships that are assigned subscriber identification (SID) numbers 1 through 10. Special subscribers can send and receive narrative traffic to and from CUDIXS.

Primary subscribers are assigned SID numbers 11 through 60. Primary subscribers are restricted to a send capability only. They can receive their shore-to-ship message traffic via other means, such as the fleet broadcast or full-period terminations. Both types of subscribers can send or receive operator-to-operator (order wire) messages.

CUDIXS/Subscriber Net Cycle

CUDIXS/subscriber communications are accomplished through a modified round robin network discipline. The basic round robin net operating concept transfers net control from one subscriber to the next on a prearranged basis, completing one net cycle when each participating subscriber has transmitted.

In the CUDIXS/subscriber modified round robin operating concept, transmission timing and scheduling are determined solely by the CUDIXS shore station designated the NCS. Each net cycle starts when the NCS transmits a Sequence Order List (SOL) along with narrative traffic and operator-to-operator messages. The SOL specifies the order in which each subscriber transmits during the next net cycle and the amount of time allocated each transmission slot. Each subscriber, in turn, will transmit at a time computed from information in the SOL.

A net cycle can range from 20 to 120 seconds, depending upon the amount of transmit time requested by the subscribers and the amount of data transferred.

System Performance/Message Accountability

CUDIXS provides a shore operator with several means of monitoring system performance and maintaining message accountability for all messages processed by the CUDIXS NCS. Specifically, the system assigns sequence numbers to all messages processed, provides link status, traffic statistics, and system summary information in system reports. The system also allows the operator to assign parameter values that control net operations and to generate various alerts concerning immediate communications difficulties.

System Interfaces

CUDIXS serves as an extension of AUTODIN by storing and forwarding messages, normally without need for human intervention. CUDIXS interfaces with AUTODIN via the NAVCOMPARS and processes narrative traffic for general fleet communications teleprinter messages.

In accomplishing its tasks, CUDIXS supplements the traffic responsibilities previously assumed by ship-to-shore and broadcast HF circuits. CUDIXS can recognize EMERGENCY COMMAND, FLASH, IMMEDIATE, PRIORITY, and ROUTINE messages on a first-in-first-out (FIFO) basis within precedence. Through system reports, the operator has the following capabilities:

- Detailed information on every message processed by CUDIXS;
- Overall statistics on the volume of message traffic processed over the link; and
- Information on the quality of link communications with each net subscriber.

COMMUNICATIONS DATA PROCESSING SYSTEM

The Communications Data Processing System (CDPS) provides the USS *Tarawa* (LHA-1) class ships with the necessary communications hardware and software to process narrative traffic and to ensure circuit reliability. CDPS is one of the most complex of the automated systems afloat and offers the following capabilities:

- Automatic broadcast screening;
- Frequency management;
- Automatic message logging;
- Automatic message continuity checks;
- On-line message preparation and storage;
- Backup control and operation;
- High-speed data interface;
- On-line operation readiness testing;
- Quality monitoring with computer aid;
- Message error analysis;
- Circuit status and record-keeping functions;
- Construction of communications circuits; and
- Ability to act as a CUDIXS special or primary subscriber.

As with many of the automated systems, the operator has the ability to modify system configuration from the control console. The operator must know how to properly use, operate, and perform system changes. Your job will involve setting up and operating input/output (I/O) devices. Some systems allow the operator to patch receivers, transmitters, modems, and antennas directly from the console.

As a Radioman, part of your routine duties will be to energize electronic equipment and monitor power levels. In the event of primary power failure, equipment must be brought up on emergency or back-up power systems. Many of the automated systems in use today have uninterrupted power sources (UPS) or battery backups to preclude a complete system failure.

For more information on power requirements for individual components, refer to the equipment technical or operator manuals. You should become familiar with emergency power requirements and procedures **prior** to an actual emergency.

SUBMARINE SATELLITE INFORMATION EXCHANGE SUBSYSTEM

The Submarine Satellite Information Exchange Subsystem (SSIXS) provides the commanding officers of SSN and SSBN submarines with an optional satellite path to complement existing VLF/LF/HF broadcasts. The subsystem provides a rapid exchange of teleprinter information between SSN and SSBN submarines and shore stations.

To use the SSIXS, the submarine must be in a line-of-sight position with a satellite. The submarine must also be in a tactical situation that permits exposure of its mast-mounted antenna.

The SSIXS provides access to a satellite path through a programmable mixture of query-response and broadcast-without-query functions. This type of access provides maximum operational flexibility to the submarine commander.

All transmissions on the SSIXS provide automatic, reliable, long-range, high-data-rate, and cryptographically secure UHF communications between submarines, and between submarines and shore stations.

AUTOMATED VOICE COMMUNICATIONS SYSTEMS

The telephone is and will continue to be a convenient and fast way to communicate. In this section, we will discuss the Secure Telephone Unit Third Generation and the Defense Switched Network, which is an updated version of the Automatic Voice Network (AUTOVON).

SECURE TELEPHONE UNIT THIRD GENERATION

The Secure Telephone Unit Third Generation (STU-III) is the newest communications system that meets the need for protecting vital and sensitive information over a telephone system. The STU-III is a compact, self-contained desktop unit capable of providing the user with clear and secure voice and data transmissions. The unit is fully TEMPEST protected and is certified by the National Security Agency for use up to and including Top Secret material.

The STU-III is unique in that it works as an ordinary telephone and as a secure telephone network to other STU-III terminals. For secure transmissions, the STU-III uses a unique keying system.

The three manufacturers of the STU-III terminals for the Navy are AT&T, Motorola, and General Electric. Figure 10-4 shows an AT&T STU-III terminal.

The STU-III is operated the same as any telephone. That is, you pick up the handset, wait for a dial tone, then dial the number of the person you want to call. All calls on the STU-III are always initiated in the clear voice mode. Once the party you have called has answered, you have the option of talking to that person in the clear voice mode, clear data mode, secure voice mode, or the secure data mode.

Terminal Setup

The STU-III terminal uses special keys with a designator of KSD-64A. The KSD-64A is a plastic device that resembles an ordinary key. Two types of keys are used with the STU-III, the seed key and the crypto-ignition key (CIK). The seed key is a special keying material used for the initial electronic setup of the terminal. The CIK key is used by the users to activate the secure mode.

When the STU-III terminal is installed, the STU-III custodian sets up the terminal with the seed key. A seed key is issued to a particular terminal only. The seed key contains a microchip that is embedded electronically with identification information. This information includes the level of security authorized for that terminal.

Once the custodian inserts the seed key into the terminal, the information on the key is transferred to the internal memory of the terminal. At this point, the seed key no longer contains any information and is considered to be "empty."

The information in the terminal is electronically registered with the Key Management Center (KMC) located in Finksburg, Maryland. The KMC is the central authority responsible for controlling the key material and issuing reports of compromised keys. The user can discuss classified information up to the security level that has been keyed to the terminal.

The crypto-ignition keys (CIKs) can now be made for users to activate the secure mode. The CIKs are "empty" keys with no information embedded in the metal strip. When the empty keys are inserted into the

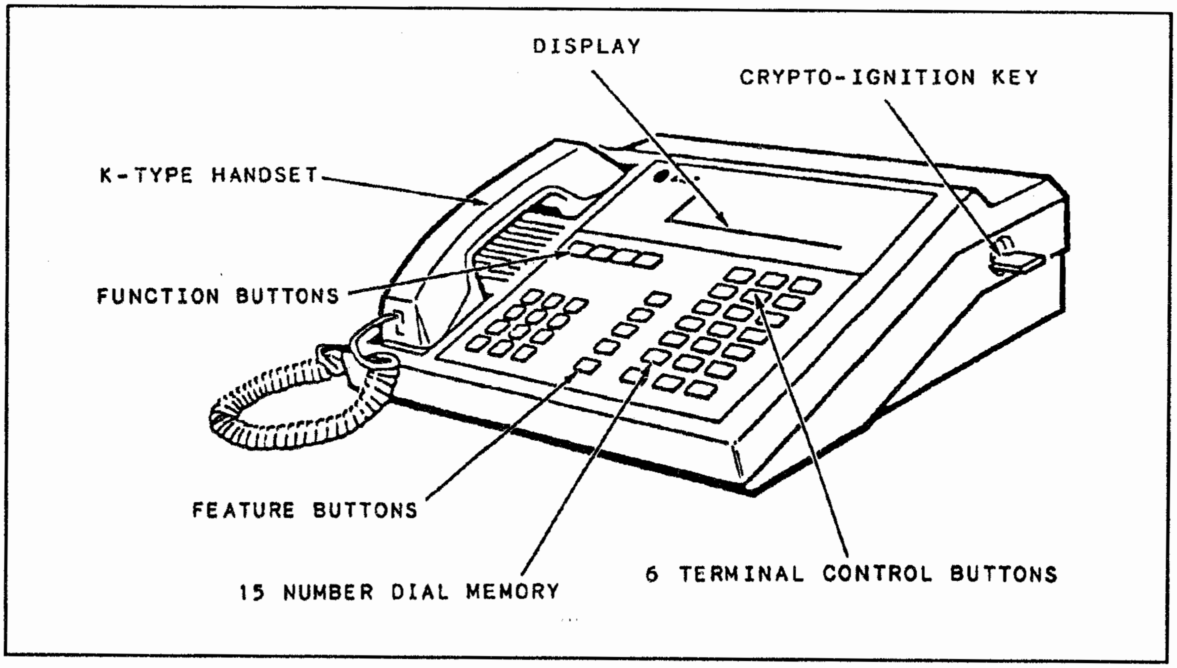


Figure 10-4.—AT&T STU-III terminal.

terminal, some of the information that is now stored in the terminal from the seed key and other information in the memory are transferred onto the metal strips. This information becomes an electronic "password" on the CIKs for that particular terminal, making the CIKs unusable on other terminals. The terminal maintains a list of authorized CIKs for each key in its memory.

Secure Mode

As we mentioned earlier, the secure mode of the STU-III is activated and deactivated using a CIK. When the CIK (figure 10-4) is inserted into the terminal, the STU-III can be used in the secure mode up to the classification of the keying material. Without the CIK, the STU-III operates as an ordinary telephone.

Calls are always initiated in the clear. To go from a clear to a secure voice transmission, either caller simply presses his or her SECURE VOICE button after the CIK is used to activate the secure mode.

Once a secure link has been initiated, the two STU-III terminals begin exchanging information. The information exchanged includes the identity of the CIK of the distant-end person, the list of compromised CIKs, and the common level of classified security information to which the two callers have access.

When two terminals communicate in the secure mode, each terminal automatically displays the authentication (identification) information of the distant terminal. This information is scrolled through the display window during secure call setup. The first line of the identification information and the classification are displayed for the duration of the secure call.

The information displayed indicates the approved classification level for the call, but does not authenticate the person using the terminal. Each terminal user is responsible for viewing this information to identify the distant party and the maximum security classification level authorized for the call.

STU-III Administration

The STU-III terminals and keys are COMSEC material. The terminals and keys may be administered either through the STU-III custodian or the CMS custodian. Both the terminals and keys are issued to users and must be signed for. Since the seed key is classified, it must be afforded protection for the level of classification in accordance with *Secure Telephone Unit Third Generation (STU-III) COMSEC Material Management Manual*, CMS 6.

Because CIKs permit the STU-III terminals to be used in the secure mode, the CIKs must be protected against unauthorized access and use. CIKs may be retained by the users who sign for them on local custody. Users must take precautions to prevent unauthorized access and must remember to remove the CIKs from the associated terminals.

When the terminals are unkeyed, they must be provided the same protection as any high-value government item, such as a personal computer. When the terminal is keyed, the terminal assumes the highest classification of the key stored within and must be protected in accordance with the classification of that key.

DEFENSE SWITCHED NETWORK

The Defense Communications System (DCS) Defense Switched Network (DSN) is a telecommunications telephone interconnected network. This system is found on most military and other Federal Government installations in the United States and overseas.

This system upgraded the Automatic Voice Network (AUTOVON) and will evolve into an all-digital network in the 1990s. The DSN incorporates capabilities that were not available in the AUTOVON system, such as automatic callback, call forwarding, call transfer, and call waiting.

Precedence of Calls

The precedence of a call indicates the degree of preference to be given a call relative to all other calls in progress. A preemption feature provides the ability to disconnect a call of lower precedence and seize the access line or interswitch trunk to complete a call of higher precedence. A unique aspect of the DSN is that switches have been programmed to determine what precedence treatment must be given each call.

The combined features of precedence and preemption used in DSN are called multilevel precedence and preemption (MLPP). The effectiveness of this system depends on the proper use of the precedence system by the users.

All users should be familiar with the system and the types of calls assigned to each precedence. Each user should ensure that his or her call is not assigned a precedence higher than that justified by the circumstance or information involved.

The DSN offers five types of call treatment. The precedences and their applications are listed below and are listed in relative order of priority in handling.

FLASH OVERRIDE (FO)—FO takes precedence over and preempts all calls on the DSN and is not preemptible. FO is reserved for the President of the United States, Secretary of Defense, Chairman of the Joint Chiefs of Staff, chiefs of military services, and others as specified by the President.

FLASH (F)—FLASH calls override lower precedence calls and can be preempted by FLASH OVERRIDE only. Some of the uses for FLASH are initial enemy contact, major strategic decisions of great urgency, and presidential action notices essential to national survival during attack or preattack conditions.

IMMEDIATE (I)—IMMEDIATE precedence preempts PRIORITY and ROUTINE calls and is reserved for calls pertaining to situations that gravely affect the security of the United States. Examples of IMMEDIATE calls are enemy contact, intelligence essential to national security, widespread civil disturbance, and vital information concerning aircraft, spacecraft, or missile operations.

PRIORITY (P)—PRIORITY precedence is for calls requiring expeditious action or furnishing essential information for the conduct of government operations. Examples of PRIORITY calls are intelligence; movement of naval, air, and ground forces; and important information concerning administrative military support functions.

ROUTINE (R)—ROUTINE precedence is for official government communications that require rapid transmission by telephone. these calls do not require preferential handling.

Security

Local command policy normally states that the DSN is to be used only for the most essential official calls. The DSN system must never be used to make personal or unofficial calls.

Telephone circuits, particularly those routed by high frequency and microwave, are susceptible to monitoring and interception. **The DSN is not a secure system!** Users must take care and use common sense to avoid divulging classified information. Giving hints or talking "around" a classified subject can lead to the compromise of classified information.

SUMMARY

With advances in communications technology, Radioman work has become easier with automated systems programmed to do much of the manual message-handling procedures. The introduction of the NSTA is evolutionary in that diskettes will eventually replace paper tape and hard-copy messages for transfer and exchange of information. The decade of the 1990s is going to prove to be an exciting time for radiomen as new equipment and systems come on-line.

RECOMMENDED READING LIST

NOTE

Although the following references were current when this TRAMAN was published, their continued currency cannot be assured. You therefore need to ensure that you are studying the latest revisions.

Automated Digital Network (AUTODIN) Operating Procedures, JANAP 128(J), Joint Chiefs of Staff, Washington, D.C., July 1983.

DSN Phase 1 User Services Guide, DCA Circular 310-225-1, Defense Communications Agency, Washington, D.C., November 1989.

Fleet Communications (U), NTP 4(C), Commander, Naval Telecommunications Command, Washington, D.C., June 1988.

Navy Ultra High Frequency Satellite Communications (U), NTP 2, Section 2 (E), Naval Computer and Telecommunication Command, Washington, D.C., July 1992.

Secure Telephone Unit Third Generation (STU-III) COMSEC Material Management Manual, CMS 6, Director, Communications Security Material System, Washington, D.C., October 1990.

CHAPTER 11

FLEET COMMUNICATIONS

CHAPTER LEARNING OBJECTIVES

Upon completing this chapter, you should be able to do the following:

- *Discuss fleet communications systems.*
- *Discuss fleet broadcasts.*
- *Describe ship-shore circuits.*
- *Outline satellite communications systems.*
- *Explain fleet satellite communications systems and subsystems.*
- *Identify special fleet communications circuits.*

The high-paced operations required of modern fleet units demand communications systems that are capable of providing high-speed, accurate, and secure transmission and reception of intelligence. To keep pace with the ever-increasing complexity of operations, today's communications systems are necessarily highly sophisticated and versatile. For our ships and submarines to operate effectively, whether independently or as part of a battle group, they must have communications systems and operators that are capable of meeting this challenge.

In this chapter, we will discuss various aspects of fleet communications systems. As a Radioman, you will be responsible for knowing the different communications systems used by the Navy and for what communications equipments make up a system.

COMMUNICATIONS SYSTEMS

Through equipment design and installation, many equipments are compatible with each other and can be used to accomplish various functions. Using this design concept, nearly all the communications needs of a ship can be met with fewer pieces of communications equipment than were previously required.

Communications can be maintained at the highest possible state of readiness when all levels of command understand the capabilities and limitations of the systems. Many communications failures are attributable to poor administration rather than to equipment failure or technical problems.

In this section, we will discuss predeployment readiness; low-, high-, very-high-, ultra-high-, and super-high-frequency communications systems; and equipment components that comprise these systems.

UNDERWAY PREPARATION

Ships deploying to overseas areas must be in a state of maximum operational and communications readiness. Type commanders determine the level of readiness of deploying ships and ensure they are adequately prepared.

A check-off list is an excellent method to ensure that step-by-step preparations are completed prior to a deployment. This list should cover all aspects of communications readiness and begin well in advance of the underway period. Some of the points to be checked include scheduling of communications assistance team (CAT) visits, maintenance and operational checks of equipment and antennas, and consumable supply levels.

The *Basic Operational Communications Doctrine (U)*, NWP 4, provides suggested minimum check-off sheets, including a **predeployment check-off sheet** and a **preunderway check-off sheet**. The first sheet provides a timetable of required checks and objectives. The second sheet is tailored to individual ships and unique requirements.

LOW-FREQUENCY SYSTEMS

The low-frequency (LF) band is used for long-range direction finding, medium- and long-range communications, aeronautical radio navigation, and submarine communications.

The low-frequency transmitter, such as the AN/FRT-72, is used to transmit a high-powered signal over long distances. Low-frequency transmitters are normally used only at shore stations or for special applications.

The low-frequency receive system is designed to receive low-frequency broadcast signals and to reproduce the transmitted intelligence. A typical low-frequency receive system is shown in figure 11-1.

Refer to the equipments in the figure as you study the next section.

1. **Antennas**—The low-frequency signal is received by the antennas, which are connected to the receiver antenna patch panels and multicouplers (AN/SRA-34, AN/SRA-57, or AN/SRA-58). As you learned in chapter 3, the multicouplers and patch panels allow the operator to select different antennas and connect them to different receivers. This way, an operator can select the correct combination suited for a particular system.
2. **LF Receiver**—The output of the receiver (audio) is fed to the receiver transfer switchboard.
3. **Switchboard**—The switchboard can connect the receiver output to numerous pieces of equipment. In figure 11-1, the receiver output is connected to the AN/UCC-1 Telegraph Terminal (discussed later).

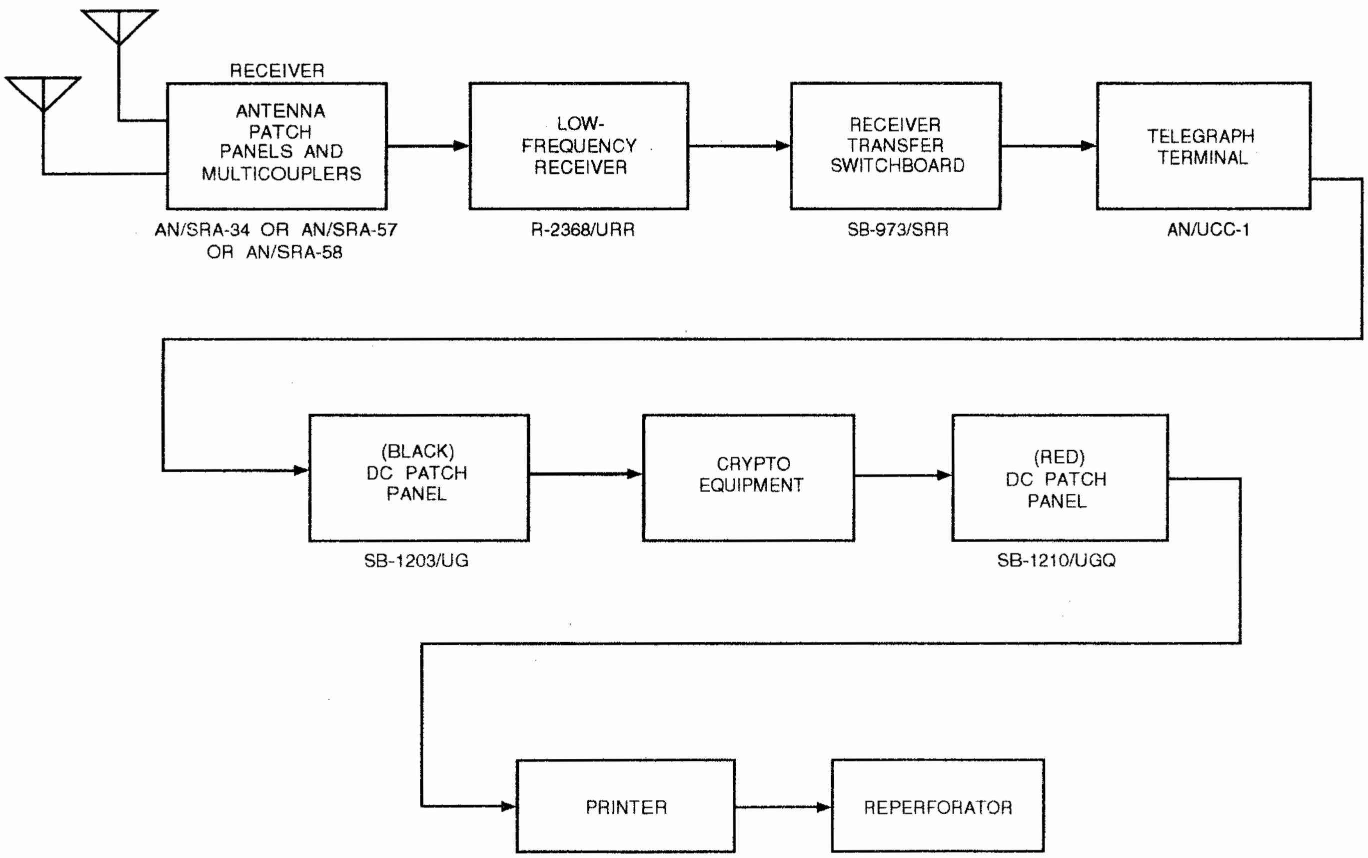


Figure 11-1.—Low-frequency receive system.

4. **AN/UCC-1**—The AN/UCC-1, as a converter comparator, converts the received audio signal to direct current (dc) for use by the teleprinter equipment.
5. **Black dc Patch Panel**—The dc output of the AN/UCC-1 is fed to the SB-1203/UG DC Patch Panel. The dc patch panel permits the signal to be patched to any cryptoequipment (discussed later) desired.
6. **Cryptoequipment**—The cryptoequipment decrypts the signal and connects its output to the red SB-1210/UGQ DC Patch Panel.
7. **Red dc Patch Panel**—The SB-1210/UGQ can be patched to a selected printer that prints the signal in plain text or to a reperforator where a paper tape is punched for storing the signal to be printed later. The SB-1203/UG and SB-1210/UGQ Patch Panels are discussed later.

HIGH-FREQUENCY SYSTEMS

The 3- to 30-MHz high-frequency (HF) band is primarily used by mobile and maritime units. The military uses this band for long-range voice and teleprinter communications. This band is also used as a backup system for the satellite communications system. We will discuss satellite communications later in this chapter.

Figure 11-2 shows a typical high-frequency transmit system. In transmitting teleprinter information, the equipments shown in figure 11-2 perform the same functions as the equipments shown in figure 11-1, except the equipments in the high-frequency system do the functions in reverse order.

In the HF transmit system, the AN/UCC-1 Telegraph Terminal converts dc signals into tone signals. The output of the AN/UCC-1 is connected to the transmitter transfer switchboard. The C-1004 Transmit Keying and Receive Control/Teleprinter is used to key the transmitter during teleprinter operation.

Voice communications from some remote locations are also connected to the transmitter transfer switchboard. Voice communications are initiated at a handset (remote phone unit) and connected to the C-1138 Radio Set Control. The output of the radio set control is connected to the transmitter transfer

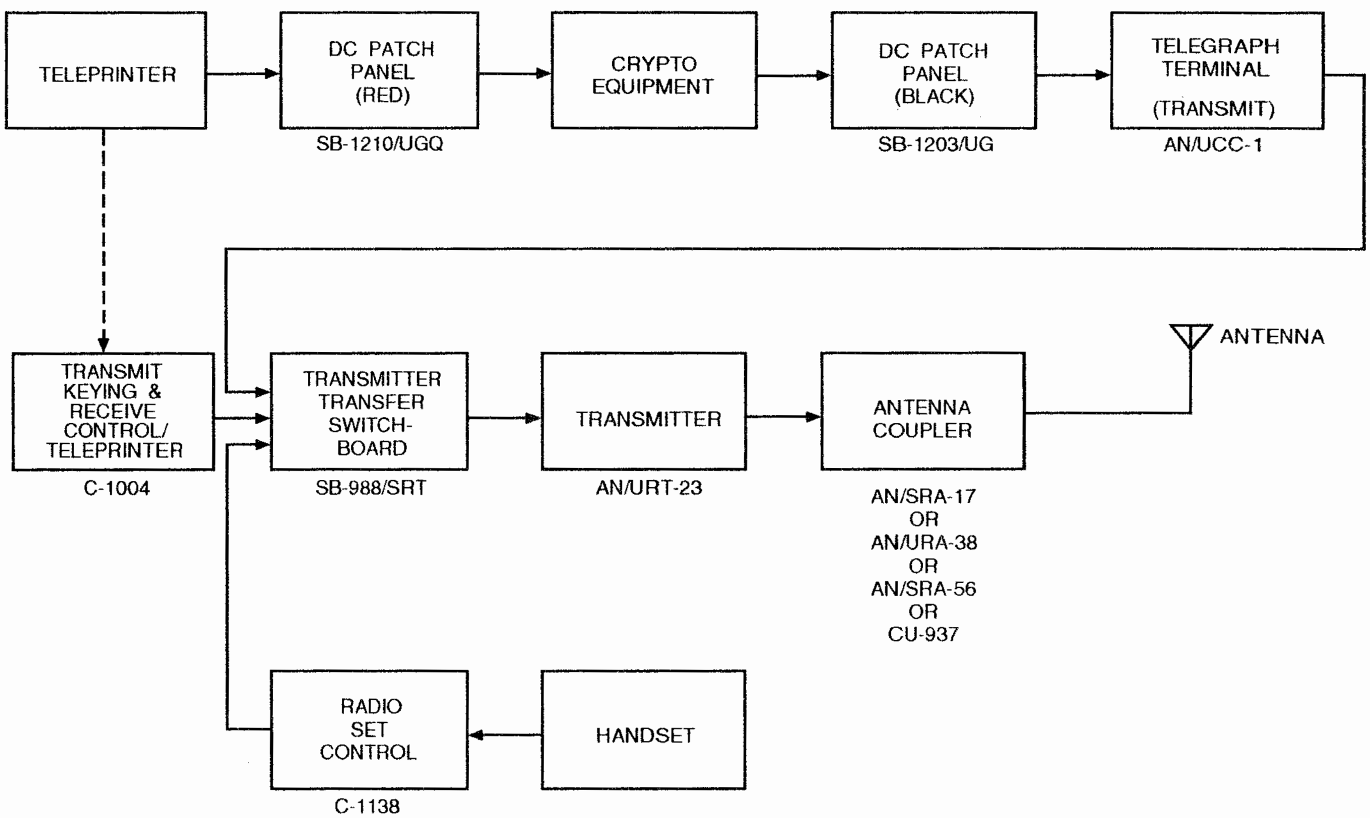


Figure 11-2.—High-frequency transmit system.

switchboard. The transmitter transfer switchboard permits the operator to select the proper transmitter for the frequency to be transmitted.

Figure 11-3 shows a typical high-frequency receive system. Refer to the figure as we follow the signal path through the system.

1. A transmitted high-frequency signal is received by the antenna, which converts electromagnetic energy to electrical energy.
2. The signal travels through a transmission line to an antenna patch panel where it can be distributed to any of a number of receivers.
3. The receiver converts the RF signal into a teleprinter or voice signal, depending upon what is desired.
4. The output of the receiver is then sent to the receiver transfer switchboard.
5. If a teleprinter signal was selected, the teleprinter signal from the switchboard goes to the AN/UCC-1 and then follows the same path as we described in the low-frequency receive section. Identical pieces of equipment are used, and they perform the same functions.
6. If a voice signal was selected, the voice signal from the receiver transfer switchboard is sent to the radio set control. The output is then sent to a handset. The voice signal can also be sent from the switchboard to a remote speaker amplifier. There, it can be placed on a speaker so that the user can listen to the received signal without holding onto the handset.

VERY-HIGH-FREQUENCY SYSTEMS

The 30- to 300-MHz very-high-frequency (VHF) band is used for aeronautical radio navigation and communications, radar, amateur radio, and mobile communications (such as for boat crews and landing parties). Figure 11-4 shows a basic block diagram of

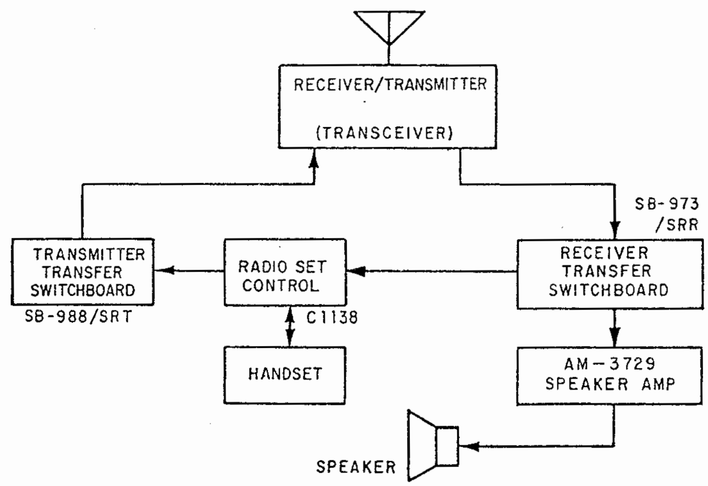


Figure 11-4.—Very-high-frequency transmit and receive system.

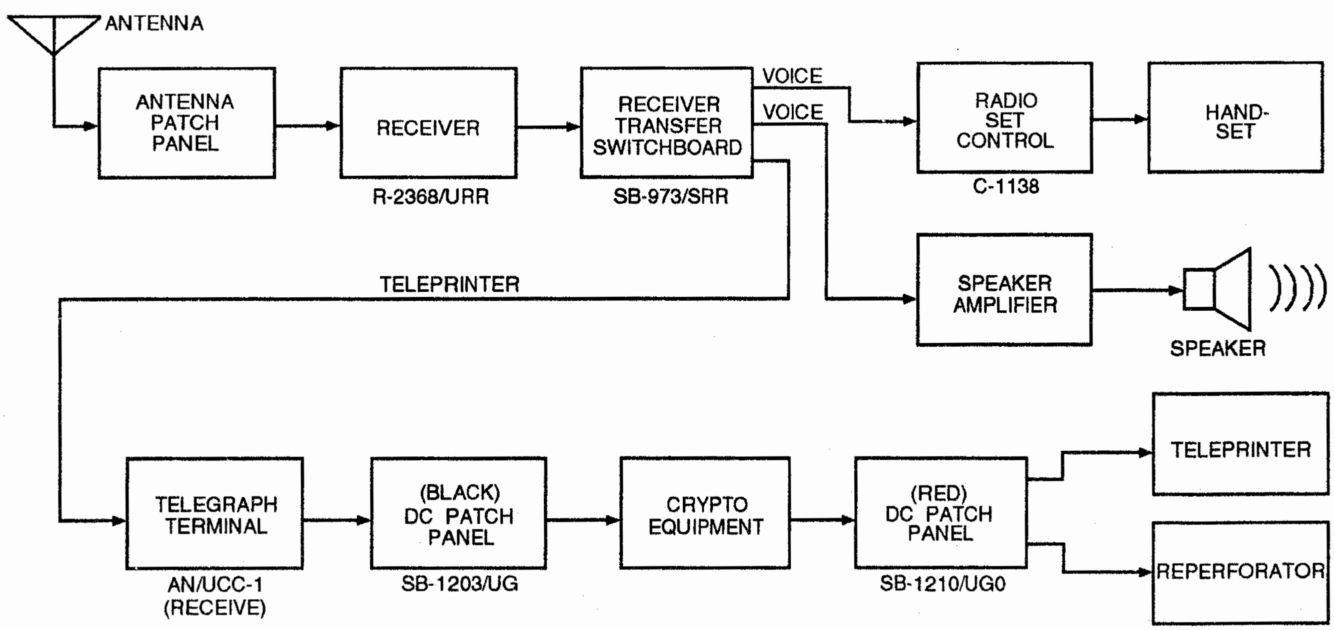


Figure 11-3.—High-frequency receive system.

a VHF transmit and receive system using a transceiver. Although a transceiver is used in this system, the transmit and receive systems are described separately. Refer to figure 11-4 as we follow the signal path on the transmit side of the system.

On the transmit side of the system, the operator, at a remote location:

1. Talks into the handset.
2. The handset is connected to the C-1138 Radio Set Control.
3. The output of the radio set control is sent to the transmitter transfer switchboard.
4. The output of the switchboard is sent to the transmit side of the transceiver.
5. The transceiver converts the input signal to an RF signal for radiation by the antenna.

Continue to refer to figure 11-4 as we follow the path of the incoming signal.

1. The incoming signal in figure 11-4 is received by the antenna.
2. This signal is sent to the receive side of the transceiver.
3. The output of the transceiver is sent to the receiver transfer switchboard.
4. From the receiver transfer switchboard, the output is sent to either the C-1138 Radio Set Control or to a speaker amplifier, or both, depending on the preference of the user.
5. The output of the radio set control is sent to a handset.
6. A speaker receives the output of the speaker amplifier.

ULTRA-HIGH-FREQUENCY SYSTEMS

The 300-MHz to 3-GHz ultra-high-frequency (UHF) band is used for line-of-sight (short-range) communications. The term "line of sight," as used in communications, means that both transmitting and receiving antennas must be within sight of each other and unaffected by the curvature of the Earth for proper communications operation.

The UHF band is also used for satellite communications. Although satellite communications are line of sight, the distance the signal travels is much greater than that of UHF surface communications because the antennas remain in sight of each other.

Figure 11-5 shows a basic block diagram of a UHF transmit system, which uses a transceiver. As in the VHF section, the transmit and receive systems will be described separately.

1. On the transmit side of the nonsecure voice system, the operator at a remote location talks into the handset. The handset is connected to the C-1138 Radio Set Control.
2. The C-1138 is connected to the transmitter transfer switchboard, where it is patched to the transmitter.
3. The operator at a remote location talks into the secure voice remote phone unit (RPU).
4. The RPU is connected to the secure voice matrix. This is the tie point for connecting more than one RPU. The output of the matrix is

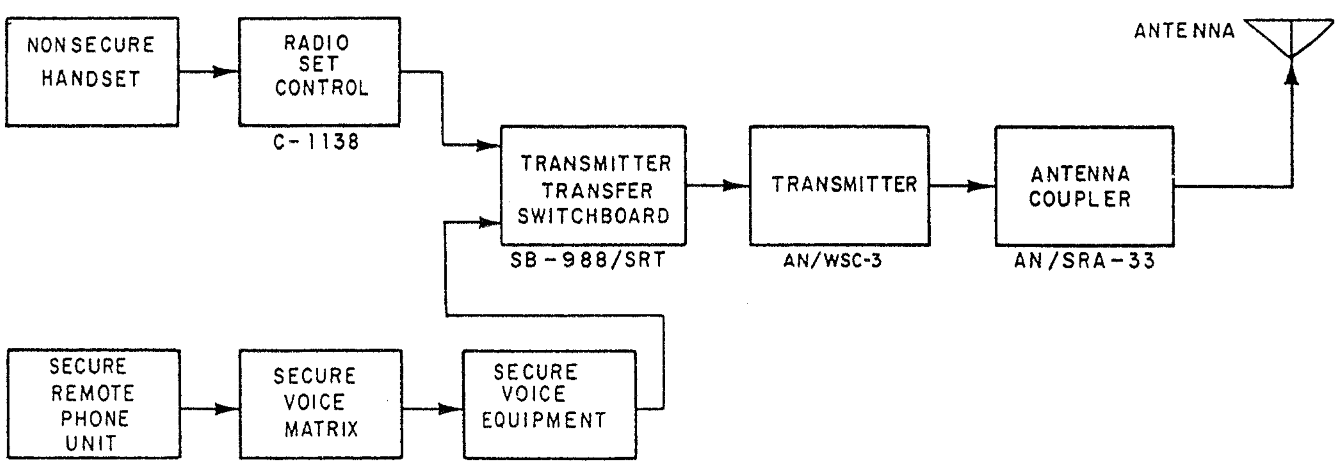


Figure 11-5.—Ultra-high-frequency transmit system.

connected to the secure voice equipment, which encrypts the information received.

5. The output of the secure voice equipment is connected to the transmitter transfer switchboard.

6. The transmitter transfer switchboard is used to connect numerous RPUs to any number of transmitters.

7. The output of the patch panel is connected to the transmitter side of the transceiver, which, in turn, is connected to an antenna coupler.

Figure 11-6 shows a basic diagram of a UHF receive system. We will next follow the UHF signal path through the receive side of the system.

1. The received signal is picked up by the antenna and connected to the receiver side of the transceiver through the antenna coupler.

2. The output of the receiver is connected to the receiver transfer switchboard. From here, it can be connected to either the nonsecure or the secure voice systems, depending upon the mode of transmission.

3. When a nonsecure signal is received, the output of the receiver transfer switchboard can be connected to the radio set control or a speaker amplifier, or both, depending on the preference of the user.

4. The output of the radio set control is connected to a handset, whereas the output of the speaker amplifier is connected to a speaker.

5. If a secure voice transmission is received, the output of the receiver transfer switchboard is connected to the secure voice equipment, where it is decrypted.

6. The secure voice equipment output is connected to the secure voice matrix. The secure voice matrix performs the same function as the matrix on the transmit system.

7. The secure voice matrix output is connected to the secure remote phone unit. Here, the signal is converted back to its original form.

SUPER-HIGH-FREQUENCY SYSTEMS

The 3- to 30-GHz super-high-frequency (SHF) band is strictly for line-of-sight communications. It is configured much the same as the UHF system. SHF is mainly used for satellite communications.

SHF satellite communications is a high-volume system that offers reliable tactical and strategic communications services to U.S. Navy elements ashore and afloat. The system is composed of the terminal segment consisting of U.S. Navy-operated Earth terminals and mobile terminals. It also includes a portion of the Defense Satellite Communications System (DSCS) satellite segment. *Navy Super High Frequency Satellite Communications*, NTP 2, Section 1 (C), provides comprehensive coverage of the Navy SHF satellite system.

PATCH PANELS

Teleprinter patch panels are used for the interconnection and transfer of teleprinter signals aboard ship. In the previous block diagrams were two patch panels,

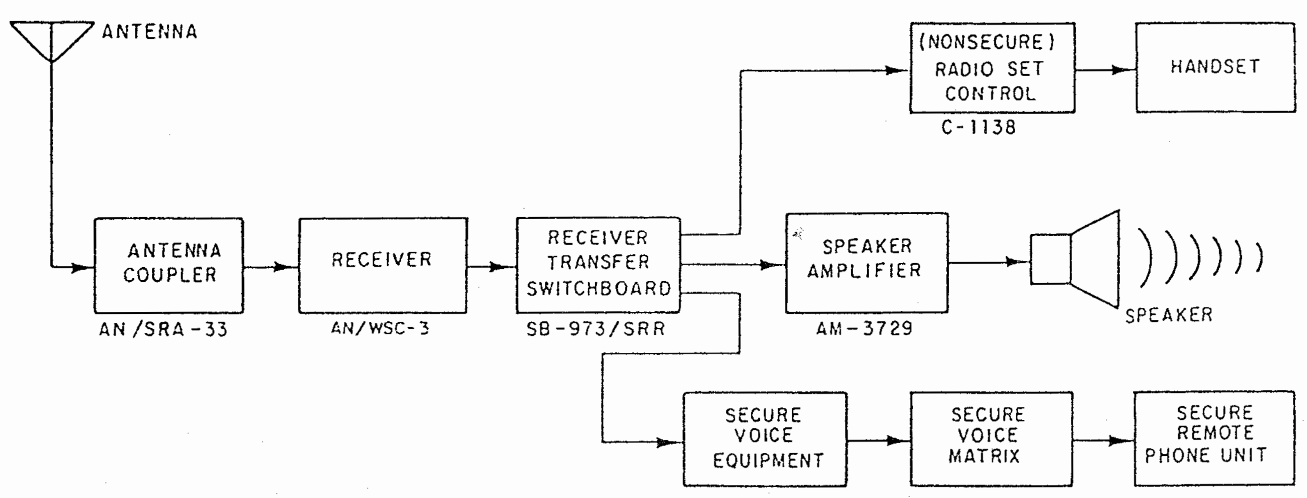


Figure 11-6.—Ultra-high-frequency receive system.

one labeled red, the other black. These are the teleprinter patch panels SB-1210/UG and SB-1203/UGQ (figure 11-7). The SB-1210/UG is intended for use with cryptographic devices; the SB-1203/UGQ is a general-purpose panel.

The patch panels are red or black to identify secure and nonsecure information. Red indicates that secure (classified) information is being passed through the panel. Black indicates that nonsecure (unclassified) information is being passed through the panel.

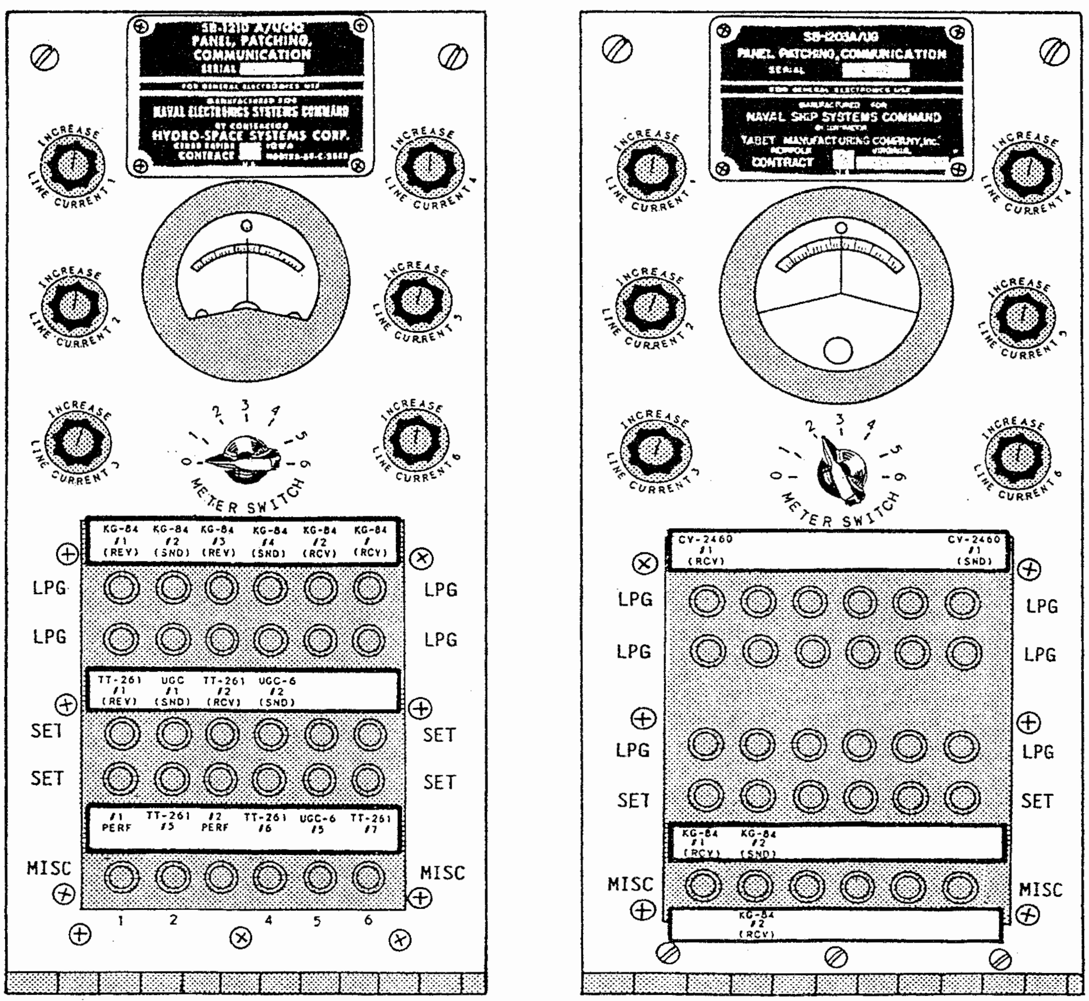
Both panels are also labeled with signs. The red panel sign has 1-inch-high white block letters that read "RED PATCH PANEL." The black panel normally has two black signs containing 1-inch-high white block letters. One sign reads "BLACK PATCH PANEL" and the other, "UNCLAS ONLY."

Each panel contains six channels. Each channel has its own series circuit of looping jacks, set jacks, and a rheostat for adjusting line current. The number of looping and set jacks in each channel varies with the panel model. Each panel includes a meter and rotary selector switch for measuring the line current in any channel.

Six miscellaneous jacks are contained in each panel. Any teleprinter equipment not regularly assigned to a channel may be connected to one of these jacks. In some instances, commonly used combinations of equipment are permanently wired together within the panel (called *normal-through*).

CRYPTOGRAPHIC EQUIPMENT

Some of the systems in the previous figures contained cryptographic equipment. Cryptographic equipment is only one of a number of the elements that make up a secure communications system. Though several different types of on-line cryptoequipments are in use throughout the naval communications system, they are



(RED), SB-1210/UG (BLACK), SB1203/UGQ

Figure 11-7.—Teleprinter patch panels.

all designed to perform the same basic function: to encipher and decipher teleprinter or digital data signals.

Simply stated, the transmitter accepts a "plaintext" teleprinter or data signal containing classified material from the classified patch panel (red). It then adds a "key," and relays the sum as "cipher text," or an enciphered signal. A key is a sequence of random binary bits used to initially set and periodically change permutations in cryptoequipment for decrypting electronic signals.

Following this encryption, the signal is fed to the unclassified patch panel (black). Here, it is patched directly to the frequency-shift keyer or the multiplex equipment of the transmitter and converted into an audio signal. The audio signal, now in a form suitable for transmission, is routed to the transmitter via the transmitter transfer switchboard.

On the receive side, the signal flow is quite similar to the send side in reverse order. The receiver accepts the enciphered signal from the black patch panel and generates a key to match the one generated by the transmitter. The receiver then subtracts the key from the cipher text input (which restores the plaintext teleprinter or data signal). Finally, it passes the signal on to the red patch panel for dissemination to the terminal equipment for printout.

For further information and operator instruction on a specific type of cryptoequipment, refer to the applicable KAO publication.

AN/UCC-1 TELEGRAPH MULTIPLEX TERMINAL

Because of the traffic volume handled, many ships and shore stations require multiple teleprinter circuits on one sideband circuit. The method for increasing circuits on a sideband is called **multiplexing**. The Navy uses two multiplexing techniques in communications: time division and frequency division. The AN/UCC-1 Telegraph Multiplex Terminal uses the frequency-division technique.

The AN/UCC-1 Telegraph Multiplex Terminal (figure 11-8) is a frequency-division multiplexed

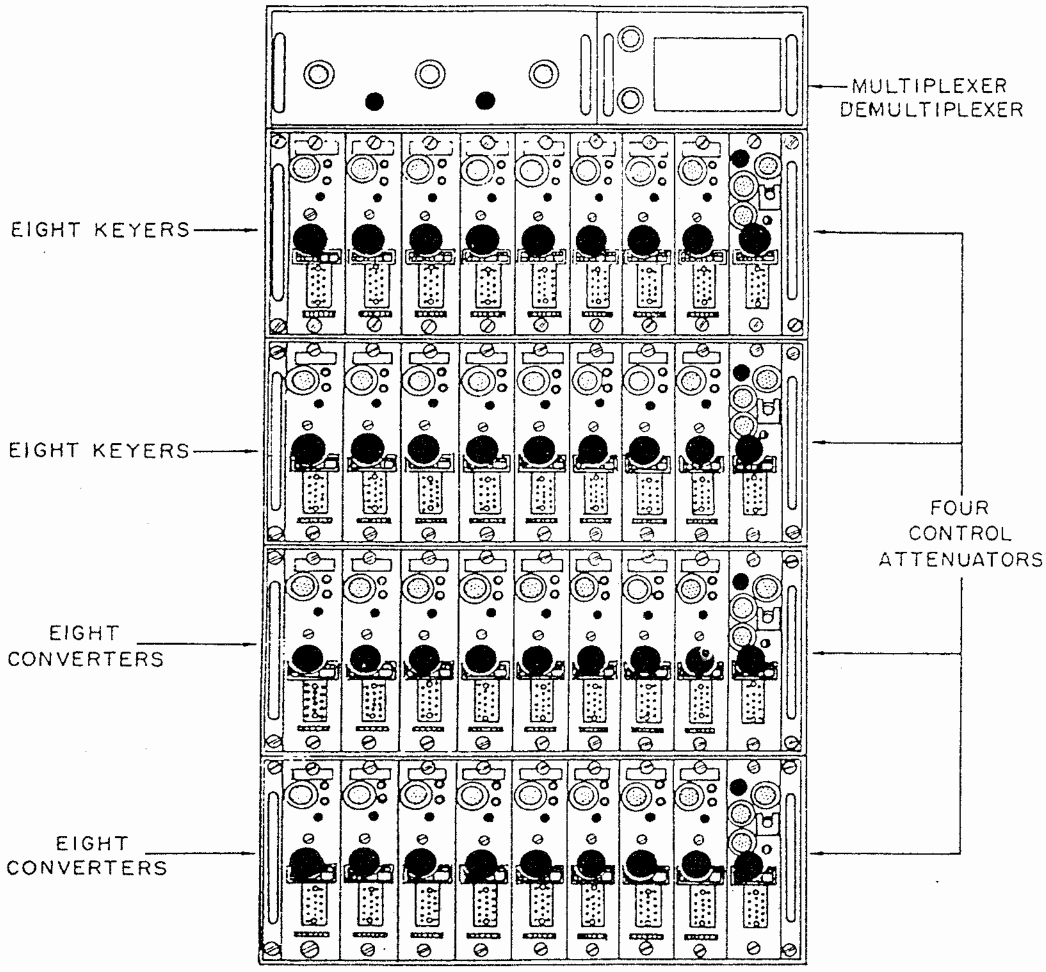


Figure 11-8.—AN/UCC-1 Telegraph Multiplex Terminal.

terminal equipment for use with single-sideband (SSB) or double-sideband (DSB) radio circuits, audio-frequency wire lines, or microwave circuits. The AN/UCC-1 is normally used afloat on a multichannel ship-shore full-period termination (discussed later).

The following is an overview of how the AN/UCC-1 works:

- At the transmitting station, the signals from the individual circuits, known as *channels*, are multiplexed into one composite signal for transmission. The transmission with the multiplexed channels is known as a *tone package*.
- At the receiving station, the composite signal (tone package) is demultiplexed (separated) into individual signals and distributed to separate teleprinters, as required.

The terminal can operate in a nondiversity, audio-frequency diversity, space diversity, or radio-frequency diversity mode. Because of this versatility, the terminal is installed in various configurations throughout the Navy.

Each electrical equipment cabinet houses one control attenuator (right side) and up to a maximum of eight frequency-shift keyers or eight frequency-shift converters.

Since the control attenuator, keyers, and converters are solid-state, integrated-circuit, plug-in modules, the number of channels can be varied by increasing or decreasing the total number of modules. Depending upon the number of modules and the configuration used, the terminal can provide up to 16 narrowband channels.

For example, if the terminal has keyers in the top cabinet and converters in the bottom cabinet, the system could transmit different information on eight channels. Each keyer would represent a channel on the transmit side and each converter, a channel on the receive side.

Each frequency-shift keyer accepts a dc telegraph signal input from an external loop and generates the appropriate audio-frequency mark and space frequency-shift output. The individual keyers each contain two oscillators operating on opposite sides of a center frequency. For example, in figure 11-9, the center frequency of keyer number one is 425 Hz, the mark frequency is 382.5 Hz, and the space frequency is 467.5 Hz. These audio-frequency mark and space

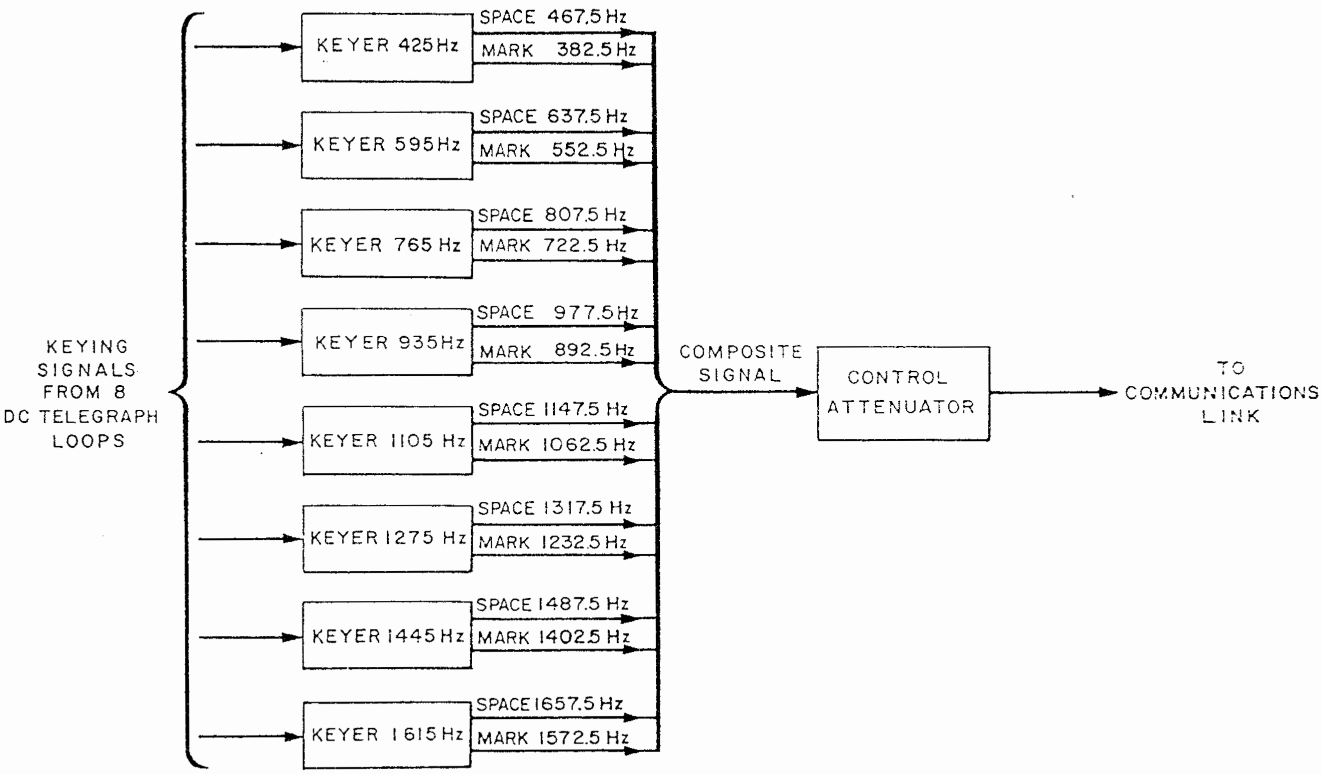


Figure 11-9.—Keying frequencies of the AN/UCC-1.

outputs are referred to as "tones"; thus keyer one has a one-channel, two-tone output.

A dc telegraph signal on channel 1 determines which frequency is gated from the keyer to the group attenuator. Each channel works in the same way. It accepts a dc signal of marks and spaces from selected equipments patched to that channel. It then provides an audio output of either a mark or space frequency-shifted tone according to the input.

The individual tones are combined at the control attenuator into a composite tone package. The control attenuator ensures that the composite tones remain at a constant amplitude for modulating the transmitter.

At the receiving end of the communications link, the AN/UCC-1 reverses the process performed at the transmitting end. The AN/UCC-1 applies the information on each of the channels to the selected equipments connected to the converter of that channel.

In a frequency-division circuit configuration, each channel has an input from a different teleprinter. If a channel fades at a particular frequency, the information on the channel could be lost or distorted. In such cases, the information may need to be retransmitted. To help prevent this, diversity switches that will permit the use of more than one channel for the same intelligence are available.

In switch position 1, only the normal channel is used. In position 2, a single teleprinter signal provides input for two adjoining keyers. In position 4, four keyers are connected to the same input loop. The switches on all keyers must be in the same position to provide the same intelligence to the selected combination of channels.

When identical intelligence in transmitted on two or four channels, it is less likely to be lost or distorted. At the receiving end, two or four corresponding converters may be used; the converter having the **stronger** signal input automatically provides the signal to be used by the receiving teleprinter.

In the fleet broadcast multiplexing system, which consists of 16 channels, 2 channels normally carry the same intelligence. This process is called *twinning*.

Another method of multiplexing mentioned earlier is time-division multiplexing (TDM). In this method, a digital input is fed to a TDM unit. Here, it is multiplexed into a composite intelligence stream for transmission. The output is sent to an end user where it is broken into its original individual inputs.

However, instead of splitting the frequencies as FDM, TDM shares time. Each input uses the full bandwidth of the assigned frequency but is assigned unique time portions of the system. Figure 11-10 illustrates the front panel of a full-duplex time-diversity modem.

FLEET BROADCASTS

Fleet broadcasts are the primary means by which mobile units receive messages. There are different types of broadcasts for the various operational units in the Navy. In chapter 5, you learned that the four major communications areas (NAVCOMMAREAs) are controlled by a Naval Computer and Telecommunications Area Master Station (NCTAMS). Each master station controls the coordination of the fleet broadcast and other communications circuits assigned to that area.

In the event of a catastrophe, each master station has an alternate NAVCOMMAREA. The alternate, in coordination with the appropriate fleet commander in chief (FLTCINC), can allocate remaining resources.

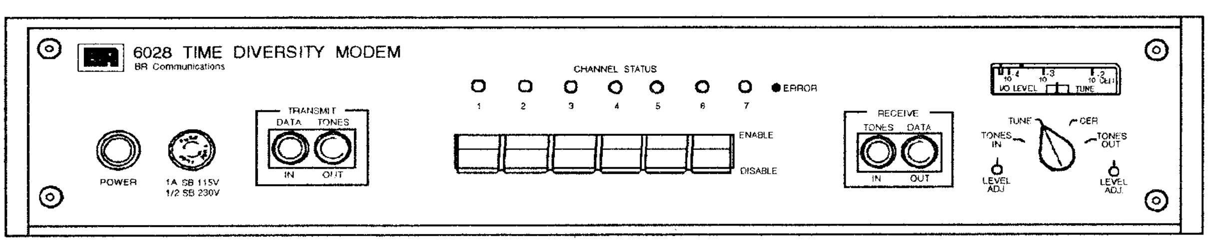


Figure 11-10.—Full-duplex time-diversity modem.

FLEET MULTICHANNEL BROADCAST (MULCAST) SYSTEM

The Fleet Multichannel Broadcast (MULCAST) system is the primary means of delivering traffic to the fleet. This broadcast system is also known as the *November System*. The MULCAST is a highly flexible system that provides global broadcast service to the fleet via the four major NAVCOMMAREAs.

The MULCAST is keyed by the automated Naval Communications Processing and Routing System (NAVCOMPARS) (discussed in chapter 10). The multichannel broadcast contains 16 separate information channels.

Ships are assigned broadcast channels by type of ship and similarity of mission. For example, destroyers may be assigned to copy channel 1, whereas amphibious ships may be assigned to copy channel 3. Ships are also assigned a channel for selectively addressed traffic and a channel for general traffic (common channel). Examples of general traffic are collective address messages and general messages.

The multichannel broadcast transmitted via satellite carries 15 channels of information. Most ships maintaining their own guard are required to copy at least the common channel. The MULCAST may be operated on low (LF), medium (MF), high (HF), and ultra-high (UHF) frequencies by satellite and nonsatellite means.

The HF component of MULCAST is pretty much relegated to a standby status. Several factors contributed to this condition, including:

- Inherent interference problems of HF propagation;
- High power usage and associated operating costs; and
- Increased technology and reliability of satellite systems.

When the HF component of MULCAST is brought up, it is transmitted simultaneously on several frequencies to permit diversity reception. In some cases, diversity reception overcomes the anomalies of HF propagation and reduces the probability of broadcast interruption. The two methods of diversity reception that recipients of the MULCAST, single-channel broadcast, HF termination, or HF ship-shore can use are **frequency** and **space**.

Frequency diversity is where the signal is transmitted and received on two radio frequencies simultaneously. Frequency diversity aboard ship permits better circuit operation since fading over different frequencies seldom occurs at the same time.

Space diversity is where two antennas and receivers are used to receive the same frequency. Space diversity is useful for shore stations but is limited for shipboard use. To be effective, the receive antennas must have at least one wavelength of separation. This is usually beyond shipboard capabilities.

SINGLE-CHANNEL BROADCAST

Ships not equipped to copy the MULCAST are required to copy the single-channel broadcast. Single-channel broadcasts are identified by the three-letter designator "RTT" preceded by the NAVCOMMAREA designation letter. For example, the LANT FLEET single-channel broadcast operated by NCTAMS LANT is designated "LRTT."

SUBMARINE BROADCAST

The submarine broadcast system is dedicated to the transmission of message traffic to submarines. It is the primary means of communications with submarines under way. Several submarine broadcasts have been established.

The multichannel broadcast for submarines is called **VERDIN**. VERDIN is the primary submarine broadcast and is operated in the VLF range. A submarine can also receive its broadcast via the Submarine Satellite Information Exchange Subsystem (SSIXS). In most instances, a submarine broadcast could also be received via LF or HF secure teleprinter.

The submarine broadcast is unique in several ways. The broadcast is repeated every 2 hours beginning with a listing of all traffic on the scheduled broadcast. Messages to units are repeated several times unless receipted for by the addressees. The number of times a message is repeated on the broadcast depends on a number of factors. Among these factors are the amount of traffic on the broadcast, the type of message, and the type of operations assigned to the addressee.

Detailed operating instructions and responsibilities of submarine broadcast operations are contained in *Basic Operational Communications Doctrine (U)*, NWP 4, and in the operational orders and instructions of appropriate fleet and force commanders. Submarine broadcast frequencies, transmitting station, and Broadcast Control Authority (BCA) can be found in type commander Communications Information Bulletins (CIBs).

ASW PATROL (VP) BROADCAST

The nature of VP aircraft operations requires dedicated transmission of all ground-to-air traffic using the broadcast method. The VP broadcast is the primary means for delivery of operational messages to aircraft, regardless of the aircraft mission, emission mode, or supplemental means for delivery.

FACSIMILE (FAX) BROADCAST

FAX is a process where graphic material, including pictures or images, is scanned and the information converted into signal waves. These waves are used locally or remotely to produce in record form a likeness (facsimile) of the copied material.

Facsimile terminal equipment is located at naval meteorological offices that prepare weather maps for transmission or at the communications center that controls the broadcast. Communications Information Bulletins (CIBs) contain facsimile frequencies.

MERCHANT SHIP BROADCAST

There is a need for rapid and reliable communications with U.S. flag merchant ships in crisis and wartime situations. Satellite communications (discussed later) provide the optimum real-time command and control necessary for Navy merchant/marine coordination and protection.

The Allied Merchant Ship Communications System (MERCOMMS) delivers U.S. Government-originated messages to merchant ships. A dual master control station concept is used with satellite communications as the primary means of communications, and high frequency (HF), as the secondary means.

Message traffic is routed through the Naval Computer and Telecommunications Station (NAVCOMTELSTA) Washington, D.C., or Naval Communications Station (NAVCOMMSTA) Stockton, California, via International Maritime Satellite (INMARSAT) systems.

HYDROGRAPHIC SCHEDULE

Messages for the hydrographic schedule are normally originated by the Naval Oceanographic Office, Stennis Space Center, Mississippi, and are addressed to all concerned in the Pacific (HYDROPAC) or Atlantic (HYDROLANT) areas. Messages on this schedule provide such information as hydrographic data, Coast Guard Notices to Mariners (navigational aids), and Notices to Airmen (NOTAMs).

Forecast and Warning Messages

Forecast and warning messages are transmitted to applicable units. Communications centers that provide guard service also receive forecast and warning messages. More detailed information, such as air observations required for flight operations, is transmitted on weather broadcasts. Schedules and frequency assignments for these broadcasts are contained in COMMAREA Communications Information Bulletins (CIBs). NWP 4 contains a chart illustrating which broadcast provides weather information for each area.

Ship Weather Reports

Operating forces transmit weather messages on existing ship-shore circuits. There are no special circuits assigned for this purpose. Time requirements for submitting weather messages are established by appropriate Fleet Weather Center (FLEWEACEN) instructions, FLTCINC instructions, or by operational commanders.

Time and Frequency Measurements

Precise time and frequency measurements are transmitted by radio stations WWV (Fort Collins, Colorado) and WWVH (Kehaha-Kawai, Hawaii). These stations broadcast on radio frequencies 2.5, 5.0, 10.0, and 15.0 MHz. In addition to these frequencies, Fort Collins also broadcasts on 20.0 MHz. You can find further information on radio time signals in *Radio Navigational Aids*, DMAHTC Pub 117.

BROADCAST CONTROL

Controlling fleet broadcasts is the responsibility of the fleet commander in chief (FLTCINC) or fleet commanders of specific communications areas. There are four distinctive components of the Fleet Broadcast

Communications System. These are discussed in the next paragraphs.

Broadcast Control Authority

The Broadcast Control Authority (BCA) is the controller of a specific broadcast, such as MULCAST or RATT. Normally, the authority is under the cognizance of the FLTCINC or force commander. The BCA provides direction and guidance to govern its assigned broadcast use, configuration, and content. The BCA may control the broadcast completely, or assign some responsibilities to a subordinate command.

Broadcast Control Station

The Broadcast Control Station (BCS) provides all the technical aspects of effecting a fleet broadcast and delivers the keying to the transmitting stations. The NCTAMS usually assembles the keystreams for all channels of a broadcast and delivers keying to the Broadcast Radiating Station (BRS) for transmission.

Broadcast Keying Station

The Broadcast Keying Station (BKS) is responsible for placing the message or facsimile traffic into the Fleet Broadcast Network. The BKS generates a keystream of broadcast-bound information to the BCS for specific channel allocation before the information is forwarded to the BRS for broadcast transmission. Because of the diversity of broadcast-bound information, individual channels of multichannel broadcast can be keyed from various BKS's within the NAVCOMMAREA.

Broadcast Radiating Station

The Broadcast Radiating Station (BRS) is responsible for radiating the broadcast signal to the fleet via satellite, HF, and LF.

BROADCAST IDENTIFICATION

Multichannel broadcasts are identified by a four-letter designator. The first letter of the designator identifies the naval communications area: L-Atlantic, M-Mediterranean, H-EASTPAC, G-WESTPAC. The second and subsequent letters identify whether the designator is a single- or multiple-channel broadcast, or broadcast type. For example, the broadcast designator "LRTT" indicates a single-channel broadcast in the Atlantic COMMAREA, whereas "LMUL" is a multichannel (MUL) broadcast. The designator "GSUB" indicates a submarine (SUB) broadcast in the WESTPAC COMMAREA.

Broadcast Message Numbering

Each message transmitted on the broadcast is assigned a alphanumeric Broadcast Sequence Number (BCSN) to ensure traffic continuity. The BCSN consists of a four-letter broadcast channel designator, and a five-digit sequence number (which indicates the number of cumulative transmissions that has occurred for the particular channel).

Sequence numbers start with 00001 at the beginning of each month and continue consecutively through 99999 until the end of the month. The numbers are reset monthly at 010001Z. Should the sequence number exceed 99999 within a given month, the counter will reset to 00001 until the end of the month. The BCSN is preceded by the message transmission identification (TI) indicator VZCZC.

BCSN numbering continuity for overload channels is maintained in the same manner as described above. In a situation where an overload channel is deactivated and then reactivated in the same month, the BCSN will run consecutively from the last number used. The overload channel activation message will indicate the first overload BCSN to be transmitted.

To ensure receipt of all messages for which a ship is an addressee, ships guarding the broadcast must maintain a complete file by BCSN of all broadcast numbers transmitted. Frequencies for specific RTT broadcasts and supplemental frequencies, as required, may be assigned by the area NCTAMS via Communications Information Bulletins (CIBs).

Broadcast Recaps

Once an hour, on the hour, a message summary (RECAP) is transmitted for each active first-run and overload broadcast channel. The RECAP provides a summary of the traffic transmitted the previous hour. RECAPs are assigned IMMEDIATE precedence and are queued at the top of the IMMEDIATE message queue.

The text of the RECAP reflects the BCSN, precedence, date-time group (DTG), originator, and broadcast addressees for each message transmitted on that broadcast channel. The DTG of RECAPs is always assigned on the hour. The following example shows the format of a RECAP for GMAA broadcast channel:

```
VZCZCGMAA01019
O 230200Z MAR 94 ZNZ
FM NCTAMS WESTPAC GUAM
TO ALL SHIPS COPYING GMAA BCST
BT
UNCLAS SVC //N00000//
GMAA RECAP 0100Z - 0200Z/023 FIRST RUN - GMBB OVERLOAD
01013 R 220933Z JCS WASHINGTON DC/USS NAPA COUNTY
01014 O 220514Z USS SAN JOSE/USS CALIFORNIA/ZNZ
01015 P 201514Z COMNAVCOMTELCOM WASHINGTON DC/CTF FOUR TWO
01016 R 230105Z USS SAN FRANCISCO/COMTHIRDFLT
01017 CANTRAN
BT
#01019
NNNN
```

Overload Channels

If traffic tempo dictates, overload channels are activated to clear first-run traffic. When required, overload channels are also used to rekey allied broadcasts in support of U.S. units participating in combined operations. Broadcast channel assignments are listed in the area CIBs.

Normally, all first-run traffic will be retransmitted 2 hours later on the associated rerun channel. This allows communications personnel the opportunity to retrieve broadcast numbers previously missed. Broadcast screen requests (BSRs) should be delayed until after receipt of the rerun transmissions.

Command Guard List

Each command is responsible for maintaining an accurate guard list. The list is composed of all AIGs, CADs, general messages, and task organization assignments required to fulfill the mission of the command. The common source route file (CSRF), the Navy's database at the LDMX/NAVCOMPARS, contains this guard list information. The file is based only on official documentation received from cognizant authorities.

When a command verifies a locally maintained guard list, it may request a copy of the CSRF guard list record to compare against the local list. If a disparity exists, the command should notify the Navy Common Source Route File (CSRF), Honolulu, Hawaii, and send copies of any documentation to support the required changes.

BROADCAST OFF-THE-AIR MONITORING (OTAM)

All broadcast channels transmitting live traffic (including the uncovered) must be monitored to ensure proper operation. Area NCTAMS may assign OTAM responsibilities for individual broadcast channels to stations other than the originating station. No more than one station is required to monitor the same broadcast channel except when unusual conditions dictate.

Support and residual stations that rekey broadcasts are required to conduct normal quality control of broadcast circuits and, where equipment allows, should spot check with OTAMs as part of the quality control effort.

BROADCAST SHIFTS

Occasionally, a ship must shift from one broadcast to another. When a ship transits the Atlantic, for instance, the Radioman will not be able to copy the Atlantic broadcast during the entire trip without reception problems. Normally, there should be a broadcast shift to the Mediterranean broadcast at about the half-way point of the transit.

The shift from one broadcast to another or a shift off the broadcast should be accomplished at 0001Z of the new radio day. The Radioman must ensure that a communications guard shift (COMMSHIFT) message is sent early enough so that it reaches Navy Common Source Route File (CSRF) Honolulu, Hawaii, between 48 and 72 hours prior to the effective time of the shift.

COMMSHIFT messages are normally assigned a ROUTINE precedence. An IMMEDIATE precedence is assigned to those COMMSHIFT messages that are effective in less than 24 hours due to an emergency change in operations or equipment failure. You can find detailed information on COMMSHIFT messages in *Fleet Communications (U)*, NTP 4.

BROADCAST CIRCUIT LOG

The form used as the broadcast circuit log and destruction sheet (figure 11-11) lists the number and classification of the messages received or transmitted. The form also serves as the record of destruction for the classified messages in the file.

Broadcast Circuit Number Log & Record of Destruction

BCSR No. CLASS	BCST No. CLASS	BCST No. CLASS	BCST No. CLASS
01 U E C S T	26 U E C S T	51 U E C S T	76 U E C S T
02 U E C S T	27 U E C S T	52 U E C S T	77 U E C S T
03 U E C S T	28 U E C S T	53 U E C S T	78 U E C S T
04 U E C S T	29 U E C S T	54 U E C S T	79 U E C S T
05 U E C S T	30 U E C S T	55 U E C S T	80 U E C S T
06 U E C S T	31 U E C S T	56 U E C S T	81 U E C S T
07 U E C S T	32 U E C S T	57 U E C S T	82 U E C S T
08 U E C S T	33 U E C S T	58 U E C S T	83 U E C S T
09 U E C S T	34 U E C S T	59 U E C S T	84 U E C S T
10 U E C S T	35 U E C S T	60 U E C S T	85 U E C S T
11 U E C S T	36 U E C S T	61 U E C S T	86 U E C S T
12 U E C S T	37 U E C S T	62 U E C S T	87 U E C S T
13 U E C S T	38 U E C S T	63 U E C S T	88 U E C S T
14 U E C S T	39 U E C S T	64 U E C S T	89 U E C S T
15 U E C S T	40 U E C S T	65 U E C S T	90 U E C S T
16 U E C S T	41 U E C S T	66 U E C S T	91 U E C S T
17 U E C S T	42 U E C S T	67 U E C S T	92 U E C S T
18 U E C S T	43 U E C S T	68 U E C S T	93 U E C S T
19 U E C S T	44 U E C S T	69 U E C S T	94 U E C S T
20 U E C S T	45 U E C S T	70 U E C S T	95 U E C S T
21 U E C S T	46 U E C S T	71 U E C S T	96 U E C S T
22 U E C S T	47 U E C S T	72 U E C S T	97 U E C S T
23 U E C S T	48 U E C S T	73 U E C S T	98 U E C S T
24 U E C S T	49 U E C S T	74 U E C S T	99 U E C S T
25 U E C S T	50 U E C S T	75 U E C S T	00 U E C S T

Signature of individual authorizing destruction	Rank	File or Service No.

LEGEND:

U = Unclassified E = Unclassified/EFTO C = Confidential

S = Secret T = Top Secret

NOTE: This form is not stocked in the Naval Supply System but may be reproduced locally.

Figure 11-11.—Broadcast Circuit Number Log and Record of Destruction.

BROADCAST FILE

The broadcast file contains a copy or filler of each message transmitted or received by the broadcast method. The file must be stored in accordance with the highest classification of the information contained. Segregated storage by classification is not required. Broadcast copies must be safeguarded in accordance with the *Department of the Navy Information and Personnel Security Program Regulation*, OPNAVINST 5510.1. Broadcast messages are retained for only 24 hours if not needed for local reference.

Top Secret and SPECAT messages addressed to the command must be filed in appropriate files and not retained in the broadcast file. Ticklers should be entered in the broadcast file in lieu of the Top Secret and SPECAT messages.

Top Secret messages received but not addressed to the command should be removed from the broadcast copies and ticklers entered in their place. These messages should be destroyed immediately by authorized methods. The destruction must be certified by two witnessing officials who place their initials next to the appropriate broadcast serial number on the check-off sheet.

BROADCAST SCREEN REQUEST

If a ship under way misses broadcast messages, the Radioman should attempt to obtain the missing messages from other ships in company, other ships present, or shore communications centers while in port. If the messages are not available locally, then the Radioman must ask for a retransmission (ZDK) of the messages from the Broadcast Keying Station by sending a broadcast screen request (BSR). BSRs are service messages designed to request a rerun of messages missed or received garbled on any fleet broadcast.

A complete copy of missed messages not addressed to the ship's guard list need not be obtained. Heading fillers of heading RECAPs can be substituted in place of the complete message. Once an hour, a message summary heading RECAP is sent on each first-run broadcast channel. This RECAP supplies the heading of the traffic from the previous hour. This is an excellent means of recovering messages that may have been missed during the previous hour via the broadcast.

COMMUNICATIONS INFORMATION BULLETINS

Designated NCTAMS and NAVCOMTELSTAs throughout the world guard ship-shore circuits to accept and relay traffic from afloat commands. The profusion of communication units guarding such circuits allows for virtually worldwide coverage for operating units, be they Navy- or MSC-controlled ships. For example, a unit operating in the mid-Atlantic may, at various times, establish circuits with NCTAMS LANT, Norfolk, and NAVCOMTELSTAs Iceland and Roosevelt Roads, Puerto Rico.

Specific frequencies and satellite channels are established by the master stations of the particular COMMAREA in a numbered Communications Information Bulletin (CIB). CIBs provide mobile commands an accurate ready reference on specific tactical communications subjects. CIBs also provide communications operating personnel with communications procedural information applicable to a specific COMMAREA.

CIBs are divided into categories. For example, CIB-2 06/94 is designated as "Frequencies" and contains pertinent information on frequencies for a particular COMMAREA. The sequence number 06 denotes that this is the sixth CIB-2 in the year 1994 from a particular NCTAMS.

Ships are required by their numbered fleet commanders to maintain a complete, current file of CIBs for the use and guidance of operating personnel. NTP 4 contains a list of the CIBs and their contents.

Several areas of the world are noted for difficulty in establishing ship-shore communications. Some of these areas are north of 75° north latitude, south of 60° south latitude, the Atlantic Ocean, the Indian Ocean, and the area off the west coast of Norway.

Before operations begin in these areas, contingency planning is vital to successfully overcome anticipated communications difficulties. If communications problems are encountered in these areas, the NCTAMS can provide additional frequency and equipment assets when requested.

Information on frequency selection in these areas is contained in *Recommended Frequency Bands and Frequency Guide*, NTP 6 SUPP-1. This publication can be used as an effective guide to circuit selection in an unknown environment.

SHIP-SHORE CIRCUITS

As we mentioned earlier, the fleet broadcast is the primary means for delivering messages to afloat commands. This section discusses a few of the other types of circuits by which a ship can transmit its message traffic ashore or to other ships for delivery or relay.

SHIP-SHORE CIRCUIT MODES OF OPERATION

There are three methods of operating circuits: duplex, simplex, and semiduplex. The mode of operation at any given time is dependent upon equipment and frequency availability.

Duplex

Duplex describes a circuit designed to transmit and receive simultaneously. In such operations, each station transmits on a different frequency and both stations transmit concurrently. Both stations are required to keep transmitters on the air at all times and to send a phasing signal at the request of the distant end. Figure 11-12 shows a diagram of a UHF/HF full-duplex FSK (frequency-shift keying) single-channel teleprinter relay circuit.

There are two types of duplex operation: full duplex and half duplex. Full duplex (FDX) refers to a communications system or equipment capable of transmitting simultaneously in two directions. Half duplex (HDX) pertains to a transmission over a circuit capable of transmitting in either direction, but only one direction at a time.

Small ships traveling in company normally use duplex in a task group common net in which they terminate with a larger ship that is serving as net control. The net control ship provides the ship-shore relay services. Ships traveling independently can use this system for an on-call ship-shore termination to transmit their outgoing messages.

Simplex

Simplex is a method of operation that provides a single channel or frequency on which information can be exchanged (figure 11-13). Simplex operation is normally reserved for UHF and those ships that do not have sufficient equipment for duplex operation. In some cases, a simplex circuit can be established when equipment casualties occur.

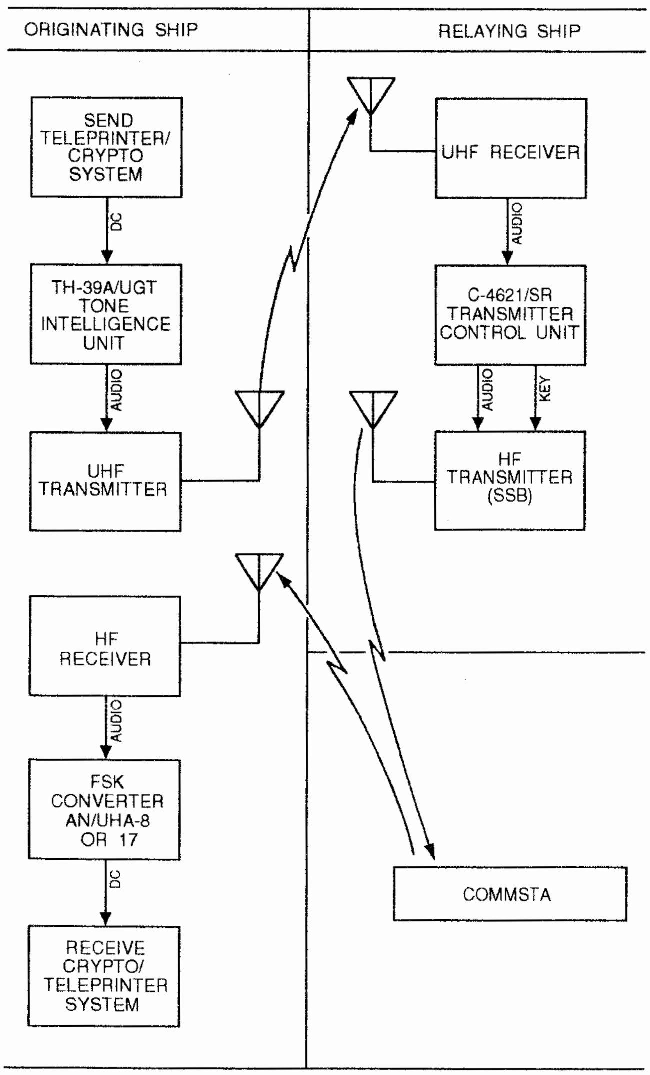


Figure 11-12.—UHF/HF full-duplex FSK single-channel teleprinter relay circuit.

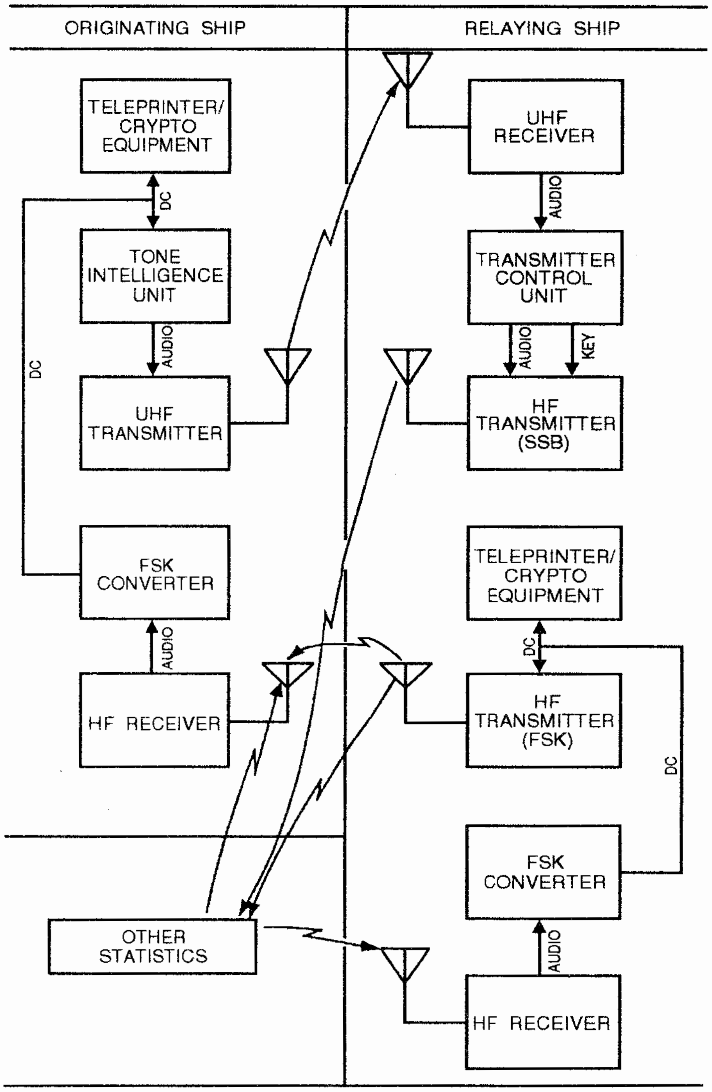


Figure 11-13.—UHF/HF netted simplex FSK teleprinter relay circuit.

Where no HF simplex frequency is indicated or guarded, ships requiring a simplex ship-shore circuit must call on a duplex ship send frequency. The ship must state "SIMPLEX" in the call-up, indicating that the ship cannot transmit and receive simultaneously.

When a ship requests simplex operation on duplex circuits, the shore station may be required to shift transmitters prior to acknowledging call-up. If no reply is received within 45 seconds, the ship should repeat the call-up procedures. If a third attempt is required, the ship should check equipment to ensure proper operation.

Semiduplex

Semiduplex circuits, used primarily on task force/task group/ORESTES, are a combination of the simplex and duplex modes. All stations except the NECOS transmit and receive on the same frequency. The NECOS transmits and is received on a second frequency. The NECOS may transmit continuously, whereas all other stations must transmit in accordance with simplex procedures.

UHF/HF RELAY

The UHF/HF relay method permits long-range, uninterrupted communications during periods of hazardous electromagnetic radiation (HERO). Figure 11-14 shows a block diagram of a UHF/HF voice relay circuit.

Modern radio and radar transmitting equipments produce high-intensity RF fields. It is possible for RF energy to enter an ordnance item through a hole or crack in its skin or to be conducted into it by firing leads, wires, and the like. Here is an example of HERO. Let's say that an aircraft carrier is arming aircraft on board. During arming operations, all HF transmitters must be secured to prevent possible detonation of the ordnance. To maintain its ship-shore

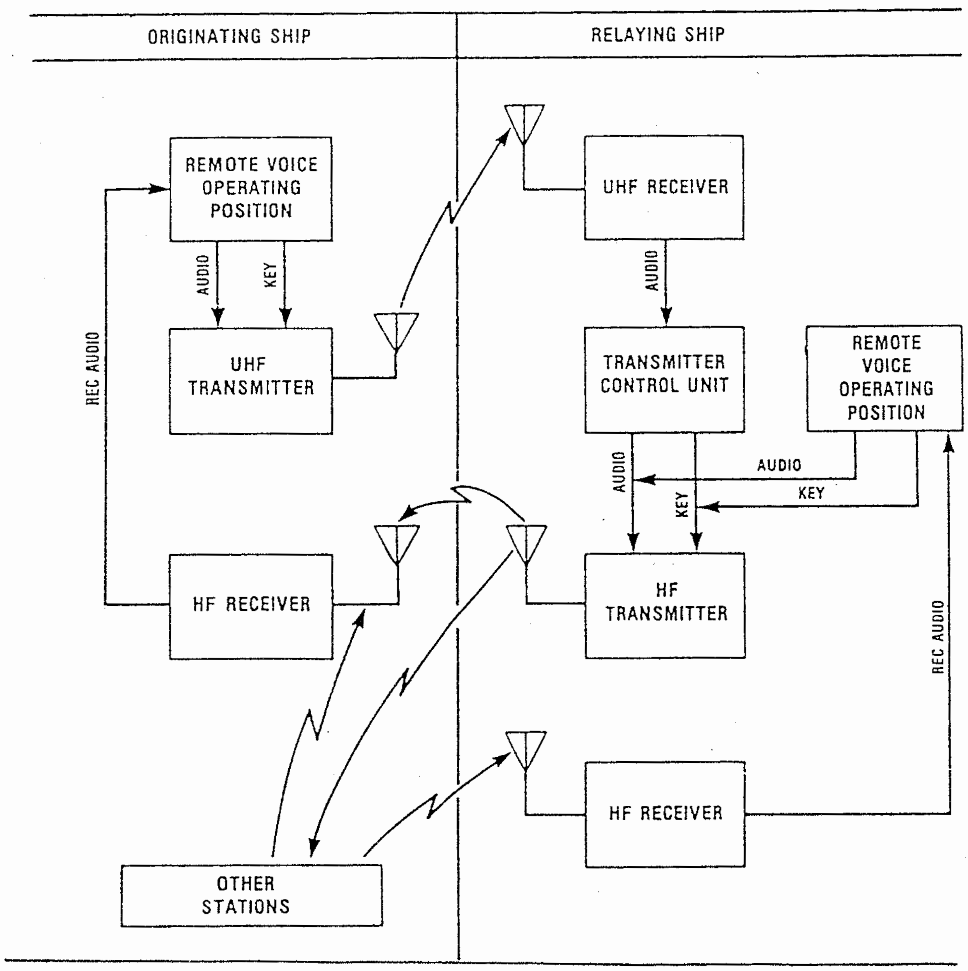


Figure 11-14.—UHF/HF voice relay circuit.

communications, the carrier transmits to a relay ship via a UHF circuit. The relaying ship then retransmits the signal on a HF circuit to a terminated NAVCOMTELSTA. On-line radioteleprinters can be relayed as well as voice using this circuit.

HIGH COMMAND (HICOM) WORLDWIDE VOICE NETWORK

The HICOM network is designed to provide real-time voice communications between forces afloat and operational commanders ashore using either HF or satellite connectivity.

HF System Control

The HICOM HF system consists of three separate networks. Each network has an area control station controlled by a FLTCINC; either CINCLANTFLT, CINCPACFLT, or CINCUSNAVEUR. Each area has subarea control stations determined by each FLTCINC to ensure worldwide coverage.

Satellite System Control

The HICOM system, using satellite transmissions, has limited shore access points at the four COMMAREA master stations and NAVCOMTELSTA Stockton, California. These sites serve as the interface channel to both the wideband and narrowband voice systems in order to extend calls to operational commanders ashore.

Net Membership

If a ship, aircraft, or shore station needs to enter the HICOM network, it must be prepared to do so with minimum time delay. Units desiring to enter the net on a temporary basis must specify the length of time and purpose for entering the net. They must also obtain permission from the appropriate control station. The area net control station (NECOS) is responsible for completing all calls originating from senior commands to all commands, ships, or aircraft within the specific FLTCINC's net. Certain rules must be observed when on the HICOM net, as follows:

- HF transmitter tuning is prohibited on HICOM. Transmitters must be calibrated and pretuned on a dummy load. Final tuning may be accomplished during live transmissions.

- All stations maintaining a continuous guard or listening watch on HICOM must maintain logs. The actual time of significant transmissions must be entered into the log. When available, recording devices must be used in lieu of a paper log.

- The HICOM net is restricted to FLASH and IMMEDIATE precedence operational voice traffic unless otherwise directed. This may include the exchange of ship-shore-ship communications coordination information in an emergency after all other attempts to effect restoration have been exhausted.

- Emergency Action Messages (EAMs) and other alerting messages may be introduced by any station within the network. Because of the vital nature of these messages, they must not be interrupted during transmission.

- With the exception of EAMs or other alerting messages, no single transmission on the net will last more than 1 minute without a 10-second pause to permit stations with higher precedence traffic to interrupt.

- The net operates as a free net unless otherwise directed by the area FLTCINC. NECOS retains the prerogative of exercising control over all transmissions to ensure proper circuit discipline.

- Each initial call-up must be identified by precedence (FLASH or IMMEDIATE) and content identification (for example, OPREP-3). The exception is for those call-ups that are authorized for restoring ship-shore circuits or technical control functions during periods of emergency.

- Voice procedures, as set forth in *Communications Instructions Radiotelephone Procedures*, ACP 125, must be used on the net unless otherwise directed.

- Except in an emergency, all units on the net will be notified of impending frequency or satellite channel shifts 5 minutes prior to the actual shift.

FULL-PERIOD TERMINATIONS

Full-period terminations are dedicated circuits that provide communications between shore stations and afloat commands. These terminations require allocation of limited NCTAMS/NAVCOMTELSTA assets. Therefore, the criteria for requesting, approving, and establishing such circuits is necessarily strict.

Termination Requests

Afloat commands and individual units can request full-period termination during special operations, deployments, intensive training periods, or exercises when primary ship-shore circuits will not suffice. Commands should request full-period terminations only when traffic volume exceeds speed and capability of ship-shore circuits and when operational sensitivity requires circuit discreetness or effective command and control necessitates dedicated circuits.

The heavy demands placed upon NCTAMS/ NAVCOMTELSTAs for full-period terminations require maximum cooperation between shore stations and afloat commanders prior to and during an operation. Ships having a need for a full-period termination, either for training or operational requirements, must submit a termination request to the COMMAREA master station at least 48 hours prior to activation time.

Emergency commitments or a command directive may necessitate a lead time of less than 48 hours. Whenever possible, however, the 2-day limit must be honored to achieve maximum preparation and coordination. NTP 4 gives details of required information that must be included in a termination request message.

The COMMAREA master station will assign a shore station for a ship's termination circuit. Once the shore station has been assigned, both the ship and the station may begin coordination to identify specific equipment keylists and frequencies needed to effect termination. The shore station will also act as NECOS. Two hours prior to the scheduled termination, the shore station can coordinate with the ship by telephone, local circuitry, or by primary ship-shore.

When the ship shifts terminations, the securing of the current termination and the establishment of a new termination should coincide with a broadcast shift whenever possible. The ship must submit a COMMSHIFT message as discussed earlier for broadcast shifts.

Termination Types

There are six types of full-period terminations, as follows

- Single-channel radioteleprinter using either radio path or landline transmission media;
- Single-channel low-data-rate satellite access using satellite transmission media;
- CUDIXS special satellite access for NAVMACS-equipped ships using satellite transmission media;
- Multichannel radioteleprinter using either radio path or landline transmission media;
- Multichannel radioteleprinter using SHF satellite transmission media; and
- Tactical intelligence (TACINTEL) access for TACINTEL-equipped ships using satellite transmission media.

Equipment Tests

To ensure that circuit equipment is in peak operational condition, complete system back-to-back off-the-air tests must be completed 24 hours prior to termination activations. Check cryptoequipment back-to-back after daily crypto changes and prior to putting circuits into service.

An aggressive PMS and quality monitoring program is essential and will be discussed later. When checking equipment, look for power levels, scorch or burn marks, proper operation of interlocks, and cleanliness. When cleaning and inspecting antennas, look for cracks, chips, or blistering of insulators. Also check for deterioration, loose connectors, and correct insulator resistance.

COMMSPOT Reports

COMMSPOT reports will be submitted by all ships, including nonterminated units, any time unusual communication difficulties are encountered. Ships will submit the COMMSPOT to the terminating communications station. Timely submission of COMMSPOT reports is necessary to minimize further deterioration of the situation.

Rules and general instructions for preparing JINTACCS formatted COMMSPOT reports are found in the *Joint Reporting System (General Purpose Reports)*, NWP 10-1-13 (Supp-1).

PRIMARY SHIP-SHORE CIRCUITS

Primary ship-shore (PRI S/S) circuits are encrypted FSK/PSK teleprinter nets that permit ships to transmit messages for delivery ashore. This service is available to units that do not maintain a full-period ship-shore termination. Navy tactical UHF satellites or the HF/UHF spectrum may be used to conduct ship-shore circuit operations. Ships may use this circuit for coordinating and establishing a full-period termination with the shore station.

The frequencies for NCTAMS and NAVCOMTELSTAs that guard primary fleet ship-shore circuits are listed in applicable CIBs distributed by the COMMAREA master stations. These frequencies are subject to change by the cognizant FLTCINC or by the NCTAMS.

STATUS BOARD

The technical control of the shore station that is NECOS for full-period terminations and PRI S/S circuits must maintain a status board. The status board should indicate, as a minimum, all systems/circuits that are active, tuned in, or in a standby status. It should also indicate all inoperative equipment. The watch supervisors must verify the accuracy of the information contained on the status board at watch turnover and update while on watch. The status board must show the following information for active and standby circuits:

- Functional title of circuit;
- Frequency(ies), both send/receive, if full-duplex operation is used;
- Circuit designator, from communication plan;
- Transmitter and receiver designations;
- For shore stations, keying line designations;
- Terminal equipment designation (for example, R-2368/URR #1);
- Cryptoequipment, keying material, and restart time;
- Operating position or remote control unit designation; and
- Remarks, as appropriate.

QUALITY MONITORING

In recent years, the volume of communications has increased dramatically. This rapid expansion has led to the installation of increasingly sophisticated equipments. Such factors as frequency accuracy, dc distortion, inter-modulation distortion (IMD), and distribution levels are critical to the operation of communications systems.

Satisfactory operation of these systems demands precise initial line-up and subsequent monitoring. System degradation is often caused by many small contributing factors that, when combined, render the system unusable. Simply looking at the page printer or listening to the signal is entirely inadequate.

Simply stated, quality monitoring is the performance of scheduled, logical checks that will ensure continuous, optimum performance and, in many cases, prevent outages before they occur. Some communications personnel quite often fail to realize the benefits of quality monitoring. An attitude develops that questions the need for quality monitoring. The result of this incorrect attitude is that circuits are either **UP** or **DOWN**. Personnel with this attitude perform no quality monitoring when the circuits are **UP** and are therefore forced to treat each outage as if it were a unique occurrence.

With no precise information concerning the trend of the system's performance, personnel must jump from one assumed probable cause to another assumed probable cause while valuable circuit time is lost. A ship with an aggressive quality monitoring program usually has personnel who are thoroughly familiar with all installed communications systems.

Quality Monitoring Program

The primary function of the quality monitoring program is the direct measurement of signal quality characteristics, including:

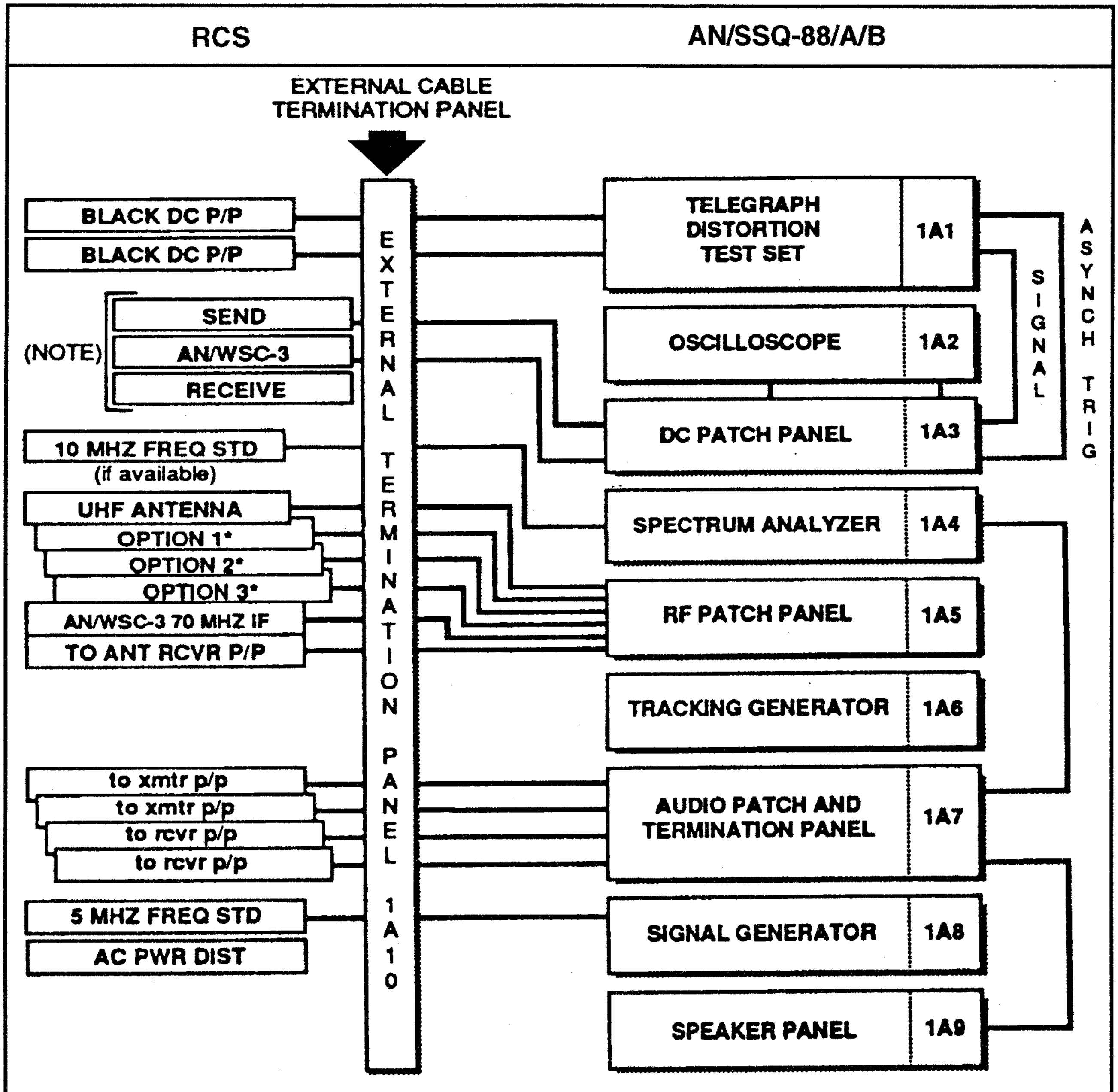
- Dc distortion;
- Audio distribution level;
- Frequency accuracy of RF signals;
- Spectrum analysis; and
- Loop current.

These measurements are broad categories and can be broken down to specific tests for specific systems.

Quality Monitoring System

Figure 11-15 is a diagram of a quality monitoring system and RCS interface. The system was designed to provide a means of monitoring and evaluating performance of any communications system used by forces afloat.

The monitoring system is a grouping of specific test equipments into a console designated as the AN/SSQ-88 Quality Monitoring Set. The set contains equipment for measuring and analyzing signals sampled by sensors installed in each communications circuit interface. The system should be operated only by personnel with sufficient knowledge to analyze the signals being transmitted and received via the ship's



(NOTE) Not used in Dual DAMA installation.

OPTIONS:
1: AN/SSQ-88()has its own dedicated HF Antenna.
2: AN/SSQ-88() shares the 2-32 MHz Antenna dedicated to AN/SRA-49 by use of a Bi-Directional Coupler.
3: AN/SSQ-88() shares the antennas for the AN/SRA-38/AN/SRA-39 and AN/SRA-40 to obtain frequency coverage of 2-32 MHz by use of a Bi-Directional Coupler.

Figure 11-15.—AN/SSQ-88 Quality Monitoring Set and RCS interface.

circuits, including individual channels of the multichannel circuits.

The console configuration shown in figure 11-16 may not be compatible with all ships; however, most ships can use equivalent test equipment to establish a quality monitoring test system.

SATELLITE COMMUNICATIONS

Satellite communication (SATCOM) systems satisfy many military communications requirements with reliable, high-capacity, secure, and cost-effective telecommunications. Satellites provide a solution to

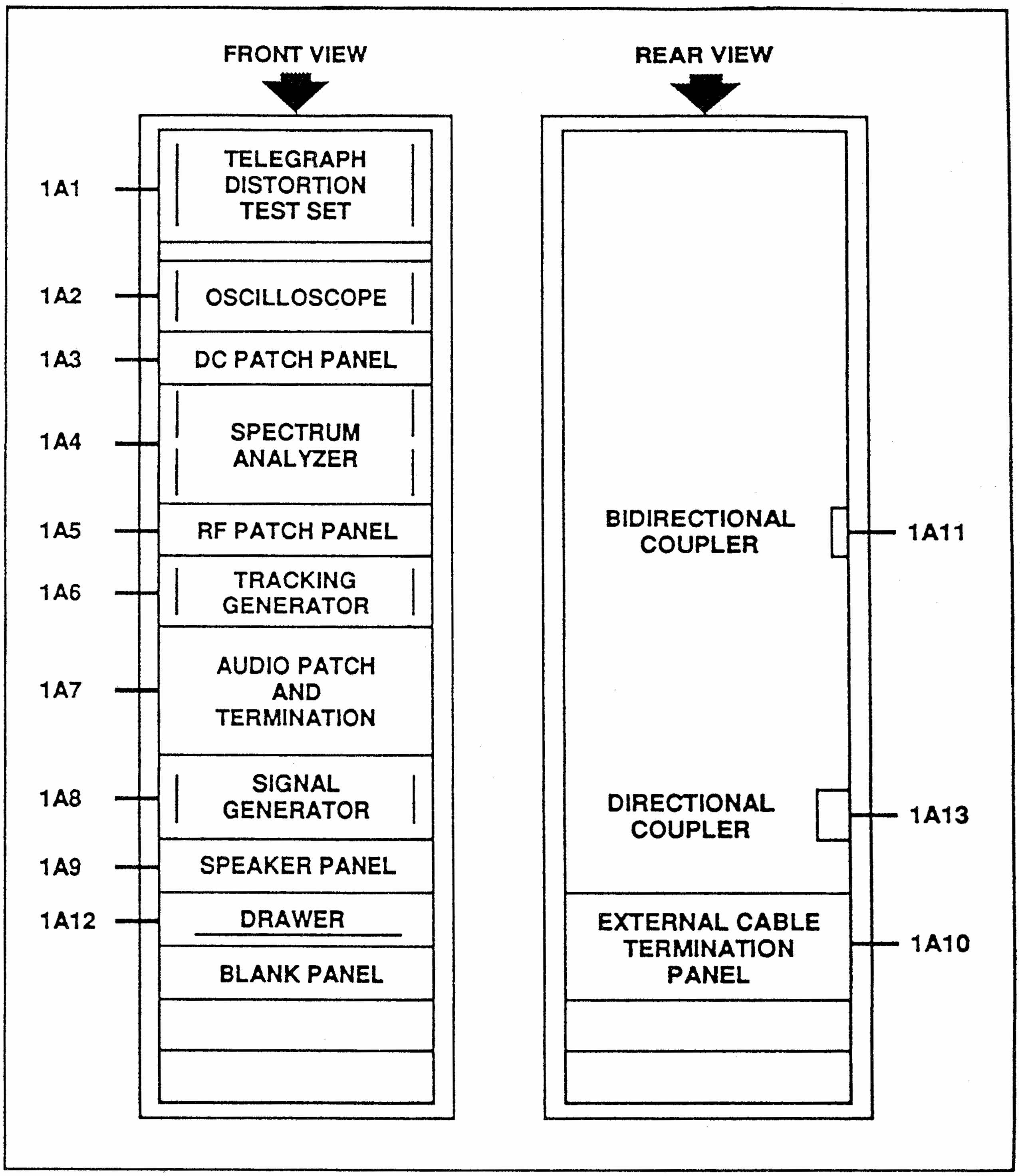


Figure 11-16.—AN/SSQ-88 equipment configuration.

the problem of communicating with highly mobile forces deployed worldwide. Satellites also provide an alternative to large, fixed ground installations. They provide almost instantaneous military communications throughout the world at all but the highest latitudes (above 70°).

TYPES OF SATELLITES

Three types of communications satellites are in use by the U.S. Navy today. They are GAPFILLER, Fleet Satellite Communication (FLTSATCOM), and Leased Satellite (LEASAT) (figure 11-17). These satellites are in geosynchronous orbit over the continental United States and the Atlantic, Pacific, and Indian oceans. Each satellite is described in the following paragraphs.

GAPFILLER

In 1976, three satellites, called MARISAT, were placed into orbit over the Atlantic, Pacific, and Indian oceans by the COMSAT General Corporation. Each satellite had three UHF channels for military use, one

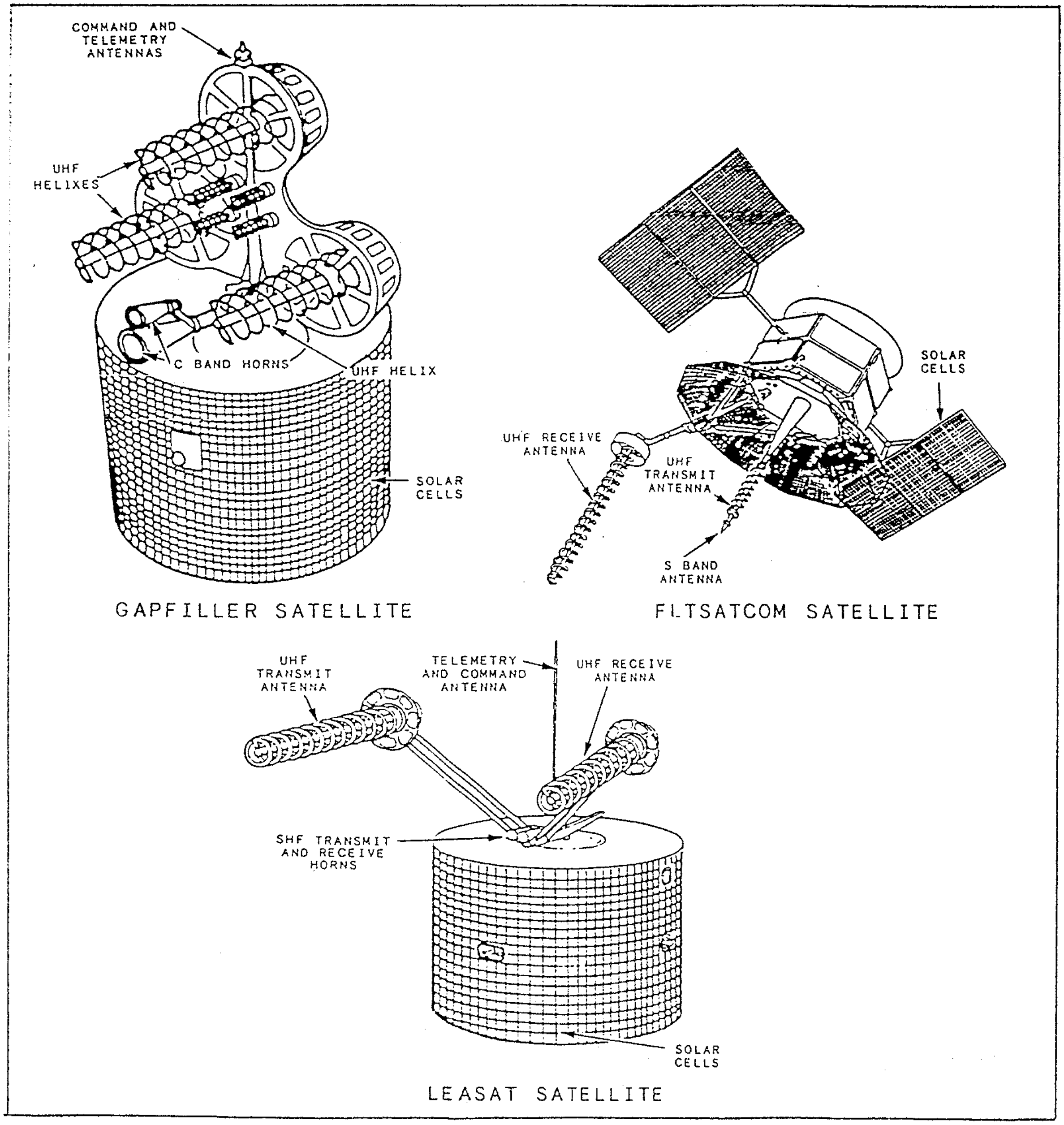


Figure 11-17.—GAPFILLER, FLTSATCOM, and LEASAT satellites.

wideband 500-kHz channel, and two narrowband 25-kHz channels.

The Navy leased the UHF section of each satellite for communications purposes. To distinguish the special management and control functions for communications on these UHF channels, the Navy gave the name GAPFILLER to the leased satellite assets.

GAPFILLER was intended to fill the need for a continuing satellite communications capability in support of naval tactical operations until the Navy achieved a fully operable Fleet Satellite Communications (FLTSATCOM) system.

The GAPFILLER satellite over the Indian Ocean is the only one still being used by the U.S. Navy. The other two GAPFILLER satellites were replaced by LEASAT. The active GAPFILLER satellite will also be replaced by LEASAT as it reaches the end of its operational life.

Within the 500-kHz band, transponders provide 20 individual 25-kHz low- and high-data-rate communications channels for 75 baud ship-shore communications and for the automated information exchange systems. The UHF receiver separates the receive band (302 to 312 MHz) from the transmit band (248 to 258 MHz).

The receiver translates the received carriers to intermediate frequencies (IFs) in the 20-MHz range and separates them into one of three channels. One channel has a 500-kHz bandwidth and two have a bandwidth of 25 kHz each. The signals are filtered, hard limited, amplified to an intermediate level, and up-converted to the transmit frequency. Each channel is then amplified by one of three high-power transmitters.

GAPFILLER also supports the FLTSATCOM system secure voice system and the fleet broadcast in the UHF range. The GAPFILLER communications subsystem will eventually be replaced by the FLTSATCOM system.

FLTSATCOM

There are four FLTSATCOM satellites in service. These satellites are positioned at 100° W, 72.5° E, 23° W, and 172° E longitudes. They serve the Third, Sixth, Second, and Seventh fleets and the Indian Ocean battle groups. These four satellites provide worldwide coverage between 70° N and 70° S latitudes (figure 11-18).

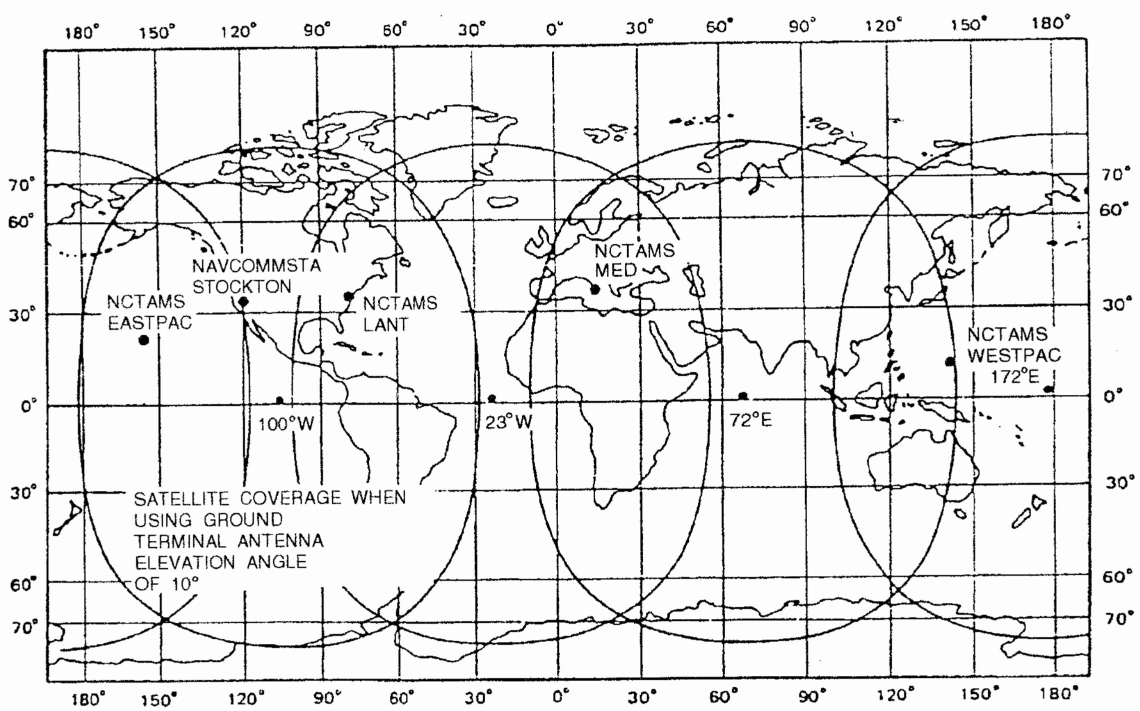


Figure 11-18.—FLTSATCOM coverage areas.

Each FLTSATCOM satellite has a 23-RF-channel capability. These include ten 25-kHz channels, twelve 5-kHz channels, and one 500-kHz channel. The 500-kHz and the ten 25-kHz channels are reserved for Navy use. Of the ten 25-kHz channels, channel 1 is used for the fleet broadcast. All channels use SHF for the uplink transmission. SHF is translated to UHF for the downlink transmission.

There is a separate UHF downlink transmitter for each channel. Each of the 23 channels has 3 different frequency plans in which the uplink or downlink may be transmitted. This capability precludes interference where satellite coverage overlaps.

LEASAT

The latest generation of Navy communications satellites is leased; hence, the program name LEASAT. As we mentioned earlier, these satellites replaced two of the three GAPFILLER satellites and augment the FLTSATCOM satellites.

CONUS LEASAT (L-3) is positioned at 105° W longitude, LANT LEASAT (L-1) is positioned at 15° W longitude, and 1O LEASAT (L-2) is positioned at 72.5° E longitude (figure 11-19).

Each LEASAT provides 13 communications channels using 9 transmitters. There are seven 25-kHz UHF downlink channels, one 500-kHz wideband channel, and five 5-kHz channels. The 500-kHz channel and the seven 25-kHz channels are leased by the Navy. One of the seven 25-kHz UHF downlink channels is the downlink for the Fleet Satellite Broadcast.

The broadcast uplink is SHF, with translation to UHF taking place in the satellite. The remaining six 25-kHz channels function as direct-relay channels with separate repeaters. Currently, the LEASAT channels provide for the following subsystems:

- Channel 1 for Fleet Satellite Broadcast transmissions;

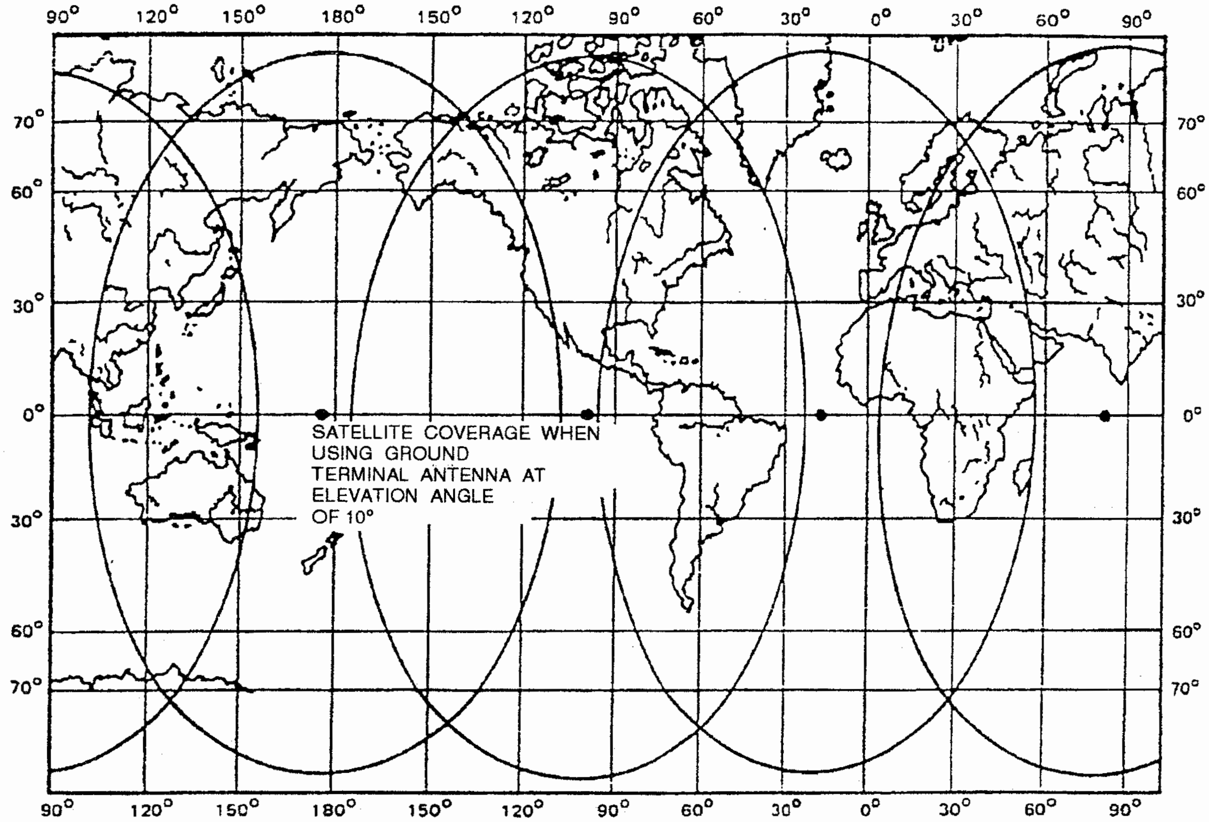


Figure 11-19.—LEASAT coverage areas.

- One 25-kHz channel for SSIXS communications;
- One 25-kHz channel for ASWIXS communications; and
- Two 25-kHz channels for subsystems that transmit or receive via DAMA (Demand Assigned Mulitlple Access) (for example, CUDIXS/NAVMACS, TACINTEL, and secure voice).

BASIC SATCOM SYSTEM

A satellite communications system relays radio transmissions between Earth terminals. There are two types of communications satellites: active and passive. An active satellite acts as a repeater. It amplifies signals received and then retransmits them back to Earth. This increases the signal strength at the receiving terminal compared to that available from a passive satellite. A passive satellite, on the other hand, merely reflects radio signals back to Earth.

A typical operational link involves an active satellite and two Earth terminals. One terminal transmits to the satellite on the **uplink frequency**. The satellite amplifies the signal, translates it to the downlink frequency, and then transmits it back to Earth, where the signal is picked up by the receiving terminal. Figure 11-20 illustrates the basic concept of satellite communications with several different Earth terminals.

The basic design of a satellite communications system depends a great deal on the parameters of the satellite orbit. Generally, an orbit is either elliptical or circular. Its inclination is referred to as *inclined*, *polar*, or *equatorial*. A special type of orbit is a synchronous orbit in which the period of the orbit is the same as that of the Earth's.

Two basic components make up a satellite communications system. The first is an installed communications receiver and transmitter. The second

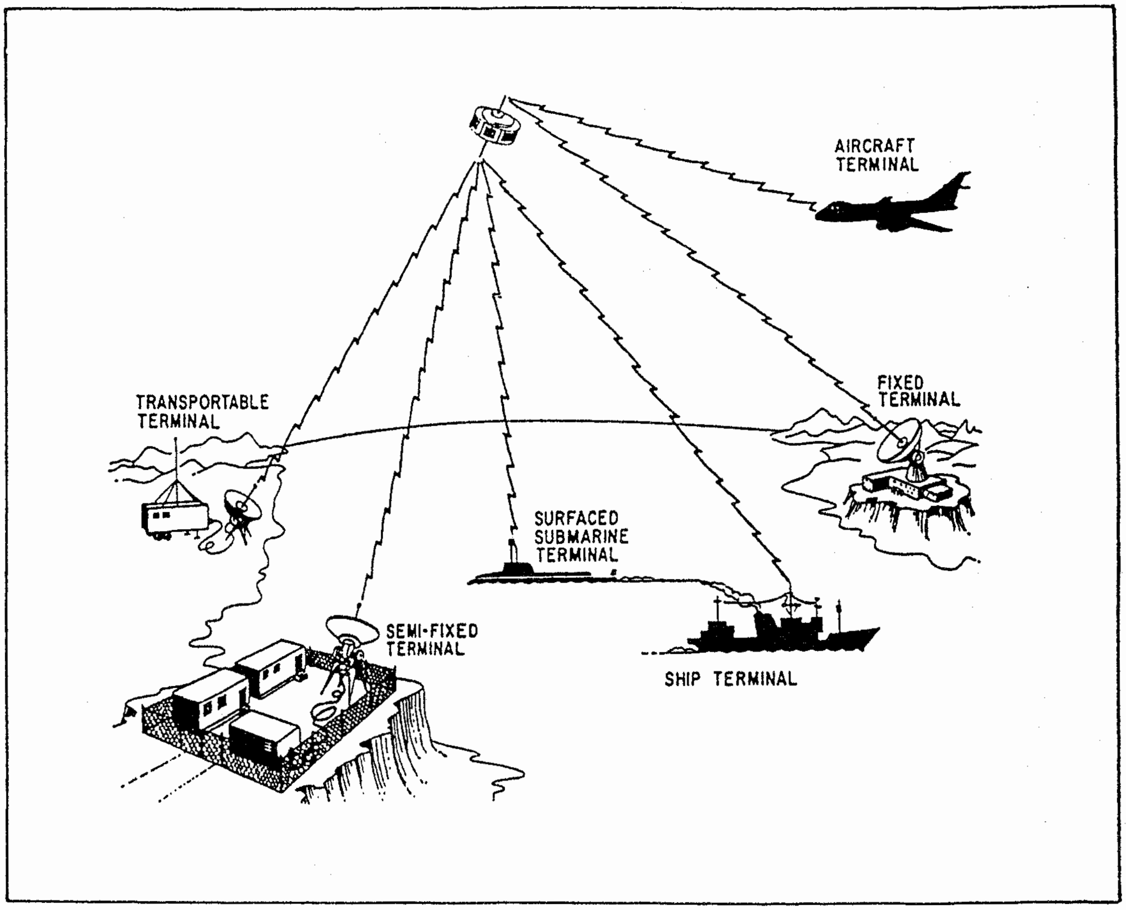


Figure 11-20.—Satellite communications systems.

is two Earth terminals equipped to transmit and receive signals from the satellite. The design of the overall system determines the complexity of the components and the manner in which the system operates.

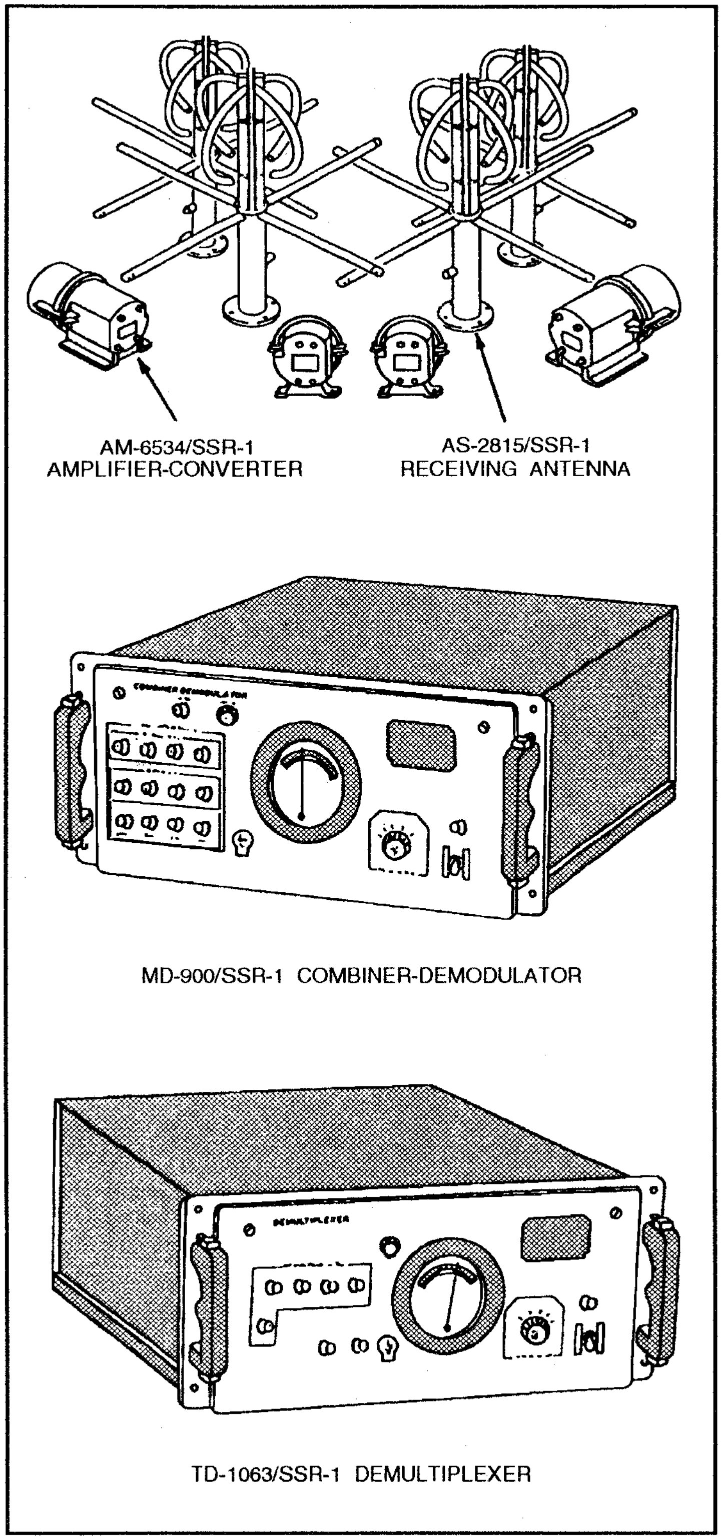


Figure 11-21.—AN/SSR-1 receiver system.

FLEET BROADCAST SUBSYSTEM EQUIPMENT

The SATCOM equipments that the Navy uses for the fleet broadcast include the SATCOM broadcast receiver (AN/SSR-1), the FLTSATCOM SHF broadcast transmitter (AN/FSC-79), the standard shipboard transceiver (AN/WSC-3), the shore station transceiver (AN/WSC-5), and the basic airborne transceiver (AN/ARC-143B). A brief description of these equipments is given in the next paragraphs.

The AN/SSR-1 is the Navy's standard SATCOM broadcast receiver system. This system consists of up to four AS-2815/SSR-1 antennas with an AM-6534/SSR-1 Amplifier-Converter for each antenna, an MD-900/SSR-1 Combiner-Demodulator, and a TD-1063/SSR-1 Demultiplexer (figure 11-21). The antennas are designed to receive transmissions at 240 to 315 MHz. The antennas and antenna converters are mounted above deck so that at least one antenna is always in view of the satellite. The combiner-demodulator and demultiplexer are mounted below deck.

The AN/FSC-79 Fleet Broadcast Terminal (figure 11-22) interfaces the communications subsystems

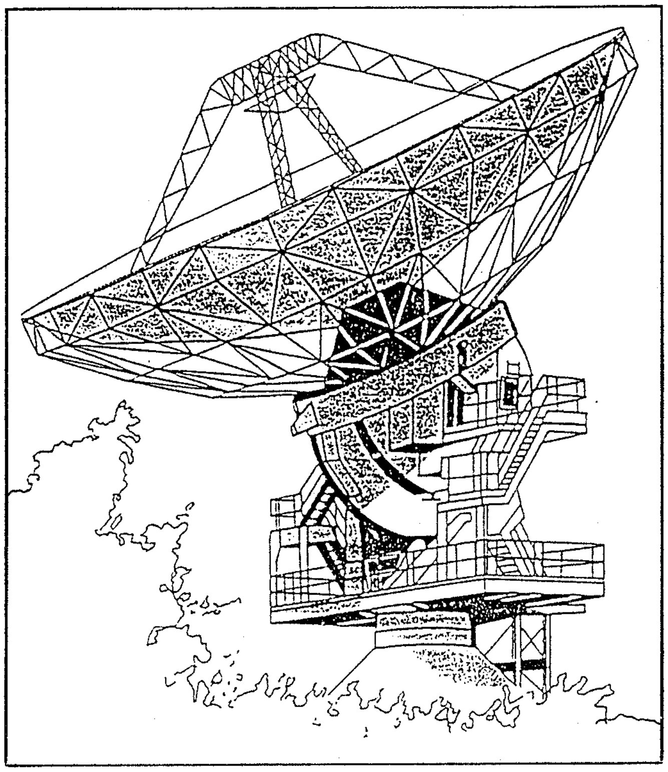


Figure 11-22.—AN/FSC-79 Fleet Broadcast Terminal.

and the satellite. The terminal provides the SHF uplink for the FLTSATCOM system and is used in particular to support the Navy Fleet Broadcast system. The AN/FSC-79 operates in the 7- to 8-GHz band and is designed for single-channel operation. The AN/FSC-79 terminal is installed at the four COMMAREA master stations and NAVCOMTELSTA Stockton, Calif.

The AN/WSC-3 Transceiver is the standard UHF SATCOM transceiver for both submarine and surface ships. The AN/WSC-3 is capable of operating in either the satellite or line-of-sight (LOS) mode and can be controlled locally or remotely.

The unit is designed for single-channel, half-duplex operations in the 224- to 400-MHz UHF band. It operates in 25-kHz increments, and has 20 preset channels. In the SATCOM mode, the AN/WSC-3 transmits (uplinks) in the 292.2- to 311.6-MHz bandwidth and receives (downlinks) in the 248.5- to 270.1-MHz band. A separate transceiver is required for each baseband or channel use.

The AN/WSC-5 UHF Transceiver (figure 11-23) is the common UHF RF satellite terminal installed at NAVCOMTELSTAs for the GAPFILLER subsystem. In FLTSATCOM operations, it is used as the common RF terminal for all subsystems except the Fleet Satellite Broadcast (FSB) and the Antisubmarine Warfare Information Exchange Subsystem (ASWIXS). The AN/WSC-5 can be used to back up the AN/FSC-79. The AN/WSC-5 transmits in the

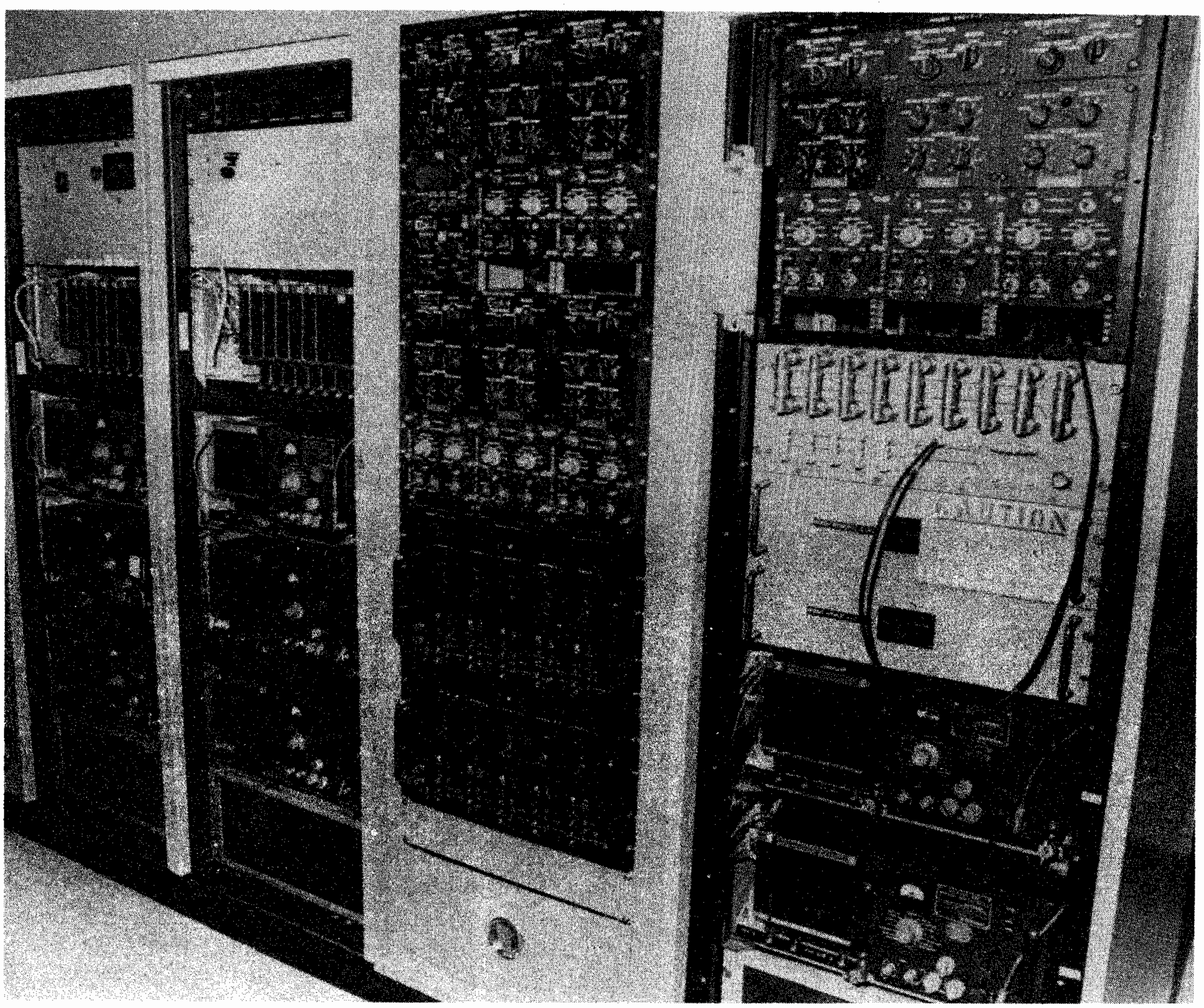


Figure 11-23.—AN/WSC-5 UHF Transceiver.

248.5- to 312-MHz range and receives in the 248.5- to 270.1-MHz range.

The AN/ARC-143 UHF Transceiver (figure 11-24) is used for ASWIXS communications and is installed at VP Antisubmarine Warfare Operation Centers and aboard P-3C aircraft. The unit has two parts: a transceiver and a radio set control. The AN/ARC-143 can be used to transmit or receive voice or data in the 255.0- to 399.99-MHz frequency range.

The systems discussed are only a few of the SATCOM equipments used by the Navy. Some of the references listed at the end of this chapter are excellent sources for more information on satellite equipment and systems.

FLEET SATELLITE COMMUNICATIONS SYSTEM AND SUBSYSTEMS

The Fleet Satellite Communications (FLTSATCOM) system and subsystems provide communications links, via satellite, between shore commands and mobile units. The system includes RF terminals, subscriber subsystems, training, documentation, and logistic support. Within each satellite, the RF channels available for use have been distributed between the Navy and the Air Force.

Equipments in support of the FLTSATCOM system are on ships, submarines, aircraft, and at shore stations. These equipment installations vary in size and complexity. Furthermore, with the exception of voice communications, the system applies the technology of processor- (computer-) controlled RF links and uses the assistance of processors in message traffic preparation and handling.

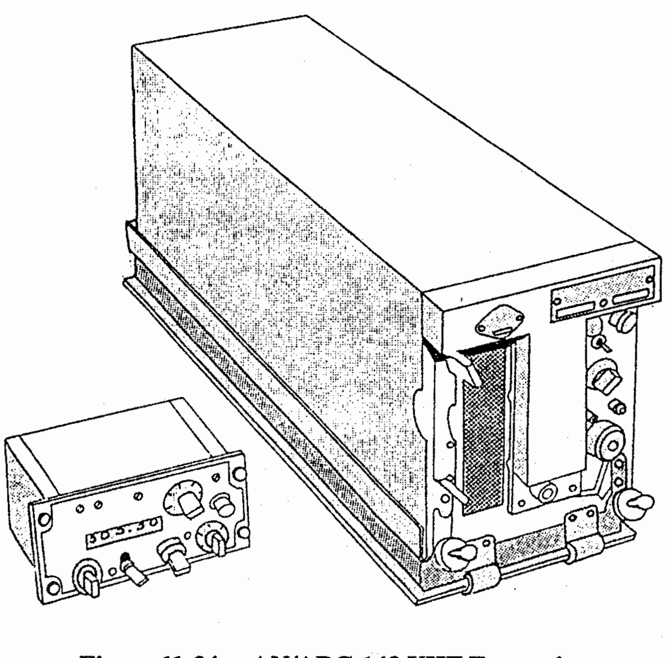


Figure 11-24.—AN/ARC-143 UHF Transceiver.

Although any part of the FLTSATCOM system can be operated as a separate module, system integration provides connections for message traffic and voice communications to DOD communications networks.

A backup capability that can be used in the event of an outage or equipment failure is provided for both shore and afloat commands. All subsystems have some form of backup mode, either from backup equipment and/or systems, facilities, or RF channels. This capability is built in as part of the system design and may limit the ability of selected FLTSATCOM systems to process information.

The FLTSATCOM system represents a composite of information exchange subsystems that use the satellites as a relay for communications. As you will learn from the following discussion, each subsystem satisfies the unique communication requirements for each of the different naval communities.

FLEET SATELLITE BROADCAST (FSB) SUBSYSTEM

The Fleet Satellite Broadcast (FSB) subsystem is an expansion of fleet broadcast transmissions that historically have been the central communications medium for operating naval units. The FSB transmits messages, weather information, and intelligence data to ships. The shore terminal transmits this data on a direct SHF signal to a satellite, where the signal is translated to UHF and downlinked. Figure 11-25 shows a standard FSB subsystem configuration.

COMMON USER DIGITAL INFORMATION EXCHANGE SYSTEM (CUDIXS) AND NAVAL MODULAR AUTOMATED COMMUNICATIONS SYSTEM (NAVMACS)

The CUDIXS/NAVMACS combine to form a communications network that is used to transmit general service (GENSER) message traffic between ships and shore installations. NAVMACS serves as an automated shipboard terminal for interfacing with CUDIXS (shore-based) (figure 11-26) and the Fleet Broadcast System.

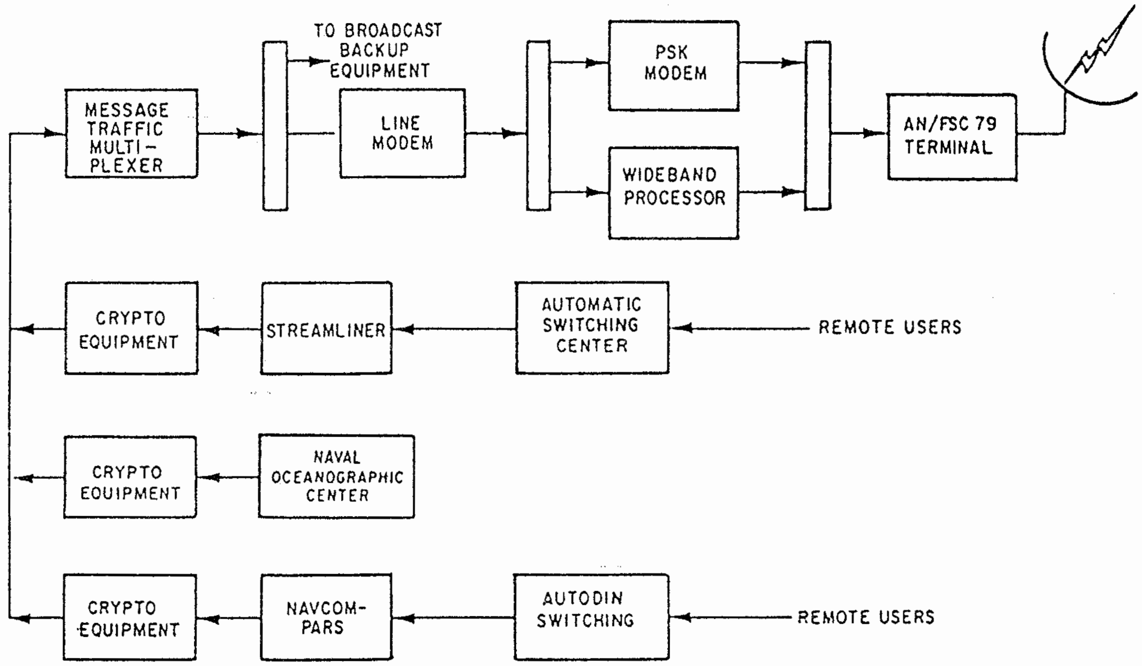


Figure 11-25.—Fleet Satellite Broadcast subsystem.

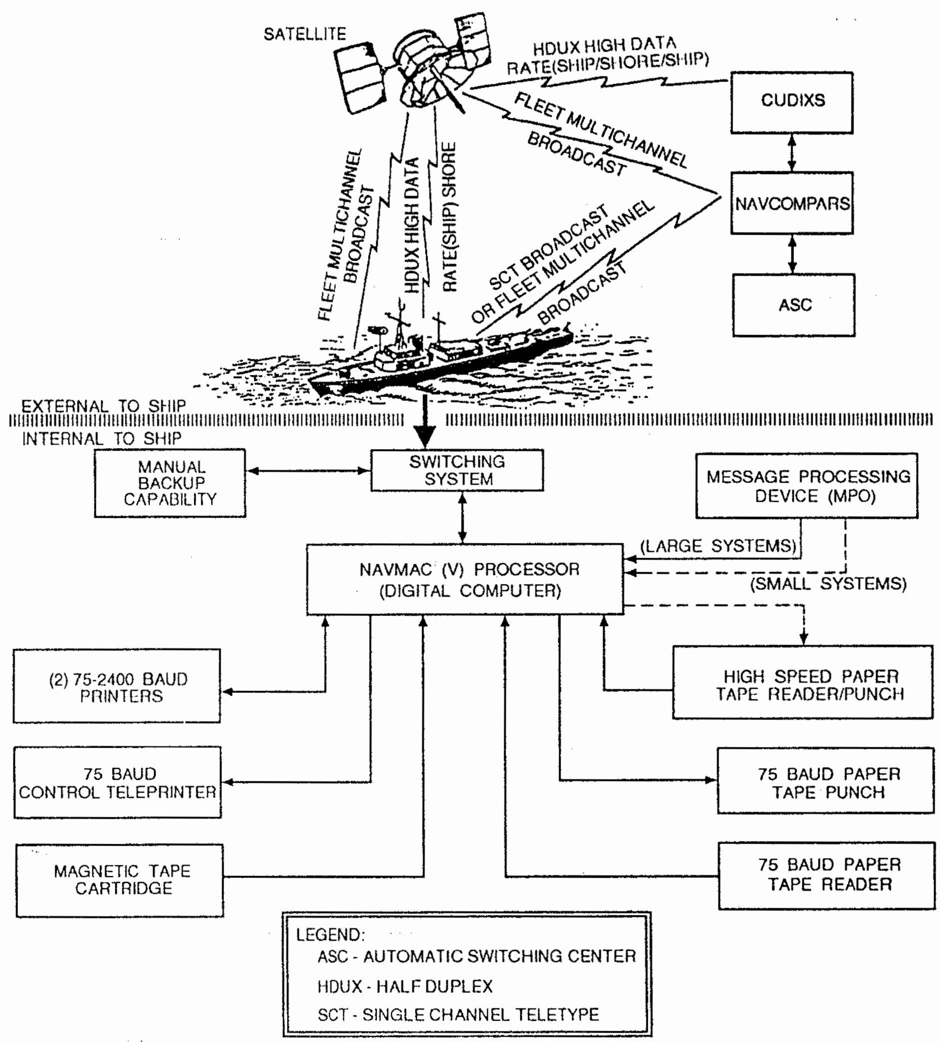


Figure 11-26.—NAVMACS (V) communications interface.

SUBMARINE SATELLITE INFORMATION EXCHANGE SUBSYSTEM (SSIXS)

The SSIXS provides a communications system to exchange message traffic between SSBN and SSN submarines and shore stations.

ANTISUBMARINE WARFARE INFORMATION EXCHANGE SUBSYSTEM (ASWIXS)

ASWIXS is designed as a communications link for antisubmarine warfare (ASW) operations between shore stations and aircraft.

TACTICAL DATA INFORMATION EXCHANGE SUBSYSTEM (TADIXS)

TADIXS is a direct communications link between command centers ashore and afloat. TADIXS provides one-way transmission of data link communications.

SECURE VOICE SUBSYSTEM

The secure voice subsystem is a narrowband UHF link that enables secure voice communications between ships. It also allows connection with wide-area voice networks ashore.

TACTICAL INTELLIGENCE (TACINTEL) SUBSYSTEM

TACINTEL is specifically designed for special intelligence communications.

CONTROL SUBSYSTEM

The Control subsystem is a communications network that facilitates status reporting and management of FLTSATCOM system assets.

OFFICER IN TACTICAL COMMAND INFORMATION EXCHANGE SUBSYSTEM (OTCIXS)

OTCIXS is designed as a communications link for battle group tactical operations.

TELEPRINTER SUBSYSTEM (ORESTES)

ORESTES is an expansion of the existing teleprinter transmission network.

LEASAT TELEMETRY TRACKING AND COMMAND SUBSYSTEM

The LEASAT Telemetry Tracking and Command subsystem is a joint operation between the U.S. Navy and contractors for controlling LEASATs. The installation of subsystem baseband equipment and RF terminals aboard ships and aircraft is determined by communications traffic levels, types of communications, and operational missions.

Since Fleet Satellite Broadcast message traffic is a common denominator for naval communications, it is received by numerous types of ships. In some installations, such as large ships, the fleet broadcast receiver represents one part of the FLTSATCOM equipment suite. A typical configuration on a large ship would include fleet broadcast, CUDIXS/NAVMACS, secure voice, OTCIXS, TADIXS, teleprinter, and TACINTEL equipment.

The FLTSATCOM subsystems apply some form of automated control to the communications being transmitted with the exception of the secure voice and control subsystems. This includes message or data link processing before and after transmittal and control of the RF network (link control) in which the messages are being transmitted. The automation of these functions is handled by a processor.

Much of the message processing before transmission and after receipt is fully automatic and does not require operator intervention. The actual message or data link transmission is fully automated and under the control of a processor. Within the limitations of equipment capability, each subsystem addresses the unique requirements of the user and the environment in which the user operates.

DEMAND ASSIGNED MULTIPLE ACCESS (DAMA)

DAMA was developed to multiplex several subsystems or users on one satellite channel. This arrangement allows more satellite circuits to use each UHF satellite channel.

Multiplexing

The number of communications networks being used is constantly increasing. As a result, all areas of the RF spectrum have become congested. Multiplexing is a method of increasing the number of transmissions taking place in the radio spectrum per unit of time.

Multiplexing involves the simultaneous transmission of a number of intelligible signals using only a single transmitting path. As we mentioned earlier, the Navy uses two multiplexing methods: time-division multiplexing (TDM) and frequency-division multiplexing (FDM). We have already discussed FDM with the AN/UCC-1. Additional information concerning both methods can be found in *Radio-Frequency Communication Principles*, NEETS, Module 17.

A UHF DAMA subsystem, the TD-1271/U Multiplexer, was developed to provide adequate capacity for the Navy and other DOD users. This subsystem was developed to multiplex (increase) the number of subsystems, or users, on one 25-kHz satellite channel by a factor of four.

This factor can be further increased by multiples of four by patching two or more TD-1271s together. This method increases the number of satellite circuits per channel on the UHF satellite communications system. Without this system, each satellite communications subsystem would require a separate satellite channel.

Transmission Rates

The DAMA equipment accepts encrypted data streams from independent baseband sources and combines them into one continuous serial output data stream. DAMA was designed to interface the Navy UHF SATCOM baseband subsystem and the AN/WSC-5 and AN/WSC-3 transceivers.

The TD-1271/U Multiplexer includes a modem integral to the transceiver. The baseband equipment input or output data rate with DAMA equipment can be 75, 300, 600, 1,200, 2,400, 4,800, or 16,000 bits per second (bps). The DAMA transmission rate on the satellite link (referred to as "burst rate") can be 2,400, 9,600, 19,200, or 32,000 symbols per second.

Circuit Restoral/Coordination

When a termination is lost in either or both directions, communications personnel must observe special guidelines. During marginal or poor periods of communications, the supervisors should assign a dedicated operator to the circuit if possible.

When normal circuit restoration procedures are unsuccessful and/or a complete loss of communications exists, an IMMEDIATE precedence COMMSPOT message should be transmitted (discussed earlier). Every means available must be used to re-establish the circuit, including messages, support from other ships or NAVCOMTELSTAs, or coordination via DAMA if available.

The guidelines established in NTP 4, CIBs, and local SOPs are not intended to suppress individual initiative in re-establishing lost communications. Circuit restoral is dependent upon timely action, quick decisions, and the ability of personnel to use any means available to restore communications in the shortest possible time.

SPECIAL CIRCUITS

During certain communications operations, you may be required to activate and operate special circuits. Some of the most common special circuits are discussed in the next paragraphs.

UHF AUTOCAT/SATCAT/ MIDDLEMAN RELAY CIRCUITS

Shipboard HERO conditions and emission control (EMCON) restrictions often prohibit transmission of RF below 30 MHz. EMCON and HERO are discussed in detail in chapters 6 and 13.

To provide an uninterrupted flow of essential communications without violating HERO and EMCON restrictions, AUTOCAT, SATCAT, and MIDDLEMAN were developed. With these techniques, the range of tactical UHF circuits (voice or teleprinter) can be extended by relay of AM UHF transmissions via HF or satellite. AUTOCAT accomplishes this using a ship, whereas SATCAT uses an airborne platform for automatically relaying UHF transmissions. MIDDLEMAN requires an operator to copy the messages with subsequent manual retransmission.

The three techniques just discussed use three different types of circuit for reception and relay of UHF transmissions. These circuits are as follows:

- A voice circuit where some units send and receive on one frequency, and other units send and receive on any other frequency;
- A voice circuit where all units transmit on one frequency and receive on another frequency; and
- A RATT circuit where all units transmit on one frequency and receive on another frequency.

FLEET FLASH NET

The Fleet Flash Net (FFN) is composed of senior operational staffs and other designated subscribers. The purpose of the FFN is to distribute high-precedence or highly sensitive traffic among subscribers. A receipt on the net constitutes firm delivery, and the message need not be retransmitted over other circuits to receipting stations. The FFN is explained in more detail in *Mission Communications*, NTP 11.

DISTRESS COMMUNICATIONS

Special methods of communication have been developed to use in times of distress and to promote safety at sea and in the air. Distress message traffic is best described as all communications relating to the immediate assistance required by a mobile station in distress. Distress traffic has priority over all other traffic. All U.S. Navy communicators must be familiar with distress signals to evaluate their meanings properly and to take appropriate action when necessary.

If a ship becomes involved in a distress situation, communications personnel should send distress messages on normal operating encrypted circuits. If the need for assistance outweighs security considerations, the ship's commanding officer may authorize the transmission of an unclassified distress message on one of the national or international distress frequencies.

When a ship in distress is traveling in company with other ships, the ship in distress would transmit the distress message to the officer in tactical command (OTC), who will take appropriate action.

Distress Frequencies

Several frequencies in different bands are designated for the transmission of distress, urgency, safety, or search and rescue (SAR) messages. The following frequencies have been designated for use during a distress or emergency situation:

- **500 kHz**—International CW/MCW distress and calling;
- **2182 kHz**—International voice distress, safety, and calling;
- **8364 kHz**—International CW/MCW lifeboat, life raft, and survival craft;
- **121.5 MHz**—International voice aeronautical emergency;
- **156.8 MHz**—FM United States voice distress and international voice safety and calling; and
- **243.0 MHz**—Joint/combined military voice aeronautical emergency and international survival craft.

During SAR missions, the following frequencies are authorized for use:

- **3023.5 and 5680 kHz**—International SAR frequencies for the use of all mobile units at the scene of a search. Also for use of shore stations communicating with aircraft proceeding to or from the scene of the search. CW and voice are authorized.
- **123.1 MHz**—International worldwide voice SAR use.
- **138.78 MHz**—U.S. military voice SAR on-the-scene use. This frequency is also used for direction finding (DF).
- **172.5 MHz**—U.S. Navy emergency sonobouy communications and homing use. This frequency is monitored by all U.S. Navy ASW aircraft assigned to a SAR mission.
- **282.8 MHz**—Joint/combined on-the-scene voice and DF frequency used throughout NATO.

The control of distress message traffic on any designated frequency is the responsibility of the station in distress. However, this station may delegate its responsibility to another station on the frequency.

Distress Watches

Navy units at sea have always maintained listening watches on distress frequencies. Communication watch requirements vary according to the operational mission of the ship and available equipment assets. Ships in company normally divide distress watch requirements among the group.

VOICE INTERFACE SYSTEMS

The Command Switch System (CSS) and DSN Universal Multiline Adaptor (UMLA) are unclassified systems with operator interface. These systems provide high-quality voice communications between operational commanders ashore and aircraft or forces afloat.

NCTAMS EASTPAC, NCTAMS MED, and NAVCOMTELSTA San Diego are equipped with the CSS. The CSS can patch calls to DSN and commercial circuits ashore. The UMLA, which patches voice communications to DSN circuits only, is being replaced by the Programmable AUTOVON Exchange (PAX).

The PAX will have both DSN and commercial patching capabilities. Each NCTAMS/NAVCOMTELSTA is equipped to extend shore telephone systems to fleet units. Because these systems rely on HF/UHF radio paths, they are highly susceptible to enemy interception, exploitation, and direction finding.

SUMMARY

Your commanding officer must be able to communicate with ships and shore stations to maintain effective command and control of the situation at hand. Communications are, and always will be, the "voice of command." In the age of nuclear weapons, guided missiles, supersonic aircraft, and high-speed ships and submarines, top performance is required of our fleet communicators. You, as a Radioman, must always be in constant readiness to meet this formidable challenge.

RECOMMENDED READING LIST

NOTE

Although the following references were current when this TRAMAN was published, their continued currency cannot be assured. You therefore need to ensure that you are studying the latest revisions.

Basic Operational Communications Doctrine (U), NWP 4 (Rev. B), Chief of Naval Operations, Washington, D.C., September 1989.

Electronics Technician 3 & 2, NAVEDTRA 10197, Naval Education and Training Program Management Support Activity, Pensacola, Fla., March 1987.

Fleet Communications (U), NTP 4(C), Commander, Naval Telecommunications Command, Washington, D.C., June 1988.

Navy Super High Frequency Satellite Communications, NTP 2, Section 1 (C), Naval Computer and Telecommunications Command, Washington, D.C., June 1992.

Navy Ultra High Frequency Satellite Communications (U), NTP 2, Section 2 (E), Naval Computer and Telecommunications Command, Washington, D.C., July 1992.

Navy UHF Satellite Communication System Description, FSCS-200-83-1, Naval Ocean Systems Center, San Diego, Calif., December 1991.

Navy UHF Satellite Communication System-Shipboard, EE130-PL-OMI-010/W142-UHFSATCOM, Space and Naval Warfare Systems Command, Washington, D.C., August 1986.

CHAPTER 12

MESSAGE CENTER OPERATIONS

CHAPTER LEARNING OBJECTIVES

Upon completing this chapter, you should be able to do the following:

- *Describe how to verify, process, and route incoming messages.*
- *Describe how to verify, process, and backroute outgoing messages.*
- *Discuss the procedures for handling messages on diskettes.*
- *Explain the procedures for maintaining message logs.*
- *Discuss the maintenance of communication center files.*
- *Identify the responsibilities of a traffic checker.*

In this chapter, we will discuss the processing of incoming and outgoing messages, including those on diskettes. Because naval telecommunications centers (NTCCs) handle message traffic for several commands, it is not unusual for an NTCC to handle several hundred messages monthly.

Besides over-the-counter customers, NTCCs also handle messages over ship-shore circuits for relay. Therefore, radiomen must follow the standard procedures issued by their message centers to prevent losing messages or causing delivery delay to subscribers.

PROCESSING INCOMING MESSAGES

Incoming messages are those messages **received** by a communications center. Incoming messages are addressed to the commands (subscribers) serviced by the NTCC. Incoming messages may also be messages accepted for relay, such as messages received on primary ship-shore circuits for relay through the AUTODIN system.

Figure 12-1 illustrates the standard flow for processing incoming messages. Today, virtually all incoming messages are processed by automated

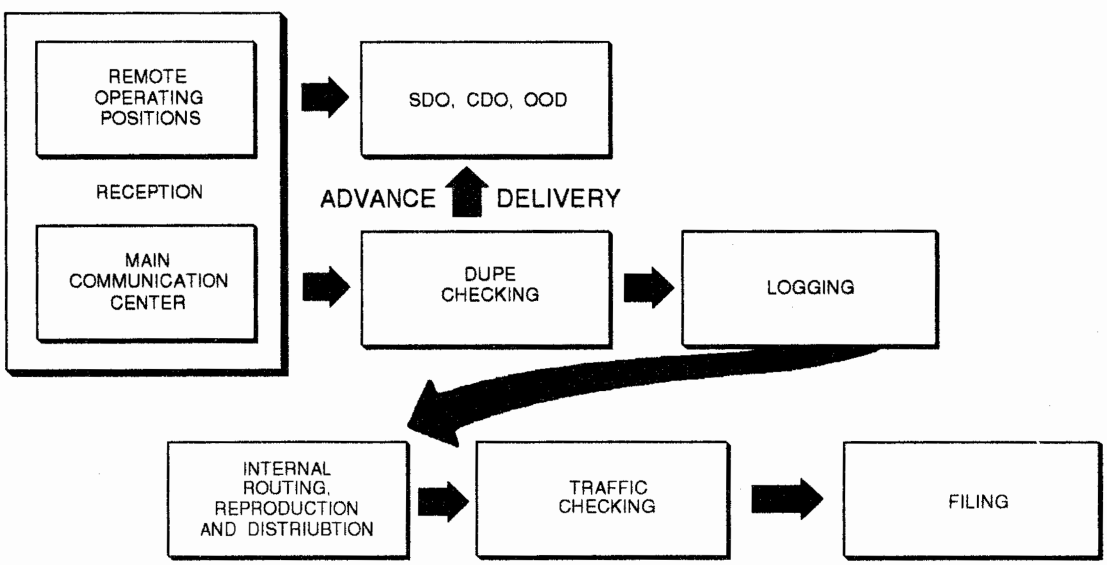


Figure 12-1.—Incoming message flow.

systems, but a knowledge of manual processing is still necessary.

PROCESSING AUTOMATIC INCOMING MESSAGES

Messages coming into the LDMX/NAVCOMPARS system from CUDIXS, WWMCCS, PCMT, or other dedicated circuits are assigned a processing sequence number (PSN). They are then stored on diskette for recovery purposes and put on queue for processing.

Messages are processed from the queue on a first-in first-out basis by precedence order. Each message is analyzed, transmission control characters deleted, and message handling and identifying fields extracted for filing and editing of the message.

Messages received on dedicated circuits carry an identifying channel sequence number (CSN). CSNs identify the number of transmissions received from a particular subscriber and are normally received in sequential order. Receipt of an out-of-sequence number alerts the system to a missed transmission. The system automatically generates a service message for missing numbers.

Under ideal conditions, a message is processed through the LDMX/NAVCOMPARS automatically. Basic steps for processing automatically received messages are shown in figure 12-2. Messages with errors, such as an incorrect date-time group, invalid classification line, or misspelled short titles, require manual intervention to correct.

The LDMX/NAVCOMPARS sends such messages to a router video display terminal (VDT). Here, the router either corrects the error and releases the message for further processing or rejects the message. If rejected, an unedited copy will be output to the service printer with a notation indicating the reason it was rejected. All duplicate messages will also be rejected to the service printer.

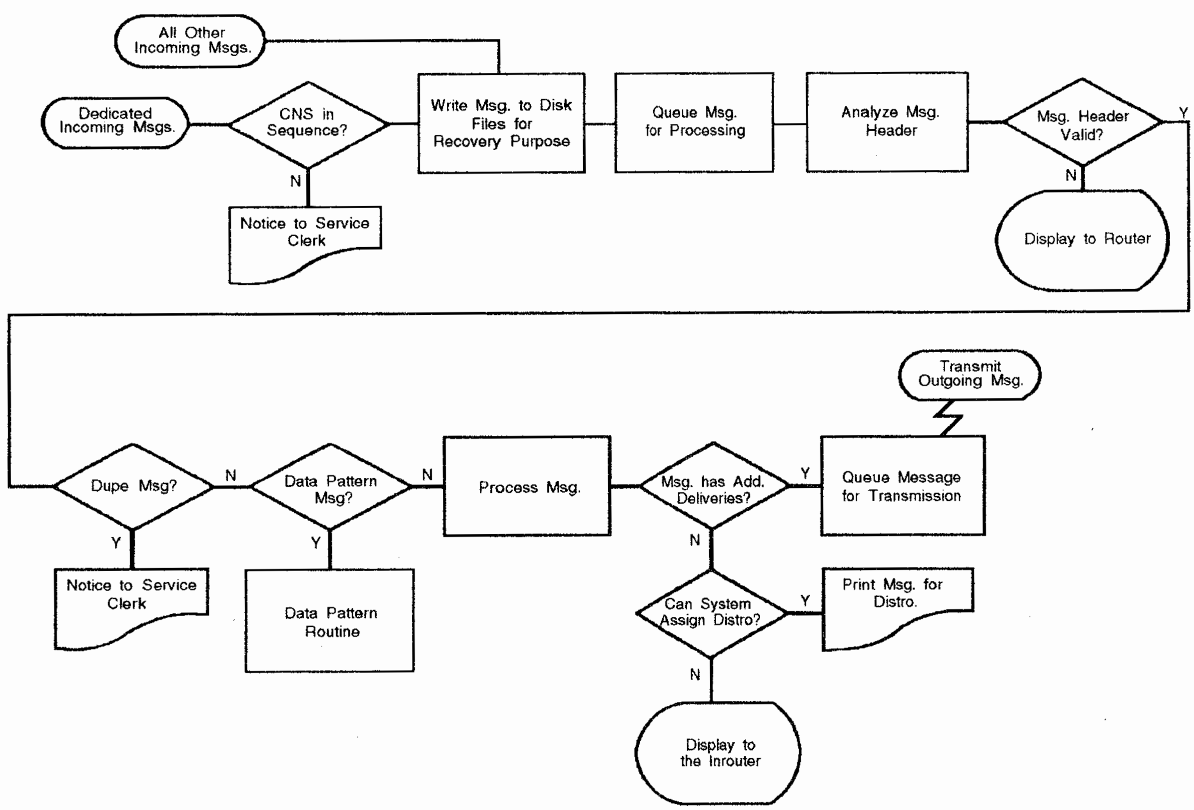


Figure 12-2.—Steps for processing automatically received incoming messages.

Automatic Internal Message Distribution

The LDMX/NAVCOMPARS automatically assigns internal message distribution for all guard commands serviced by the communications center. Each command is able to specify the order in which routing distribution criteria (AIGs/CADs, flagwords, SSICs, reference routes, or others) are assigned.

If specified distribution keys are not found, the system displays the first seven lines of the message to the inrouter video display terminal (VDT) for manual distribution (discussed later). Commands are required to review and update their internal message distribution file or database periodically.

Some commands have the capability to receive traffic in other spaces at the same time the traffic is received in the main communications center. These remote positions do not change incoming message-handling procedures for the message center; rather, this process simply provides advance copies faster than manual procedures allow.

Manual Internal Message Distribution

Messages are routed to the inrouter when unable to be routed automatically. The inrouter can assign a subject code, call for and modify a distribution code, or assign unique routing. A knowledge of command functions and experience are invaluable assets for an inrouter. Using content or subject of the message, the inrouter appends internal distribution.

A reproducible mat is printed in edited format, and the message is handled in accordance with NTP 4. The system then stores the completely edited message with internal distribution on a disk file for 10-15 days and also writes it on a journal tape.

INROUTER

As stated earlier, the majority of messages received by telecommunications centers are automatically processed. In the event that manual processing is required, the responsibility falls to the inrouter.

The inrouter prepares both incoming messages from the various circuits and outgoing messages that have been transmitted for distribution to appropriate subscribers or departments. By using transmission instructions, routing indicators, and addresses, the inrouter can determine if a message is a misroute (discussed later), or if it should be internally distributed or relayed to another unit.

For incoming messages, the inrouter is responsible for ensuring that PRIORITY and above (high-precedence) messages are handled first and for notifying the addressees concerned of the message(s). Upon receiving a high-precedence message, the inrouter informs the addressee(s) concerned of the precedence and the subject line if it is unclassified.

Once the command or department is notified, the inrouter makes a notation on the message of the name of the person contacted and time of call. The inrouter then ensures that the distribution clerk makes an advance copy of the message for immediate pickup by the command or department called. It is the responsibility of both the circuit operators and the inrouter for checking the precedence of each incoming message. Circuit operators are responsible for immediately informing the inrouter of all high-precedence incoming messages.

The inrouter must log in all incoming messages in the Central Message Log. Likewise, the circuit operators must log each message received in the appropriate circuit log prior to passing it on to the inrouter if the message is received on non-automated systems. Logs are discussed later in this chapter.

The inrouter must ensure that the message is complete before routing it for distribution to the addressees. For example, if a message has three sections (incoming or outgoing), the inrouter must have all the sections before routing.

When routing messages, the inrouter checks the action and information addressees in format lines 7 and 8. The inrouter routes each message by annotating on the bottom of the messages the command(s) and/or departments that are to receive the message. The inrouter should annotate the number of copies of the message that each command or department requests in accordance with the message center's routing guide.

A routing guide is based on the Standard Subject Identification Code (discussed shortly). The guide lists subject matters that are pertinent to the message center's subscribers. The guide also lists the cognizant offices next to the subject matter.

Although a message may be addressed to a particular department, it may need to be routed to another department because of the subject matter. For example, a message on a personnel transfer would be routed to the Personnel Support Activity. However, because of the nature of the transfer, the supply department may be routed a copy of the message for transportation and/or household goods move information. The office assigned as action addressee in the guide is responsible for informing the communications center of any changes in routing for a particular subject matter.

The inrouter must check the messages for any special-handling designators or passing instructions to ensure they are afforded proper handling and limited distribution. In many cases, these messages require that a minimum number of people handle them. For example, AMCROSS messages may be handled only by the watch supervisor and inrouter since these messages contain personal information for the recipient. Normally, an AMCROSS message is routed to the recipient, executive officer, and the command chaplain's office.

Top Secret and SPECAT messages are handled only by those communications personnel designated in writing by the commanding officer of the communications center. Communication centers have Standard Operating Procedures (SOPs) manuals that provide guidance for handling different types of messages.

STANDARD SUBJECT IDENTIFICATION CODE

The subject matter of a message is coded by the Standard Subject Identification Code (SSIC) in format line 12 after the classification. The Navy's SSIC system is broken down into 13 major subject groups. These major subject groups are then divided into primary, secondary, and tertiary subdivisions.

Primary subjects are designated by the last three digits of the code number. For example, following are three of the primary subdivisions under General Administration and Management, whose subject group code is 5000 (Remember, the SSIC always contains five digits, preceded by the letter N; for example, N05000.):

- General categories use zeros—5000 General Administration and Management;
- Example of a primary subject—5200 Management Programs and Techniques;
- The last two digits designate secondary subjects—5210 Records Management;
- The last digit reflects a tertiary subject—5211 Filing, Maintenance, Retrieval, and Privacy Act Systems.

Some subject groups are not subdivided below the primary division. Some groups are divided into many secondary and tertiary subjects, depending on the complexity of the major subject. Normally, a message center develops a routing guide to help route all messages based on the SSICs.

The routing guide normally lists the number of copies the message center should make for each command or department. The inrouter can find the subject matter and its associated SSIC in the *Department of the Navy Standard Subject Identification Codes*, SECNAVINST 5210.11. This publication is available to all personnel who draft messages and correspondence.

CLASSIFICATION MARKINGS/STAMP

Each page of a classified message must be stamped at the top and bottom with the appropriate classification. However, automated systems print the classification at the top and bottom of each page. As long as the printed classification markings are clearly distinguishable, the inrouter does not need to apply a stamped marking. Messages with special-handling markings, such as NOFORN and LIMDIS, must be appropriately stamped.

SERVICE MESSAGES

The inrouter may have to draft service messages if the message center does not have an appointed service clerk. As an inrouter or service clerk, you may have to draft a service message for message correction or misrouted, missent, or duplicate (DUPE) messages. Service messages are drafted in accordance with *Automatic Digital Network (AUTODIN) Operating Procedures*, JANAP 128.

A **misrouted** message is a message that contains an incorrect routing indicator. When a misrouted message is received, the header (format line 2) is corrected and the message retransmitted to the correct routing indicator. A service message is sent to the originator advising of the reroute action, correct routing indicator, and the time of transmission (TOT).

The TOT of the rerouted message should satisfy any tracer actions for excessive delay in delivery to the correct communications station. The content indicator code (CIC) ZOVW is used in format line 2 if the CIC in the misrouted message is ZYUW. The CIC "ZOVW" means "This message is being rerouted to your station." The CIC "ZYUW" means "This is a narrative message." JANAP 128 lists the CICs used in messages.

The following example is a single-call message received as a misroute at RUCLAKA:

```
RTTUZYUW RUEDABA6725 1831330-UUUU—
RUCLAKA.

ZNR UUUUU

R 021315Z JUL 94

REMAINING FORMAT LINES
```

Here is an example of the above message after header change (note the use of the operating signal ZOV in format line 4 for a single-address message):

```
RTTUZOVW RUCLAKA6725 1831410-UUUU—RUEBALA.

ZNR UUUUU ZOV RUCLAKA1294 REROUTE OF
RUEDABA6725

1831330

R 021315Z JUL 94

REMAINING FORMAT LINES
```

In the case of multiple-address messages, the prosign T is preceded by routing indicator(s) (RIs) and followed by plain language addressees (PLAs), as indicated in the example below.

```
RTTUZOVW RUCLAKA6725 183141-UUUU—RUEBALA.

ZNR UUUUU ZOV RUCLAKA1294 REROUTE OF
RUEDABA6725

RUEBALA T USS MOUNT WHITNEY

RUEBALA T NAVCOMM DET SOUDA BAY GR

RUEBALA T NCTS PENSACOLA FL

R 021315Z JUL 94

REMAINING FORMAT LINE
```

The following example is a service message to the originating station:

```
RTTUZYVW RUCLAKA6803 1831430-UUUU—RUEDABA.

ZNR UUUUU

BT

UNCLAS SVC ZEQ3 RUEDABA6725 1831330

021315Z JUL 94 RUEBALA 021415Z

BT
```

A **missent** message is one that contains the correct addressee but is transmitted to a station other than the one represented by the routing indicator. This situation may happen because of equipment malfunction, incorrect switching, or, in some cases, operator error. When a missent message is received, it must be retransmitted as a suspected duplicate (SUSDUPE) with the appropriate format line 2 change as per JANAP 128.

A service message must then be sent to the serving automatic switching center (ASC) citing the complete header and time of receipt and advising that the message has been protected. A service message is sent to the originating station if the message is received garbled or incomplete.

The following examples show a changed format line 2 and a service message for a missent message received at RUCLADA:

```
RTTUZYUW RUCLADA1349 1811545-UUUU—RUCLDBA.

ZNR UUUUU

R 031520Z JUL 91

REMAINING FORMAT LINES
```

The header change of the above message would be:

```
RTTUZFDY RUCLADA1349 1811545-UUUU—RUCLDBA.

ZNR UUUUU ZFD RUCLEDA

R 031520Z JUL 94

REMAINING FORMAT LINES
```

A service message sent to the serving ASC would be:

```
RTTUZYVW RUCLEDA0123 1811555-UUUU—RUCLCSA.

ZNR UUUUU

BT

UNCLAS SVC ZEQ1 RUCLADA1349 1811545 031520Z JUL
94

1811550
```

An ASC receiving a service message advising of a missent notification must perform a search to determine the cause of the missent message.

An **unmarked duplicate** is a message retransmitted by mistake by the originating station. A **SUSDUPE** is a message that the originating station suspects has been transmitted but does not have proof of prior transmission. The CICs for suspected duplicates are ZFDY, ZFGY, ZFD, and ZFG. When an unmarked duplicate message is received, a service message must be sent to the originating station citing complete header format of the received message.

The following example is a service message to the originating station that sent an unmarked duplicate message:

```
RTTUZYVW RUHHABA1234 1881130-UUUU—RUMLDFA.

ZNR UUUUU

UNCLAS SVC ZUI RUMLDFA3124 1881010 DUPED

TOR 1881035 AND 1881120 HEADER FOLLOWS

RTTUZYUW RUMLDFA3124 1881010-UUUU—RUHHABA.

BT

#1234

NNNN
```

Since the initial message received has been routed to the appropriate addressee(s), the inrouter notates the retransmitted message as a DUPE, which is then filed with no further action required. The originating station must advise the serving ASC by service message if only one transmission can be accounted for.

Service messages may be generated to correct any portion of a message. When a service message is received to correct a message that has been received and distributed to the addressee(s), the inrouter corrects the original copy by underlining the corrected portion. The notation "THIS IS A CORRECTED COPY; UNDERLINED PORTION CORRECTED PER ORIGINATOR" is made on the original copy, and the message is redistributed to the addressee(s).

If a message is received with portions garbled, the inrouter underlines these areas and notates on the message "UNDERLINED PORTIONS RECEIVED GARBLED; WILL SERVICE ON REQUEST." If action is being taken on a message, then the inrouter makes the appropriate annotations.

MESSAGE FILLERS

The inrouter prepares message fillers (also called ticklers) for the master station message file for those messages that may be placed in another file and for readdressals. They are then filed in the appropriate order in the master file (discussed later). Fillers are discussed in detail later in this chapter.

PROCESSING OUTGOING MESSAGES

Outgoing messages are those messages originated by:

- The command;
- Commands served by the communications center;
- An afloat command if a flag officer is embarked;
- An addressable unit onboard the ship as well as all messages accepted for relay.

The flow chart in figure 12-3 shows the actions required to process outgoing messages.

HANDLING AUTOMATICALLY PROCESSED OUTGOING MESSAGES

Those messages introduced into the LDMX/NAVCOMPARS from a PCMT, VDT, paper tape reader, data speed reader (DSR), card reader, or magnetic tape are considered "outgoing." They are prepared in JANAP 128, modified ACP 126, or other acceptable formats. Most outgoing messages are destined to be delivered to distant communications centers and commands. Others also have delivery requirements for in-house distribution to commands

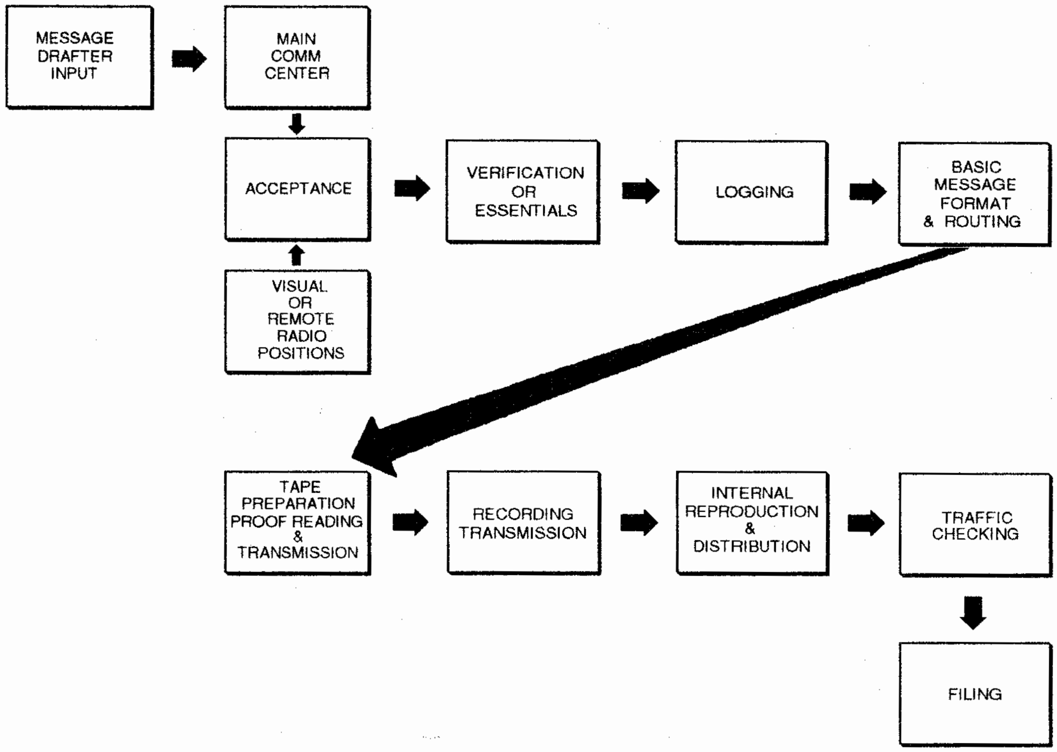


Figure 12-3.—Steps for processing outgoing messages.

serviced by the communications center. The basic steps for processing outgoing messages are shown in figure 12-4.

The system recognizes whichever format is used upon entry and then validates the start-of-message and end-of-message. After validation, the system outputs either an accept or a reject notice to the operator via the outgoing log. Together with the action notice, the system then outputs a unique header line to identify the message. Accepted messages are assigned a PSN,

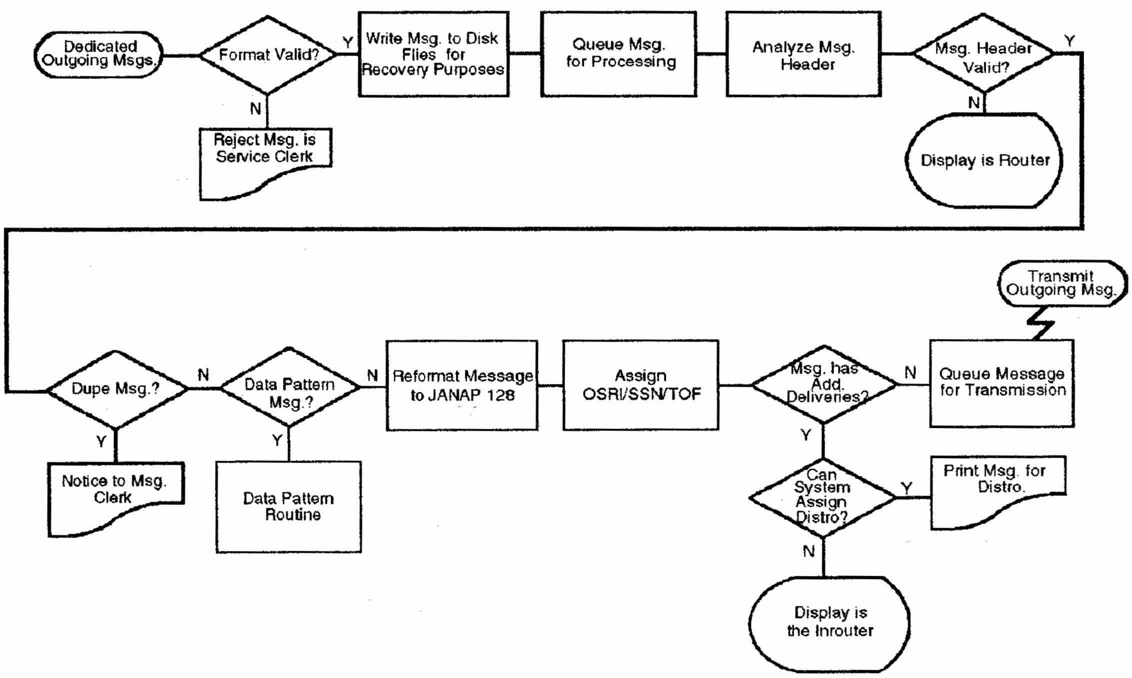


Figure 12-4.—Steps for processing automatic outgoing messages.

which is included in the accept notice. They are then stored on diskette for recovery purposes and queued for processing on a first-in-first-out basis by precedence order.

Emergency command or FLASH precedence messages cause any lower precedence messages to be interrupted and a cancel transmission (bust) sequence to be transmitted. The emergency command or FLASH message is transmitted, and normal message processing by precedence is resumed.

Messages are selected for processing based on their precedence and on the order they arrived into the system; first ones in are the first ones processed out. The LDMX/NAVCOMPARS validates the message header and assigns routing indicators (RIs) for delivery as required.

If the system cannot assign an RI automatically, it will display the addressee line to the router VDT. The router may assign the correct RI, place the message on a queue, reject the message from further processing, or correct the short title of the addressee if in error.

A system status containing accounting information pertinent to all the messages on a hold queue will be displayed to the router via the VDT, when the router queue is empty or upon demand by the operator. The router can then retrieve any message on the hold queue by its PSN. If the router rejects the message, it will be recorded by the system and a reject notice printed on the service log.

Any message determined by the LDMX/ NAVCOMPARS system to be duplicated will be rejected to the service printer with the proper annotation.

After all routing is appended to the message, the system assigns the language and media format (LMF) (JANAP 128), content indicator code (CIC) (JANAP 128), originating station routing indicator (OSRI), station serial number (SSN), and time of file (TOF) to the message. The message is then paged and sectioned according to JANAP 128, and queued for transmission.

Data-pattern messages may be introduced into the system via card or magnetic tape. The format will be in accordance with JANAP 128 procedures for data messages. During the message preparation, processing, transmission, and filing, the same controls and restraints used for narrative message processing will also apply to data-pattern messages.

The message may also have delivery requirements for distribution to commands serviced by the communications center. The system will automatically assign internal message distribution for all guard commands. If the system cannot provide internal distribution, the message will be displayed to the inrouter for assistance.

OUTROUTER

When outgoing messages are unable to be processed automatically, they become the responsibility of the outrouter. The outrouter performs basically the same functions for outgoing messages as the inrouter does for incoming messages.

Message Completeness and Accuracy

Prior to processing an outgoing message, the outrouter must verify the presence of certain elements that may not be substantively altered without permission from the originator. Some important areas of a message the outrouter must check are:

- The classification in format line 2 agrees with the classification in the text;
- Classified messages contain downgrading instructions;
- A precedence is assigned;
- The person releasing the message is authorized to release messages;
- MINIMIZE CONSIDERED is typed in the appropriate area during minimize conditions; and
- The addressee(s) is/are constructed in accordance with the Distributed Plain Language Address Verification System (DPVS) and contain(s) office codes.

The outrouter is authorized to correct procedural errors in a message, such as the incorrect typing of an addressee, to avoid delay in delivery of PRIORITY and above messages. However, changes in the message, such as adding downgrading instructions or correcting the message classification, must be corrected by the drafter. Remember, the responsibility for message correctness (proper use of dual precedence, references, correct plain language addresses [PLAs], and special-handling designators) rests with the drafter.

The outrouter is authorized to change incorrect addresses (PLAs) when they are misspelled, improperly abbreviated, or, in some other procedural way, are not in accordance with message procedures. The communications center is held accountable for incorrect PLAs and, therefore, must ensure that local procedures are established to reduce transmission of incorrect PLAs.

The only authorized source for U.S. activity short titles and geographical locations is in the Distributed Plain Language Address Verification System (DPVS). The DPVS is for use by message drafters and is not solely a communications center tool.

When minimize is imposed, the outrouter must screen all outgoing messages currently held and return ROUTINE messages to the drafter(s) for reconsideration under minimize criteria. Navy messages originated in or destined for an area under minimize can be accepted for transmission only if the releaser's name and rank/grade appear as the last line of the text and the words "MINIMIZE CONSIDERED" are included on the message form.

Station Serial Number

Once a message is received for transmission from a subscriber or a circuit for relay, the outrouter logs the message in the outgoing message log. The outrouter assigns each message accepted for transmission a station serial number (SSN) and records each message in the Central Message Log.

The SSN is a way of identifying messages. For example, the first message accepted for transmission on a new radio day (raday) would be 0001 in the Central Message Log. The next message would be 0002, and so forth. The log lists the date-time group (DTG), originator, precedence, classification, and the outrouter's initials.

Normally, the distribution clerk who receives messages from a subscriber over the counter assigns the date-time group if the originating command did not assign one. After the outrouter checks a message for completeness and accuracy, it is then turned over to the circuit operator for transmission.

The recording of the transmission may be accomplished either manually or by the automated system. If a message is sent over teletype circuits, the operator notates on the teletype paper the time of transmission, date, circuit, and the operator's personal sign. The operator also logs the message in the appropriate circuit log. After the message is transmitted, it goes to the inrouter for internal routing according to the drafter's routing instructions.

DISTRIBUTION CLERK

The distribution clerk reproduces copies of the messages according to the routing instruction of the inrouter and outrouter. The distribution clerk is responsible for making the required number of copies each subscriber requires and slotting the messages into the appropriate subscriber box.

It is important that the clerk remain alert to prevent slotting messages into the wrong box. This could cause a nondelivery situation. The distribution clerk, who handles a great number of messages throughout the watch, must be aware of high-precedence messages and ensure that they are reproduced and distributed in a timely manner for immediate pickup by the subscriber. The clerk must also be "up" on the message center's current SOP for handling special and classified messages.

To prevent viewing by unauthorized personnel, certain messages, such as PERSONAL FOR, AMCROSS, and classified messages, must be placed in envelopes for pickup by subscribers.

Classified messages are placed in two envelopes; the inner envelope is stamped with the classification and any special-handling markings, and then sealed in accordance with local instructions. The outer envelope is marked with the addressee, originator, and DTG of the message, and then sealed.

After reproducing and distributing a message, the distribution clerk places the original copy into a box for filing by the file clerk. When a message is reproduced from the sole copy of a broadcast message, the original copy or a filler must be returned to the broadcast file. If two-ply paper is used on the circuit, the top copy may be used as the master file copy and the bottom copy retained as the circuit monitor copy.

Handling Messages over the Counter

The distribution clerk usually handles over-the-counter customer transactions by accepting outgoing messages and giving authorized subscriber couriers their message traffic. When accepting a message for transmission, the distribution clerk is responsible for checking the message for the releasing signature, any special-handling markings, precedence, and any downgrading instructions.

As we mentioned earlier, the distribution clerk assigns the DTG to a message if one has not been assigned by the subscriber. The subscriber provides the clerk with the original and one copy of each message.

The clerk time-stamps both copies and returns the copy to the courier for the subscriber's files. Upon receiving a high-precedence message, the clerk must inform the outrouter immediately.

Courier Authorization List

Before accepting outgoing messages or allowing couriers to pick up messages, the clerk must check the authorization list submitted by each courier's office or command. Offices and subscribers having duty officers or couriers who deliver, pick up, or screen messages must submit an authorization letter or memorandum to the communications center. This letter must list command couriers by name, rank/grade, social security number, highest classification to be viewed or picked up, and specify those personnel authorized to receive and transport SPECAT/special-handling messages. The letter of authorization must be signed by the commanding officer, officer in charge, or some other officer in command status.

Message Release Authority

Besides providing an authorization list for couriers, subscribers must also provide the communications center a letter for releasing authority. This letter lists the name, grade/rank, social security number, and signature of each person authorized to release messages. The distribution clerk must check the releasing signature on messages against the signature on the letter.

All commands are required to adopt message-release procedures to ensure that all messages delivered to the message center have been properly released and annotated as either operational or administrative messages. Release authority is an administrative function that must be exercised by the command entering messages into the communications system.

A number of automated systems, such as the Worldwide Military Command and Control System (WWMCCS), Antisubmarine Warfare Operations Center (ASWOC), and other remote terminals, both afloat and ashore, are capable of automatically generating and releasing messages. Such messages can be directly interfaced to a communications central processor (such as LDMX/NAVCOMPARS) for onward transmission or entered directly into communications channels.

When messages can be introduced by direct interface, the control of release authority is an administrative function of the command controlling the message traffic at the generating computer. Therefore, there is no requirement for communications personnel to validate release or authorization at the end of electronic courier circuits or other communications centers.

HANDLING MESSAGES ON DISKETTES

The greatest difference between preparing messages on diskettes and using other methods is that a personal computer and diskettes are used for preparing, storing, and delivering messages.

Diskettes must be prepared by a software system that is compatible with formats used by the Navy in accordance with *Telecommunications Users Manual*, NTP 3. Any diskette submitted by a subscriber that cannot be read because of incompatible media or diskette file formats must be returned to the subscriber.

INCOMING DISKETTE MESSAGE PROCEDURES

Subscribers supply the servicing communications center with properly formatted blank diskettes so that the center can copy its incoming message traffic onto the diskettes. Messages received by serving facilities via automated message-processing systems for delivery to over-the-counter customers will be stored on the provided diskette. These diskettes will be placed in the customer message box for pickup. Customers must be notified by phone call upon receipt of an action message of IMMEDIATE or higher precedence.

Not all messages may be stored on diskettes. Top Secret and limited-access messages, such as AMCROSS, SPECAT, PERSONAL FOR, LIMDIS, NOFORN, are automatically diverted to a designated printer for delivery by hard copy.

In addition to these types of message, other high-precedence messages may also have to be printed out for delivery by hard copy. See your message center local operating instructions regarding receipt of high-precedence messages and subscribers' needs for hard-copy message delivery.

OUTGOING DISKETTE MESSAGE PROCEDURES

In accordance with NTP 3, subscribers are responsible for preparing outgoing messages on diskettes prior to delivery to the NTCC for transmission. Diskettes that are not properly formatted or do not follow proper message procedures should be returned to the subscriber for correction.

Customers are urged to use 3 1/2-inch floppy diskettes. Experience has shown that these diskettes are less susceptible to damage than the 5 1/4-inch diskette. Customers are required to scan each diskette for computer viruses prior to delivery to the message center.

Subscribers may have both unclassified and classified messages up to and including Secret on a single diskette. Diskettes containing classified messages must be properly marked with the highest message classification on the diskette.

To prevent possible tampering with the messages, subscribers are required to affix a write protect tab to each diskette prior to delivering it to the NTCC. No diskette received by the NTCC containing message traffic will be written to by the NTCC computer equipment. Subscribers are advised to check with their local serving communications facility for current handling and processing requirements.

SECURITY MARKINGS AND HANDLING OF DISKETTES

All diskettes used for message preparation must be handled in accordance with the *Department of the Navy Information and Personnel Security Program Regulation*, OPNAVINST 5510.1, hereinafter called the *Security Manual*, the *Department of the Navy Automatic Data Processing Security Program*, OPNAVINST 5239.1, and local security instructions for magnetic diskette media. As a minimum, the diskette must have an external label listing the command name, the permanent diskette identification number, the highest level of classification, and the most restrictive marking or associated markings for any message stored on it. The diskette identification number is recorded as the Diskette Volume Label. The external labels are color coded to show the classification of the diskette. The colors for each classification are as follows:

- GREEN for Unclassified;
- BLUE for Confidential;
- RED for Secret; and
- ORANGE for Top Secret.

When not in use, all classified diskettes must be stored properly in security containers. The diskettes must also be afforded the same security protection as any other classified document.

When delivering diskettes to the servicing NTCC, subscribers should transport them in courier pouches. Courier pouches provide the diskettes security protection and keep them from being bent and protect them from moisture, heat, and magnetic fields.

CARE OF DISKETTES

A diskette consists of three parts: a plastic disk, a protective liner, and an outer jacket. The plastic disk is constructed of a flexible plastic material that is coated with magnetic oxide material. It can be stretched or bent easily, leaving distortions in its surface that will destroy its usefulness.

The protective liner, a sleeve of cloth-like material that cleans the disk and traps dust particles, is placed around the disk. The outer jacket adds additional protection and makes the disk somewhat rigid. The outer jacket of the disk has three openings and a notch along one side. The large center opening is used by the disk drive to grip the disk and rotate it. The small circular hole to one side is used for timing purposes. The long slot is used for access to the disk itself by the read/write head, which reads and records information from and to the surface of the disk.

The notch along one side of the disk is the write/protect notch. Placing an opaque tab over the write/protect notch makes the diskette "write protected" and prevents the computer from recording on the disk. A protective envelope is used to cover the exposed area of the disk when it is not in use or when it is being stored.

Take care when handling diskettes because they are easily damaged. You should observe the following precautions anytime you handle diskettes:

- Hold the diskettes by the covered areas—usually a corner or edge. Never touch the exposed parts of the diskette. Oily residue from fingerprints may cause the diskette to lose contact with the head and interrupt the read/write process.
- When preparing a label for a diskette, you should write on the label before placing it on the diskette. Point pressure can damage your diskette. If you must write on a label that is already on a diskette, use a felt-tip pen. Never use a ballpoint pen or pencil to write on a label that is already on a diskette.
- Store diskettes upright in their protective envelopes away from direct sunlight and high temperatures.
- Never bend or fold diskettes.

- Do not attach clips, staples, or rubber bands to diskettes.
- Never expose diskettes to magnetic fields, such as a computer video screen, power supply, telephone, or magnets. Magnets and magnetized objects can erase some or all of the information stored on the diskette.
- Keep diskettes away from moisture. Some fluids may distort and otherwise damage the surface of the recording media.
- Never open the door of the disk drive when the drive light is on. Doing so can make the contents of the diskette unreadable.

MESSAGE LOGS

Accounting for messages addressed to your guard list (list of commands for which you receive message traffic) is the most important part of processing messages. Accounting for all messages processed in your message center is accomplished with logs. Although ashore and afloat automated systems automatically log, store, and retrieve messages, there still is a need to manually log and file both incoming and outgoing messages.

DATE ____________

CENTRAL MESSAGE LOG
OUTGOING/INCOMING

SSN	PREC	DTG	ORIG	SUBJ	CLASS	TOR	TOD	CKT

Figure 12-5.—Central Message Log for outgoing and incoming messages.

CENTRAL MESSAGE LOG

Depending upon the traffic volume processed, a message center may use either a separate outgoing/incoming log or a combined Central Message Log to record processed message traffic. All messages are logged in the Central Message Log after they have been logged in the appropriate circuit log. The normal practice is to use separate logs for outgoing and incoming messages (figure 12-5).

The entries in the Central Message Log are station serial number (SSN), precedence, DTG (original on a readdressal), originator (original on a readdressal), subject, classification, time of receipt (TOR) for incoming messages or time of delivery (TOD) for outgoing messages for each message. It is also useful to indicate on the log over which circuit the message was relayed. This is helpful during tracer situations. The Central Message Log is filed in the communications center master file on top of the messages processed for that raday.

TOP SECRET CONTROL LOG

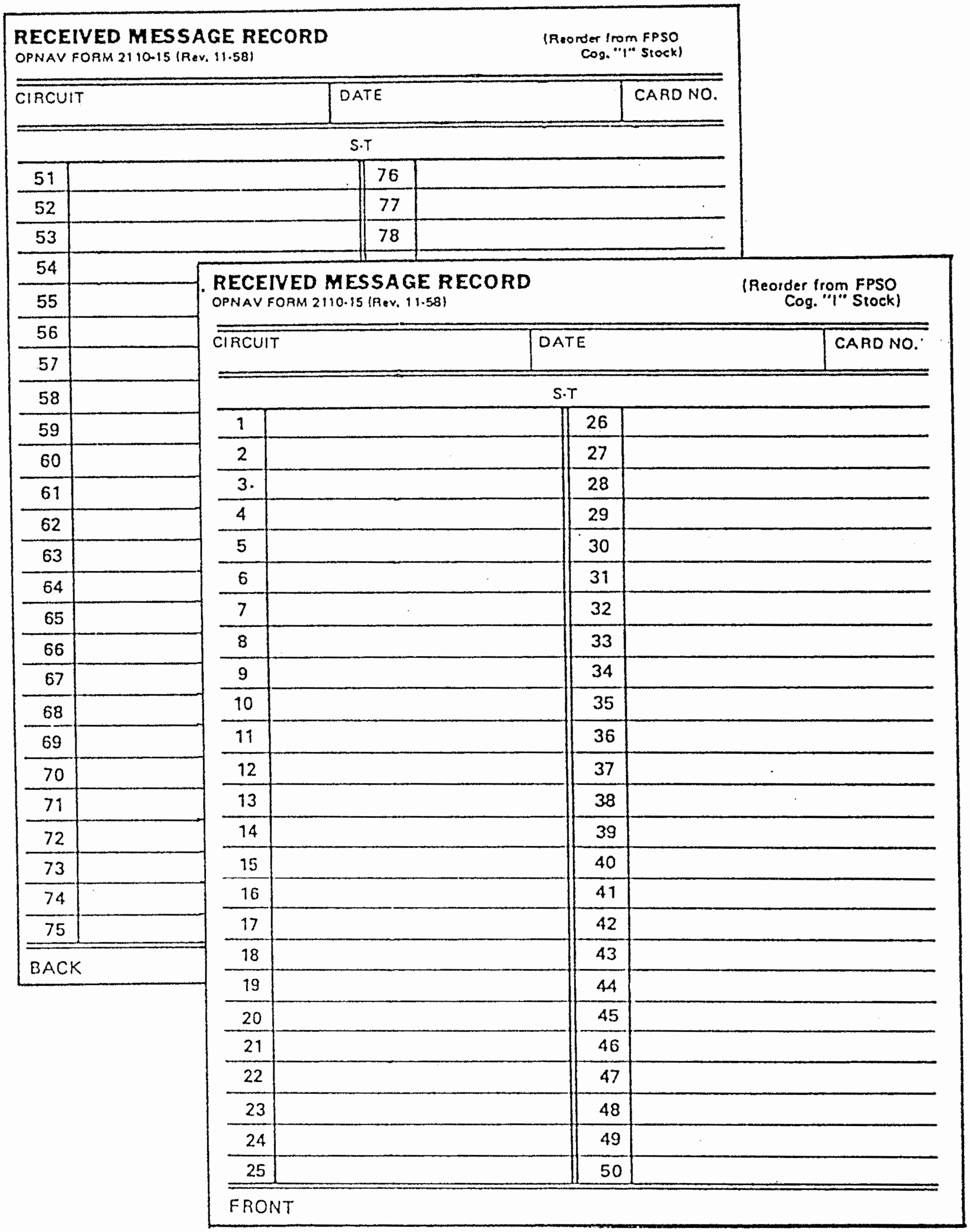
Upon receipt of a Top Secret message, including SPECAT SIOP-ESI, addressed to the parent command or subscriber of the message center, the center assigns a sequential number and enters the originator, DTG, and copy count of the message into the Top Secret Control Log. A separate entry is made for each addressee. The messages must be annotated as "Copy ___ of ___" and "Page ___ of ___." The message must also be assigned a Top Secret control sequential number.

CIRCUIT LOGS

Records of messages sent via ship-shore circuits, whether primary ship-shore, full-period termination, and so on, must be maintained. This ensures continuity of traffic, accurate times of delivery/receipt, and precise files for possible tracer action. These actions should be recorded on the Received Message Record, OPNAV Form 2110-15 (figure 12-6). Although this form is primarily designed as a record of received messages, only a pen-and-ink change is necessary for its use as a send log.

JOURNAL LOGS

In most automated systems, all significant system events are entered in a journal log. This log is a chronological record of data processing operations, which may be used to reconstruct a previous or updated version of a file.



RECEIVED MESSAGE RECORD
OPNAV FORM 2110-15 (Rev. 11-58)
(Reorder from FPSO Cog. "I" Stock)

CIRCUIT	DATE	CARD NO.

S-T

51		76	
52		77	
53		78	
54			
55			
56			
57			
58			
59			
60			
61			
62			
63			
64			
65			
66			
67			
68			
69			
70			
71			
72			
73			
74			
75			

BACK

RECEIVED MESSAGE RECORD
OPNAV FORM 2110-15 (Rev. 11-58)
(Reorder from FPSO Cog. "I" Stock)

CIRCUIT	DATE	CARD NO.

S-T

1		26	
2		27	
3		28	
4		29	
5		30	
6		31	
7		32	
8		33	
9		34	
10		35	
11		36	
12		37	
13		38	
14		39	
15		40	
16		41	
17		42	
18		43	
19		44	
20		45	
21		46	
22		47	
23		48	
24		49	
25		50	

FRONT

Figure 12-6.—Received Message Record, OPNAV Form 2110-15.

All system-level commands entered by an operator are logged. Log entries are usually queued for delivery to a printer as they are generated but this is optional. However, they are always journaled to a file from which they can be recalled and printed at a later time, as desired. This log gives a system operator or supervisor the ability to review current and previous system events.

In addition, the journal log supports message accountability. The system records the receipt of every formal message and the termination of every formal message delivery that it schedules.

COMMUNICATIONS CENTER FILES

Every message handled by a ship or communications station is placed in one or more files. Some files are maintained by all ships and stations. Other files are optional and are maintained only to fill the needs of a particular ship or station.

COMMUNICATIONS CENTER MASTER FILE

The communications center master file is the heart of the filing system. This file contains a copy or filler of every message sent or received by your command. Messages or fillers must be filed in DTG order to facilitate speed in locating messages. Those messages not having DTGs should be filed behind messages of the same date. Separate incoming and outgoing communications center master files may be maintained.

CRYPTOCENTER FILE

The cryptocenter file contains a copy of each Top Secret, SPECAT (less SIOP-ESI), and messages designated for special privacy, regardless of classification. Tight Control (TICON) and NATO messages must have their own files. Fillers for messages in this file must be placed in the master station file.

SPECAT SIOP-ESI FILE

The SPECAT SIOP-ESI file contains the master copy of all SIOP-ESI messages received by the communications center. Fillers for these messages must be placed in the master station and cryptocenter files.

BROADCAST FILE

The broadcast file contains a copy or filler of each message transmitted or received by the broadcast method. This file must be stored in accordance with the highest classification of the information contained. Top Secret and SPECAT messages addressed to the command must be filed in their appropriate files and a filler for these messages placed in the broadcast file.

STATION FILE

The station file is divided into two parts: communications center master file and visual station file. With the exception of broadcast messages, the master file contains the circuit or "as is" copy, including any message endorsements, of all messages transmitted, received, or relayed by the communications center. Narrative visual messages or fillers must be filed in the communications center master file.

GENERAL MESSAGE FILE

The general message file contains copies of all effective general messages that require retention based on the communications center's current guard list. This file is subdivided by general message title (such as ALNAV, ALCOM, NAVOP), and messages are filed in serial number order instead of DTG order. An example of a general message serial number is ALNAV 10/94. This indicates that it is the 10th ALNAV sent in 1994.

The individual file is marked with the classification of the highest classified message contained therein. The classified files may be segregated by security classification if desired. If a general message is canceled during the current year, the message may be destroyed, but a filler must be placed in the file to identify and indicate the disposition of all current year general messages.

FACSIMILE FILE

The facsimile file contains a copy of all transmissions processed by facsimile equipment. A filler for all facsimile messages must be placed in the communications center master file.

COMMERCIAL TRAFFIC FILE

The commercial traffic file contains messages sent by commercial systems in accordance with *Commercial Communications Instructions*, NTP 9(B). This file is maintained by the commercial traffic clerk.

EMBARKED COMMAND FILE

The embarked command file is maintained by the embarked commander's staff. When embarked commanders depart their flagships, they may require that their files accompany them. Therefore, the embarked command file is maintained separately from the flagship file. Flagship communications personnel are responsible for processing outgoing and incoming messages for the embarked staff.

NATO/ALLIED FILES

Classified messages of foreign origin must be provided the same protection as U.S. messages of equivalent classification. Foreign Restricted messages, for which there is no U.S. equivalent, must be protected the same as U.S. Confidential messages, except that Restricted messages do not have to be stored in a security container. You can find U.S. equivalent and foreign classifications in the *Security Manual*.

NATO classified messages may not be filed with U.S classified messages. However, NATO classified message files may be stored in the same storage area with U.S. messages provided that the NATO files are clearly marked as such.

FILE FILLERS

Because of repeated reference to previously sent message traffic, you must be able to locate all messages easily and quickly. Therefore, you must always return a message to the same file from which it was removed and in the proper filing order. When you remove a message from a file, always insert a filler, or tickler, in its place.

Fillers are locally prepared forms that identify the message by the original DTG, the message originator, information as to where the message is located, and the personal sign of the person removing the message from the file and completing the filler. For readdressal messages, a filler is made for each readdressal date-time group. The message itself is filed under the original date-time group. Figure 12-7 shows an example of a message filler, or tickler.

FILE MAINTENANCE

Messages and fillers are filed in ascending date-time group order. The earliest message of the raday will be at the bottom of the file. Automated systems print the DTG of each message on the lower right-hand corner of each message. For messages processed on nonautomated systems, the DTG should also be printed on the lower right-hand corner. This aids personnel in easily locating messages in the files. When a message is removed from a file, it is important that it be refiled as soon as possible.

The importance of maintaining well-kept files and of cooperating among the various watch sections cannot be overemphasized. Maintaining accurate files and records and observing proper procedures contribute to an efficient shipboard or shore communications organization. You should be aware that different ships and stations may do basic procedures in slightly different ways. All commands, however, must conform to the requirements contained in communications operating instructions and publications.

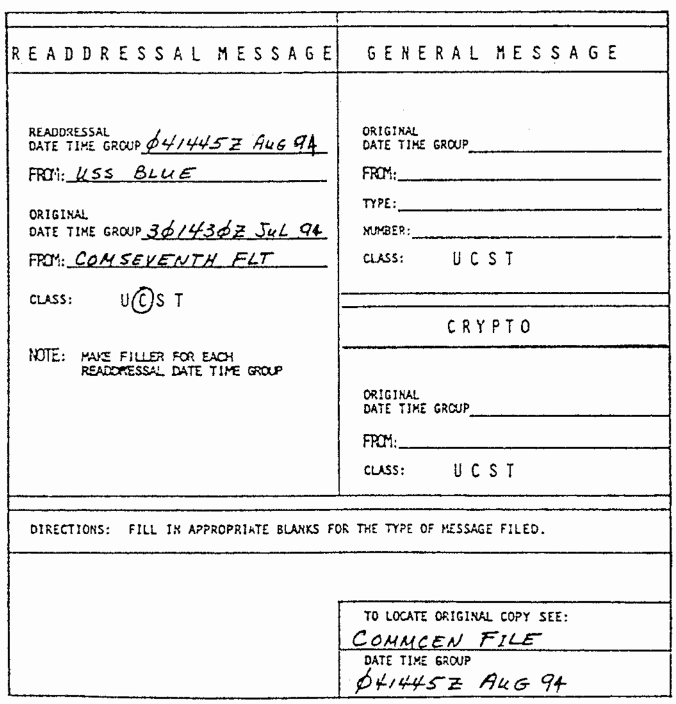

READDRESSAL MESSAGE
READDRESSAL DATE TIME GROUP ∅41445Z AUG 94
FROM: USS BLUE
ORIGINAL DATE TIME GROUP 3∅143∅Z JUL 94
FROM: COMSEVENTH FLT
CLASS: U (C) S T
NOTE: MAKE FILLER FOR EACH READDRESSAL DATE TIME GROUP
GENERAL MESSAGE
ORIGINAL DATE TIME GROUP
FROM:
TYPE:
NUMBER:
CLASS: U C S T
CRYPTO
ORIGINAL DATE TIME GROUP
FROM:
CLASS: U C S T
DIRECTIONS: FILL IN APPROPRIATE BLANKS FOR THE TYPE OF MESSAGE FILED.
TO LOCATE ORIGINAL COPY SEE:
COMMCEN FILE
DATE TIME GROUP
∅41445Z AUG 94

Figure 12-7.—Example of a message filler.

RETENTION OF FILES

Communication logs and files are retained by a communications center for a specified time period, as shown in table 12-1. After the time period indicated, the logs and files should be destroyed either by burning or shredding. Because of the volume of message traffic processed, logs and files can take up significant space in the message center; therefore, they should be destroyed in a timely manner

TRAFFIC CHECKER

The traffic checker is the message center's final safeguard against error. Every message handled by the center passes through the traffic checker for a final, thorough check before it is filed. Good traffic checkers will do their best to keep up with the traffic load. By doing so, the traffic checker can catch errors before the messages leave the station, thus saving the need for service messages and corrected copies.

A traffic checker must thoroughly understand the message center's message-handling procedures. The checker must be acquainted with in-house memorandums and directives, official publications, and the communications organization book. Additionally, the traffic checker must have a well-rounded knowledge of guard lists, routing indicators, and fleet organization.

For incoming messages, the traffic checker ensures message accountability and sequence. The checker also ensures that all messages have been distributed properly. When checking outgoing messages, the checker ensures that all parts of the message are correct. For outgoing messages, the traffic checker also ensures that proper transmission instructions are included, addresses are correct, and that precedence and text are the same as assigned by the drafter.

Traffic checks should be performed during each watch, and must be conducted, as a minimum, on a daily basis. All errors must be corrected immediately.

After checking the messages, the traffic checker must file them in the communications center master file. Therefore, the checker normally maintains this file. This includes removing old messages from the files for destruction in accordance with the message-retention tables set forth in table 12-1 and in *Fleet Communications (U)*, NTP 4.

SUMMARY

This chapter has introduced you to the standard procedures associated with handling incoming and

Table 12-1.—Retention Period of Logs and Files

FILE/LOG	RETENTION PERIOD
Broadcast	24 Hours
Card	30 Days
Central message log	30 Days
Circuit (teleprinter)	5 Days
Commercial traffic	12 Months
Communications center master (Either paper or LDMX/NAVCOMPARS journal tapes)	30 Days
Cryptocenter file	2 Years
Cryptocenter destruction log	2 Years
Facsimile	60 Days
General Message	When Cancelled
Intelligence summaries	10 Days
Messages incident to distress or disaster	3 Years
Messages incident to or involved in any complaint for which the command has been notified	2 Years
Messages of historical or continuing interest	Permanently
Meteorological maps and summaries	2 Days
Monitor rolls and message tapes	24 Hours
SPECAT SIOP-ESI file	60 Days
TOP SECRET control log	60 Days
Watch-to-watch inventory	30 Days

outgoing messages. Because of the volume of messages a telecommunications center processes, it is essential that communications personnel observe all the handling procedures to prevent losing or delaying delivery of messages to subscribers.

The tasks of a message center are extremely important. Your understanding of the handling procedures is key to providing fast and accurate communications to the fleet.

In addition to the information presented in this chapter, we have provided helpful references at the end of the discussion. You are encouraged to study them, as required, for more information on the topics discussed.

RECOMMENDED READING LIST

NOTE

Although the following references were current when this TRAMAN was published, their continued currency cannot be assured. You therefore need to ensure that you are studying the latest revisions.

Automatic Digital Network (AUTODIN) Operating Procedures, JANAP 128(I), Joint Chiefs of Staff, Washington, D.C., March 1983.

Department of the Navy Information and Personnel Security Program Regulation, OPNAVINST 5510.1H, Chief of Naval Operations, Washington, D.C., April 1988.

Fleet Communications (U), NTP 4(C), Commander, Naval Telecommunications Command, Washington, D.C., June 1988.

Telecommunications Users Manual, NTP 3(I), Commander, Naval Computer and Telecommunications Command, Washington, D.C., January 1990.

CHAPTER 13

COMMUNICATION SYSTEMS MAINTENANCE AND SAFETY

CHAPTER LEARNING OBJECTIVES

Upon completing this chapter, you should be able to do the following:

- *Discuss communication systems diagnosis and quality assurance.*
- *Identity the purpose of communication systems tests.*
- *Explain how to perform basic systems measurements.*
- *Describe how to accomplish performance testing measurements.*
- *Explain how to perform antenna testing and maintenance.*
- *Identify correct communication systems safety procedures.*

Part of your duties as a Radioman when stationed aboard ship will be to perform routine testing and maintenance on communication systems and equipment. However, you will not be expected to do Electronics Technician (ET) maintenance.

While aboard ship, you may also be required to perform planned and emergency maintenance on antenna systems. For this reason, you must be aware of radio-frequency (RF) radiation and other hazards when working aloft. Safety precautions save lives and help prevent injuries. **You must be aware of and heed safety precautions when working on electronic equipment**.

The objectives of this chapter are to increase your knowledge of the testing and assurance procedures of the more basic communications equipment while increasing your awareness of the safety aspects of this work.

SYSTEM DIAGNOSIS AND QUALITY ASSURANCE

To properly diagnose communications system trouble symptoms and to assure reliable equipment operating standards, you must understand that efficient and accurate testing procedures are indispensable. Measurements are made periodically while the equipment is functioning properly to disclose any decline in the quality of equipment performance. However, even the most systematic checks will not replace the operator's knowledge of basic communication systems and functional equipment operation.

You can eliminate potential problems and keep equipments operating at peak efficiency and reliability by combining your knowledge of basic systems and functional operation with proper communications testing procedures.

The terms "system diagnosis" and "quality assurance" tend to be confusing. System diagnosis simply means the detection of a potential or real problem in a communications system and the isolation of that problem. Quality assurance is defined as a planned, systematic pattern of actions necessary to provide relative confidence so that a system or equipment will perform satisfactorily in actual operation.

The Planned Maintenance System (PMS) portion of the 3-M System provides some quality assurance for us. System diagnosis provides additional quality assurance through unscheduled, watch-to-watch, minor maintenance and the knowledge acquired by communications maintenance personnel.

OPERATOR MAINTENANCE

Generally speaking, there are two basic types of maintenance that you must concern yourself with: operational and preventive. Operational maintenance is low-level technical maintenance that an equipment operator may be able to perform while on watch or during periods of equipment shutdown. This includes such procedures as recording built-in meter readings, making front-panel adjustments, and replacing minor parts, such as fuses and indicator lamps.

Operational maintenance also covers such routine items as visual inspections of equipments conducted for the purpose of locating and correcting conditions of dirt, corrosion, loose connections, and mechanical defects. Although these inspections overlap the category of preventive maintenance, operational maintenance is a separate function since it is practiced routinely on a Navy-wide and normally unscheduled basis.

The most effective maintenance is preventive in nature. It is better to detect and correct potential failures than to allow them to develop into actual failures. Preventive maintenance (PMS) is accomplished by the use of Maintenance Requirement Cards (MRCs). MRCs outline the preventive task to be accomplished in a step-by-step manner. These scheduled maintenance tasks serve to reduce major equipment breakdowns and lengthen the useful life of the equipment or system.

Preventive maintenance consists mainly of cleaning, lubricating, and periodic testing of equipment. This maintenance is aimed at discovering conditions which, if not corrected, may lead to serious malfunctions. As you will learn in this chapter, preventive maintenance tasks often require the use of basic test equipments in making systems checks.

TECHNICIAN MAINTENANCE

The functioning of any shore or shipboard communications facility is almost entirely dependent upon proper continuous operation of communications equipment. The technician is the primary person responsible for ensuring that equipment stays operational.

The technician is highly trained and is familiar with the theory of operation and actual working of the equipment. The technician uses a systematic and logical approach to troubleshoot communications equipment problems. This method has proven more effective and less costly than the old style "hit-and-miss" approach. The technician uses procedures outlined in the *Ship's 3-M Maintenance Material Management Manual*, OPNAVINST 4790.4, hereinafter called the *3-M Manual*.

The 3-M system is the nucleus for managing maintenance aboard all ships and shore stations throughout the Navy. This system provides all maintenance and material managers with the means to plan, acquire, organize, direct, control, and evaluate manpower and material resources expended or planned for expenditure in support of maintenance. All personnel need to recognize the importance of the system and the role everyone plays in maintaining the material readiness of equipment in the fleet. For additional information on preventive maintenance and associated topics, review *the 3-M Manual*.

SYSTEMS TESTS

There are probably as many types of systems tests as there are systems. Although it is possible to divide systems functionally by operation, systems may be simple, such as basic send-receive types; or complex computer groups. Each system, in turn, is made up of separate subsystems or components. Each system or subsystem is composed of certain groups of equipments or units. Testing may comprise all units of the system or only one. For instance, when making quality assurance (QA) checks on a transmitting system, you may be required to make radiation resistance checks on the antenna or output power measurements on the transmitter. You may also make a simple insulation resistance check of the RF cabling between the transmitter and the antenna.

Tests and checks help diagnose and eliminate a system problem or assist in performing scheduled PMS checks. No one particular test or check can be considered as being a part of either system diagnosis or quality assurance exclusively. However, all of our tests, checks, and measurements combined serve to qualitatively determine the condition of systems, subsystems, and individual equipments.

System maintenance techniques vary from very simple to very complex, and you can normally select from more than one technique. For example, you can monitor a transmitter that produces a modulated signal by observing the output meter on the transmitter front panel. However, a more accurate method would be to connect an ammeter in series with the antenna lead. When antenna current remains steady on the ammeter, an unmodulated carrier is being produced. However, if the antenna current varies, the output is being keyed or modulated. In this example, the output meter and the ammeter indicate essentially the same information. This is an example of having more than one method for performing a basic check.

You should always select a maintenance technique that is readily accessible, easy to perform, and capable of providing the most information on the operation of the system or subsystem. You must consider each of the above factors to select the technique that gives the most results for the time and effort invested. Normally, built-in monitoring setups are provided for communication systems operators.

Basic systems tests can be subdivided into the following general categories:

- Overall performance tests and checks;
- Minimum performance tests;
- Sensitivity/selectivity tests;
- Power input/output tests; and
- Property measurement tests.

OVERALL PERFORMANCE TESTS AND CHECKS

Overall performance tests and checks can indicate the total capability of an individual piece of equipment or of an entire system. An example would be the testing of a transmitter in all operational modes (for example, CW, AM, FM, SSB, FSK) in accordance with the performance standards contained in the equipment technical manual. This test would indicate the overall capability of the transmitter.

MINIMUM PERFORMANCE TESTS

Minimum performance tests can measure specific equipment or the minimum standards expected of a system. For example, if a transmitter is supposed to deliver 125 watts of power when an AM signal is fed into a properly tuned antenna but delivers only 95 watts, minimum standards are not being met. Therefore, action must be taken to bring the equipment up to minimum standards through repair or adjustment.

SENSITIVITY AND SELECTIVITY TESTS

Sensitivity and selectivity tests are associated primarily with receivers. Sensitivity is the ability of a receiver to amplify a weak signal. Selectivity is the ability of a receiver to reject unwanted frequencies and to accept the desired frequency. However, the terms "sensitivity" and "selectivity" may be applied to any amplifier or frequency-determining network. Any piece of equipment that contains amplifiers or frequency-determining networks can be given sensitivity and selectivity checks.

POWER INPUT AND OUTPUT TESTS

Power input and output tests normally deal with the ability of a transmitter or antenna to deliver or accept rated levels of power and operate at prescribed efficiency levels. Radiation resistance checks and field-strength tests are also part of power testing.

PROPERTY MEASUREMENT TESTS

Property measurement tests are conducted to determine basic electrical properties, such as resistance, capacitance, and inductance. An example would be a basic resistance test using an ohmmeter. Property measurement is the most extensive of the basic tests and is discussed in detail in the next section.

BASIC MEASUREMENTS

In this section, we will discuss the validity of basic resistance and voltage measurements as well as how to use an oscilloscope in making various checks.

RESISTANCE MEASUREMENTS

Defective components and equipment parts can usually be located by measuring the dc resistance between specific points in a circuit and a reference point (or points); usually ground. This detection method works because of the change in the resistance values of components whenever a fault develops. Point-to-point resistance charts in the equipment technical manual can help you when using this method.

When taking resistance measurements, you must remember that, unless otherwise stated, the values given in equipment charts are measured between the indicated points and ground. For safety, you must always secure the power to the equipment under test and discharge all capacitors before taking resistance measurements.

VOLTAGE MEASUREMENTS

Most troubles encountered in equipments and systems either result from abnormal voltages or produce abnormal voltages. Because of this, voltage measurements should be one of the first methods that you use when troubleshooting and performing QA checks. Testing techniques that use voltage measurements have the advantage that circuit operation is not interrupted.

Point-to-point voltage measurement charts are normally contained in equipment and system technical manuals. These charts contain the normal operating voltages encountered in the various stages of the equipment. Unless otherwise stated, the values shown in the equipment charts are measured between the indicated points and ground.

When you take voltage measurements, it is a good practice to initially set the voltmeter to its highest range. This way, possible high voltages existing in a circuit will not cause overloading of the meter. To obtain increased accuracy, you can then set the voltmeter to the best range for comparison with the value given in the voltage charts.

You should remember that the sensitivity (in ohms per volt) of the voltmeter used to prepare the voltage charts in the technical manual is always given on the chart. Therefore, if a meter of similar sensitivity is available, you should use it. This way, the effects of loading will not have to be considered.

The following precautions are general safety measures that apply to the measurement of voltages. You should always comply with these precautions when making preventive or corrective checks on electronic equipment.

First, connect the ground lead of the voltmeter. When taking voltage measurements, you should always place one hand in your pocket or behind your back to avoid making a complete circuit with your body.

If the voltage to be measured is less than 300 volts, place the end of the test probe on the point to be tested.

If the voltage to be measured is greater than 300 volts, proceed as follows:

1. Shut off the circuit power.
2. Discharge the capacitors.
3. Ground the point to be measured.
4. Connect (clip on) the proper test lead to the high-potential point.
5. Make sure you are not touching any part of the meter.
6. Turn on the circuit power and read the voltage.

Do not touch any part of the equipment or the meter while the power is on. You should constantly keep in mind that almost all voltages are dangerous and can be fatal if contacted.

OSCILLOSCOPE MEASUREMENTS

Oscilloscope measurements are often referred to as "waveform comparisons." These measurements are a very important part of preventive maintenance, although they are used primarily in corrective maintenance. Waveforms may be observed at indicated test points as shown in waveform charts or on MRCs.

The waveforms given in charts, MRCs, or instruction booklets are often idealized and may not show details that are normally present when the actual waveform is displayed on an oscilloscope. Consequently, many apparent "troubles" that are detected really do not exist. This results in many lost man-hours in unneeded corrective maintenance or in search of a problem that has been tentatively diagnosed.

If there is no trouble present in the equipment or system, a waveform observed at a designated point generally should resemble the reference waveform given for that test point. However, test equipment characteristics or usage can cause distortion of the observed waveforms even though the equipment or system is operating normally. Some of the more common causes of these distortions are as follows:

- The leads of the test oscilloscope may not have been connected in the same manner as those of the oscilloscope used in preparing the reference waveforms, or the lead lengths may differ considerably.

- An oscilloscope having a different input impedance and frequency response may have been used to obtain the reference waveforms.
- Operator front-panel errors may result from lack of knowledge of oscilloscope operation for test purposes.

In general, you should not waste time in searching for faults when relatively minor differences are detected between the reference waveforms and those obtained by basic checks.

PERFORMANCE TESTING MEASUREMENTS

There are specific tests for each category of equipment when conducting performance testing of communications equipments and systems. In practice, performance tests indicate the operating condition of an equipment section, complete piece of equipment, or a full system. Although performance tests are normally covered in PMS, they may also be given as part of post-availability tests, post-overhaul testing, and special inspections.

In the following paragraphs, we will discuss the performance measurements used in the testing of communication equipments and systems. These measurements include:

- Receiver noise measurements;
- Receiver gain measurements;
- Receiver sensitivity measurements;
- Transmitter power output measurements;
- Standing wave ratio tests and measurements; and
- Frequency spectrum measurements.

RECEIVER NOISE MEASUREMENTS

In theory, it is possible to amplify a weak signal by any desired factor. For example, a receiver may have an amplification factor of 10 or 1,000. This simply means that any signal introduced into the receiver input will be amplified (increased in amplitude) 10 or 1,000 times.

Receiver amplification is closely linked to receiver sensitivity. To distinguish between them, you must remember that the sensitivity of a receiver is its ability to amplify weak signals; whereas the amplification factor of a receiver is the relative increase in amplitude from the input to the output.

There is a limit to both the amplification factor and the sensitivity of a receiver. This limit is determined in each receiver by the amount of noise present in the receiver at any one time. The noise present in the receiver may come from random electrical disturbances in the atmosphere or from the electrical components in the receiver circuits. Whatever the source, most noise enters the receiver amplification circuits by way of the antenna input stage.

Noise that originates in the atmosphere enters the receiver by means of the antenna itself. However, if the noise originates in the circuit components, it enters the receiver by means of the first RF amplifier. This is because only the noise generated in the first stage is amplified throughout the receiver. Noise generated in the remainder of the receiver is not as harmful as that generated in the first stage of amplification.

Basically, this means that the crucial quantity in any receiver is the signal-to-noise ratio present at the input of the first RF amplifier. The absolute magnitudes of signal and noise are not important; only their ratio.

The noise generated through atmospheric disturbances can be controlled somewhat through the use of a noise limiter, squelch, and volume control circuits. However, inherent receiver noise is caused by the design of the receiver and is harder to contend with. Therefore, the inherent noise generated in a receiver establishes the minimum limit of signal that a receiver can usefully amplify. This is what determines receiver sensitivity.

Self-generated receiver noise is usually thermal in nature. Thermal noise is caused by the random motion of the electrons in the antenna and receiver circuits (sometimes called resistance noise). Receiver noise exists across the entire RF spectrum and increases as the bandpass of a receiver increases.

At the higher operating frequencies, practically all noise originates in the receiver. This is because there is less atmospheric noise present at the higher frequencies than there is at the lower frequencies. In fact, external noise in the microwave region of the spectrum is almost nonexistent.

Receiver noise determines the weakest signal that can be practically amplified. The behavior and measurement of noise are of fundamental importance for equipment that may be used to receive very-low-intensity signals. These receiver noise measurements are normally made with a noise generator or with an RF signal generator.

Basically, a noise generator produces a random noise signal at any frequency within its design frequency range. For example, a noise generator could be designed to produce a pure noise signal at any frequency between 2 MHz and 32 MHz. The noise generator method of determining the noise figure of a receiver has the advantage that no knowledge of the gain of the receiver or amplifier under test is necessary.

This method of noise measurement consists of comparing the noise actually present in the receiver or amplifier with the nonvarying, calibrated output of the noise generator. You should remember that a noise measurement can be made on an individual amplifier or on an entire receiver.

Figure 13-1 shows a block diagram for making a noise measurement on a receiver using a calibrated noise generator. For an accurate measurement, the noise generator output impedance is adjusted to the same impedance as the normal signal source to the receiver or amplifier circuit under test. In most cases, this input impedance value is given in the equipment technical manual and is the impedance at the antenna input, since the signal is normally injected at the first RF amplifier of a receiver under test.

For best results, the shortest possible leads with good connectors should be used between the noise generator and the receiver input. Ideally, the measurements should be performed in a shielded space. If this is not possible, you should select a location where minimum interference from radio transmitters or other electrical devices is present.

As shown in figure 13-1, the noise generator output is injected into the receiver. This output frequency must be in accordance with the standards and specifications set forth in the equipment technical manual or maintenance standards manual. The meter used at the output is normally an ac voltmeter; however, a wattmeter may also be used to conduct this test. You should disable the automatic volume control and noise limiter circuits when performing this test.

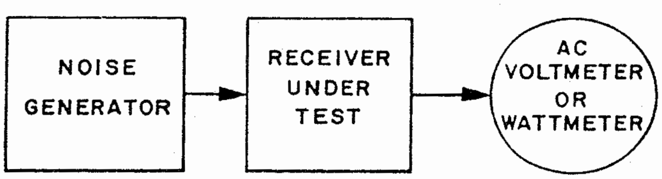


Figure 13-1.—Block diagram of a basic receiver noise measurement.

When using a voltmeter as the output indicator, you first observe the receiver with no input signal applied. Then, you adjust the noise generator for an output voltage of 1.4 times the no-input voltage indication. The noise figure is then indicated on the output level control of the noise generator. If using a wattmeter as the output indicator, you should adjust the noise generator for twice the no-input reading.

The signal-generator method of making receiver noise measurements is similar to the noise-generator method in that the basic block diagram is the same as that shown in figure 13-1. The only difference is that a signal generator is used instead of a noise generator. The advantage of this method is that sine wave generators are used more widely and are usually easier to obtain than are noise generators.

However, the signal-generator method is not as practical or accurate as the noise-generator method. When using the signal generator, you must take into account the bandwidth and the response of the receiver under test—something you do not have to do with the noise-generator method. With a signal generator, as with a noise generator, measurements are made under conditions of no-signal and signal inputs.

RECEIVER GAIN MEASUREMENTS

Gain measurements are useful in determining the gain of a particular amplifier within a receiver or of an entire receiver from input to output. The gain of a particular stage within a receiver is expressed by the equation:

$$Receiver\ Gain\ (RG) = \frac{Output\ Signal}{Input\ Signal}$$

That is, by inserting a test signal at the input stage and measuring it at the input to the succeeding stage, we can determine the voltage gain (VG) of the input stage. Similarly, the voltage gain (also simply called gain) of an entire receiver can be determined. We can determine the gain of the entire receiver by inserting a signal into the antenna or the first RF amplifier stage and measuring it at the output of the receiver with a voltmeter. Expressed by the equation:

$$Voltage\ Gain = \frac{Voltage\ at\ Succeeding\ Stage}{Voltage\ at\ Input\ Stage}$$

When gain measurements are being made, it is important that the normal operation of the stage not be disturbed by the test equipment involved. Figure 13-2 shows a basic block diagram of a typical AM receiver. A signal frequency from the signal generator (figure 13-2) can be inserted at either point a or point b. The signal that is injected and the connections that are made must be in accordance with technical manual specifications or the maintenance standards manual.

The output of the receiver is measured with a voltmeter connected at the output of the last amplifier stage. Interpretation of the voltage reading from the input to the output will give you the total gain of the receiver. This method may also be used between single stages, measured one at a time.

RECEIVER SENSITIVITY MEASUREMENTS

Sensitivity measurements provide a convenient overall measurement of a receiver. Sensitivity can be defined as the ability of a receiver to amplify weak signals. Sensitivity can be further defined as the input carrier voltage required to develop a standard value of output.

Sensitivity measurements require the application of an accurately calibrated signal to the antenna input terminals of a receiver. This is normally done through a "dummy" antenna, which approximates the impedance characteristics of the antenna with which the receiver is designed to be used.

This dummy antenna simulates normal operating conditions and ensures that the receiver has the proper impedance match. It also ensures that the signal current during testing is equivalent to the signal current obtained from a real signal of equivalent magnitude. Figure 13-3 shows, in block form, a typical signal generator, dummy antenna, and receiver hook-up in preparation for sensitivity measurements.

Most signal generators have an output impedance of about 50 ohms. Most low-impedance receivers have an input impedance of about 50 ohms as well. Therefore, for sensitivity measurements of these low-impedance receivers with a corresponding signal generator, no dummy antenna is necessary. The dummy antenna is necessary only where the impedances between the signal generator and receiver must be matched for proper measurements.

As shown in figure 13-3, the signal generator injects a signal into the dummy antenna. This injected

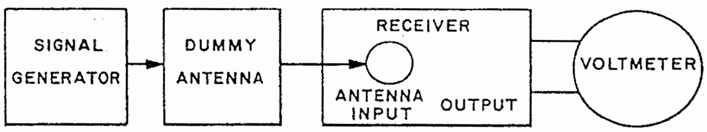


Figure 13-3.—Typical block diagram in preparation for sensitivity measurements.

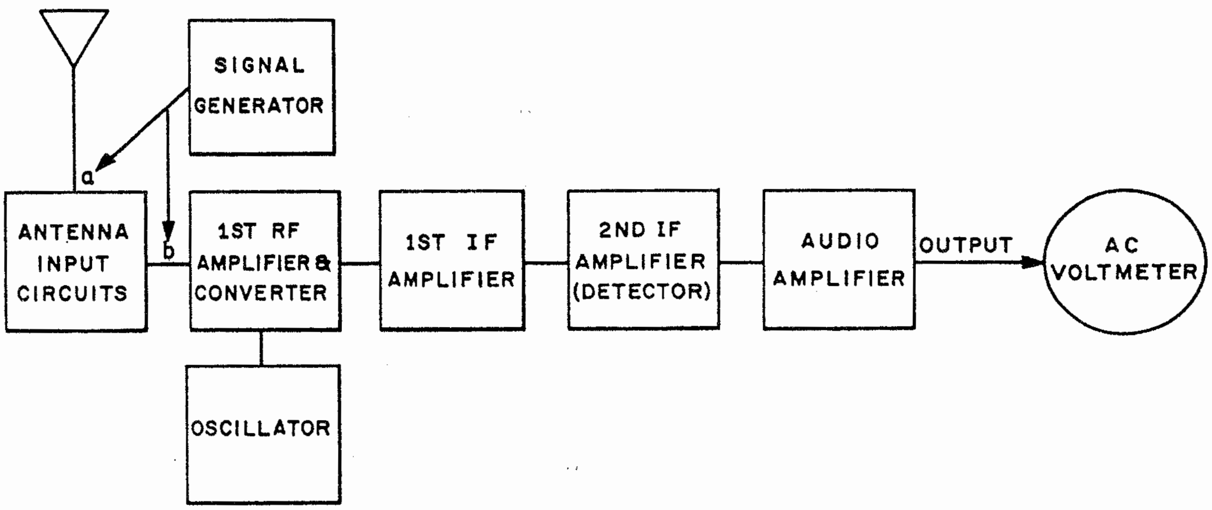


Figure 13-2.—Basic block diagram of receiver gain measurement using signal generator.

signal must be in accordance with either the technical manual or reference standards tables. The signal is then injected into the receiver circuits at the antenna input.

At the output of the receiver, an indicating device, such as a voltmeter, is used to measure the value of the test output in reference to the standard test input of the signal generator. This determines the sensitivity of the receiver. To obtain valid results, it is important that you follow the step-by-step procedures and connections in accordance with the equipment technical or reference standards manuals.

TRANSMITTER POWER OUTPUT MEASUREMENTS

The measurement of power output is important in determining the efficiency and proper operation of all output stages and systems. Power output measurements apply to both radio and audio frequencies. For continuous-wave (CW) transmissions, the power output is measured under key-down conditions for maximum output into a properly terminated antenna system or a dummy antenna of equivalent characteristics.

In modulated systems, the power output is measured for normal carrier output and for peak power at 100-percent modulation. An oscilloscope is normally used to determine the drive necessary for 100-percent modulation. Exceeding this drive level causes distortion and unwanted shifting of the carrier.

An output power measurement is available for every type of transmitter in operation. These measurements are generally easier to make than sensitivity measurements. However, unless proper technical manual precautions are followed to the letter when the measurements are made, the test equipments used in conjunction with these tests will be permanently damaged.

STANDING WAVE RATIO (SWR) TESTS AND MEASUREMENTS

SWR tests and measurements are included in the scheduled preventive maintenance procedures for some equipments. The SWR test is basically the ratio of current or voltage at a loop to current or voltage at a node along the length of the antenna. A low SWR is indicative of a properly matched system and is a prerequisite for good performance of all communications transmission lines.

Procedures for checking the current or voltage variations, which are the components of the standing waves, are basically dependent upon the frequency of the system. Again, you should follow technical manual and reference standards procedures when making these checks and measurements.

FREQUENCY SPECTRUM MEASUREMENTS

The amplitude of a group of frequencies that comprise a signal is called the frequency spectrum. Various types of equipment provide a visual or a meter indication of this spectrum. Equipments used for observing or measuring segments of the audio-frequency band are called AF spectrum analyzers.

Test equipments used for observing small segments of the RF spectrum, or of RF oscillators, are called spectrum analyzers or pulse analyzers. The equipment most used in communications checks is the spectrum analyzer. Some of the more important measurements that can be accomplished with the spectrum analyzer include:

- Intermodulation harmonic distortion checks;
- Tone linearity checks;
- Signal-to-noise checks;
- Carrier suppression tests;
- Frequency and sideband measurements; and
- Power measurements.

ANTENNA TESTING AND MAINTENANCE

Shipboard communications antenna systems are a vital link in the naval communications network. It is therefore imperative that the best methods and procedures be used during the testing and maintenance of antenna systems. In this section, we will discuss the testing and maintenance of shipboard antennas and their associated equipment.

Communications personnel are responsible for the day-to-day mechanical and electrical condition of the communications antenna systems. The operational capabilities of the systems can be realized only if an adequate preventive and corrective maintenance program is in effect. Regularly scheduled inspections and tests are necessary to maintain the systems at their maximum capabilities.

Test procedures involve physical inspection, mechanical maintenance and repair, and instrumentation to perform electrical tests. Proper evaluation of system performance requires that each antenna system have a set of standard operating conditions developed from information accumulated during initial tune-up and operation. Any deviation from these values is an indication of probable system degradation.

A naval ship operates in an environment that is highly corrosive to antenna components. Salt deposits and stack gases contribute to corrosion and the formation of low-impedance paths across insulators. Vibration, flexing, and operations in heavy seas and strong winds increase the possibility of loose connections and excessive stresses on antennas and mountings. Typical shipboard antenna systems are shown in figure 13-4.

The frequency of tests required to maintain maximum operational capability should be based on the mission of the ship, duration of time at sea, and the area of operation. The Planned Maintenance System (PMS) and Maintenance Requirement Cards (MRCs) define specific preventive maintenance tasks in step-by-step procedures.

Figures 13-5 and 13-6 are examples of antenna MRCs. Routine tests should be scheduled at least quarterly and more often when conditions warrant. Tests must be performed immediately when there is any degradation of operation so that damage to antennas and transmitting systems can be detected and corrected.

MECHANICAL TESTING AND MAINTENANCE

Mechanical testing and maintenance include a visual system inspection for indications of physical deterioration and mechanical discrepancies, such as broken insulators and loose connections. Maintenance procedures generally consist of cleaning, replacing broken or worn parts, and tightening mechanical and electrical connections. Since physical defects generally result in changes in the electrical characteristics, mechanical testing and maintenance should be conducted prior to electrical tests.

Visual Inspection

Wire antennas are protected with a Vinylite jacket. This protects the antennas from salt and stack gases. These jackets, along with the proper sealing of connectors with Scotch Clad No. 1706, should eliminate monthly maintenance. Thereafter, quarterly PMS should be little more than a visual inspection for weathertightness.

When checking wire antennas, you should pay particular attention to points that are subjected to strain and chafing. The primary points of concern are where supporting clamps attach to the antennas and where the antennas connect to trunks or transmission

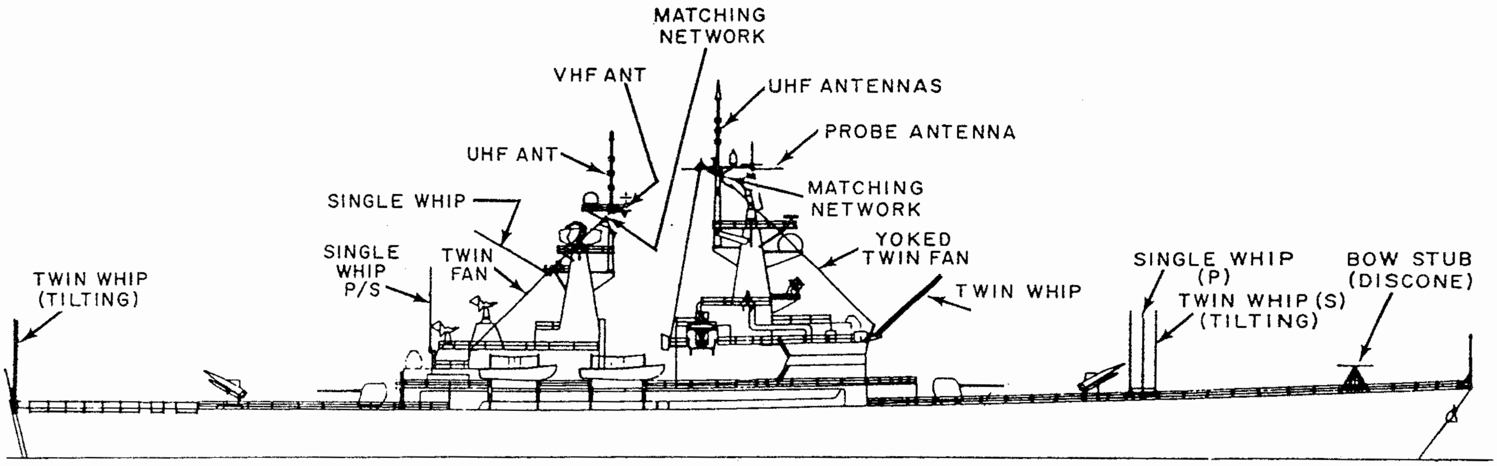


Figure 13-4.—Shipboard antenna systems.

SHIP SYSTEM	SUBSYSTEM	MRC CODE	
Communications	Wire, Whip, and Dipole Antennas	C-405 A-1R	
SYSTEM	EQUIPMENT	RATES	M/H
Antennas		2RMSN	2.0

MAINTENANCE REQUIREMENT DESCRIPTION

1. Clean and preserve wire, whip, and dipole communication antennas.

TOTAL M/H 2.0

ELAPSED TIME 1.0

SAFETY PRECAUTIONS

1. Observe standard safety precautions.
2. Turn OFF and tag transmitter power switch.
3. Comply with ship's regulations for working aloft.

TOOLS, PARTS, MATERIALS, TEST EQUIPMENT

1. Wire brush
2. Clean rags
3. Safety belts
4. Warning tags
5. Bucket of fresh water
6. Primer treatment, FSN G 8030-165-8577
7. Dow-Corning compound, FSN 5970-159-1598
8. Zinc chromate primer, FSN KE-8010-161-7419
9. Haze gray paint (No.27), FSN G 8010-285-8298
10. Gun slushing compound Type B, or hard film corrosion preventive
11. Strap wrench (2)
12. 8" Adjustable wrench
13. Coil 1/2" nylon line
14. 1", 3" Paintbrush (2)
15. Solvent PSN 6810-184-4794

PROCEDURE

NOTE 1: Preform annually or when directed as a result of antenna inspection.

Preliminary

a. Turn OFF and tag transmitter power switches.
b. Comply with ship's regulations for working aloft.

1. Clean and Preserve Wire, Whip, and Dipole Communication Antennas.

a. Clean and preserve wire antennas:
(1) Disconnect and lower wire antenna to the deck, using nylon line; exercise care not to damage the insulators.
(2) Clean isnulators by wiping with a clean rag and fresh water. Replace creacked or chipped insulators.
(3) Wirebrush metal fittings and hardware to remove dirt, salt, and corrosion.

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MAINTENANCE REQUIREMENT CARD (MRC)
OPNAV 4790/82 (REV. 2-82)

Procedure (Cont"d)

(4) Where antenna is uncoated, brush with wire brush.
(5) Where antenna is coated, clean with rag saturated with solvent.
(6) Inspect shackles and shackle pins for evidence of wear; replace badly worn shackle pins.
(7) Use brush to paint cleaned hardware and fittings with gun slushing compound or hard film corrosion preventive.
(8) Return antenna to its original location. Ensure shackle pins, clamps, and fittings are tight, and that insulators are not in a position which places an unnatural strain on them. If safety links are installed, ensure that they are properly formed and that seising is secure.

b. Clean and preserve whip antennas:

(1) Remove antenna from bowl insulator.
(2) Lower whip to the deck; exercise caution not to damage the antenna.
(3) Use strap wrenches to disconnect antenna sections.
(4) Inspect whip closely for cracks and corrosion; remove flaking or blistered paint, salt deposits, dirt,oxidation power, and rust from the antenna and base coating with a wire brush.
(5) Clean threads with wire brush.
(6) Wipe antenna with dry rag.
(7) Wash antenna with fresh water.
(8) Apply Dow-Corning compound to threaded sections.
(9) Reconnect antenna sections.
(10) Preserve cleaned antenna if required; allow ample time for drying between coats.

NOTE 2: Fiber glass whip antennas do not require painting.

(a) Apply 1 coat of primer treatment. FSN G 8030-165-8577.
(b) Apply 1 coat of zinc chromate primer, FSN KX-8010-161-7419.
(c) Apply 2 coats of hase gray paint (No.27), FSN G 8010-285-8298.

CAUTION: Under no circumstances will metallic paint be used.

(11) Clean and inspect bowl insulators; remove paint and other foreign material with clean rag and water; inspect bowl closely for cracks. Cracked or badly chipped bowls must be replaced.

(12) Return whip to its original position; tighten all associated hardware. If connection box is mounted below whip antenna, ensure drain hole is clear.

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MAINTENANCE REQUIREMENT CARD (MRC)
OPNAV 4790/82 (REV. 2-82)

Procedure (Cont"d)

c. Inspect and preserve dipole antennas:

(1) Inspect condition of Teflon separators. Remove paint, soot, and salt deposits with a clean rag and water.
(2) Inspect metallic elements for corrosion; remove all corrosion with a wire brush; preserve cleaned surfaces as described in step 1.b.(10).

NOTE 3: Brass dipole need not be painted with zinc chromate.

d. Return antenna to desired condition.

e. Comply with ship's regulations for completing work aloft.

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MAINTENANCE REQUIREMENT CARD (MRC)
OPNAV 4790/82 (REV. 2-82)

Figure 13-5.—Maintenance Requirement Card (MRC); antenna cleaning and preservation.

SHIP SYSTEM	SUBSYSTEM	MRC CODE
Communications	Wire, Whip, and Dipole Antennas	C-405 Q-1

SYSTEM	EQUIPMENT	RATES	M/H
Antennas		2RMSN	1.0

MAINTENANCE REQUIREMENT DESCRIPTION

1. Wash down whip and dipole communication antennas.

TOTAL M/H 1.0
ELAPSED TIME 0.5

SAFETY PRECAUTIONS

1. Observe standard safety precautions.
2. Turn OFF and tag transmitter power switch.
3. Comply with ship's regulations for working aloft.

TOOLS, PARTS, MATERIALS, TEST EQUIPMENT

1. Warning tags
2. Clean, day rags
3. Fresh water hose

PROCEDURE

Preliminary

a. Turn OFF and tag transmitter power switches.
b. Comply with ship's regulations for working aloft.

1. Wash Down Whip and Dipole Communication Antennas.
   a. Wash antenna, using fresh water to remove soot and salt residue.
   b. Wipe insulator dry, using clean rag
   c. Return equipment to desired condition.
   d. Comply with ship's regulations for completing work aloft.

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MAINTENANCE REQUIREMENT CARD (MRC)
OPNAV 4790/82 (REV. 2-82)

SHIP SYSTEM	SUBSYSTEM	MRC CODE
Communications	Wire, Whip, and Dipole Antennas	C-405 M-1

SYSTEM	EQUIPMENT	RATES	M/H
Antennas		RM3 RMSN	2.0 2.0

MAINTENANCE REQUIREMENT DESCRIPTION

1. Inspect wire, whip, and dipole communication antennas and associated hardware.
2. Clean antenna insulators.
3. Measure antenna insulation resistance.
4. Measure antenna continuity.

TOTAL M/H 4.0
ELAPSED TIME 2.0

SAFETY PRECAUTIONS

1. Observe standard safety precautions.
2. Turn OFF and tag transmitter power switch.
3. Comply with ship's regulations for working aloft.

TOOLS, PARTS, MATERIALS, TEST EQUIPMENT

1. Clean rags
2. Wire brush
3. Vinyl tape
4. Rubber tape
5. Safety belts
6. Warning tags
7. Bucket of warm, fresh water
8. Multimeter, AN/PSM-4 or equivalent
9. Insulation test set,AN?PSN-2 or equivalent
10. Insulating varnish
11. Dow-Corning compound
12. 8" Adjustable wrench
13. Soap and water solution
14. Solvent PSN 6810-184-4794
15. 6" Normal duty screwdriver
16. Grounding strap

PROCEDURE

Preliminary

a. Turn OFF and tag transmitter power switches.
b. Comply with ship's regulations for working aloft.

1. Inspect Wire, Whip, and Dipole Communication Antennas. and Associated Hardware.
   a. Inspect wire, whip, and dipole antennas and related hardware for security, corrosion, and pitting. Antennas mounted in the vicinity of the stacks require particular attention. If antennas require cleaning and preservation, perform applicable sections of MRC A-1R.
   b. Tighten loose grounding lugs and bolts. Replace broken grounding straps; clean grounding area thoroughly with wire brush.
   c. Beware coaxial connectors exposed to weather are watertight. If a connector is found that is not watertight, or a connection has been disconnected, the following steps should be taken.

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MAINTENANCE REQUIREMENT CARD (MRC)
OPNAV 4790/82 (REV. 2-82)

Procedure (Cont'd)

(1) Ensure the coaxial connectors are clean and dry.
(2) Coat threads of connectors with Dow-Corning compound.
(3) Reconnect connectors.
(4) Wrap rubber tape around connectors and around cable 4" on both sides of connectors.
(5) Wrap vinyl tape on top of rubber tape 6" on both sides of connectors.
(6) Apply insulating varnish liberally over the taped area.

2. Clean Antenna Insulators.

CAUTION: Do not use any metal objects to clean or scrape insulators.

   a. Remove foreign material such as paint, salt, and soot deposits from insulators with a clean rag saturated with solvent. Wash with soap and water, followed by several rinsings with clean, fresh water.
   b. Inspect insulators; replace any insulators found to be cracked or chipped.

3. Measure Antenna Insulation Resistance.
   a. Disconnect static leak resistors from ground on wire receiving antennas.
   b. Measure insulation resistance of each antenna, using appropriate test instrument connected between transmission line center conductor and ground on antenna side of coupler-tuners or antenna patch panel.
      (1) For open antenna, any reading below 100 megohms should be investigated.
      (2) For shorted antenna, any reading above 2 ohms should be investigated.
   c. Disconnect insulation test set or multimeter from transmission line coaxial connectors.
   d. Reconnect static leak resistors to ground on wire receiving antennas.

4. Measure Antenna Continuity.
   a. Measure continuity of each antenna.
      (1) Connect grounding strap between antenna and ground.
      (2) Connect multimeter leads between antenna cable center conductor and ground; multimeter should indicate 2 ohms or less.
      (3) Disconnect multimeter and grounding strap.
   b. Reconnect transmission line to associated equipment.
   c. Remove warning tags.
   d. Return equipment to desired condition.
   e. Comply with ship's regulations for completing work aloft.

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MAINTENANCE REQUIREMENT CARD (MRC)
OPNAV 4790/82 (REV. 2-82)

Figure 13-6.—Maintenance Requirement Card (MRC); antenna test and maintenance.

lines. You should also check insulators for cracks and other signs of deterioration.

You can usually inspect whip antennas without lowering them. Look for rust spots, loose mounting bolts, and loose or frayed connections. As with wire antennas, check all insulators for chips, cracks, and cleanliness.

Most whip antennas are hollow and may collect moisture inside, depending upon how they are mounted. This condition does not affect their efficiency, but it does contribute to their physical deterioration. To prevent whip antennas from gradually filling with water, small drainage holes are sometimes drilled near their bases.

Maintenance of VHF and UHF antennas is complicated by inaccessibility. Often, it is necessary to climb masts or stacks to properly inspect the antennas. For this reason, these antennas are sometimes neglected until a major casualty occurs. VHF and UHF antennas are susceptible to rust, loose mountings, and broken connections and must be inspected regularly. Technical manuals for the various types of VHF/UHF antennas are available and should be used during checks and maintenance. These manuals are generally simple and easy to use.

Antenna insulators have a glazed surface to which foreign material does not adhere readily. The glazed surface tends to wash clean during rainstorms. Although helpful, an occasional rain cannot be depended upon to keep insulators free of salt spray, soot, and dirt. For this reason, antenna insulators should be cleaned at least once a month, and more often when conditions warrant (such as a prolonged period at sea). Insulators can be cleaned with a dishwashing compound mixed in fresh hot water. One dirty insulator can render an antenna useless.

Coaxial Cable Transmission Lines

Coaxial cable transmission lines should be inspected for physical abrasions and cuts, deformation at watertight fittings, and sagging and stretching. They should also be inspected for excessive heat in the vicinity of the cable, moisture and corrosion, and loose connectors and end seals. You should also ensure that the specified bending radius has not been exceeded.

You should pay particular attention to cuts or holes in the outer jacket of flexible coaxial cables wherever they are exposed to the weather. Any moisture that enters the cable will seep under the jacket and eventually short the cable at a connector. Salt water reacts with the copper braid outer conductor. This will cause corrosion and eventually complete deterioration.

Defective coaxial cable lines should be replaced with complete runs without splices or connectors. However, in an emergency the lines may be spliced, but they should be replaced at the first opportunity. If the line is pressurized, it should be checked to determine that the specified pressure is being maintained. Loss of pressure indicates loose fittings or holes in the outer conductor.

Wire Antennas

Wire antennas should be inspected for corrosion, kinks, frayed strands, and loose hardware. Kinked or frayed wire with broken strands should be replaced immediately. Broken strands reduce overall tensile strength and tend to create radio-frequency interference (RFI) problems because of arcing and corona discharges when exposed to high-energy RF fields.

All antenna hardware, including patented terminating devices, turnbuckles, and shackles, should be inspected for tightness, corrosion, and wear. The bonding across mechanical junctions should also be inspected for corrosion and tightness. Figure 13-7 shows examples of various wire rope connectors and fittings.

The proper dress and stressing of wire antennas are important. If the antenna is stressed too tightly, it may break under the strain of shipboard vibrations. Conversely, excessive slack can introduce sufficient variations in the capacitance of the antenna to detune the system from the motion of the ship.

Feed wires from coupler units or termination boxes to tuned antennas should be a minimum of 48 inches from metal surfaces. Feed wires from HF broadband fan-type antennas should be installed in such a manner that insulators are not required to maintain separation from metallic mast structures.

Insulators should be inspected for cleanliness, surface damage, and cracks in the insulating surfaces. Insulators with cracks and chips in the porcelain indicate possible early failure and are depositories for dirt and should be replaced. If the insulators show evidence of soot or salt deposits, they should be

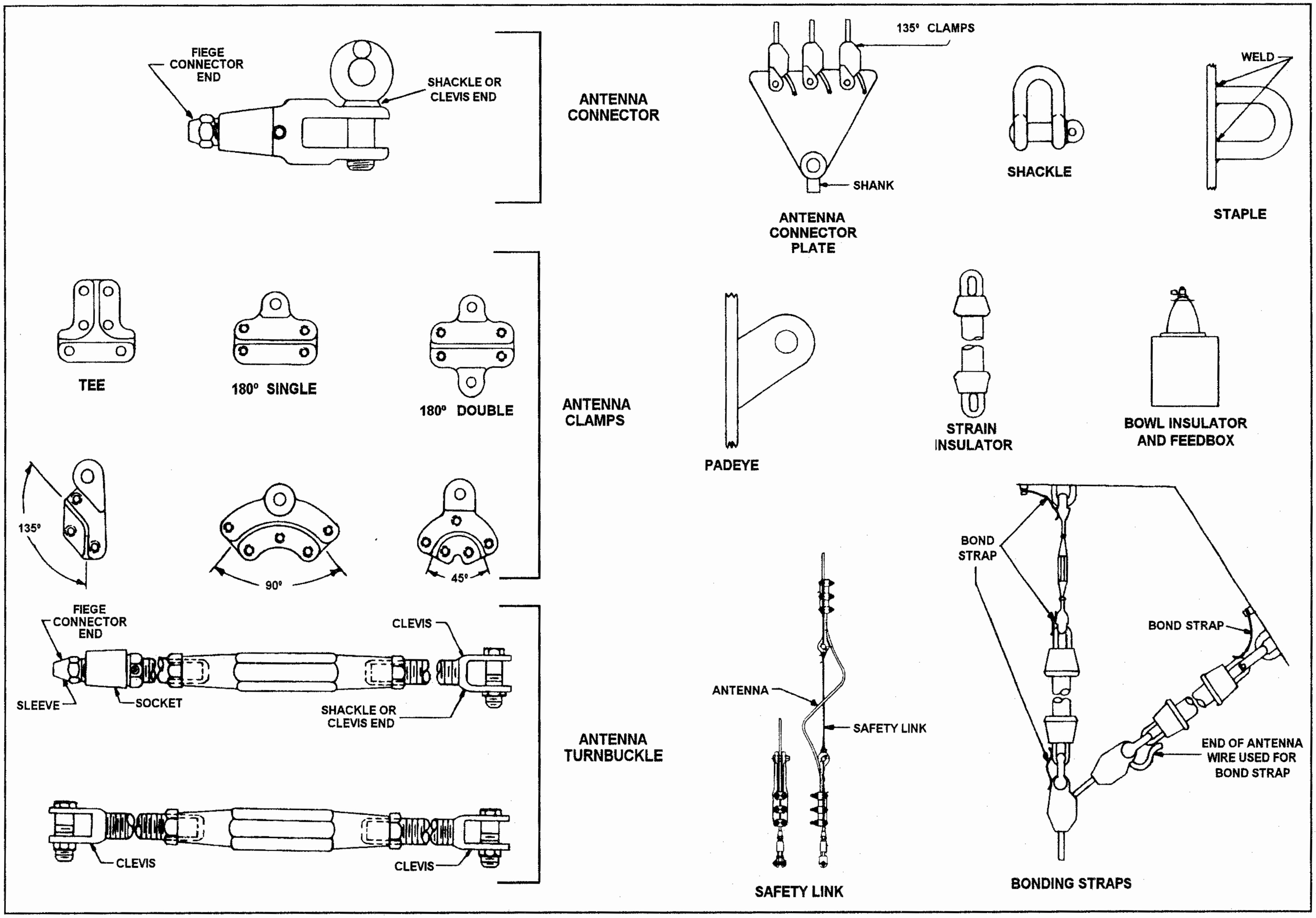

Figure 13-7.—Wire rope connectors and fittings.

washed with a dishwashing compound in a solution of fresh hot water until all surface dirt is removed.

A thin coat of Dow-Corning Compound No. 4 should be applied to the surface of the insulators. This compound forms a film that sheds water and reduces the formation of salt deposits and the accumulation of dirt. Similarly, threaded portions of antenna hardware should be coated with an antiseizing compound.

Whip Antennas

Both fiberglass and metal whip antennas are currently installed aboard ship. The metal types, made of aluminum, are mounted on a base insulator by means of a cast aluminum adapter. Some fiberglass whip antennas are mounted in this same manner; others are furnished with an integral fiberglass base insulator.

Metal antennas should be inspected for metal fatigue, loose section joints, and corrosion. Cracked or peeling paint accelerates corrosion, especially on antennas subjected to high temperatures and stack gases. Before these antennas are repainted, the entire area should be thoroughly cleaned of old paint and corrosion.

The area should be repainted in accordance with the procedures outlined in *Shipboard Antenna Systems, Antenna Installation Details*, NAVSHIPS 0967-177-3020. This publication contains complete information for preparing and painting of aluminum surfaces.

Metal whip antennas must have a 1/8- to 3/8-inch drain hole at their bases to prevent moisture from accumulating within the antenna. In addition to accelerated corrosion caused by the water inside the antenna, serious physical damage can result if water is allowed to collect and freeze during operations in cold climates.

Fiberglass antennas are subject to chips and cracks in the fiberglass. This can permit moisture to collect within the lamination. Moisture within the antenna, especially salt water, can cause corrosion of the metal strips of the antenna. In cold climates, freezing moisture can further separate the laminations. These antennas cannot be repaired in the field and should be replaced if severe cracks and laminations are found.

Particular attention should be given to the hold-down bolts on the base insulator and the aluminum adapter. The mounting surface of the base insulator is either bronze or a corrosion-resistant metal that is compatible with the adapter piece. However, care must be exercised in selecting mounting hardware so that metals conducive to electrolytic action between the various components are not used.

A small magnet can be used to ensure that mounting bolts are not manufactured from ferrous metals. Complete information on the correct assembly procedures and materials for the insulation of whip antennas is outlined in NAVSHIPS 0967-177-3020.

Areas near whip antennas should be examined to ensure that antennas will not become fouled by the ship's rigging. This examination could also reveal if antenna flexing in a seaway could cause contact with shipboard structures.

Trussed whip and discone/cage broadband antennas are physically constructed of a support pole and wires. The mechanical tests for these antennas are similar to those described for the wire and whip antennas in the preceding paragraphs. However, because of the large number of mechanical and electrical joints in trussed whip and discone/cage broadband antennas, particular attention must be given to loose fittings and corrosion. The proper dress and stressing of the wire sections of these antennas are vital in maintaining mechanical and electrical balance.

VHF/UHF and Probe Antennas

VHF/UHF antenna assemblies and probe antennas, such as those supplied with the AN/SRA-17 Antenna Coupler Group, should be inspected for corrosion, dirt on the insulating surfaces, and loose mounting hardware. Particular attention should be given to the VHF/UHF antennas for indications of moisture leakage around the coaxial cable connector and assembly gaskets.

Some antenna assemblies, such as the AS-390/SRC, are equipped with a pipe plug that can be removed to check for the presence of moisture. The antennas are subject to severe damage from freezing if moisture is allowed to collect within the assembly. Therefore, if moisture is detected, the antenna must be disassembled, thoroughly dried out, all corrosion removed, and then reassembled with proper gaskets and sealants.

Probe antennas are supplied as an integral part of an assembly that consists of a mounting box containing a tuning unit and cable terminations. The whip should be inspected for corrosion and metal fatigue. The base insulator should be inspected for dirt and cracks and the mounting for loose hardware. The method of cleaning the base insulator is the same as that for whip antennas.

Antenna Tilting Devices

Aircraft, VERTREP, helicopter, and ordnance operations require that antennas installed in certain areas aboard ship be equipped with tilting devices to reduce their vertical height so as not to interfere with the aircraft. There are several designs for tilting devices. Some are operated manually, whereas others are operated hydraulically or electrically.

Manual types must be counterbalanced to operate properly. All types require positive locking devices in the horizontal and vertical positions. All moving joints must be fitted with electrical bonding straps. The tilting mechanism should be inspected for rust and corrosion, worn or damaged parts, proper lubrication of all moving parts, and loose fittings and connections.

The connections between the matching network, coaxial cable line terminals, and base insulators must be free from kinking or stretching during operation. The area near tilting mechanisms must be kept free of any temporarily stowed items or other obstructions that would prevent antenna movement.

Satellite Antennas

The sensitive and critical nature of satellite system antennas prevent all but cleaning and visual inspections. Before you perform any maintenance or testing on a satellite antenna, refer to its technical manual or to *Electronics Installation and Maintenance Book*, SE000-00-EIM-010. Removal, replacement, or overhaul of any satellite antenna group should be attempted only by specifically qualified technicians or a repair facility.

Environmental Considerations

The prime objective of a maintenance program is to ensure operability of equipment. When determining a ship's antenna maintenance schedule, the senior RM should consider the operating schedule of the ship. If the ship will be deploying in areas of climatic extremes, environmental conditions must be considered.

Communications equipment is sensitive to temperature extremes. This is especially true for antennas and associated hardware, which are continuously exposed. A determination must be made of the possible effects of the environment on your equipment and a course of action taken to offset these effects.

SAFETY

Accidents do not respect persons or rights. Statistics show that a high percentage of accidents or casualties could have been prevented if some specific precautionary measures had been taken. Common sense, good indoctrination, and training are required of all personnel maintaining and operating shipboard equipment.

When working with radio, or with any other electronic equipment, you should remember this rule: **SAFETY FIRST.** Dangerous voltages energize much of the equipment with which you work. Power supply voltages can reach 40,000 volts, and RF voltages can be even higher.

Electrical fields that exist in the vicinity of antennas and antenna leads may introduce fire and explosion hazards, especially where flammable vapors are present. In this situation, special precautions are necessary. Additional precautions are needed to prevent injuries to personnel working aloft from falls and stack gases.

The safety precautions outlined in this chapter are not intended to supersede information given in instruction books or in other applicable electronic equipment instructions. Additional safety information is contained in applicable NAVSEA Electronics Installation and Maintenance Books (EIMBs), *Navy Occupational Safety and Health (NAVOSH) Program Manual for Forces Afloat*, OPNAVINST 5100.19, *Naval Ships' Technical Manual*, chapter 300, and in equipment technical manuals. Before performing maintenance on equipment, you should study these sources and observe all required safety precautions. If you ever have doubts about the steps and procedures you should observe while working on electronic equipment, consult the technician or Radioman in charge.

Danger signs and suitable guards are always provided to warn and prevent personnel from coming into contact with high voltages. The RF radiation hazard warning signs shown in figure 13-8 are posted on or near every radio transmitter, transmitting antenna lead-in trunk, and in radar rooms and other electronic spaces throughout the workspaces. Additional signs warn against such hazards as explosive vapors and the effect of stack gases aloft aboard ship. Look for warning signs and obey them. You should also be alert for dangerous conditions for which no warning signs are posted. Notify your supervisor immediately if you discover any unsafe conditions.

ELECTRICAL SHOCK

One of the greatest safety hazards for radiomen is electrical shock. To avoid this hazard, you must understand its causes and effects. If 60-Hz alternating current (ac) passes through a person from hand to hand or from hand to foot, the following effects will occur when current is increased gradually from zero:

- At about 1 milliampere (0.001 ampere), the shock can be felt.
- At about 10 milliampere (0.01 ampere), the shock is severe enough to paralyze muscles so that the person is unable to release the conductor.
- At about 100 milliampere (0.1 ampere), the shock is fatal if it lasts for 1 second or longer.

The resistance of the human body is insufficient to prevent fatal shock from 115-volt, or even lower voltage circuits if the current is high enough. Remember that **current**, NOT VOLTAGE, determines the severity of an electrical shock.

Electrical shock can be a painful jarring, shaking sensation. You can receive an electrical shock from an electrical circuit or from lightning. The victim usually experiences the sensation of a sudden blow and, if the voltage is sufficiently high, unconsciousness. Severe burns may appear on the skin at the place of contact. Muscular spasm can occur, causing a person to grasp the apparatus or wire that caused the shock and be unable to release it.

Electrical shock can kill its victim by stopping the heart or stopping breathing or both. It may sometimes damage nerve tissue and result in a slow wasting of muscles that may not become apparent until several weeks or months after the shock is received.

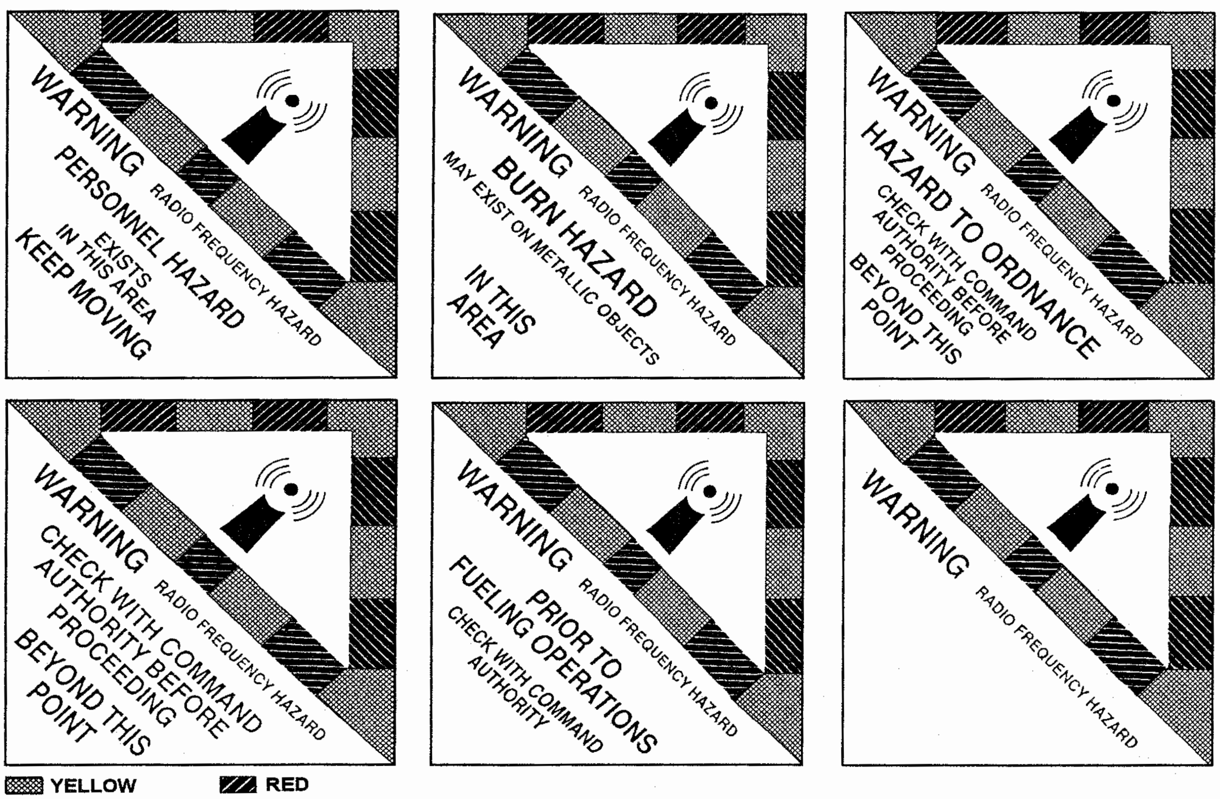

Figure 13-8.—RF radiation hazard warning signs.

Conditions for Shock

Two conditions must be met for current to flow through a person. First, the body must form or become part of a closed circuit (come in contact with electrical current while being grounded). Second, there must be enough voltage to cause current to flow through the circuit. If these two conditions exist, and the potential difference between the points of contact is high enough (115 volts is more than high enough), the body resistance is low enough, and the current path goes through some of the body's vital organs, the person can be fatally shocked.

There can be other serious secondary effects. Surprise from receiving a small shock can cause a person to fall from a high structure. For these reasons, you need to take care that your body does not form part of a closed circuit through which current can flow.

Do not go aboard ship with a casual regard for the deadly potential of electric current. Few people would handle electrical appliances while in a bathtub, nor would they stand ankle-deep in a flooded basement and fumble for a light switch. What you should realize is that the hull of a ship, which floats in salt water, is an excellent conductor. From an electrical viewpoint, personnel aboard ship are "standing in a bathtub" all the time. Do not be ignorant or contemptuous of the lethal capability of electric current.

Rescue of Shock Victims

The rescue of shock victims depends upon prompt first aid. Although acting quickly is important, to avoid becoming a victim yourself, you must observe the following safety precautions:

1. Shut off the voltage at once.
2. If the voltage cannot be turned off immediately, you should free the victim from the live conductor by using a dry board, belt, dry clothing, or other nonconducting material. **DO NOT MAKE DIRECT CONTACT WITH ANY PART OF THE VICTIM'S BODY WITH ANY PART OF YOUR BODY!** If you do, you will become part of the same circuit.
3. After you remove the victim from the power source, determine if the victim is breathing. If the victim is not breathing, you must apply cardiopulmonary resuscitation (CPR) without delay. Loosen the clothing about the neck, chest, and abdomen so that breathing is easier. Once breathing is established, protect the victim from exposure to cold. Cover with a warm cover if possible.
4. Prevent movement by the victim. After a strong shock, the heart is very weak. Any sudden effort or activity may result in heart failure.
5. Send for a doctor or corpsman, and stay with the victim until medical help has arrived. Do not give stimulants to the victim.

To be able to successfully rescue a shock victim, it is extremely important that you and your shipmates be qualified in CPR.

RF ENERGY BURNS

Alternating current (ac) above 10 kHz produces heat when passing through the body. Eventually, excessive heat results in the destruction of tissue. The heating action penetrates the tissue down to and including the bone. The action is similar to heating something with a microwave oven.

Few, if any, nerves are present inside the body that can distinguish between sensations of hot and cold. Thus, it is entirely possible for a person to sustain destruction of nerves, tissue, and body organs from heat, even though the individual feels little or no sensation. Furthermore, the consequences of such destruction may not be realized for some time. Delayed effects of both shock and RF burns include:

- Insanity;
- Mental inertia;
- Diseases of the blood vessels;
- Cataracts;
- Nerve disturbances of various kinds;
- Disturbances in the heart system; and
- Destruction of internal organ tissue.

It is dangerous and foolish to deliberately subject yourself to a shock or an RF burn.

You must exercise caution when working on transmitting antennas, since your reaction to an RF burn may cause you to fall from an elevated structure. Additionally, take adequate precautions to ensure that transmitters are not energized when they are connected to an antenna that you are inspecting or working on. To prevent RF shock, the antenna, whether used to receive or transmit, must be grounded to the hull of the ship. You should also determine whether the RF energy from nearby transmitting antennas is harmful.

SAFETY PRECAUTIONS FOR WORKING ALOFT

You must wear a safety harness at all times when working aloft. The safety harness must be of the approved type and must be tested periodically for its rated load. When aloft, you should attach these devices to a strong permanent support, preferably the mast itself. Figure 13-9 shows how to properly wear a safety harness. Two editions of *Ships Safety Bulletin*, June 1988 and September 1988, provide specifications for safety harnesses.

When wearing a tool belt, you must take care to prevent tools from falling. All hand tools must be tied to the belt with a carrier line sufficient to permit ease in working. In addition to the precautions just discussed, you must observe the following safety requirements when going aloft. These precautions are outlined in OPNAVINST 5100.19:

- Obtain permission from the combat information center (CIC) watch officer, communications watch officer (CWO), and officer of the deck (OOD).
- Check with the engineering officer to ensure that boiler safety valves are not being set.
- Tag out and secure proper transmit antenna switches.
- Ground the applicable antenna to the hull of the ship.
- Enlist the assistance of a person qualified in rigging.
- Ensure good footing and grasp at all times.
- Remember and heed the expression HOLD FAST.

PMS TAG-OUT PROCEDURES

Before starting any maintenance on electrical or electronic equipment, you must first ensure that the main supply or cutout switches are secured in the OPEN or SAFETY position and tagged. Equipment that is tagged with a DANGER tag (figure 13-10) alerts all personnel that it is not to be energized.

The DANGER tag is a red tag that prohibits the operation of equipment that could jeopardize personnel safety or endanger equipment, systems, or

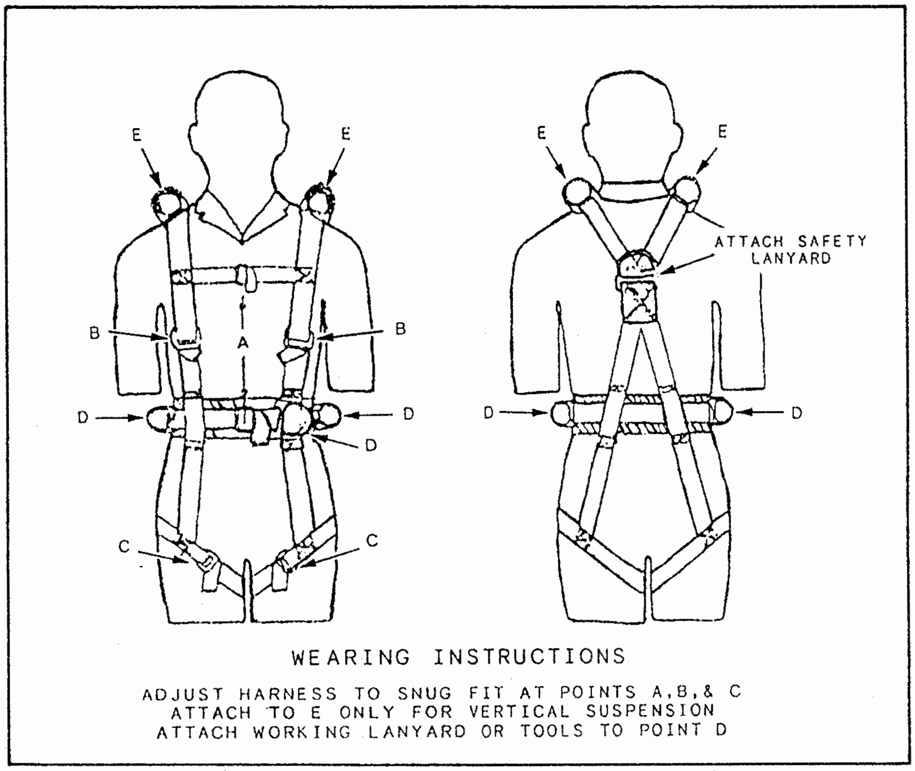

Figure 13-9.—Proper wearing of a safety harness.

Figure 13-10.—DANGER tag.

components. **Under no circumstances will equipment be operated or removed when tagged with a DANGER tag.**

The DANGER tags designated for PMS maintenance are laminated and serialized by the work center in the Work Center PMS Red Tag Record notebook. All laminated red tags used for PMS maintenance are recorded in this notebook for inventory purposes. When issuing a tag, the work center supervisor must record the serial number of the tag, date of issue, the MRC for which the tag was issued, and the name of the person to whom the tag was issued. When the tag is returned, the work center supervisor enters the date and time in the notebook.

Before issuing a tag, the supervisor must receive permission from authorizing personnel on the Tag Guide List (TGL). A TGL contains the number of tags required for the tag-out, the location of each tag, the position of the tagged item (open, shut, off, and so forth), and the permission and notification requirements for the maintenance and tag-out action. The TGLs are laminated and attached to the applicable MRCs.

The TGLs are prepared by the work center supervisor, and reviewed by the division officer and the department head. The commanding officer must approve the TGLs. After receiving permission, the person doing the PMS maintenance fills in the appropriate data on the DANGER tag using a grease pencil. The tag is placed on the appropriate item as specified by the TGL and then signed. A witness designated by the supervisor verifies the tag-out action is in compliance with the TGL, and also signs the tag.

When the maintenance action is completed, a second person verifies the clearance condition, then the maintenance person returns the tag to the supervisor. The supervisor then notifies the person from whom permission was originally obtained.

HIGH-FREQUENCY OPERATING HAZARDS

Aside from shock danger, hazards incident to operating electronic equipment in the high-frequency range can be divided into two categories: (1) radiation hazards (RADHAZ) to personnel, and (2) hazards of electromagnetic radiation to ordnance (HERO).

Radiation Hazard (RADHAZ)

Radio-frequency (RF) high-powered transmitters and high-gain antennas have increased the possibility of injury to personnel working in the vicinity. An electromagnetic radiation hazard (RADHAZ) exists when electronic equipment generates an electromagnetic field that has any of the following effects:

- Causes harmful or injurious effects to humans or wildlife;
- Induces or otherwise couples currents and/or voltages of magnitudes large enough to ignite electroexplosive devices or other sensitive explosive components of weapons systems, ordnance, or other explosive devices;
- Creates sparks sufficient to ignite flammable mixtures or materials that must be handled in the affected areas.

These hazardous situations can be caused by transmitters or antenna installations that generate electromagnetic radiation in the vicinity of personnel, ordnance, or fueling operations in excess of established safe levels. When personnel, ordnance, or fueling evolutions are located in an area that can be affected by electromagnetic radiation, hazardous situations may occur.

Electromagnetic radiation is hazardous to personnel. It can cause RF burns or have biological, thermal, and neurological effects on personnel. Because of the differences in characteristics and safety precautions required for the various effects, they will be discussed separately.

An RF burn hazard is a hazardous condition caused by the existence of RF voltages in places where they are not intended to be. Any ship with high-power HF transmitters is susceptible. Potentially hazardous voltages have been found in many areas. Some of these areas are lifelines, vertical ladders, ASROC launchers, gun mounts, rigging for underway replenishment, boat davits, and on aircraft tied down on carrier and helicopter flight decks.

The potential that an induced voltage will create an RF burn hazard depends on whether personnel will come into contact with the object being energized. Generally, only the voltage between an object and the deck is important. The RF burn occurs when a person comes into contact with a source of RF voltage in a manner that allows RF current to flow through the body at the point of contact. Resistance of the skin to the current flow at the contact point causes heat. The effect of the heat on a person ranges from noticeable warmth to a painful burn.

The most useful and widespread technique in reducing RF burn hazards is the proper bonding and grounding of all metallic objects in the RF radiation field.

In some cases, the RF burn hazard can be eliminated only through the use of restrictive operating procedures. These procedures govern the simultaneous use of transmitting and cargo equipment. Such techniques as operating transmitters at reduced power and prohibiting simultaneous use of certain combinations of antennas, frequencies, and cargo-handling equipment are used.

Most studies on radiation hazards have emphasized the impact of electromagnetic radiation because of the biological, thermal, and neurological effects that occur in human organs and other tissues. Certain organs of the body are more susceptible than others to the effects of electromagnetic radiation. The overwhelming danger appears to be the hazard from thermal effects, which are a function of the intensity and frequency of the radiation. This is particularly true in the range of 1 to 3 GHz. Thermal effects appear to taper off in severity outside this range.

Overexposure to RF radiation is thermal in nature. It can cause an increase in overall body temperature or a temperature rise in specific body organs.

You should always take precautions to avoid entering an electromagnetic field. If you do enter such a field, your body tissues will gradually produce heat as they absorb the electromagnetic energy. If the tissues cannot dissipate this heat energy as fast as it is produced, the internal temperature of the body will rise. This increase in temperature can result in damage to your body tissue and, if the rise is sufficiently high, in your death.

Keep in mind that you cannot see or normally feel electromagnetic radiation. Its presence must be measured by instruments. Warning signs are located at appropriate points to warn you when you are entering an area that may be a radiation hazard.

Hazards of Electromagnetic Radiation to Ordnance (HERO)

Another danger of RF radiation is the risk of premature firing of ordnance or explosion of their warheads during loading and off-loading operations. The hazard to electronic explosive devices (EEDs) occurs because of the heat generated by a current passing through the sensitive wires surrounding a temperature-sensitive explosive. If energy is dissipated into the wires, current will flow, the explosive becomes hot, and an explosion can result.

Transmitters and their antennas have only one purpose—to radiate electromagnetic energy. The initiating elements of ordnance items need only to be supplied with the proper amount of energy for an explosion to take place. RF energy may enter a weapon through a hole or crack in the skin of the weapon. RF energy may also be conducted into the weapon by the firing leads or other wires that penetrate the weapon enclosure.

The probability of unintentional EED actuation is not totally predictable since detonation depends upon such variables as frequency, field strength, and environment. In general, ordnance systems that have proven to be susceptible to RF energy are most susceptible during loading, unloading, and handling in RF electromagnetic fields.

Shipboard HERO conditions may sometimes prohibit the transmission of RF frequency energy below 30 MHz. To maintain essential communications when HERO conditions are in effect, you will be required to use other frequencies or communications methods.

SUMMARY

Communication systems are periodically tested to ensure they operate efficiently and accurately. The combined tests, checks, and measurements help determine the condition of systems, subsystems, and individual equipments. Tests and measurements of communication systems and equipments range from the very simple to the very complex.

The Planned Maintenance System (PMS) is a valuable tool in keeping your equipment in operational condition. When assigned PMS on a piece of equipment, you must always perform the maintenance as specified on the Maintenance Requirement Card (MRC). You should never take PMS lightly and assume that it is not an important task. Without PMS, reliability will deteriorate, and the equipment will eventually fail.

Remember, accidents are preventable. You have a responsibility to yourself and to your shipmates to recognize unsafe conditions and to see that they are corrected before they cause accidents. In all cases, when working on or near electrical or electronic equipment, learn to respect the potential of your equipment for accidental damage and injury. By knowing and observing safety precautions, you will help keep your equipment operating and, quite possibly, ensure your own survival.

RECOMMENDED READING LIST

NOTE

Although the following references were current when this TRAMAN was published, their continued currency cannot be assured. You therefore need to ensure that you are studying the latest revisions.

Electronics Installation and Maintenance Book—*Communications*, NAVSEA SE000-00-EIM-010, Naval Sea Systems Command, Washington, D.C., September 1979.

Electronics Installation and Maintenance Book—*General*, NAVSEA SE000-00-EIM-100, Naval Sea Systems Command, Washington, D.C., April 1983.

Fleet Communications (U), NTP 4(C), Naval Telecommunications Command, Washington, D.C., June 1988.

Military Requirements for Petty Officer Third Class, NAVEDTRA 10044-A, Naval Education and Training Program Management Support Activity, Pensacola, Fla., October 1987.

Navy Occupational Safety and Health (NAVOSH) Program Manual for Forces Afloat, Vols I and II, OPNAVINST 5100.19B, Chief of Naval Operations, Washington, D.C., April 1989.

Ships' Maintenance and Material Management (3-M) Manual, OPNAVINST 4790.4B, Chief of Naval Operations, Washington, D.C., August 1987.

Standard Organization and Regulations of the U.S. Navy, OPNAVINST 3120.32B, Chief of Naval Operations, Washington, D.C., September 1986.

CHAPTER 14

COMMERCIAL TRAFFIC

CHAPTER LEARNING OBJECTIVES

Upon completing this chapter, you should be able to do the following:

- *Describe the duties of the commercial traffic clerk.*
- *Discuss the handling of commercial traffic funds.*
- *Identify forms and explain procedures for commercial traffic reports.*
- *Discuss commercial abstracting.*
- *Explain coastal harbor radiotelephone (R/T) service.*
- *Explain high seas radiotelephone (R/T) service.*

Naval communications facilities do not compete with privately owned and operated commercial communication companies. However, under the terms defined in the Communications Act of 1934, the Navy is authorized to use its communications assets for private messages when commercial communication stations cannot provide the service. The terms of this act include reception and transmission of press and private messages between ships. They also include messages between Navy ships and shore stations and between shore stations and privately operated ships.

Instructions contained in *Commercial Communications Instructions*, NTP 9, cover the handling of commercial communications, including official government toll traffic and unofficial traffic, by U.S. naval communications personnel. These instructions are based on the International Telecommunications Convention, Geneva, 1959; the Telegraph Regulations, Geneva, 1958; the Communications Act of 1934; the American Telephone and Telegraph rate and rule book; rules and regulations of the Federal Communications Commission; and applicable Department of Defense (DOD) publications and instructions.

The policy of the Department of the Navy in the handling of commercial traffic is shown below.

"Every effort will be made to provide timely delivery of commercial traffic on an 'as soon as practicable' basis. However, it shall not take precedence over official government traffic. Neither will guaranteed delivery nor specific delivery times be assured or implied."

The above statement should be brought to the attention of all senders prior to the acceptance of commercial traffic.

COMMERCIAL TRAFFIC CLERK

The commanding officer of each naval ship, station, or activity authorized to handle commercial communications or to receive personal messages for transmission via the Naval Telecommunications System will designate, in writing, a commercial traffic clerk. Usually, the commercial traffic clerk is an experienced Radioman but is not necessarily the senior Radioman aboard.

The commercial traffic clerk handles all commercial traffic funds and prepares all reports concerning commercial traffic. This person is not required to be bonded unless required by the Commander, Naval Computer and Telecommunications Command (COMNAVCOMTELCOM). A short summary of duties performed by the commercial traffic clerk follows:

- Maintains a complete file of all commercial messages accepted for transmission;
- Keeps a complete file of all incoming commercial and official government messages received from sources other than naval communications for abstracting purposes;
- Maintains and understands all instructions and materials concerned with handling commercial traffic, including rate sheets, bulletins, publications, and forms;
- Collects proper charges and safeguards funds collected;
- Prepares reports correctly and timely and submits them to the communications officer for review; and
- Maintains preservation of any message being divulged to any person other than those authorized by the commanding officer.

The duties of the commercial traffic clerk are performed under the supervision of the communications officer. The communications officer reviews all reports and correspondence prepared by the commercial traffic clerk and forwards them to the commanding officer for signature.

COMMERCIAL TRAFFIC FUNDS

Naval commercial traffic funds should be kept separate from all other funds. The fund records should be inspected monthly and upon relief of the commercial traffic clerk. This inspection should be done by a two-person board consisting of officers and/or senior enlisted personnel. If available, one of the inspectors should be from the supply department. This inspection should include an audit of all accounts and a verification of the cash balance and rates used.

If there is an account irregularity, the report of the inspection should be forwarded to Defense Finance and Accounting Service (DFAS) via official channels. The report should include endorsements showing what action has been taken or recommendations, if any.

Reports showing no irregularities are retained for at least 1 year. Original records may be called for by COMNAVCOMTELCOM or the Commanding Officer, DFAS.

Unless approved by COMNAVCOMTELCOM, the maximum commercial traffic funds permitted to accumulate may not exceed $100. Accumulated funds must be deposited at least weekly with the supply or disbursing officer. Only the amount needed to make change should be retained.

When required for remittance, these deposited funds must be made available to the commercial traffic clerk. These funds must be in the form of a U.S. Treasury check or money order made payable to the Disbursing Officer, DAO, Arlington, Va., or to AT&T Easylink, as appropriate. Checks for class E messages are made payable to AT&T Easylink.

If the commercial traffic clerk is relieved and no replacement is immediately designated, the commercial traffic funds should be retained by the command supply officer or disbursing officer. The communications officer or a naval postal clerk should not handle naval commercial traffic funds.

USES OF COMMERCIAL TRAFFIC FUNDS

Expenditures from naval commercial traffic funds are authorized for the following purposes:

- Money order fees;
- Postage for mailing reports, if necessary; and
- Registration fees if determined that registered mail is necessary to protect or ensure delivery of reports.

These uses for commercial traffic funds should be documented on the Statement of Account, NAVTELCOM Form 7210/1 (discussed later in this chapter).

REFUNDS

A refund may be made to a person sending a nongovernment message if the ship, station, or activity sending the message is unable to get the message through to its destination for such reasons as circuit breakdown, cable break, landline down, or ship out of range. No refund is given for a message not delivered because of such reasons as "addressee deceased," "addressee unknown," "addressee has moved," or similar causes. Under these conditions, the carrier's obligation is considered to have been fulfilled.

If a refund is given for a message, a copy of the message must be sent to Defense Finance and Accounting Service. An explanation should be included on the message form showing the reason for the refund.

COMMERCIAL TRAFFIC REPORTS

In reporting commercial traffic, the traffic clerk uses two abstracting forms. A detailed discussion of each is included later in the chapter. The title, form numbers, and a brief description of the classes of traffic reported on each form are as follows:

- Statement of Account, NAVTELCOM Form 7210/1 (figure 14-1). This form is required when remittances are forwarded for class D private commercial messages, press messages, radiophotos, and class D messages entitled to class E privilege.
- Abstract for Commercial Messages, NAVTELCOM Form 2101/1 (figure 14-2). This form is used for:

  — All classes of A and B messages (including official radiotelephone [R/T] messages) transmitted by a naval ship directly to a domestic or foreign commercial shore radio station;

  — All classes of A and B messages received by a naval ship directly from a commercial shore radio station;

  — All class D messages originated by a naval ship;

  — All class D messages received and delivered on board or relayed by a naval ship;

  — All class D messages originated, received, forwarded, or delivered by a naval station or activity;

  — All class D messages entitled to class E privilege; and

  — All class E messages involving tolls.

The forms listed above are available as cognizant symbol "I" material from the naval supply centers in Norfolk and Oakland.

Copies of commercial traffic reports should be retained in the ship or station files for at least 1 year.

RESPONSIBILITY FOR REPORTS

Commercial traffic reports are required for any calendar month in which they are processed. The reports are prepared by the commercial traffic clerk and signed by the communications officer and the commanding officer. For submarines (except when on detached duty), the reports are submitted by the tender or submarine base to which the submarine is attached. For service craft attached to a naval district, the reports are submitted by the district commandant. Submarine and service craft reports are arranged and labeled for each craft that originates the traffic.

Monthly commercial traffic reports should be mailed under one letter of transmittal to Defense Finance and Accounting Service. Reports from naval ships should be mailed by the 5th of the month (for the previous month) and from naval stations and activities by the 10th of the month.

A report for class D messages and class D messages entitled to class E privilege consists of an abstract form, one copy of each message reported, the remittance, and a Statement of Account. Class E messages involving toll charges are reported by using an abstract form, one copy of each message, and the remittance.

Negative commercial reports are not required. However, the following statement should be inserted on the first line of the next class D or class E abstract submitted: "No class D (or E as appropriate) traffic handled during the month(s) of ________."

SERIAL NUMBERS

All commercial traffic handled by naval communications is assigned serial numbers for accounting and identification purposes. These numbers are known as SRS numbers. Every commercial message handled is assigned an SRS number by each ship, station, or activity involved in the handling.

Naval communication stations assign consecutive SRS numbers up to 10,000. All other naval activities and ships assign consecutive SRS numbers up to 1,000 on an annual basis, commencing with number 1 on 1 January of each year. If a commercial message requires servicing, such service messages are given the SRS number of the message to which they refer. This is followed by "A" for the first service message, "B" for the second service, and so on.

STATEMENT OF ACCOUNT

(NAVAL TELECOMMUNICATIONS) 0108-LF-072-1000
NAVTELCOM FORM 7210/1 (9-77)

Report for the month of

To: Commanding Officer, U.S. Navy Regional Finance (Code FR-FC), Washington D.C. 20371

REPORTING ACTIVITY (SHIP OR STATION)

Date Forwarded

INSTRUCTIONS

1. Forward in duplicate with remittance to Navy Regional Finance Center, Washington, D.C. 20371 for Class "D" and Class "D" entitled to "E" privilege traffic.
2. Naval Commercial Traffic Funds shall be forwarded by exchange-for -cash U.S. Treasury check when possible.
3. For further instructions refer to NTP-9

RECEIVED		AMOUNT		PAID OUT		AMOUNT	
CHANGES ON MESSAGES FILED DURING THE CURRENT MONTH		$		REFUNDS			
FEDERAL TAX COLLECTED DURING THE CURRENT MONTH				MONTH	ERROR NOTICE REFERENCE NUMBER		
COLLECTIONS ON MESSAGES PREVIOUSLY REPORTED ON WHICH NO CHARGE OR A SHORT CHARGE WAS MADE						$	
MONTH	ERROR NOTICE REFERENCE NUMBER						
				REPLY PAID VOUCHER NUMBERS			
				REMITTANCE HEREWITH:			
				CHECK or MONEY ORDER NUMBER			
				DATED			
				DRAWN ON			
TOTAL AMOUNT RECEIVED		$		TOTAL AMOUNT PAID OUT		$	

TOTAL AMOUNT RECEIVED MUST EQUAL TOTAL AMOUNT PAID OUT

FOR USE BY NAVY REGIONAL FINANCE CENTER ONLY

I certify this is a true statement of all moneys received and disbursed by me this month for the Naval Commercial Traffic Fund of this command, Class "D" Traffic. There is forwarded herewith a remittance in the sum recorded on this form.

CERTIFICATION: *(Commercial Traffic Clerk)*

______________________________ ,USN
(Signature)

REVIEWED: *(Communications Officer)*

______________________________ ,USN
(Signature)

FORWARDED: *(Commanding Officer)*

______________________________ ,USN
(Signature)

Figure 14-1.—NAVTELCOM Form 7210/1.

ABSTRACT FOR COMMERCIAL MESSAGES
(NAVAL TELECOMMUNICATIONS)
NAVTELCOM FORM 2101/1 (9-77)
0110-LF-721-0100

Name of Ship/Station/Activity: USS HALSEY (CG 23)

ABSTRACT FOR COMMERCIAL MESSAGES
(CHECK APPROPRIATE BLOCK)

☐ CLASS "D" ☒ CLASS "E" ☐ CLASS "D/E"

Page ONE of ONE pages

During month of JANUARY 1994

SRS No (1)	DATE SENT (2)	DATE REC'D (3)	OFFICE OF ORIGIN (4)	ADDRESSEE (5)	DESTINATION (6)	TRANSMITTING DATA (USE CALL LETTERS ONLY) RECEIVED FROM (7)	TRANSMITTING DATA (USE CALL LETTERS ONLY) SENT TO (8)	DO NOT USE (9)	REMARKS NRFC USE (10)	REMARKS ACTIVITY USE (11)	NUMBER OF WORDS (12)	COASTAL OR SHIP STATION CHARGE (13)	COAST and LANDLINE CHARGE (14)	NRFC USE ONLY (15)	TOTAL AMOUNT DUE OR CASH REMITTED (16)
001E	04		USS HALSEY	D. ALEXANDER	SAN DIEGO CA		NPG				25	$7.85			$ 7.85
002E	09		USS HALSEY	H. RICHARDSON	SAN DIEGO CA		NPG				19	6.77			6.77
003E	10		USS HALSEY	B. JOHNSON	SAN DIEGO CA		NPG				45	11.45			11.45
											TOTALS	$26.07			$26.07
											TOTALS BROUGHT FORWARD				
											GRAND TOTAL	$26.07			$26.07

INSTRUCTIONS: Use a separate abstract for each class of message. Class E and Class D entitled to E use columns 1, 2, 5, 6, 8, and 12. Class D use columns 1–8, 12–16. In all cases submit monthly reports to Navy Regional Finance Center, Code FSP 12132B, Washington, D.C. 20371. Class E reports will consist of NAVTELCOM Form 2101/1 (Abstract), one copy of each message and check/money order payable to the Western Union Telegraph Co. Class D and Class D/E reports will consist of NAVTELCOM Form 2101/1 (Abstract). Two copies NAVTELCOM Form 7210/1 (Statement of Account), two copies of each message and check/money order, payable to Navy Regional Finance Center. Negative reports are not required. For detailed instructions refer to NTP 9 series.

CERTIFICATION

I certify this is a true statement of all moneys received and disbursed by me this month for the Naval Commercial Traffic Fund of this activity. Class E *Traffic.*

There is forwarded herewith a remittance of $26.07

Commanding Officer

(Signature)

Figure 14-2.—NAVTELCOM Form 2101/1.

Paid service messages are not affected by this provision. The letters in table 14-1 are suffixed to the regularly assigned SRS numbers, depending on the commercial traffic class being reported.

As you can see from the information in the above table, one message may be assigned different SRS numbers by various handling stations.

REPORT SYMBOLS

The Navy Comptroller has assigned NAVCOMPT report symbols to commercial communications reports for handling, auditing, and accounting purposes. The appropriate report symbol must be placed on the envelope or cover when commercial traffic reports are forwarded. This symbol should also appear on the abstract form itself. More than one report symbol may be used on one abstract form.

WORD COUNT SYSTEMS

As a means of collecting fees for expenses that are incurred when commercial communications are handled, the Navy uses two systems of word count: domestic and international. Domestic word count applies only to domestic messages and is based on domestic rules and regulations. International word count is used for radiotelegrams and international telegrams and is based on international rules and regulations.

Domestic telegrams are messages originated at and addressed to points on shore within the continental United States (CONUS) (which includes Hawaii and Alaska), Canada, Mexico, or Saint Pierre-Miquelon Islands. These telegrams are then transmitted in domestic form by wire or radio over all or part of their route.

A radiotelegram is a message originating at or intended for a mobile station and transmitted over all or part of its route by radio communication channels of the mobile service. International telegrams are messages originating at or destined to points other than the United States, Canada, Mexico, or Saint Pierre-Miquelon Islands. Both radiotelegrams and international telegrams are drafted in international form.

A detailed explanation of both word count systems is given in NTP 9. Many examples in NTP 9 illustrate the rules and show how representative words and groups are counted differently according to their location in a message address, text, or signature.

MESSAGE CLASSES AND COMMERCIAL ABSTRACTING

In this section, we will discuss message classes and methods of abstracting commercial messages. Of the five classes of messages, class C messages are not involved in commercial abstracting. Therefore, they are not discussed here.

CLASS A AND B MESSAGES

Class A and B messages are official U.S. Government messages. Class A messages consist of official messages of the DOD. Class B messages comprise official messages of U.S. Government departments and agencies except for DOD messages. Both classes are addressed in this section because of

Table 14-1.—Examples of Commercial Message Station Serial Numbers and Suffix Letters

CLASS OF TRAFFIC	SUFFIX LETTER	EXAMPLE
A	A	SRS 1A
B	B	SRS 2B
D (radiogram)	D	SRS 3D
P (press)	P	SRS 4P
D (entitled to the class E privilege)	C	SRS 6C
E	E	SRS 7E
Service message		SRS 7EA

the similarities in handling, abstracting, and accounting.

Both class A and B messages are prepared in joint form for transmission over military circuits. Detailed coverage of procedures for handling messages over military circuits is provided in *Fleet Communications (U)*, NTP 4.

Class B messages requiring commercial refile must always carry an accounting symbol to denote the government department or agency responsible for payment of commercial charges. When class B messages are filed with a domestic communications company, the accounting symbols are preceded by the government indicator "GOVT." This indicator appears as the first entry in the address. In messages sent to or via foreign communications companies, the government indicator is changed to "US GOVT."

Use and Handling of Commercial Communications Systems

When it is necessary to file or refile a class A or B message with a commercial communications company, the following rules apply:

- When filed directly with a commercial communications company by an originator outside CONUS or destined to an addressee outside CONUS, messages are sent via the nearest U.S. military communications facility serving the area in which they originated.
- If either the originator or addressee is not served by military communications, messages may be filed directly or refiled with American Telephone and Telegraph (AT&T) without further transmission on military circuits. This rule applies when charges for delivery to an addressee are the same as (or less than) such charges for delivery from a designated commercial refile point.
- When a message is refiled by a shore station within CONUS and addressed to a point in the United States, Canada, Mexico, or Saint Pierre-Miquelon Islands, domestic form and word count are used. The point of actual origin is added to the signature.
- When a message is refiled by a shore station in CONUS and addressed to points outside the United States, Canada, Mexico, or Saint Pierre-Miquelon Islands, international form and word count are used. The point of refile is treated as the point of origin. The point of actual origin is added to the signature.
- When a message is filed or refiled by a shore station outside CONUS, international form and word count are used. The point of file serves as the point of origin, or the point of refile is the point of origin, and the point of actual origin is added to the signature.
- When a joint form message must be sent through a commercial communications system for further transmission by a military system, the message in joint form, complete with heading, is embodied in the text of the commercial message.
- When a message is transmitted directly by a U.S. Navy ship to a commercial shore radio station, international form and word count are used.

The following example is a GOVT NAVY message as transmitted by a ship to a shore station for refile with a commercial company:

```
RTTUZYUW RULYEDOI470 2921400-UUUU--RUWDSAA.
ZNR UUUUU
R 191400Z OCT 93
FM USS AUSTIN
TO JOHN N DOE
  FOUR TWO TWO QUEENS COURT
  ERIE PA
BT
UNCLAS
YOUR LEAVE EXPIRES ON BOARD AT NORFOLK VA
0730 25 OCT 93
BT
#1470
```

The preceding message would be commercially refiled in the following form (underlined words chargeable):

```
CK12 WASHINGTON DC 19 OCTOBER 1993 424PME GOVT
NAVY
JOHN N DOE 422 QUEENS COURT ERIE PA
-YOUR LEAVE EXPIRES ON BOARD AT NORFOLK VA
0730 25 OCT 93
        COMMANDING OFFICER
        USS AUSTIN
```

Abstracting Class A and B Messages

Class A and B and official R/T messages transmitted directly to a commercial shore radio station by a U.S. Navy ship must be reported on NAVTELCOM Form 2101/1 and forwarded to Defense Finance and Accounting Service. Two copies of all messages are required with each report. No remittance is made; settlement of accounts is the responsibility of COMNAVCOMTELCOM.

Incoming class A and B messages received by U.S. Navy ships directly from commercial shore radio stations are reported on NAVTELCOM Form 2101/1. Other requirements are the same as for outgoing messages explained earlier.

Naval shore stations designated commercial refile activities in ACP 117, U.S. SUPP-1, are required to submit monthly speedletter reports of all class B messages refiled with commercial communication companies. None of the NAVTELCOM forms that we mentioned previously are used.

Reports are mailed directly to COMNAVCOMTELCOM within 10 days after receipt and verification of the traffic billing of the commercial communications company. A speedletter report must contain the following information in the order indicated:

1. Report of class B messages;
2. Calendar month and year of the report; and
3. Inclusive serial numbers of class B messages reported.

A speedletter report must be accompanied by two copies of each message reported. One copy of each message must be in the military form in which received. These copies, in groups of 100 or fewer, must be arranged in SRS number order, secured by metal file fasteners, and placed between cardboard covers. These covers must be labeled to indicate the type of traffic, the name of the reporting station, and the month and year of commercial refile.

The second copy of each message must be in the commercial form in which it was refiled and segregated into packets according to accounting symbols.

Both message copies must show complete transmission data and include the following information in the lower right corner:

- SRS number (for example, SRS 23B);
- Accounting symbol (for example, INT);
- Commercial company and city where refiled (for example, AT&T, WASHDC);
- Commercial service indicator (for example, NL);
- Commercial charges (for example, $1.25); and
- Date and time of refile (for example, 011300Z AUG 93).

Copies of service messages relating to commercially refiled class A and B messages must be forwarded with copies of the messages to which they pertain.

Responsibility for Payment

A reporting activity does not collect toll charges or send remittances when it forwards class A and B message reports. CNO is responsible for the settlement of accounts for class A and B messages transmitted by U.S. Navy ships to commercial shore stations. Since bills submitted by commercial companies often contain amounts for other classes of message, initial payment is made by Defense Finance and Accounting Service.

Charges for class B traffic are then billed to COMNAVCOMTELCOM by Defense Finance and Accounting Service. In turn, COMNAVCOMTELCOM bills other government agencies responsible for originating their class A and B messages involving toll charges. Thus, naval communications facilities are reimbursed for the non-Navy messages they handle.

Payment is handled differently for class A and B messages refiled with commercial companies by shore stations. Commercial communication companies bill a refile activity directly. The refile station verifies the monthly billing and certifies it as official U.S. Government traffic. It then forwards the certified billing (with supporting message copies) for payment to the local disbursing office of Defense Finance and Accounting Service office serving the area in which the refiling activity is located.

CLASS D MESSAGES

Class D messages are nongovernment (private-commercial) messages handled by naval communications that were received or sent via commercial communication companies. Class D messages include:

- Commercial (private) messages;
- Commercial (private) messages entitled to class E privilege; and

- Press and related service messages.

Class D messages are always in commercial form. Handling of class D traffic by Navy ships and stations is usually suspended or curtailed in wartime.

Unless specific exceptions are made, class D messages are not accepted, transmitted, or relayed by military communications if it is possible for the messages to be handled by commercial means.

A class D message is sent when the sender does not qualify for, or the message destination does not meet, the restrictions imposed for class E messages. For example, a message from or to an addressee in Manila, Republic of the Philippines, would be a class D message.

Commercial (Private) Messages

Class D commercial (private) messages may be filed during peacetime by any person, whether in the naval service or not. They may be filed from the following ships, stations, and activities:

- All naval ships at sea or in ports where adequate or reliable commercial facilities are unavailable.
- All overseas naval stations and activities at locations where adequate and reliable commercial communications facilities are unavailable.
- The Naval Computer Telecommunications Area Master Station (NCTAMS), WESTPAC, Guam. This is the only facility authorized to handle commercial ship-to-shore and shore-to-ship traffic.

In U.S. Navy ships, the requirements for filing commercial messages are as follows:

- Approved by the commanding officer, or an officer designated by him or her, and duly released;
- Filed with the commercial traffic clerk who determines word count and collects the charges.

Following transmission, the original and one copy of the message (with proper servicing data entered) are returned to the commercial traffic clerk for filing and abstracting purposes. If the proper charges cannot be determined by the appropriate operating signal, the maximum charge is collected. In such cases, the name and address of the sender are entered on the message form so that proper reimbursement can be made when the account is audited.

INTERNATIONAL FORM.—A commercial message originating at or relayed by a naval ship or a NAVCOMMTELSTA open to commercial traffic is handled in the international form.

In the following example of a class D commercial message in international form, chargeable words or groups are underscored. An explanation of component parts is given at the conclusion of this message example.

```
PCH DE NMWW NRI INTL USS GOODSHIP/NMWW CK27 12
1430 VIA RCA BT MP BT TC BT
LOUIS COLBUS
69 EASTTHIRTYSIXTH
NEWYORKCITY BT
SELL TEN SHARES COMPTOMETER AND TWENTY SHARES
PULLMAN, BUY SIXTY SHARES MAGNAVOX. ALL AT MARKET
ADVISE TRANSACTION DATE BT FORD COX AR NMWW K
```

As you can see in our example, the international abbreviation "INTL" appears after the call and station serial number. Next is the office of origin, USS *Goodship*, followed by its call sign. The check (CK) consists of the number of chargeable words (27 in our example) in the address, text, and signature. Remember that only the chargeable words are underscored in this example.

In a commercial message, such as the one in our example, the date and local time of filing are always given in two numeral groups. The date is separated by a space from the four-digit hours and minutes group.

The message address contains the paid service indicator "MP" in addition to the name and address of the addressee. The indicator "MP" means that the sender requests delivery of the message to the addressee in person—not by mail or telephone. More than a dozen different service indicators are authorized. NTP 9 contains the complete list. As shown in the above example, the paid service indicator is the first word of the address. It is counted as a chargeable word and is included in the CK.

The sender's name comes after the text and is called the signature. There is no requirement to transmit the signature. However, when transmitted, the signature is chargeable and is separated from the text by the prosign "BT."

As you can see in the example, the prosign "BT" appears several times. This prosign separates the preamble from the paid service indicator, the paid service indicator from the rest of address, the address from the text, and the text from the signature. The prosign "BT" is never counted or charged in the CK.

DOMESTIC FORM.—The following example is a domestic form class D message with the chargeable words or groups underscored:

> NRI CKII NL NAVSECGRUACT ADAK 16 AUG 93 I030 AMP
> RABER KIEF (INC)
> SEATTLE WASHINGTON
> THE CAPTAIN WOULD RATHER HAVE BLUE PAINT ON OUR
> CAMP BUILDING
> L. MORSE

The example above reflects no charge for a single address and signature in a domestic telegram. Therefore, the check (CK) consists of the total number of words in the text plus any extra matter that may be added in the address or signature.

The service indicator provides supplementary instructions requested by the originator, such as DL (day letter) or NL (night letter). Commercial communication companies show the city or town where the message was filed (originated). The domestic form contains the month and year transmitted in addition to the date and time. The hour is followed by "AM" or "PM" and the civil zone time indicator (E for Eastern time, P for Pacific time, and so on).

The normal address of a domestic telegram is transmitted free of charge. The importance of a complete address cannot be overemphasized. The text of the message and any extra matter added to the address or signature are counted and charged. One plain language signature is transmitted free. Coded signatures are charged. An extra passing instruction added to the address is also charged.

CHARGES AND ACCOUNTING.—All messages involving tolls should be prepaid. Charges for messages include the following:

- The charges that accrue to land radio stations;
- The charges that accrue to mobile (ship) radio stations;
- The relay charges of the intermediate land or mobile radio station; and
- The charges for service over landlines or cable and special service, if any, required by the sender.

After the rate per word for transmission over the entire distance involved has been computed, the charges for the message are determined by multiplying the rate per word by the number of chargeable words. Special service charges and taxes, if applicable, are added to determine the total charge.

All charges that are due on commercial (private) messages should be collected from the sender in advance of the transmission. Since the specific rates for commercial messages change from time to time, it is important to check the rates as reflected in the latest change to NTP 9.

RATE REQUESTS.—The International Telecommunications and Radio Conference held at Geneva in 1959 authorized shipboard stations to make inquiry, without cost, to coastal stations concerning proper rates for messages. Because U.S. Navy ships are not issued commercial tariff books used for computing charges for class D messages, it is necessary to send a rate request (QSJ or service message) to determine charges on each message.

The operating signal QSJ (preceded by "INT" for military usage, or followed by "IMI" for operations with commercial stations) means "What is the charge to be collected per word to ________ including your internal telegraph charge?" As a reply, "QSJ" means "The charge to be collected per word to ________ including my internal telegraph charge is ________ francs."

Charges in international communications should be expressed in francs. When the request is handled on U.S. military circuits, for example, between NAVSTA Guantanamo Bay, Cuba, and NAVCOMM DET Cheltenham, Maryland, the total charges in the QSJ answer should be expressed in U.S. dollars. A copy of the rate request and the reply concerning the charges on all commercial messages should be attached to the applicable commercial message that is submitted to Defense Finance and Accounting Service.

ABSTRACTING CLASS D MESSAGES.—Class D messages are reported on NAVTELCOM Form 2101/1. When class D messages are originated at your ship or station, the money paid by senders must be forwarded with the abstract. The Treasury check or money order used for a remittance must be made payable to Defense Finance and Accounting Service, Arlington, Va. Actual transfer of funds between naval communications and commercial communications companies is made by DFAS.

A complete class D message report consists of the following:

- Abstract (NAVTELCOM Form 2101/1);
- Copy of each class D message;
- Statement of Account, NAVTELCOM Form 7201/1 (original and one copy); and
- Remittance.

All class D messages handled together, whether charges are involved or not, must be reported. Ships sometimes mistakenly fail to report class D messages received over Navy circuits. Failure to make these reports often results in financial loss to the government. Failure to make reports required for either sent or received messages usually causes needless correspondence and delay in account settlement.

Message copies forwarded with an abstract must be legible and complete, including full transmission or receiving data. Duplicates must be retained in ship or station files for at least 1 year. Message copies forwarded and duplicates retained in files must show any discrepancies in counting chargeable words.

These copies and duplicates must also contain an explanation of delays exceeding 1 hour between receipt and transmission in relaying or between filing time and transmission time charges collected (if any). Any other pertinent information deemed appropriate must also be included.

In abstracting class D messages, you should include the name of the point of origin on the abstract (NAVTELCOM Form 2101/1). In the case of communications with ships (naval or merchant), the call sign is shown on both the abstract and the message copy immediately following the name of the ship. The name and call sign of the ship are separated by a slash (/).

SAFETY OF LIFE MESSAGES.—Several special types of authorized commercial (private) messages are listed in NTP 9. One of the most important of these special types is the safety of life message.

Safety of life messages are accorded absolute priority. Every office receiving a safety of life message concerning safety at sea or in the air must take action to transmit or deliver it at once. A safety of life message is identified by the indicator "SVH" both at the beginning and at the end of the preamble. Telegraph offices should exercise no control over safety of life messages.

RATES.—The charges for commercial (private) messages are subject to change (by message corrections to NTP 9). To compute rates, you should consult NTP 9 or obtain the charges via a QSJ rate request. Where heavy commercial traffic is handled, it is advisable to make a chart listing the type of message, the number of words chargeable, and the rate to charge the sender. This chart is used for convenience and to save time of both the commercial traffic clerk and the sender. Naturally, the chart must be updated each time the charges are changed in NTP 9.

Class D Messages Entitled to Class E Privilege

Occasionally, because of the location of addressees, naval personnel are unable to send a message in class E form, even though the contents of the message comply in all respects with provisions for class E messages. For example, the addressee may be at a geographical location other than CONUS, such as Hawaii, Puerto Rico, Panama, Japan, or Europe.

A category of message known as **private commercial message (class D) entitled to class E privilege** has been established. This is simply a modified version of class E messages. Particular care must be taken when handling and accounting for these messages so that they are not combined and reported with regular class E traffic.

Class D messages entitled to class E privilege are handled in international form as shown in the message example below. For identification purposes, each message carries the symbol "COMLE" as the first word of the text. COMLE is counted and charged as one word. Therefore, this type of message is sometimes called a class D COMLE.

```
RTTUZRUW RUHGMIB0410 3002000–UUUU––RUHGSUU.
ZNR UUUUU
R 272000Z OCT 93
FM USS AMERICA
TO NCTAMS EASTPAC HONOLULU HI
BT
UNCLAS//N00000//
USS AMERICA CK18 27 1800 BT
MRS H. E. FLICK
HOTEL HILTON HONOLULU HI BT
COMLE MEET ME IN KANUI RESTAURANT AT SIX.
HARLEY
BT
#0410
NNNN
```

CHARGES.—Charges for class D messages entitled to class E privilege are collected from the sender in advance of transmission. The charges include commercial shore station receiving charges and tolls involved in the landline or cable transmission to effect final delivery.

Handling by naval communications personnel is without charge. However, charges must be collected from the sender to cover handling and delivery by a commercial communications company. International word count applies.

When a message is transmitted to a commercial shore radio station, the coast station charge and the internal telegraph charge are collected. When the message is transmitted to a naval station or activity, only the commercial refile charge is collected. In many cases, the correct charges for the handling and delivery by the commercial communications company can be obtained by use of the QSJ operating signal or a service message.

ABSTRACTING.—Ships and stations originating class D messages entitled to class E privilege are required to submit monthly reports using NAVTELCOM Form 21O1/1.

Reports of class D messages entitled to class E privilege must include the following:

- The abstract, NAVTELCOM Form 2101/1;
- One copy of each message, showing complete transmission data. A related rate request (QSJ or service message) must be attached to the message;
- The Statement of Account, NAVTELCOM Form 7201/1, in duplicate; and
- The remittance, made payable to Defense Finance and Accounting Service, Arlington, Va.

An additional monthly report is required of shore stations effecting commercial refile of class D messages entitled to class E privilege. For this report, you should use NAVTELCOM Form 2101/1. If the shore station also handles regular class D traffic during the month, the two reports can be combined.

Commercial traffic clerks must exercise extreme caution to ensure that class D messages entitled to class E privilege are not reported with regular class E messages. Traffic clerks must also ensure that the check or money order (remittance) is not made payable to AT&T. As we will discuss later in this chapter, the check made out to AT&T is for class E messages only.

Press Messages

In peacetime, the Navy frequently grants permission for duly accredited news reporters to embark in its ships for the purpose of reporting naval operations and activities. In such cases, reporters are usually authorized to file press messages on board. The same privilege may be extended at isolated overseas bases where commercial communications facilities are not available.

When correspondents are embarked, equitable treatment should be extended to all. The command should ensure that press messages do not overload the facilities available. Priority must be given to official traffic. Normally, press messages take precedence immediately after operational traffic. As a category, press messages should be handled on a first-come, first-served basis.

PRESS AND DAY PRESS RATE (DPR) INDICATORS.—Ships and stations should exercise particular care when they use the indicators "PRESS" and "DPR." The paid service indicator "PRESS" is used on all press messages either transmitted to or refiled with an international communications carrier by naval communications.

The domestic service indicator "DPR," followed by the word "COLLECT" or "PAID," as appropriate, should be used on press messages transmitted directly to or from a CONUS naval station or activity and handled commercially only by AT&T. The indicators "PRESS" and "DPR" cannot be used together in the same message.

CHARGES FOR PRESS MESSAGES.—It is preferable that correspondents not pay for press messages when filed. However, payment may be accepted if a U.S. correspondent desires to pay. If payment is made, the principle of "tolls follow the traffic" is applied and the full charges are collected from the sender. The commercial charges could be determined by a QSJ rate request or service message.

When the correspondent elects not to pay for the press message, settlement should be effected by Defense Finance and Accounting Service. The settlement is based on the abstracts submitted by the originating or refiling station.

In international communications, press messages cannot be sent collect. Normally, the correspondent has the charges billed to the newspaper or association to which he or she is accredited.

Press messages can be transmitted by naval ships and overseas naval stations to a CONUS naval station or activity for commercial refile by AT&T. Those destined for a point in the United States may be transmitted "DPR PAID" or "DPR COLLECT," depending on the correspondent's wishes. This means correspondents can pay the charges in advance or have the charges billed to their newspaper or association.

When the charges are to be billed to the newspaper or news association, the bill prepared by Defense Finance and Accounting Service covers Navy handling only. The commercial carriers involved are responsible for collecting their portion of the tolls. On the other hand, if the charges are paid in advance, the tolls involved in the total transmission are collected from the sender. Defense Finance and Accounting Service will then effect settlement with AT&T.

The international system of word count is used on all press messages handled by naval communications. The paid service indicator "PRESS," when applicable, is written as the first word of the address and charged as one word. The indicator "DPR," when applicable, is written in two places: the preamble following the CK and as the first word of the address. DPR is not counted or charged for in the preamble but is counted and charged as one word in the address.

ABSTRACTING PRESS MESSAGES.—Ships and stations handling press messages are required to submit monthly reports using NAVTELCOM Form 2101/1.

The SRS numbers assigned to press messages use the suffix letter *P* after the number; for example, SRS 116P. Remember that SRS numbers are used for message identification in abstracting and accounting only. They are never transmitted.

Press message abstracts, accompanied by message copies and remittances, are forwarded to Defense Finance and Accounting Service. All remittances are by Treasury check or money order. Reports from ships should be mailed as previously indicated.

The following example is an international commercial form press message for transmission to any commercial shore station. These messages must never be sent with the COLLECT indicator.

```
RTTUZYUW RULYMNO0001 3001200–UUUU--RULYSUU.
ZNR UUUUU
R 271200Z OCT 93
FM USS JOHN PAUL JONES
TO NCTAMS EASTPAC HONOLULU HI
BT
UNCLAS //N02092//
INTL USS JOHN PAUL JONES NR1/CK 95 16 1430 BT
PAGE 1/50 BT
PRESS BT
TOKYO DAILY NEWS TOKYO JAPAN BT
(FIRST 46 WORDS OF PRESS TEXT, AND 4 WORDS OF
SERVICE INDICATOR AND ADDRESS) BT
NR1 USS JOHN PAUL JONES 1430 PRESS PAGE 2/45 BT
(REMAINING 44 WORDS OF TEXT PLUS ONE WORD OF
SIGNATURE) BT
TARAWA
BT
#0001
NNNN
```

The next example shows a domestic form press message with a naval heading. This message is for transmission to any Navy shore station in CONUS for delivery by AT&T to an address within CONUS.

```
RTTUZYUW RULYMNO0001 3001201–UUUU--RULYSUU.
ZNR UUUUU
R 271201Z OCT 93
FM USS JOHN PAUL JONES
TO NCTAMS LANT NORFOLK VA
BT
UNCLAS //N02092//
CK 95 DPR COLLECT USS JOHN PAUL JONES 27 OCT 93
115PME VIA AMERICAN TELEPHONE AND TELEGRAPH BT
DPR COLLECT
NEW YORK TIMES
220 SOUTH STREET NEW YORK BT
(PRESS MESSAGE TEXT DIVIDED INTO TRANSMISSION
SECTIONS IN ACCORDANCE WITH APPROPRIATE
INSTRUCTIONS FOR LONG MESSAGES OF OVER 90 LINES OF
TYPEWRITTEN TEXT) BT
TARAWA
BT
#0001
NNNN
```

CLASS E MESSAGES

Class E messages are personal messages. Part of your job as a Radioman is to restrict the routing of such messages to keep them personal. All communications personnel should be instructed that under no circumstances may they divulge the contents of class E messages to unauthorized personnel.

Class E message privileges are restricted to the naval establishment. There is no comparable service for the Armed Forces as a whole. The class E privilege exists primarily as a morale factor to afford naval personnel at sea or overseas duty stations a means of rapid communications for personal matters.

All overseas naval stations and activities and all naval ships are authorized to handle class E messages. Stations located in CONUS are extended class E privileges where commercial communications are unavailable. In time of war or emergency, the class E privilege may be suspended at the discretion of COMNAVCOMTELCOM.

Non-naval personnel aboard naval ships or isolated overseas areas served by naval communications may be extended class E privilege by the commanding officer when commercial communication facilities are unavailable or inadequate. Personnel afforded the class E privilege should be in one of the following categories:

- U.S. military personnel of other services;
- Members of Congress or other U.S. Government, state, and municipal officials and their dependents;
- Dependents of U.S. military personnel;
- Retired U.S. military personnel and their dependents;
- Civil service employees of the U.S. Government;
- U.S. Navy technicians; or
- U.S. media representatives embarked in U.S. Navy ships.

Refile of Class E Messages

NAVCOMMSTA Stockton, California, and NAVCOMM DET Cheltenham, Maryland, are the authorized Navy refile points for class E messages. This includes messages from and to authorized personnel on board ships and overseas duty stations.

There is no charge for processing class E messages via the naval communications circuits. Therefore, the only charge incurred by the sender is the commercial carrier charge for delivery from the Navy refile point to the addressee.

When transmitted over U.S. Navy circuits, class E messages should normally be given a precedence of ROUTINE. A higher precedence could be assigned only in the most unusual circumstances and if approved by the commanding officer.

Class E messages concerning death or serious illness should be refiled and delivered promptly to ensure that messages in this category are not delayed.

Toll-free Class E Messages

There are several instances in which a class E message may be transmitted toll free. In general, these are personal messages handled between ships, from ship to shore, from shore to ship, and from shore to shore, when both the originator and addressee are outside CONUS and in the same ocean area.

"Ocean area," as used here, includes U.S. Navy ships, stations, and activities in the Atlantic, Mediterranean, Caribbean, and Middle East. Ships, stations, and activities in the Pacific, Far East, and Alaska are also considered to be in the same ocean area.

A toll-free class E message may be sent from a ship or overseas station to a CONUS addressee if the ship or overseas activity is in direct (point-to-point) communications with the shore station and the final delivery can be made without the use of commercial communications.

The following example is a toll-free class E message from a naval ship to a naval activity. This example could also apply to toll-free class E messages from ship to ship, station to ship, or station to station.

```
RTTUZYUW RULYUSA0001 3001230–UUUU– –RULYSUU.
ZNR UUUUU
R 271230Z OCT 93
FM USS AMERICA
TO NAVSTA GUANTANAMO BAY CUBA
BT
UNCLAS //N02092//
MSG RMC JOHN DOE
RECEIVED PICTURES FROM LAST TRIP. LYNDA AND
CHILDREN APPRECIATE THE HELP. SEE YOU SOON.
HARLEY
BT
#0001
NNNN
```

It is also possible to send a collect class E message to the Navy Federal Credit Union, Washington, D.C., and the Navy Federal Credit Union, San Diego. The command sending the collect class E message must be a ship or naval activity overseas, as outlined above. NTP 9 provides examples of collect class E messages.

Personnel on board ships and overseas activities may also receive telegrams from a person outside the naval establishment at no cost to the military person.

The originator of such a message usually must send an AT&T telegram to either NAVCOMM DET Cheltenham, Maryland, or NAVCOMMSTA Stockton, California (depending on the location of the addressee), for refile with the correct telegraphic address of the military person.

The correct telegraphic address should consist of the individual's name, rank or rating, ship or station, and be in care of the appropriate communications station or communications unit mentioned above.

By the time the message arrives at the refile station, the sender has already paid AT&T for transmission from the point of origin to the refile station. The refile station then routes the message to the fleet broadcast or overseas circuit, for which there is no charge. No accounting or abstracting is necessary by the commercial traffic clerk because the Navy has handled no money.

Toll Class E Messages

A toll class E message is a message that is handled partially by a commercial carrier. This type of message is subject to toll because the refile station must transfer the message to AT&T for delivery to the addressee. As we mentioned earlier, the two naval communications activities authorized to receive and refile class E messages commercially with AT&T are NAVCOMMM DET Cheltenham, Maryland, and NAVCOMMSTA Stockton, California.

If the originator is in the Pacific Ocean, Far East, or Alaska, class E messages should be addressed to NAVCOMMSTA CLASS E REFILE STOCKTON CA for relay to AT&T. If the originator is in the Atlantic, Mediterranean, Middle East, or Caribbean area, class E messages should be addressed to NAVCOMM DET CLASS E REFILE CHELTENHAM MD.

Class E messages may be sent as telegrams or overnight telegrams. Telegrams are full-rate messages and are accepted for immediate transmission with a minimum charge rate of 10 words. Additional words incur additional charges. Overnight telegrams are usually accepted anytime during the day and up to 0200 for delivery the next morning. Overnight telegrams are held for transmission until message traffic conditions are slow enough so that they may be transmitted. Overnight telegrams carry the service indicator "NL" for distinction as a message to be handled at the end of the working day. Full-rate telegrams carry no service indicator.

The following example is a class E message from a ship to a Navy class E refile point for AT&T delivery:

```
RTTUZYUW RULYMIB0002 3001300–UUUU––RULYSUU.
ZNR UUUUU
R 271300Z OCT 93
FM USS AMERICA
TO NAVCOMM DET CLASS E REFILE CHELTENHAM MD
BT
UNCLAS //N02092//
MSG CK14 NL COMLE SRS 375 E
JOHN DOE DLR300
144 OAK STREET
WISCONSIN RAPIDS, WI 54494
DAD. NEED TWO HUNDRED DOLLAR LOAN FOR CHRISTMAS
EXPENSES. PLEASE SEND SOON.
JANE DOE USS AMERICA
BT
#0002
NNNN
```

When the indicator "MSG" is included, it is transmitted as the first group after the classification line. This indicates that this is an intra Navy class E message or is to be refiled with AT&T. The commercial check (CK), followed by the chargeable word count, is transmitted after the indicator "MSG." Only the text and any additional material added to the signature are counted as chargeable words in commercially refiled class E messages.

In the example above, the service indicator "NL" designates the message as an overnight telegram. The commercial designator "COMLE" is included on all class E messages to be refiled with AT&T. The text follows with the name of the ship or activity of origin as the last words. The name of the ship or activity at the end is chargeable, but the signature is not if no additions are made to it. A social security number added to the signature, for example, would increase the number of chargeable words.

Class E Rates

Rates for class E messages filed with one of the authorized Navy transfer points are normally set up on a flat-rate schedule as determined by agreement between AT&T and COMNAVCOMTELCOM. The rate tables are provided in NTP 9 and are subject to change by COMNAVCOMTELCOM.

The minimum charge for an overnight telegram is for 100 words. Any words in excess of that minimum are charged on a per-word basis.

Personnel aboard ships and overseas stations should be kept aware of the availability of class E message service and the current rates applicable. Personnel should also be encouraged to send the information concerning their telegraphic address to their families. This will make it easier for their families to contact them if the need arises.

Abstracting Class E Messages

All naval ships, stations, and activities originating class E messages involving tolls will submit monthly reports listing all toll messages handled. All reports should be mailed to Defense Finance and Accounting Service, Arlington, Va.

The class E message report should consist of the following:

- Abstract for Commercial Messages, NAVTELCOM Form 2101/1;
- One copy of each class E message handled, showing complete transmission data; and
- The remittance.

The remittance should be in the form of an exchange-for-cash U.S. Treasury check, U.S. postal money order, or an American Express money order made payable to AT&T Easylink. The check or money order should accompany the report sent to Defense Finance and Accounting Service. Commercial traffic clerks must ensure that the check is made payable to AT&T Easylink for class E messages, even though the report and the check are mailed to Defense Finance and Accounting Service.

COASTAL HARBOR RADIOTELEPHONE (R/T) SERVICE

Coastal harbor R/T service is a two-way telephone communications service. This service is through a commercial land R/T station between a naval vessel and any telephone on land. This service is provided to meet the needs of ships operating within a few hundred miles of the shore and is known commercially as the coastal harbor service.

Except for USNS contract-operated vessels, naval vessels using this service are limited to calls originating from the ship. Calls are normally made collect to keep shipboard abstracting to a minimum. Incoming calls to the ship (except those necessary to complete shore-to-ship connections that involve some delay) are not accepted.

The coastal harbor R/T service is authorized for passing official messages when appropriate. Any official message passed via this circuit requires release by an authorized releasing officer. U.S. Navy ships are authorized to use this service in peacetime unless otherwise directed by appropriate authority.

INITIATION OF SERVICE

No prior arrangements are necessary to use coastal harbor R/T service for collect calls, toll credit card calls, or calls that are billed to a third number (that is, other than the calling or called party). If the service is to be used for calls paid aboard ship, as may be the case of USNS contract vessels, the ship or aircraft squadron commander must establish an account with the telephone company representative nearest the home port assigned to the unit.

When filled out, the form letter shown in figure 14-3 contains all the data required to establish a coastal harbor service billing account. Ships desiring to use the Hawaiian coastal ship-to-shore service must first make local arrangements with the Commercial Manager, Hawaiian Telephone Company, Honolulu, Hawaii. An established account covers service through all the coastal harbor stations in CONUS.

If a ship is assigned a new home port, another form letter must be sent to the telephone company representative nearest the new home port to establish a new account. Also, a copy must be forwarded to the representative handling the former account to discontinue that account.

SHIPBOARD ARRANGEMENTS

Shipboard arrangements for using telephone service are handled by the communications officer. The communications officer or designated representative serves as the shipboard technical operator. This person is responsible for all technical details incident to shipboard operation of equipment.

RATES FOR SERVICE

The charge for service depends upon the location of the ship as well as the land telephone. The coastal waters are divided into rate areas, as shown in NTP 9. Calls are normally made collect. Charges (toll plus tax) on all calls must be collected when it is

(date) ____________

From: Commanding Officer, USS ____________

To: ____________

Subj: COASTAL HARBOR (AND OR) HIGH SEAS RADIOTELEPHONE SERVICE; REQUEST FOR ESTABLISHMENT OR DISCONTINUANCE OF ACCOUNT

1. Type account: Coastal Harbor ____________
High Seas ____________
Other ____________

2. Action: Establish ____________
Discontinue ____________

3. The following data is submitted:

Name of Vessel	USS ____________
International Call Sign	____________
Assigned Home Port:	____________
Billing Address:	Communications Officer USS ____________ (C/O F.P.O. or other as appropriate) ____________

4. The account with representative for Coastal Harbor and/or High Seas Accounts at ____________ to be terminated effective ____________ 19____.

5. This vessel will/will not accept incoming traffic and therefore will/will not monitor Coast Station Roll Calls.

____
(The letter will be signed by the Commanding Officer or a duly authorized representative by direction.)

Copy to:
(Type Commander)

Figure 14-3.—Request form for coastal harbor and/or high seas radiotelephone service.

impractical to make the call collect. The marine operator will furnish the charges upon request.

EQUIPMENT

All standard Navy MF/HF transmitters designed for A3A or A3H (voice) emission are, if properly tuned and adjusted, adaptable to coastal harbor service. All standard Navy MF/HF receivers designed for A3 reception are also suitable for this service. Accurate tuning to the correct frequency is essential to ensure good service.

The push-to-talk, release-to-listen method is the most practical and satisfactory type of operation. However, this method may present difficulties to unpracticed users and some instruction may be necessary. Frequencies, station location, and call signs are listed in NTP 9.

PLACING A CALL

To place a call, an individual must first make necessary arrangements with the communications officer. The transmitting and receiving equipments are then properly adjusted and tuned to the desired shore station frequency. The circuit operator aboard ship then uses the following procedures:

1. Listens to make certain that the circuit is not in use.
2. If the circuit is clear, calls the marine operator by voice. If there is no immediate response, repeats the call after a short interval. Excessive testing, calling, and transmission of signals without identification are forbidden.

   Example: "Norfolk marine operator, this is USS AMERICA, over."

3. When the telephone company marine operator responds, give the name of the ship, the city, and land telephone number desired.

   Example: "This is USS AMERICA, calling Minneapolis, Minnesota 612-336-1O95 collect, over."

Time and charges for noncollect calls should be requested from the marine operator at this time.

4. After the telephone company marine operator has recorded call details and made necessary connections, informs the person making the call that the circuit is ready. For best results, one should speak naturally and not too loudly. Also, one should wait until the other party has finished speaking before starting to talk.

5. Upon completion of the conversation, immediately advises the telephone company marine operator that the call is completed.

   Example: "This is USS AMERICA. Call completed."

HIGH SEAS RADIOTELEPHONE (R/T) SERVICE

Ship R/T service through high seas R/T stations provides communications between a ship and a land telephone. Service is furnished through land R/T stations WOO, Manahawkin, New Jersey; KMI, Pt. Reyes, California; and WOM, Ft. Lauderdale, Florida.

Authorization and availability of this service are the same as for coastal harbor R/T service. Because of the distances involved, however, service through these stations is more subject to transmission, atmospheric, and other limitations.

Ordinarily, service to ships operating near the coastline of the United States is furnished through coastal harbor R/T stations. These stations have been established to provide radio communications over relatively short distances. In general, ship R/T service through high seas R/T stations is used by ships operating beyond the range of these coastal harbor stations.

CONDITIONS UNDER WHICH SERVICE IS FURNISHED

The conditions under which high seas R/T service is furnished are essentially the same as those for coastal harbor stations. The primary exception is that with high seas R/T service, the shore station is furnished with the best line of bearing from the shore station to the ship to permit use of directional antennas. Operating frequencies are found in NTP 9.

Personal calls can be made only if billed collect or third party accepted (billed to a number other than the one being called) and if authorized prior to the start of the call. Calls may be person-to-person or to a specified number.

Official calls are usually made only after the establishment of a billing account and with authorization of the command. Additional information on official calls is available in NTP 9.

SERVICE CHARGES

High seas R/T service charges depend on the location of both the ship and the land telephone. The United States is divided into land rate areas by state groups. The oceans are also divided into rate areas.

Normally, all calls are made collect. If a call cannot be made collect, the charges are billed against the coastal harbor telephone service account of the ship.

DIFFERENCE IN OPERATING PROCEDURES

The traffic procedures for high seas R/T stations are similar to coastal harbor station procedures. The primary differences for high seas operation are as follows:

- After the radio circuit is established between ship and shore traffic operators, all information on awaiting calls is passed. Additionally, any reports relating to previous calls can be accomplished at this time.
- When several calls are pending, an order of precedence must be followed. Normally, calls are dealt with in the order in which they are booked.
- When more than one call is active at the same time, the shore traffic operator assigns a serial number to each call. This makes call identification easier.
- Calls, reports, or orders sometimes require mention or inclusion of the time of day. To ensure standardization, the time of the shore station is always used.

SUMMARY

In this chapter, you have been presented with an introduction to commercial message traffic. We discussed the various types of messages authorized for commercial use and the two types of commercial voice circuits available for ship-to-shore operation. We learned who is granted the class E privilege and how we interface with private commercial communications systems.

Not all of our work is concerned with strategic or tactical operations. Establishing circuits, abstracting, and accounting for commercial communications are just a few of many facets of our complex and diverse job.

RECOMMENDED READING LIST

NOTE

Although the following reference was current when this TRAMAN was published, its continued currency cannot be assured. You therefore need to ensure that you are studying the latest revision.

Commercial Communications Instructions, NTP 9(B), Commander, Naval Computer and Telecommunications Command, Washington, D.C., August 1993.

APPENDIX I

GLOSSARY

A

ACCOUNTABILITY LEGEND—A number assigned to COMSEC material that governs the method by which the material is accounted for; abbreviated AL.

ACCOUNTING SYMBOL—Combination of letters used to indicate the agency, service, or activity that is financially responsible for any charges accrued to a message.

ACKNOWLEDGMENT—A reply from an addressee indicating that a message was received, understood, and can be complied with.

ACP (ALLIED COMMUNICATIONS PUBLICATION)—A publication that provides communications instructions and procedures essential to conducting combined military operations and communications in which two or more allied nations are involved.

AF (AUDIO FREQUENCY)—A frequency that can be detected as a sound by the human ear. The audio-frequency range extends from approximately 20 to 20,000 Hz.

AGT (AUTODIN GATEWAY TERMINAL)—The primary AUTODIN interface point for a single organization as part of the Navy Standard Teleprinter Ashore (NSTA) program.

AIG (ADDRESS INDICATING GROUP)—A single address that represents 16 or more action and/or information addressees; for example, AIG 67.

ALTERNATION—One-half of one cycle. Equal to 180°, or one-half circle.

AM (AMPLITUDE MODULATION)—The method in which the information of the audio signal is imposed on the carrier signal by varying the amplitude of the carrier in accordance with the information to be transmitted.

AMPLIFICATION—The action of increasing a low-amplitude audio signal to the level required to operate auxiliary equipment, such as a speaker.

AMPLIFIER—A device that amplifies (increases) an input signal without appreciably altering the original signal.

AMPLITUDE—The size of a signal. When plotted on a graph, the arcs of the signal are measured from a reference line to a maximum value point above or below the line.

ANTENNA—A device used to radiate or receive radio waves.

ANTENNA COUPLER—A device used for impedance matching (tuning) between an antenna and a transmitter or receiver.

ANTENNA RECIPROCITY—The ability of an antenna to both transmit and receive electromagnetic energy.

ANTENNA TUNING—The process where an antenna is electrically "matched" to the output frequency and impedance of the transmitter.

ASC—AUTODIN Switching Center.

AST—AUTODIN Subscriber Terminal.

ASWIXS—Antisubmarine Warfare Information Exchange Subsystem.

ASWOC—Antisubmarine Warfare Operations Center.

ATTENUATION—A deliberate reduction or an unintended loss in RF signal strength.

AUTHENTICATION—A security measure designed to protect a communications or command system against fraudulent transmissions or simulation.

AUTODIN (AUTOMATIC DIGITAL NETWORK)—A worldwide automatic communications system that provides automatic data service.

B

BANDWIDTH—Any section of the frequency spectrum occupied by specific signals.

BEADWINDOW—A term describing a real-time procedure used to alert circuit operators that an unauthorized disclosure has occurred.

BIDIRECTIONAL ANTENNA—An antenna that radiates in or receives most of its energy from only two directions.

BOOK MESSAGE—A message destined for two or more addressees but is of such a nature that the drafter considers it unnecessary that each addressee be informed of any other addressee(s).

BUFFER—A voltage amplifier used between the oscillator and power amplifier.

C

CAD (COLLECTIVE ADDRESS DESIGNATOR)—A single-address group that represents a set of four or more activities linked by an operational or administrative chain of command.

CARRIER—The unmodulated signal originally produced in the oscillator section of a transmitter.

CARRIER FREQUENCY—The final RF output without modulation. The assigned transmitter frequency.

CASREP—Casualty report.

CDPS—Communications Data Processing System; used on USS *Tarawa* (LHA-1)-class ships.

CHANNEL—A carrier frequency assignment, usually with a fixed bandwidth.

CIB—Communications Information Bulletin.

CIC—(1) Content Indicator Code. (2) Combat Information Center. The intended meaning will be readily apparent to the reader by the subject matter contents.

CIK (CRYPTO IGNITION KEY)—Key used to activate the secure mode of the STU-III.

CMS—Communications Security Material System.

CMS USER—An individual who requires COMSEC material to accomplish a task.

CMS WITNESS—An individual who witnesses the destruction or inventorying of COMSEC material.

COMPLEX WAVE—A transmitted radio signal composed of different frequencies.

COMPROMISE—The known or suspected exposure of classified information or material to an unauthorized person or persons.

COMSEC (COMMUNICATIONS SECURITY)—A term used to define those specific procedures applicable to the security of telecommunications.

CONFIDENTIAL—Information the unauthorized disclosure of which could reasonably be expected to cause damage to the national security.

CONUS—Continental United States.

COUNTERPOISE—The ground plane, or reflective surface, comprising an antenna's reflected image at a given wavelength.

CRITICAL FREQUENCY—The highest transmitted frequency that can be propagated directly upward and still be bent, or "refracted," back to Earth.

CRYPTO—A communications marking that means the material indicated requires special consideration with respect to access, storage, and handling. CRYPTO is not a security marking.

CRYPTOINFORMATION—Information normally relating to the encryption or decryption process of a particular cryptosystem.

CRYPTOMATERIAL—All material, including publications, devices, equipment, or apparatus, essential to the encryption, decryption, or authentication of telecommunications.

CRYPTO-RELATED—Information normally associated with cryptomaterial, but is not significantly descriptive of it.

CRYPTOSYSTEM—Information encompassing all the associated items of cryptomaterial that are used together to provide a single means of encryption or decryption.

CRYPTOVARIABLE—The elements of a cryptosystem directly affecting the encryption and decryption process. Cryptovariables are divided into two types, PRIMARY and SECONDARY.

CUDIX—Common User Digital Information Exchange System.

CW (CONTINUOUS WAVE)—Radio telegraphy; the transmission of short or long pulses of RF energy to form the dots and dashes (dits and dahs) of the Morse code characters.

CYCLE—Two complete alternations of alternating current, or one complete revolution in any period of time, equal to 360°.

D

DAMA (DEMAND ASSIGNED MULTIPLE ACCESS SUBSYSTEM)—Subsystem that multiplexes several subsystems on one satellite channel.

DETECTION (also DEMODULATION)—The process in a receiver whereby the original modulating frequencies (intelligence) are recovered, or recreated, for further amplification in the output circuit.

DIFFRACTION—The bending of radio waves around the edges of a solid object or dense mass.

DIRECTED NET—A net in which member stations must obtain permission from the net control station (NECOS) prior to communicating with other stations on the net.

DIRECTIONAL ANTENNA—An antenna that radiates or receives radio waves more effectively in some directions than in others.

DIRECTIVITY—The sharpness or narrowness of an antenna's radiation pattern in a given plane.

DIRECT WAVE—A radio signal that travels in a direct line-of-sight path from the transmitting antenna to the receiving antenna.

DISTORTION—An undesired change in a signal that occurs between transmission and reception.

DOUBLE SIDEBAND (DSB)—A method of sideband transmission where both the upper and lower sidebands of a radio signal contain the same information.

DSN (DEFENSE SWITCHED NETWORK)—A nonsecure telecommunications telephone interconnected network among military and other government installations (formerly AUTOVON).

DUCTING—A phenomenon in which radio waves are trapped inside an atmospheric layer.

DUMMY LOAD—A nonradiating device used at the end of a transmission line in place of an antenna for tuning a transmitter. The dummy load converts transmitted energy into heat so that no energy is radiated outward or reflected back.

E

EAM (EMERGENCY ACTION MESSAGE)—A message with a predetermined format (pro forma) containing key instructions or information from high-level authority.

ECP (EMERGENCY COMMAND PRECEDENCE)—A precedence prosign (Y) used within the AUTODIN system for designated emergency action command and control information.

EEFI—Essential Elements of Friendly Information.

EFTO (ENCRYPT FOR TRANSMISSION ONLY)—A special message marking used to denote FOUO (For Official Use Only) information that is to be transmitted outside CONUS.

EHF (EXTREMELY HIGH FREQUENCY)—The band of frequencies from 30 GHz to 300 GHz.

ELECTRIC FIELD—A field produced as a result of a voltage charge on an antenna.

ELECTROMAGNETIC ENERGY—An RF source composed of both an electric and a magnetic field.

ELECTROMAGNETIC WAVES—Energy produced at the output of a transmitter. Also called radio waves.

EMCON (EMISSION CONTROL)—General or specific restrictions placed on electromagnetic radiations for a particular area or areas.

ENCRYPTION—The process of converting intelligible information to an unintelligible form for transmission.

EOM—End of message.

EXEMPT—An element of a collective call sign that is not an intended addressee of the message. Designated by the prosign XMT.

F

FADING—Variations, usually gradual, in the field strength of a radio signal that are caused by changes in the transmission path or medium.

FAX (FACSIMILE)—A method of communications in which a photograph, map, or other fixed graphic material is scanned and the information converted into signals for transmission by wire or radio to a facsimile receiver at a remote point.

FEED POINT—The point on an antenna at which the RF cable that carries the signal from the transmitter is connected.

FIDELITY—The measure of how well a receiver can reproduce the original intelligence signal that appears at its input.

FM (FREQUENCY MODULATION)—The process of causing the incident carrier to vary in direct proportion to the amplitude of the modulation.

FOT (FREQUENCY OF OPTIMUM TRANSMISSION)—The most reliable frequency for propagation at a specific time.

FOUO (FOR OFFICIAL USE ONLY)—The designation used for messages that contain official information which requires some degree of protection for the good of public interest, but is not safeguarded by a classification category in the interests of national security.

FREE NET—A communications net of which member stations need not obtain permission of the net control station (NECOS) to transmit.

FREQUENCY—The number of complete cycles per unit of time.

FREQUENCY DIVERSITY—The method in which the information signal is transmitted and received on two separate radio frequencies simultaneously to take advantage of the fact that fading does not occur simultaneously on different frequencies.

FSK (FREQUENCY-SHIFT KEYING)—The process of shifting the incident carrier above and below the carrier frequency to correspond to the marks and spaces of a teleprinter signal.

FTOC—Fleet Telecommunications Operations Center.

FTP—Fleet Telecommunications Publication.

G

GAIN—An increase in signal strength.

GATEGUARD—A security subsystem that allows commands to interface directly with the AUTODIN system as part of the NSTA program.

GENADMIN (GENERAL ADMINISTRATIVE)—Message format used for most narrative messages.

GIGAHERTZ (GHz)—1000 megahertz.

GMT (GREENWICH MEAN TIME)—Mean solar time at the meridian of Greenwich, England; used as a basis for standard time throughout the world.

GRNC—Groups Not Counted.

GROUND—A term used to denote a common electrical point of zero potential.

GROUND-PLANE ANTENNA—A type of antenna that uses a ground plane (a metallic surface) as a simulated ground to produce low-angle radiation.

H

HALF-WAVE DIPOLE ANTENNA—A common type of half-wave antenna made from a straight piece of wire cut in half. Each half operates at a quarter of the wavelength. Normally omnidirectional with no gain.

HERO—Hazards of electromagnetic radiation to ordnance.

HERTZ (Hz)—A unit of frequency equal to one cycle per second.

HERTZ ANTENNA—An ungrounded half-wave antenna that is installed some distance above ground and positioned either vertically or horizontally.

HETERODYNE—The process of mixing the incoming signal with the oscillator frequency to produce sum and difference frequencies.

HF (HIGH FREQUENCY)—The band of frequencies from 3 MHz to 30 MHz.

HICOM—High Command worldwide voice network.

I

IF (INTERMEDIATE FREQUENCY)—The frequency to which all amplifiers preceding the detector stage are tuned in a superheterodyne receiver.

IMPEDANCE—The total opposition to the flow of alternating current.

INCIDENT WAVE—The RF energy that travels from the transmitter to the antenna for radiation.

INDEPENDENT SIDEBAND (ISB)—Radiation of a reduced RF carrier on which one intelligence is used to modulate the upper sideband and another intelligence is used to modulate the lower sideband.

INDEX OF REFRACTION—The degree of bending of an RF wave when passing from one medium to another.

INDUCTION FIELD—The electromagnetic field produced around an antenna when current and voltage are present on the antenna.

IONIZATION—The electrically charged particles produced by high-energy radiation, such as light or ultraviolet rays.

IONOSPHERE—That part of the Earth's atmosphere above the stratosphere where ions and electrons are present in quantities sufficient to affect the propagation of radio waves. Consists of up to four layers of ionized gases designated as D, E, F1, and F2.

IONS—Atoms or molecules that have been electrically charged.

J

JANAP—Joint Army-Navy-Air Force Publication.

K

KILOHERTZ (kHz)—1000 hertz.

L

LAN—Local area network.

LDMX—Local Digital Message Exchange.

LEASAT—Leased satellite.

LF (LOW FREQUENCY)—The band of frequencies from 30 kHz to 300 kHz.

LIMDIS (LIMITED DISTRIBUTION)—Material that requires limited distribution within an activity.

LMF—Language and media format.

LOCAL HOLDER—A command or activity whose COMSEC material needs are met by drawing the material from a single CMS account.

LOS—Line of sight.

LOWER SIDEBAND (LSB)—The band of frequencies in a radiated RF wave that extends below the RF carrier frequency.

LUF (LOWEST USABLE FREQUENCY)—The lowest frequency that can be used at a specific time for ionospheric propagation of radio waves between two specified points.

M

MAD—Message Address Directory.

MAGNETIC FIELD—One of the fields produced when current flows through a conductor or an antenna.

MAINTENANCE DATA SYSTEM (MDS)—A system by which maintenance personnel report corrective maintenance actions on all categories of equipment. Part of the 3-M Systems.

MARCEMP (MANUAL RELAY CENTER MODERNIZATION PROGRAM)—An automation support system for all aspects of HF message relay operation in the Fleet Center.

MARCONI ANTENNA—A quarter-wave antenna that is operated with one end grounded and is positioned perpendicular to the Earth.

MEDIUM—The vehicle through which an electromagnetic wave travels from one point to the next. Air and water are examples.

MEGAHERTZ (MHz)—1,000,000 hertz.

MESSAGE IDENTIFIER (MSGID)—A set identifier in messages that prescribes field arrangements and content.

MF (MEDIUM FREQUENCY)—The band of frequencies from 300 kHz to 3 MHz.

MIJI (MEACONING, INTERFERENCE, JAMMING, AND INTRUSION)—A term covering all the basic types of communications interference likely to be encountered in a given situation.

MINIMIZE—The condition imposed in a specific communications area to reduce voice and record traffic so that essential traffic can be efficiently handled.

MIRROR IMAGE—That part of the radiated signal of a quarter-wave antenna (Marconi antenna) appearing to come from an underground image of the real antenna. This image is also called ground reflection.

MODULATED WAVE—The wave that results after the information from the modulating signal is impressed onto the carrier signal. The wave that is transmitted.

MODULATING WAVE—An information wave representing intelligence.

MODULATION—The process of adding, or superimposing, information on an RF carrier wave.

MOVREP—Movement report.

MUF (MAXIMUM USABLE FREQUENCY)—The highest operating frequency that can be used at a specific time for successful radio communications between two points.

MULCAST—Fleet Multichannel Broadcast.

MULTICOUPLERS—Couplers that patch receivers or transmitters to antennas.

N

NAVCOMPARS—Naval Communications Processing and Routing System.

NAVCOMTELSTA (NAVAL COMPUTER AND TELECOMMUNICATIONS STATION)—A former NAVCOMMSTA that has merged with a Navy Regional Data Center (NARDAC) and provides requisite communications services for an area within a NAVCOMMAREA.

NAVMACS—Naval Modular Automated Communications System.

NCTAMS (NAVAL COMPUTER AND TELECOMMUNICATIONS AREA MASTER STATION)—A former NAVCAMS that has merged with a NARDAC and serves as the control coordinator of all naval communications within a NAVCOMMAREA.

NECOS—Net control station.

NOFORN (NOT RELEASABLE TO FOREIGN NATIONALS)—Official information that is not releasable in any form to foreign governments, foreign nationals, or non-U.S. citizens without permission of the originator.

NOISE—Any electrical disturbance that interferes with the normal reception of a transmitted signal.

NOTAL (NOT TO ALL)—Acronym used with message references indicating that a reference may not be held by all activities addressed in a message.

NOTAM—Notice to airmen.

NST—Navy Standard Teleprinter.

NSTA—Navy Standard Teleprinter Ashore.

NTCC—Naval Telecommunications Center.

NTP—Naval Telecommunications Publication.

NWP—Naval Warfare Publication.

NWPL—Naval Warfare Publications Library.

O

OMNIDIRECTIONAL ANTENNA—An antenna that radiates or receives equally well in all directions, except directly off the ends.

OPORD (OPERATION ORDER)—Directive issued by naval commanders to subordinates for the purpose of effecting coordinated execution of an exercise or operation.

OPSIGs (OPERATING SIGNALS)—Brief communications expressions that convey larger meanings.

OSCILLATOR—An electrical circuit that generates alternating current at a particular frequency.

OSRI—Originating station routing indicator.

OTAM—Off-the-air monitoring.

OTC—Officer in tactical command.

P

PARABOLIC ANTENNA—An antenna with a "dish" form that radiates its signal back into a large reflecting surface (called the dish) for radiation.

PASEP (PASSED SEPARATELY)—Acronym used with message references indicating that a reference was sent by other means.

PCMT (PERSONAL COMPUTER MESSAGE TERMINAL)—A PC-based microcomputer that is the main part of the NSTA program.

PERIOD (of a wave)—The time required to complete one cycle of a waveform.

PLA—Plain Language Address.

PMS (PLANNED MAINTENANCE SYSTEM)—A standardized means for planning, scheduling, controlling, and performing planned maintenance on equipment.

POLARIZATION (of antennas)—The plane (horizontal or vertical) of the electric field as radiated from a transmitting antenna.

PRO FORMA—A message format in which all textual elements and information will always appear in the same location, such as MOVREPs and CASREPs.

PROGRAM—A series of instructions that control the operation of a computer.

PROPAGATION—The transmission of radio waves from one point to another.

PROSIGNS—Letters, or combinations of letters, that convey frequently sent orders or instructions in a simple, standard format.

PROWORDS—The phonetic equivalent of prosigns.

Q

"Q" MESSAGES—The classified portions of the navigational warning system of allied nations.

R

RADHAZ (RADIATION HAZARD)—Electromagnetic radiation hazard generated from electronic equipment.

RADIATION FIELD—The electromagnetic field that radiates from an antenna and travels through space.

RADIATION RESISTANCE—The resistance that, if inserted in place of an antenna, would consume the same amount of power that is radiated by the antenna.

REFLECTED WAVE—An electromagnetic wave that travels back toward the transmitter from the antenna because of a mismatch in impedance between the two.

REFLECTION—Occurs when a radio wave strikes the Earth's surface at some distance from the transmitting antenna and is returned upward toward the atmosphere.

REFRACTION—The bending of a propagated radio wave as it passes from one layer in the ionosphere into another layer of different ion density.

REPRODUCTION—The ability of a receiver to reproduce accurately, in its output, the signal that appears in its input.

RF (RADIO FREQUENCY)—A frequency in the range within which radio waves can be transmitted. Frequencies used for radio communications fall between 3 kHz and 300 GHz.

RF ENERGY—Radio-frequency energy. Energy produced at the output of a transmitter.

R/T—Radiotelephone.

S

SAS (SINGLE AUDIO SYSTEM)—Integrated secure and nonsecure shipboard voice communications system.

SECRET—Information the unauthorized disclosure of which could reasonable be expected to cause serious damage to the national security.

SEED KEY—Special keying material used for the initial electronic setup of the STU-III terminal.

SELECTIVITY—The ability of a receiver to select and reproduce a desired signal and reject unwanted signals.

SENSITIVITY—The ability of a receiver to reproduce very weak signals.

SERVICE MESSAGE—A short, concise message between communications personnel requiring prompt attention.

SHD—Special-handling designator.

SHF (SUPER HIGH FREQUENCY)—The band of frequencies from 3 GHz to 30 GHz.

SIGNAL—Detectable transmitted energy that can be used to carry information.

SINGLE SIDEBAND (SSB)—The method of sideband transmission in which only one sideband is transmitted.

SINGLE-SIDEBAND FULL CARRIER (SSBFC)—The method of sideband transmission in which one sideband is filtered out but the carrier remains.

SINGLE-SIDEBAND SUPPRESSED CARRIER (SSBSC)—The method of sideband transmission in which one sideband and the carrier are filtered out before transmission.

SKIP DISTANCE—The shortest distance from the transmitting antenna at which a sky wave is first returned to Earth after reflection from the ionosphere.

SKIP ZONE—That area between the end of the surface wave and the point where the sky wave first returns to Earth where the transmitted signal cannot be received.

SKY WAVE—That portion of a propagated signal that moves upward and outward and is not in contact with the Earth.

SOGs (SPECIAL OPERATING GROUPS)—Four-letter combinations that are used to represent a particular command, activity, or unit, and are effective only when authorized by CNO.

SPACE DIVERSITY—The method in which two separate antennas and receivers are used to receive the same frequency.

SPACE WAVE—That component of a propagated signal which travels through the troposphere from the transmitting antenna to the receiving antenna.

SPECAT (SPECIAL CATEGORY)—Material that requires special handling procedures in addition to the care required by the security classification assigned.

SRT—Standard Remote Terminal.

SSIC—Standard Subject Identification Code.

SSIX—Submarine Satellite Information Exchange Subsystem.

SSN—Station serial number.

STANDING WAVES—The stationary waves that build up along an antenna during radiation.

STRATOSPHERE—That portion of the Earth's atmosphere above the troposphere extending from about 7 to 50 miles above the surface.

STU-III (SECURE TELEPHONE UNIT THIRD GENERATION)—Desktop phone unit that provides users with both clear as well as secure voice and data transmissions.

SUNSPOTS—Dark spots occurring on the surface of the Sun during violent solar eruptions.

SUPERHETERODYNE RECEIVER—A type of receiver that uses a mixer to convert the RF signal to an IF signal for amplification.

SUPPRESSION—The process of eliminating an undesired portion of a signal, such as a sideband or the carrier.

SURFACE WAVE—A propagated wave that travels along the surface of the Earth.

SWR (STANDING-WAVE RATIO)—A term used to express the degree of resonance attained between the antenna and the transmission line when being tuned for transmission.

T

TELECOMMUNICATIONS—All systems in which electromagnetic signals are used to transmit information between or along points.

TEMPERATURE INVERSION—The condition in which warm air is formed above a layer of cold air near the Earth's surface.

TEMPEST—Unclassified short name for compromising emanations that are unintentional data-related or intelligence-bearing signals.

TOP SECRET—Information the unauthorized disclosure of which could reasonable be expected to cause exceptionally grave damage to the national security.

TPI (TWO-PERSON INTEGRITY)—Security measure taken to prevent single-person access to COMSEC keying material.

TRACER—A message sent to determine the reason for excessive delay in the delivery or nondelivery of previously sent message traffic.

TRANSMISSION LINE—A device designed to guide electrical or electromagnetic energy from one point to another.

TROPOSPHERE—That portion of the Earth's atmosphere extending from the Earth's surface to a height of about 6 miles to 10 miles.

U

UHF (ULTRA HIGH FREQUENCY)—The band of frequencies from 300 MHz to 3 GHz.

UNIDIRECTIONAL ANTENNA—An antenna that radiates in only one direction.

UPPER SIDEBAND (USB)—The band of frequencies in an RF wave that extends from the RF carrier to 3 kHz above the RF carrier.

V

VHF (VERY HIGH FREQUENCY)—The band of frequencies from 30 MHz to 300 MHz.

VLF (VERY LOW FREQUENCY)—The band of frequencies from 3 kHz to 30 kHz.

W

WAVEFORM—The shape of an electromagnetic wave.

WAVELENGTH—The distance traveled, in feet or meters, by a radio wave in the time required for one cycle.

WWMCCS—Worldwide Military Command and Control System.

APPENDIX II

REFERENCES USED TO DEVELOP THE TRAMAN

NOTE

Although the following references were current when this TRAMAN was published, their continued currency cannot be assured. You therefore need to ensure that you are studying the latest revisions.

Some of the following references were originated by the Naval Education and Training Program Development Center (NETPDC), Pensacola, Fla. Effective 1 September 1986, the title NETPDC was officially changed to Naval Education and Training Program Management Support Activity (NETPMSA), Pensacola, Fla.

Chapter 1

Cryptologic Technician Training Series (U), Module 5, *Satellite Communications (U)*, NAVEDTRA A95-05-44-89, NETPMSA, Pensacola, Fla., 1989.

Electronics Installation and Maintenance Book—*Communications,* NAVSEA SE000-00-EIM-010, Naval Sea Systems Command, Washington, D.C., September 1979.

Navy Electricity and Electronics Training Series, Module 1, *Introduction to Matter, Energy, and Direct Current*, NAVEDTRA B72-01-00-92, NETPMSA, Pensacola, Fla., 1992.

Navy Electricity and Electronics Training Series, Module 2, *Introduction to Alternating Current and Transformers*, NAVEDTRA 172-02-00-91, NETPMSA, Pensacola, Fla., 1991.

Navy Electricity and Electronics Training Series, Module 8, *Introduction to Amplifiers*, NAVEDTRA 172-08-00-82, NETPDC, Pensacola, Fla., 1982.

Navy Electricity and Electronics Training Series, Module 9, *Introduction to Wave-Generation and Wave-Shaping Circuits*, NAVEDTRA 172-09-00-83, NETPDC, Pensacola, Fla., 1983.

Navy Electricity and Electronics Training Series, Module 10, *Introduction to Wave Propagation, Transmission Lines, and Antennas*, NAVEDTRA 172-10-00-83, NETPDC, Pensacola, Fla., 1983.

Navy Electricity and Electronics Training Series, Module 12, *Modulation Principles*, NAVEDTRA 172-12-00-83, NETPDC, Pensacola, Fla., 1983.

Navy Electricity and Electronics Training Series, Module 17, *Radio-Frequency Communications Principles*, NAVEDTRA 172-17-00-84, NETPDC, Pensacola, Fla., 1984.

Navy UHF Satellite Communication System Description, FSCS-200-83-1, Commander, Naval Ocean Systems Center, San Diego, Calif., 1991.

Chapter 2

Navy Electricity and Electronics Training Series, Module 8, *Introduction to Amplifiers*, NAVEDTRA 172-08-00-82, NETPDC, Pensacola, Fla., 1982.

Navy Electricity and Electronics Training Series, Module 12, *Modulation Principles*, NAVEDTRA 172-12-00-83, NETPDC, Pensacola, Fla., 1983.

Navy Electricity and Electronics Training Series, Module 17, *Radio-Frequency Communications Principles*, NAVEDTRA 172-17-00-84, NETPDC, Pensacola, Fla., 1984.

Technical Manual Operation and Maintenance Instructions with Parts List, Receiver R-2368/URR, EE125-FC-OMI-010/R-2368/URR, Space and Naval Warfare Systems Command, Washington, D.C., 25 May 1989.

Chapter 3

Navy Electricity and Electronics Training Series, Module 2, *Introduction to Alternating Current and Transformers*, NAVEDTRA 172-02-00-91, NETPMSA, Pensacola, Fla., 1991.

Navy Electricity and Electronics Training Series, Module 10, *Introduction to Wave Propagation, Transmission Lines, and Antennas*, NAVEDTRA 172-10-00-83, NETPDC, Pensacola, Fla., 1983.

Shipboard Antenna Systems, Volume 1, *Communications Antenna Fundamentals*, NAVSHIPS 0967-177-3010, Naval Ship Systems Command, Washington, D.C., September 1972.

Shipboard Antenna Systems, Volume 3, *Antenna Couplers, Communications Antenna Systems*, NAVSHIPS 0967-177-3030, Naval Ship Systems Command, Washington, D.C., January 1973.

Shipboard Antenna Systems, Volume 5, *Antenna Data Sheets*, SPAWAR 0967-LP-177-3050, Space and Naval Warfare Systems Command, Washington, D.C., May 1973.

Navy Ultra High Frequency Satellite Communications (U), NTP 2, Section 2 (E), Naval Computer and Telecommunications Command, Washington, D.C., July 1992.

Chapter 4

Fleet Communications (U), NTP 4(C), Commander, Naval Telecommunications Command, Washington, D.C., June 1988.

Naval Telecommunications Procedures, Recommended Frequency Bands and Frequency Guide, NTP 6 Supp-1(S), Commander, Naval Computer and Telecommunications Command, Washington, D.C., 1993.

Naval Telecommunications Procedures, Spectrum Management Manual, NTP 6(C), Commander, Naval Telecommunications Command, Washington, D.C., November 1988.

Navy Electricity and Electronics Training Series, Module 10, *Introduction to Wave Propagation, Transmission Lines, and Antennas*, NAVEDTRA 172-10-00-83, NETPDC, Pensacola, Fla., 1983.

Chapter 5

Basic Operational Communications Doctrine (U), NWP 4(B), Chief of Naval Operations, Washington, D.C., September 1989.

Fleet Communications (U), NTP 4(C), Commander, Naval Telecommunications Command, Washington, D.C., June 1988.

Fleet Telecommunications Procedures for Atlantic and Mediterranean Naval Communications Areas, NCTAMS LANT/MEDINST C2300.1, Naval Computer and Telecommunications Area Master Station LANT/Naval Computer and Telecommunications Area Master Station MED, September 1993.

Fleet Telecommunications Procedures for the Pacific and Indian Ocean Naval Communication Areas, NCTAMS EASTPAC/NCTAMS WESTPACINST C2000.3D, Naval Computer and Telecommunications Area Master Station EASTPAC/Naval Computer and Telecommunications Area WESTPAC, 10 August 1992.

Naval Warfare Documentation Guide, NWP 0 (Rev. P), Chief of Naval Operations, Washington, D.C., January 1990.

Chapter 6

Allied Call Sign and Address Group System—Instructions and Assignments, ACP 100(F), Joint Chiefs of Staff, Washington, D.C., March 1984.

Automatic Digital Network (AUTODIN) Operating Procedures, JANAP 128(J), Joint Chiefs of Staff, Washington, D.C., July 1993.

Basic Operational Communications Doctrine (U), NWP 4(B), Chief of Naval Operations, Washington, D.C., September 1989.

Communication Instructions—General (U), ACP 121(F), Joint Chiefs of Staff, Washington, D.C., April 1983.

Communications Instructions—General, ACP 121 US SUPP-1(F), Joint Chiefs of Staff, Washington, D.C., June 1981.

Communication Instructions—Operating Signals, ACP 131(D), Joint Chiefs of Staff, Washington, D.C., May 1986.

Communications Instructions—Tape Relay Procedures, ACP 127(G), Joint Chiefs of Staff, Washington, D.C., November 1988.

Communications Instructions—Teletypewriter (Teleprinter) Procedures, ACP 126(C), Joint Chiefs of Staff, Washington, D.C., May 1989.

Fleet Communications (U), NTP 4(C), Commander, Naval Telecommunications Command, Washington, D.C., June 1988.

Message Address Directory, Joint Chiefs of Staff, Washington, D.C., June 1990.

Operational Reports, NWP 10-1-10, Chief of Naval Operations, Washington, D.C., November 1987.

Telecommunications Users Manual, NTP 3(I), Commander, Naval Telecommunications Command, Washington, D.C., January 1990.

U.S. Call Sign & Address Group System Instructions & Assignments, ACP 100 U.S. SUPP-1(N), Joint Chiefs of Staff, Washington, D.C., June 1989.

U.S. Navy Address Indicating Group (AIG) and Collective Address Designator (CAD) Handbook, NTP 3 SUPP-1(K), Commander, Naval Telecommunications Command, Washington, D.C., August 1986.

Chapter 7

Basic Operational Communications Doctrine (U), NWP 4(B), Chief of Naval Operations, Washington, D.C., September 1989.

Communications Instructions—Security (U), ACP 122, Joint Chiefs of Staff, Washington, D.C., 1981.

Communications Security Material System (CMS) Policy and Procedures Manual, CMS 1, Department of the Navy, Washington, D.C., March 1993.

Department of the Navy Information and Personnel Security Program Regulation, OPNAVINST 5510.1H, Chief of Naval Operations, Washington, D.C., April 1988.

Fleet Communications (U), NTP 4(C), Commander, Naval Telecommunications Command, Washington, D.C., June 1988.

Telecommunications Users Manual, NTP 3(I), Commander, Naval Telecommunications Command, Washington, D.C., January 1990.

Chapter 8

Call Sign Book for Ships, ACP 113(AC), Joint Chiefs of Staff, Washington, D.C., April 1986.

Communication Instructions—General, ACP 121(F), Joint Chiefs of Staff, Washington, D.C., April 1983.

Joint Voice Call Sign Book, JANAP 119, Joint Chiefs of Staff, Washington, D.C., January 1984.

Radiotelephone Procedure, ACP 125(E), Joint Chiefs of Staff, Washington, D.C., August 1987.

Voice Communications, NTP 5(B), Naval Telecommunications Command, Washington, D.C., August 1984.

Chapter 9

Communications Instructions—Tape Relay Procedures, ACP 127(G), Joint Chiefs of Staff, Washington, D.C., November 1988.

Communications Instructions—Tape Relay Procedures, ACP 127 US SUPP-1(H), Joint Chiefs of Staff, Washington, D.C., May 1984.

Communications Instructions—Teletypewriter (Teleprinter) Procedures, ACP 126(C), Joint Chiefs of Staff, Washington, D.C., May 1989.

Navy Training Plan, Navy Standard Teleprinter AN/UGC-143A(V), NTP E-70-8409A, Chief of Naval Operations, Washington, D.C.

Teleprinter Set AN/UGC-143A(V), Commander, Space and Naval Warfare Systems Command, Washington, D.C., March 1989.

Chapter 10

Automatic Digital Network (AUTODIN) Operating Procedures, JANAP 128(J), Joint Chiefs of Staff, Washington, D.C., July 1993.

DSN Phase 1 User Services Guide, DCA Circular 310-225-1, Defense Communications Agency, Washington, D.C., November 1989.

Fleet Communications (U), NTP 4(C), Commander, Naval Telecommunications Command, Washington, D.C., June 1988.

Navy Ultra High Frequency Satellite Communications (U), NTP 2, Section 2 (E), Naval Computer and Telecommunications Command, Washington, D.C., July 1992.

Secure Telephone Unit Third Generation (STU-III) COMSEC Material Management Manual, CMS 6, Director, Communications Security Material System, Washington, D.C., October 1990.

Chapter 11

Basic Operational Communications Doctrine (U), NWP 4(B), Chief of Naval Operations, Washington, D.C., September 1989.

Navy Super High Frequency Satellite Communications, NTP 2, Section 1 (C), Naval Computer and Telecommunications Command, Washington, D.C., June 1992.

Electronics Technician 3 & 2, NAVEDTRA 10197, NETPMSA, Pensacola, Fla., March 1987.

Fleet Communications (U), NTP 4(C), Commander, Naval Telecommunications Command, Washington, D.C., June 1988.

Navy Ultra High Frequency Satellite Communications (U), NTP 2, Section 2 (E), Naval Computer and Telecommunications Command, Washington, D.C., July 1992.

Navy UHF Satellite Communication System Description, FSCS-200-83-1, Naval Ocean Systems Center, San Diego, Calif., December 1991.

Navy UHF Satellite Communication System—Shipboard, EE130-PL-OMI-010/W142-UHFSATCOM, Space and Naval Warfare Systems Command, Washington, D.C., August 1986.

Chapter 12

Automatic Digital Network (AUTODIN) Operating Procedures, JANAP 128(J), Joint Chiefs of Staff, Washington, D.C., July 1993.

Department of the Navy Information and Personnel Security Program Regulation, OPNAVINST 5510.1H, Chief of Naval Operations, Washington, D.C., April 1988.

Fleet Communications (U), NTP 4(C), Commander, Naval Telecommunications Command, Washington, D.C., June 1988.

Telecommunications Users Manual, NTP 3(I), Commander, Naval Telecommunications Command, Washington, D.C., January 1990.

Chapter 13

Electronics Installation and Maintenance Book—*Communications*, NAVSEA SE000-00-EIM-010, Naval Sea Systems Command, Washington, D.C., September 1979.

Electronics Installation and Maintenance Book—*General*, NAVSEA SE000-00-EIM-100, Naval Sea Systems Command, Washington, D.C., April 1983.

Fleet Communications (U), NTP 4(C), Naval Telecommunications Command, Washington, D.C., June 1988.

Military Requirements for Petty Officer Third Class, NAVEDTRA 10044-A, NETPMSA, Pensacola, Fla., October 1987.

Navy Occupational Safety and Health (NAVOSH) Program Manual for Forces Afloat, Vols I and II, OPNAVINST 5100.19B, Chief of Naval Operations, Washington, D.C., April 1989.

Ships' Maintenance and Material Management (3-M) Manual, OPNAVINST 4790.4B, Chief of Naval Operations, Washington, D.C., August 1987.

Standard Organization and Regulations of the U.S. Navy, OPNAVINST 3120.32B, Chief of Naval Operations, Washington, D.C., September 1986.

Chapter 14

Commercial Communications Instructions, NTP 9(B), Commander, Naval Computer and Telecommunications Command, Washington, D.C., August 1993.

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☆ U.S. GOVERNMENT PRINTING OFFICE: 1994 — 633-011/07