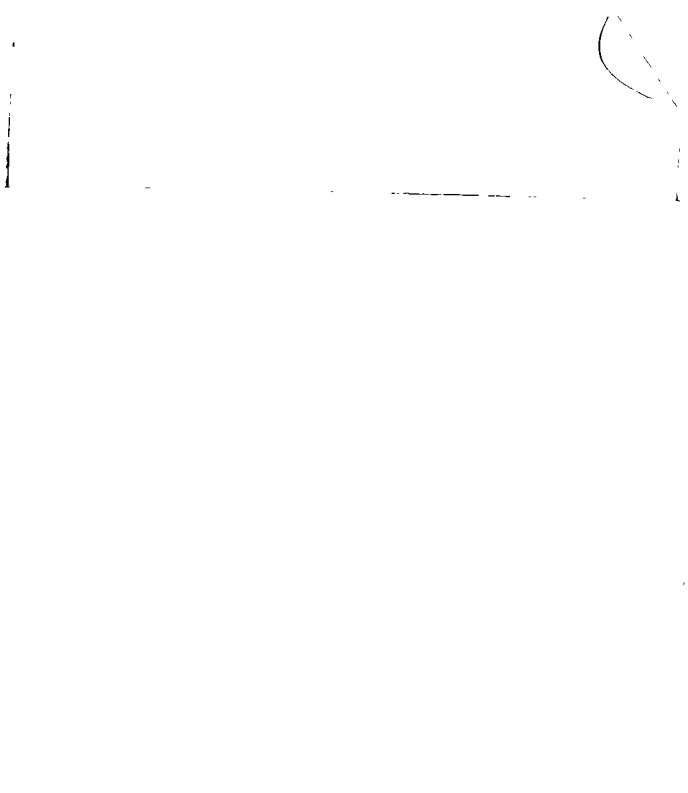
FM 6-10

FIELD MANUAL

FIELD ARTILLERY

COMMUNICATIONS

HEADQUARTERS, DEPARTMENT OF THE ARMY
MARCH 1975



FIELD MANUAL
No. 6-10

HEADQUARTERS
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WASHINGTON, D. C., *31 March 1975*

FIELD ARTILLERY COMMUNICATIONS

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CHAPTER 1

INTRODUCTION

1-1. Purpose and Scope

This manual is a guide for commanders, staff officers, and personnel concerned with field artillery communications. The purpose of the manual is to provide, in a detailed but nontechnical explanation, the basic knowledge required in the application and employment of efficient field artillery communications.

1-2. Application

a. Unless otherwise specified, this manual applies to nuclear and nonnuclear warfare.

b. This manual should be used with appropriate references indicated throughout this manual and in appendix A.

1-3. Changes or Comments

Users of this manual are encouraged to submit recommended changes or comments to improve the manual. Comments should be keyed to the specific page, paragraph, and line of the text in which the change is recommended. Reasons should be provided for each comment to insure understanding and complete evaluation. Comments should be prepared using DA Form 2028 (Recommended Changes to Publications and Blank Forms) and forwarded direct to Commandant, US Army Field Artillery School, ATTN: ATSF-CTD-TOL, Fort Sill, Oklahoma 73503.

1-4. References

Publications dealing with communications are listed in appendix A.

1-5. Symbols

Symbols used in this manual are described in appendix B.

CHAPTER 2

GENERAL COMMUNICATION REQUIREMENTS

Section I. GENERAL

2-1. Introduction

The ability of field artillery to provide effective fire support depends on good communication. The field artillery commander must rely on his communication system in controlling elements of his command, in gathering information and distributing intelligence, and in coordinating the fires of his units. Responsibility for communication rests with the commander at each echelon. The commander exercises this responsibility through his staff communications-electronic officer, who prepares communication plans and orders, directs and supervises the installation, operation, and maintenance of the communication system. The training of organic personnel in the use of the various communication means is also the responsibility of the communications-electronics officer. In addition, he supervises communication security within the unit, and supervises the electronic counter-countermeasures activities of the unit.

2-2. Area Communication Systems

The command and area communication systems, installed by the Signal Corps, are used by field artillery units to augment field artillery communication systems and to provide an alternate means of communication. The area system offers a means to quickly set up a wire network between field artillery elements when the length of lines required is too long for the unit to put in and maintain. When the area system is used, the artillery unit must lay a trunk line to the nearest area signal center where it will be connected to the signal center switchboard, thus, gaining access to division or corps communication systems. If the field artillery desires to use the area communications system to pass fire control traffic, sole user circuits must be requested from the division or corps signal officer (as appropriate). The communication-electronics officer must be provided with early information of future displacements so he can inform the agency responsible for providing common user telephone service in the new area. For detailed information on the operation of communications systems, see appropriate field manuals in the 11 and 24 series.

2-3. Priority of Installation

When a field artillery communication system is set up, elements of the system concerned with fire support and fire direction are set up first. During movements and in the initial phase of occupation of position, reliance is placed on radio, but wire circuits are installed to parallel radio nets as soon as the situation permits. Once the wire system is installed it must be used as the primary electrical communication means in order to minimize the effects of enemy electronic warfare activities.

2-4. Communication Planning

Communication planning is a continuous operation which begins with the commander's estimate of the situation. Communication planning is done at the same time as operational planning and is coordinated with the planning of the other staff officers. Communication planning follows the normal phases of staff planning described in FM 101-5. Communication plans include all details necessary to make clear and coordinate the communications/electronics activities of the units, such as wire recovery, radio retransmission, and sole-user circuits.

Section II. COMMUNICATION IN ASSEMBLY AREAS

2-5. General

In assembly areas, all echelons receive information concerning future operations and make their plans. Staff conferences are held for coordination of effort. Command posts are so organized that communication and personnel requirements may be held to a minimum.

2-6. Communication Activities in Assembly Areas

During the occupation of the assembly area, communication activities include the following:

a. Establishment and operation of message centers by each headquarters. Messengers are stationed at battalion and higher headquarters

message center. Scheduled or on call messenger service may be provided if the volume of traffic warrants.

b. Wire installations are held to a minimum within the assembly area radio stations generally are silenced or restricted in their operation. All radio sets are serviced and tested on frequencies prescribed in the CEOI (Communications-Electronics Operating Instructions) and CESI (Communications Electronics Standing Instructions) prior to arrival in the assembly area.

c. Inspection of all communications equipment for operating condition and adequacy and equipment shortages are replaced.

d. Training is continued and intensified. Emphasis is placed on requirements for the particular operation being planned.

e. Appropriate CEOI items to include NSA (National Security Agency) approved codes and authentication tables are passed out.

Section III. COMMUNICATION DURING MARCHES AND HALTS

2-7. Communication During Marches

a. During marches, communication facilities are used for column control and for contact with reconnaissance and security parties and with supported and higher units.

b. A march message center is established by each headquarters in one of the leading vehicles of the column. Normally, messengers are used between march units and within groups and serials of individual march units.

c. Wire communication is impractical; however, wire teams may precede the column to the new area to install wire communications or stay behind to pick up wire from the old area, or both.

d. If radio communication is not prohibited for security reasons, each field artillery unit operates on its command/fire direction net. Battalion commanders and separate battery commanders operate also in the next higher headquarters command/fire direction net, FM. Divisional light aircraft and field artillery reconnaissance and security parties keep radio communication with the marching columns.

2-8. Communication During Halts

During temporary halts, communication is kept as during the march. The use of messengers and radio (if not restricted) is continued.

Section IV. COMMUNICATION DURING THE ATTACK, REORGANIZATION, PURSUIT, AND RETROGRADE

2-9. General

a. When the supported force is committed, the field artillery must be ready to provide continuous fire support. Meterological messages, warning orders, and other infomation are disseminated to the field artillery units as rapidly as possible. The communication system must be set up rapidly in order for the field artillery to accomplish its mission.

b. At times in an engagement, control of the field artillery may be decentralized. However, centralized control is resumed as soon as the situation permits to give the force commander a mass of firepower with which to influence the action.

2-10. Command Posts

In order to effect the necessary centralization of command, field artillery units establish command posts to coordinate all the field artillery fires of the force. Continuous communication is maintained between the command posts of the field artillery and those of the supported units. Initial communications may be expanded into more complete systems. For example, during the preparation for the attack of an organized position, enough time usually is available to permit the installation of wire systems to parallel radio nets.

2-11. Displacement of Command Posts

a. Displacement of command posts follows the general plan indicated in FM 6-20. Regardless of whether or not a move is made by echelon, communications must be maintained with the command post of the supported unit.

b. Since movement by echelon presents many problems, communication plans made before a move include the possiblity that all means of communication except radio may become temporarily impractical. The first consideration in a movement by echelon is that communication must be maintained between the forward and rear echelons of the command post, as well as between

the command post and the supported unit, with the forward observers, and with the fire support officers. Usually, the moving echelons of a field artillery battalion use the battalion command/fire direction net for internal communications.

2-12. Communication During the Attack

The field artillery commander determines how the wire and radio systems of the units are to be set up in any tactical situation. At first communication is by radio and messenger, but wire communication is set up as rapidly as possible. Although speed is important during the attack, communication security is vital. Since radio traffic is a source of information to the enemy, it is held to a minimum. Messages sent by radio must be brief, and the rules of communication security must be followed (communications security is discussed in chapter 5 and in ACP 122, FM 32-5 and FM 32-6.) Maximum use is made of authorized codes.

2-13. Communication During Reorganization

a. After an attack has reached the objectives or has been stopped short of the objective, the force commander may decide to continue the attack, to withdraw, or to defend. In any event, forces are regrouped and communication systems are changed to fit the new plan of action.

b. The reorganization phase is critical for field artillery communication. Field artillery support must be continuous to protect the supported units and to assist in stopping counter-attacks. Communication-electronics officers maintain existing communication systems and prepare to extend or modify them as soon as a new decision is made. Radio nets continue in operation.

c. In preparation for a displacement, the communications/electronics officer insures that communications/electronics equipment is salvaged, serviced, and repaired. He may recommend the redistribution of equipment within the units if required.

2-14. Communication During Pursuit

a. The field artillery usually is attached to the unit making the pursuit. Maintaining communication is more difficult during a pursuit because of the speed of the operation and the increased distances between units. Therefore reliance must be placed on radio communication.

b. Rapid movement requires rapid and frequent displacement. Keeping contact between units and between a unit's advance and rear command posts requires message center personnel, messengers, other communication personnel, and appropriate communications/electronics equipment at each installation.

c. When a field artillery unit displaces by echelon, the first echelon includes radio sets for communication in command and fire direction radio nets. Messengers are kept as needed at message centers. Aircraft may be used for drop and pickup service.

Section V. COMMUNICATION DURING DEFENSE

2-15. General

a. In a prepared defense, enough time is available for the planning and installing a complete wire system. Radio may not be used at first, but all nets are established and operators maintain listening silence. Wire communication is provided for fire support officers and forward observers. Duplicate circuits should be established, using different wire routes. Wire is installed to alternate positions to facilitate early communication if these positions are occupied.

b. Particular attention is given to the maintenance and improvement of wire circuits. Wire routes that afford maximum natural cover and concealment are selected, regardless of distance. Wire is installed with great care, and improvement of the wire system is continuous.

2-16. Lateral Communication

Lateral circuits should be established between units to provide coordination and alternate circuits for emergencies. Use of commercial circuits or other circuits already in existence is prohibited except as expressly approved by the division or corps signal officer on a case-by-case basis.

2-17. Communication During Retrograde Movements

The communication-electronics officer must be prepared to submit a plan for using existing communication facilities to the best advantage during the withdrawal. On receipt of the necessary information for the plan of withdrawal, he plans the communication system to be used by subordinate units. The plan includes—

a. Provisions for strict regulation of radio operation, which may include silencing certain stations or establishing dummy stations, as needed, for deception.

b. A plan for the most effective use of existing wire circuits.

2-18. Communication During Displacements

a. Communication personnel continue the operation of existing systems while preparing for displacement.

b. If the situation permits, wire not in use by units is picked up. When time does not permit complete recovery, the abandoned wire lines should be cut in several places.

c. Radio listening silence normally is maintained during retrograde movements. For the purposes of deception, with approval of higher headquarters, the normal level of radio traffic may be maintained at the old position.

d. All practical means of communication are used, including existing wire circuits between the old and new positions. Messenger service is available at all times.

CHAPTER 3

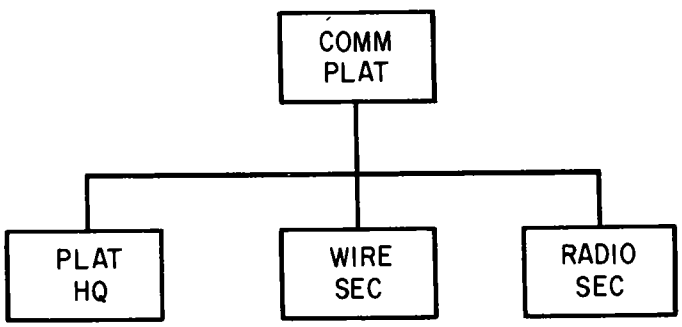
DUTIES OF COMMUNICATION PERSONNEL

3-1. General

The tables of organization and equipment (TOE), from the highest to the lowest echelon of field artillery authorize communication personnel whose main duties are to install, operate, and maintain communication systems. Field artillery units of battalion size and larger are authorized a communications-electronics officer (a signal corps officer) who is a member of the commander's special staff. Some units are authorized an assistant communications-electronics officer (also a signal corps officer), who serves as executive officer of the headquarters battery and commands the communications platoon.

3-2. Communication Platoons

Each field artillery battalion headquarters is authorized a communication platoon which normally is organized as shown in figure 3-1.



3-1. Organization of Communication Platoon

(Text key: para 3-2)

Figure 3-1. Organization of communication platoon.

a. Platoon Headquarters. The platoon headquarters consists of the assistant communications-electronics officer, the communication chief, radio mechanics, and the message center personnel. In units that are not authorized an assistant communications-electronics officer, the communication chief is in charge of the platoon.

b. Wire Section. The wire section includes a section chief, wire teams, and switchboard operators (the number depends on the type of unit).

c. Radio Section. The radio section includes a section chief and sufficient radio operators and radio teletypewriter operators to operate the equipment in the section.

3-3. Communication Personnel in Other Sections

In some units, radio and radio teletypewriter operators are assigned to sections other than the communication platoon. Although each operator works in the section to which he is assigned, the radio section chief should oversee their training and performance.

3-4. Battery Communication Section

The battery communication section generally consists of a communication chief, wire teams, and switchboard operators, the number depending on the type of unit.

3-5. Duties of Communication-Electronics Officer

a. The communication-electronics officer is a signal corps officer. He is a member of the commander's special staff. Although staff officers may prepare and transmit orders to subordinate units, they do so only as representatives of, and in the name of, the commander. The scope of this authority is determined by the commander's policy.

b. As a representative of the commander, the communication-electronics officer has the following responsibilities.

(1) *Reconnaissance.* Recommends the general location of the command post, as viewed from the communications standpoint in coordination with the S3 and headquarters battery commander.

(2) *Plans.* Plans the communication system of the unit with attached, reinforced, and supported units; coordinates displacement communications plans.

(3) *Direction and supervision.* Directs and supervises the installation, operation, and maintenance of the communication system of the unit.

(4) *Adviser to commander and staff.* Advises the commander and staff of pertinent electronic counter-countermeasures and security of all electromagnetic emitters.

(5) *Administration.*

(a) Prepares the communication SOP and communication portions of orders.

(b) Submits reports, line route maps, and other items to higher headquarters.

(c) Advises the S4 on supply matters pertaining to communications-electronics equipment.

(6) *Liaison.* Contacts communications-

electronics officers of senior, subordinate, reinforcing, reinforced, and adjacent units to coordinate and to improve communications.

(7) *Training.* Plans and supervises all communication training in the unit.

(8) *Inspections.* Conducts technical inspections of communications/electronics equipment.

(9) *Maintenance.* Has overall maintenance responsibility for COMEL equipment.

3-6. Duties of Assistant Communication-Electronics Officer (Communication Platoon Leader)

The assistant communication-electronics officer assists the communication-electronics officer in all his duties and has the following additional duties.

a. Direction and Supervision. Exercises direct supervision over the installation, operation, and maintenance of all communication equipment installed by headquarters battery. Commands the communication platoon and advises on electronic warfare matters in the absence of an electronic warfare cryptological officer (EWCO).

b. Administration. As executive officer of headquarters battery, assists the headquarters battery commander in battery administration.

c. Training. Conducts the training of the communication platoon.

3-7. Duties of Communication Chief

The communication chief—

a. Takes personal charge of the installation of all communication means set up by his platoon and supervises their operation and maintenance.

b. Assists in the teaching and in the training of the communication platoon or section.

c. Keeps himself informed of all communication aspects of artillery operations.

d. When appropriate, performs the duties of the assistant communication officer.

e. Coordinates all communication within the command post.

f. Supervises message center operations.

g. Supervises and coordinates, under the direction of the communication-electronics officer, organizational maintenance of communications/electronics equipment within the battalion.

3-8. Duties of Chief Message Clerk, Senior Message Clerk (Battalion and Higher Headquarters), and Message Clerk (Code Clerk)

The chief message clerk, senior message clerk, and message clerk—

a. Install and operate the message center.

b. Keep message center records.

c. Train and supervise message clerks and messengers.

d. Process messages delivered to the message center.

e. Encode and decode messages.

3-9. Duties of Radio Mechanics

Any field radio mechanic 31B20 who receives an additional 2 weeks' training on FADAC maintenance and 2 days' training on the M36 chronongraph qualifies for MOS 31B30 (AR 611-201). In cannon battalions and Honest John battalions equipped with FADAC (M18 gun direction computer), an MOS 31B30 is required. In all other missile battalions and field artillery units not authorized FADAC or the M36 chronograph, an MOS 31B20 is required.

a. The field radio mechanic 31B20—

(1) Performs organizational maintenance on tactical communication, COMSEC, and RADIAC (radiation detection, indication, and computation) equipment.

(2) Schedules and performs preventive maintenance.

(3) Prepares and maintains equipment records.

b. The FADAC/field radio mechanic 31B30 performs the duties outlined in *a* above and; in addition, performs organizational maintenance on the M18 gun direction computer and all associated test equipment, and the M36 chronograph.

3-10. Duties of Wire Section Chief

The wire section chief—

a. Reconnoiters (makes reconnaissance) of wire routes.

b. Plans wire systems.

c. Takes personal charge of the installation, operation, and maintenance of all wire installed by headquarters battery.

d. Trains wire section personnel.

e. Serves as communication chief during the latter's absence.

3-11. Duties of Wire Team Chief

The wire team chief—

a. Selects wire routes.

b. Assists in the preparation of line route maps.

c. Supervises the laying maintaining of and wire lines.

d. Trains wiremen and telephone switchboard operators.

e. Serves as wire section chief during the latter's absence.

3-12. Duties of Radio Section Chief

The radio section chief—

a. Suggests locations for the elements of the radio stations.

b. Trains members of the radio section.

c. Reports any changes in radio communications status to the message center.

d. Assists the communciation chief in supervising organizational maintenance of radio equipment within the unit.

3-13. Communication Teams

All communication personnel must be able to perform the duties of other members of the section, i.e., operate switchboard and radiotelephone equipment, use the CEOI and CESI, operate motor vehicles, and act as messengers. The communication teams and their general capabilities are listed below.

a. Message Center Team.

(1) Clears messages through the message center without delay.

(2) Plans and executes synchronization of time.

(3) Keeps a record of communications-electronics operation instruction and changes, and sends the changes promptly to the interested agencies.

(4) Knows the status of communication at all times in order to utilize available means most efficiently, and securely.

(5) Encodes and decodes messages.

(6) Safeguards cryptographic systems and equipment.

b. Wire Section Team.

(1) Prepares the unit wire SOP along with the assistant communication-electronics officer.

(2) Establishes wire communication with minimum delay, using proper procedures, and coordinates the activities of wire personnel of subordinate units.

(3) Cooperates with wire personnel of senior, subordinate, adjacent, reinforced, and supported units to maintain communication.

(4) Maintains unbroken wire communication during movement when possible.

(5) Works closely with the unit message center.

(6) Observes rules of transmission security.

(7) Moves through difficult terrain, using simple pioneer methods.

(8) Notifies the message center of any change in status of wire communication.

c. Radio Section Team.

(1) Prepares the unit radio SOP along with the assistant communication-electronics officer.

(2) Establishes radio stations promptly when the time and place for opening nets are indicated.

(3) Coordinates the activities of radio personnel of subordinate units.

(4) Enforces net discipline and tramsmission security.

(5) Assumes the entire traffic load of the unit at any time.

(6) Functions as a panel team.

(7) Works closely with the unit message center.

(8) Notifies the message center of any changes in status of radio communication.

CHAPTER 4

MEANS AND PRINCIPLES OF COMMUNICATION

Section I. MEANS OF COMMUNICATION

4-1. General

Within field artillery units, the means of communication available are radio, wire, visual signals, sound signals and messengers. The makeup of the means in each unit depends on the personnel, equipment, and transporation provided by the table of organization and equipment and by the unit or higher commander. The many means of communication have different capabilities and limitations; thus, they are so employed that they complement each other and that total dependence is not placed upon any one means. The reliability of communication systems is greatly increased by the use of all the means that can be had. However, the failure of one or all available electronic means does not relieve a commander of his communication responsibility. In brief, the means employed in a given situation generally are those that provide the maximum reliability, flexibility, security, and speed.

4-2. Wire Communication

a. General.

Wire is one of the means of communication used by the field artillery. Wire equipment includes field telephone wire, cable assemblies, wire laying and recovery equipment, battery-operated and sound-powered telephones, switchboards, teletypewriters, and associated equipment. Wire affords person-to-person conversation with break-in operation (capability of interrupting the conversation). Wire communications are less open to attack by hostile electronic warefare actions than radio communications, but the security of classified information is never assured when the information is transmitted in the clear. The decision to establish wire communication depends on the need for it, the time available to install and use it, and the capability to install and maintain it. The supply of wire on hand, the expected resupply, and future needs are also considered. Wire communication can be used over most terrain and in most situations. Tables of organization and equipment provide units with equipment to install and maintain their wire communication systems. For the employment of wire communication in various units, see chapter 16.

b. Range. The range of wire communication varies, depending principally on the weather and the condition of the wire. Wet weather, poor splices, and damaged insulation reduce the range appreciably. For ranges of wire communication equipment, see paragraph (16-15 through 16-18).

c. Time Required for Installation. More time is required to set up wire communication than to set up any other means. The time required depends mainly on the length of the lines and the method of laying (vehicle, aircraft, or manpack). Other factors to be considered in estimating the installation time are the personnel available and their training, the terrain, routes, weather, and visibility.

d. Installation.

(1) Wire lines usually are laid by wire teams. One man on foot can lay a short wire line by using a wire dispenser or light reeling equipment. Across bodies of water or unusually difficult terrain, wire may be laid from dispensers attached to light aircraft or attached to a rocket and fired over an obstacle. For details on laying wire from a dispenser, see TM 11-2240.

(2) A wire line generally is laid on the ground parallel to a road with approximately 20-percent of the total length of the line distributed as slack. Lines may be strung overhead in areas such as command posts, where it is impracticable to bury the lines or leave them lying on the ground. When wire lines must cross roads, the wire is buried, strung overhead, or placed under bridges and through culverts. Areas in which wire is likely to be damaged by traffic or enemy fire are avoided. Part of a wire team lays the wire, and the remainder of the team polices it (throws it off the road, makes road crossings, etc.). The laying of a line is not delayed for policing however, except in areas of heavy use.

e. Switchboards. Switchboards are used to increase the flexibility of the wire systems and to recuce the number of wire lines needed. The line capacities of switchboards vary.

f. Use of Telephones. Telephones are reserved for occasions when there is a need for discussion and speed. To insure that calls are brief and to facilitate the entry of messages in the unit or staff

journal, telephone users should put the main parts of messages in writing before conversations begin. During critical periods the use of telephones may be restricted to designated personnel, except for emergency calls.

g. Use of Teletypewriters. In some artillery units teletypewriters are used in wire or radio circuits to transmit messages. This equipment furnishes both parties a written record of the messages exchanged in the form of a printed page or perforated tape or both.

4-3. Radio Communication

a. General. Since radio is a principal means of communication, a sufficient number of radios are provided to make radio communication available to all commanders and key staff officers. Additional radios are provided for command posts, for fire control, and for other uses. All radio sets issued within the field artillery are capable of voice operation. Radios are also provided for communication between aircraft and from air to ground. The types of radio equipment organic to artillery units are discussed in chapter 15. For the employment of radio communication in various units, see chapter 16.

b. Capabilities and Limitations. Radio communication is subject to natural interference (static) and interference from other friendly radio stations and deliberate interference (electronic countermeasures to include jamming and deception) by unfriendly forces. Additionally, radio communication is highly vulnerable to hostile communications intelligence (COMINT) activities to include direction finding. The tactical situation and the characteristics of the radio sets dictate their employment. The most important characteristics of the radio sets used in field artillery units are shown in chapter 15. To be capable of operating together, radio sets must have a common or overlapping frequency range, must be of the same type of modulation, and must transmit and receive the same type of signal. In addition, the stronger set must be kept within the transmitting range of the weaker set. The operating ranges shown in chapter 15 are for average conditions; the ranges obtained may be more or less, depending on the skills of the operators, the weather, the terrain, the time of day, the interference, and the locations from which the sets are operated. Powerlines and steel structures close to operating sites reduce operating ranges.

4-4. Messenger Communication

a. General.

(1) Messenger communication is one more means available to all units. The efficiency of messenger service depends on the selection and training of the individuals who serve in this capability.

(2) Messenger communication is the most secure of all the means of transmission and it is flexible and reliable. Its speed depends on the mode of travel, which may be by foot, vehicle, or aircraft. It is the only means available for transmitting large size maps and documents. Messenger service has some limitations, however. It is vulnerable to enemy action in forward areas, does not afford person-to-person conversation, and usually is slower than other means.

(3) Messengers are used when security dictates or when messenger service is faster than other means. Messenger service is an effective means for delivering long messages over short distances.

b. Types of Messenger Communications. Scheduled messengers (air, motor, or foot) are used when unit locations change infrequently and the quantity of traffic warrants a routing schedule. Special messengers are used whenever more rapid service or special handling is required.

c. Messenger Employment. Messengers are briefed on the route, rate of travel, and location of delivery points and on whether an answer is expected. Very important messages may be sent over more than one route and/or by two messengers. Two messengers normally are used when extremely hazardous combat conditions make single-messenger delivery questionable. They should keep in sight of each other, but far enough apart to prevent being injured, killed, or captured by the enemy. Advance reconnaissance of messenger routes should be made to determine if they can be used during both day and night. Messenger relay posts may be set up when there is frequent message service between the same points or units. Other factors to be considered in setting up messenger relay posts are distance, type of the terrain, and hostile activity.

4-5. Visual Communication

a. General. Visual communication is one more means of communication that is available to all units. Visual signals in field artillery units are generally limited to panels, arm-and-hand signals, and other prearranged visual signals, such as pyrotechnics and the maneuver of aircraft. These visual means are used to send prearranged messages rapidly over short distances. However, these visual signals are easily misunderstood. They are vulnerable to interception and the enemy may use like signals to deceive or to create confusion. Their use is restricted during periods of poor visibility or when there are no line-of-sight locations and they may be prohibited for security reasons.

b. Panels. Two general types of panels are issued for communication with aircraft—marking and identifying panels, and panels for transmitting messages. Marking and identifying panels are made in bright fluorescent colors. They may be used to mark positions and identify units as friendly. Black and white sets of panels for transmitting messages are issued for use on light and dark backgrounds, respectively. They are used to transmit brief messages or to identify a particular unit. The combined panel system and panel recognition code, which is included in the unit CEOI an FM 21-60, is used for this type of visual communication.

4-6. Sound Communication

Sound communication is another means of communication that is available to all units. Sound signals are transmitted by whistles, bugles, horns, gongs, klaxons, weapons, and other noisemaking devices. Their main use is to attract attention, transmit prearranged messages, and spread alarms; they are kept simple to prevent misunderstanding. They serve as a rapid means of communication over short distances, but sound signals are very vulnerable to interception, and their use may be prohibited for security reasons. Their range and reliability are greatly reduced by battle noise.

4-7. Integration of Radio and Wire Communication Systems

Wire and radio are separate and distinct means of communication. They may be interconnected by using radio/wire integration equipment and radio relay equipment. For details pertaining to remote control equipment and the interconnection of radio and wire systems, see the 11-486 series of technical manuals.

Section II. PRINCIPLES OF COMMUNICATION, ESTABLISHMENT AND RESPONSIBILITY

4-8. General

Responsibility for the establishment of communication at various echelons of command is specified in paragraphs 4-9 through 4-16. Variations may occur, depending on the tactical mission of the unit. Although one unit may be charged with setting up and maintaining communication with another, both units coordinate the initial establishment of communication and the commanders of both units are equally responsible for taking immediate and aggressive action to restore disrupted communication. A commander is personally responsible for the need and proper use of the communication system within his command and for its operation in the system of the next higher headquarters. The authority to set up, maintain, control, and coordinate the employment of the various communication means within a command may be exercised by a subordinate in the name of the commander. However, the command responsibility for these means cannot be delegated. The basic principles of command responsibility are discussed in detail in FM 22-100.

4-9. Senior to Subordinate

The commander of a higher echelon or senior unit is responsible for the establishment and maintenance of communications with a unit of a lower echelon or with a subordinate unit. Attached units are subordinate to the command to which attached.

4-10. Supporting to Supported

The commander of a supporting unit is responsible for the establishment and maintenance of communication with the supported unit.

4-11. Reinforcing to Reinforced

The commander of a unit reinforcing the fires of another artillery unit is responsible for the establishment and maintenance of communications with the reinforced unit.

4-12. Lateral Communication

Responsibility for the establishment of lateral communication between units may be fixed by the next higher commander or may be established in the standing operating procedure (SOP). In the absence of orders fixing the responsibility, the commander of the unit on the left is responsible for establishing communication with the unit on the right, (facing the FEBA).

4-13. Internal Communications

The commanding officer of each unit is responsible for the installation, maintenance, and operation of the internal communications of his command.

4-14. Levels to Which Tactical Communications Are Provided to the Command

Communications within a combined force (a force which includes allied troops) are essential down to battalion or equivalent level.

Note. Within the US Army, this is construed to include internal battalion communications; that is, battalion headquarters to company headquarters, company headquarters to platoon, etc.

4-15. Standardization

It is the responsibility of commanders to insure that combined forces under their control are able to provide at least the minimum basic communication (para 4-15) without having to make special arrangements. To achieve this degree of integration and standardization, the commanders must insure that—

a. Voice radio sets and the associated security equipment, are capable of operating in the same net.

b. Mutually agreed upon call signs, call words, prosigns, and codes are used.

c. Telephones and switchboards are interoperable, and the need for other equipment is kept to a minimum.

d. Multichannel radio and carrier systems are capable of interface (interconnection) at audiofrequencies.

e. Telegraph and associated security equipment are interoperable and tape relay networks are capable of interconnection.

4-16. Maintenance

Effective maintenance requires the close coordination and joint participation of all units concerned. If communication is stopped it is the duty of all affected units to reestablish communication. The responsibility however, remains with the unit that is responsible for installing the line.

4-17. Practical Application of Principles of Communication

a. The principles stated paragraphs 4-9 through this paragraph define the responsibility to establish and maintain communications. Responsibility cannot be delegated but can be transferred from one commander to another when ordered by a higher commander.

b. The installation of communications is not necessarily done by the responsible commander. Often it becomes necessary for the responsible commander to delegate the actual installation of communications to a subordinate unit. Such practice is not a change from set principles, since only the physical installation is delegated, not the command responsibility.

CHAPTER 5

COMMUNICATIONS SECURITY

Section I. GENERAL

5-1. Definition

Communications security is the protection resulting from all measures designed to deny unauthorized persons information of value that might be gotten from use and study of our telecommunications. Communication security includes cryptosecurity, physical security, transmission security, and emission security. Emmission security, which is discussed in AR 530-4, is designed to protect noncommunications transmitters from enemy use. Examples of noncommunications devices that transmit signals are radars, radio beacons, unattended ground sensors, and variable time (VT) fuzes. Cryptosecurity, physical security, and transmission security are discussed in paragraphs 5-5 through 5-17.

5-2. Responsibility

a. Communications security is a command responsibility. However, every individual preparing a message for transmission or in the actual transmission of a message is responsible for compliance with procedures governing preparation, transmission, and safeguarding of communications.

b. In carrying out his communications security responsibilities, the commander is assisted by the intelligence officer, who plans, coordinates, and exercises staff supervision over security matters within the command. The commander is also assisted by the communications-electronics officer and the electronic warfare cryptological officer (EWCO) if one is assigned to fulfill his responsibility for communications security, the commander must—

(1) Maintain a continuous control system to account for classified information, equipment, and material.

(2) Conduct periodic and thorough inspections to determine the adequacy of physical security measures for the protection of classified information and cyptographic equipment. He must also insure that cryptosystems are properly used.

(3) Develop adequate emergency plans, including emergency destruction plans (AR 380-5 and AR 380-40).

(4) Consider communications security requirements in all operation planning.

(5) Take action to eliminate causes of communication security violations.

c. Responsibility rests with each person of the command to assist the commander in fulfilling his task. The security consciousness of every individual is of primary importance. The finest communication system cannot overcome the effect of a careless user. The discussion of classified information with unauthorized personnel or in unsuitable places causes a great hazard to security. Therefore, it is the responsibility of all individuals to report to his superiors any apparent violation of, or weakness in, communications security.

5-3. Security Classification

Security classification is based on the degree of danger to national security that would result from unauthorized disclosure of military or official information. The classification system which is discussed in detail in AR 380-5, establishes a standard of care for handling, storage, and spreading of information in each classification.

5-4. Security Measures

Security measures for the protection of military information, equipment, and material include defense against capture, salvage, theft, espionage, observation, photography, interception, direction finding, traffic analysis, cryptoanalysis, and imitative deception. High standards of training will reduce carelessness of personnel. It is of greatest importance that all personnel remain alert at all times to provide maximum protection of defense information, equipment, and material.

a. Authentication is a communications security measure that protects against imitative communication deception. The authentication system used with a command will be specified and procured by the commander concerned. Commanders at all levels are responsible for expressing their needs for the authentication system necessary for maintaining communication security within their command. Requests for authentication systems should be submitted

through command channels to the Commander, US Army Security Agency (CDRUSASA) in accordance with instructions contained in AR 380-52.

b. Procedures for use of each authentication system will be provided with the system when issued.

c. By using transmission authentication, a calling station can establish its validity without requiring any transmission from the called station. The transmission authentication used by the calling station is in accordance to the specific authentication system in effect (AR 380-52).

Section II. CRYPTOSECURITY

5-5. Definition

Cryptosecurity is that part of communications security dealing with the proper use of authorized codes, cipher devices, and machines for encrypting and decrypting messages. For detailed information on the handling of cryptomaterial, see AR 380-40 and AR 380-41. The following cryptosystems are available to most field artillery units:

a. Operating Codes. Operations codes may be sued for general or limited purpose communications but may not be used when a more secure system is available. Operations codes may not be used in conjunction with any other security code. For further details, see AR 380-52.

b. Numeral Codes. Numeral codes are used to encrypt map references, and other numeric information that must be encrypted when, for operational necessity, the remainder of the message is transmitted in plain language. For further details, see AR 380-52.

c. Cipher Machines and Devices. On-line cipher equipment is available to most units requiring such equipment. In addition speech security equipment is available in certain artillery units.

5-6. Sending Messages in Clear Test

a. Army regulations require that all classified messages be transmitted in encrypted form unless, during actual hostilities, the urgency of a message does not permit encrypting and the enemy will not have enough time to act upon the information contained in the message. The exception to this rule concerns messages classified TOP SECRET; they are NEVER transmitted in the clear over electrical means. The transmission of a classified message in the clear MUST be authorized by the commander of the headquarters transmitting the message or his specifically designated representative. For further details, see AR 380-51.

b. IN order to conceal the contents of unclassified messages transmitted by electrical means, message center personnel should encrypt the messages for transmission. When this technique is used, the abbreviation "EFTO" (encrypted for transmission only) will be used in place of the security classification in the message format. See AR 380-26 for information on proper use of this technique.

5-7. Compromise, Loss, or possible Compromise

a. An essential part of cryptosecurity is the prompt reporting of possible or actual compromise of cryptographic material. Prompt action is necessary so that communications security material determined to have been compromised may be withdrawn from further use and information encrypted with the compromised systems may be reviewed and necessary action taken. The report should contain as much of the following information that can be applied:

(1) Nature of violation.

(2) Identity (publication, system, or equipment).

(3) Length of message(s).

(4) Date-time group.

(5) Means of transmission.

(6) Originator and all addressees.

b. In the event of loss or physical compromise subsequent to the initial report, a thorough investigation will be made and a complete report will be sent through correct channels to the Army Security Agency. For further details see AR 380-40.

5-8. Clearance of Personnel

No person is entitled to knowledge or possession of classified material solely by his grade. Such material will be entrusted only to those individuals whose official, or Government, duties require such knowledge. All persons whose duties require access to classified material must be cleared to receive classified information.

Section III. PHYSICAL SECURITY

5-9. Definition

Physical security is that portion of communication security having to do with the physical measures necessary to safeguard classified communication equipment and material from use by unauthorized persons. For details on safeguarding, distributing, and accounting for cyrptocommunication security material see AR 380-40 and AR 380-41.

5-10. Need for Physical Security

Unsuspected physical compromise is far more serious than known loss. If an undisclosed compromise occurs and the cryptosystem continues to use, an enemy may be able to decrypt all messages sent in that system.

5-11. Procedures for Physical Security

Effective physical security insure the maximum protection of classified material from the time it is produced until it is destroyed. Protection against physical compromise of classified communication equipment and material can be accomplished if the following precautions are observed:

a. Proper handling by all personnel concerned.
b. Adequate storage when not being used.
c. Complete destruction when required.

5-12. Destruction of Classified Material

Certain nonregistered classified material is destroyed when its destruction is directed by competent authority. All such material will be destroyed by burning, if possible. As far as humanly possible, classified material will be protected from falling into enemy hands. Destruction should be carried out as described in AR 380-5 and AR 380-40.

Section IV. TRANSMISSION SECURITY

5-13. Definition

Transmission security is that part of communications security resulting from all measures designed to protect transmissions from unauthorized interception, traffic analysis and imitative deception.

5-14. Means of Transmission

Users of communication systems should select the method of transmission most appropriate to the delivery of messages in accordance with delivery time and security requirements. Means and types of transmission available are—

a. Messenger.
b. Mail.
c. Wire circuits.
d. Prearranged visual signals.
e. Prearranged audio signals.
f. Radio.

Note. For more information concerning the means of transmission listed in *a* through *f* above, see FM 32-5 and ACP-122( ).

5-15. Message Preparation

a. Transmission security within a command is increased when personnel directly concerned with message preparation are familiar with the fundamentals of tramission security. Such personnel include the—

(1) *Originator.* The commander by whose authority messages are sent. The commander is responsible for all messages released by his command.

(2) *Drafter.* The person who prepares a message.

(3) *Releaser.* The person who approves the message for transmission. The releaser's signature on the message indicates that he has reviewed the content of the message and that the priority, security classification, and text of the message are correct and proper.

b. Although all messages are sent in the name of the commander, few are likely to be written by him personally. It is, therefore, of utmost importance that the commander insure that the message writers within his command know the principles of communication security. For details pertaining to message preparation, see chapter 8. In fulfilling his responsibilities, the drafter must consider the following:

(1) *Classification.* Each message must be assigned the proper security classification.

(2) *Text.* The text of a message must be clear, accurate, and as brief as possible.

(3) *Precedence.* Each message must be assigned the proper precedence, depending on the importance of the message and the requirements for rapid delivery. Improper precedence can cause overloaded communication facilities. For further details, see AR 105-31 and FM 24-17.

5-16. Communications Intelligence.

Communications intelligence (COMINT) is technical and intelligence information derived from communications by other than the in-

tended recipient. Strict radio discipline and a sound communications security program are the primary defenses against hostile communications intellignence activities. Operators can decrease the vulnerability of friendly communications to hostile communications intelligence by—

a. Avoiding unauthorized transmission and unnecessary equipment testing, thus decreasing the opportunities for direction finding.

b. Using the broadcast method of transmitting traffic whenever possible in preference to the receipt method.

c. In the absence of a prearranged plan, concealing the instructions to shift frequency by encryption.

d. Adjusting the transmitter accurately, use of the authorized frequency, and maintaining strict circuit discipline.

e. Using communications security equipment.

5-17. Operator Training

Operating and maintenance personnel must be trained to recognize and avoid the following practices which endanger communication security:

a. Violation of radio silence.

b. Unofficial conversation between operators.

c. Transmitting in a directed net without permission.

d. Excessive repetitions of prosigns or operating signals.

e. Use of plain language in place of proper prosigns or operating signals.

f. Use of unauthorized prosigns.

g. Incorrect and unauthorized procedure.

h. Identification of unit locations.

i. Identification of individuals belonging to an organization.

j. Transmitting at speeds beyond the capabilities of receiving operators.

k. Use of excessive transmitting power.

l. Consuming excessive time in tuning, testing, changing frequency, or adjusting equipment.

m. Improper use of call signs.

n. The use of unauthorized codes or those codes not authorized by the National Security Agency (NSA) or US Army Security Agency (USASA).

CHAPTER 6

ELECTRONIC COUNTERMEASURES (ECM)

6-1. Definitions

a. Electronic Countermeasures (ECM). Actions taken to prevent or reduce the enemy's effective use of the electromagnetic spectrum. Electronic countermeasures include electronic jamming and electronic deception.

b. Electronic Jamming. The deliberate introduction of electronic energy onto a frequency used by an enemy. Electronic jamming operations may be conducted against both communication (radio) and noncommunication (radar) receivers. The objective of jamming is to prevent or impair the enemy's use of his electronic systems or to confuse his operators or both.

c. Electronic Deception. The deliberate radiation, re-radiation, alteration, absorption, or reflection of electromagnetic energy in a manner intended to mislead an enemy in the interpretation or use of information received by his electronic systems. Electronic deception can be categorized as manipulative and imitative deception.

d. Operating Procedure. Formulation of policies, procedures, and plans specifically incorporating procedures designed to minimize success of enemy ECM efforts.

e. Electronic Warfare Doctrine. The principles and doctrine of Electronic Warfare are found in FM 32-20.

6-2. Radio Jamming

a. All radio receivers are open to attack by jamming. It must be assumed that the enemy will employ jamming signals whenever jamming is advantageous to him. Jamming should be expected, and antijamming measures should be planned in advance. Any transmitter that can be tuned to the proper frequency may be used for jamming.

b. Radio jamming may be conducted with two basic types of emission jammers—

(1) *Spot jamming*—Enemy transmission of a narrow-band signal on a specific frequency or channel.

(2) *Barrage jamming*—Simultaneous interference on a broad band of frequencies or adjacent channels.

c. It is assumed that the enemy is constantly striving to devise new and more confusing forms of jamming signals. Any signal may be used, but some are more effective than others. Identification of the signal being used may be useful to higher headquarters in determining the jamming source. The signals are classified as unmodulated, amplitude modulated (AM), frequency modulated (FM), or pulse modulated (PM) by a virtually unlimited variety of modulating signals. Some of the more common jamming signals are explained in (1) through (6) below, for a complete list see FM 32-20.

(1) *Spark*—A simple, easily produced jamming signal that is most effective. The signal consists of numerous bursts of noise of short duration, high intensity, and high repetition rate, normally much louder or higher in level than the desired signal. The noise is similar to that which an electric razor produces in some broadcast receivers. Because of the broadband characteristic of the signal, a number of channels can be covered by one jammer using this type signal.

(2) *Stepped tones or bagpipes*—A signal consisting of multiple audio tones repeated over and over again. The sound is like that of a Scottish bagpipe and has a demoralizing effect on voice operators. This signal usually is employed against single-channel voice nets.

(3) *Noise (random or resistance)*—A signal that is random both in amplitude and frequency, with no periodically recurring frequency. It produces a sound similar to the rushing noise heard in an FM receiver when squelch is off, volume is maximum, and no signal is being received. It is especially dangerous, since the operator may mistake the signal for normal receiver or atmospheric noise and fail to take antijamming action. Noise is regarded as one of the better types of jamming modulation and is effective against all types of radio transmissions.

(4) *Random-keyed, modulated continuous wave*—A signal produced by transmitting a continuous wave keyed at random and modulating the keyed signal with spark noise.

(5) *Rotary*—A signal produced by a low-pitched, slowly varying audio frequency, producing a grunting sound. It is used against voice communications.

(6) *Voice jamming and recorded sounds*—Any transmission made by voice, singing, talking, chattering, whistling, screams, music, and machinery noise are examples of the many possibilities that could be used.

6-3. Deception by an Enemy

a. Deception by an enemy is the not easily

detected use of countermeasures and is closely related to the enemy jamming. Deception may be put into a radio net by an enemy station posing as a friendly station.

b. Deception usually is intended as a nuisance but may be used by an enemy to gain tactical or communication intelligence. Deceptive techniques include transmitting false tactical instructions in clear test or requesting that various types of classified information be transmitted in the clear.

6-4. Recognition or Detection of Jamming

a. If interference is received, the antenna should be disconnected from the receiver or the antenna should be grounded to determine the source of the interference. If there is no change in the receiver noise level after these actions are taken, the receiver is probably at fault. However, if the noise level drops, the source is outside the receiver; the interference may be caused by jamming or it may be accidental interference.

b. Accidental interference may be a radio communications signal (transmitted by friendly forces or even by enemy forces) or it may be a broad band interfering signal emanating from power lines or rotating electrical equipment.

c. Barrage jamming is difficult to distinguish from broadband accidental interference. Each usually spreads over all or most of the tuning range of the receiver. However, the range of noncommunications accidental interference is relatively short, and a search of the nearby area may disclose the source. The possibility of accidental interference should be eliminated before a disturbance is reported as jamming. Unidentifiable signals should be reported as soon as possible to the communications electronics officer at the next higher headquarters.

6-5. Reporting Jamming

a. An enemy jamming attack usually is part of a well-organized plan and often precedes important tactical maneuvers. Properly correlated jamming information can be warning and may provide intelligence of possible enemy action.

b. Jamming information to be reported, in order of importance, is as follows:

(1) Frequency or channel being jammed, including bandwidth of the jamming signal, if known.

(2) Type of jamming signals.

(3) Time and duration of jamming including any repetition.

(4) Signal strength and effect on radio communications, including effect on other stations in the net. Signal strength should be classified as strong, medium, or weak.

(5) Unit, name, and rank of operator making the report.

c. The detailed report should be made by the operator to the commander and should be processed through channels to higher headquarters. All ECM must be reported in accordance with AR 105-3: Reporting Meaconing, Intrusion, Jamming and Interference of Electromagnetic Systems. Reports Control Symbol: JSC 1066 (MIN).

6-6. Operating Procedures

During a jamming attack, continue attempts to transmit the message and to confuse the enemy jammer as to his effectiveness. The following procedures will lessen the effect of, and assist in working through, enemy jamming:

a. Precautionary Measures.

(1) Radio and antenna siting and antenna orientation are important. Locate the antenna so that hill formations, buildings, or other natural screens and obstructions are between the antenna and the enemy. Use remote control equipment to site the radio set in the most favorable position.

(2) Use the directional characteristics of a long-wire antenna or another type of directional antenna. Orient the antenna toward the specific station or stations with which you must communicate or, if using a half-wave horizontal antenna, orient the null of the antenna (the direction of the antenna wire) toward the jamming station.

(3) Transmit only when necessary. Use only the amount of radiated power necessary to communicate.

(4) Use proper operating signals and brevity lists. Use station and message authentication to prevent deception. Do not engage the enemy in conversation.

(5) Adjust speed of transmission to particular circumstances. However, do not suddenly reduce speed during a jamming attack, because this gives the enemy an indication that the jamming is effective. Your deceptive tactics may discourage him from continued or further jamming efforts for a particular operation.

(6) Do not cease operation during a jamming attack even if you are unable to continue passing traffic on your radio net. Continued operations keeps the enemy jammer engaged and gives him no indication of his effectiveness.

b. Receiver Control Techniques.

(1) Tune carefully to the incoming signal rather than to a dial mark.

(2) Adjust the volume control for the best signal-to-jamming ratio.

(3) Use the frequency change system.

Switch to an alternate frequency in accordance with some prior arrangement. Change call signs and suffixes simultaneously with frequency change. Use only authorized alternate frequencies.

6-7. Antijamming Instructions

The enemy can jam all radio circuits and stations. To reduce the effectiveness of jamming attacks, personnel should take the actions specified in *a* through *c* below.

a. Commander and Staff Officers. The commander and staff officers should—

(1) Reduce the use of radio to the absolute minimum.

(2) Preplan all operations when possible and use brevity lists to effect plans and directives.

(3) Keep messages as short as possible.

(4) Stress radio discipline and security.

(5) Destroy enemy jamming stations when possible.

(6) Always inform the next higher headquarters of jamming.

b. Communication-Electronics Officers. Communication-electronics officers should—

(1) Train operators to use the radio only when needed.

(2) Train radio operators to readjust equipment and to continue operation through jamming.

(3) Enforce radio discipline and security.

(4) Require authentication of all transmissions.

(5) Site radio stations and antennas to reduce the effect of enemy jamming.

(6) Always include alternate call signs and frequencies in communications-electronics operations instructions (CEOI) and include prearranged plans, for their use.

(7) Always report jamming to the commanding officer and staff.

c. Radio Operators. Each radio operator should—

(1) Site the station and antenna to reduce the effect of enemy jamming.

(2) Learn to recognize enemy jamming and report details to the officer in charge.

(3) Learn to readjust his set to minimize the effect of jamming.

(4) Learn to copy and operate through jamming.

(5) Operate with the minimum power necessary to pass trafficc

(6) Shift to alternate frequencies and call signs as directed.

(7) Authenticate all transmissions.

CHAPTER 7

COMMUNICATIONS-ELECTRONICS ORDERS AND INSTRUCTIONS

7-1. The Operation Order

a. General. The operation order is a means by which a commander directs his organization in an operation. In some cases, because of the short time, it may be impossible to prepare complete written communications-electronics (C-E) estimates and plans. Thus, it sometimes becomes necessary that paragraph 5 (the C-E part) of the operation order be prepared on the basis of the communication-electronics officer's estimate and plan. The C-E part may be issued orally. The C-E part of the operation order must be issued in sufficient time to permit the installation of the required communication systems before the beginning of the action concerned. For details on paragraphs 1, 2 and 3 of the operation order, see FM 101-5.

b. Paragraph 4, Service Support. Details of communications/electronics supply and repair may be included in paragraph 4 of the operation order as follows:

(1) Special priority of C-E troops or vehicles on roads.

(2) Locations of communications-electronics depots.

(3) Communications-electronics distribution points.

(4) Special instructions concerning the issue of communications-electronics supplies.

c. Paragraph 5, Command and Communication-Electronics. The extent of the communication instructions and information contained in paragraph 5 of the operation order depends on the decision of the unit commander. Paragraph 5 may contain only the index number and issue number of the communications-electronics operation instruction (CEOI) that are in effect, or it may be expanded to include reference to the communications-electronics annex (if one is included) or to repeat important instructions of the C-E annex or CEOI. It may also contain other information of importance that is deemed necessary or desirable by the commander; e.g., locations of subordinate command posts, axis of signal communication, locations of advance message centers, restrictions on the use of equipment and pyrotechnics, and the data and hour of radio net opening.

7-2. Communications-Electronics Annex

The C-E annex to an operation order is prepared when the C-E instructions are too voluminous to be included in paragraph 5 of the operation order. The C-E annex is based on the C-E plan and is made as short as possible by reference to routine C-E instructions contained in the standing operating procedures (SOP). The C-E annex, which follows the format of the operation order, includes information and instructions that directly affect C-E support. A C-E annex becomes a part of the operation order, even though it may be distributed at a different time and may receive different distribution. A comprehensive SOP and CEOI-CESI will minimize the need for a C-E annex.

7-3. Standing Operating Procedure

An SOP is a set of instructions giving the procedure to be followed by a particular unit in performing those operations, both tactical and administrative, that the commander desires to be routine.

a. Purpose of Communications-Electronics SOP. The purpose of this SOP is to—

(1) Gain speed and precision in operations by standardizing the operating methods, procedures, and techniques.

(2) Simplify and perfect the training of all personnel.

(3) Reduce the number and length of communications-electronic orders.

(4) Simplify staff planning.

(5) Facilitate control and coordination of effort at all levels of command.

(6) Promote teamwork.

(7) Enable all members to understand what the rest of the unit will do under certain circumstances.

(8) Reduce the number of minor decisions to be made by the commander and his subordinates.

b. Form and Content. Communications-electronics SOP's are prepared in accordance with the format described and illustrated in FM 101-5. In addition, a checklist for preparation of a field artillery unit SOP is shown in FM 6-140. The content of the communications-electronics SOP will depend on the desires of the commanding officer, the recommendations of the communications-electronics officer, the SOP of the next higher headquarters, and the state of training of the command.

c. Flexibility. A communications-electronics SOP must be revised from time to time as the training of the unit progresses in order to

eliminate superfluous details and to insure the development of concise, final instructions suitable to plan operations.

d. Use of the Communications-Electronics SOP. The communications-electronics SOP should have widespread distribution within the unit. All key operating personnel should be familiar with the communications-electronics SOP of the unit, since it affects not only communications personnel but also users of the communication systems.

7-4. Communications-Electronics Operation Instructions

a. General. The communications-electronics operation instructions (CEOI) consist of technical instructions that are subject to frequent change and that are required in the employment of equipment and systems. The CEOI generally is prepared and issued by the communication-electronics officer at division and higher headquarters. Radio frequencies and call signs may be assigned to corps artillery and division artilleries in blocks, and the communications-electronics officers of these commands will be required to prepare an extract CEOI assigning frequencies and call signs to subordinate units. Units authorized retransmission equipment should be assigned noninterfering frequencies, as shown in TM 11-5820-401-12.

b. Distribution. Distribution of the communication-electronics operation instructions is made to subordinate units, the next higher headquarters, and the headquarters of adjacent commands. Certain items of the CEOI should be extracted and given wide distribution within the unit.

c. Classification. Each portion of the CEOI is classified according to its content, as prescribed by AR 380-5 and AR 380-40. The classification is marked or stamped at the top and bottom of each page of the classified portion. The assembled CEOI is assigned the same classification as the portion with the highest classification.

d. Security. CEOI's include information that is of particular value to the enemy because it could serve as a means of gaining additional intelligence. Therefore, the complete CEOI of any echelon should not be taken forward of the command post of the echelon to which it is issued. When a CEOI or an extract is compromised, the fact must be reported immediately and the CEOI must be replaced immediately. For information concerning the storage of classified material, see AR 380-5 and AR 380-40. A record should be kept of all extracted parts of a CEOI, and personnel within units should be instructed to destroy these items if capture is likely to happen without delay.

7-5. Communications-Electronics Standing Instructions

The communications-electronics standing instructions contain operating instructions that are not subject to frequent change and that are required in the employment of units throughout the issuing command. The CESI includes instructions that explain the various procedures to be followed in using the individual items of the CEOI. When no CESI is published, these instructions are included in the CEOI.

a. Distribution. Items of the communications-electronics instructions receive the same distribution as CEOI items. The communications-electronics officer may make additional distribution, when necessary.

b. Classification. The CESI is classified in the same manner as the CEOI.

7-6. Routine Communications-Electronics Orders

To insure coordination of communications throughout the command, it is necessary from time to time to issue routine communications-electronics orders. These orders are prepared by the staff communications-electronics officer and contain information and instructions of general and more than temporary interest. The following subjects might be covered in routine communications-electronics orders:

a. Changes in allowances of equipment.

b. Correction of abuses in the use of equipment and services.

c. Deficiencies in training and operations.

d. Standing operating procedure.

e. Supply and maintenance instructions.

CHAPTER 8

THE FIELD MESSAGE

8-1. General

a. In field artillery units, messages should be prepared on blank message forms (fig 8-1 and 8-2), which are requisitioned and issued as DA Form 4004 (Message Book). In the field, this book usually is referred to as message book M-210. The procedures given in this chapter apply when the message book is used and also when the form is not available and the drafter must improvise. The basic rules of message preparation and the description of elements of a message will apply to any message form.

b. Message preparation is not limited to commanders or staff officers. All military personnel, regardless of grade or position, are authorized and may be required to prepare field messages.

c. This chapter describes the procedures and rules for composing a tactical message. The text of a message contains the basic idea to be made known to the addressee and must be prepared in such a manner that he will fully understand its contents.

THESE SPACES FOR MESSAGE CENTER ONLY

TIME FILED	MSG CEN NO.	HOW SENT

PRIORITY (PRECEDENCE)

MESSAGE (SUBMIT TO MESSAGE CENTER IN DUPLICATE)

No. 6 Date 27FEB 73

To Cdr 1ST BN, 45th F.A.

CLASSIFICATION

FOR S3

PLAN SIERRA EFFECTIVE 28Ø13ØS

AUTHORIZED TO BE SENT IN CLEAR

John A. Smith, CPT

CLASSIFICATION

OFFICIAL DESIGNATION OF SENDER Cdr 20th INF DIV ARTY

TIME SIGNED Ø815S

SIGNATURE AND GRADE OF WRITER Oscar F Foley LTC, S3

Figure 8-1. Completed field message.

8-2. Basic Rules for Preparing Message

In the preparation of a message—and this includes writing the text—certain rules must be followed.

a. Writing. Each word must be printed in block capital letters (except signatures, which must be written in longhand).

b. Abbreviations. Normally, abbreviations will not be used. However, if the writer has just knowledge that the addressee is familiar with the abbreviations, those authorized by AR 310-50 may be used.

c. Punctuation. Punctuation should not be used unless needed for clarity. When punctuation is needed, only the following punctuation symbols may be used: dash or hyphen (-), question mark (?), colon (:), apostrophe ('), period (.), comma (,), slant (/), quotations marks ("), parentheses ( ), and the letter X representing an asterisk.

d. Repetition. Repetition will not be used solely for the purpose of emphasis. It may be used to insure correct receipt of a vital word or an unpronounceable series of unrelated letters. An example in which repetition serves a legitimate purpose is as follows: MIYAZAKI I SAY AGAIN MIYAZAKI (to minimize the possibility of mistaken identity or incorrect spelling).

e. Isolated Letters. The phonetic alphabet is used for each letter placed alone. Route A, for example, must be written as ROUTE ALFA. The initials of a person's name, however, are never given the phonetic alphabet equivalent.

f. Numbers. Numbers may be written as numerals. Roman numerals will be expressed as cardinal numbers preceded by the word "Roman," e.g., IX should be written as ROMAN 9. The dollar sign ($) may be used with numbers to indicate money.

g. Spacing. If possible, the text should be written on every other line of the message form.

8-3. Message Book (DA Form 4004) (M-210)

a. The forms contained in the M-210 message book are arranged in sets of three and are interleaved with carbon paper; thus every message can be prepared in three copies. When a written message is to be routed through the message center, the number of copies sent to the message center will depend on the unit standing operating procedure.

b. The message form is used whether the message is to be transmitted by electrical means or carried by messenger. If message book M-210 is not available, the drafter may use a plain sheet of paper, but the message format as discussed in paragraph 8-4 must still be followed.

8-4. Procedures for Writing the Message

Filling in the message form involves the steps discussed in *a* through *l* below. A completed field message is shown in figure 8-1.

a. Precedence. The assignment of precedence to a message is the responsibility of the originator. To the drafter, precedence means the required speed of delivery to the addressee. The drafter determines the precedence on the basis of the contents of the message and the time factor involved. He must select the lowest suitable precedence. To communication personnel, precedence means the relative order of handling and delivery. To the addressee, precedence indicates the order in which he notes or reads a message. The four precedence designations are shown in table 8-1. The precedence will not be taken for granted; one of the authorized designations must be used.

Table 8-1. Precedence Designation

Precedence designation	Example of use
FLASH	Flash precedence is reserved for initial reports of enemy contact or for operational combat messages of extreme urgency.
IMMEDIATE	Used for reports amplifying initail enemy contact. Urgent intelligence and/or operational combat messages and all fire missions are automatically assigned a precedence of IMMEDIATE.
PRIORITY	Used for messages concerning the conduct of operations in progress; urgent administrative message.
ROUTINE	Used for messages concerning normal peace-time military operations; operational plans concerning projected operations.

Note. The above four precedences have been approved for US joint usage. Allied countries may use six precedences—FLASH, EMERGENCY, OPERATIONAL IMMEDIATE, PRIORITY, ROUTINE, and DEFERRED. In operations with allied nations, EMERGENCY would be transmitted after FLASH and before OPERATIONAL IMMEDIATE, OPERATIONAL IMMEDIATE would be transmitted after EMERGENCY and before PRIORITY, and DEFERRED would be transmitted after ROUTINE.

THESE SPACES FOR MESSAGE CENTER ONLY

TIME FILED	MSG CEN NO.	HOW SENT

ROUTINE
(PRECEDENCE)

MESSAGE (SUBMIT TO MESSAGE CENTER IN DUPLICATE)

No. _____ Date 28 FEB 73

To. FSO #1, 1ST BN, 45 TH F.A.

UNCLASSIFIED

REPORT YOUR LOCATION

UNCLASSIFIED

S-3, 1ST BN, 45TH F.A.
OFFICIAL DESIGNATION OF SENDER

0946S
TIME SIGNED

SIGNATURE AND GRADE OF WRITER Henry A Davis, MAJ, S3

Figure 8-2. Example of a message when the drafer and the addressee are both on the same commander's staff.

b. Number. The drafter's message number is entered in the space provided after the abbreviation "No." There are no regulations concerning the assignment of this number, each command specifies its own procedures. The message number is not transmitted when the message is transmitted by electrical means.

c. Date. The day, the month (abbreviated), and the year (last two digits), in that order, are entered in the space provided after the word "Date." The first three letters of the month constitute the correct abbreviations.

d. Official Designation of the Addressee. The official designation of the addressee is entered in the space provided after the word "To." The addressee normally is the commander of the unit or command for whom the message is intended.

e. Official Designation of Sender. The official designation of the originator is entered in official designation of sender block. The originator is identified as the sender on the M-210 message form. Normally, the originator is the commander (designated by title and organization) by whose authority the message is sent. He must be distinguished from the drafter who composes the text. The drafter and the originator may or may not be the same person.

f. Originator, Drafter, and Addressee on the Same Commander's Staff. When the drafter and the person for whom the message is intended are on the same commander's staff (fig 8-2), for example, when the S3 of a unit sends a message to the fire support officer of the same unit, *d* and *e* above do not apply.

g. Security Classification. AR 380-5 requires that the security classification be marked or stamped (not typed) at the top and bottom of a classified item. The proper security classification—TOP SECRET, SECRET, CONFIDENTIAL, or UNCLASSIFIED—is entered above and below the text of the message. The classification is circled to separate it from

other parts of the message. If the message contains cryptoinformation, it will be marked in accordance with AR 380-40.

(1) The originator is responsible for the security classification of the message (the originator is identified as the sender in the M-210 message form), but the drafter is responsible for determining the proper security classification of the message in the name of the originator. No assumptions can be made about security. The drafter must show the security classification of each message.

(2) Local SOP will decide how a message will be processed if no classification has been made. In an emergency, a message with a classification up to and including SECRET may be sent in the clear (fig 8-1). Only the commanding officer or his specifically authorized representative can authorize a message to be sent in the clear. Before a classified message can be sent in the clear, the following conditions must exist:

(a) The unit must be engaged in actual hostilities.

(b) Speed is so essential that time cannot be taken to encode the message.

(c) The transmitted information cannot be acted on by the enemy in time to hurt current operations.

h. Encrypted for Transmission Only. In the interest of transmission security, it is sometimes necessary to encrypt certain unclassified messages to prevent disclosure of their textual contents. A message requiring this protection is designated EFTO (encrypted for transmission only). The abbreviation UNCLAS EFTO is marked or stamped immediately above and below the text of the message on the M-210 message form.

i. Text. The text of a message must be clear, accurate, and brief. As few words as are required for clarity will be used in the message. Conjunctions, prepositions, and articles, such as a, but, for, in, on, and the, should be eliminated unless they are essential to the meaning. The text of a message may consist of two parts, the internal instructions and the body.

(1) *Internal Instructions.* The internal instructions may consist of any required additional addressee and originator designations (*d* above) and will begin on the first line of the body of the message form. The word "For" will be used to show that the message should be delivered to a specific officer or individual at the location addressed. It is followed by an abbreviated title of the person or office within the agency, command, or installation for whom the message is intended.

(2) *Body.* The body of the message is the basic idea of the originator. The body of the text will follow the internal instructions.

j. Time Signed. The drafter enters the time he signed the message in the TIME SIGNED block. If he signs the message on the same day shown in the DATE block, he will enter only the hour, minute, and zone suffix. If he signs the message on a day other than that shown in the DATE block, he enters the complete date-time group to show the day of the month, the hour, and the zone suffix.

(1) A sample date-time group is 211415Z. The first two digits (21) indicate the 21st day of the current month. (Two digits are always shown; for days prior to the 10th, a zero is added before the digit. For example, the seventh day would be shown at 07). The next two digits (14) indicate the hour, and the last two digits (15) indicate the minutes after the hour; Z is a suffix indicating the time zone.

(2) The TIME SIGNED block should bear a time zone suffix to indicate the time zone used. The theater commander may authorize the local suffix for messages that will not leave the time zone in which the theater is located. In other instances, the theater commander may require the use of Greenwich mean time (Zulu time).

k. Signature and Grade of Writer. The drafter signs his name and enters his grade in the block provided.

l. Authorized to be Sent in the Clear. Each classified message to be transmitted in the clear must be authorized separately by the commander of the headquarters transmitting the message or his specifically authorized representative. This authorization is indicated by the statement "Authorized to be sent in clear" followed by the signature and grade of the authorizing person (FM 24-17). This authorization is circled to keep it apart from the other elements of the message. If the message is not authorized to be sent in the clear, it will be encrypted prior to transmission by electrical means.

CHAPTER 9

MESSAGE CENTER OPERATION

Section I. GENERAL

9-1. General

The message center of a headquarters is the communication agency that receives, transmits, and delivers messages of record for the commander and the staff of the headquarters served by the message center. The message center of the headquarters of a field artillery unit is operated by organic communication personnel. The commander is responsible for establishing message center procedures that will best meet the needs of his unit and yet conform to the specific requirements established by his higher headquarters. Accuracy and speed are the results desired in formulating an operating procedure for a message center. However, security will not be given up to gain speed.

9-2. Organization of Message Center

a. The tables of organization and equipment (TOE) for field artillery units provide for personnel to operate a message center. These personnel are the—

(1) *Chief message clerk or senior message clerk.* The chief message clerk senior message clerk supervises all activities of the message center to include cryptography, receipt, transmission, and delivery of all messages processed through the message center.

(2) *Message clerk.* The duties of the message clerk are the same as those of the senior message clerk. He normally acts as code clerk, when required, when both he and the senior message clerk are present in the message center.

(3) *Messenger.* The messenger assists in the operation of the message center. His main duty is to pick up and deliver messages as required.

b. Although not specifically provided by the TOE, certain other personnel are required by duty assignment to work in the message center and should be trained in message center procedures. These personnel are—

(1) *Messengers.* When the number of messengers authorized by TOE is not sufficient to meet current needs, additional assigned personnel are detailed as messengers.

(2) *Operators.* Radio and teletypewriter operators are trained in cryptography to assist in processing messages requiring encryption or decryption when message center personnel are not available and to insure 24-hour operation.

9-3. Forms and Equipment

Certain forms, publications, and equipment are necessary for the efficient operation of a message center. The operation of the message center may be simplified by use of the minimum required recording procedures and by maximum use of the communication facilities available to the unit. The required forms are listed in *a* through *c* below. These forms make message handling easier and are used when available.

a. Message Book (DA Form 4004). This form provides a set of blank message forms for writing or recording messages.

b. Joint Message Form (DD Form 173). This form is used for messages originating within a headquarters for transmission over the on-line cryptofacilities of a communication center. When a message requires more than one page, the same form will be used.

c. Telecommunication Center Delivery List (DA Form 4011). This form may be used as a receipt form for delivery of messages within the same headquarters (fig 9-1). The message may be delivered directly to an individual or to the distribution center in the headquarters.

9-4. Files and Records

Elaborate records must be avoided. However, pertinent classified and unclassified publications governing the operation of mechanical and electromechanical cipher devices and the control of associated material must be on hand. All message center personnel must be familiar with the instructions included in these publications, and responsible commanders must insure strict compliance with these directives. Additional records that may be required are listed in *a* through *f* below.

TELECOMMUNICATIONS CENTER DELIVERY LIST

For use of this form, see TM 11-490; the proponent agency is the United States Army Strategic Communications Command.

DELIVERIES TO: OPERATIONS | DATE: 16 MAR 74 | PAGE 1 OF PAGES

CONTROL NO.	ORIGINATING HQ OR OFFICE	DATE TIME GROUP	NO. OF COPIES	CLASSIFICATION	RECEIPT SIGNATURE	TIME OF DELIVERY
101	*	*	*	*	*	*
102	*	*	*	*	*	*
103	20TH INF DIV ARTY	160105S	1	C	Ben Jones, Cpt	0130

DA FORM 1 APR 73 4011 REPLACES DA FORM 11-39, 1 SEP 54, WHICH IS OBSOLETE. ☆ U.S. G.P.O. 1973-769859/198

Figure 9-1. Telecommunications Center Delivery List (DA Form 4011).

COMMUNICATION STATUS LOG			DATE
UNIT	TIME ZONE	PAGE NO.	NO. OF PAGES

UNITS TO WHICH CONNECTED	AM RAD		FM RAD		TT		TEL		VHF		REMARKS
	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	

DA FORM 2150-R, 1 Dec 64 Replaces edition of 1 Aug 58

Figure 9-2. Communication Status Log (DA Form 2150-R).

MESSAGE CENTER LOG										☐ INCOMING ☐ OUTGOING
										DATE
UNIT									PAGE NO.	NO. OF PAGES
MESSAGE CENTER NUMBER	TIME FILED	MEANS	PREC	DATE/TIME	CRYPT	GR COUNT	CLEARED			REMARKS
							TO/FROM		TIME OF RECEIPT	

DA FORM 2151-R, 1 Dec 64 Replaces edition of 1 Aug 58

Figure 9-3. Message Center Log (DA Form 2151-R).

a. Pending File. The duplicate clear test copy or skelton copy of each outgoing message processed by the message center is placed in the pending file. This copy remains in the pending file until a receipt is obtained from the receiving headquarters. It is then indorsed and placed in the cleared file.

b. Cleared File. The cleared file consists of the duplicate copies of all receipted outgoing messages and completed receipt forms. This file is turned over to the S1 or other designated person by the communications-electronics officer at frequent intervals (usually daily) so that messages may be included in the unit journal or other official records of the headquarters.

c. Message Clerk's File. The message clerk retains on file the original clear text copy of each outgoing cryptogram and the original cryptographed copy of each incoming cryptogram. Care must be taken to insure that the clear text copy and the cryptographed copy of the same message are never filed together. These files are disposed of as directed by the communication-electronics officer. The message cryptolog is maintained by the message clerk or teletypewriter (or radioteletypewriter) operator, who, in certain circumstances, is the cryptographer. The cryptolog is maintained separately for incoming and outgoing messages and reflects messages transmitted and received electrically. This log is used in submitting the encrypted traffic report, when required. The log is disposed of on instructions of the security officer in accordance with AR 340-18-5 and AR 380-40.

d. Operator's File. The file kept by the radio and teletypewriter operators contains a copy of each message sent or received. The file is disposed of as directed by the communication-electronics officer.

e. Communication Status Log. The Communication Status Log (DA Form 2150-R) is a record kept by the message center to show the current availability of all means of communication used by the message center. It is used to determine the best available routing for messages. The operators of the various communication facilities must keep the message center informed of their status of communication with other units. The communication status log (fig 9-2) is reproduced locally on 8 by 10½-inch paper. The log is closed out at 2400 daily and a new log opened at 0001. Only existing available communication is shown on the new log. The old log is placed in the cleared file.

f. Message Center Log. The Message Center Log (DA Form 2151-R) is a daily chronological record of all messages handled by the message center. Separate logs are maintained for incoming and outgoing messages. The logs are closed as of 2400 daily. Any message not yet receipted for must be checked to insure that the message has been received by the addressee. When all messages have been cleared, the log is placed in the cleared file. The message center log (fig 9-3) is reproduced locally on 8- by 10½-inch paper. Since separate logs should be kept for recording incoming and outgoing messages, a message numbering system should be used to distinguish between incoming and outgoing messages. The unit SOP will determine the proper message identification numbering system depending on the volume of expected traffic.

9-5. Unit COMSEC Custodian and COMSEC Officer

The unit COMSEC custodian and COMSEC officer should have a detailed knowledge of the regulations governing the maintenance of cryptographic records and reports and of physical security requirements. These officers must be thoroughly familiar with the following list of references: AR 380-5, AR 380-40, AR 380-46, AR 340-18-5, and AR 380-41.

Section II. HANDLING OUTGOING MESSAGES

9-6. Outgoing Messages by Messenger Service Scheduled or Special (Cleartext)

a. Origin. The outgoing message is prepared by the writer and submitted to the message center in sufficient copies.

b. Processing. The message center clerk enters the time the message was filed, the message center number, and how the message was sent in the spaces provided on all copies of the message form. The duplicate or skelton copy is placed in the pending file. A delivery list (fig 9-4) is prepared when the message is ready for delivery.

c. Dispatch of Messages. The delivery list and the messages for delivery are given to the messenger. Prior to dispatch, the messenger should be instructed concerning—

(1) The route to follow.

(2) The importance of the message.

(3) Whether or not to wait for an answer to the message.

(4) Other information concerning the delivery of the message.

ROUTE DELIVERY LIST

For use of this form, see AR 105-23; the proponent agency is Office of the Assistant Chief of Staff for Communications - Electronics.

TIME DISPATCHED	TIME RETURNED
1240	

MESSAGE IDENTIFICATION	SIGNATURE IN FULL	TIME RECEIVED
202		

DA FORM 1 DEC 57 11-63 EDITION OF 1 APR 48 IS OBSOLETE. GPO 1958 O—950251

Figure 9-4. Route Delivery List (DA Form 11-63).

d. Message Center Log Entry. After dispatching the messenger, the senior message clerk uses the duplicate or skeleton copy to record the message in the outgoing message center log.

e. Delivery of the Message. When the messenger arrives at the addressee's unit, he delivers the message to the message center and obtains the signature of the message center clerk on the delivery list. Prior to departing, the messenger inquires if there are any messages for his unit.

f. Recording Receipt of the Message. When the delivery list (receipt) is returned to the message center, the message center clerk removes the duplicate or skeleton copy of the message from the pending file, enters the time of receipt and his initials on the message, and circles these entries. He attaches the duplicate or skeleton copy to the delivery list and places both in the cleared file. He closes the outgoing log entry pertaining to the message by entering the time of delivery in the TIME OF RECEIPT column of the log.

9-7. Outgoing Messages by Electrical Means (Encrypted)

a. Origin. The message is prepared by the writer in three copies and submitted to the message center in two copies.

b. Processing. The message clerk enters on all copies of the message the time filed, the message center number, and how sent. He retains the original copy of the message for encrypting and gives the duplicate or skeleton copy to the senior message clerk who enters the message in the outgoing message log and places the duplicate or skeleton copy in the pending file.

c. Security Procedure. The message text is encrypted by the message clerk, who uses the operations code. A copy of the encrypted text is entered on a message form together with the time the message was filed, the message center number, how the message was sent, and the date-time group of the message. Radio call signs or routing indicators are placed on the message in lieu of the clear designation of the orginator and addressee. The proper authentication and group count are also placed on the message, which is then sent to the operator for transmission. The clear text original copy is placed in the message clerk's file. Worksheets and other material related to the message are destroyed by burning. The senior message clerk is notified of the group count, and this information is entered on the outgoing message log. The message clerk makes the necessary entries in the outgoing cryptolog.

d. Transmission. The message is transmitted by the operator to the addressee. When the addressee station receipts for the message, the operator places his initials and the time of receipt on the message. He notifies the message center of the time of receipt and places the message in his operator's file.

e. Recording Receipt of the Message. On receiving the time of receipt from the operator, the message clerk removes the duplicate or skeleton copy from the pending file, indorses it, completes the entry in the outgoing message log, and files the copy in the cleared file.

Section III. HANDLING INCOMING MESSAGES

9-8. Incoming Messages by Messenger

a. Receipt of the Message. On receiving a message delivered by a special or scheduled messenger, the senior message clerk signs the receipt form and indicates the time received.

b. Processing. The senior message clerk makes the proper entries in the incoming message log, prepares a delivery list, and dispatches the message or messages to the addressee or appropriate staff officer. When the receipt is returned to the message center, the message clerk enters the time of receipt in the incoming message log.

9-9. Incoming Messages by Radio

a. Receipt of the Message. The operator copies the incoming messages in triplicate on the message form. After receipting for the message to the transmitting station, the operator places his initials and the time of receipt on the message. He files the third copy in his operator's file and forwards the original and duplicate copies to the message center.

b. Processing. The message clerk decrypts the message and copies the clear text version on a message form. The originator and addressee designations are determined from the radio call sign and entered on the clear text version. Authentication is checked and noted on the message form along with the time of receipt by the operator and the initials of the person who decrypted the message. The original encrypted copy is placed in the message clerks' file. The clear text copy is delivered, and the message is recorded in the incoming message log as indicated in paragraph 9-4*f*. All worksheets and extra copies of the message are destroyed by burning. The message clerk makes the appropriate entries in his classified file.

9-10. Message Center SOP

The commander must assure that all message center personnel are familiar with the operational procedures of his message center. The communication-electronics officer prepares an SOP for message center operations to aid the commander.

CHAPTER 10

RADIOTELEPHONE PROCEDURE—CONDUCT OF FIRE

Section I. GENERAL

10-1. Introduction

All branches of the service use radiotelephone procedure for command, operations, and administration. The field artillery also uses its communication system for conduct of fire. A specific radiotelephone procedure known as the short-phrase, repeat-back method is used for this purpose. Although the conduct of fire procedure may be modified according to the type of fire mission, the basic procedure remains unchanged.

10-2. Deviations from Normal Procedure

The radiotelephone procedure for the adjustment of artillery fire deviates from the normal communication procedure outlined in ACP 125 and allied publications. Specific deviations are—

a. Limited use of procedure words and not using the normal message format. New meanings are given to some procedure words. For example, the word OVER indicates the end of the transmission; another station is expected to transmit next. The word OUT indicates the end of the transmission, but the same station is expected to transmit next. The word OUT also indicates the termination of a read-back.

b. Wide use of clear or modified clear text.

c. Automatic read-back without the transmission instructions READ BACK.

d. Omitting the elimination of call signs after identities have been established and when no confusion will result. At certain times, when identification is required, transmissions are identified by the use of call sign suffix numbers only.

10-3. Automatic Read-Back Method of Transmission

Transmissions are made in short phrases to use the transmission of firing data and to minimize requests for repetition. Each phrase is repeated by the receiving operator just as it was received. The length of each phrase or the number of elements of firing data included in each transmission should be in accordance with established procedure and training and experience of the operators. To insure accuracy, the transmitting and receiving operators must be familiar with the sequence of the conduct of fire.

10-4. Net Organization

Four frequency modulated (FM) channels normally are allotted to a divisional howitzer battalion performing a direct support mission. These four channels will be assigned as a command/fire direction net (CF), fire direction net 1 (F1), fire direction net 2 (F2), and fire direction net 3 (F3). Since the command/fire direction channel is not intended primarily for fire direction, it will not be discussed further in this chapter. Each battery may operate on a separate fire direction net, which includes a net control station (NCS) at battalion, a fire support officer, and a number of forward observers. (The number of forward observers depends on the type of unit.)

a. Stations normally concerned with the conduct of fire are—

(1) Each forward observer and air observer.

(2) Each fire support officer.

(3) The NCS in the battalion fire direction center (FDC).

(4) Each battery fire direction center.

(5) A relay station, when necessary.

b. A fire mission may be conducted by using any combination of radio and wire. This discussion will include examples of fire missions conducted by radio only.

Section II. EXAMPLE MISSIONS

10-5. Sequence of Transmissions for a Battalion Mission

A battalion fire mission may be initiated by one of the forward observers, who transmits the request over his assigned frequency to the NCS operator of the net in which he is operating. The mission illustrated in *a* through *i* below is a battalion mission in which Battery B is the adjusting

battery and Battery A and Battery C are the nonadjusting batteries. The requesting forward observer is operating on fire direction net 2 (F2).

a. Call for Fire. The radiotelephone operator for the forward observer (INLAND GALL 44) calls the fire direction net 2 NCS (INLAND GALL 18) in the battalion fire direction center, stating that he has a target upon which he wishes to bring fire.

Forward observer ... INLAND GALL 18, THIS IS INLAND GALL 44, FIRE MISSION OVER
F2 NCS ... INLAND GALL 44, THIS IS INLAND GALL 18, FIRE MISSION, OUT

These two transmissions correspond to a preliminary call; they are the initial establishment of communication and must be made in this manner for every mission. The remainder of the call for fire may be sent in short phrases.

Forward observer ... GRID 482902, OVER
F2 NCS ... GRID 482902, OUT
Forward observer ... DIRECTION 5680, OVER
F2 NCS ... DIRECTION 5680, OUT
Forward observer ... INFANTRY COMPANY ASSEMBLY AREA, VT IN EFFECT, ADJUST FIRE, OVER
F2 NCS ... INFANTRY COMPANY ASSEMBLY AREA, VT IN EFFECT, ADJUST FIRE, OUT

b. Message to Observer.

F2 NCS ... BATTALION BRAVO, 4 ROUNDS, TARGET ALFA FOXTROT 7022, OVER
Forward observer ... BATTALION BRAVO, 4 ROUNDS, TARGET ALFA FOXTROT 7022, OUT

c. Initial Fire Commands. The batteries are alerted by the appropriate battalion NCS that they are to fire the mission. Battery A is notified by F1 NCS; Battery B, by F2 NCS; Battery C, by F3 NCS. All three batteries are notified simultaneously.

F2 NCS ... BATTERY ADJUST, OVER
Btry B Operator ... BATTERY ADJUST, OUT
F1 NCS ... BATTERY ADJUST, OVER
Btry A operator ... BATTERY ADJUST, OUT
F3 NCS ... BATTERY ADJUST, OVER
Btry C operator ... BATTERY ADJUST, OUT

Note. If adequate frequencies are available and are being used, call signs are dropped after establishment of good communications, otherwise each station will transmit its own suffix number only. (The procedure for simultaneous missions is illustrated in para 10-7 *b*.)

d. Remaining Initial Fire Commands to the Adjusting Battery.

F2 NCS ... SHELL HE, LOT X RAY, CHARGE 5, FUZE QUICK, OVER
Btry B operator ... SHELL, HE, LOT X RAY, CHARGE 5, FUZE QUICK, OUT
F2 NCS ... CENTER 1 ROUND, BATTERY 4 ROUNDS, VT IN EFFECT, OVER
Btry B operator ... CENTER 1 ROUND, BATTERY 4 ROUNDS, VT IN EFFECT, OUT
F2 NCS ... DEFLECTION 2891, QUADRANT 360, OVER
Btry B operator ... DEFLECTION 2891, QUADRANT 360, OUT

e. Remaining Initial Fire Commands to the Nonadjusting Batteries. While Battery B was receiving the data in *f* above on fire direction net 2, the nonadjusting batteries were receiving their initial fire commands on fire direction nets 1 and 3.

F1 NCS ... SHELL, HE, LOT X, CHARGE 5, FUZE VT, OVER
Btry A operator ... SHELL HE, LOT X, CHARGE 5, FUZE VT, OUT
F1 NCS ... BATTERY 4 ROUNDS, DO NOT LOAD, OVER
Btry A operator ... BATTERY 4 ROUNDS, DO NOT LOAD, OUT
F1 NCS ... DEFLECTION 2976, TIME 20.0, QUADRANT 362, OVER
Btry A Operator ... DEFLECTION 2976, TIME 20.0, QUADRANT 362, OUT. . . BATTERY IS LAID, OVER
F1 NCS ... BATTERY IS LAID, OUT
F3 NCS ... SHELL HE, LOT X, CHARGE 5 FUZE VT, OVER
Btry C operator ... SHELL HE, LOT X, CHARGE 5 FUZE VT, OUT
F3 NCS ... BATTERY 4 ROUNDS, DO NOT LOAD, OVER
Btry C operator ... BATTERY 4 ROUNDS, DO NOT LOAD, OUT
F3 NCS ... DEFLECTION 2732, TIME 19.0, QUADRANT 361, OVER
Btry C operator ... DEFLECTION 2732, TIME 19.0, QUADRANT 361. OUT. . . BATTERY IS LAID, OVER
F3 NCS ... BATTERY IS LAID, OUT

f. Subsequent Corrections and Fire Commands (Adjustment). While the nonadjusting batteries were receiving their initial data, the adjusting battery was proceeding with the adjustment.

Btry B operator ... SHOT, OVER
Forward observer ... SHOT, OUT. . .RIGHT 100, ADD 400, OVER
F2 NCS ... RIGHT 100, ADD 400, OUT. . .DEFLECTION 2835, QUADRANT 368, OVER
Btry B operator ... DEFLECTION 2835, QUADRANT 368, OUT. . .SHOT, OVER
Forward observer ... SHOT, OUT. . .DROP 200, OVER
F2 NCS ... DROP 200, OUT. . . DEFLECTION 2835, QUADRANT 363, OVER
Btry B operator ... DEFLECTION 2835, QUADRANT 363, OUT. . .SHOT, OVER
Forward observer ... SHOT, OUT. . .LEFT 50, ADD 100, OVER
F2 NCS ... LEFT 50, ADD 100, OUT. . . DEFLECTION 2860, QUADRANT 366, OVER
Btry B operator ... DEFLECTION 2860, QUADRANT 366, OUT. . .SHOT, OVER
Forward observer ... SHOT, OUT. . .RIGHT 10, DROP 50, FIRE FOR EFFECT, OVER

F2 NCS — RIGHT 10, DROP 50, FIRE FOR EFFECT, OUT

g. Subsequent Fire Commands (Fire for Effect). At this time fire-for-effect data are produced for each battery and sent to all batteries simultaneously.

(1) For the adjusting battery.

F2 NCS — FUZE VT, BATTERY 4 ROUNDS, DEFLECTION 2853, TIME 20.0, QUADRANT 365, OVER

Btry B operator — FUZE VT, BATTERY 4 ROUNDS, DEFLECTION 2853, TIME 20.0, QUADRANT 365, OUT

(2) For the nonadjusting batteries.

F1 NCS — BATTERY 4 ROUNDS, DEFLECTION 2938, TIME 20.0 QUADRANT 367, OVER

Btry A operator — BATTERY 4 ROUNDS, DEFLECTION 2938, TIME 20.0, QUADRANT 367, OUT

F3 NCS — BATTERY 4 ROUNDS, DEFLECTION 2785, TIME 20.0, QUADRANT 367, OVER

Btry C Operator — BATTERY 4 ROUNDS, DEFLECTION 2785, TIME 20.0, QUADRANT 367, OUT

h. Firing for Effect. As each battery begins fire for effect, the RTO announces SHOT.

Btry B operator — SHOT, OVER

Forward observer — SHOT, OUT

Note. The forward observer is informed when the first round in fire for effect has been fired. If the battery that is on his frequency fires first, the forward observer reads back the transmission directly to the battery. If one of the batteries that is not on the forward observer's frequency fires first, the NCS on the forward observer's frequency relays this information to the forward observer.

Btry A operator — SHOT, OVER

F1 NCS — SHOT, OUT

Btry C operator — SHOT, OVER

F3 NCS — SHOT, OUT

i. Rounds Complete. As each battery completes fire for effect, the operator sends ROUNDS COMPLETE, which is read back by the NCS. When all batteries have completed firing for effect, the NCS working with the forward observer informs the observer that the battalion has completed its fire for effect.

Btry B operator — ROUNDS COMPLETE, OVER

F2 NCS — ROUNDS COMPLETE, OUT

Btry A operator — ROUNDS COMPLETE, OVER

F1 NCS — ROUNDS COMPLETE, OUT

Btry C operator — ROUNDS COMPLETE, OVER

F3 NCS — ROUNDS COMPLETE, OUT

F2 NCS — BATTALION, ROUNDS COMPLETE, OVER

Forward observer — BATTALION, ROUNDS COMPLETE, OUT, END OF MISSION, ESTIMATE 40 CASUALTIES, REMAINDER DISPERSED, OVER

F2 NCS — END OF MISSION, ESTIMATE 40 CASUALTIES, REMAINDER DISPERSED, TARGET ALFA FOXTROT 7022, OVER

The F2 NCS, in making the last transmission above, has in actuality made two transmissions; he has read back to the forward observer his transmission and initiated a transmission to Battery B, giving them end of mission and the target number of the mission. Battery B operator may now answer in one of two ways—he may read back exactly what the F2 NCS has transmitted, or he may omit the forward oberserver's surveillance. His transmission will depend on the local SOP.

Btry B operator — END OF MISSION, TARGET ALFA FOXTROT 7022, OUT

F1 NCS — END OF MISSION, TARGET ALFA FOXTROT 7022, OVER

Btry A operator — END OF MISSION, TARGET ALFA FOXTROT 7022, OUT

F3 NCS — END OF MISSION, TARGET ALFA FOXTROT 7022, OVER

Btry C operator — END OF MISSION, TARGET ALFA FOXTROT 7022, OUT

Note. Each battery ends its transmission with the procedure word OUT because they are the battery that made the last transmission on its fire direction net. No further transmissions are expected or required in this mission.

10-6. Sequence of Short-Phrase, Repeat-Back Transmissions

a. Call for Fire. The radiotelephone operator for a forward observer (PALM CRIMSON 24) operating on fire direction net 1 (F1) calls the F1 NCS (PALM CRIMSON 18) in the battalion fire direction center to establish communications and to inform the battalion fire direction center that he has a fire mission.

Forward observer — PALM CRIMSON 18, THIS IS PALM CRIMSON 24, FIRE MISSION, OVER

F1 NCS — PALM CRIMSON 24, THIS IS PALM CRIMSON 18, FIRE MISSION, OUT

If a fire mission is already being conducted on fire direction net 1, the battalion S3 may direct the forward observer to change to fire direction net 2 or fire direction net 3. Having been directed to send his mission, the radiotelephone operator for the forward observer transmits the call for fire in short phases, omitting call signs when only one mission is being sent on that channel.

Forward observer — *GRID 4322, OVER

F1 NCS — GRID 4322, OUT

Forward observer — 3445, OVER

F1 NCS — 3445, OUT

Forward observer — DIRECTION 800, OVER

F1 NCS — DIRECTION 800, OUT

Forward observer — TWO MACHINEGUNS, VT IN EFFECT, ADJUST FIRE, OVER

F1 NCS — TWO MACHINEGUNS, VT IN EFFECT, ADJUST FIRE, OUT

**Note.* Normally, eight-place coordinates are sent in two transmissions and six-place coordinates are sent in one transmission.

b. Correction of Errors. If any error is made during the transmission or read-back of any element, the operator announces CORRECTION and transmits the correct version of the element in error.

Forward observer . . . . GRID 4322, OVER
F1 NCS . . . . . GRID 4332, OUT
Forward observer . . . . . CORRECTION, GRID 4322, OVER
F1 NCS . . . . . CORRECTION, GRID 4322, OUT

c. Battalion Fire Order. After the call for fire has been received, the battalion S3 issues the fire order, pertinent parts of which are transmitted to the forward observer. This is then read back by the forward observer.

F1 NCS . . . ALFA, 4 ROUNDS, TARGET ALFA FOXTROT 7012, OVER
Forward observer . . ALFA, 4 ROUNDS, TARGET ALFA FOXTROT 7012, OUT

d. Initial Fire Commands to the Battery.

F1 NCS . . . . BATTERY ADJUST, OVER
Btry A operator . . . . . BATTERY ADJUST, OUT
F1 NCS . . . . . SHELL HE, LOT HOTEL, CHARGE 5, FUZE QUICK, OVER
Btry A operator . . SHELL HE, LOT HOTEL, CHARGE 5, FUZE QUICK, OUT
F1 NCS . . CENTER 1 ROUND, BATTERY 4 ROUNDS, VT IN EFFECT, OVER
Btry A operator . . CENTER 1 ROUND, BATTERY 4 ROUNDS, VT IN EFFECT, OUT
F1 NCS . . . DEFLECTION 2765, QUADRANT 381, OVER
Btry A operator . . . DEFLECTION 2765, QUADRANT 381, OUT

When the pieces fire, the operator reports.

Note. Previous establishment of reliable communications between the base set operator, F1, and Battery A operator allows the operator to not use call signs and suffix numbers.

e. Subsequent Corrections and Fire Commands.

Foward observer . SHOT, OUT. . .LEFT 100, DROP 200, OVER
F1 NCS . . . . LEFT 100, DROP 200, OUT. . .DEFLECTION 2784, QUADRANT 365, OVER
Btry A operator . . DEFLECTION 2784, QUADRANT 365, OUT. . .SHOT, OVER
Forward observer . SHOT, OUT. . .ADD 100, OVER
F1 NCS . . ADD 100, OUT. . .DEFLECTION 2787, QUADRANT 373, OVER
Btry A operator . DEFLECTION 2787, QUADRANT 373, OUT. . .SHOT, OVER
Forward observer . SHOT, OUT. . .LEFT 20, DROP 50, FIRE FOR EFFECT, OVER
F1 NCS . LEFT 20, DROP 50, FIRE FOR EFFECT, OUT. . .FUZE VT, BATTERY 2 ROUNDS, DEFLECTION 2788, OVER
Btry A operator . . FUZE VT, BATTERY 2 ROUNDS, DEFLECTION 2788, OUT
F1 NCS . . . . . TIME 20.0, QUADRANT 369, OVER
Btry A operator . . . . . TIME 20.0, QUADRANT 369, OUT. . .SHOT, OVER
Forward observer . . . . SHOT, OUT
Btry A operator . . . . . ROUNDS COMPLETE, OVER
Foward observer . . . . ROUNDS COMPLETE, OUT. . .END OF MISSION, MACHINEGUNS SILENCED, ESTIMATE 4 CASUALTIES, OVER
F1 NCS . . . . . END OF MISSION, MACHINEGUNS SILENCED, ESTIMATE 4 CASUALTIES, TARGET ALFA FOXTROT 7012, OVER
Btry A operator . . . . . END OF MISSION, TARGET ALFA FOXTROT 7012, OUT

10-7. Sequence of Transmission for Special Situations

The flexibility of conduct of fire procedure permits its modification to meet special situations.

a. Fire for Effect, Precision Fire. The radiotelephone procedure used in the fire-for-effect portion of a precision fire mission is similar to that used in adjustment except that, to avoid possible confusion, the operators do not use prowords when spottings are transmitted.

Forward observer . . . SHOT, OUT. . .ADD 50, FIRE FOR EFFECT, OVER
F2 NCS . . . ADD 50, FIRE FOR EFFECT, OUT. . .QUADRANT 295, OVER
Btry B operator . QUADRANT 295, OUT. . .SHOT, OVER
Forward observer . SHOT, OUT. . .SHORT LEFT
F2 NCS . . . SHORT LEFT, DEFLECTION 2810, QUADRANT 299, OVER
Btry B operator . DEFLECTION 2810, QUADRANT 299, OUT. . .SHOT, OVER
Forward observer . SHOT, OUT. . .OVER LINE
F2 NCS . . . . . OVER LINE, DEFLECTION 2812, QUADRANT 297, OVER
Btry B operator . DEFLECTION 2812, QUADRANT 297, OUT. . .SHOT, OVER
Forward observer . SHOT, OUT. . .SHORT LINE
F2 NCS . . . . SHORT LINE, QUADRANT 297, OVER
Btry B operator . QUADRANT 297, OUT. . .SHOT, OVER
Forward observer . . SHOT, OUT. . .SHORT LINE, OVER
F2 NCS . SHORT LINE, DEFLECTION 2811, QUADRANT 297, OVER
Btry B operator . . DEFLECTION 2811, QUADRANT 297, OUT. . .SHOT, OVER
Forward observer . SHOT, OUT. . .SHORT LINE
F2 NCS . SHORT LINE, BASE PIECE 2 ROUNDS, QUADRANT 295, OVER
Btry B operator . BASE PIECE 2 ROUNDS, QUADRANT 295, OUT. . .SHOT, OVER
Forward observer . SHOT, OUT
Btry B operator . ROUNDS COMPLETE, OVER
Forward observer . ROUNDS COMPLETE, OUT. . .OVER LINE, OVER LEFT

F2 NCS . . . . . OVER LINE, OVER LEFT, OBSERVE TIME REGISTRATION, OVER
Forward observer . . . OBSERVE TIME REGISTRATION, OUT
F2 NCS . . . . . TIME 21.0, QUADRANT 285, OVER
Btry B operator . . . FUZE TIME, TIME 21.0, QUADRANT 285, OUT. . .SHOT, OVER
Forward observer . . . . SHOT, OUT. . .AIR
F2 NCS . . . . . AIR, TIME 21.4, QUADRANT 285, OVER
Btry B operator . . . . . TIME 21.4, QUADRANT 285, OUT. . .SHOT OVER
Forward observer . . SHOT, OUT. . .GRAZE
F2 NCS . . . . . GRAZE, OBSERVE 3 ROUNDS, OVER
Forward observer . . . . . OBSERVE 3 ROUNDS, OUT
F2 NCS . . . . . BASE PIECE 3 ROUNDS, TIME 21.2, QUADRANT 285, OVER
Btry B operator . . . . . BASE PIECE 3 ROUNDS, TIME 21.2, QUADRANT 285, OUT. . .SHOT, OVER
Forward observer . . . . . SHOT, OUT
Btry B operator . . . . . ROUNDS COMPLETE, OVER
Forward observer . . . . . ROUNDS COMPLETE, OUT. . .AIR, AIR GRAZE

b. Simultaneous Missions. There are times when it becomes necessary to fire two or more missions simultaneously on the same fire direction net. When this situation arises, it is necessary that stations identify their transmissions in order to avoid confusion. The battalion fire direction center controls all simultaneous missions. *Each station* when receiving or transmitting, *uses its own suffix number.* In the example shown below, the battalion fire direction center indicates that Battery A will fire for F01 (24) and that Battery B will fire for FO 2 (44). The transmissions will be made on fire direction net 1. Interruptions should be made in this procedure only during natural pauses. Such pauses are—

(1) After the call for fire and before the first round is fired.

(2) After a report of SHOT (i.e., during the time of flight).

Example. Simultaneous missions.

FO 1 DARK ERRAND 18, THIS IS DARK ERRAND 24, FIRE MISSION, OVER
Bn FDC . . DARK ERRAND 24, THIS IS DARK ERRAND 18, FIRE MISSION, 29 AVAILABLE OVER
FO 1 29 AVAILABLE, OUT
FO 1 . DARK ERRAND 29, THIS IS DARK ERRAND 24, FIRE MISSION, OVER
A FDC . DARK ERRAND 24, THIS IS DARK ERRAND 29, FIRE MISSION, OUT
FO 1 . . GRID 43218213, DIRECTION 800, OVER
A FDC . GRID 43218213, DIRECTION 800, OUT
FO 1 . . . . TWO MACHINEGUNS FIRING, VT IN EFFECT ADJUST FIRE, OVER
A FDC . . . . . TWO MACHINEGUNS FIRING, VT IN EFFECT ADJUST FIRE, OUT
A FDC . . . . . 29 5 ROUNDS, TARGET ALFA FOXTROT 7829, OVER
FO 1 . . . . . 29 5 ROUNDS, TARGET ALFA FOXTROT 7829, OUT
A FDC . . SHOT, OVER
FO 1 . . . SHOT, OUT
FO 2 . . . . DARK ERRAND 18, THIS IS DARK ERRAND 44, FIRE MISSION, OVER
Bn FDC . DARK ERRAND 44, THIS IS DARK ERRAND 18, FIRE MISSION, 49 AVAILABLE, OVER
FO 2 . . . . 44, 49 AVAILABLE, OUT
FO 2 . . . . DARK ERRAND 49, THIS IS DARK ERRAND 44, FIRE MISSION, OVER
B FDC . . DARK ERRAND 44, THIS IS DARK ERRAND 49, FIRE MISSION, OUT
FO 2 . . . . 44, GRID 422189, DIRECTION 980, SURVEY PARTY IN OPEN, ADJUST FIRE, OVER
B FDC . 49, GRID 422189, DIRECTION 980, SURVEY PARTY IN OPEN, ADJUST FIRE, OUT
FO 1 . . . 24, RIGHT 100, DROP 200, OVER
A FDC . . . . . 29, RIGHT 100, DROP 200, OUT
B FDC . . 49, SHOT, OVER
FO 2 . . . 44, SHOT, OUT
A FDC . . 29, SHOT, OVER
FO 1 . . 24, SHOT, OUT
B FDC . 49, 3 ROUNDS, TARGET BRAVO JULIET 7716, OVER
FO 2 . . . 44, 3 ROUNDS, TARGET BRAVO JULIET 7716, OUT
FO 1 . . 24, ADD 100, OVER
A FDC . . 29, ADD 100, OUT
A FDC 29, SHOT, OVER
FO 1 . 24, SHOT, OUT
FO 2 . . 44, LEFT 50, ADD 100, OVER
B FDC . . 49, LEFT 50, ADD 100, OUT
B FDC . 49, SHOT, OVER
FO 2 44, SHOT, OUT

Note. The missions continue in this manner until one firing unit has completed its task. Thereafter, suffix numbers are omitted.

c. Splash and Standby Procedure. In circumstances in which the warning SPLASH must be transmitted to the forward observer or in which the warning STANDBY must be transmitted to the spotter (SP), the following radiotelephone procedure will apply:

(1) Assume that the forward observer has requested SPLASH from the FDC or that the spotter has requested STANDBY from the fire support ship (FSS). When the guns have been firing, the following will be transmitted:

Field artillery	*Naval gunfire*
FDC—SHOT, OVER	FSS—SHOT. . .STANDBY, OUT
FO—SHOT, OUT	
FDC—SPLASH, OVER	

(2) SPLASH or STANDBY are transmitted 5 seconds prior to the burst of the projectile.

Field artillery	*Naval gunfire*
FO—SPLASH, OUT	
FO—LEFT 100, DROP 400 OVER	SP—LEFT 100, DROP 400, OVER
FDC—LEFT 100, DROP 400, OUT	FSS—LEFT 100, DROP 400, OUT
FDC—SHOT, OVER	

Field artillery	*Naval gunfire*
FO—SHOT, OUT	
FDC—SPLASH, OVER	FSS—SPOT. . .STANDBY,
FO—SPLASH, OUT	OUT

Note. In the adjustment of naval gunfire, the transmission SHOT. . .STANDBY is terminated with OUT, with no read-back required.

d. Relay Procedure. In circumstances in which direct radio contact between the forward observer and the fire direction center or the fire support ship cannot be established because of such factors as distance or terrain, and pending the availability of automatic retransmission equipment, the relay procedure shown below is prescribed and will be used by all concerned, as fit. Normally relay is accomplished by the field artillery fire support officer and the naval gunfire liaison officer, as appropriate at the combat battalion. For an example, assume that direct radio contact cannot be established between the FO and the FDC or the SP and the FSS. However, the field artillery fire support officer (DARK ERRAND 76) is able to contact both the FO and the FDC. Similarly, the naval gunfire liaison officer (LOST PARROT 26 OSCAR) is able to contact both the SP and the FSS. If the liaison officer hears no reply to the preliminary call, he will, without instructions or request, transmit as follows:

Field artillery	*Naval gunfire*
FSO—DARK ERRAND 18, THIS IS DARK ERRAND 76, FROM DARK ERRAND 64, FIRE MISSION, OVER	LO—MUSTANG UNION, THIS IS LOST PARROT 26 OSCAR, OVER
FDC—DARK ERRAND 76, THIS IS DARK ERRAND 18, FIRE MISSION, OUT	FSS—LOST PARROT 26 OSCAR, THIS IS MUSTANG UNION, OUT
FSO—76, OUT	LO—LOST PARROT 26 CHARLIE, SEND YOUR MISSION, OVER

With communication now established, the FO and the SP continue with the call for fire.

Note. To permit the originator to correct any mistake made by the relay station, there should be a pause of 5 seconds between the relay station transmission and the read-back.

Field artillery	*Naval gunfire*
FO—FROM REGISTRATION POINT 1, DIRECTION 940, RIGHT 600, OVER	SP—TARGET NUMBER 1357 BEARING 5460 MILS, GRID 598610, HEIGHT 120, ANTITANK WEAPONS, DANGER SOUTH 800, 2 GUNS MAIN ARMAMENT, ADJUST FIRE, OVER
FSO—76, FROM REGISTRATION POINT 1, DIRECTION 940, RIGHT 600, OVER	TITANK WEAPONS, DANGER SOUTH 800, 2 GUNS MAIN ARMAMENT, ADJUST FIRE, OVER
FDC—FROM REGISTRATION POINT 1, DIRECTION 940, RIGHT 600, OUT	LO—TARGET NUMBER 1357, BEARING 5460 MILS, GRID 598610, HEIGHT 120, ANTITANK WEAPONS, DANGER SOUTH 800, 2 GUNS MAIN ARMAMENT, ADJUST FIRE, OVER
The mission continues in this manner until all elements of the call for fire have been received and read back by the FDC.	FSS—TARGET NUMBER 1357, BEARING 5460 MILS, GRID 598610, HEIGHT 120, ANTITANK WEAPONS, DANGER SOUTH 800, 2 GUNS MAIN ARMAMENT, ADJUST FIRE, OUT

The relay station reads back that portion of the call for fire transmitted by the FO or the SP and transmits the information to the FDC or the FSS. In field artillery only, the suffix number of the relay station is retained to insure that the originating and receiving stations are not confused.

Field artillery	*Naval gunfire*
FDC—BATTERY 5 ROUNDS, TARGET BRAVO GOLF 7112, OVER	FSS—GUN-TARGET LINE 1200 MILS GRID, FIRST SALVO AT NORTH 800, READY, 25, OVER
FSO—76, BATTERY 5 ROUNDS, TARGET BRAVO GOLF 7112, OVER	LO—GUN-TARGET LINE 1200 MILS GRID, FIRST SALVO AT NORTH 800, READY, 25, OUT
FO—BATTERY 5 ROUNDS, TARGET BRAVO GOLF 7112, OUT	SP—FIRE, OVER
FSO—76, OUT	LO—FIRE, OUT

The mission continues to be transmitted, relayed, and acknowledged in this manner until it is finished. After the firing units and FDC have completed the fire mission, the FSO transmits 76, OUT to inform the FO that no further transmission is expected.

Note. The relay procedure described above illustrates the method employed by an intermediate station in relaying a call for fire. The relay was completed without the aid of operating instructions, address designations, etc. However, when necessary, the originating station will use whatever transmission instructions are required to complete the mission.

CHAPTER 11

TELEPHONE AND SWITCHBOARD PROCEDURE

11-1. General

To effectively put to use the wire communication that a unit has on hand, all persons who use this means of communication should be familiar with the proper procedure and techniques needed in its operation.

11-2. Telephone Directory

The purpose of the military telephone directory is to simplify and to speed up communication in a field telephone system. The telephone directory consists of two parts, directory names and directory numbers, both of which are found in the CEOI-CESI. Telephone directory names are assigned to organizations normally equipped with switchboards. The names are changed when there is a chance of confusion with directory names of other divisions or units or for security reasons. Command and staff officers and installations *not* normally equipped with switchboards are assigned telephone directory numbers. The military telephone directory is prepared as part of the CEOI-CESI by the communications-electronics officer of the division or of a higher echelon.

a. Directory Names. Directory names of all major units of a division begin with the same letter. Separate battalions and batteries are assigned separate directory names. Units at battery level use the directory name of their battalion plus the correct suffix; for example, ALFA, BRAVO, or CHARLIE. A separate battery may be assigned a directory name or may be assigned a telephone number as a suffix to the directory name of its parent unit. Directory names should not be used alone but should always be used in conjunction with the appropriate directory number or echelon of the installation being called.

b. Directory Numbers. Telephone directory numbers, once assigned, are not changed. The same number is appointed for similar officers and offices throughout the command to prevent confusion. A complete list is published in the unit CESI. Each telephone is assigned a directory number or is identified by an appropriate abbreviation or word description of the installation.

11-3. Telephone Operation

The telephone is used to provide personal contact between two or more individuals. Conversations should be as short as possible. Written messages should not be transmitted by telephone unless it is unavoidable and/or speed is essential.

a. Classification of Calls. There are two types of telephone calls, *urgent* and *routine.*

(1) An urgent call is one that is given precedence over existing circuits to the extent that it warrants interruption of a connection already made. However, one urgent call normally will not interrupt another urgent call already in progress. Urgent calls are reserved for reports containing information that may materially affect plans or change a course of action, such as reports of initial contact with the enemy, amplifying or subsequent enemy contact reports, and artillery fire missions. Normally, only personnel designated by the commander are authorized to place urgent calls; however, in an emergency, anyone may place an urgent call.

(2) Routine calls have no precedence but are handled in the order in which they are received by the operator. Routine calls constitute the bulk of the traffic handled over a military wire system. These calls may contain routine information that, although important, does not require special handling. All personnel using the military telephone system are authorized to place routine calls.

b. Placing Calls. In placing a telephone call, the calling party must be familiar with, or refer to, the telephone directory. Switchboard operators should not be required to look up telephone directory names and numbers for the calling party.

(1) In placing an urgent call, the calling party initiates the call, using the operating phrase URGENT CALL FOR. He then announces the called party's telephone directory name and number followed by the operating phrase THIS IS and his official designation. For example, an urgent call from the fire support officer, 1st Battalion, 3d Field Artillery, to the battalion commander would be announced to the switchboard operator as URGENT CALL FOR KENNEL 7, THIS IS KENNEL 9.

(2) In placing a routine call, the calling party announces to the switchboard operator the directory name and number of the called party. For example, a routine call from the commanding officer of Battery A, 1st Battalion, 3d Field Artillery, to the battalion S3 would be announced to the switchboard operator as KENNEL 3.

c. Response. In response to telephone calls, the answering party should state the directory name and number of the telephone and his official

designation; for example, KENNEL 7, COMMANDING OFFICER SPEAKING; KENNEL 3, S3 SPEAKING; KENNEL 3, OPERATOR SPEAKING.

d. Conversations. The procedure in person-to-person conversations, other than that used in placing and answering the call, follows no particular pattern of operating words and phrases. To obtain maximum benefit from the military telephone system, the user should know what he wants to say before he places the call. The use of prepared notes is recommended.

e. Oral Messages. The transmission of an oral message differs from person-to-person conversations in that the persons transmitting and receiving the message usually are not the originator and the addressee. An oral message normally is not written on the prescribed message form or submitted to the message center for transmission; however, since a third person is involved, operating words and phrases are used. For example, after the calling and called parties have been connected, the word MESSAGE is used by the transmitting operator to alert the receiving operator that a message that requires recording is about to follow. Procedure words and phrases, such as READ BACK, I READ BACK, THAT IS CORRECT, WRONG, SAY AGAIN, I SAY AGAIN, ROGER, OVER, AND OUT, are used by both parties when applicable.

(1) Assume that the S3, 1st Battalion, 3d Field Artillery, tells his operations sergeant to call the commanding officer of Battery A and give him the following message: HAVE SURVEY DETAIL CONSISTING OF 4 MEN AND 1 VEHICLE REPORT TO POINT XRAY AT 1320 SIERRA. The operations sergeant, using the S3 phone, rings the switchboard operator and says KENNEL ALFA 7.

(2) The switchboard operator puts the call through, and the battery commander's operator answers KENNEL ALFA 7, OPERATOR SPEAKING.

(3) The operations sergeant then transmits THIS IS KENNEL 3, OPERATIONS SERGEANT SPEAKING, MESSAGE FOLLOWS, READ BACK, HAVE SURVEY DETAIL CONSISTING OF 4 MEN AND 1 VEHICLE REPORT TO POINT XRAY AT 1320 SIERRA, OVER.

(4) The receiving operator at KENNEL ALFA 7 transmits I READ BACK, HAVE SURVEY DETAIL CONSISTING OF 4 MEN AND 1 VEHICLE REPORT TO POINT XRAY AT 1320 SIERRA, OVER.

(5) The message was read back correctly, and the operations sergeant transmits CORRECT, OUT.

11-4. Switchboard Operating Phrases

The switching central provides the wire system with flexibility and is the heart of the wire system. It is important that all switchboard operators and communication personnel use a standardized procedure and method in operating the switchboard. A complete list of words and phrases to be used by operators, for all types of operations, is published in ACP 13-4. A partial list of the more commonly used operating phrases is given in *a* through *m* below.

a. KENNEL OPERATOR—In answering an incoming call, the switchboard operator announces his telephone directory name followed by the word OPERATOR.

b. KENNEL 7—On receiving the number from the calling party, the switchboard operator repeats the telephone directory name and number exactly as it was given to him by the calling party.

c. WHAT NUMBER PLEASE—Phrase used by the operator to request repetition of a number that he has not understood.

d. THE LINE IS BUSY—Phrase used by the operator to report that the local telephone is already in use or that all trunks to a desired central are in use.

e. KENNEL 7, URGENT CALL—On receiving an urgent call, the switchboard operator repeats the telephone directory name and number followed by the phrase URGENT CALL.

f. ACORN DOES NOT ANSWER—Phrase used by the KENNEL operator to inform the calling party that the called telephone center (ACORN) does not answer.

g. I WILL RING AGAIN—Phrase used by the operator when, in supervising a connection, he is informed that the called party did not answer.

h. WHAT IS YOUR NUMBER PLEASE—Phrase used by the operator if, after supervising a connection, he is given a new number to call by one of the parties but is unable to identify the calling party.

i. HAVE YOU FINISHED—Phrase used by the operator in supervising a connection. He repeats the challenge once more; if no reply is heard, he breaks the connection.

j. CONFERENCE CALL, KENNEL 6, KENNEL 3, KENNEL 2, I WILL CALL YOU BACK—Phrases used by the operator to indicate that he has understood correctly the numbers given to him by the calling party and that, after completing the calls, he will call the originator back as requested.

k. CONFERENCE CALL, KENNEL 6, KENNEL 3, KENNEL 2, ONE MOMENT PLEASE—Phrases used by the operator to indicate that he has understood correctly the

numbers given to him and to hold the calling party on the line while the connection is being completed.

l. CONFERENCE CALL FOR YOU, ONE MOMENT PLEASE—Phrases used by the operator to inform the called party that he has a conference call for him and that there will be a delay in completing the connection.

m. YOUR CONFERENCE CALL, GO AHEAD, PLEASE—Phrase used by the operator to inform the calling party that the connection is complete and conversation may begin.

CHAPTER 12

AERIAL FIELD ARTILLERY COMMUNICATIONS

12-1. General

The communication system of the aerial field artillery battalion enables the battalion to react with speed and decisiveness. It is essential that the system be capable of continuous communication with higher, adjacent, and supported and/or reinforced headquarters. All means of communication are used, and maximum use must be made of both communications security devices and communication security techniques.

12-2. Communication Requirements, Aerial Field Artillery Battalion and Battery

The communication requirements of the aerial field artillery battalion and battery are generally the same as those of other field artillery battalions and batteries.

a. The requirements of the aerial field artillery battalion are described in (1) and (2) below.

(1) *Internal requirements.* The internal communication requirements of the aerial field artillery battalion are those necessary for internal command and administration of the battalion, to include facilities for—

(a) Tactical and administrative control, to include aircraft control and flight operations.

(b) Fire direction and fire control.

(c) Collection, exchange and dissemination of information and intelligence.

(d) Dissemination of warnings.

(e) Dissemination of weather information.

(f) Dissemination of airspace use information.

(2) *External requirements.* The external communication requirements of the aerial field artillery battalion are those necessary for communication with higher, adjacent, and supported and/or reinforced units, to include facilities for—

(a) Receipt of tactical orders and administrative supervision.

(b) Receipt of fire missions.

(c) Collection, exchange, and dissemination of information and intelligence.

(d) Receipt of warnings.

(e) Receipt of weather information.

(f) Receipt of airspace use information.

b. The battalion and battery communications sections are divided into radio and wire sections. Wire plays a lesser role; normally, wire communications will be laid for internal communications only. Amplitude modulated (AM), single sideband (SSB), and frequency modulated (FM) radios are found throughout the battalion and are used to maintain the required radio nets. Maximum utilization of speech security equipment in frequency modulated nets is made in order to provide partial voice secure communications on these nets. UHF/VHF radios are used for aircraft control and direction. The battalion internal and external radio nets are listed in (1) and (2) below.

(1) *Internal.*

(a) Battalion command/fire direction net, FM.

(b) Battalion command/fire direction net, AM-SSB (Voice).

(c) Battalion aircraft control net FM (UHF/VHF).

(2) *External.*

(a) Division artillery command/fire direction net, FM.

(b) Division artillery command/fire direction net, AM-SSB, (RATT).

(c) Reinforced artillery unit command/fire direction net, FM.

c. The aerial field artillery battery internal and external nets are listed in (1) and (2) below.

(1) *Internal.* Battery command/fire direction net.

(2) *External.*

(a) Battalion command/fire direction net, FM.

(b) Battalion command/fire direction net, AM-SSB (voice).

(c) Battalion aircraft control net, FM (UHF/VHF).

(d) Reinforced artillery unit command/fire direction net, FM or Reinforced artillery unit fire direction net, FM.

d. The Communications-Electronics Operation Instructions (CEOI) and the Communications-Electronics Standing Instructions (CESI) provide information regarding frequencies, nets, unit call signs, and codes. Additional communications-electronics information can be found in the unit SOP, paragraph 5 of the Operation Order and/or in the Communications-Electronics Annex of the Operation Order.

12-3. Communications Security and Electronic Warfare

a. General. The mission of the battalion makes it a profitable target for enemy communications intelligence and electronic warfare actions. The battalion must use all available security equip-

ment and measures to reduce the effect of such actions and its operations.

b. Electronic Warfare. FM 32-20 provides general guidance for employment of electronic counter-countermeasures in unit radio operations. Special attention is required to provide for another means of communication to reduce the effect of jamming. Actual or suspected jamming and imitative deception communications activities by the enemy will be reported to the net control station (NCS) by secure means, such as speech-secure equipment and/or authorized codes.

c. Communications Security (COMSEC). COMSEC is the protection resulting from all measures designed to deny unauthorized persons information of value that might be obtained from the possession and study of communications or to mislead unauthorized persons in their interpretation of the results of such a study. All commanders training personnel in communications should be thoroughly familiar with the provisions of FM 32-5 and FM 32-6.

12-4. Wire System

The size of the aerial field artillery battalion wire system depends on the tactical situation, the length of time the unit remains in position areas, and the mission assigned to the unit. Normally, wire communications will be established for internal communications only; however, as a minimum, external wire communications should be established to the local area communications center providing the battalion access into the division area multichannel communications system. Switchboards are used where needed to ease control. For detailed information on communications security of wire systems, see FM 32-5.

CHAPTER 13

TRAFFIC DIAGRAM AND LINE ROUTE MAP

13-1. Traffic Diagram

A traffic diagram is an illustration showing the telephone and teletypewriter circuits existing between switching centrals of a wire system. Long local circuits may also be shown.

a. Preparation. A traffic diagram is prepared at each switching central by the wire chief or chief operator, assisted by the operator on duty. The operator will keep the traffic diagram updated during his tour of duty. The traffic diagram may be drawn on the yellow strip provided on the switchboard. Circuits will be tested and determined to be in operating condition before they are recorded on the traffic diagram.

b. Purpose. The traffic diagram is used by the switchboard operator to route calls by the most direct route. A traffic diagram also shows alternate routes for use when direct routes are busy or out of service.

c. Security. Local security measures will determine the extent of information that will be placed on traffic diagrams.

13-2. Constructing a Traffic Diagram

A switching central is indicated by the appropriate directory name inclosed within a large circle on the traffic diagram (fig 13-1). Unit designations may be shown by symbols when security is not jeopardized. A local telephone is represented by a small circle with an identifying abbreviated designation.

a. A trunk circuit is indicated by a single line drawn between switching centrals.

b. A local circuit is represented by a single line drawn between the appropriate symbols; e.g., between a switching central and a telephone.

c. The number of channels available is indicated by a number placed along the line between switching centrals. Simplex circuits and phantom circuits are included as channels only when the switchboard operator can control these circuits; e.g., when the phantom or simplex circuit is terminated through a repeating coil and a line pack.

d. When possible, systems connecting higher, lower, and adjacent units should be included in the diagram.

e. Marginal information is not included in a traffic diagram. However, if a copy of the traffic diagram is to be forwarded to higher headquarters, the copy forwarded should include the—

(1) Name of the diagram.
(2) Unit designation of the originator.
(3) Date and time of preparation.
(4) Authentication. (The communication-electronics officer or his authorized representative must sign the traffic diagram before it is forwarded.)

f. Figure 13-1 represents a traffic diagram prepared by the 1st Battalion, 3d Field Artillery, to be forwarded to higher headquarters.

13-3. Line Route Map

a. Definition. A line route map is a map, a map substitute, or an overlay, suitably titled, on which the actual or projected routes of wire circuits are shown. The line route map does not show the actual connection at the switching central.

b. Uses. The principal uses of the line route map are to report the physical location of wire circuits as actually installed on the ground, to direct the installation of the wire system, to aid in the maintenance of the wire system, to aid in the recovery of wire, and to turn wire circuits over to a relieving unit.

c. Preparation. The battalion communications-electronics officer is responsible for the construction, use, forwarding, and safeguarding of the battalion line route map. The line route map is prepared in duplicate. It normally is prepared by the wire chief and checked by the communication chief. When so directed, the battery wire team chief prepares the battery line route map.

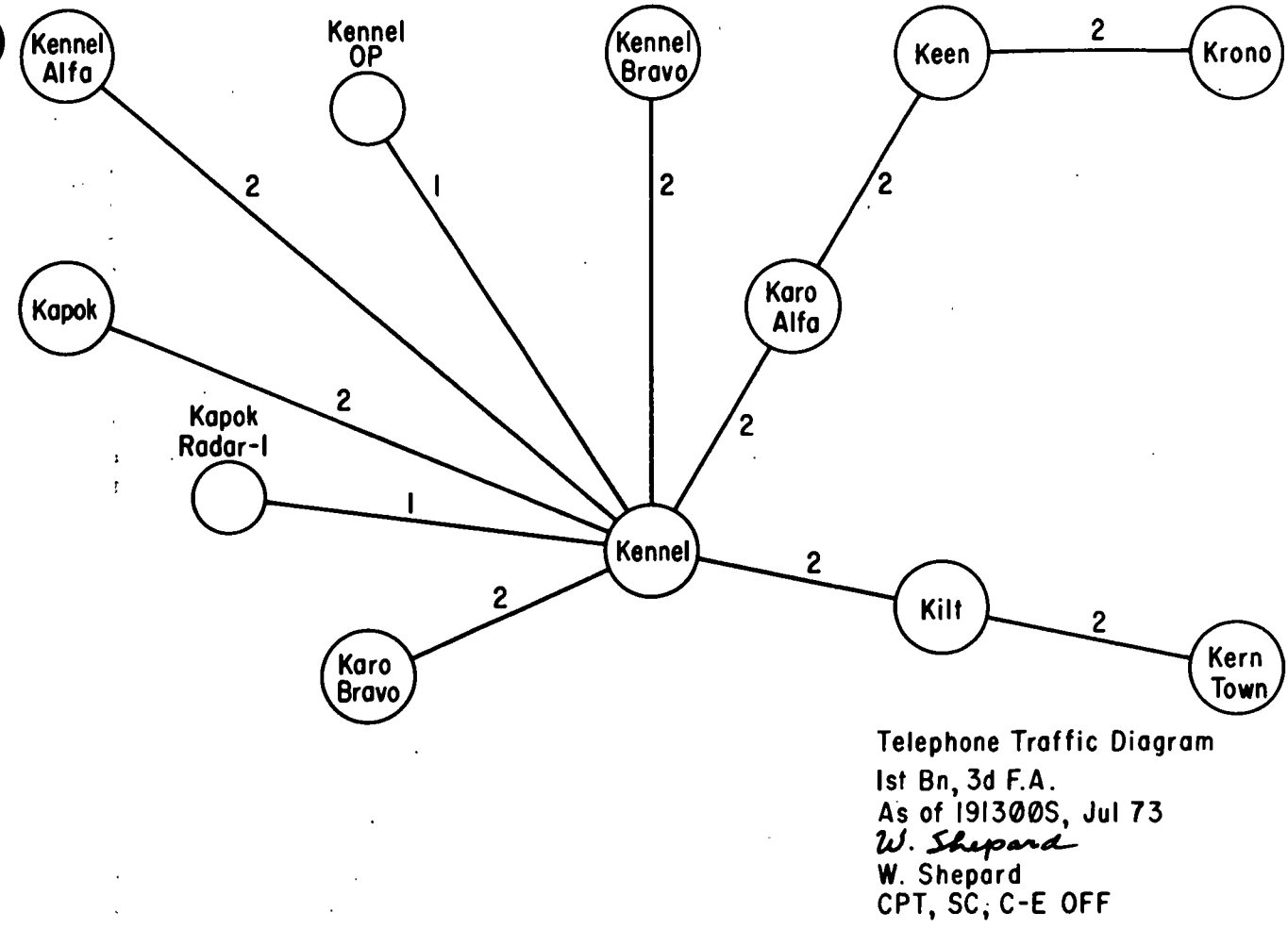
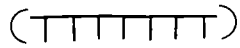
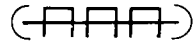


Figure 13-1. Type traffic diagram.

d. Disposition. One copy of the line route map is sent to the next higher headquarters; the other copy is posted in the vicinity of the switchboard of the originating headquarters. Battery line route maps are forwarded as directed or in accordance with local standing operating procedures.

e. Construction. The line route map should contain only those lines, symbols, and notations necessary for clarity. Each headquarters or establishment served by the wire system is shown by the authorized military symbol. Switching centrals, which are part of the wire system; each switching central is shown by the authorized military symbol. A telephone, when shown, is represented by a small circle. A trunkline or long local is represented by a single line drawn along the exact route over which the circuit is installed. The number of physical circuits installed along a particular route is indicated by a number placed next to the line. Simplex and phantom circuits are not shown on the line route map. Field wire circuits indicated on the line route map are laid on the ground unless otherwise indicated. An overhead circuit  or underground circuit  is shown by the appropriate symbol. A line route map prepared on overlay paper includes at least two widely separated orientation points taken from the map from which the overlay was made. The following information will be placed on the line route map wherever space is available:

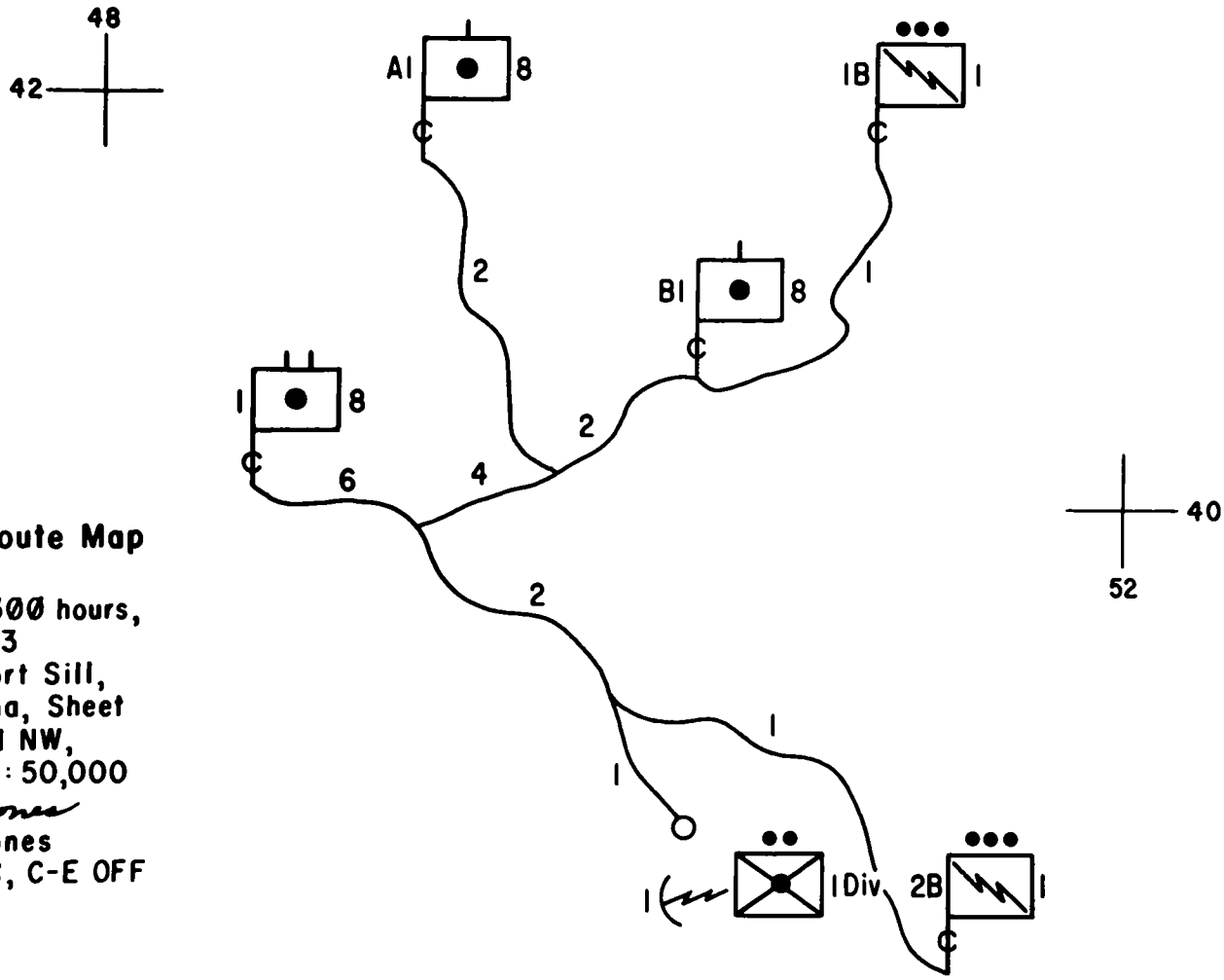
(1) The title (Line Route Map).

(2) The designation of the unit preparing the line route map.

(3) The date and time of preparation.

(4) The title and scale of the map.

(5) Authentication. The line route map normally is authenticated by the unit communications-electronics officer.



Line Route Map
1st F.A.
As of 1300 hours,
19 Jul 73
Map - Fort Sill,
Oklahoma, Sheet
6353 III NW,
Scale, 1 : 50,000
W. L. Jones
W. L. Jones
CPT, SC, C-E OFF

Figure 13-2. Type line route map overlay.

f. Security. Line route maps normally will not be taken into forward areas. Maintenance crews will carry only the extracts that pertain to their particular mission. Such extracts will not include unit designations.

g. Typical Line Route Map. Figure 13-2 shows a typical line route map prepared by the 1st Battalion, 8th Field Artillery.

h. Conversion of Map Distance to Actual Distance. The conversion chart below is a convenient means for converting map distances, measured in inches or centimeters on maps of various scales, into actual distance on the ground. The table can also be used for planning wire installations and estimating the actual amount of wire required for a particular situation.

CHAPTER 14

FIELD EXPEDIENTS

Section I. GENERAL

14-1. Causes of Poor Communication

Poor radio communication or lack of radio communication can be due to a variety of reasons. It is imperative that communication personnel understand the application of field expedients for maintaining radio communication. When available, antenna group RC-292 should be used to increase the range of, or to obtain better communication with FM radios. If the equipment is in good condition and is operated properly, other causes of poor communication or lack of communication must be considered. For example:

a. Too great a distance between sets.

b. Bad terrain, such as hills and mountains.

c. Poor choice of location at one or both ends of the circuit.

d. Insufficient battery power.

e. Noise and interference.

14-2. Operating Hints.

a. The following operating hints are useful in obtaining good communication:

(1) Use a headset instead of a loudspeaker when the signal is weak. This will cut out local noise.

(2) Be sure the microphone or handset is in good condition. Allow a few seconds for the transmitter tubes to warm up after pressing the press-to-talk switch; then speak directly into the microphone. Speak slowly and distinctly.

(3) If the set is in a vehicle, run the engine of the vehicle or generator enough to keep the battery charged.

(4) Moving the antenna a few feet to a new location may improve reception.

(5) Use CW in place of voice for increased range on AM radios.

(6) Do not start a vehicle when the radio is on.

b. When a grounded quarter-wave whip antenna is mounted on a vehicle, the metal of the vehicle will affect the operation of the antenna. As a result, the direction in which the vehicle is facing may also affect the transmission and reception of signals, especially distant or weak signals. A radio with a whip antenna mounted on the left rear of the vehicle will transmit its strongest signal in a line running from the antenna through the right front of the vehicle. The solid arrows in figure 14-1 show the direction of transmission. In some cases, the best direction can often be determined by driving the vehicle in a small circle until the best position is located. The best direction for receiving from a distant station is also the best direction for transmitting to that station.

Note. The AN/VRC-12 series of radio sets use a center-fed, half-wave antenna (AT-912/VRC or AS-1729/VRC). The mass of the vehicles will not appreciably affect the radiation pattern.

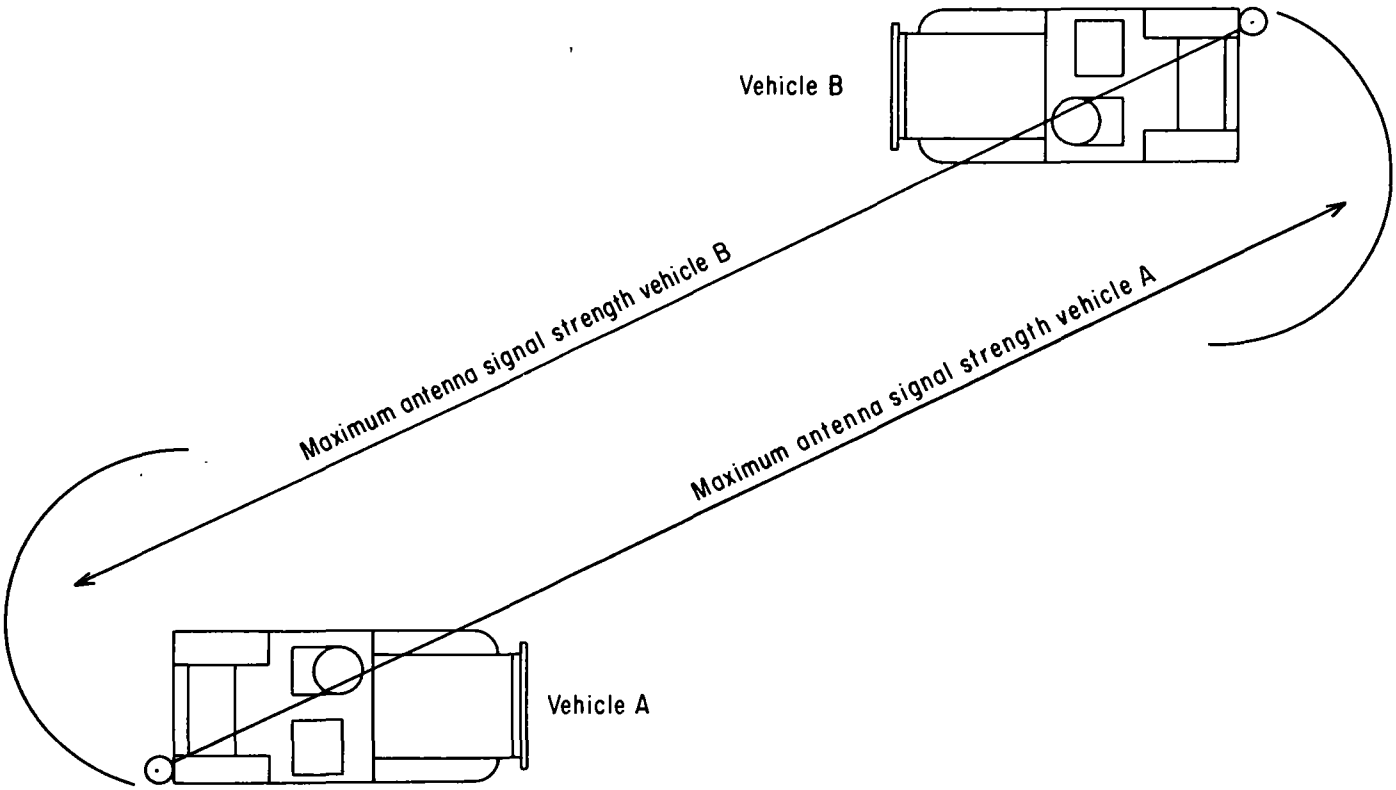


Figure 14-1. Best directivity of whip antenna mounted on vehicle.

Section II. IMPROVISED ANTENNAS

14-3. Vertical Antennas

Nearly all the radio sets in the combat areas use whip antennas. This is the type of antenna that commonly is used with sets mounted in vehicles and with manpack sets that operate in motion. More detailed information on antennas can be found in the manual pertinent to the set being used and in FM 24-18. Whip antennas may be broken in use. When replacements are not immediately available, it is possible to improvise a satisfactory antenna by using telephone cable WD-1/TT (fig 14-2) or by lashing together the broken pieces (fig 14-3).

14-4. Horizontal Antennas

When the situation does not require mobility and the antenna group RC-292 is not available, greater distance may be obtained by the use of horizontal antennas. Figures 14-4 and 14-7 show the construction of two types of horizontal antennas that will greatly extend the transmission range of a radio set. Note, however, that a huge reduction in received signal strength results when the antennas of a radio circuit (except a skywave circuit) are not of the same polarization.

a. Wave Antenna Without Resistor and Ground. The most practical antenna for antijamming use in a tactical unit for the FM radio is the field expedient long-wire antenna. Maximum radiation is off the ends of the antenna, which tends to reject or reduce signals received from other directions. The long-wire antenna must be a minimum of 3 wavelengths long (100 to 150 feet) for current tactical FM radio set and should be made of telephone cable WD-1/TT. One end of the directional longwire antenna is connected directly to the antenna receptacle on the receiver-transmitter, and the other end is pointed toward the station with which communication is desired.

b. Wave Antenna with Resistor and Ground.

(1) The wave antenna (fig 14-4) is a highly directional long-wire antenna. To complete the physical length of this or any antenna, use the formula $L = \frac{468}{F\ (MHz)}$, where L represents the length in feet, 468 is a constant, and F represents the operating frequency in megahertz.

(a) As an example, if you are operating on 24 megahertz and you desire to construct a wave antenna 2½ wavelengths long, you compute the half-wavelength as follows:

$$L = \frac{468}{F\ (MHz)}, \text{ or } L = \frac{468}{24}, \text{ or } L = 19.5 \text{ feet.}$$

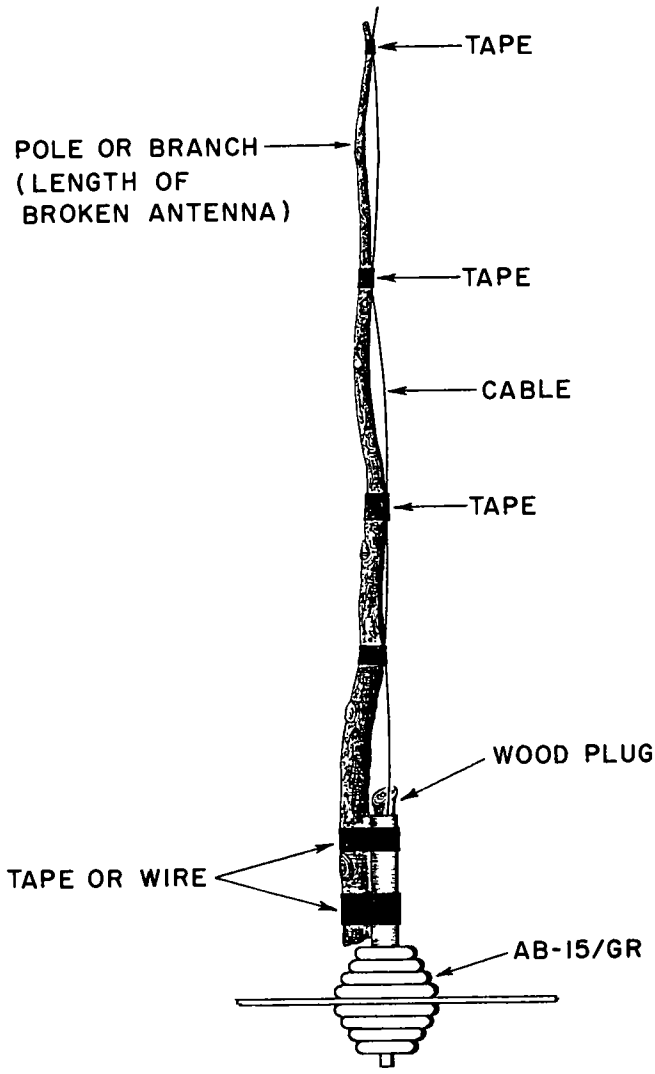


Figure 14-2. Emergency repair of ship antenna using Telephone Cable WD-1/TT.

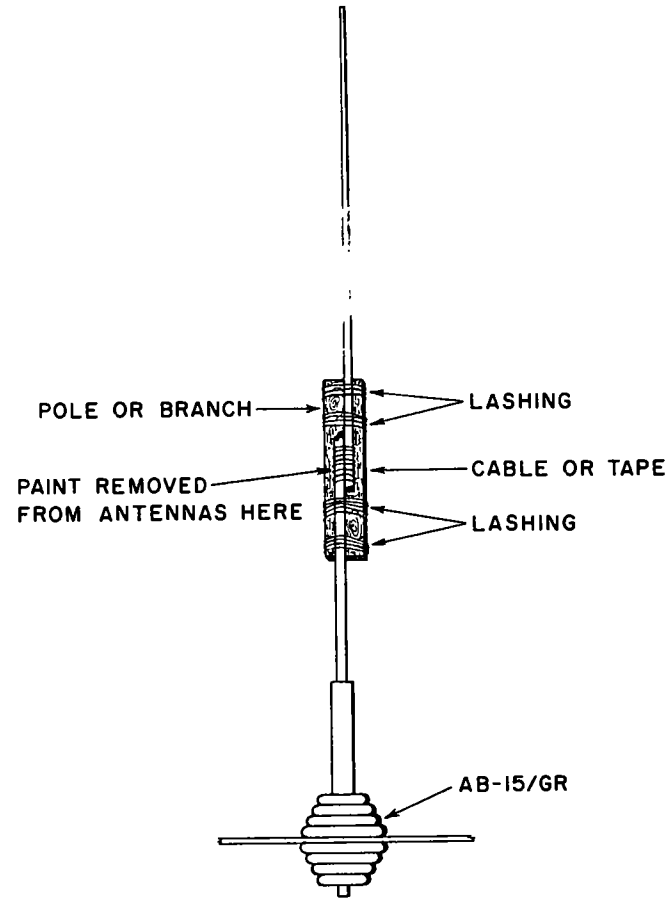
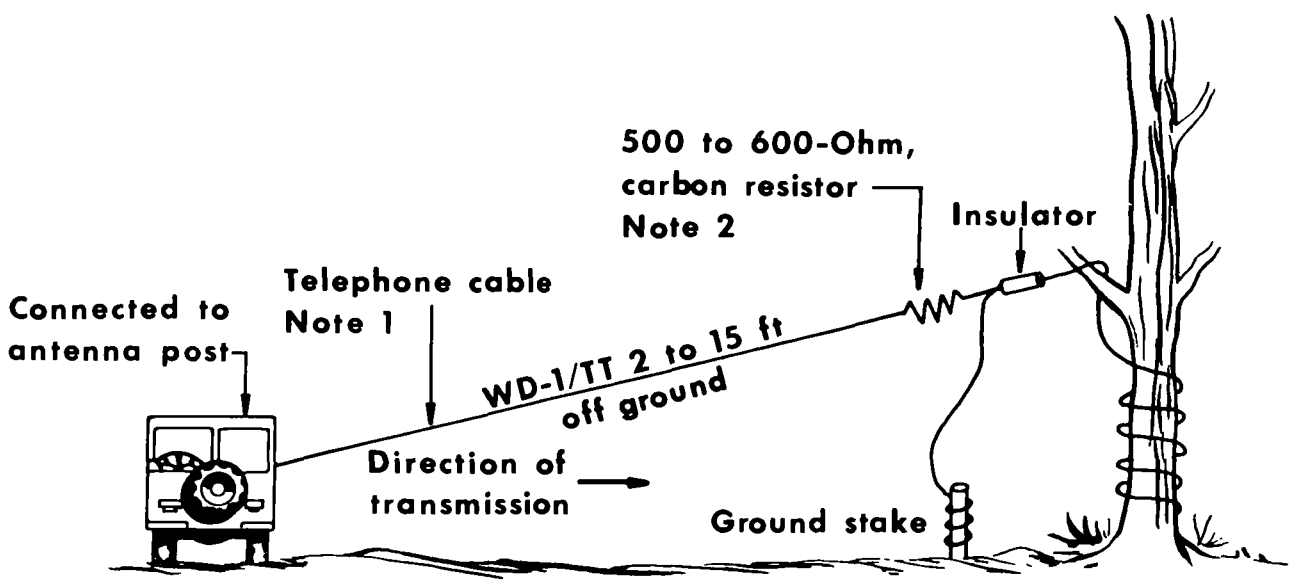


Figure 14-3. Emergency repair of whip antenna using broken antenna sections.

(b) If 19.5 feet represents a half-wavelength, a full wavelength (one wavelength) is equal to 39 feet (twice the length of the half-wavelength). Multiply 39 feet by 2½ for the actual length of the 2½-wavelength antenna. The actual length is 97.5 feet. As the antenna length is increased from the half-wavelength, the antenna becomes more undirectional. This is illustrated in figure 14-6. The lobes represent the direction of transmission.

(2) A suspended antenna causes considerable pull on the radio set at the connection. Difficulty may be experienced in keeping the antenna connected to the binding post. To overcome the difficulty, remove the regular whip antenna from the mounting base. Place a broken stub in the mounting base. Drill a hole through the broken stub, push the end of the antenna through the hole, and tie the antenna to the stub. The connection to the radio set is already on the stub. This expedient will keep the weight of the wire from pulling the wire away from the binding post. Be sure to remove the paint from the area on the stub where the antenna is connected (fig 14-5).

c. Center-Fed Hertz (Doublet) Antenna. The center-fed Hertz (doublet) antenna is a half-wave antenna which can be used with AM and AM (SSB) radio equipment. It consists of two quarter-waves, one on each side of the center insulator. The antenna is suspended in the air at a height of 10 to 50 feet. For ideal use, the antenna should be suspended as close to one-half wavelength above ground as possible. The formula for computing the physical length of this antenna is the same as that for computing the physical length for the wave antenna. Bring the twisted pair of lead-in wires to the front panel of the radio set. Strip about one-half inch of insulation from each end of the wire. Bring one lead to the 50-ohm terminal and insert it into the small center connection of the connector. Push the spring-loaded guard back to the left and secure it out of the way with a block of wood or by other means. The lead must make contact with the "hot," or center, connection and not be allowed to touch the outside shell. Ground the other lead by loosening any screw on the front panel, scraping paint from under screwhead, inserting the wire behind the screw, and tightening the screw. This antenna radiates on both sides, broadside to its length (fig 14-6), and will greatly increase the transmission planning range of the radio set.



Formula for length of Half Wave

Length (in feet) $= \frac{468}{\text{Frequency (in MHz)}}$

Note 1: This antenna is preferably two or more wave lengths long.

Note 2: Capable of handling one half of the transmitter output power.

Figure 14-4. Wave antenna for use with AM and FM radios.

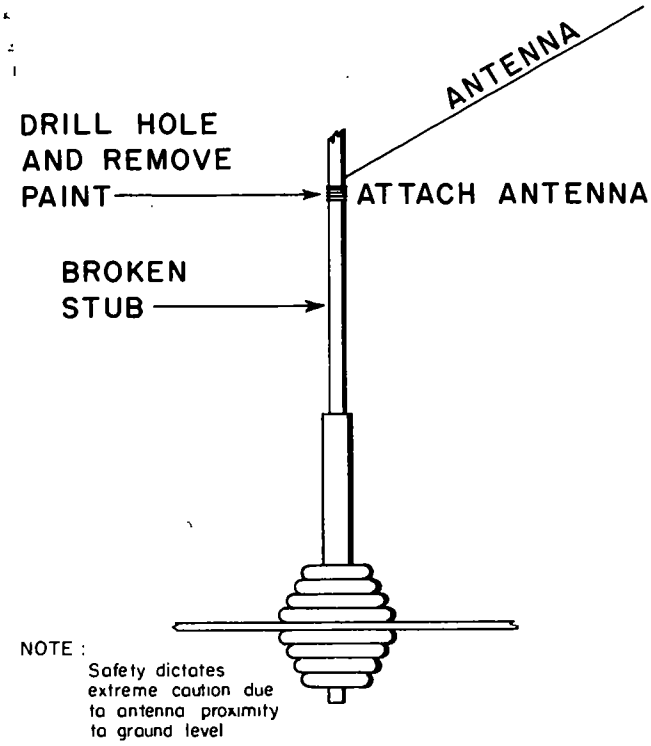


Figure 14-5. Expedient method of connecting a wave antenna.

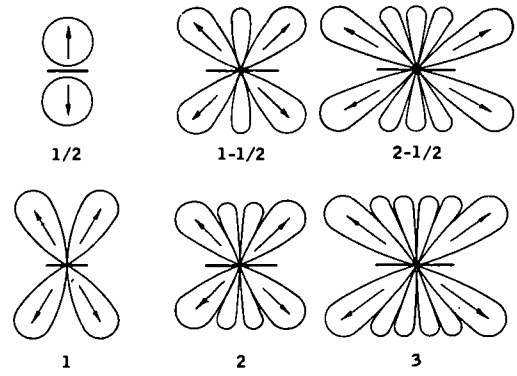


Figure 14-6. Radiation patterns from one-half wavelength to three wavelengths.

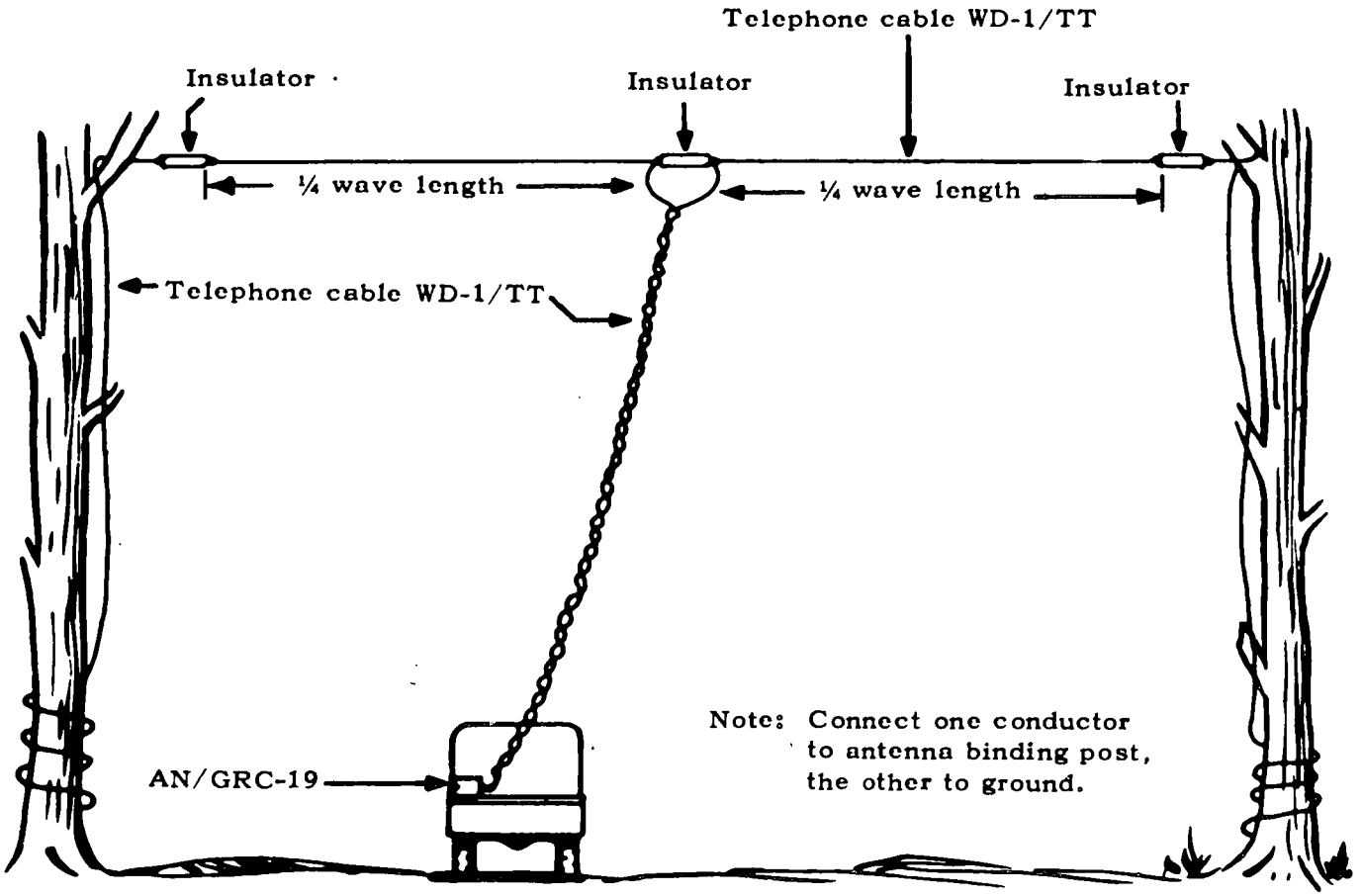


Figure 14-7. Center-fed Hertz (doublet) antenna for use with AM and FM radios.

14-5. Elevated Antennas

a. General. An elevated antenna for FM radios (fig 14-8) can be constructed from materials readily available in most combat units. The standard vehiclar antenna complete with bracket and mast base may be raised on poles to a desired height; the antenna may be connected to the radio set with standard telephone cable WD-1/TT. The guy wires, with insulators properly installed, can be used as the ground plane or counterpoise. This antenna, properly constructed, provides a radiation pattern that is omnidirectional in the horizontal plane. An example of an older series antenna is shown in figure 14-8. However, if new series antennas such as the AT-912/VRC or the AS-1729/VRC, are used, the antenna matching unit must be pretuned in order to match the antenna length to the operating frequency prior to elevating the antenna. This is necessary because the limited length of the cable which is used for automatic tuning, precludes its use on an elevated antenna. To pretune antenna AT-912/VRC before it is elevated, the cable used for automatic tuning must be attached to both the antenna and the receiver-transmitter (RT), the operating frequency set on the RT is then tuned. The automatic tuning cable is then detached from the antenna matching unit and the antenna is elevated. The procedure pre-tuning antenna AS-1729/VRC requires only that the antenna matching unit have a setting in the same range as the frequency set on the receiver-transmitter.

b. Vertical Half-Rhombic Antenna. The vertical half-rhombic antenna (fig 14-9) is more efficient than a whip antenna when used with FM radios directional off the terminated end. The gain of this antenna increases with size. When the limiting factor in the size of the antenna is available mast height, a leg length is used as indicated in the formula $L = \frac{H^2 f}{222} + \frac{56}{f}$ where f is the frequency in megahertz, H is the mast height in meters, and L is the leg length in meters. The example in figure 14-9 is solved for a mast height of 10 meters and a frequency of 30 megahertz.

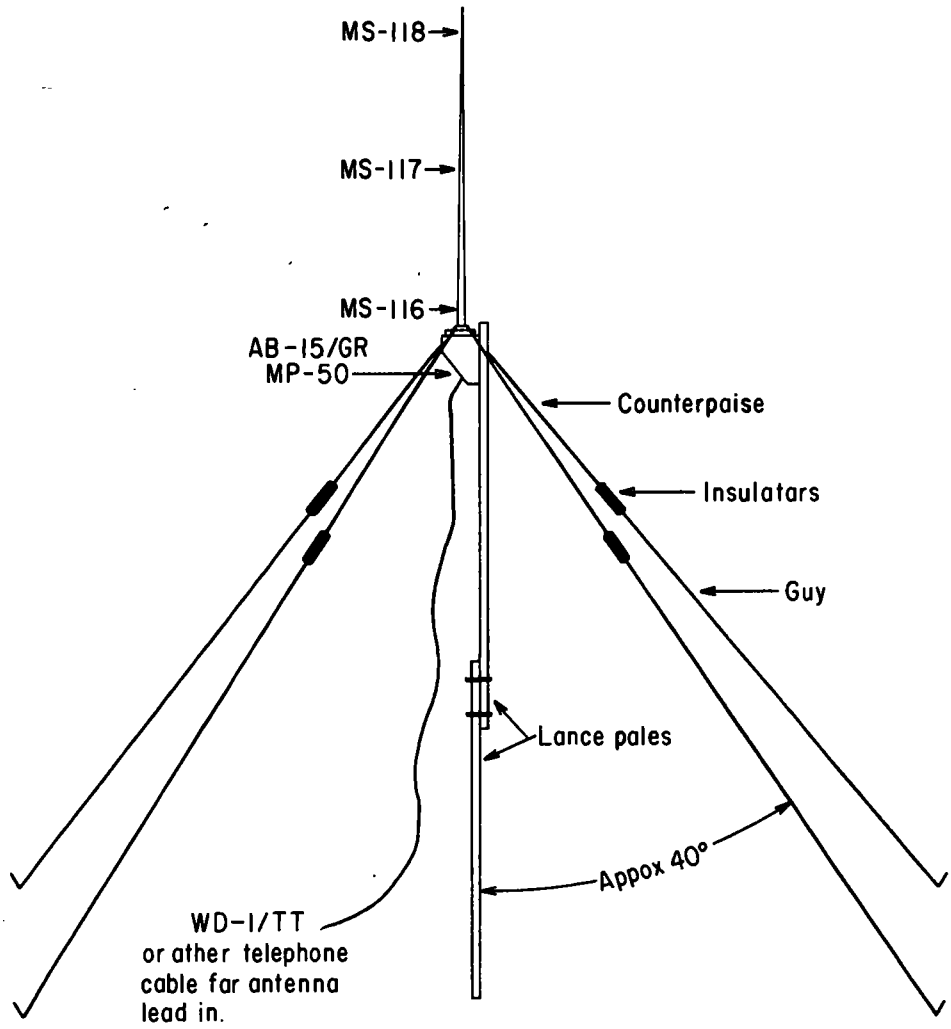


Figure 14-8. Improvised elevated antenna.

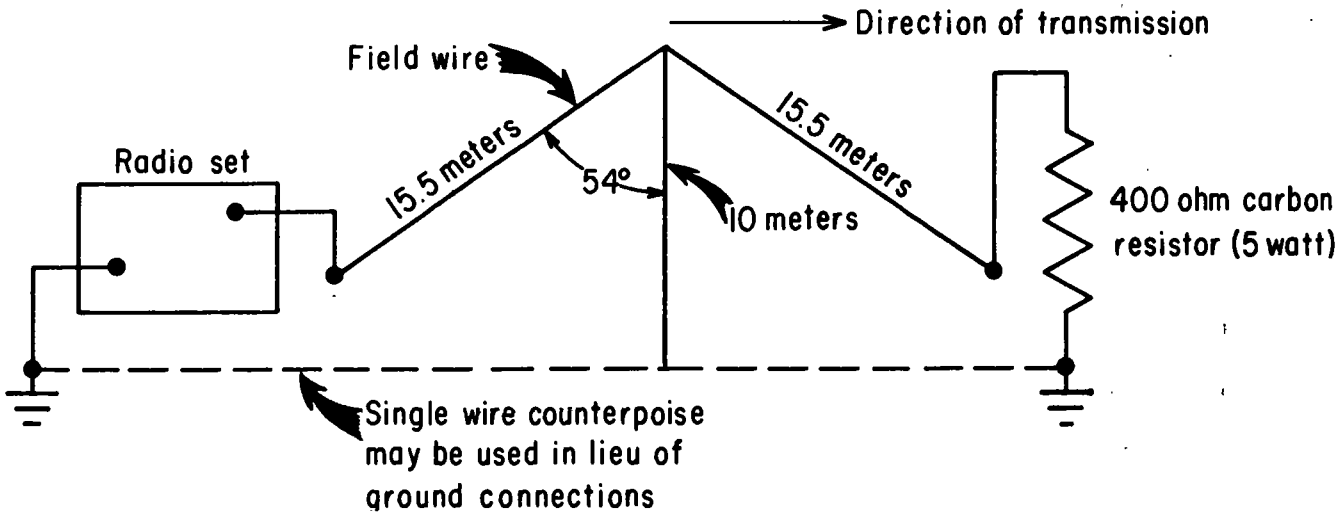


Figure 14-9. Vertical half-rhombic antenna.

CHAPTER 15

COMMUNICATION EQUIPMENT

Section I. INTRODUCTION

15-1. General

This chapter contains general information concerning communications equipment used in field artillery units. For detailed information pertaining to this equipment and equipment not included in this chapter, see the appropriate technical manuals of the 11-series. Also see the tabulated equipment data in appendix C.

15-2. Wire Equipment

Wire equipment consists of communications-electronics equipment, including teletypewriter equipment necessary to install, operate, and maintain a unit wire system.

15-3. Radio Equipment

Radio equipment consists of communications-electronics equipment, including teletypewriter equipment necessary to install, operate, and maintain unit radio nets.

Section II. WIRE EQUIPMENT (EXCEPT TELETYPEWRITER EQUIPMENT)

15-4. General

This section contains general information concerning the characteristics of wire equipment used by field artillery units. For operating instructions and detailed information related to this equipment, see the appropriate technical manuals of the 11-series.

15-5. Telephone Cable WD-1/ TT

Telephone cable WD-1/TT (fig 15-1) consists of two twisted, individually insulated conductors with the following characteristics:

a. American wire gage (AWG) no. 23 (each conductor).

b. Four tinned-copper strands and three galvanized-steel strands (each conductor).

c. Inner insulation of polyethylene and outer insulation jacket of nylon.

d. Tensile strength of about 200 pounds (both conductors).

e. Weight of 48 per mils.

f. Direct current (DC) loop resistance of 200 to 234 ohms per mile at 70° Fahrenheit (F).

g. Signal loss at 1 kilohertz (kHz) at 68° F of 2.5 decibles (db) per mile under wet conditions or 1.5 decibles per mile under dry conditions.

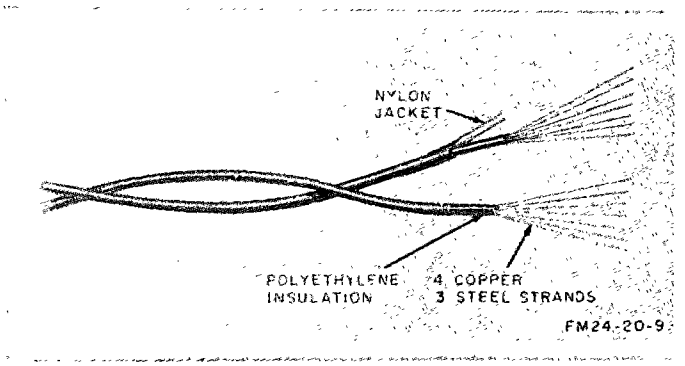


Figure 15-1. Telephone Cable WD-1/TT.

15-6. Telephone Wire Splicing Equipment

Field telephone wire splices can be made with either telephone cable splicing kit MK-356/G or tool kit TE-33.

a. Splicing Kit, Telephone Cable, MK-356 - ( )/G. Splicing kit, telephone cable, MK-356 ( )/G (fig 15-2) is designed for rapidly splicing telephone cable WD-1/TT (standard splice). The kit consists of splicing tool TL-582/U, 4 magazines, a carrying bag, and 200 splicing connectors (sleeves). The kit is 12 inches long and weighs about 3½ pounds.

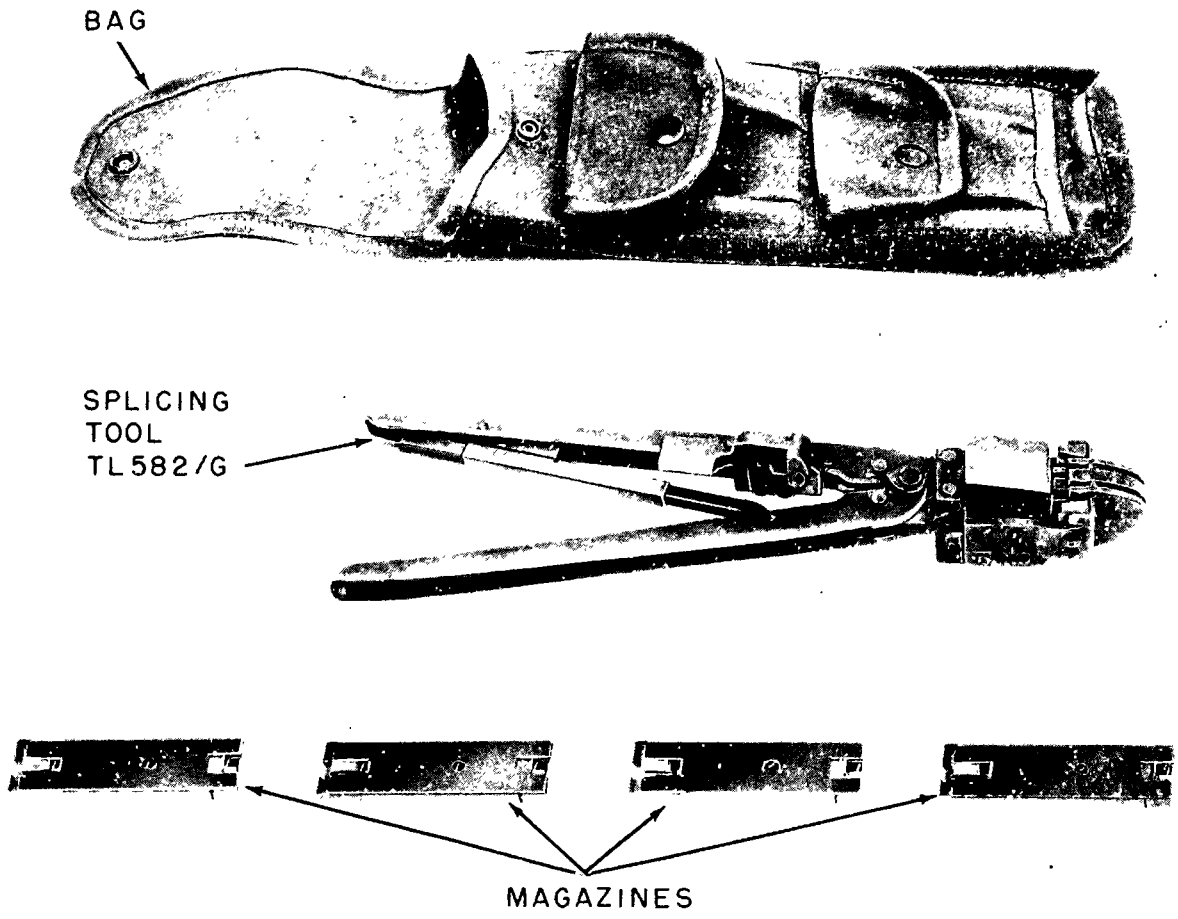


Figure 15-2. Telephone Cable Splicing Kit MK-356 ( )/G.

b. Tool Kit TE-33. Tool kit TE-33 (fig 15-3) is also used for making telephone cable and wire splices. It consists of a holder, carrying, lineman's pliers, CS-34; pliers TL-13A; and electrician's knife TL-29. Two types of insulating tape are used in making telephone cable and wire splice—electrical tape TL-636/U (black polyethelene), used in hot weather and electrical insulation tape TL-600/U (white polyethlene), used in cold weather. Tape TL-83 (friction) may be used for added protection of the splice. A small-gage, softdrawn copper wire (known as seizing wire) may be used to improve the splice mechanically and electrically. Seizing wire may be obtained from the copper conductors in a piece of telephone cable.

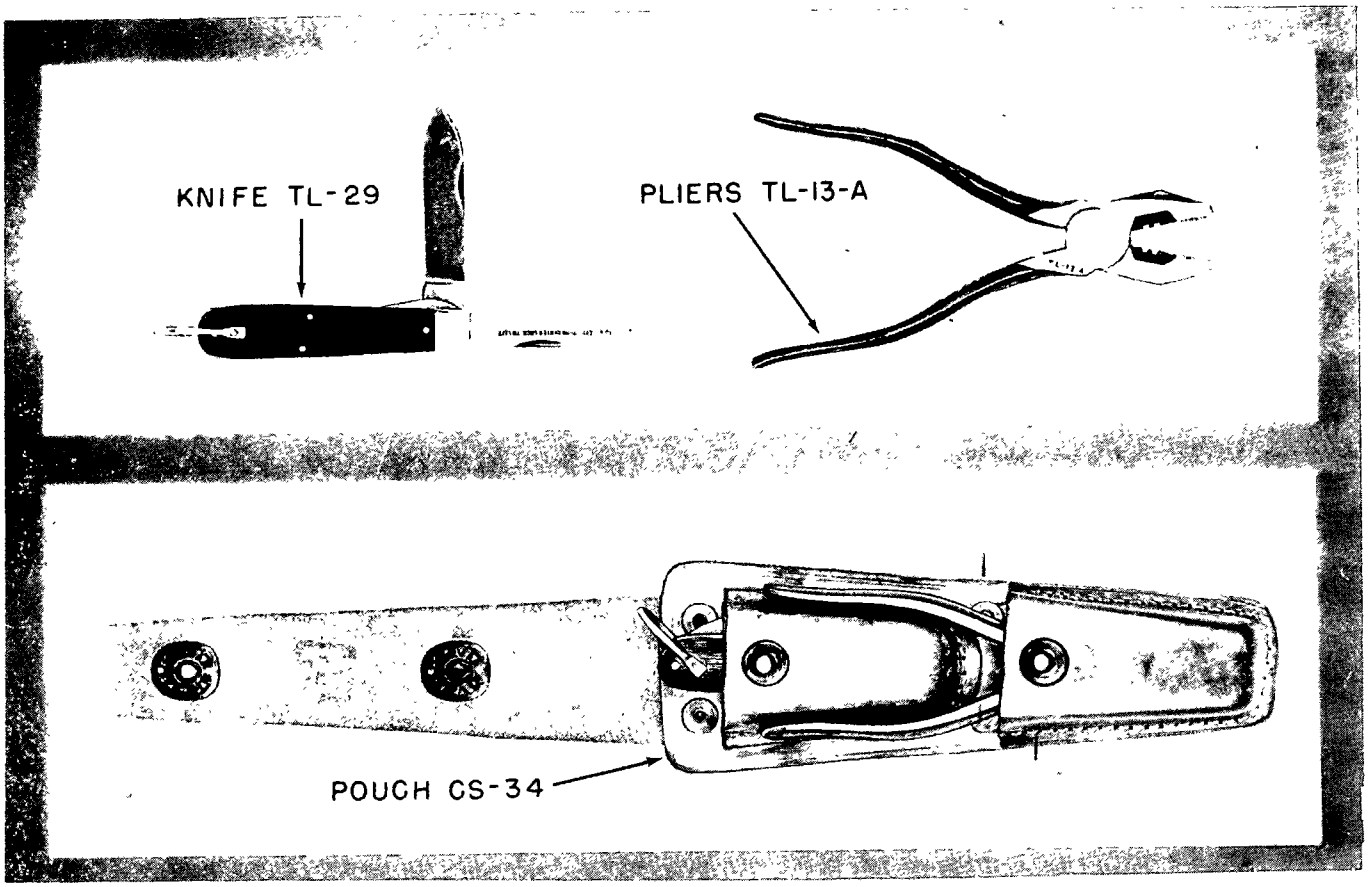


Figure 15-3. Tool Equipment TE-33.

15-7. Telephone Cable Reels

The three types of reels (fig 15-4) available for use with telephone wire are as follows:

a. Cable Reel DR-5. Cable reel DR-5 is a metal, spool-type container used to store, transport, lay, or recover telephone cable WD-1/TT. It will hold 2½ miles of telephone cable and can be mounted on cable reeling machine, hand, RL-31 or cable reeling machine, engine-driven, RL-207/G.

b. Cable Reel RL-159/U. Cable reel RL-159/U is a metal spool-type container used to store, transport, lay, or recover telephone cable WD-1/TT. The reel will hold 1 mile of cable and can be mounted on cable reeling machine, hand, RL-31; cable reeling machine, hand RL-27; cable reeling machine, motor-driven, RL-172; or cable reeling machine, engine-driven, RL-207/G.

c. Cable Reel DR-8. Cable reel DR-8 is a metal container used to lay or recover telephone wire. The reel will hold one-fourth mile of telephone cable WD-1/TT and can be mounted on cable reeling machine, hand, RL-39.

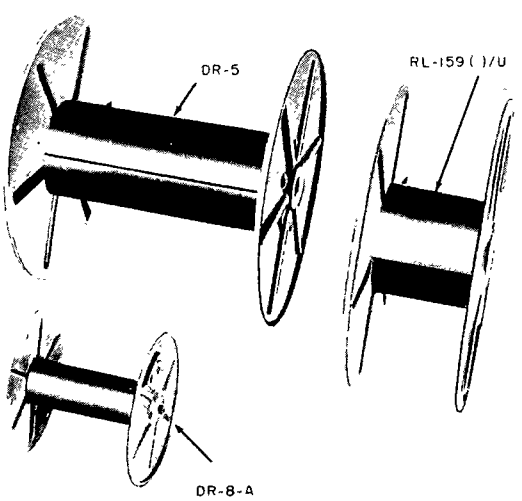


Figure 15-4. Reels for telephone cable.

15-8. Wire Dispenser MX-306 ( )/ G

a. Wire dispenser MX-306 ( )/G (fig 15-5) is a cylindrical canvas and tape container that holds near one-half mile of telephone cable WD-1/TT. The telephone cable of two or more dispensers may be prespliced in tandem when it is necessary to lay more than one-half mile of wire without stopping to make a splice.

b. Wire dispenser MX-306 ( )/G has many useful features.

(1) It is portable.

(2) It will pay out wire at high speeds from land and amphibious vehicles or from fixed and rotary-wing aircraft.

(3) It will function at speeds up to 100 miles per hour.

(4) It lays the wire flat on the surface of the ground without spirals or kinks.

c. No special mounting devices are necessary if a single dispenser is used to lay the wire. Wire dispenser cases CY-1064/ATC (which holds four dispensers) CY-1064/ATC (which holds five dispensers) and CY-196/ATC (which holds six dispensers) are available for use in laying telephone cable from aircraft. For more detailed information, refer to TM 11-2240.

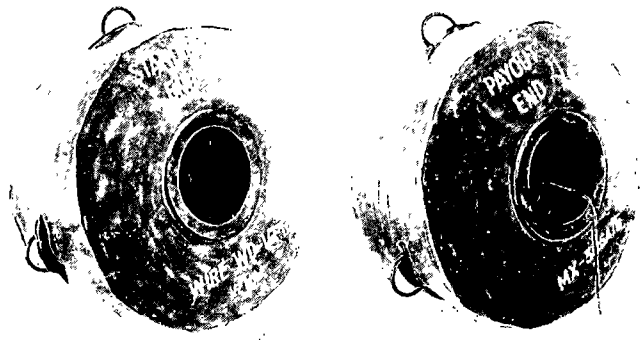


Figure 15-5. Wire Dispenser MX-306A/G.

15-9. Cable Reeling Machine, Hand, RL-27

Cable reeling machine, hand, RL-27 (fig 15-6), is a simple axle designed for laying and recovering telephone cable. The axle is a machined steel bar (2½ feet long) with two knurled handles, one of which can be removed to mount cable reel RL-159/U on the axle. It is equipped with roller bearings and a removable crank for rewinding the wire. The reeling machine can be carried by two men, or it can be placed on some improvised mounting.

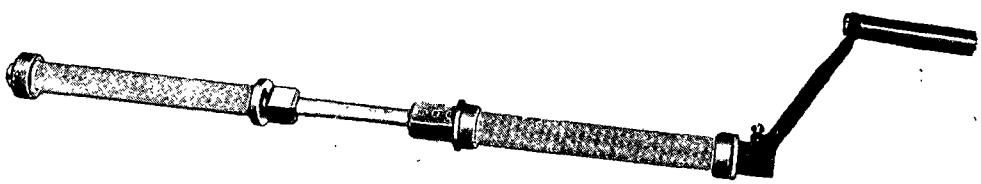


Figure 15-6. Cable Reeling Machine, Hand, RL-27.

15-10. Cable Reeling Machine, Hand, RL-31

a. Cable reeling machine, hand, RL-31 (fig 15-7) is a lightweight, portable, folding A-frame of steel tubing used for laying and recovering telephone wire and cable assemblies. This reeling machine is equipped with—

(1) A brake unit for controlling the speed of the reels as the wire or cable is payed out.

(2) A crank for winding the wire or cable on the reels.

(3) A carrying strap for carrying the reeling machine litter style.

(4) A divided axle for use when two reels are mounted on the reeling machine. This axle allows either reel to operate free of the other. (When the divided axle is used, two cranks and two brakes are needed for operation. This equipment is issued with the reel unit.)

b. The reeling machine will hold one cable reel DR-5, one cable reel DR-15 ( ), or two cable reels RL-159/U. Cable reels DR-15 are used with cable assemblies.

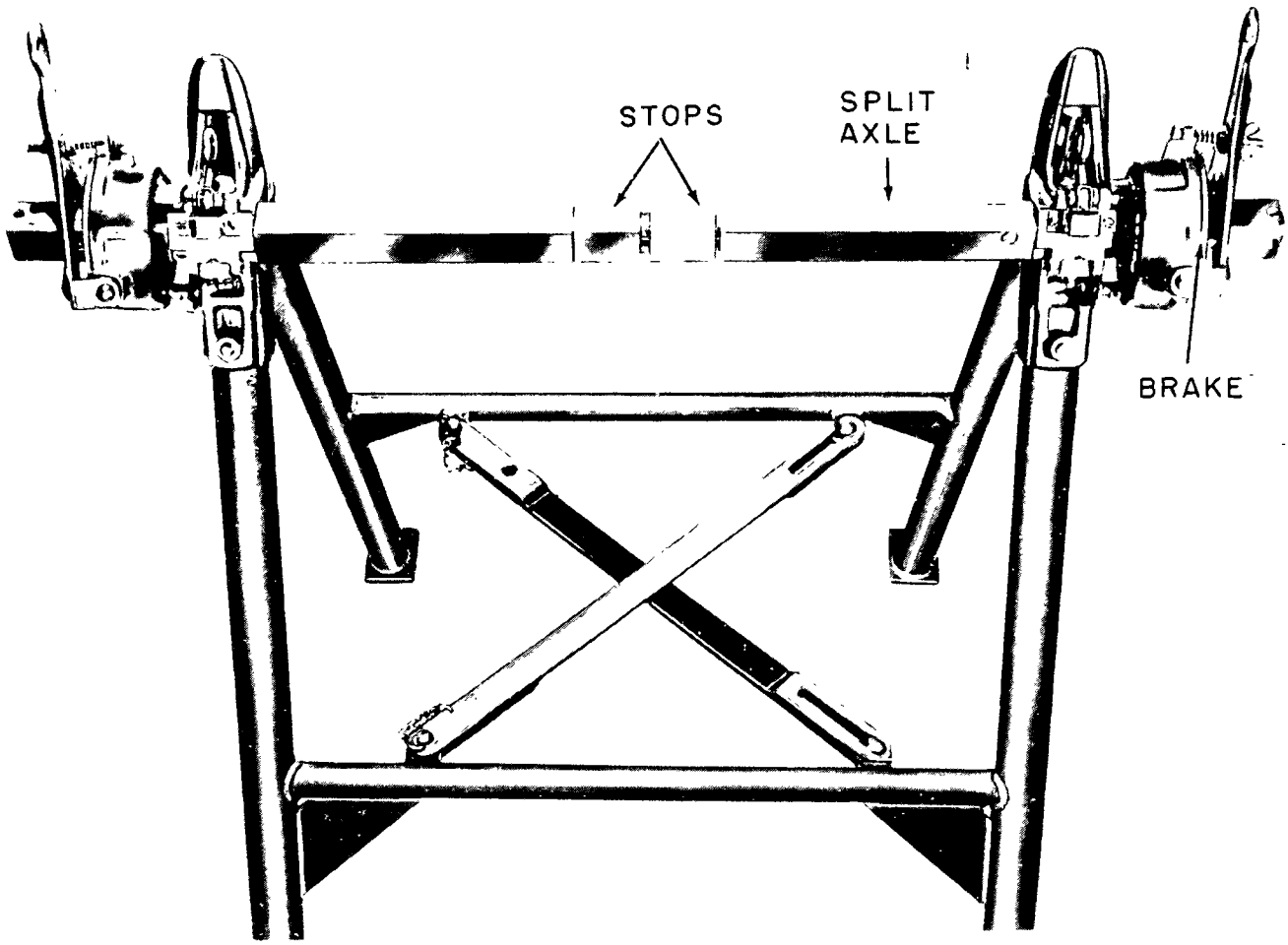


Figure 15-7. Cable Reeling Machine, Hand, RL-31.

15-11. Cable Reeling Machine, Motor-Driven, RL-172/ G

a. Cable reeling machine, motor-driven, RL-172/G (fig 15-8), which weighs near 160 pounds, is used to lay and recover telephone field wire. The reeling machine normally is mounted vertically on the tailgate of a truck but may also be mounted and operated from a horizontal position on the bed of a truck.

b. The reel is driven by a 24-volt DC motor. Power for the motor is furnished by the battery of the vehicle in which the reeling machine is mounted. The vehicle on which the RL-172/G is to be operated should be equipped with a 100-ampere alternator instead of the DC generator, and it must be equipped with a receptacle, slave, 24-volt, waterproof, with cable.

c. A handcrank is provided for manual operation.

d. The reeling machine is designed for one-man operation and is equipped with controls for starting, stopping, and reversing the movement of one cable reel RL-159/U.

e. The telephone cable can be payed out up to a maximum speed of 25 miles per hour and can be recovered at speeds of 7 to 17 miles per hour. The speed of the reel can be controlled, and the payout speed is determined by the speed at which the vehicle can be safely operated.

f. For complete details on the operation and organizational maintenance of and repair parts for the unit, refer to TM 11-3895-207-10, -20, and 20P.

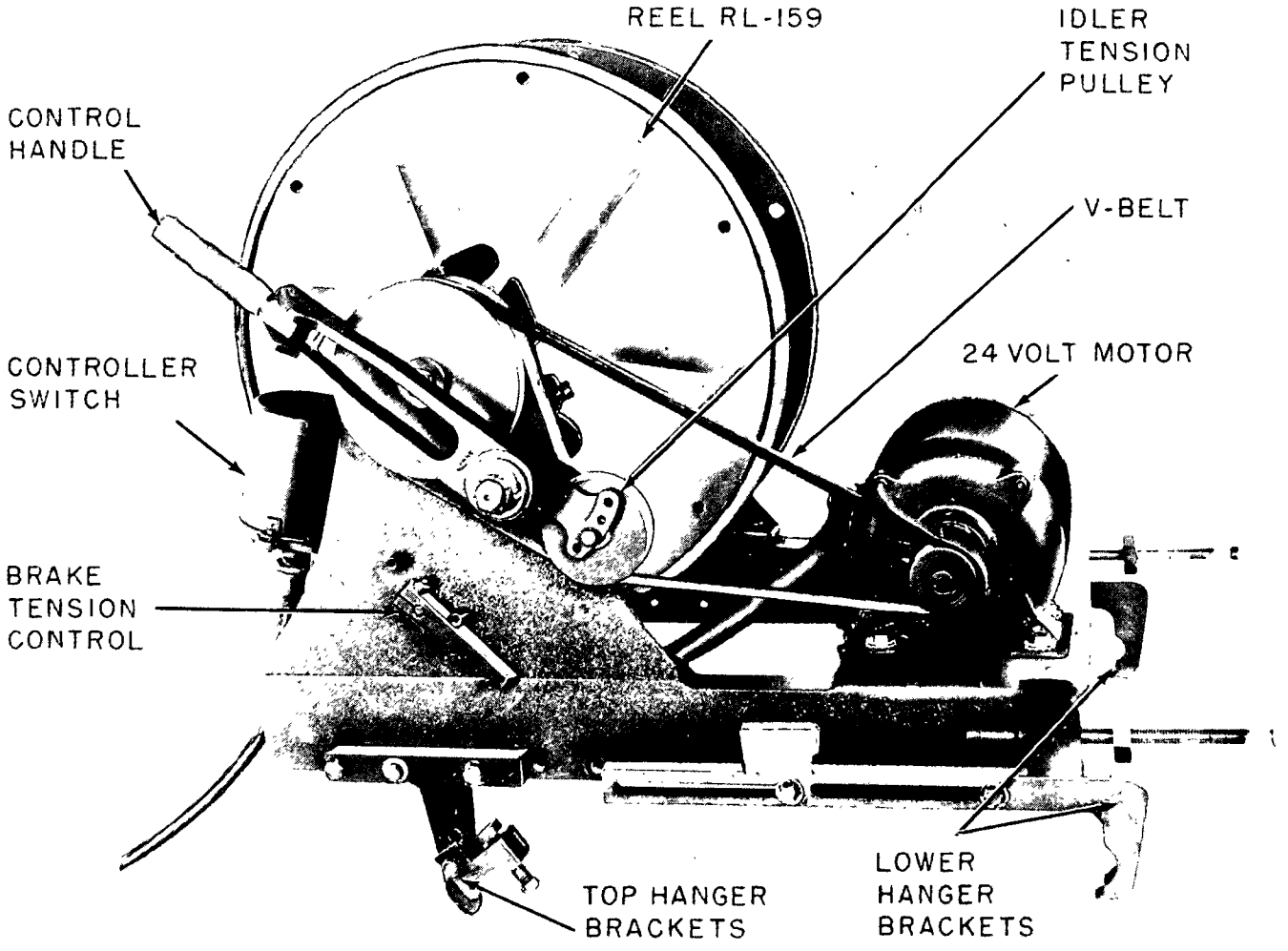


Figure 15-8. Cable Reeling Machine, Motor-Driven, RL-172/G.

15-12. Wire Pike MC-123

Wire pike MC-123 is a two-section pole joined by metal fittings. The top section ends in a hook fitted with a roller, which is used by wiremen to lay or recover telephone wire. As the wire is payed out, the hook is used to guide the wire along the side of the road. For wire recovery, it provides an even feed and guides the wire to the reeling machine.

15-13. Climbers LC-240/ U

a. General. Climbers LC-240/U (fig 15-9) are adjustable, lightweight metal climbers. The length of the climbers can be adjusted from 14 2/3 inches to 19½ inches to fit different leg lengths. Climbers LC-240/U are made up of two leg irons, 2-inch and 3-inch interchangeable gaffs, leather fastening straps, and climber pads. The 2-inch gaffs are used for climbing poles or trees with thin bark, and the 3-inch gaffs are used for climbing trees with thick bark.

b. Adjustment. The leg irons can be adjusted by removing the two leg iron screws, moving the slide assembly on the leg iron to the desired length, and inserting and securing the leg iron screws in the nearest screw holes.

c. Gaff Removal. The gaffs can be removed by releasing the two gaff retaining screws and moving the gaff downward toward the stirrup and lifting it out of the retaining slot. This procedure is reversed to replace the gaffs.

d. Gaff Sharpening. A new gaff may be used as a guide to sharpen dull gaffs; however, gaffs should be sharpened only when new gaffs are not available. They must be sharpened on the inside flat surface only; the outside surface must not be touched if the proper angle is to be maintained (FM 24-20).

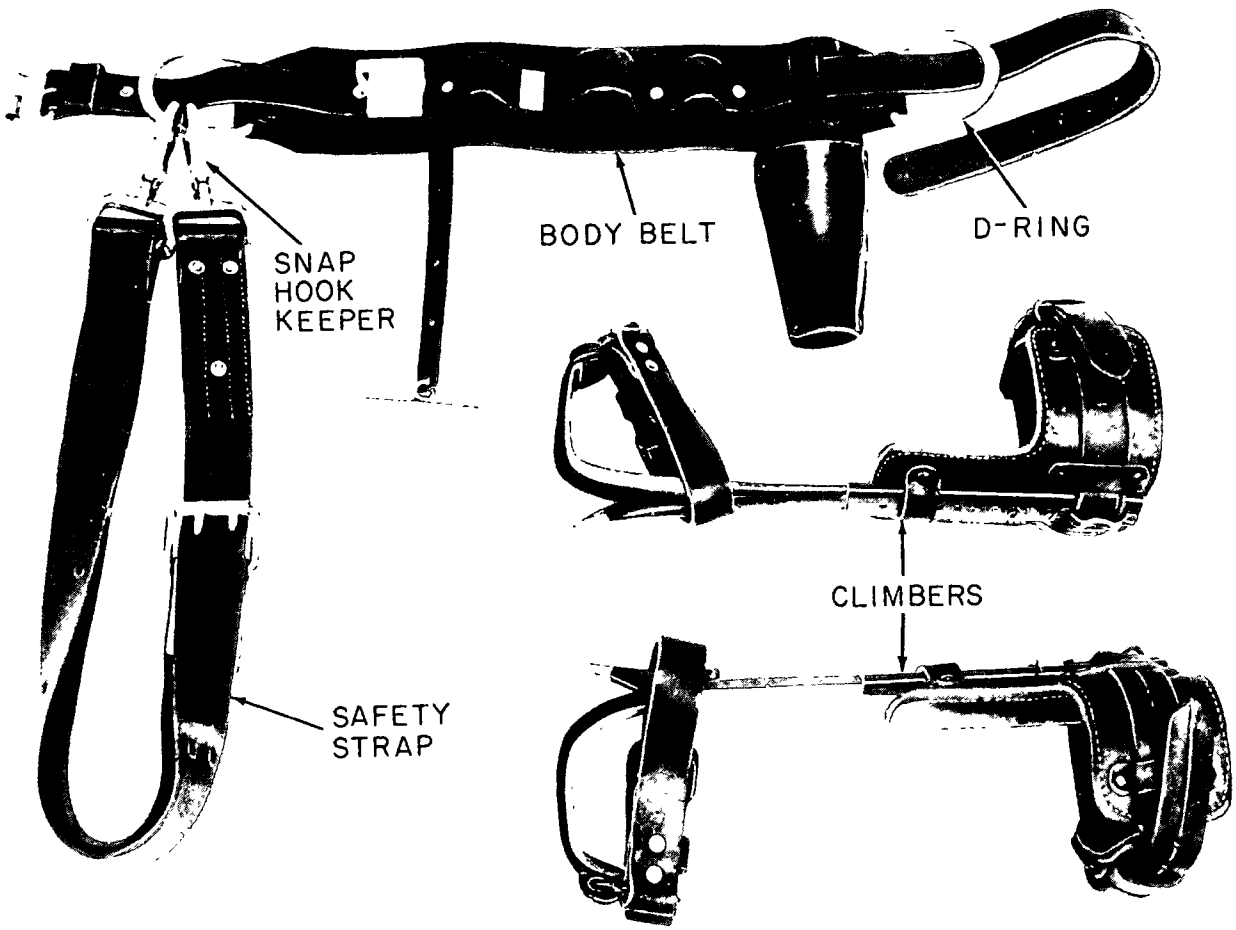


Figure 15-9. Lineman's equipment.

15-14. Lineman's Belt LC-23

Lineman's belt LC-23 consists of a leather belt and an adjustable leather safety strap. The body belt is supplied in various sizes, measured in inches between the D-rings. Safety straps are furnished in 61-, 68-, and 70-inch lengths (fig 15-9).

15-15. Field Telephones, General

a. Field telephone sets are portable, self-contained telephones designed for field use. These sets combine durable construction with portability. The specific telephone to be used depends on the length and type of the circuit and the type of switchboard to be used in the circuit.

b. The two principal types of field telephones are sound-powered and battery-powered telephones.

(1) In a sound-powered telephone, the transmitter unit generates the electrical energy. The sound waves created by the voice of the speaker strike the transmitter unit and are converted directly into electrical energy. The receiver unit of the distant telephone reconverts this electrical energy to the original sound waves. Sound-powered telephones, which have a shorter voice range than battery-powered telephones, can be used with, or in the place of, local-battery (LB) telephones. Sound-powered telephones cannot be used in common-battery (CB) systems.

(2) In a local-battery-powered telephone, small dry cell batteries normally contained inside the telephone, are the source of transmission power. When a local-battery-powered telephone is used in a common-battery system, dry cell batteries inside the telephone may not (depending on the equipment) be necessary. Field telephones contain hand-operated magnetos or ringing generators for signaling. The incoming ringing signals are indicated audibly by a bell or buzzer or visually by a silent signal device, such as a light.

c. The talking ranges of the principal field telephones are summarized in the following chart:

Field telephones	Talking distance, over telephone cable WD-1/TT (nonloaded)	
	Wet conditions (km)	Dry conditions (km)
TA-1/PT	6.4	16
TA-312/PT	22.5	35.4
TA-264/PT:		
With amplifiers	53	96.5
Without amplifiers	19.3	29

* Note. The above distances are approximate, since talking range is also affected by the number and quality of splices, weather conditions, the number of switching centrals and test stations, and noise, crosstalk, and other interference in a circuit.

15-16. Telephone Set TA-1/PT

a. Telephone Set TA-1/PT (fig 15-10) is a sound-powered telephone providing facilities for talking and signaling without batteries. The approximate talking and signaling range of the TA-1/PT is from 6.5 to 16 kilometers over telephone cable WD-1/TT.This telephone set can be used to advantage in forward areas, in switched networks that have magneto signaling switchboards, in closed nets, and in point-to-point circuits.

b. The telephone handset contains sound-powered transmitter and receiver units, a hand generator that is operated by a lever-type switch, and a push-to-talk switch. The user can receive either visual or audible-level signaling indications during operation.

c. The telephone is installed by connecting the wire conductors to the binding posts on the terminal block at the end of the cord.

d. The distant telephone is signaled by depressing and then releasing the generator lever. The audible signal is silenced by turning the switch at the back of the set of OFF. The volume of the audible signal can be controlled by turning the switch to various settings between OFF and LOUD.

e. The push-to-talk switch is depressed to talk to the distant station. It is possible to hear the distant party faintly if he tries to interrupt while the push-to-talk switch is depressed, but it is necessary to release the switch to hear him clearly.

f. For complete details on the operation and organizational maintenance of and repair parts for telephone set TA-1/PT, refer to TM 11-5805-243-12 and -20P.

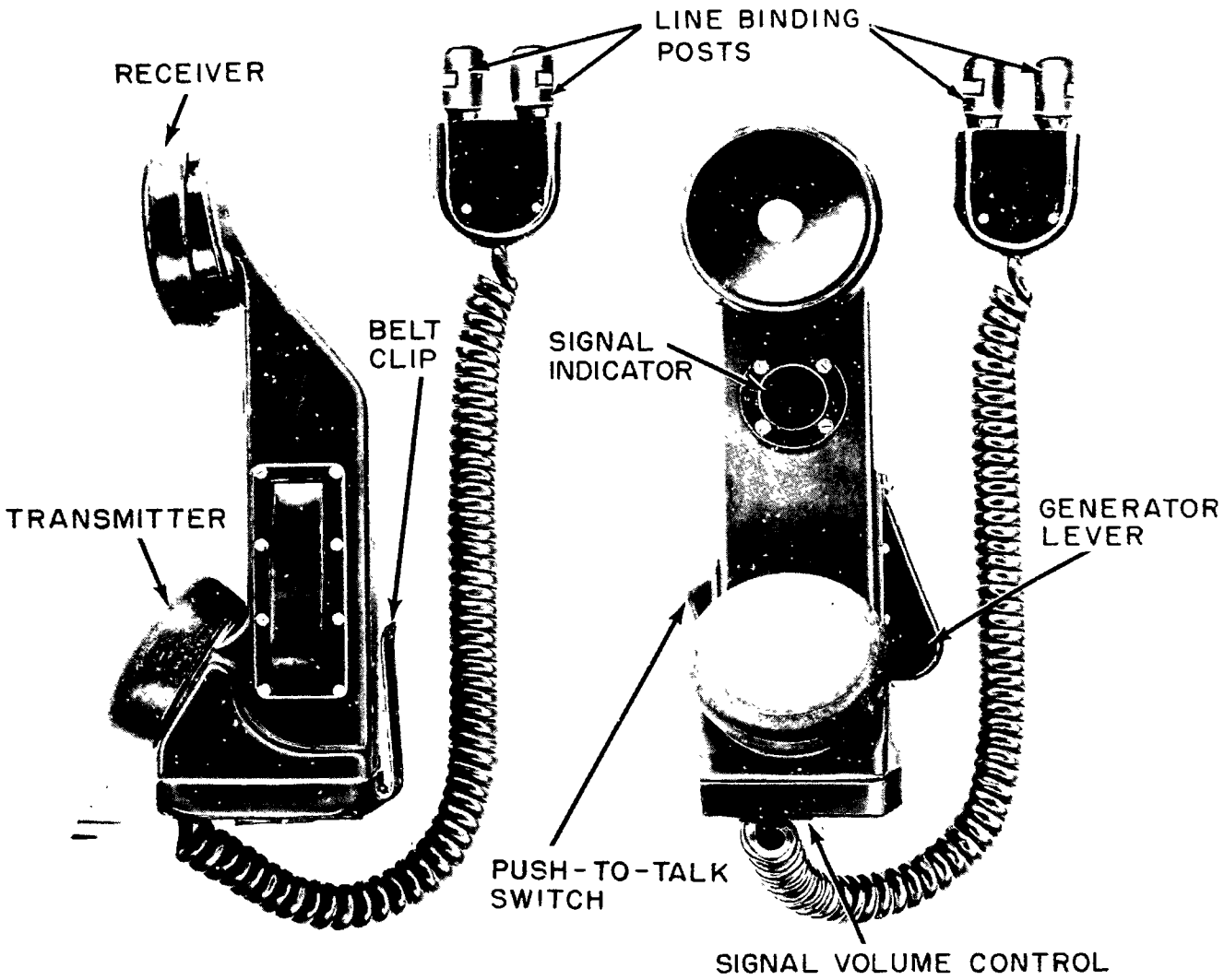


Figure 15-10. Telephone Set TA-1/PT.

15-17. Telephone Set TA-312/PT

a. Telephone set TA-312/PT (fig 15-11) contains all the elements needed for operation in either a local battery (LB), common battery (CB), or common battery signaling (CBS) system.

b. Telephone set TA-312/PT can be used under all outdoor conditions or as a desk or wall-mounted telephone. A receptacle is provided for connecting a handset-headset, which may be used in place of the handset provided.

c. The rated operating range of the TA-312/PT is from 22.5 to 35 kilometers.

d. For complete details on the operation and organizational maintenance of and repair parts for telephone set TA-312/PT, refer to 11-5805-201-12.

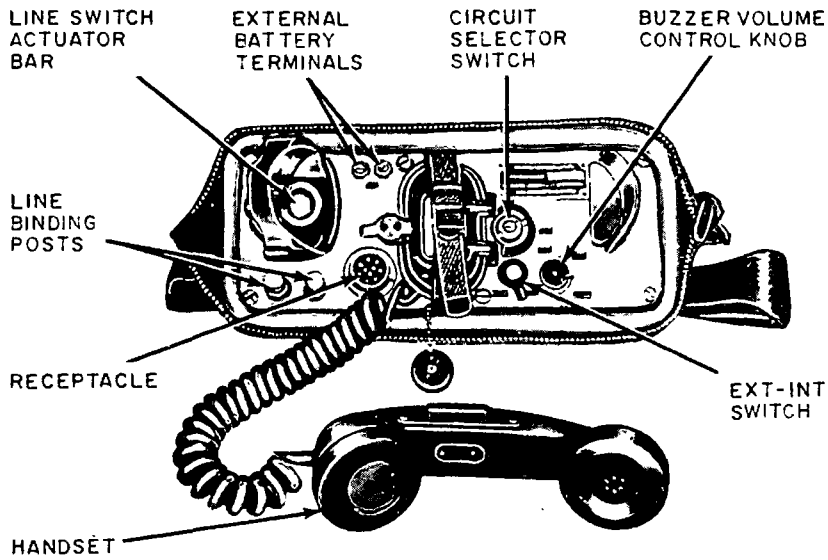


Figure 15-11. Telephone Set TA-312/PT.

15-18. Telephone Set TA-264/PT

a. Telephone set TA-264/PT (fig 15-12) is a portable, battery-powered, field-type telephone designed for use on long field cable lines. Vacuum-tube amplifiers in both the transmitting and receiving circuits of the telephone permit communication over greater distances than is possible with other field telephone sets. When the amplifiers are in use, communication is on a one-way reversible basis. The incoming ringing can be indicated audibly or visually.

b. Telephone set TA-264/PT cannot be used in common-battery systems or over telephone carrier circuits.

c. For further information, refer to TM 11-2059.

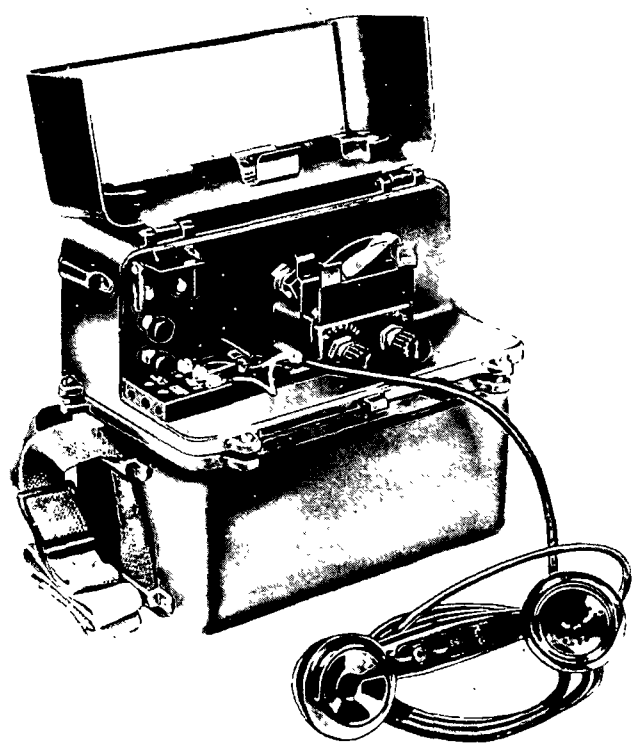


Figure 15-12. Telephone Set TA-264/PT.

15-19. Telephone Connecting and Switching Group MX-155/ GT

The telephone connecting and switching group MX-155/GT (fig 15-13) provides a quick and simple means of establishing an intercommunication system within the firing battery. It provides a rapid means of connecting individual or conference telephone circuits between the battery executive officer, the battery fire direction center, and the individual pieces. The kit is designed for use with wire equipment already issued to the battery and is available to most types of field artillery units. This discussion is limited to its use with a six-piece battery.

a. Description of components. The components of the telephone connecting and switching groups MX-155/GT are described in (1) through (4) below.

(1) *Jack panel SB-16/GR.* The jack panel SB-16/GT is a metal panel with two brackets for quick attachment or installation at the executive officer's position. Ten jacks are internally connected to form two separate circuits as follows:

(a) Jacks labeled ADJ GUN and EXEC are wired in parallel for one circuit and provide for individual conversation between the executive officer and any other party.

(b) Jacks labeled EXEC, ASST EXEC, and 1, 2, 3, 4, 5, and 6 are for the firing battery circuit and are wired in parallel.

(2) *Reel bracket.* The reel bracket provides a means of mounting cable reel DR-8 in a swivel mounting to permit field wire to be drawn out freely in any direction. The connecting and switching group MX-155/GT contains seven reel brackets. One is mounted on the trail or in the vicinity of each of the six pieces, and one is mounted at the executive officer's post.

(3) *Jack U-17/GT.* Sevenjacks U-17/GT are issued with the kit and are mounted on the cable reel DR-8. These jacks provide a plug-in type of connection for the telephone at the piece.

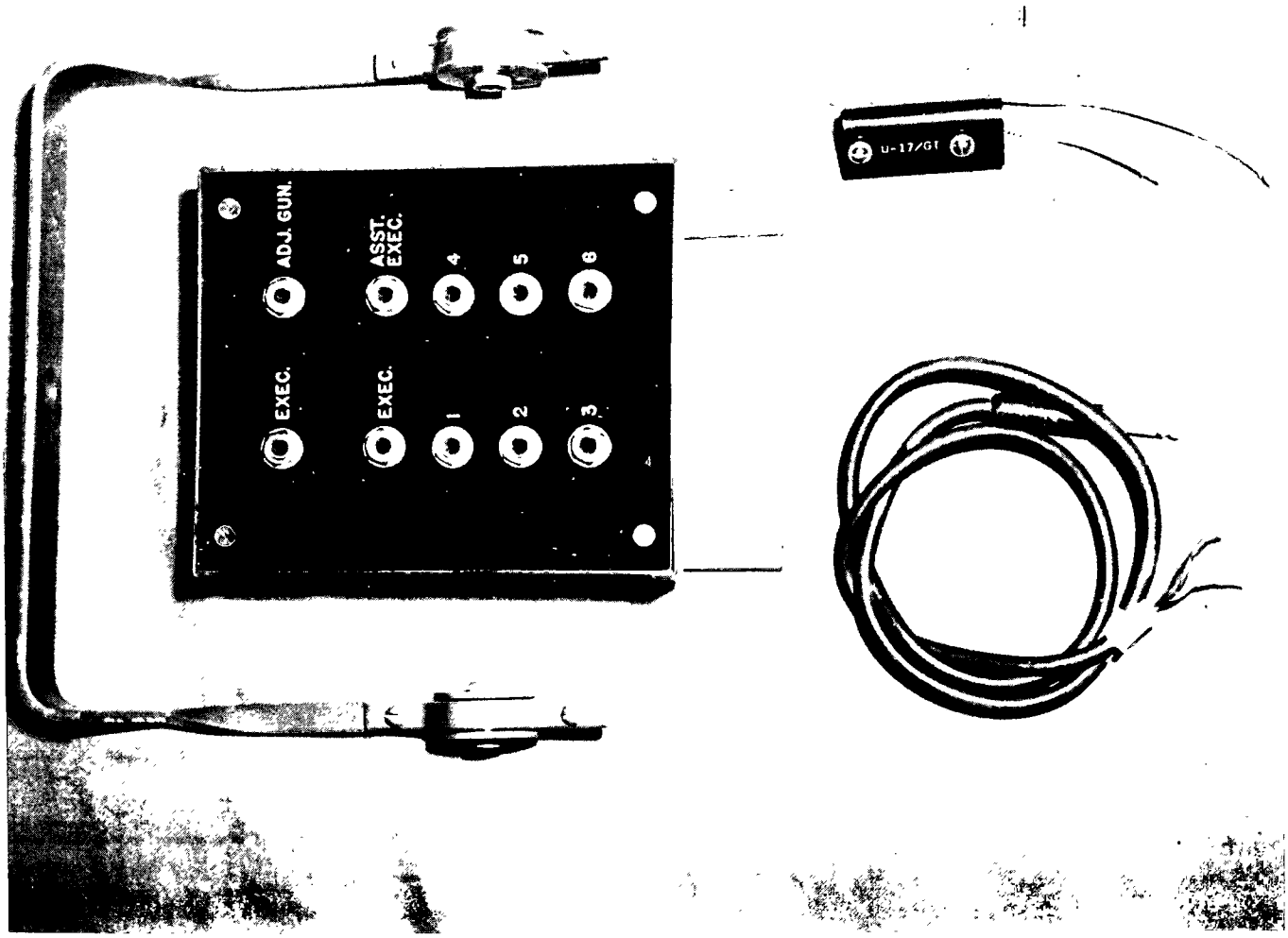


Figure 15-13. Telephone Connecting and Switching Group MX-155/GT.

(4) *Cord CX-231/GT.* Cord CX-231/GT is a 36-inch, two-conductor cord with one end terminating in a plug and the other end bared 3 inches for connection to field wire. Fifteen cords are issued with the kit. One cord is used at each gun position and the FDC, and eight are used at the jack panel.

b. Other Items. In addition to the components described in *a* (1) (*b*) above, the following TOE items are required for operation of the MX-155/GT:

(1) Seven cable reels DR-8.

(2) Reeling machine cable, hand, RL-39.

(3) Sufficient field telephones (minimum of seven) to allow the desired circuit arrangements.

c. Installation.

(1) The jack panel SB-16/GT is installed near the executive officer's post. The executive officer's telephone is then connected to the jack marked EXEC.

(2) A wire is laid between each piece and the jack panel by pulling the wire from the modified reel DR-8, which remains mounted at the piece. Since the cord CX-231/GT is permanently spliced to the running end of the wire line, the connection is completed by simply plugging the cord into the appropriate jack on the jack panel. Wire should be staked and buried if time permits.

(3) The bared end of the cord CX-231/GT is connected to the binding posts of the telephone at the piece. This cord may be extended, when necessary, by splicing in telephone cable WD-1/TT. The telephone is connected to the circuit by plugging the cord CX-231/GT into the jack on the modified reel DR-8.

15-20. Manual Telephone Switchboards, General

a. Manual telephone switchboards are designed for use in three types of operation, common-battery, local battery, and common-battery signaling/local-battery operation. Some field switchboards are designed specifically for one type of operation. Others are designed for all three types of operation.

b. Field telephone switchboards are manually operated; they are constructed to withstand rough handling and designed for quick, simple installation.

c. In a common-battery system, the source of electrical energy for speech and ringing signals is located at the switchboard telephone central. In a local-battery system, the source of electrical energy is located at the telephone set. In a common-battery-signaling/local-battery system, the source of power for speech is located at the telephone set and the power for signaling the switchboard is located at the switchboard.

15-21. Manual Telephone Switchboard SB-993/GT

a. Manual telephone switchboard SB-993/GT is a light, portable, local-battery switchboard normally used in company-size units. The switchboard consists of a plug holder and seven 2-pronged adapter plugs U-184/GT in a case. A field telephone is required for the operator's use. The SB-993/GT may be used as an emergency field replacement for any local-battery switchboard.

b. Each adapter plug U-184/GT consists of a neon glow lamp, two binding posts, two plugs, and two jacks, all molded together in a translucent plastic housing. The plugs serve as the thrumbscrew ends of binding posts to which incoming lines are connected. The plugs may be inserted into the jacks of another adapter plug U-184/GT to establish a connection between two lines.

c. Several adapter plugs U-184/GT can be connected in tandem for conference connections (several parties connected together).

d. An incoming ringing signal lights the neon lamp in the switchboard plug connected to the line the lamp glows for the duration of the signal. There is no audible signal when the neon lamp lights unless the switchboard operator's telephone is connected to that line. The operator must always be alert for an incoming signal.

15-22. Manual Telephone Switchboards SB-22/PT and SB/22A/PT.

a. Manual telephone switchboards SB-22/PT (fig 15-14) and SB-22A/PT are lightweight, local-battery, field-type switchboards that provide facilities for interconnecting 12 voice-frequency circuits. The SB-22/PT normally is used to interconnect local-battery telephone circuits, remote-controlled radio circuits, and voice-frequency teletypewriter circuits or a combination of these facilities. A capacity of 29 circuits can be obtained by stacking two switchboards and replacing the operator's pack of one switchboard with five additional line jacks.

b. The SB-22/PT obtains operating power for transmitting and for night alarm circuits from four batteries BA-30 or from an equal DC power source. A hand generator, mounted within the operator's pack, supplies 20 hertz, 90 to 100 volts for ringing.

c. The SB-22/PT and SB-22A/PT are identical except that in the SB-22A/PT one of the line jacks, furnished in the accesory kit, is replaced by a trunk jack. The trunk jack is used on common-battery-signaling circuits.

d. For complete details on the operation and organizational maintenance of and repair parts for switchboards SB-22/PT and SB-22A/PT, refer to TM 11-5805-262-12 and -20P.

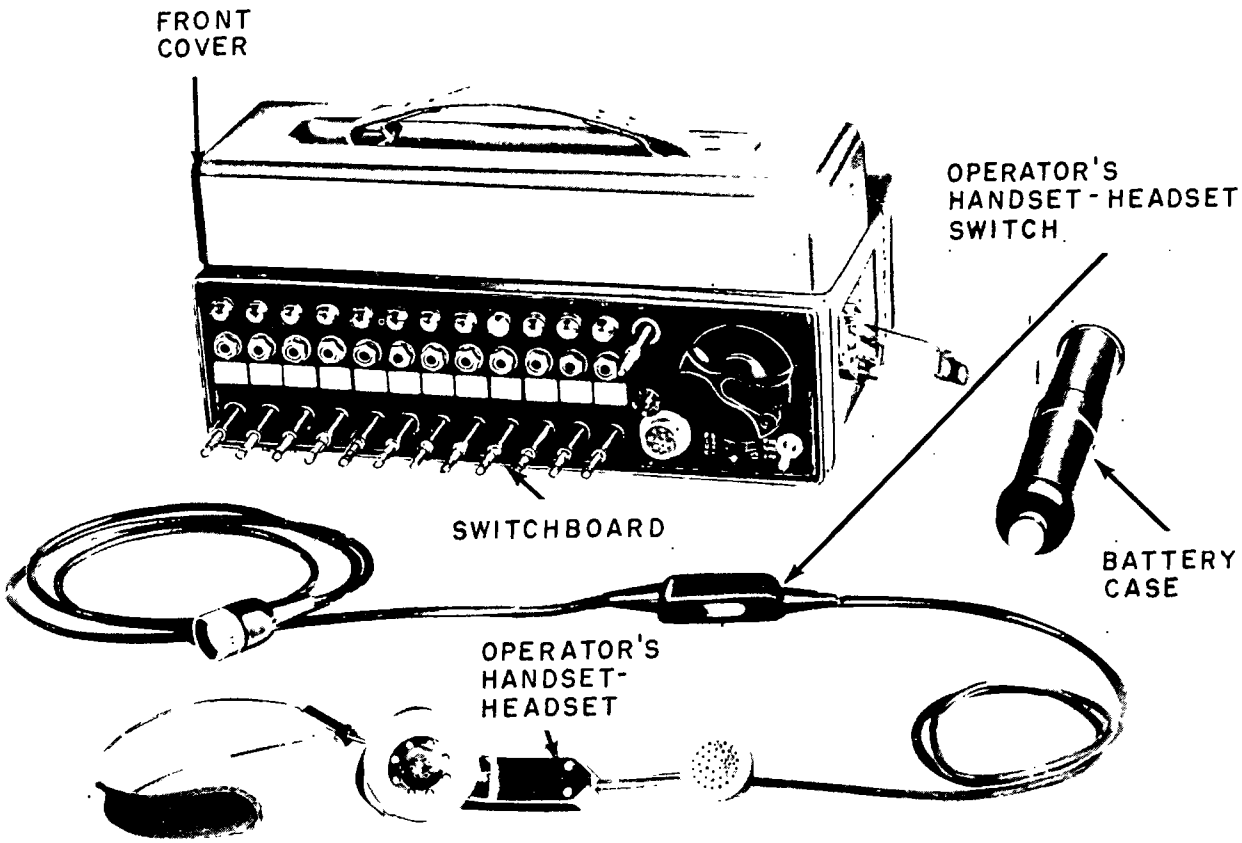


Figure 15-14. Manual Telephone Switchboard SB-22/PT.

15-23. Terminal Telephone Switchboard SB-86/ P

a. Terminal telephone switchboard SB-86/P (fig 15-15) is a portable, field-type switchboard used primarily in the field telephone cable system. The component parts of the switchboard can be rapidly assembled or taken apart during tactical employment. Switchboard SB-86/P can be used to connect voice-frequency teletypewriter circuits.

b. Terminal telephone switchboard SB-86/P consists of a portable switchboard assembly TA-207/P (commonly called a jack field section), manual telephone switchboard section SB-248/P, and power supply PP-990/G.

(1) The jack field section has a capacity of 30 complete line circuits. In addition, it contains the line signals, designation strips, panel lamps and switches necessary for operation of the switchboard. A second jack field section can be stacked on the first to increase the capacity of the switchboard to 60 line circuits (TA-207( )/P).

(2) The switchboard section consists of eight replaceable cord packs, a cord telephone circuit TA-208/P, and an operator's circuit TA-220/P. Each TA-208/P has two answering and two calling cord circuits, four supervisory signals, and two cord circuit switches.

c. Local-battery or common-battery signaling can be selected by using a switch connected with each line circuit. There are also two common-battery line circuits to be used with common battery switchboards.

d. The cord circuit of the switchboard does not supply battery power to the distant telephone for speech transmission; therefore, only local-battery telephones or telephones designed for common-battery signaling can be used with this switchboard.

e. For further information, refer to TM 11-2134 and TM 11-5805-303-20P.

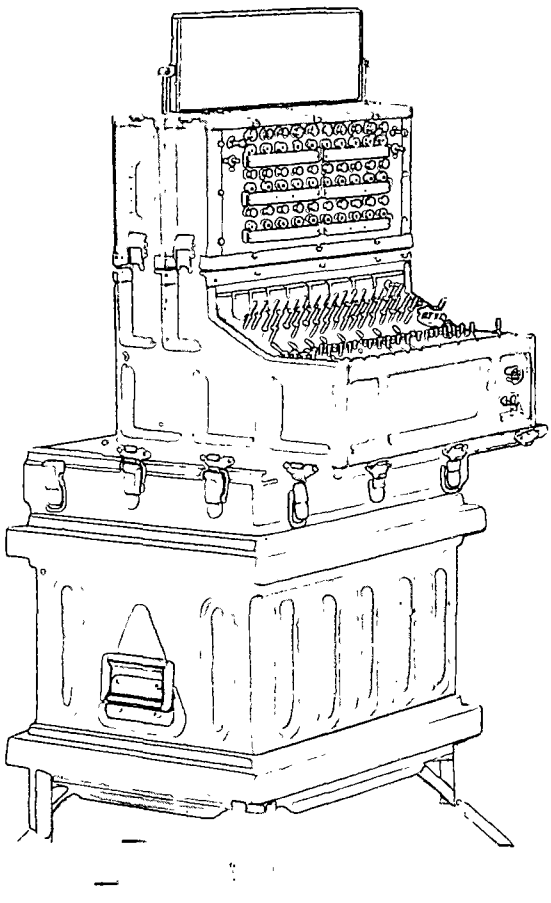


Figure 15-15. Terminal Telephone Switchboard SB-86/P.

15-24. Terminal Board TM-184

a. Terminal board TM-184 (fig 15-16) is a block of insulating material on which are mounted 28 insulation-piercing binding posts and 4 mounting holes. This terminal board can terminate seven pairs of telephone wire.

b. Two methods of connecting the lines to the terminal board are described in (1) and (2) below.

(1) In one method about one-half inch of insulation is removed from the end of the conductor to be connected to the terminal board. The knob on the binding post is unscrewed as far as possible, and the end of the conductor is inserted into the slot so that it projects through the binding post.

(2) In an alternate method, about 1 inch of insulation is removed from the wire; another 1-inch strip of insulation is cut and moved to the end of the bared conductor. The bared portion is doubled and is inserted into the slot of the binding post. The knob is tightened firmly with the fingers, and the conductors are clamped securely in the slot. Pliers must not be used to tighten or unscrew the knob. Use of pliers could result in stripping the threads on the binding posts.

c. Terminal boards mounted in the open and subjected to the effects of weather must be protected. Since a cover is not provided with the terminal board, a cover must be improvised from any suitable material by the installing personnel. Care must be exercised to prevent short circuiting the terminals.

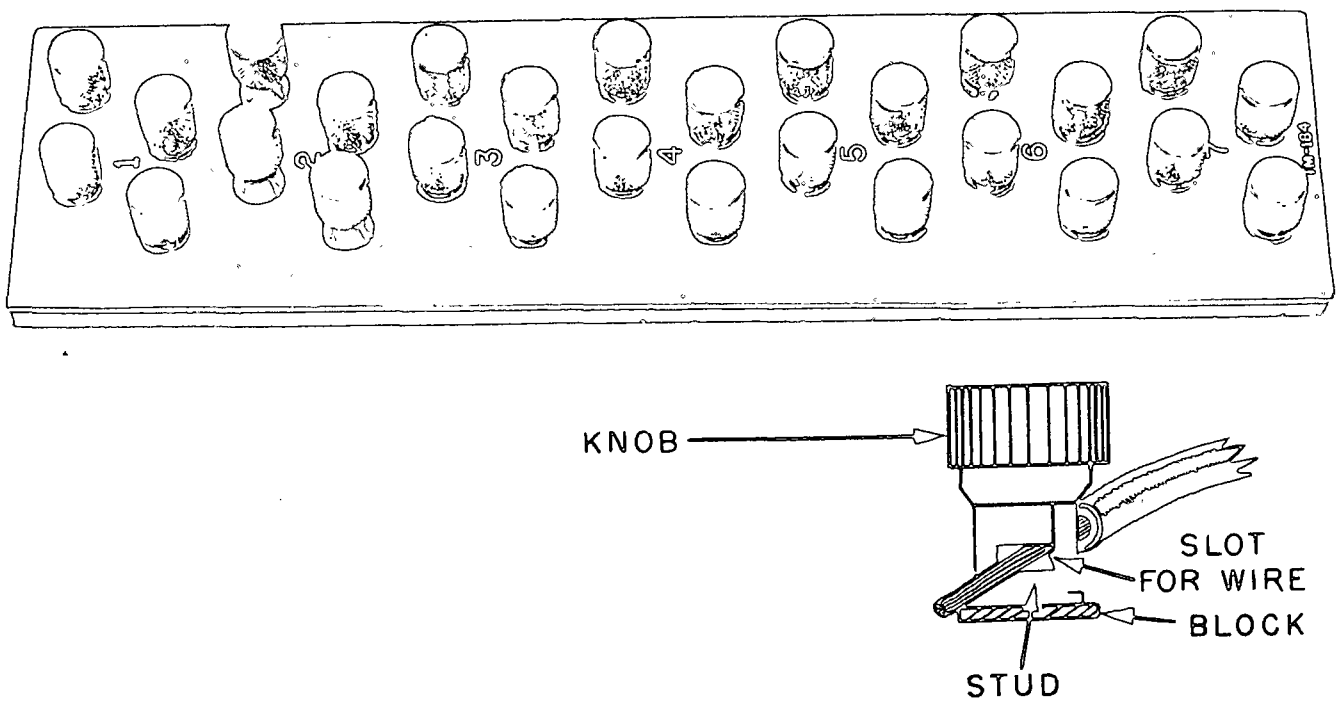


Figure 15-16. Terminal Board TM-184.

15-25. Repeating Coils

a. A repeating coil is an audiofrequency transformer (usually with a 1-to-1 winding ratio) which transfers energy from one electrical circuit to another and permits the formation of simplex and phantom circuits for additional teletypewriter or telephone channels. The coil consists of two balanced windings. One winding—the line side—is connected to a line terminal. The other winding—the switchboard side— is connected to switchboard terminal. When a telephone is used in place of a switchboard, these windings are connected to the telephone and the line side of the coil is tapped at midpoint. This tap, called the leg, provides a means for forming simplex and phantom circuits.

b. Telephone repeating coil C-161 (fig 15-17) is a ring-through transformer with a 1-to-1 winding ration. The lineside winding of this transformer is tapped at the center for simplex or phantom circuit operation. The LINE binding posts are connected directly to the line, the SWITCHBOARD binding posts are connected to the line terminals on a switchboard or telephone, and the TELEG binding post is connected to one line terminal of a teletypewriter (except in a phantom circuit, in which case it is connected to the switchboard binding posts of the phantom cable).

c. Additional circuits can be obtained from existing metallic cirucits with repeating coils. These circuits are as follows:

(1) A simplex circuit is defined as a ground-return telephone or telegraph circuit set on a single metallic circuit to obtain an additional circuit.

(2) A phantom circuit is obtained from two metallic circuits to provide an additional telephone or telegraph circuit.

(3) A simplex-phantom circuit combines the principles of both simplex and phantom circuits to obtain a fourth circuit.

d. For further information concerning repeating coils, refer to TM 11-678.

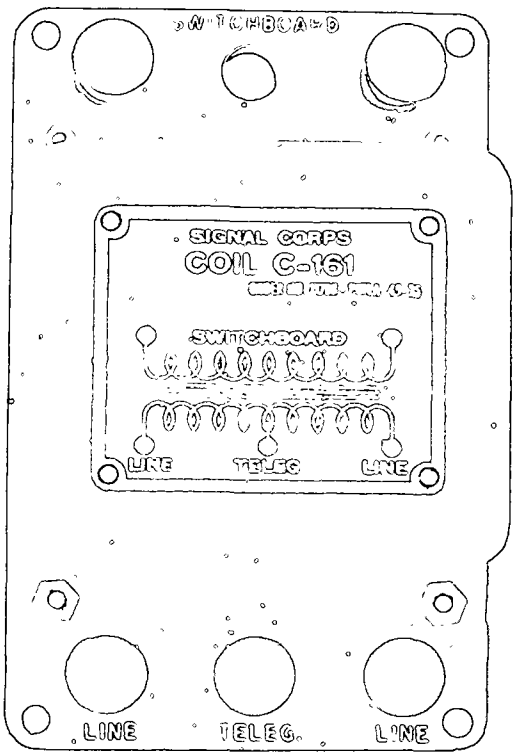


Figure 15-17. Telephone Coil, Repeating, C-161.

Section III. TELETYPEWRITER EQUIPMENT

15-26. Teletypewriter Sets, General

a. A teletypewriter is an electromechanical machine used for the transmission and reception of coded electrical impulses which are converted into a recorded message. Messages are recorded by one of two methods—typed page copy (page-printed teletypewriters) or code punched on tape (reperforators). Some teletypewriters that record messages by code perforations on tape also record the typewritten characters on the edge of the same tape. Teletypewriter messages are transmitted manually by typing the message on a keyboard or automatically from perforated tape in a transmitter-distributor.

b. The series-governed type motors used in teletypewriter sets require 105-125 volts DC or 60 hertz AC. Synchronous motors require 60 hertz alternating current. Direct current must be used for the line signal circuits.

c. Tactical teletypewriter sets are equipped with carrying cases and the necessary ac-

cessories such as recording paper, printing ribbons, and a supply of spare parts.

15-27. Teletypewriter Set AN/ PGC-1

a. Teletypewriter set AN/PGC-1 (fig 15-18) is a lightweight portable, page-printing, sending and receiving set that is designed for field use. It consists of a standard communications teletypewriter (teletypewriter T-4/TG) and case CY-594A/PGC-1.

b. Teletypewriter TT-4/TG is capable of sending and receiving standard teletypewriter start-stop, five-unit code impulses at speeds of 60,66, 75, or 100 words per minute, depending on the motor-drive gear set used. It is designed for DC neutral or voice-frequency operation over cable circuits or for DC or voice frequency operation over telephone carrier systems. The carrier systems may operate over spiral-four cable or radio relay carrier systems. Operation with either 20- or 60- milliampere direct line current is made possible by use of a changeover switch.

c. Teletypewriter T-4/TG is not equipped to supply DC power for the line current; this power must be supplied by some external source. A power source of 105- to 125-volt alternating current or direct current is required to operate the teletypewriter.

d. For complete details on the operation and organizational maintenance of and repair parts for this equipment, refer to TM 11-5815-206-12 and -20P.

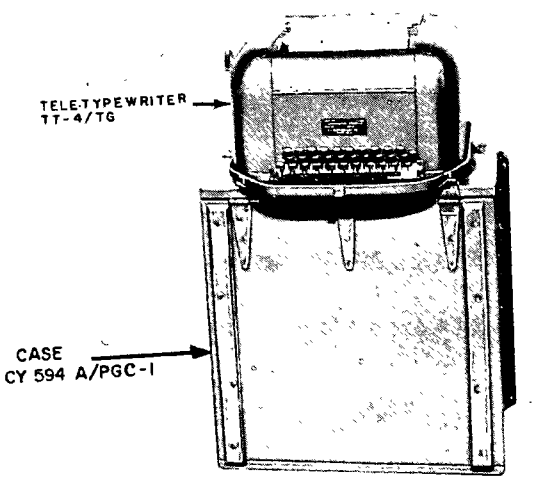


Figure 15-18. Teletypewriter Set AN/PGC-1.

15-28. Teletypewriter Set AN/ GGC-3

Teletypewriter set AN/GGC-3 (fig 15-19) is a lightweight, portable, sending and receiving set used in either a tactical or fixed-station military communication system. The transmitted message is sent from either a keyboard or a transmitter-distributor. The received signals are recorded both in code perforations and in typewriter characters on the same tape. Teletypewriter reperforator-transmitter TT-76/GGC, the major component of the set, is equipped with a standard communication keyboard and type wheel. Teletypewriter reperforator-transmitter TT-76/GGC can be arranged to operate the neutral signals and, if modified, polar signals on a half- or full-duplex basis. The selector magnet of this unit can be adapted for 20- or 60-milliampere direct line current. The unit can send and receive standard teletypewriter five-unit, stop-start code impulses at 60, 66, 75, or 100 words per minute, depending on the motor-drive gear that is used. The teletypewriter set is not equipped to supply DC power for the line current. This must be supplied by an external source. A 115- or 230-volt AC power source is required for the motor and rectifier portions of the teletypewriter.

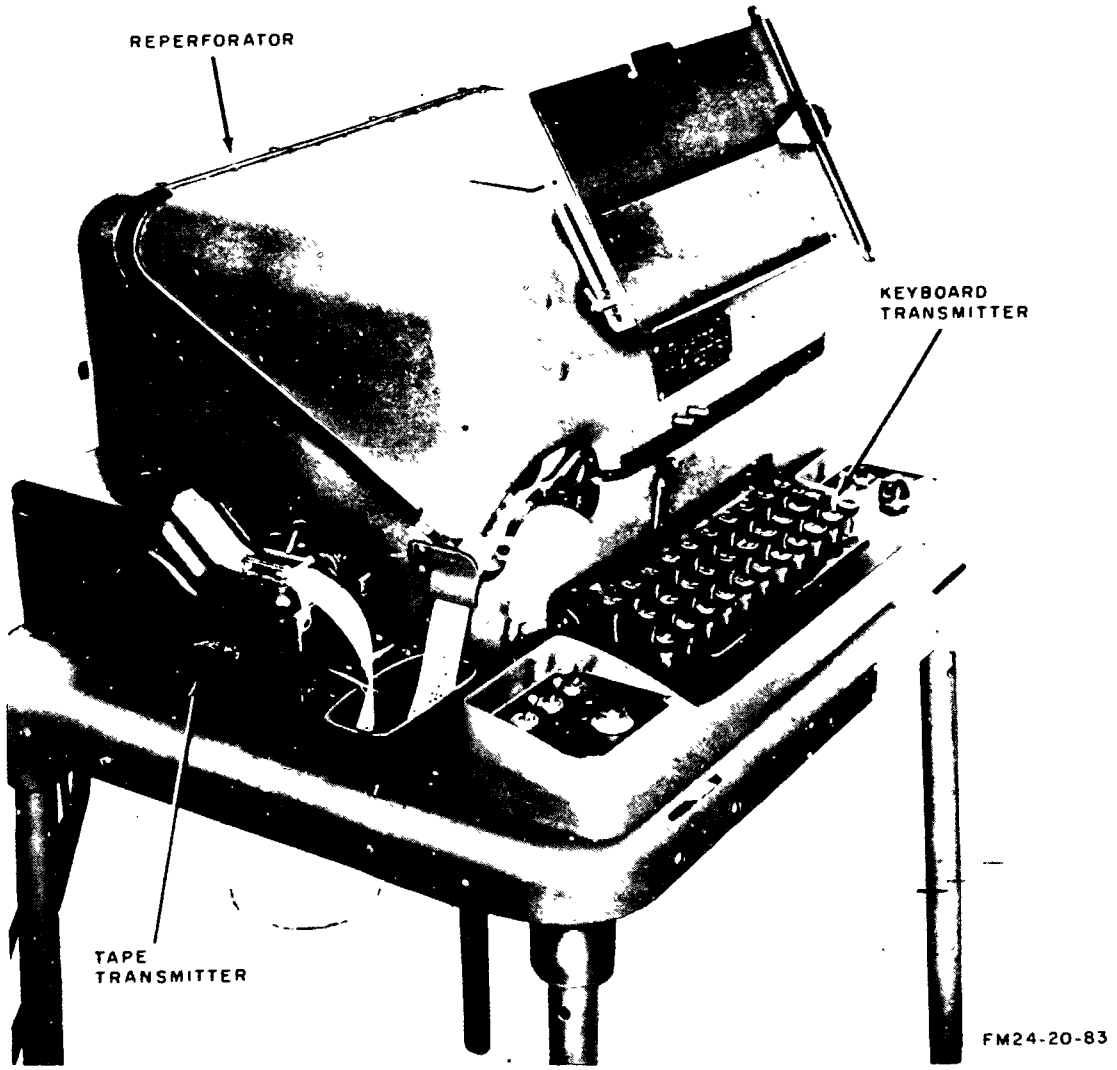


Figure 15-19. Teletypewriter Set AN/GGC-3.

15-29. Teletypewriter Reperforator-Transmitter TT-76 ( )/ GGC

a. Teletypewriter reperforator-transmitter TT-76( )/GGC (fig 15-20) is part of radio teletypewriter sets AN/VRC-29, AN/GRC-46, and AN/GRC-142. The keyboard of this teletypewriter is used to perforate a 7/8-inch paper tape and print along the length of the tape a readable copy of the message. The taped message is sent through an automatic tape-sending device, the transmitter-distributor, which is also part of this teletypewriter. As the taped message is transmitted, a printed copy of the message appears simultaneously on typewriter set AN/UGC-4. Controls of the TT-76( )/GGC can be arranged to also punch a tape of any received traffic. This tape sends up the relaying of messages.

b. For additional information, see TM 11-5815-238-12.

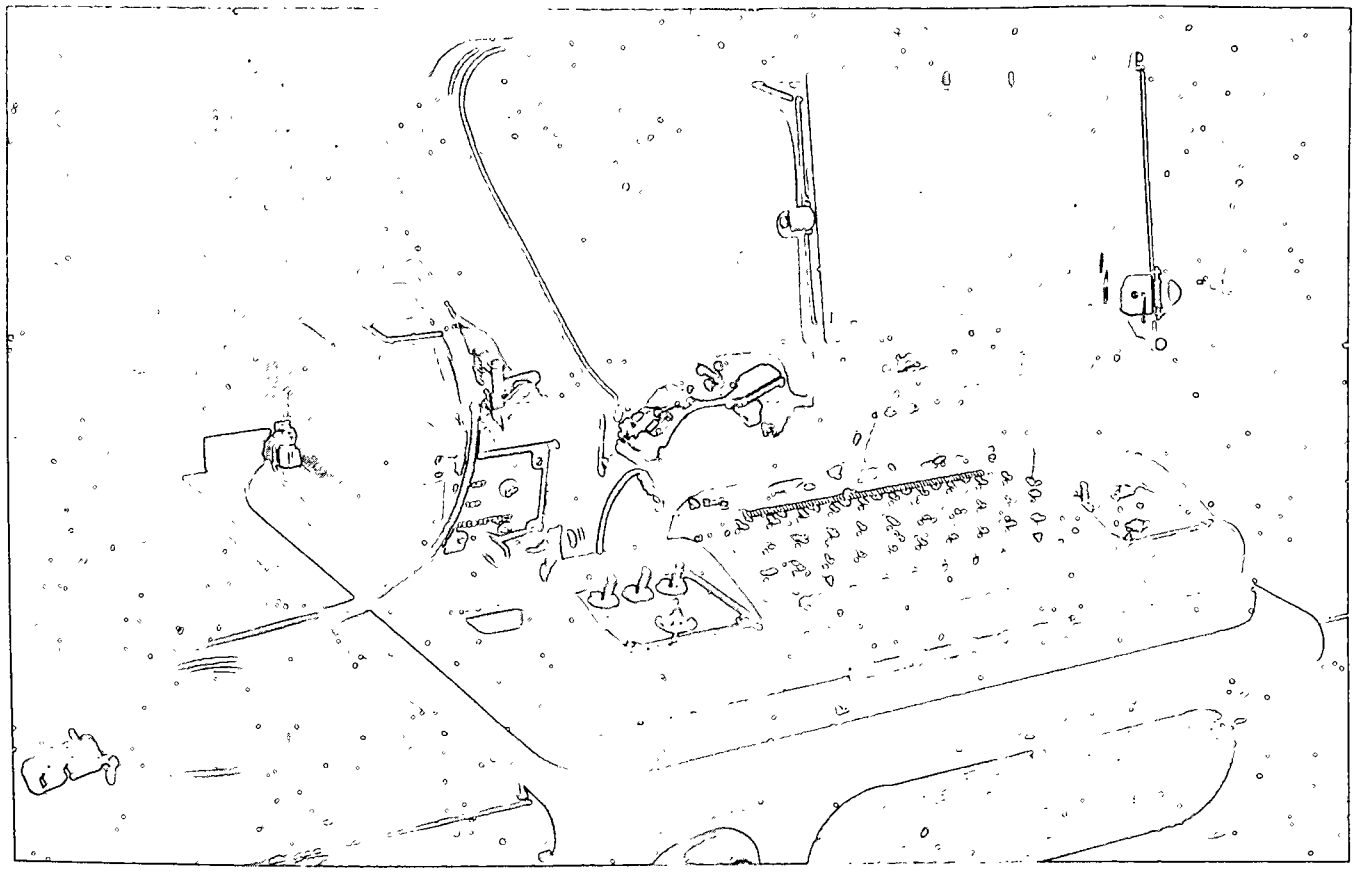


Figure 15-20. Teletypewriter Reperforator-Transmitter TT-76/GGC.

15-30. Teletypewriter Set AN/ UGC-4

a. General. Teletypewriter set AN/UGC-4 (fig 15-21) is a page-printing, keyboard-sending teletypewriter designed for use on direct-wire, carrier, or radioteletype circuits. It is part of the equipment of radio teletypewriter sets AN/VRC-29, AN/GRC-46, and AN/GRC-142. It is designed to operate at 60 words per minute; however, it is capable of operating at 66, 75, or 100 words per minute. The operator can type 72 characters per line. A bell signals the operator that he is nearing the end of the line. Page-printed copies (and carbon copies as desired) of all sent and received traffic are obtained.

b. Use with Radio Teletypewriter Sets.

(1) Keyboard sending is not often used with radio teletypewriter sets AN/VRC-29, AN/GRC-46, and AN/GRC-142 because these sets have tape-punching and tape-sending equipment (para 17-32).

(2) When, as in the case of the AN/VRC-29 and AN/GRC-46, a power supply PP-978/FG is inserted into the chassis of teletypewriter TT-98/FGC, the machine is referred to as teletypewriter set AN/UGC-4.

c. Reference. For additional information, see TM 11-5815-200-12.

Figure 15-21. Teletypewriter Set AN/UGC-4.

15-31. Telegraph Terminal Group AN/ TCC-14

a. General. Telegraph terminal group AN/TC-C-14 is a combination of three separate components—telegraph terminal TH-5/TG (fig 15-22), telegraph-telephone signal converter TA-182/U (fig 15-23), and electrical filter assembly F-98/U (fig 15-24.) This combination permits simultaneous transmission of telegraph pulses and speech. The telegraph signals use a portion of the frequency band used by the telephone channel but do not interfere with the use of the channel for speech transmission.

b. Use. Telegraph terminal group AN/TCC-14 may be used in conjunction with four different systems. Because of the technical characteristics of the AN/TCC-14, it is advisable that no teletypewriter circuit be superimposed on a common-user (switched) telephone circuit. When sole-user voice circuits are available, these circuits should be the first ones considered for speech plus.

(1) *Point-to-point system.* A point-to-point system is a system of communication between two fixed teletypewriter stations.

(2) *Network system.* A network system is a system of communication between three or more teletypewriter stations. In this type of system, any station may communicate with any other station by using a prearranged code call.

(3) *Switched system.* A switched system is a system of communication between teletypewriter stations that are connected through a switchboard. the station operator makes contact with the switchboard operator, who connects the station with another station.

(4) *Remote control radio system.* A remote control radio system is a system of communication that integrates radio and wire

facilities. The remote control device automatically connects a radio transmitter upon receipt of the proper calling signal and automatically disconnects the radio transmitter when the calling signal is removed.

c. Technical Characteristics. The technical characteristics of telegraph terminal group AN/TCC-14 are as follows

(1) *Telegraph terminal TH-5/TG.*

(a) *Mark frequency.* 1325 hertz.

(b) *Space frequency.* 1225 hertz.

(c) *Type of modulation.* Frequency shift.

(d) *Bandwidth.* 200 hertz.

(e) *Transmission speeds.* 60, 75, and 100 words per minute (wpm).

(f) *Receiving direct current.* 20 milliamperes (ma) (minimum).

(g) *Power drain.* 60 watts.

(h) *Power source requirement.* 115 volts, 60 hertz.

(2) *Telegraph-telephone signal converter TA-182/U.*

(a) *Frequency of telegraph signaling.* 1225 hertz.

(b) *Frequency of telephone signaling.* 1600 hertz.

(c) *Low-frequency signal input.* 20 hertz.

(d) *Power drain AC source.* 40 watts.

(e) *Power source requirements.* 115 volts, 60 hertz.

(3) *Electrical filter assembly F-98/U.*

(a) *Midfrequency operation.* 1275 hertz.

(b) *Bandwidth.* From 100 to 200 hertz.

(c) *Supervisory signal.* 20 hertz at 100 milliamperes.

d. Description of Components.

(1) Telegraph terminal TH-5/TG is a 15-tube, frequency-shift-carrier modulator and demodulator. It modulates DC teletypewriter pulses to 1225-hertz and 1325-hertz frequencies. It demodulates 1225-hertz and 1325-hertz frequencies to DC teletypewriter pulses. These DC pulses must be capable of activating a teletypewriter selector magnet, which requires a 20-milliampere current. The TH-5/TG is a compact, lightweight unit of miniature construction. The panel contains two 3-position wafer-type switches, which are used to select the type of operation; a nonlocking lever switch, which is used to transmit the 20-hertz frequency; three jacks for teletypewriter connections; and six binding posts for connections in two-wire, four-wire, and radiotelegraph application. Operation with the TH-5/TG is known generally as one-way reversible; that is, only one TH-5/TG may transmit at a time. If two TH-5/TG transmit signals at the same time, the transmitted signal in each case would blank out the received signal; thus, a break-in would not be possible. However, a 20-hertz ringing signal can be transmitted by the receiving station to the transmitting station when break-in is desired.

(2) Telegraph-telephone signal converter TA-182/U provides a means of signaling in circuits that will not pass 20-hertz ringing signals because of line or equipment characteristics. It is an eight-tube, frequency-shift-carrier modulator and demodulator. It modulates 20-hertz frequencies to either 1225-hertz frequencies for teletypewriter signaling or to 1600-hertz frequencies for telephone signaling. It demodulates both the 1225-hertz and 1600-hertz frequencies to 20-hertz frequenices to activate the signaling device on a switchboard or telephone. The panel contains two 2-position wafer-type switches, which are used to select the specific type of operation. A toggle switch is used to adjust the sensitivity of the TA-182/U receiving circuit. Eight binding posts are used for line and loop connections.

(3) Electrical filter assembly F-98/U is a two-section filter. The band-pass section is used for teletypewriter transmission. The band-stop section is used for telephone transmission. Use of the F-98/U permits simultaneous teletypewriter and telephone service; the band-pass and band-stop sections of the F-98/U separate the teletypewriter and telephone signals. The F-98/U is made airtight by sealing, required no adjustment, and has no controls or indicators. The six binding posts located on the face of the panel are for interconnection with the associated equipment and the line.

e. Installation. Normally, the AN/TCC-14 is installed near the equipment to which it is connected. Prior to installation, the components are mounted in racks or stacked at the equipment site. For detailed information on other applications, refer to TM 11-5805-254-15.

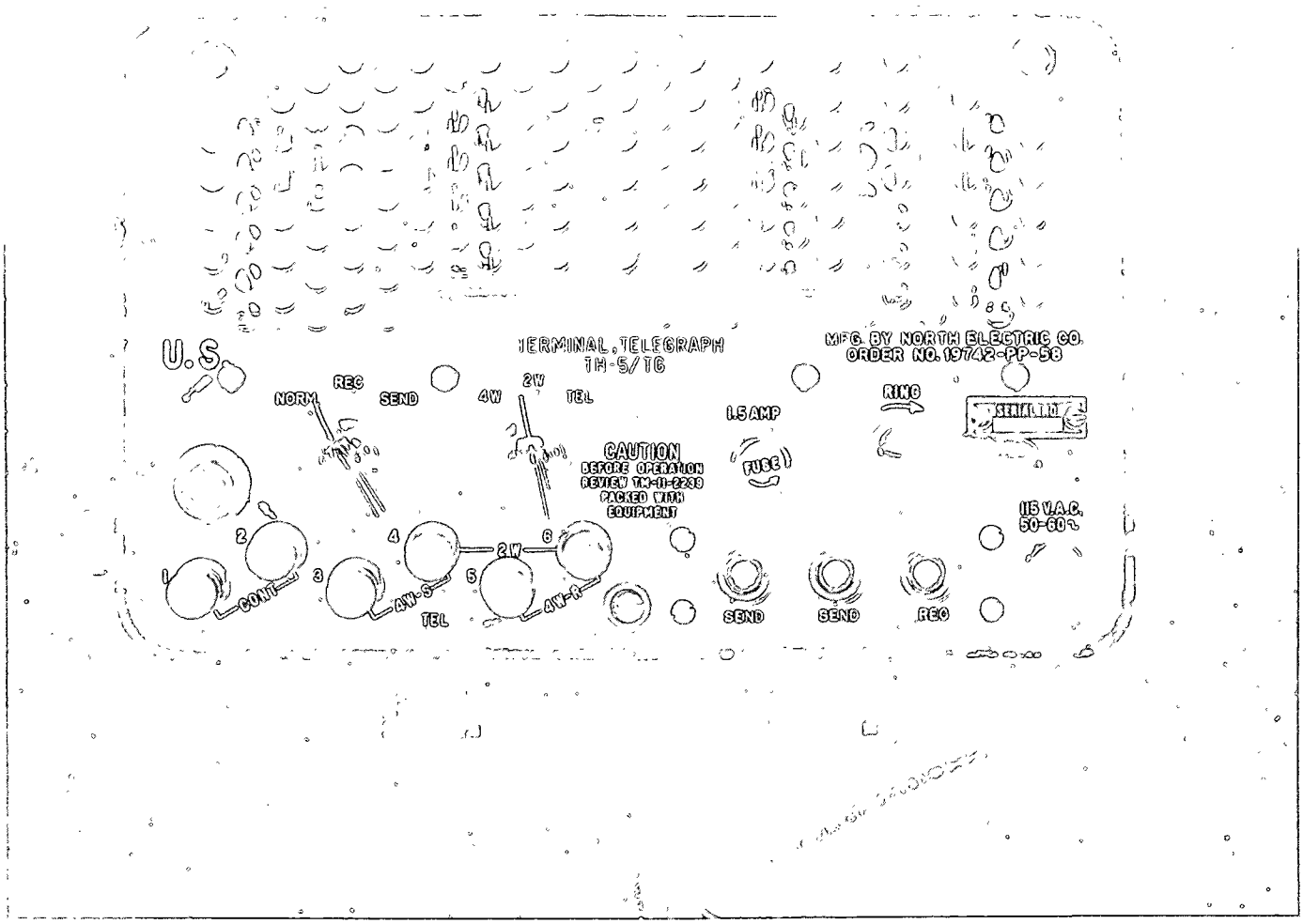


Figure 15-22. Telegraph Terminal TH-5/TG.

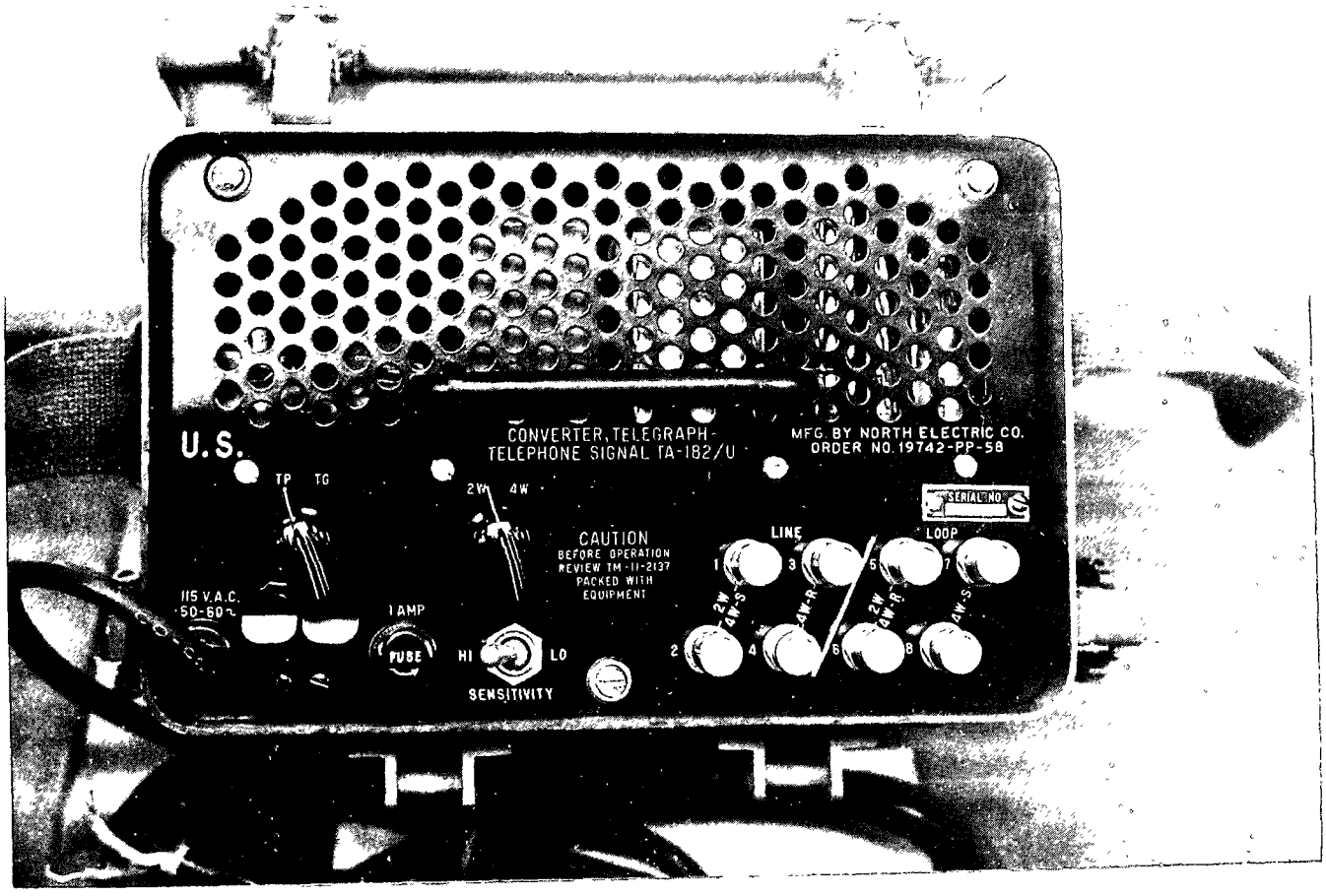


Figure 15-23. Telegraph-Telephone Signal Converter TA-182/U.

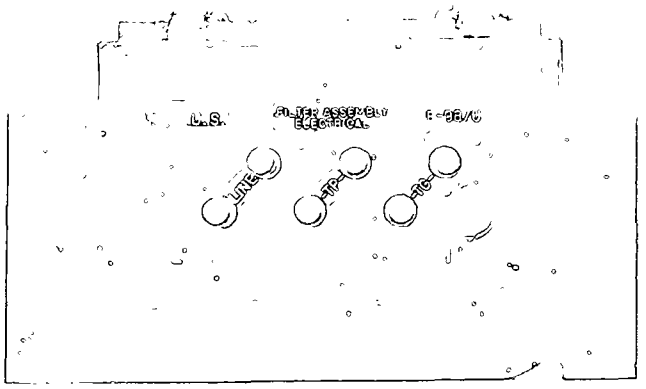


Figure 15-24. Electrical Filter Assembly F-98/U.

15-32. Technical Characteristics of AN/ TCC-29

a. Telegraph Terminal TH-22/TG. Telegraph terminal TH-22/TG is a transistorized frequency-shift modulator and demodulator. During transmission, it modulates direct current teletypewriter pulses (mark and space) to 1317.5 hertz for the frequency-shift modulator and 1232.5 hertz for the demodulator. During teletypewriter receiving operations, it demodulates these frequencies to direct current pulses. It also provides break-in (1180 hertz) signaling during teletype reception—20—hertz and voice-frequency signaling (1232.5 hertz)—and remote control keying of radio equipment. The TH-22/TG operates from a 115/230-volt, 50- to 60-hertz AC or 24-volt DC power source. This component is essentially the transistorized counterpart of the old telegraph terminal TH-5/TG (fig 15-25).

Figure 15-25. Telegraph Terminals TH-22/TG and TH-5/TG.

b. Electrical filter assembly F-316/U. Electrical filter assembly F-316/U is an airtight sealed two-section filter designed to separate the teletype transmission frequencies from the telephone transmissions frequencies. A band-pass section of 1100 to 1400 hertz is used for teletypewriter transmission. The remaining portion of the 300- to 3500-hertz voice band is used for telephone transmission. Use of this filter assembly permits simultaneous teletypewriter and telephone transmissions. This component requires no power source and is essentially the lightweight counterpart of the old filter assembly F-98/U (fig 15-26).

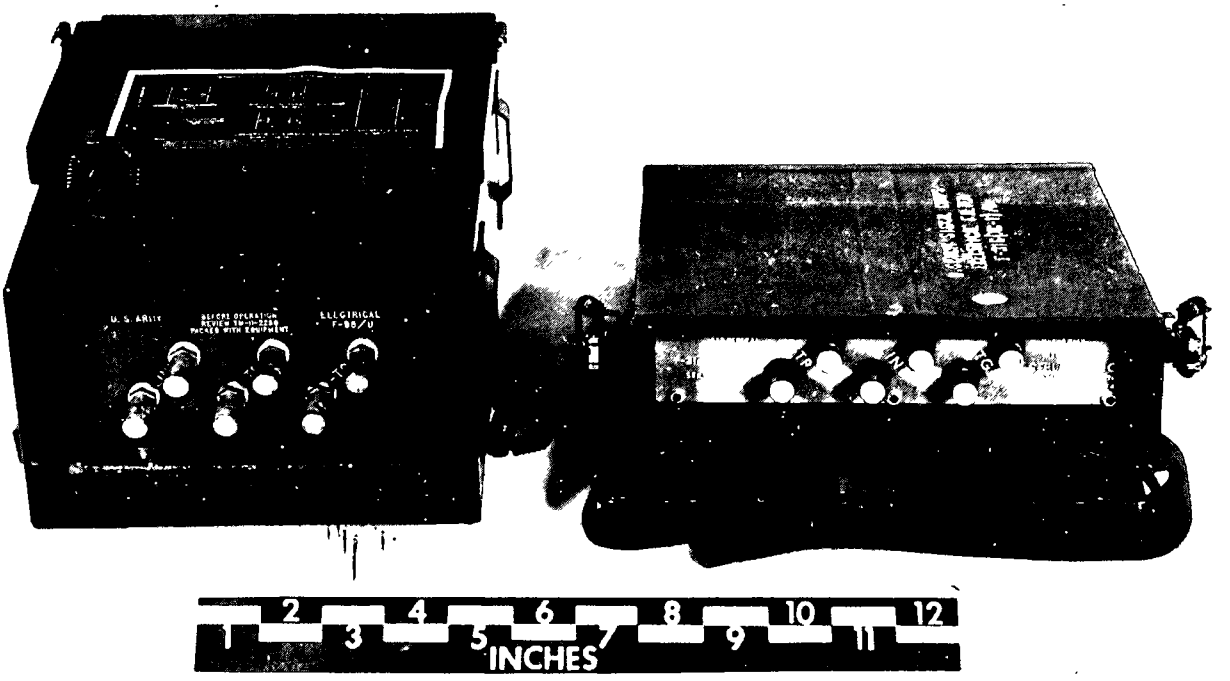


Figure 15-26. Electrical Filter Assemblies F-98/U and F-316/U.

c. Telegraph-Telephone Signal Converter CV-425/U. Telegraph-telephone signal converter CV-425/U provides the capability of voice-frequency signaling. It converts 20-hertz loop signaling frequencies to 1232.5 hertz for teletypewriter line signaling and to 1600 hertz for telephone line signaling. A power source of 115/230 volts alternating current is required for this item. This component is the transistorized counterpart of the old telegraph-telephone signal converter TA-182/U (fig 15-27).

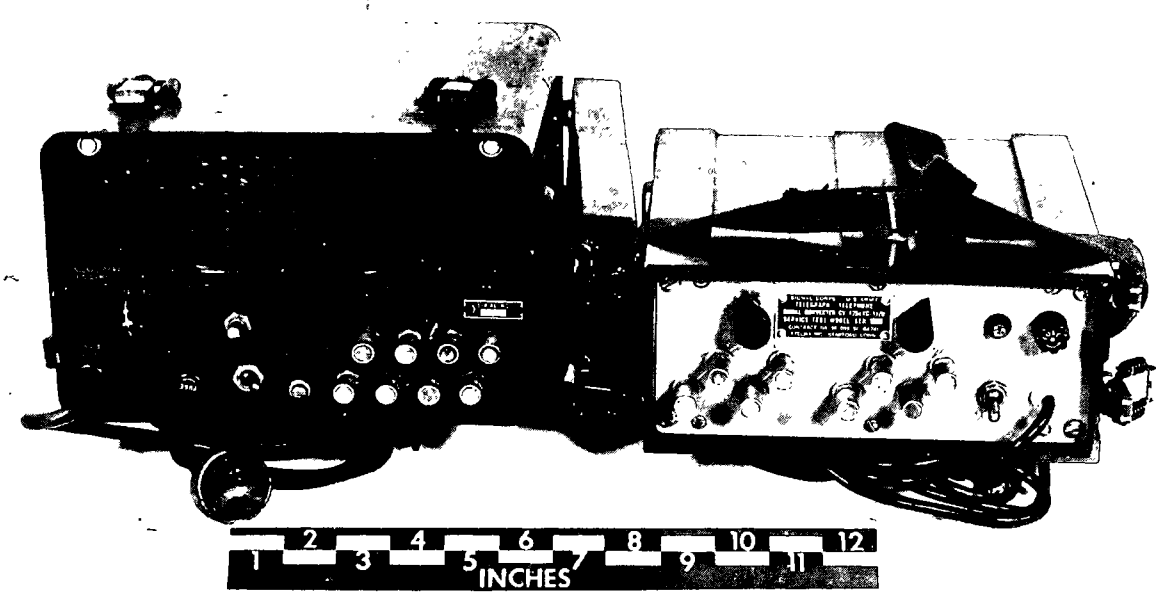


Figure 15-27. Telegraph-Telephone Signal Converters TA-182/U and CV-425/U.

Section IV. RADIO EQUIPMENT

15-33. General

This section contains general information concerning the characteristics of the major items of radio equipment used by field artillery units. For operating instructions and detailed information pertaining to this equipment, see the appropriate 11-series of technical manuals. For type radio nets, see chapter 16. For detailed information on field radio techniques, see FM 24-18.

15-34. Radio Set AN/ VRC-24

a. Radio set AN/VRC-24 (fig 15-28) is a VHF-UHF, amplitude modulated, voice communication radio used for vehicular ground-to-air communication.

b. Technical characteristics of radio set AN/VRC-24 are as follows:

(1) *Frequency range.* From 225.0 to 399.9 megahertz.

(2) *Communication channels.* 1,750

(3) *Preset channels.* 19

(4) *Power source.* 24 volts direct current.

(5) *Operating range.* Depends on the line of sight and on the altitude of the aircraft (about 48 kilometers at 1,000 feet; more than 160 kilometers at 10,000 feet).

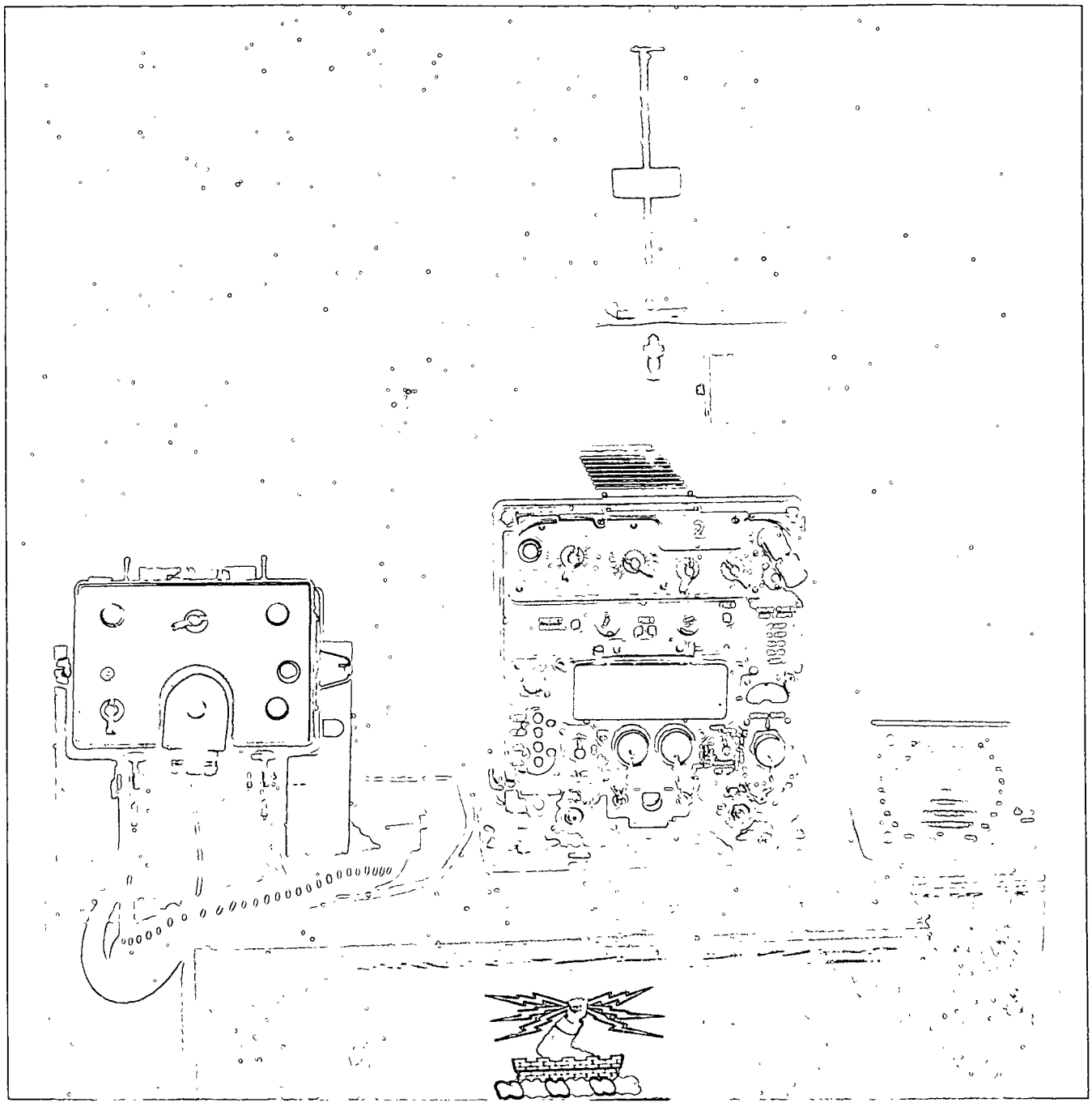


Figure 15-28. Radio set AN/VRC-24.

(6) *Antenna.* A 10-inch vehicular antenna is provided with the set.

(7) *Type of modulation.* Amplitude.

(8) *Operation.* Local or remote.

c. For information concerning the operation, organizational maintenance, and repair parts, refer to TM 11-5820-222-10, -20, and -35.

15-35. Radioteletypewriter Set AN/ GRC-46

a. Radioteletypewriter set AN/GRC-46 (fig 15-29) consists of assemblies of transmitting, receiving, and teletypewriter equipment arranged in a shelter and mounted on a vehicle. The AN/GRC-46 can provide either separate or simultaneous transmissions or receptions of voice and radio-teletype signals. The major components of the AN/GRC-46 are transmitter T-195/GRC-19, receiver R-392/VRR, radio transmitter modulator MD-203/GR, frequency-shift converter CV-278( )/GR, teletypewriter reperforator-transmitter TT-76 ( )/GGC, teletypewriter set AN/VGC-4, and interconnecting box J-249/GR. All the components

are mounted in a shelter equipped with electric lights, a heater, a ventilation system, and blackout blinds. Although designed primarily for use in a 3/4-ton truck, the radio may be installed in any vehicle that is large enough to accommodate the shelter and has a suitable electrical power system.

b. Technical characteristics are as follows:

(1) *Type of installation.* Vehicular (shelter on ¾-ton truck).

(2) *Type of modulation.* Amplitude modulated.

(3) *Type of emmission.* Voice, continuous-wave (CW), or frequency-shift-keyed (FSK) (RATT) or voice and FSK simultaneously.

(4) *Frequency range.*

(a) *Transmitter.* From 1.5 to 20.0 megahertz.

(b) *Receiver.* From 0.5 to 32.0 megahertz.

(5) *Transmission planning range (with whip antenna).*

(a) *Voice/FSK.* 80 kilometers (50 miles).

(b) *CW.* 80 kilometers (50 miles).

(6) *Power output (nominal).* 100 watts.

(7) *Power source.* From 22 to 30 volts direct current.

(8) *Antenna.*

(a) Whip, 15 feet long (three MS-116, one MS-117, one MS-118).

(b) Doublet.

(9) *Teletypewriter speed (automatic).* 60 words per minute.

c. For detailed information concerning the operation, organizational maintenance, and repair parts, refer to TM 11-5815-204-10, -20, and 20P.

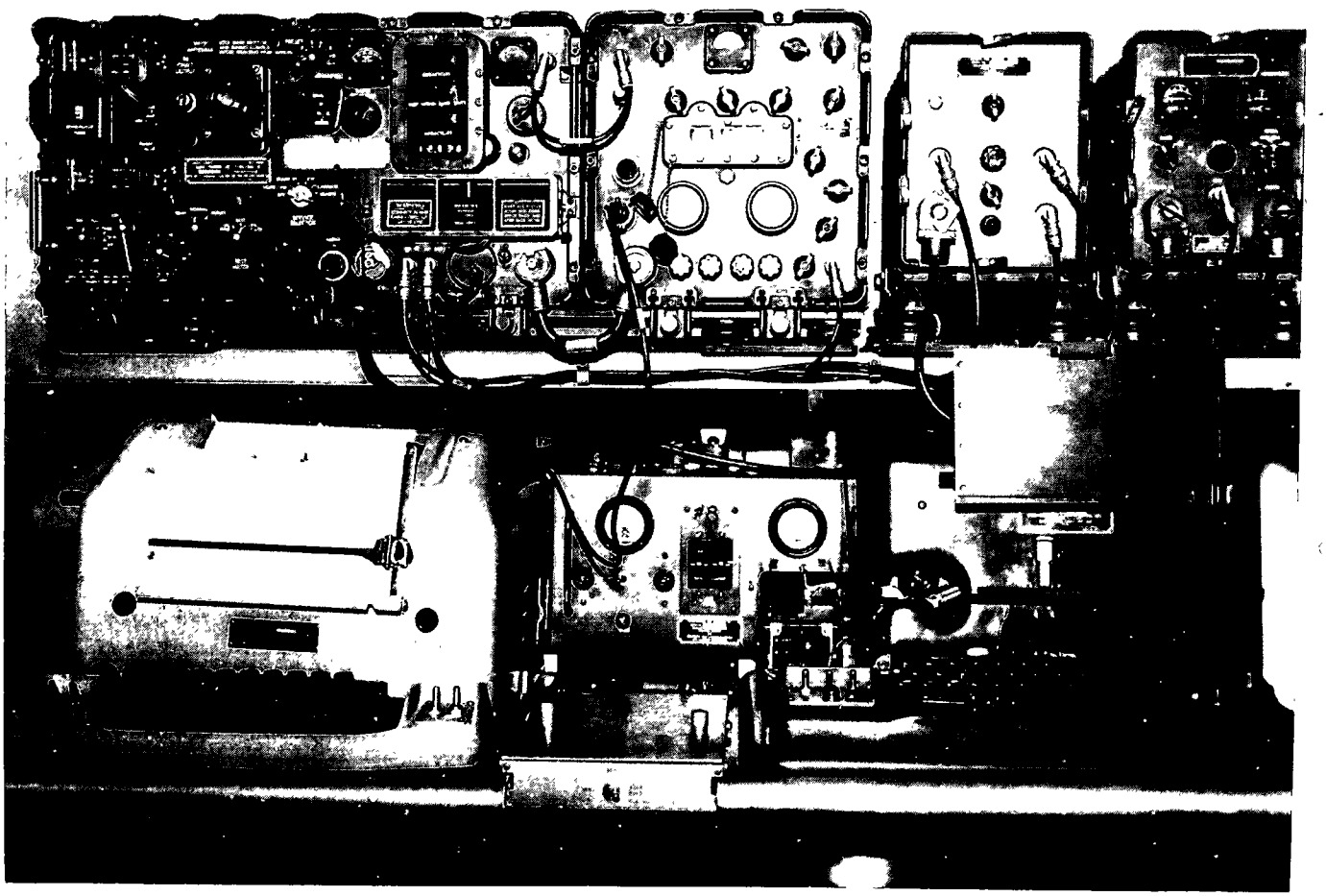


Figure 15-29. Radioteletypewriter Set AN/GRC-46.

15-36. Radio Sets AN/ VRC-12 and AN/ VRC-43 Through 49

a. Radio sets AN/VRC-12 and AN/VRC-43 through -49 are the most recent vehicular radio communication equipment designed for armor, artillery, and infantry units. The radio sets are frequency modulated and are replacing radio sets AN/GRC-3 through -8, AN/VRC-7 through -10,

AN/VRC-13 through -18, AN/VRC-20 through -22, and AN/VRQ-1 through -3. All configurations of the new radio sets consist of various combinations of two basic components—a receiver-transmitter and an auxiliary receiver. There are two versions of the receiver-transmitter— a manually tuned model, the RT-524/VRC, (fig 15-30) and an automatically tuned model, the RT-246/VRC-9 (fig 15-30). Both models have the same characteristics. The manual model contains a built-in loudspeaker in the space occupied by the pushbuttons of the automatic model. The manually tuned RT-524/VRC was developed primarily for issue to artillery and infantry units, since their need for self-contained loudspeaker is greater than their need for automatic tuning. Armor units will be issued the automatic receiver-transmitter RT-246/VRC because of limited access in tracked vehicles. Any of the 10 preset channels can be remotely selected from crew positions. The auxiliary receiver R-442/VRC is manually tuned. Each component of the new radio sets has its individual mount. Tune squelch (NEW SQUELCH position) prevents this series of radios from netting with the AN/PRC and VRC-8, -9, and -10 series of radios and with many Army aircraft FM radios. The older family of radios are unable to communicate through the 150-H tone squelch of the 12-series of radios whenever the squelch switch is in the NEW SQUELCH position.

b. The characteristics of receiver-transmitters RT/524/VRC and RT-246/VRC are as follows:

(1) *Frequency range.* From 30.00 to 75.95 megahertz.

(a) *Band A.* From 30.00 to 52.95 megahertz.

(b) *Band B.* From 53.00 to 75.95 megahertz.

(2) *Preset channels.* 10 (RT-246/VRC only).

(3) *Number of channels.* 920.

(4) *Channel spacing.* 50 kilohertz.

(5) *Type of modulation.* Frequency modulation (FM)

(6) *Type of transmission and reception.* Voice.

(7) *Transmitter power output.*

(a) *High power.* 35 watts, minimum.

(b) *Low power.* 1 to 3 watts.

(8) *Rated range.* 40 kilometers

(9) *Input power requirements.*

(a) *High power.* 10 amperes at 24 volts direct current.

(b) *Low power.* 3 amperes at 24 volts direct current.

(10) *Antenna.* Center-fed whip.

(11) *Types of squelch.* Noise and tone operated.

c. The characteristics of radio receiver R-442/VRC are as follows:

(1) *Frequency range.*

(a) *Band A.* From 30.00 to 52.95 megahertz.

(b) *Band B.* From 53.00 to 75.95 megahertz.

(2) *Number of channels.* 920.

(3) *Channel spacing.* 50 kilohertz.

(4) *Type of modulation.* Frequency modulation.

(5) *Type of signal received.* Voice.

(6) *Types of squelch.* Noise and tone operated.

(7) *Antenna.* Three-section whip (one MS-116, one MS-117, and one MS-118).

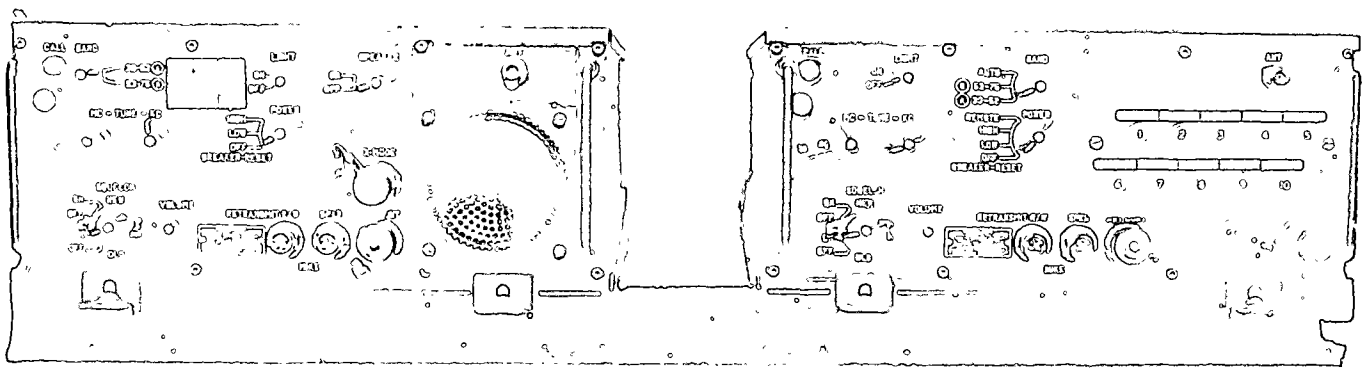


Figure 15-30. Radio Receiver-Transmitters RT-524/VRC and RT-246/VRC.

15-37. Radio Receiver R-442/ VRC

Radio receiver R-442/VRC (fig 15-31) is a rugged, lightweight, compact receiver housed in a watertight case. All operating controls are located on the front panel. An electrical connector at the rear mates with a connector on the mount MT-1898/VRC. Two guide pin holes at the rear are recessed for the guide pins on the mount. The top

and bottom covers are held in place by captive screws. The receiver is part of radio sets AN/VRC-12, AN/VRC-44, AN/VRC-47, and AN/VRC-48.

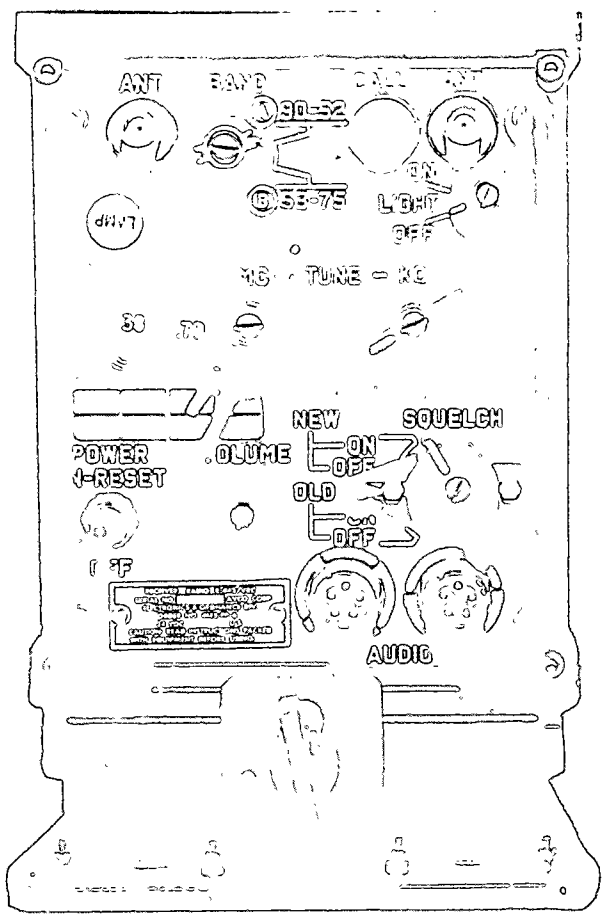


Figure 15-31. Radio Receiver R-442/VRC.

15-38. Radio Receiver-Transmitter RT-246/ VRC

Receiver-transmitter RT-246/VRC (fig 15-30) is a rugged, lightweight, compact receiver-transmitter housed in a watertight case. All operating controls are located on the front panel. The hinged cover, held in place by two captive screws in front of the pushbutton assembly, provides access to the presetting adjustments for maintenance personnel. The connector at the rear mates with a connector on the front of the junction box on mount MT-1029/VRC. Two guide pin holes are recessed for the guide pins on the mount. The blower inside the case aids in cooling the set. The top and bottom covers are held in place by captive screws.

15-39. Radio Receiver-Transmitter RT-524/ VRC

Receiver-transmitter RT-524/VRC (fig 15-30) is similar to receiver-transmitter RT-246/VRC except that it has a self-contained loudspeaker instead of a pushbutton assembly on the front panel.

15-40. Radio Set AN/ VRC-12

Radio set AN/VRC-12 (fig 15-32) provides facilities for monitoring two channels simultaneously or for monitoring one channel while transmitting on another. It has 10 preset channels. For more information on radio set AN/VRC-12, refer to TM 11-5820-401-12.

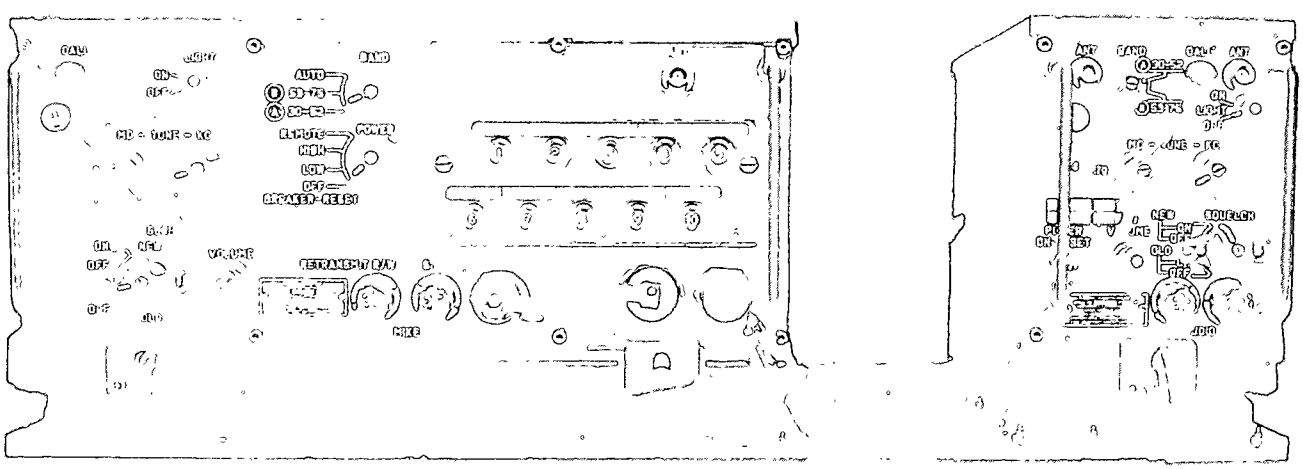


Figure 15-32. Radio Set AN/VRC-12.

15-41. Radio Set AN/ VRC-46

a. General. Radio set AN/VRC-46 (fig 15-33) is similar to the AN/VRC-47 (para 17-47) except it has no auxiliary receiver R-442/VRC. It is a manually tuned radio set.

b. Components. The main components of the AN/VRC-46 are—

(1) Radio receiver-transmitter RT-524/VRC.
(2) Mounting MT-1029/VRC.
(3) Antenna AT 912/VRC (replaced by AS-1729).

c. Characteristics and Capabilities. See paragraph 15-36 for the characteristics and capabilities of radio set AN/VRC-46.

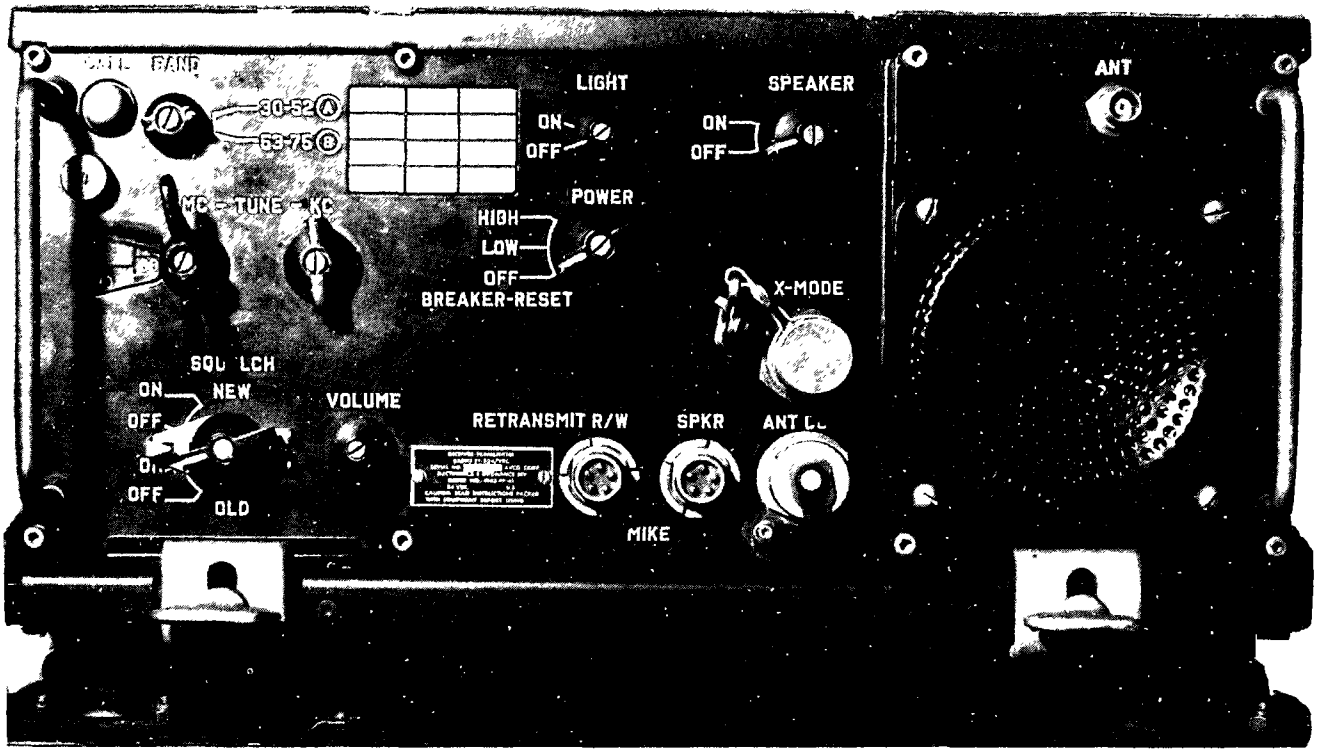


Figure 15-33. Radio Set AN/VRC-46.

15-42. Radio Set AN/ VRC-47

a. General. Radio set AN/VRC-47 (fig 15-34) provides facilities for monitoring two channels at the same time or for monitoring one channel while transmitting on another. It is a manually tuned radio set.

b. Components. The main components of the AN/VRC-47 are—

(1) Radio receiver-transmitter RT 524/VRC.
(2) Radio receiver R-442/VRC.
(3) Mounting MT 1029/VRC.
(4) Mounting MT-1898/VRC.
(5) Antenna AT-912/VRC (replaced by AT-1729).

c. Characteristics and Capabilities. See paragraph 15-36 for the characteristics and capabilities of radio set AN/VRC-47.

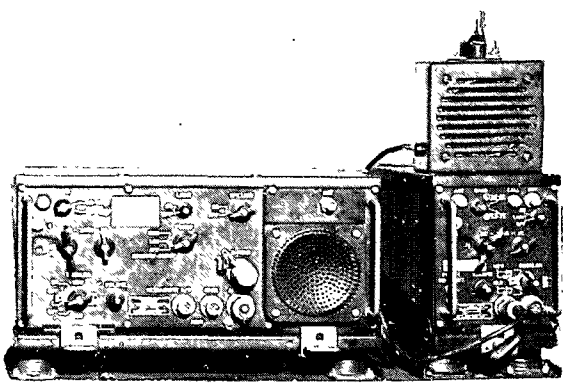


Figure 15-34. Radio Set AN/VRC-47.

15-43. Radio Set AN/ VRC-49

a. General. Radio set AN/VRC-49 (fig 15-35) provides facilities for monitoring two channels simultaneously, or monitoring one channel while transmitting on another. In addition, the radio set control C-2299/VRC is used to control automatic retransmission between two distant stations.

b. Components. The main components of the AN/VRC-49 are as follows:

(1) Two radio receiver-transmitters RT-524/VRC.

(2) Two mountings MT-1029/VRC.

(3) Two antennas AT-912/VRC (replaced by AS-1729).

(4) One radio set control C-2299/VRC.

c. Characteristics and Capabilities. See paragraph 15-36 for the characteristics and capabilities of radio set AN/VRC-49.

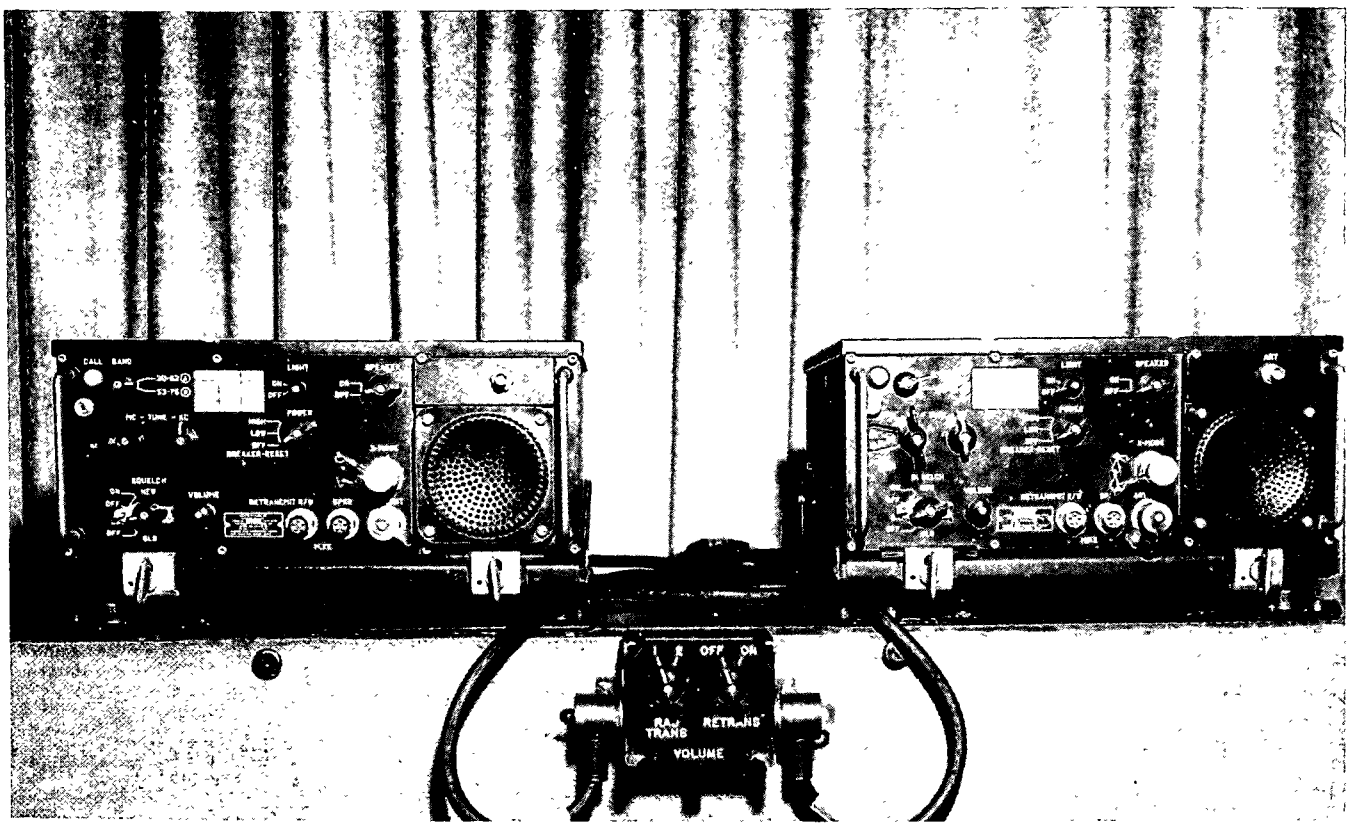


Figure 15-35. Radio Set AN/VRC-49.

15-44. Radio Sets AN/ PRC-77 (25), AN/ VRC-64 (53), and AN/ GRC-160 (125)

a. General. Radio set AN/PRC-77 (fig 15-36) is a versatile, lightweight, frequency modulated radio set that can be operated from a pack or a vehicle. It is replacing the AN/PRC-25 on an attrition basis. It is an improvement over the AN/PRC-25 in that it permits reliable operation with speech security equipment. The basic difference between the two sets is the receiver-transmitter. The AN/PRC-77 uses the RT-841/PRC-77 and the AN/PRC-25 uses the RT-505/PRC-25. Each is powered by a dry battery or by a special vehicular power supply. The basic radio set is referred to as the AN/PRC-77 (25); however, recent changes in nomenclature make the following distinctions in the use of the receiver-transmitter RT-841/PRC-77 (RT-505/PRC-25).

(1) When used for manpack operation only, the radio is referred to as the AN/PRC-77, which is replacing the AN/PRC-25.

(2) When used for vehicular operation only, the radio is referred to as the AN/VRC-64, which is replacing the AN/VRC-53.

(3) When used for manpack or vehicular operation, the radio is referred to as the AN/GRC-160, which is replacing the AN/GRC-25.

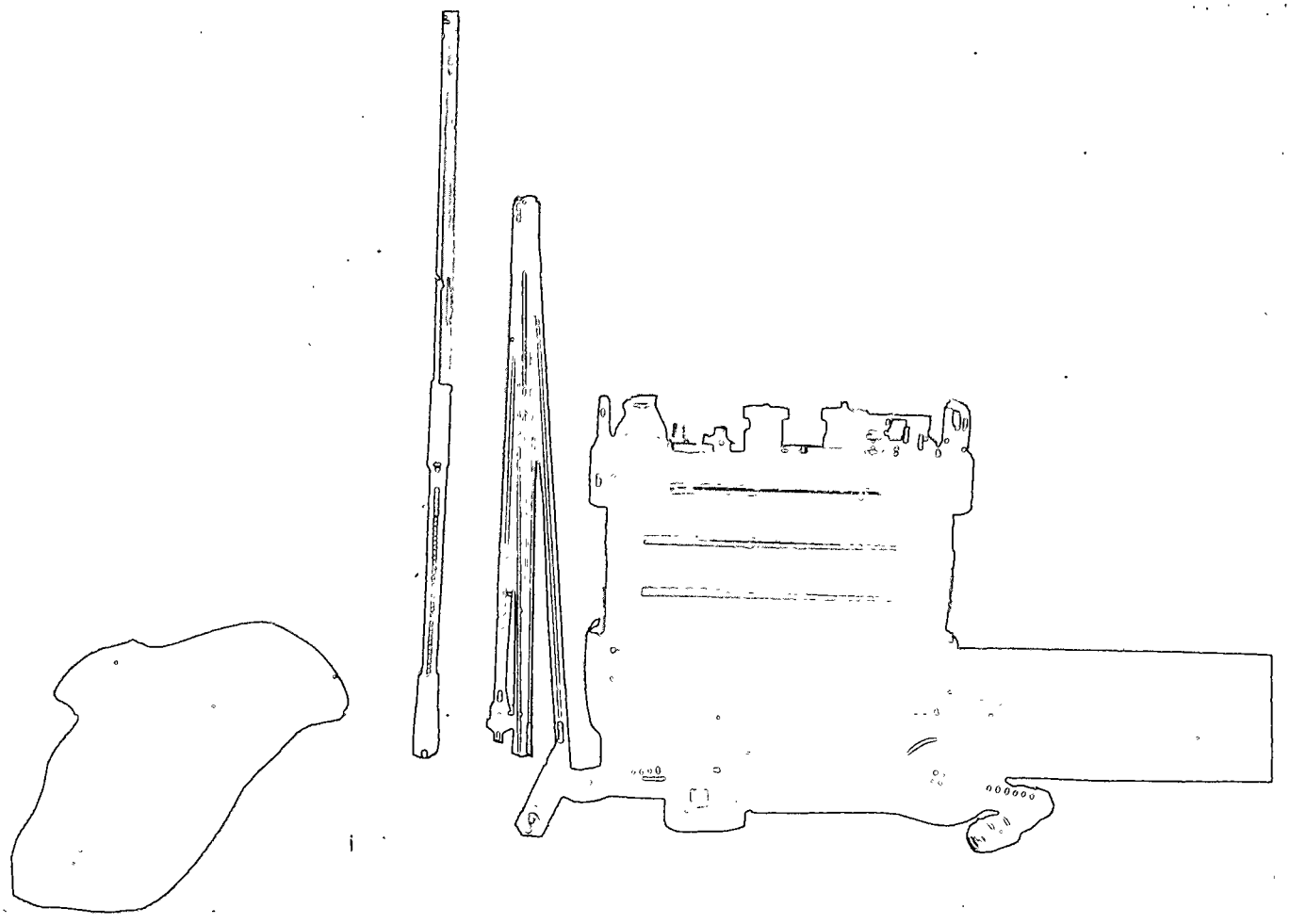


Figure 15-36. Radio Set AN/PRC-25 or AN/PRC-77.

b. Characteristics. The characteristics of radio receiver-transmitters RT-841/PRC-77 and RT-505/PRC-25 are as follows:

(1) *Frequency range:*

(a) *Low band.* 30.00 to 52.95 megahertz.

(b) *High band.* 53.00 to 75.95 megahertz.

(2) *Preset channels.* Two.

(3) *Number of channels.* 920.

(4) *Type of modulation.* Frequency modulation.

(5) *Type of transmission and reception.* Voice.

(6) *Transmitter power output* 1.5 to 4.0 watts.

(7) *Type of squelch.* Tone operated.

(8) *Distance range.* 8 kilometers (5 miles).

(9) *Type of tuning.* Detent.

(10) *Antennas.*

(a) AN/VRC-64, AT-912/VRC or AS-1729/VRC, center-fed whip (AN/VRC-53).

(b) AN/GRC-160, AT-912/VRC or AS-1729/VRC, center-fed whip: AT-271A/PRC (AN/GRC-125) 10-foot multisection whip; AT-892/PRC-25, 3-foot semirigid tape.

(c) AN/PRC-77 AT-271A/PRC, 10-foot multisection whip; AT/892/PRC-25, (AN/PRC-25) 3-foot semirigid tape.

(11) *Battery life.* The BA-386/U is a standard carbon dry cell battery that will provide approximately 20 hours of operation for the RT-505/PRC-25 or 30 hours for the RT-841/PRC-77. The BA-4386/U is a magnesium cell battery that will operate about twice as long as the BA-386/U.

(12) Power supply. Amplifier-power supply group OA-3633/GRC is used with the AN/VRC-64 (53) and AN/GRC-160 (125). Input voltage is 24 volts DC.

15-45. Radio Receiver-Transmitters RT-841/ PRC-77 and RT-505/ PRC-25

The receiver-transmitter is housed in a watertight case and secured with four captive screws. All controls are on the front panel. A battery plug projects from the receiver-transmitter and mates

with the connector of the battery. The battery box, which is part of the receiver-transmitter, protects and houses the battery. The battery rests on a foam rubber pad fastened to the bottom of the case.

15-46. Amplifier-Power Supply Group OA/ 3633/ GRC

a. The amplifier-power supply group OA-3633/GRC consists of amplifier-power supply AM-2060 /VR and special purpose electrical cable assembly CX-4655/U. The CX-4655/U provides for interconnection of the AM-2060/VR and an installed receiver-transmitter.

b. The AM-2060/VR is a one-piece cast-aluminum housing containing an internally mounted plug-in module, operating controls, connectors, and a loudspeaker. All operating controls are on the front of the unit.

c. An access plate, attached with six mounting screws, can be removed to provide access to the internally mounted plug-in module and components. Two mounting clamps at the front of the unit and a mounting plate at the rear attach the AM-2060/VR to the receiver-transmitter. Two slides allow easy insertion of the receiver-transmitter, and a bumper plate at the rear of the base assembly provides cushioning.

d. On the rear of the unit are a power input connector which distributes power, control, and signal voltages between the OA-3633/GRC and other equipment of the radio set system; an antenna control connector; cable clips for storing the CX-4655/U when not in use; and two guide pin holes to aid in holding the AM-2060/VR to the mounting MT-1029/VRC.

e. For discussion of vehicular installation, see TM 11-5820-498-12.

15-47. Retransmission Cable Kit MK-456A/ GRC

Two radio sets AN/PRC-77 (AN/PRC-25) at a suitable location may be used to retransmit automatically the signals of two other radio sets that are too far apart to communicate directly with each other. This action can be accomplished by connecting the MK-456A/GRC between the two sets. The MK-456A/GRC consists of a junction box and a 50-foot cable with a five-pin connector at each end. The junction box has a connector for a handset H-138/U, which can be used for monitoring the retransmission signals. This retransmission kit can be obtained for special situations. For further details see TM 11-5995-202-15.

15-48. Radio Set AN/ PRC-74 ( )

The initial version of radio set AN/PRC-74 (fig 15-37) operates at a frequency range of 2.0 to 11.999 megahertz. The modified AN/PRC-74B provides dependable two-way communications within the frequency range of 2.000 to 17.999 megahertz. This is a single-sideband (SSB) receiver-transmitter RT-794/PRC-74, which provides either voice or telegraph continuous-wave communication. Since the radio set operates at the low end of the high-frequency spectrum, signals are propagated by both the groundwave method and the skywave method. Groundwave propagation normally is used for communication at distances up to 40 kilometers. For greater distances sky wave propagation is used and signals reach distant points by refraction from the ionosphere. The operating range of this radio set may be extended to several hundred kilometers by proper selection of frequency, antenna, and time of day. This radio set is designed primarily for use in areas where direct line-of-sight communication is difficult. The set may be operated with a 12-volt portable unit battery pack (nickel-cadmium) or a dry battery pack consisting of two batteries BA-4386. For fixed installation with 110/220 volt, AC, single-phase power, power supply PP-4514/PRC-74 can be used. For further information, see TM 11-5820-590-12-1.

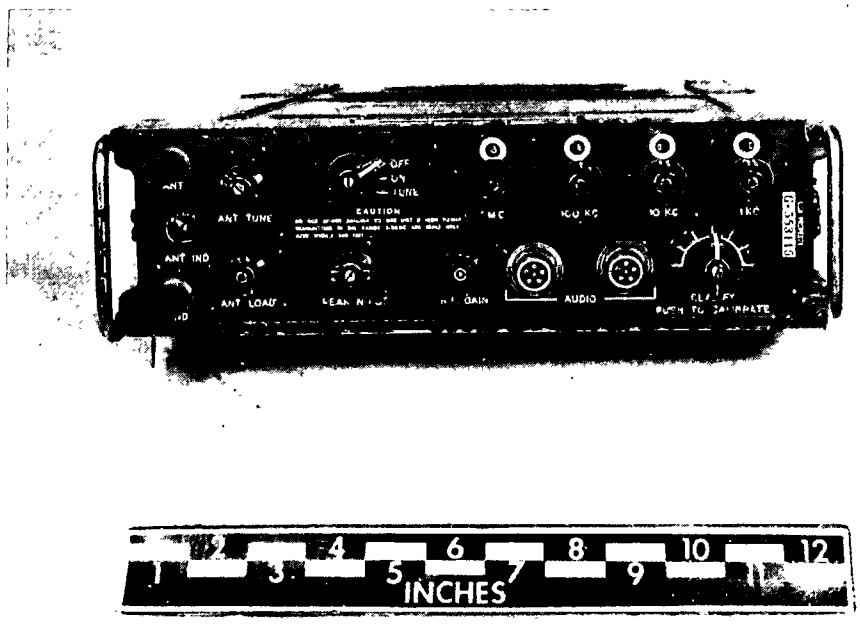


Figure 15-37. Radio Set AN/PRC-74 ( ).

15-49. Radio Set AN/ GRC-106

a. General. Radio set AN/GRC-106 (fig 15-38) is a high frequency, single sideband receiving-transmitting radio set. It operated on any one of 28,000 selectively tuned channels, spaced in 1-kilohertz increments, in the 2.000- to 29.999-megahertz frequency range. The additional feature of vernier tuning (±500 hertz about any 1-kilohertz increment) allows reception on any frequency.

b. Use. The AN/GRC-106 is used for receiving and transmitting upper sideband (USB) voice, USB-compatible amplitude modulated (AM) and continuous wave signals on push-to-talk operation over an 80-kilometer range, ground-wave and up to 2400 kilometers skywave. The AN/GRC-106 can receive but cannot transmit conventional double-sideband (DSB) amplitude modulated signals. With appropriate ancillary radioteletype equipment, the set can receive and transmit frequency-shift-keyed and narrow-frequency-shift-keyed (NSK) signals.

c. Components. The components of the AN/GRC-106 are receiver-transmitter RT-662/GRC, radiofrequency amplifier AM-3349/GRC-106, mounting MT-3140/GRC-106, a standard 15-foot whip antenna group, a doublet antenna group, and an installation kit.

d. Reference. For additional information, see TM 11-5820-520-34P-1.

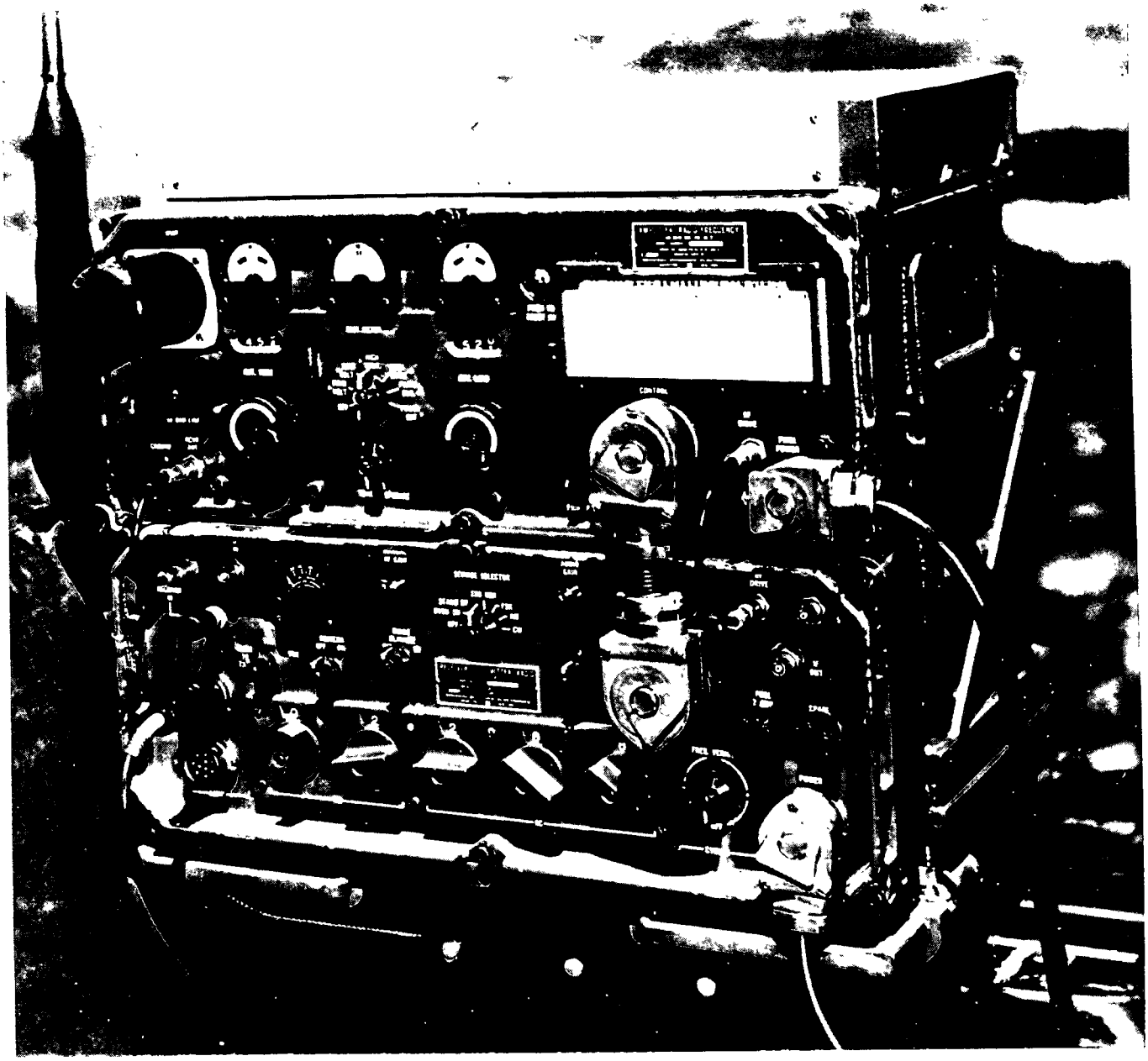


Figure 15-38. Radio Set AN/GRC-106.

15-50. Radioteletypewriter Set AN/ GRC-142

a. General. Radioteletypewriter set AN/GRC-142 (fig 15-39) is installed in electrical equipment shelter S-318( )/G, or S-250/G which is mounted on a vehicle. The radio components are the same as those used in radio set AN/GRC-106 (para 17-55). Additional equipment is provided for radioteletypewriter (RATT) communication. The AN/GRC-142 has the capability of providing a half-duplex circuit, using upper-sideband voice, upper-sideband-compatible AM, continuous wave, frequency-shift-keyed, and narrow-frequency-shift-keyed signals. Primary power is provided by the vehicle, which is equipped with a high-capacity (100 amperes), 28-volt electrical system. The AN/GRC-142 was designed to replace radioteletypewriter set AN/GRC-46( ).

b. Major Components. The major components of radio teletypewriter set AN/GRC-142 are as follows:

(1) Receiver-transmitter RT-662( )/GRC.

(2) Radiofrequency amplifier AM-3349( )/GRC-106.

(3) Radioteletypewriter modem unit MD-552( )/GR.

(4) Teletypewriter set TT-98/FG.

(5) Teletypewriter reperforator-transmitter TT-76( )/GGC.

(6) Electrical equipment shelter S-318( )/G.

(7) Inverter, motor generator.

(8) Air conditioner (6,000 BTU, supported only with AN/GRC-142 serial number 1-697).

c. Characteristics. The characteristics of radio teletypewriter set AN/GRC-142 are as follows:

(1) *Receiver-transmitter RT-662/GRC.*

(a) *Number of electron tubes.* Two.

(b) *Number of transistors.* 142.

(c) *Frequency range.* From 2.0 to 29.999 megahertz.

(d) *Channels.* 28,000 in locked 1-kilohertz steps.

(e) *Types of transmission.* Upper-sideband voice, upper-sideband-compatible AM, continuous-wave, frequency-shift-keyed, and narrow frequency-shift-keyed.

(f) *Type of reception.* Upper-sideband, compatible and conventional double-sideband AM, continuous wave, frequency-shift-keyed and narrow frequency-shift-keyed.

(g) *Type of Control.* Crystal-controlled synthesizers referenced to a highly stable 5 MHz internal standard.

(h) *Power source.* 28 volts DC.

(2) *Radio-frequency amplifier AM-3349( )/GRC-106.*

(a) *Number of electron tubes.* Three.

(b) *Number of transistors.* 10.

(c) *Frequency range.* From 2.0 to 29.999 megahertz.

(d) *Power source.* 28 volts DC.

(e) *Power output.*

1. Continuous-wave and radio-teletypewriter (FSK and NSK), 200 watts average.

2. Upper-sideband voice and compatible AM voice, 400 watts peak envelope power (PEP).

(f) *Planning range.* 50 miles (80 km) ground wave; up to 1,500 miles (2,400 km) sky wave under suitable conditions and with the proper choice of frequencies, antennas, and time of day.

(g) *Type of antennas.*

1. Whip, 15 feet long (three MS-116's, one MS-117, and one MS-118).

2. Doublet AN/GRA-50.

(3) *Radioteletypewriter modem unit MD-552( )/GR.*

(a) FSK. Frequency shift, 850 hertz.

(b) NSK. Frequency shift, 85 hertz.

(4) *Inverter, motor generator.* The rotary inverter converts 28 volts DC to 115 volts AC at 60 hertz for the teletypewriter equipment.

d. References. For further details, see TM 11-5815-334-12.

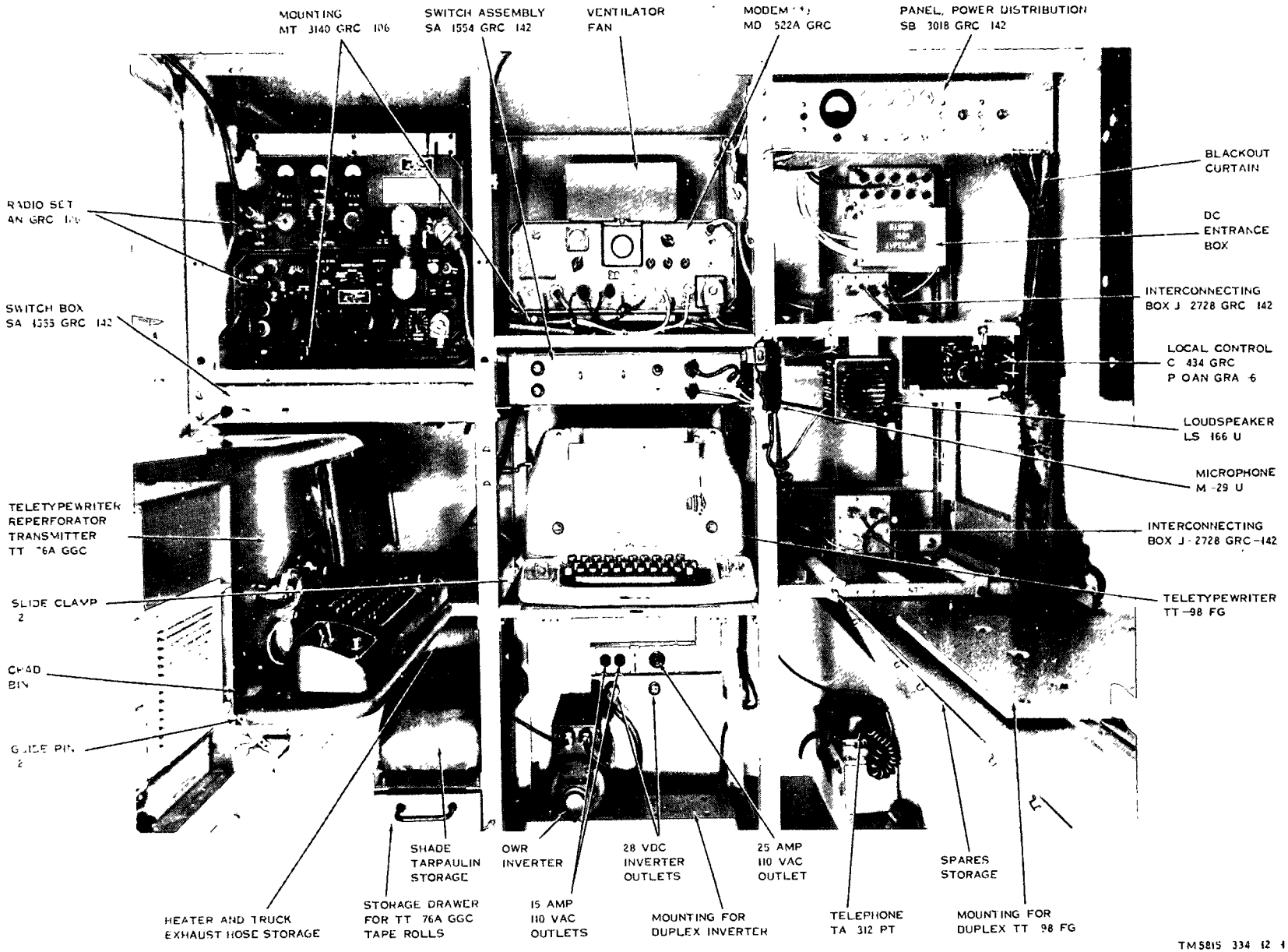


Figure 15-39. Radioteletypewriter Set AN/GRC-142.

15-51. Radio Teletypewriter Set AN/ GRC-122. Radioteletypewriter set AN/GRC-122 (fig 15-40) and radioteletypewriter set AN/GRC-142 are similar except that the AN/GRC-122 has an additional RT-662( )/GRC, teletypewriter set TT-98/FG, and inverter. The AN/GRC-122 has the added capability of providing full-duplex operation in all types of service.

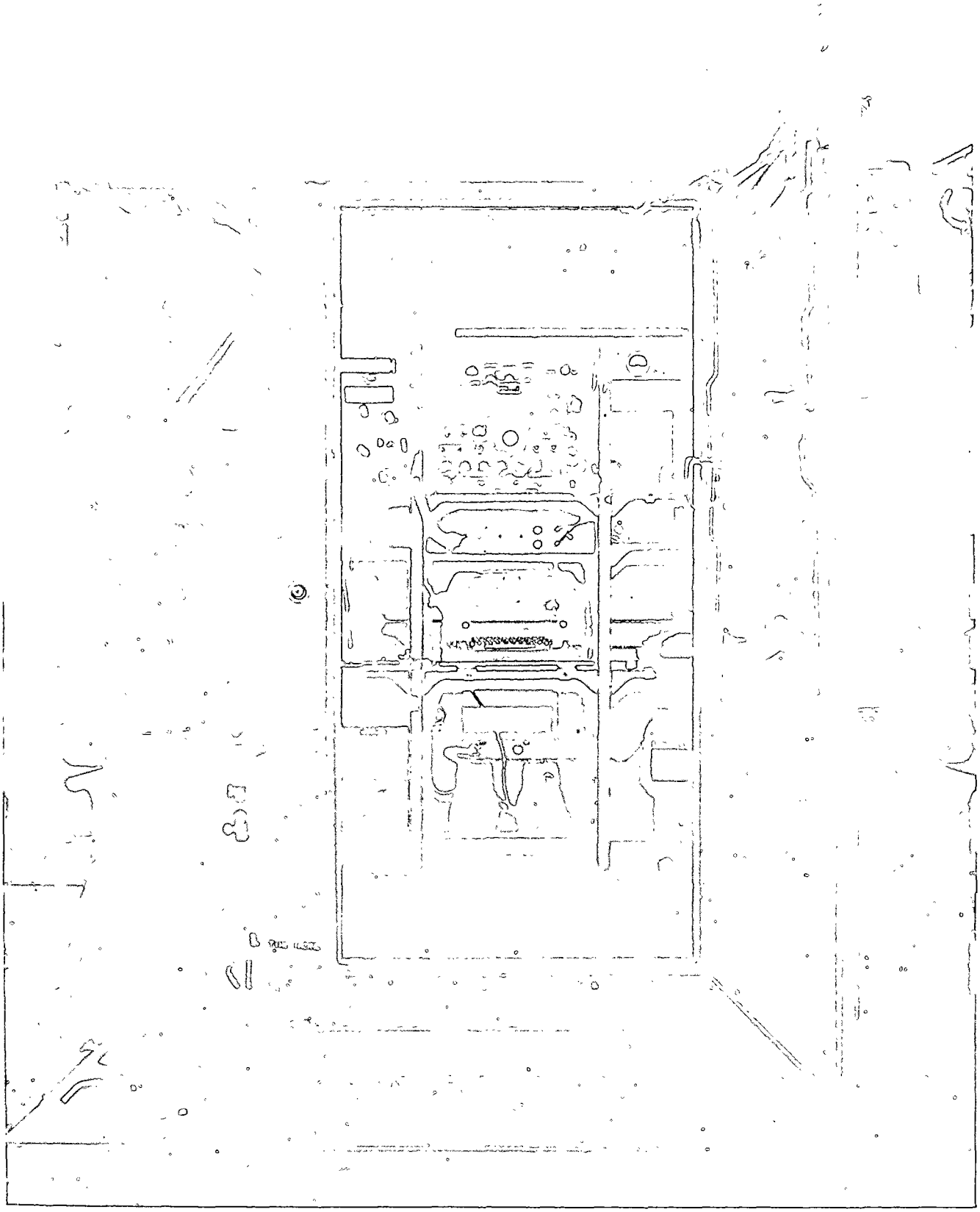


Figure 15-40. Radioteletypewriter Set AN/GRC-122.

15-52. Radioteletypewriter Set AN/ VSC-3

Radioteletypewriter set AN/VSC-3 (fig 15-41) and radio teletypewriter set AN/GRC-142 are identical except that the AN/VSC-3 is arranged and mounted in an armored vehicle M577 and does not have an independent shelter.

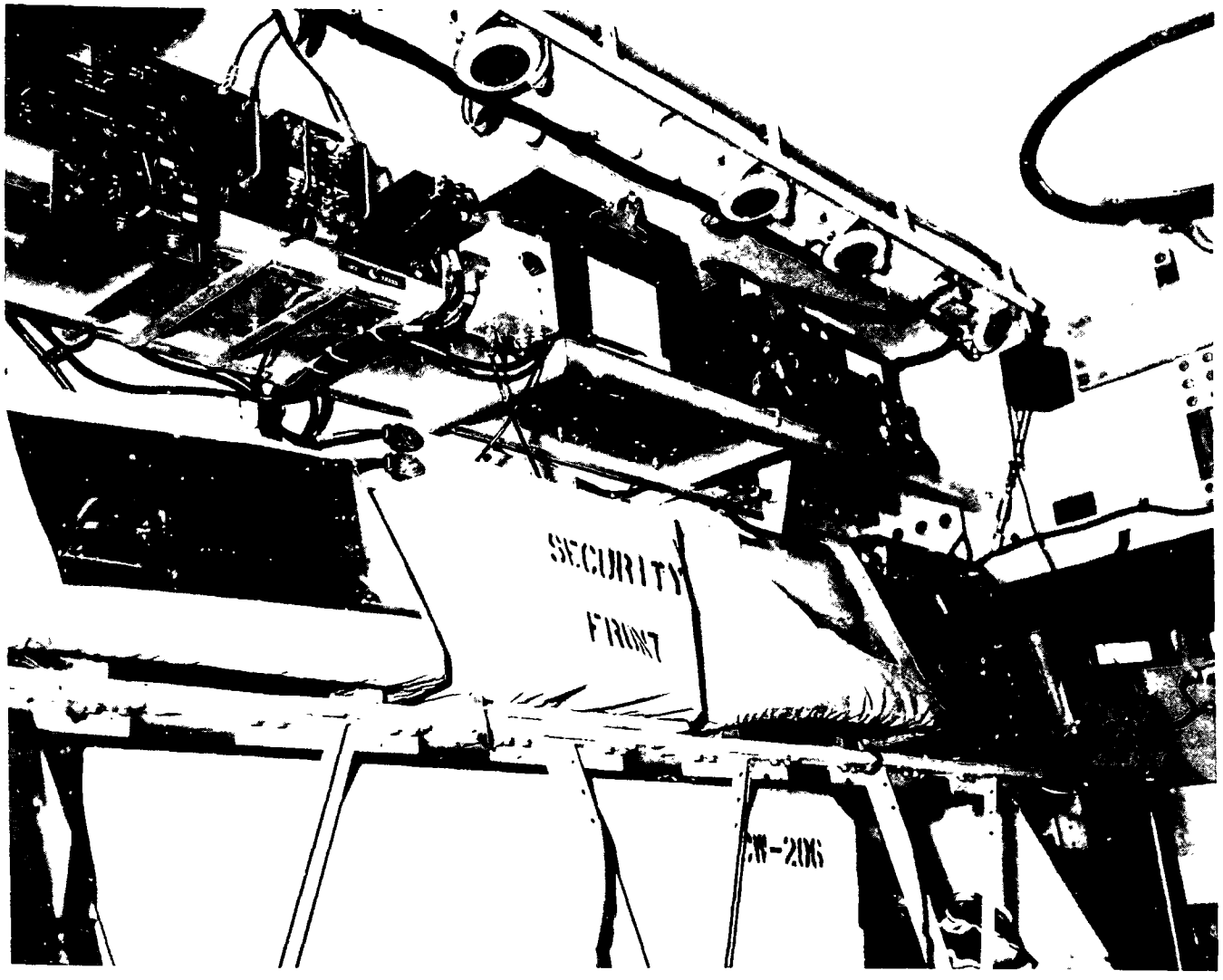


Figure 15-41. Radioeteletypewriter Set AN/VSC-3.

15-53. Radio Teletypewriter Set AN/ VSC-2

Radio teletypewriter set AN/VSC-2 (fig 15-42) is vehicle-mounted in a ¼-ton vehicle. The radio components of the AN/VSC-2 are the same as those employed in radio set AN/GRC-106. Additional equipment is provided for radio teletypewriter communication. The AN/VSC-2 has the same characteristics and facilities as the AN/VSC-142 except that it does not include the teletypewriter reperforator-transmitter TT-76( )/GGC and shelter. The AN/VSC-2 normally is authorized in airborne and airmobile units. For further details, see TM 11-5815-331-14.

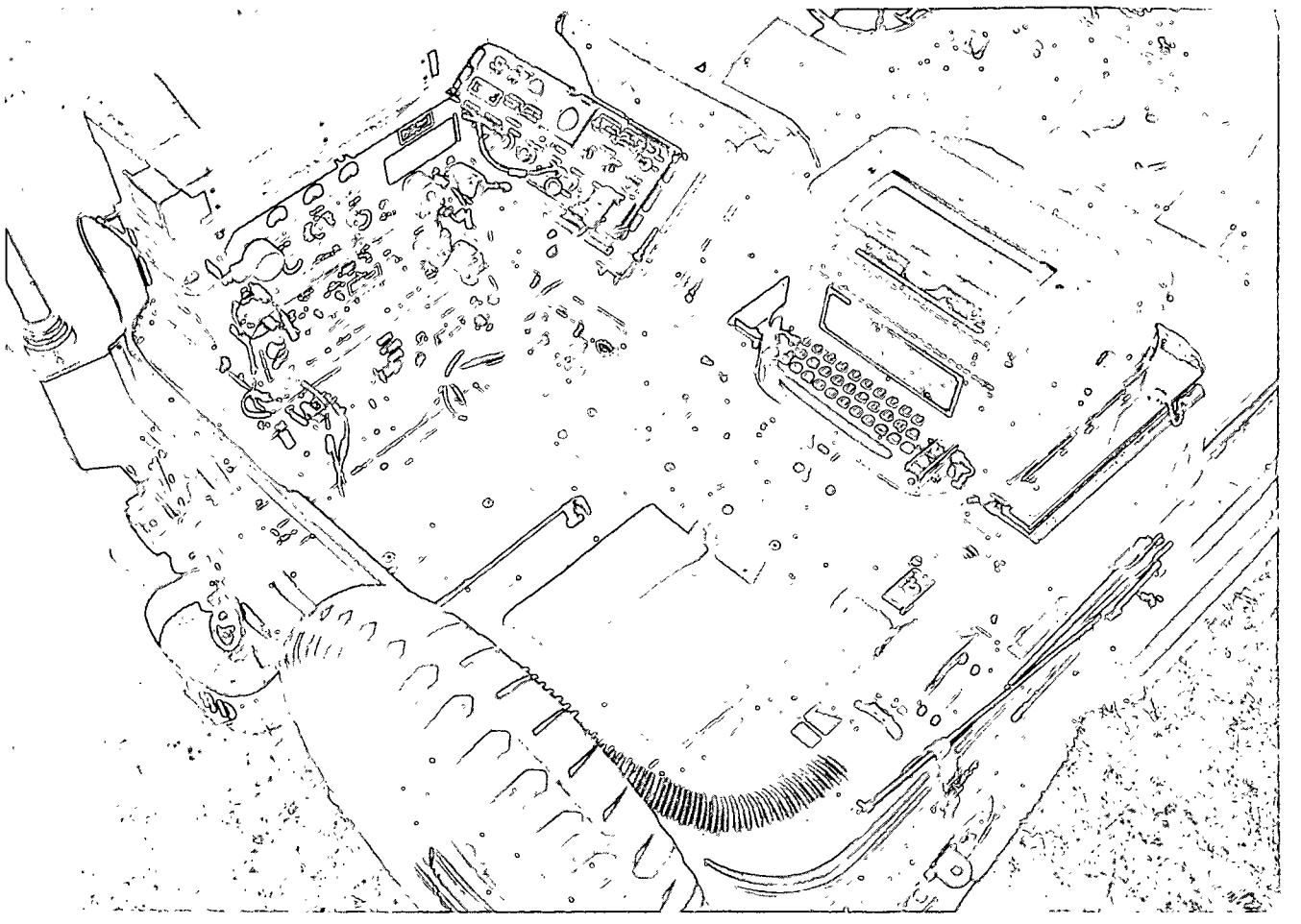


Figure 15-42. Radioteletypewriter Set AN/VSC-2.

15-54. Radio Set Control AN/ GRA-39

a. Radio set control AN/GRA-39 (fig 15-43) is used with radio sets AN/VRC-12, AN/VRC-43 through -49, AN/PRC-77 (AN/PRC-25), AN/VRC-64 (AN/VRC-53), AN/GRC-160 (AN/GRC-125), and other similar tactical radio sets. The AN/GRA-39 allows voice transmission or reception through a radio set from a distance up to 3 kilometers. Voice transmission or reception through a radio set is established from either remote control unit C-2328/GRA-39 or local control unit C-2329/GRA-39 at the option of the operator. Provision is also made for voice communication between the local and remote operators.

b. The characteristics of the remote control and local control units of radio set control AN/GRA-39 are as follows:

(1) *Radio set control C-2328/GRA-39 (remote control units).*

(a) *Number of transistors.* Seven.

(b) *Control distance (max).* 3.2 kilometers.

(c) *Operating voltage.* From 9.0 to 6.6 volts direct current.

(d) *Power supply.* Six batteries BA-30 for each unit.

(e) *Battery lift expectancy.* 24 hours.

(f) *Tone generator frequency.* 3900 hertz.

(2) *Radio set control C-2329/GRA-39 (local control unit).*

(a) *Number of transistors.* Seven.

(b) *Operating voltage.* From 9.0 to 6.6 volts direct current.

(c) *Power supply.* Six batteries BA-30.

(d) *Battery lift expectancy.* 72 hours.

c. Radio set control AN/GRA-39 can be used for the following types of operation:

(1) Telephone communication between the remote and local control operators.

(2) Radio set transmission and reception from the remote control unit.

(3) Radio set transmission and reception from the local control unit.

d. For additional information, see TM 11-5820-477-12.

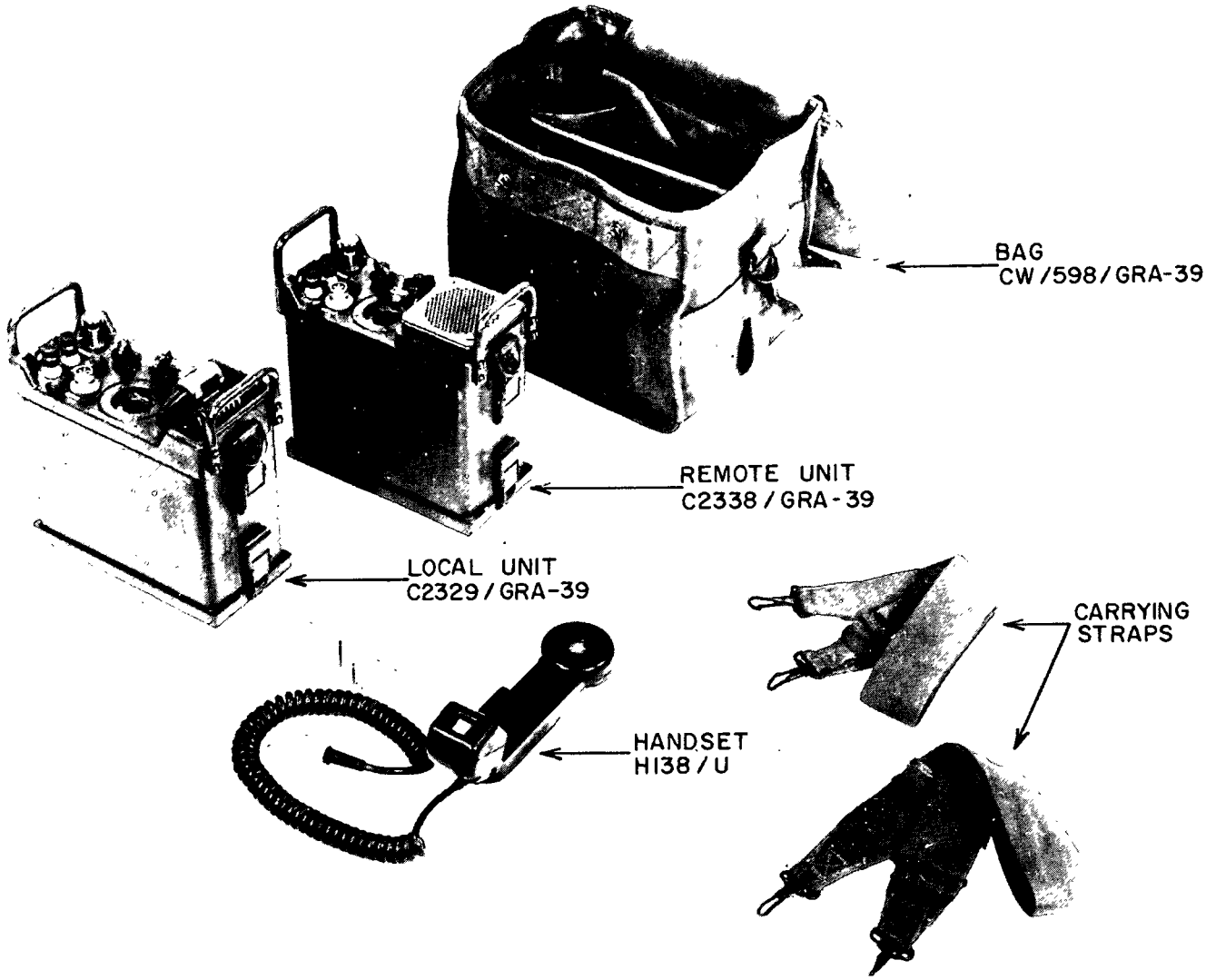


Figure 15-43. Radio Set Control AN/GRA-39.

15-55. Radio Test Set AN/ VRM-1

Radio test set AN/VRM-1 is a compact, lightweight, waterproof test set designed for testing the plug-in modules of the R-442/VRC, RT-246/VRC, and RT-524/VRC (AN/VRC-12 equipments). The equipment is designed on a simple GO and NO GO basis—a glowing green light indicates a serviceable module; a glowing red light, a defective module. The equipment is intended for issue to organizational maintenance personnel. For further details on the AN/VRM-1, see TM 11-6625-496-12.

15-56. Radio Test Set AN/ GRM-55 (Electronic Circuit Plug-In Unit)

Radio test set AN/GRM-55 is a compact, lightweight, waterproof instrument, designed to make tests at all available test points of receiver-transmitter RT-505/PRC-25 and to isolate a failure to a particular module. This test set cannot be used for the AN/PRC-77 configurations, since the basic unit is the RT-841 not the RT-505. The AN/GRM-55 is issued for use by radio mechanics at battalion level. For further details, see TM 11-6625-514-12. No special test set for the AN/PRC-77 is contemplated.

15-57. Antenna Equipment RC-292

Antenna equipment RC-292 (fig 15-44) is a modified ground plane antenna designed to increase the transmission range of FM radio sets from 50 to 200 percent over a frequency range of 20 to 76 megahertz. The sections of the supporting base raise the antenna 30 feet above the surface of the ground, increasing the line-of-sight distance to the horizon. The vertical element above the mast base is the antenna. The three ground plane elements are installed at a 142° angle to the antenna to act as the counterbalancing weight. The antenna equipment is

connected to the radio set by a 68-foot coaxial cable. This equipment provides a radiation pattern that is omnidirectional in the horizontal plane. The length of the antenna and ground plane elements must be preadjusted to the desired frequency range, as shown in chart 15-1 because the frequency range varies with the number of antenna sections used.

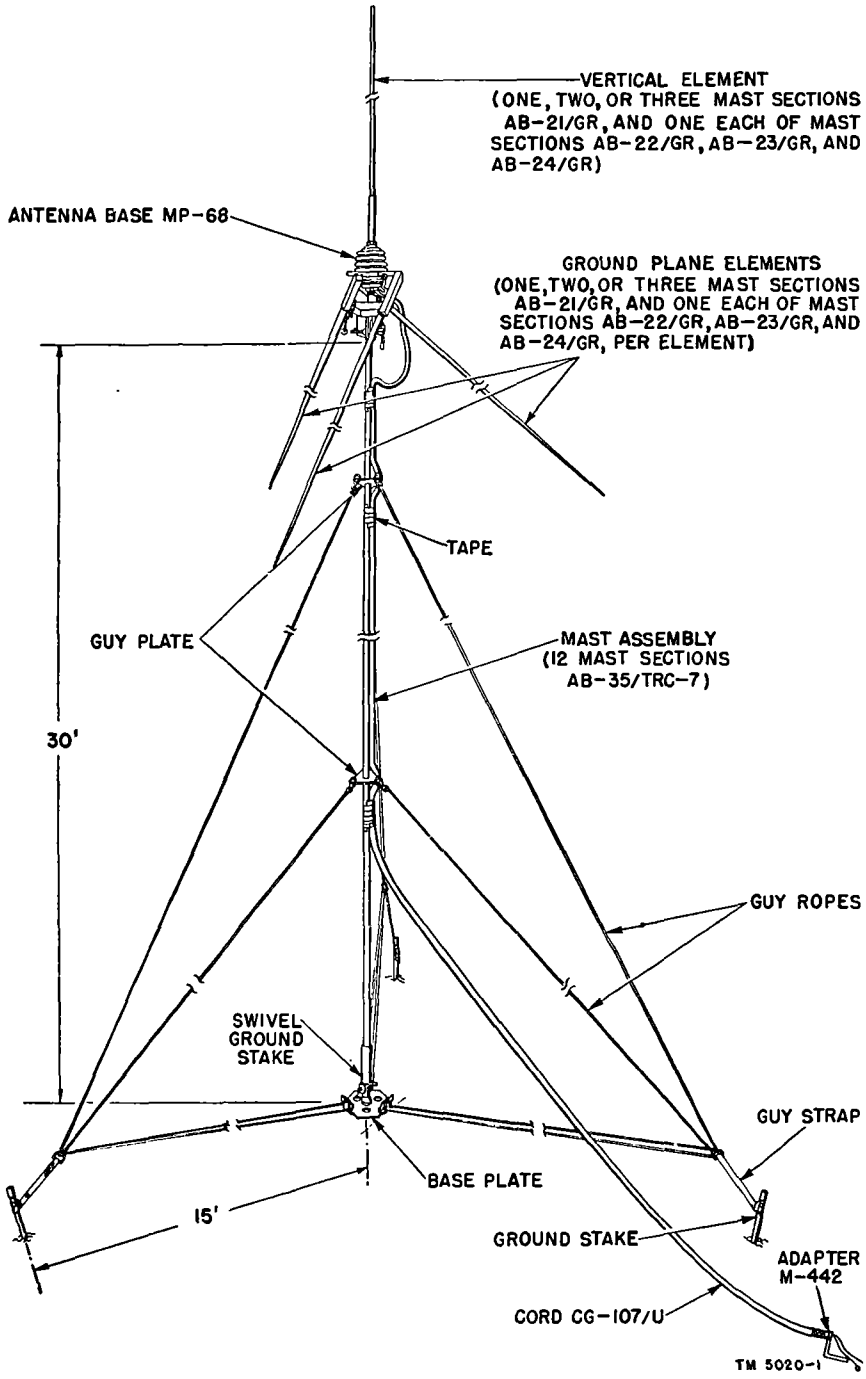


Figure 15-44. Antenna Group RG-292.

Chart 15-1. Antenna and Ground Plane Elements

Operating frequency (MHz)	Number of antenna sections required	Antenna sections used				Number of plane sections required	Ground plane sections used			
		AB-21/GR	AB-22/GR	AB-23/GR	AB-24/GR		AB-21/GR	AB-22/GR	AB-23/GR	AB-24/GR
30 to 36.5	4	1	1	1	1	15	2	1	1	1
36.5 to 50.5	3	0	1	1	1	12	1	1	1	1
50.5 to 75.95	2	0	1	0	1	9	0	1	1	1

15-58. Radio Terminal Set AN/ TRC-133A.

a. General. Radio terminal set AN/TRC-133A (fig 15-45) is a high frequency single-sideband (SSB) voice radio terminal with five (5) independent operating positions. The AN/TRC-133 is mounted in shelter S-141/G and the AN/TRC-133A in shelter S-380A/G. Power for the set is provided by two generators 120 volt, 60 Hz, 10 kilowatt generator set PU-610/M mounted in a 1½ ton trailer. The shelter and the trailer are transported by a 2½ ton truck. The AN/TRC-133A must be in operation 24 hours a day in Pershing QRA units.

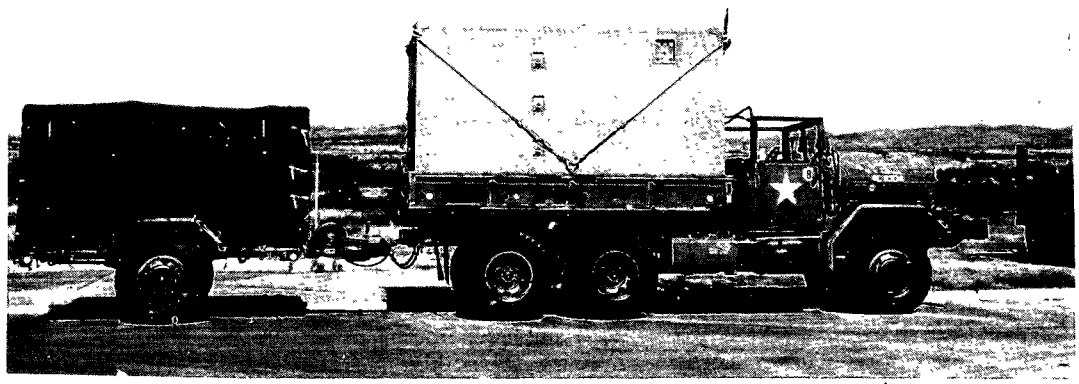


Figure 15-45. Radio Terminal Set AN/TRC-133A.

b. Capabilities. Radio terminal set AN/TRC-133 can operate in five half-duplex radio nets (nonsecure voice) from a semifixed position and in one half-duplex net in a mobile configuration. The AN/TRC-133A can operate in two nets in mobile configuration. The AN/TRC-133( ) contains five radio positions, each using a receiver-transmitter, radio RT-718/FRC-93 (Collins model KWM-2A), with control, radio set C-6118/FRC-93 (Collins crystal packet CP-1), and microphone, dynamic M-127/FRC-93. Five doublet antennas are provided—one for each position. One 15-foot mast antenna is provided for position 5 of the AN/TRC-133, two 15-foot masts are provided for the AN/TRC-133A for positions 1 and 2. In addition, the AN/TRC-133A has one 500-watt amplifier, radio frequency AM-3979/FRC-93 (Collins model 30L-1), which can be used with any one of the five receiver-transmitters RT-718. Tuners and 28-volt DC power supplies are provided for the receiver-transmitters that can be operated in a mobile configuration.

c. Technical Characteristics.

(1) *Receiver-Transmitter, Radio RT-718/FRC-93.*

(a) *Frequency range.* 3.4 to 5.0 MHz and 6.5 to 30 MHz.

(b) *Channels.* Variable tuning in 1-KHz steps.

(c) *Types of transmission.* Upper-sideband (USB) voice, lower-sideband (LSB) voice, CW-50 percent duty cycle; compatible with the AN/GRC-106, AN/PRC-74, AN/GRC-122, and AN/GRC-142 on USB voice within its frequency range.

(d) *Frequency stability.* Variation not more than 100 Hz after warm up.

(2) *Remote control facility.*

(a) *AN/TRC-133.* Monitor three sets and transmit on set 5.

(b) *AN/TRC-133A.* Monitor and transmit on all five sets.

(3) *Power Output.*

(a) *AN/TRC-133.* 100 watts PEP (peak envelope power) on each transceiver.

(b) *AN/TRC-133A.* 100 watts PEP on each transceiver plus 500 watts PEP on any one (1) transceiver in a semifixed position.

(4) *Power requirement.*

(a) *Semifixed position.* 100 volts, single-phase, 60 hertz.

(b) *Mobile.* 28 volts DC, 24 amps maximum.

(5) *Antennas.*

(a) *AN/TRC-133.* Five doublets for semifixed operation; one 15-foot mast for mobile operation.

(b) *AN/TRC-133A.* Five doublets for semifixed operation; two 15-foot masts for mobile operation.

(6) *Planning range.* 80 kilometers (50 miles) groundwave, worldwide skywave with proper choice of frequencies and antennas.

d. Employment. The AN/TRC-133A is used by Pershing missile units to maintain continuous communications with higher commanders who can direct actual Pershing missile firing. The set must be operational 24 hours per day from hardstand peacetime QRA sites and must be prepared to move to covert field positions and resume operation on short notice. In covert positions, transmission should be prohibited or restricted to an absolute minimum, because of the signature characteristics of the set and the vulnerability of the set to enemy ground-based intercept and location by direct-finding techniques. Siting requirements dictate positions that will permit the erection and proper orientation of at least three doublet antennas within 150 feet of the shelter. Each antenna must be erected in the open, with its center within 150 feet of the shelter. Each antenna requires an area of about 190 by 50 feet (fig 15-46). The shelter must be located at the very edge of an area that will provide cover, with the antennas in the open. Selection of Pershing unit position will almost certainly be restricted by these considerations.

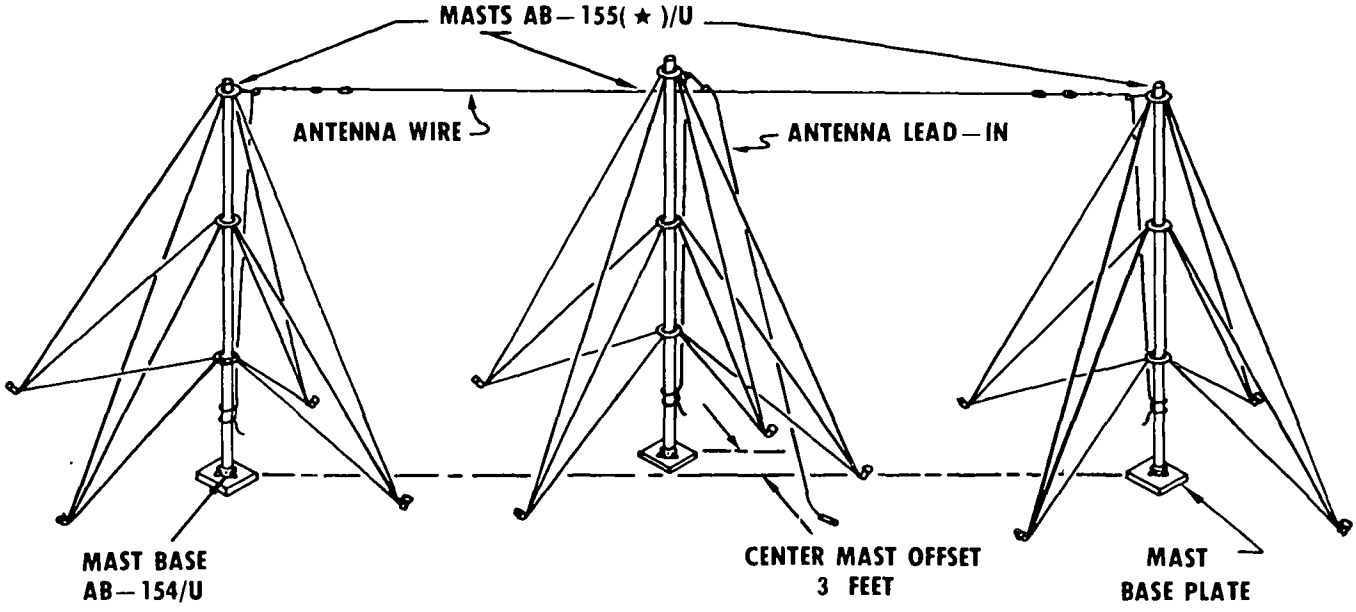


Figure 15-46. Doublet antenna erected.

e. Electromagnetic Pulse. Resistance to electromagnetic pulses is a part of the basic design of the AN/TRC-133A and the set can be expected to remain operational after a nuclear detonation. Supervisors, operators, and maintenance personnel must be aware of the EMP design in the equipment and must operate strictly according to the published technical manual. Any deviation from published directives may compromise this design feature. In a nuclear environment, the ground range of SSB equipment may be enhanced, but skywave ranges will be blacked out for a period of time.

f. References.

(1) Radio Terminal Set AN/TRC-133—TM 11-5820-610-14.

(2) Radio Terminal Set AN/TRC-133A—TM 11-5820-610-14.

15-59. Radio Terminal Set AN/ TRC-80B

a. General. Radio teminal set AN/TRC-80B (fig 15-47) was developed to meet the com-

munication requirements of the Pershing weapon system and to operate as a part of the weapon system. It is used to provide highly reliable communication between the Pershing Brigade, the Pershing Battalion, and the Pershing firing battery. The AN/TRC-80 is capable of providing 99.9 percent transmit reliability operating in the tropospheric scatter, diffractive, line-of-sight, or reflective mode of operation. The AN/TRC-80B provides four half-duplex or full-duplex voice channels and a teletype channel, as well as an order wire circuit which is used by the operators for control and coordination. Two radio terminal sets can provide communication between sites separated by 110 kilometers. Four radio terminal sets operating in the diversity mode can provide communication between sites separated by 160 kilometers. Radio terminal set AN/TRC-80 features high transmitter power (1,000 watts), extremely sensitive low-noise receivers (-93 dbm) with a 30 db signal-to-noise ratio) and highly directional parabolic antennas (2° beamwidth). These design features provide the highest possible immunity to enemy countermeasures, such as intercept and jamming, when position areas are such that transmitted energy is not beamed toward enemy-controlled terrain. The AN/TRC-80 is unique in that the engine generator is mounted inboard for transport and extended outboard on rails for operation and the inflatable antenna is stowed within the shelter for transport. These features permit the AN/TRC-80 to be transported by helicopter as a single load and placed in operation within 10 minutes of arrival on an operating site. The normal mode of transport for the AN/TRC-80 in the Pershing units is the 5-ton 8 x 8 truck M656 (fig 15-47).

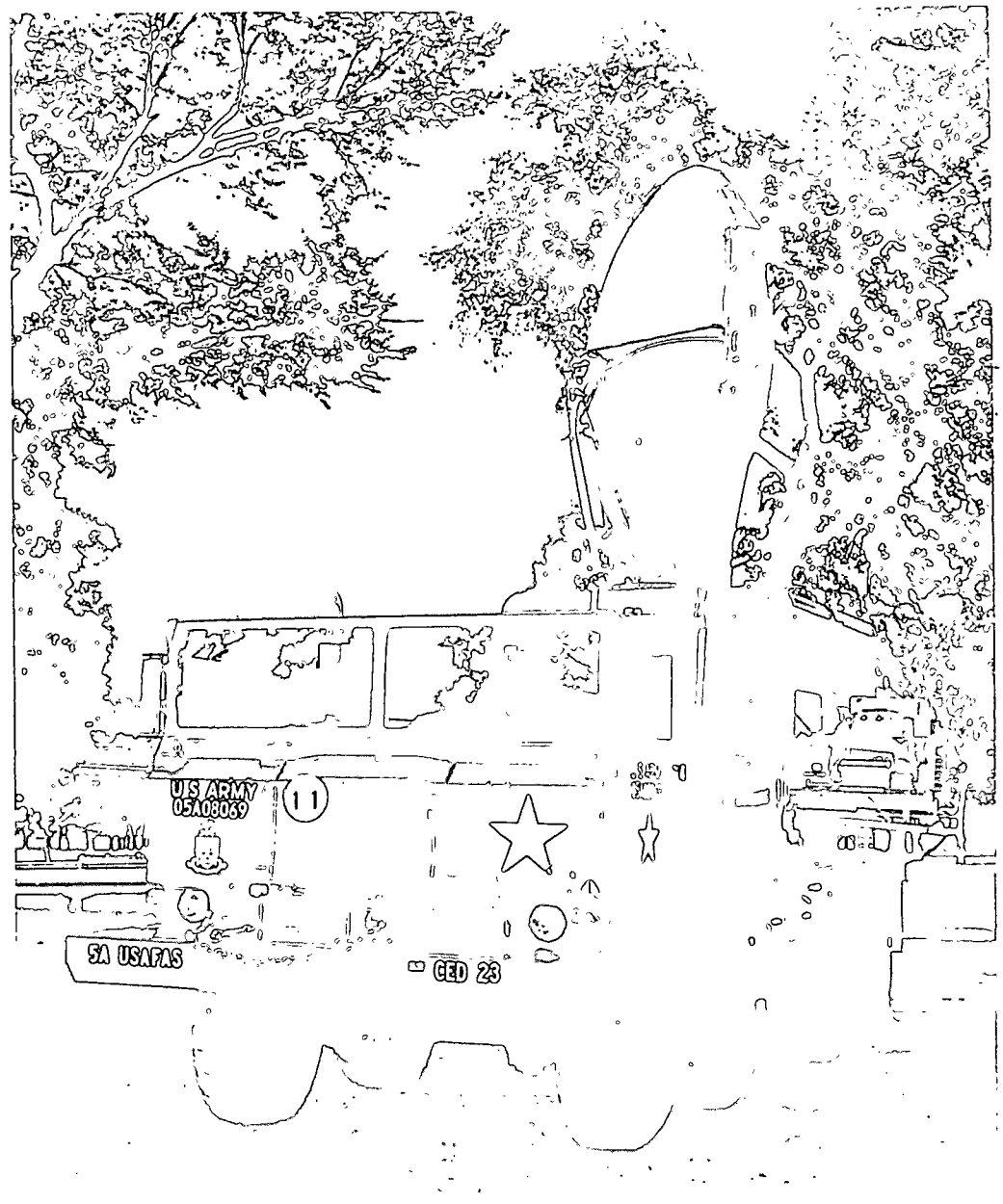


Figure 15-47. Radio Terminal Set AN/TRC-80B on 5-Ton, 8 x 8 Truck, M656.

b. Principles of Tropospheric Scatter. Radiofrequency energy waves passing through the troposphere tend to bend back toward the earth's surface (fig 15-48). This phenomenon is called refraction and is the result of continuous changes in the velocity of propagation of the energy. Such velocity changes are the direct result of adjacent air masses of different density. Density variations occur because of differences in temperature, humidity, wind velocity, and wind direction that exist in the troposphere. Refraction is enhanced by moisture, dust, atmospheric disturbances, and pollution of the troposphere. These characteristics occur only in the troposphere which comprises approximately the first 10,000 meters of the atmosphere above the earth and they decrease with altitude above the earth. For the required circuit reliability, the algebraic sum of the antenna elevation angles must not exceed 0.3 °. At higher elevation angles, the common volume area is so high in the troposphere that excessive losses occur and reliability is decreased to unacceptable levels. The algebraic sum of the antenna elevation angles can be decreased to less than zero with a resultant increase in range or reliability or increased to more than 0.3 ° with decreased reliability or range. If tropospheric scatter radio terminal sets are to provide 99/9 percent reliability at the rated range, the operating sites must be such that the sum of the elevation angles does not exceed 0°. For a more detailed discussion of these characteristics, see TM 11-486-6, chapter 6.

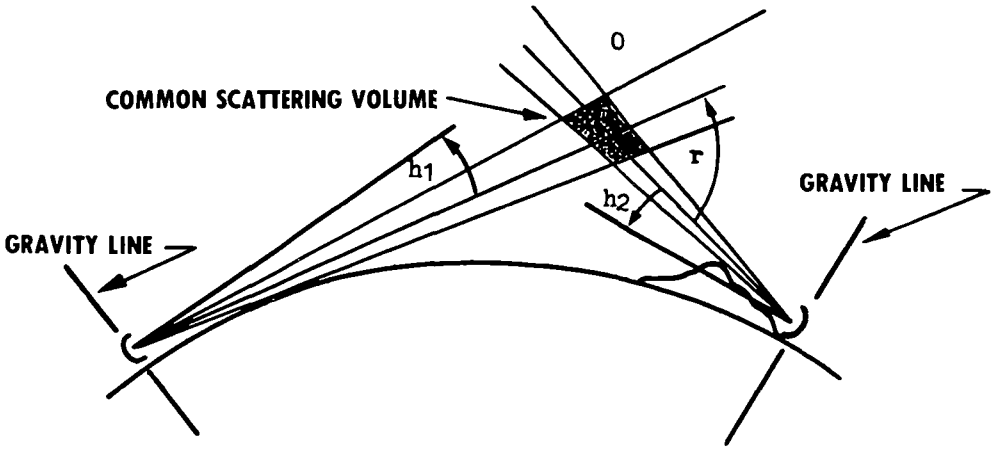


Figure 15-48. Geometry of Tropospheric Scatter.

c. Operating Ranges. At ranges up to 110 kilometers, two Radio Terminal Sets AN/TRC-80 are capable of providing 99.9 percent reliability, utilizing two frequencies and two suitable sites provide a sum of the antenna elevation angles can not exceed 0° (fig 15-49). At ranges of 110 to 160 kilometers, diversity operation must be employed to obtain 99.9 percent reliability with 0° elevation angles (fig 15-50). Diversity operation requires two AN/TRC-80's at each end of the circuit and two transmitting frequencies. The Pershing missile battalion headquarters battery TOE provides two AN/TRC-80's to be used on a diversity circuit to any one of the four firing batteries. One set must be sent to the battery to provide diversity reception at the battery and the other set kept at battalion for diversity reception at the battalion.

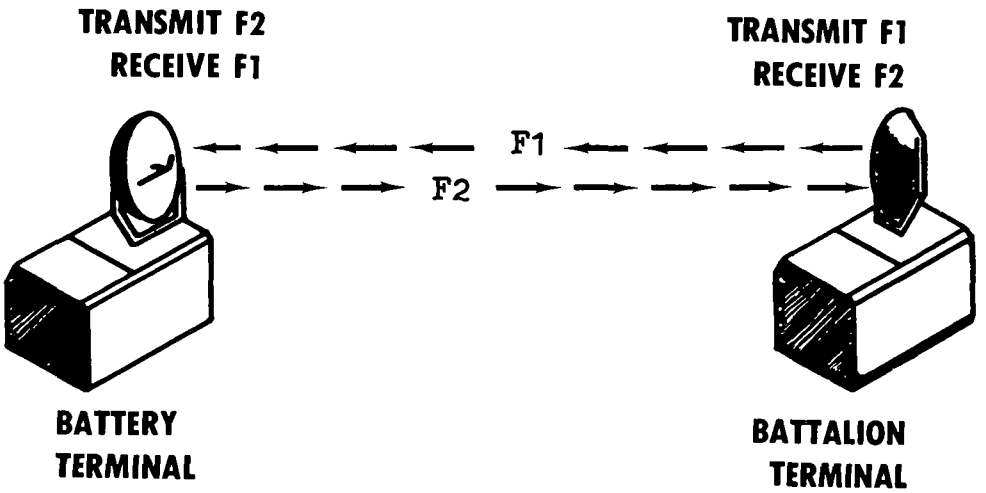


Figure 15-49. Radio Terminal Set AN/TRC-80B, nondiversity operation.

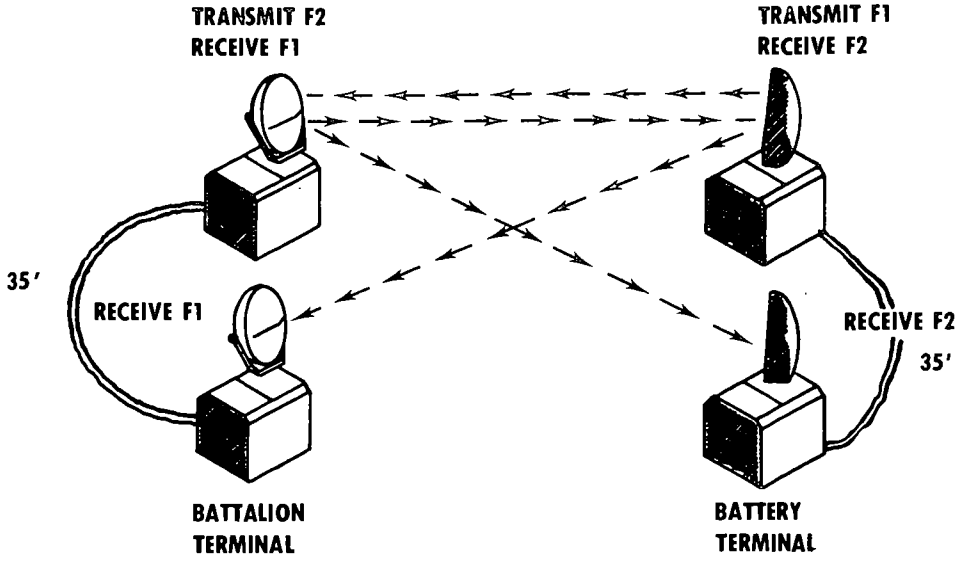


Figure 15-50. Radio Terminal Set AN/TRC-80B, diversity operation.

d. Communication Facilities. The AN/TRC-80 can provide a nonsecure full-duplex teletype circuit between two terminals and a single nonsecure voice circuit. It also provides facilities for remoting the teletypewriter circuit on a two-wire voice-frequency basis to a separate secure teletypewriter facility and four telephone circuits which can be connected to subscriber facilities by field wire. It has an additional capability, not used in the Pershing units, of terminating and switching telephone and teletypewriter field wire circuits provided by the army area communication system.

e. Technical Characteristics.

(1) *Type of installation.* M-656 truck with special mounting kit.

(2) *Type of modulation.* Frequency modulation.

(3) *Type of emission.* Four frequency division multiplex telephone channels plus one voice-frequency teletype channel multiplexed on the order wire.

(4) *Frequency range.* 4400 to 5000 megahertz (super high frequency).

(5) *Channels.* 12,000.

(6) *Transmission planning range.*

(a) *Line of sight.* 50 kilometers (30 miles) or as far as line of sight exists.

(b) *Diffractive.* As far as line of sight exists to the sharply defined obstacle from both terminals.

(c) *Tropospheric scatter.*

1. Nondiversity. 100 kilometers (70 miles).

2. Diversity. 160 kilometers (100 miles).

(7) *Reliability.* 99.9 percent.

(8) *Power output.* 1,000 watts or approximately 1 watt low power.

(9) *Power requirement.* 10-kilowatts, 208/120-volt, 3-phase, 400-hertz, 4-wire.

(10) *Power source.* Bogue 5380A engine generator mounted in shelter, Bogue 5380B engine generator mounted on M656 truck or 45 kw diesel engine PU-614/U through Electrical Cable Assembly Set AN/GSA-105.

(11) *Antenna.* Parabolic reflector, air inflatable, 2 ° radiation pattern.

f. Major Components.

Nomenclature	*Common name*
(1) Electrical equipment shelter S-254/TRC-80.	Shelter
(2) Audiofrequency-radiofrequency monitor MX-8383/TRC-80B.	Monitor
(3) Amplifier-converter AM-4917/TRC	Transmit converter
(4) Modulator-multiplier MD-465/TRC-80	Modulator-multiplier
(5) Demultiplexer-multiplexer TD-550/TRC-80.	Multiplexer
(6) Cooler, air, electrical equipment HD-545/TRC-80 (two).	Blower
(7) Power distribution panel SB-1565/TRC-80.	Switch panel
(8) Communication control panel SB-1564/TRC-80.	Control panel

Nomenclature	*Common name*
(9) Electrical frequency synthesizer 0-1462A/TRC (three).	Synthesizer
(10) Amplifier-converter AM-4916/TRC (two).	Receiver converter
(11) Intermediate-frequency amplifier AM-6028/TRC-80B (two).	IF amplifier
(12) Power supply PP-4936/TRC (two).	Converter power supply
(13) Power supply PP-3313/TRC-80 (two).	IF power supply
(14) Radiofrequency amplifier AM-3308/TRC-80.	Power amplifier
(15) Antenna assembly AS-1270/TRC-80.	Antenna
(16) Air conditioner, self-contained, CE-6A-400 (two).	Air conditioner
(17) Telegraph terminal TH-5A/TG or TH-22/TG.	Telegraph terminal
(18) Teletypewriter set TT-335/TG.	Teletypewriter
(19) Power supply PP-6290/TRC.	Max power supply
(20) Telephone terminal TA-833/TRC.	Telephone terminal
(21) Engine generator set Bogue 5380A consisting of—	Generator
(a) Instrument control panel assembly.	Generator control panel.
(b) Auxiliary control panel assembly.	Auxiliary panel
(c) Contactor, remote	Contactor
(22) Circuit breaker panel	Breaker panel

g. Required Ancillary Equipment. For radio terminal sets AN/TRC-80 issued to the Pershing Brigade or the Pershing Battalion headquarters battery, engine generator set PU-614 and electrical cable assembly AN/GSA-105 provide an auxilary power source. These items are issued on the basis of one per three AN/TRC-80's. For AN/TRC-80's is issued to a Pershing firing battery, the installation kit for the radio set contains a mount and special cables for use with engine generator set Bogue 5380B, which is authorized on the battery TOE.

h. Electromagnetic Pulse (EMP). Resistance to EMP is a part of the basic design of the AN/TRC-80B and the radio can be expected to remain operational after a nuclear detonation. Supervisors, operators, and maintenance personnel must be aware of the EMP design in the equipment and must operate strictly according to the published technical manual. Any deviation from published directives may compromise this design feature.

i. Reference. TM 11-5820-469-10.

15-60. Teletypewriter Central Office AN/ MGC-17 (AN/ TGC-30)

a. General. Teletypewriter central office AN/MGC-17, which is transportable by air or vehicle, is a voice-frequency telegraph switching center. It is issued to the Pershing firing battery and is used to terminate teletypewriter and telephone circuits from the radio terminal set AN/TRC-80B and/or the army area communication system. It contains four teletypewriters, which are capable of full-duplex or half-duplex operation. There are two racks for mounting communication security equipment, which provides on-line cryptosecurity on one full-duplex circuit or two half-duplex teletypewriter circuits. The AN/MGC-17 is capable of operating on two secure circuits at one time. When the operator's pack is installed in the switchboard SB-22, the AN/MGC-17 will terminate 12 telephone and 2 teletypewriter circuits from the AN/TRC-80B, the army area communication system, or local subscribers. Trailer-mounted gasoline engine generator set PU-617M (two power units SF-3.0) provides 3-kilowatt, 115-volt, 60-hertz, single-phase, AC power to operate the AN/MGC-17.

b. Major Components. The major components include organizational equipment.

(1) Modified electrical equipment shelter S-144/G complete with mountings.

(2) A trailer-mounted gasoline engine generator set PU-617/M.

(3) Electrical space heater HD-375/H.

(4) Three-combination, dial-type security safe.

(5) Communication security equipment racks (two).

(6) Manual telephone switchboard SB-22/PT.

(7) Telegraph terminal TH-5/TG (three).

(8) Telegraph-telephone signal converter TA-182/U (six).

(9) Teletypewriter TT-4/TG (two).

(10) Teletypewriter reperforator-transmitter TT-76/GGC (two).

c. Technical Characteristics.

(1) *Teletypewriter circuits.* Two half-duplex or one full-duplex.

(2) *Telephone circuits.* 12 (manual switching).

(3) *Security circuits.*

(a) *Full-duplex.* One.

(b) *Half-duplex.* Two.

(4) *Power requirement.* 115 volts ± 10 percent, 60-Hertz, single-phase.

(5) *Total power consumption.* 3,113 watts.

(6) *Output from SF 3.0 (part of PU-617/M).* 3,000 watts.

(7) *Shelter weight.* 1,400 pounds complete with organizational equipment.

15-61. Battery Control Central AN/ MSW-8

a. General. The battery control central (BCC) AN/MSW-8 provides a centralized facility for consolidation of all communications and for command and control functions in the Pershing battery. The BCC is housed in a modified expansible van mounted on vehicle M656 (fig 15-51). The expanded van incloses twice the volume of the retracted van. A trailer-mounted 15-kilowatt AC generator provides 120/208-volt, 60-hertz power for operating the AN/MSW-8. Five circuit breaker switches in the circuit breaker switch box distribute AC power to the BCC equipment. Direct current power required for operation of the equipment normally is obtained from two 25-volt DC power supplies and one 9-volt DC power supply. During emergency power operation (15-kw generator power not available), DC power is obtained from the vehicle battery for operation of selected equipment and emergency lights.

Figure 15-51. Battery Control Central AN/MSW-8.

b. Inside Physical Description. The interior of the van is divided into two functional areas: the command and control area on the right side and the recording area on the left side. The command and control area (fig 15-52) contains the equipment required for conducting tactical command and control functions. A remote speaker console is removed from the AN/TRC-133 or AN/TRC-133A and placed on the worktable in the command control area. Equipment used in, but normally not issued with, the BCC includes two radio set controls C-2328/GRA-39, which are connected to remote FM receivers; two telephone switchboards SB-22/PT; two telephones TA-312/PT, and one AM receiver R-392/VRR if authorized. One Radio Set AN/VRC-46, and one AN/VRC-47 are components of the control central.

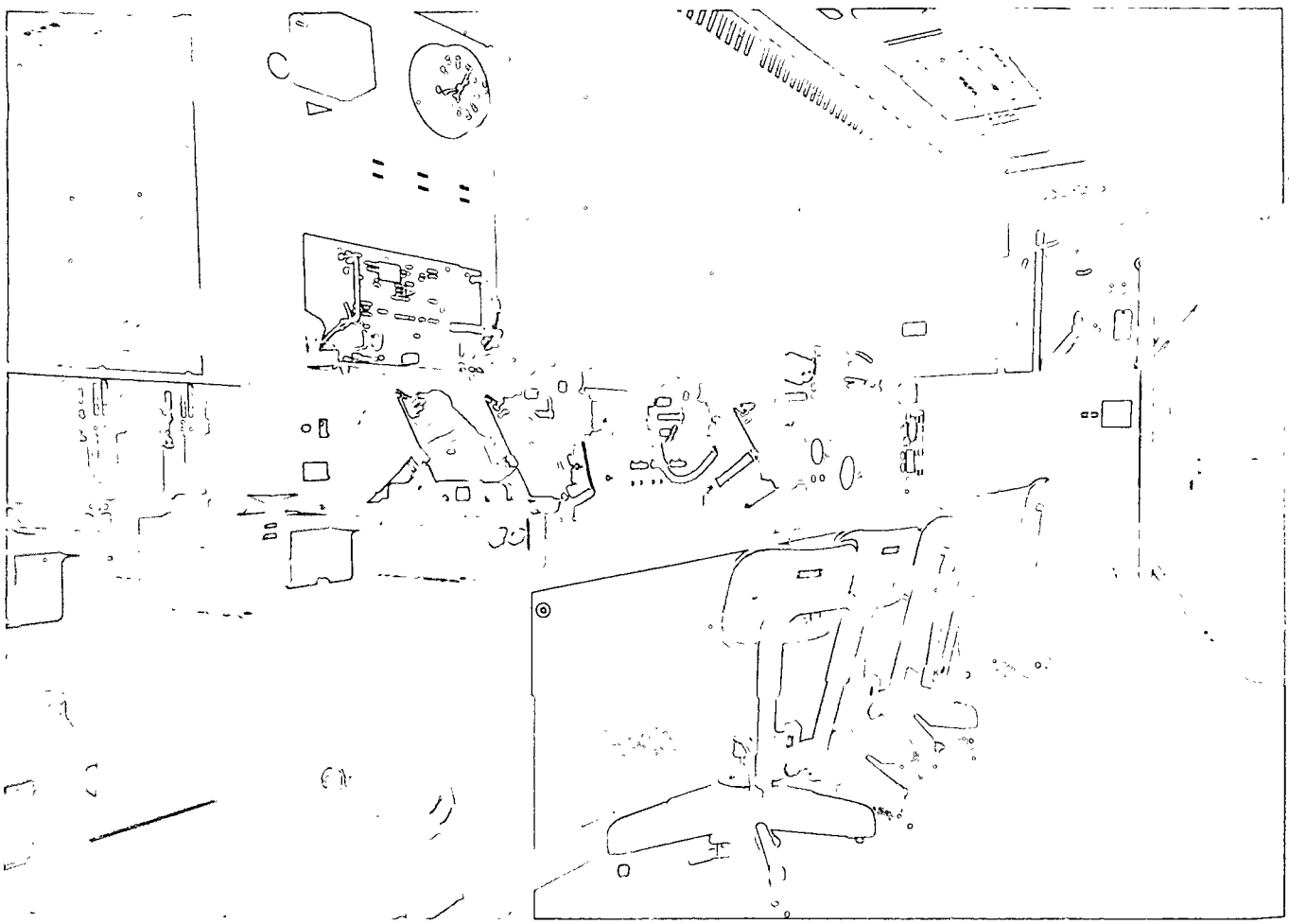


Figure 15-52. Command and Control Area of an AN/MSW-8.

c. Communications Equipment.

(1) The TOE authorizes one Radio Set AN/VRC-47 (one FM transceiver and one FM receiver) and one Radio Set AN/VRC-46 (one FM transceiver) for installation in the AN/MSW-8. The FM receiver for the AN/VRC-47 is mounted on the tabletop to the left front of the transceiver. The radio sets provide for communication within the battery and communications to higher headquarters when range permits. A noise suppression cover is installed on the rear of the transceiver.

(2) *Remote speaker console.* The remote speaker console provides a method of receiving and transmitting through the five receiver-transmitters located in the AN/TRC-133 or AN/TRC-133A. The console also provides intercommunication between the BCC and the AN/TRC-133.

(3) *Telephone TA-312/PT.* Two telephone TA-312/PT are provided in the BCC (not components). One of the telephones is used for an order wire circuit to communication radio set AN/TRC-133A, and one is used for access to the local field switchboard.

(4) *Radio Set Control C-2328/GRA-39.* Eight radio set controls are provided in the BCC. Two radio set controls are connected through the signal entrance panel to FM transceivers, one is used for communications to the AN/TRC-80B, and five are used for intercommunication with the programmer-test stations (PTS). The batteries in the radio set controls, except the two connected to FM transceivers, are replaced with power adapters so that the controls can be operated from the BCC 9-volt DC power supply or from the vehicle batteries during emergency operation.

(5) *PTS/BCC intercommunications.* The PTS/BCC intercommunications equipment consists of five radio set controls C-2328/GRA-39, three recorder's control boxes, two intercom select panels, three headsets H-161( )/U, and two handsets H-138/U. A 20-Hz oscillator generates a signal voltage for operation of the call and ring system. Three radio set controls C-2328/GRA-39 with headsets H-161( )/U are used by recorders on

the left side of the van. Each radio set control is connected to a programmer-test station. The sets have a stored position and cables long enough to permit their use by seated recorders at the foldout tabletop. A recorder's control box is provided for the radio set control at each recorder position. The control box permits individual selection of all phones or discrete circuits and also permits the recorder to activate indicators at the duty officer and NCO positions. Two radio set controls with handsets H-138/U and intercom select panels are provided on the right side of the van for the NCO and duty officer.

(6) Patching switchboard. The patching switchboard provides interconnection for telephone switchboards SB-22/PT and the signal entrance panel.

d. Reference. TM 9-1427-381-14.

CHAPTER 16

FIELD ARTILLERY COMMUNICATIONS SYSTEM

Section I. GENERAL

16-1. General

To provide effective fire support, an artillery unit must have an efficient and reliable communication system. This system must provide the commander with the means of controlling his unit, exercising fire direction, and maintaining contact with high headquarters and with either a reinforced or a supported unit during both conventional and nuclear war. Because of the number of different types of field artillery battalions, it would be an extremely difficult and complex task to attempt to learn the communication systems of all the field artillery units with any reliable degree of both accuracy and retention. What is needed is a means whereby a system can be deduced through utilization of interunit communication interfaces and intraunit communication modules and then finally made up by comparison with the authorized (or on-hand) unit personnel and equipment.

Section II. SYSTEMS SYNTHESIS CONSIDERATIONS

16-2. System Fundamentals

A communication system is not something that has a real existence. It is a means of aiding a particular unit to accomplish its mission through utilization of both its personnel and communication equipment. Therefore, the preliminary analysis required before the communication system of a specific unit can be derived consists of two main parts:

a. What must the unit do; what is its mission?

b. What communications personnel and equipment does the unit have to accomplish the mission with?

16-3. Communication Responsibilities Inherent in Tactical Field Artillery Missions

Each of the four standard tactical missions that may be assigned to a field artillery battalion imposes specific responsibilities, one of which is the responsibility for establishing communications.

a. General Support. An artillery unit with the mission of general support does not have the responsibility for establishing communications with any other unit.

b. General Support-Reinforcing. An artillery unit with the mission of general support-reinforcing is responsible for establishing communications with the reinforced artillery unit.

c. Reinforcing. An artillery unit with the mission of reinforcing is responsible for establishing communications with the reinforced artillery unit.

d. Direct Support. An artillery unit with the mission of direct support is responsible for establishing communications with the supported maneuver force.

e. Modified Missions. When a tactical mission is modified so that a unit can better meet the fire support needs posed by a special tactical situation, the responsibilities for establishing communications must be described in detail.

f. On-Order Missions. An artillery unit will often be assigned, besides its present tactical mission, an on-order mission to be executed at some unspecified future time. An artillery unit with an on-order mission must first meet the responsibilities for establishing communications for its present mission. The unit must then establish communications, to the degree possible, to support the requirements of the on-order mission in order to facilitate future operations.

16-4. Additional Communications Responsibilities

a. Commander Is Responsible. The commander is personally responsible for the adequacy and proper use of the communication system within his command and for its operation in the system of the next higher headquarters. The authority to establish, maintain, control, and coordinate the various communication means within a command may be exercised by a subordinate in the name of the commander. However, the responsibilities of the commander,

which are defined in FM 24-1, cannot be delegated.

b. Senior to Subordinate. The senior unit is responsible for the establishment of communications with its subordinate units whether organic or attached. This responsibility is primarily one of planning and directing the establishment of the linking communication system, since assets belonging to either the senior headquarters element or to a subordinate unit may be utilized.

c. Joint Maintenance. Regardless of who is responsible for establishing a communication system, all units being served by the system assist in restoring it once it is disrupted.

16-5. Means of Communication.

The various means of communication available are radio, wire, messenger, visual signals, and sound signals. The composition of the means in a unit is dependent on the personnel, equipment, and transportation provided by its table of organization and equipment. The various means of communication have different capabilities and limitations; thus, they are employed so that they complement each other and so that total dependence is not placed on any one means. The reliability of a communications system is greatly increased by the use of all means available. However, the failure of one or all of the available electronic means does not relieve a commander of his communications responsibility. In brief, the means employed in a given situation are generally those that provide the maximum required reliability, flexibility, security, and speed.

16-6. Communication System

a. A communication system is the result of a communication plan designed to fulfill the requirements of a specific mission. This plan is based on the assigned mission, the table of organization and equipment that provides the communications means, and the communications responsibilities. For artillery units, standard systems are used for each of the four normal standard tactical missions. Because of net standardizations, rapid and accurate interface of units is possible in a combat environment. These standard net structures and designations should not be arbitrarily changed. Only when a modified mission is assigned to an artillery unit does the need arise for modification of the net structures in order tc meet new communication requirements. Even so, such modification should be kept to a minimum to meet the requirements of the situation.

b. These standard net structures and designations should be incorporated into the standing operating procedures of a unit for each mission that may be assigned to the unit. Normally, systems diagrams will depict this information in the clearest manner. As TOE's change, the addition and/or deletion of both personnel and equipment will cause concurrent changes in these systems diagrams. These SOP diagrams must be kept current at all times. These systems diagrams should show those communication nets needed to satisfy both internal and external communications requirements. For purposes of clarity, separate diagrams should be developed for the wire and radio systems.

c. Communication systems must be as simple as possible and must be carefully planned. To insure efficient and expeditious operation in combat, a unit must use its communication system during its various training phases.

d. When properly planned, a prearranged communication system eliminates the need for publication of numerous and detailed signal orders and instructions and increases the efficiency of the system.

e. The extent of the unit wire system depends on the length of time the unit remains in a particular position. A unit must continually improve its wire communication system by installing duplicate lines over alternate routes, constructing overhead wire crossings, cabling multiple lines, and rerouting lines around exposed points in the system.

16-7. Title of Radio Nets

A radio communications system is composed of a number of internal and external nets. The titles of all nets have been standardized; each title includes three elements:

a. Controlling headquarters (division artillery, battalion, etc.).

b. Designated purpose of net (command, fire direction, intelligence, etc.).

c. Modulation (frequency modulated (FM), single-sideband (SSB), or amplitude modulated (AM)). Additionally, the AM or SSB net title normally will indicate whether the net is a voice net only or a radioteletype (RATT) net.

16-8. Communications Requirements

a. General. The communications system of an artillery unit, regardless of the size of the unit, must satisfy two types of communications requirements—internal and external.

b. Internal Communications Requirements. Internal communication requirements include the facilities for control and coordination of the activities of the unit. The installation and maintenance of the internal communication system is the responsibility of the unit commander. In a higher headquarters, such as a battalion or a division, the internal communication system

serves as a portion of the external communication system of the subordinate units. For instance, the division artillery command/fire direction net, FM, is a portion of the divison artillery internal communication system; however, it also serves as a portion of the external communication systems of the battalions that are organic or attached to the division artillery. An internal communication system must furnish an artillery unit with communication facilities to perform the functions listed below. These requirements will vary when missions are modified.

(1) Fire direction and fire control for both conventional and nuclear ammunition.

(2) Tactical and administrative control.

(3) Collection, exchange, and dissemination of information and intelligence.

(4) Dissemination of warnings.

(5) Dissemination of meteoroligical data.

(6) Dissemination of accurate time.

(7) Coordination of survey.

c. External Communications Requirements. External communications requirements include the facilities by which a unit maintains communications with its next higher headquarters, adjacent units (as required), and supported or reinforced units for the purpose of receiving data and other information necessary for the unit to accomplish its mission. The commander of any unit is responsible for the installation of his communication system and for its effective integration into the communication system of the next higher headquarters. An external communication system must furnish an artillery unit with communication facilities to perform the functions listed below. These requirements will vary when missions are modified.

(1) Receipt of fire missions and requests for and coordination of fire support for both conventional and nuclear ammunition.

(2) Tactical and administrative control.

(3) Collection, exchange, and dissemination of information and intelligence.

(4) Receipt of warnings.

(5) Receipt of meteorological data.

(6) Receipt of accurate time.

(7) Coordination of survey.

(8) Communications with reinforced or supported unit.

16-9. Communications During Unit Displacement

A unit radio communication system remains unchanged during displacement of the unit. All stations will continue to operate in their designated nets.

16-10. Radioteletype Communications Control During Displacements

All radioteletypewriter nets must continue to operate in their designated nets during a displacement; therefore, a telephone should be installed between the radioteletypewriter shelter and the cab of the prime mover. The telephone wire line will be removed upon installation of the set at the new location. Additionally, when in convoy, the radioteletypewriter prime mover should be positioned as the second vehicle in the convoy column. Upon receipt of a message requiring immediate action, the driver of the prime mover will signal the convoy commander in the leading vehicle by use of a prearranged signal, such as blowing the vehicle horn or flashing its headlights.

16-11. Establishment of Priorities for Allocation of Electronic Speech-Secure Equipment

Because of the variances among field artillery cannon battalions in the amount of speech-secure equipment authorized and assigned, each unit must establish priorities for intraunit issue in accordance with functional requirements. Type priorities are listed below.

a. Direct Support Battalion.

(1) Battalion FDC/operations center.

(2) Battalion commander/brigade fire support coordinator.

(3) Brigade fire support officer.

(4) Field artillery battery FDC's.

b. General Support Battalion.

(1) Battalion FDC/operations center.

(2) Battalion commander.

(3) Field artillery battery FDC's.

Section III. SYNTHESIS OF UNIT COMMUNICATION SYSTEMS—RADIO

16-12. Major Communications Interface Units

The external radio nets that a field artillery battalion must operate in are primarily internal radio nets of division artillery, a corps artillery, or a field artillery group. The radio communications systems of these major artillery control units, both internal and external, are discussed below.

a. Division Artillery (AIM) Radio System. A type division artillery radio system is shown in figure 16-1.

(1) *External nets with division.*

(a) Division command net, FM (voice). This net is intended primarily for communication between the division commander, his staff, and

the commanders of most of the immediate subordinate units within the division. The division artillery commander and the division artillery fire direction center operate radios in this net.

(b) *Division tactical operations net, SSB (voice)*. This net is a long-range, SSB, voice net. The major subordinate commands of the division, including the Chaparral-Vulcan battalion and the armored cavalry squadron, operate in this net. The net is used within the division for operational planning, control, and coordination and for collection, exchange, and dissemination of both information and intelligence.

(c) *Division operations/intelligence net, SSB (RATT) (op/intel)*. This net is used by the division artillery to receive command and operational traffic from the division. In addition, the net provides a radioteletype link between the division artillery and the major combat elements of the division. This net is also used to collect, exchange, and disseminate both information and intelligence. It may be used for lateral communications between the division artillery and the other major subordinate units of the division.

(d) *Division administrative/logistics net, SSB (RATT) (admin/log)*. The division establishes this net for administrative and logistical traffic between the division headquarters and the service support elements of the division. Division artillery operates in this net on a full-time basis.

(2) *External nets with corps artillery.*

(a) *Corps artillery fire direction net, SSB (RATT) (F)*. This net provides a radioteletype link between the division artilleries and the corps artillery for requesting additional fire support and for coordinating artillery fire support.

(b) *Corps artillery survey channel, FM (voice) (S)*. Corps artillery allocates one frequency for the use of all survey sections in the corps area. Its sole purpose is to provide surveyors with a means of exchanging information and coordinating survey. No net control station or net organization is needed, since this channel is used only for intracommunication within a unit survey party.

(3) *Internal nets within the division artillery.*

(a) *Division artillery command/fire direction net, FM (voice) (CF)*. This net is used for communications both within the division artillery headquarters and with the subordinate units (organic, attached, and reinforcing) within the division artillery. It is a multipurpose net used for command and administrative matters, tactical fire direction, and the collection, exchange, and dissemination of both information and intelligence.

(b) *Division artillery command/fire direction net 1, SSB (RATT) (CF1)*. Division artillery operates this net to communicate with its close support field artillery battalions and any attached or reinforcing nonnuclear units. Division artillery uses the net to transmit tactical and administrative orders, fire missions, and meteorological data to the battalions. The battalions use this net to request additional fire support from division artillery. Traffic density on this net is extremely high because the net is used for coordination of extensive fire support plans between the division artillery and the close support battalions. Additionally, it is used for the collection, exchange, and dissemination of both information and intelligence.

(c) *Division artillery command/fire direction net 2, SSB (RATT) (CF2)*. Division artillery operates this net to communicate with its organic general support battalions, any reinforcing or attached nuclear battalions, and any reinforcing field artillery groups. All direct support battalions, both nuclear—and nonnuclear—capable, must operate in this net to coordinate nuclear fires for the supported maneuver brigades. One of the principal stations operating in this net is the fire support element (FSE), a section of the headquarters of division artillery, which normally operates in the division tactical operations center (DTOC). The FSE is charged with the responsibility for coordinating all nuclear fires in the division area in a timely manner. This net is also used for the transmission of command and administrative matters to those artillery units other than the close support and nonnuclear battalions. Further, the net is used for processing intelligence information and for disseminating meteorological data.

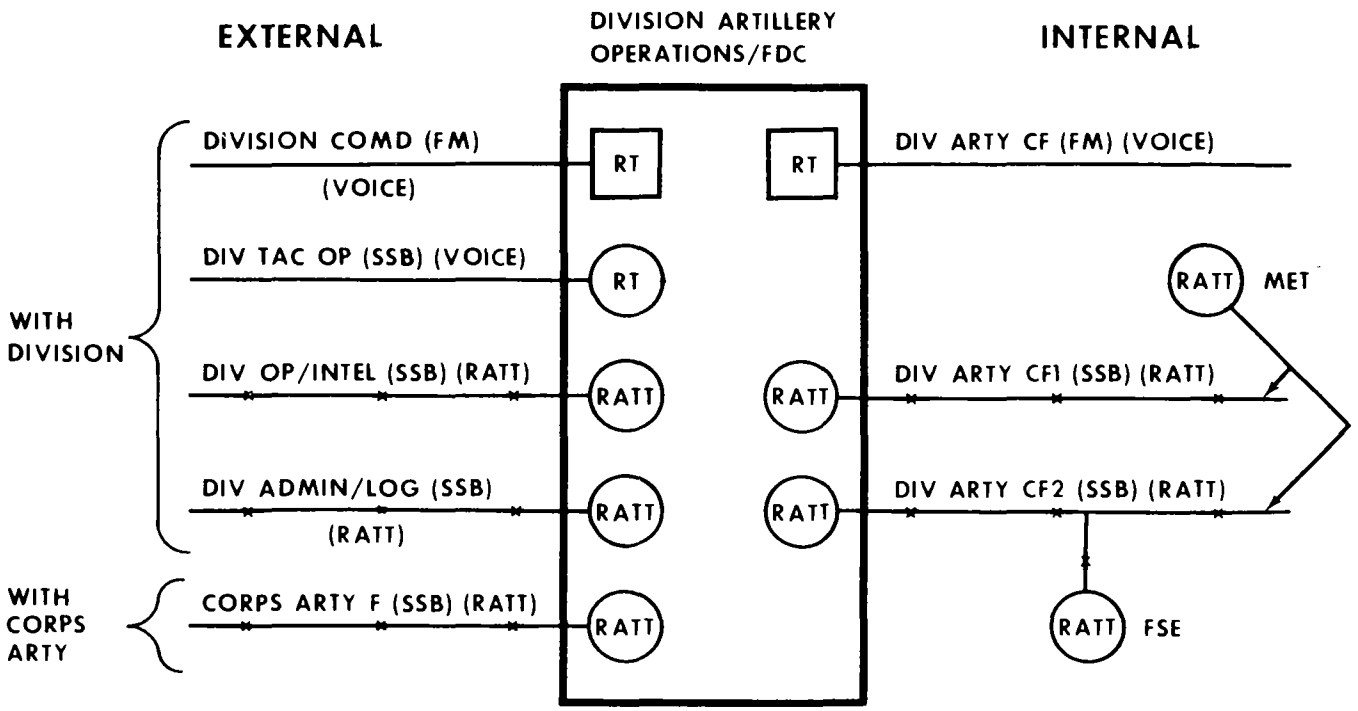


Figure 16-1. Division artillery (AIM) communications interfaces, radio.

b. Corps Artillery Radio System. A type corps artillery radio system is shown in figure 16-2.

(1) *External nets with corps.* The corps signal elements, of either battalion or brigade size, provides radioteletypewriter nets from corps headquarters to major subordinate corps units. Radioteletypewriter sets are provided to the corps artillery to operate in both the corps command net 3, SSB (RATT), and the corps command net 4, SSB (RATT).

(2) *Internal nets.* In addition to the nets described in (*a*) through (*c*) below, the corps artillery has two organic radioteletypewriter sets that are used for communications with the artillery elements of the corps covering force.

(a) *Corps artillery fire direction net, SSB (RATT) (F).* This net provides radioteletype communication between the corps artillery and the division artilleries within the corps for requesting additional fire support and for coordinating artillery fire support, both nuclear and nonnuclear.

(b) *Corps artillery command/operation net, SSB (voice) (CO).* This net is a long-range, SSB, voice net. It links the corps artillery operations/intelligence section with the operations/fire direction centers of the field artillery groups operating under the control of the corps artillery. This net is used by the corps artillery for tactical and administrative control of its subordinate field artillery groups to include coordinating and requesting fire support. Also, it is used for the collection, exchange, and dissemination of both information and intelligence.

(c) *Corps artillery command/fire direction net, SSB (RATT) (CF).* Corps artillery operates this net to communicate with its field artillery groups, its target acquisition battalions, and its missile battalion and with the fire support element from the corps artillery working at the corps tactical operations center (CTOC). The FSE utilizes this net to coordinate the artillery nuclear fire support within the corps. This net is also used for transmission of command and administrative matters, for the processing of intelligence information, and for the dissemination of meteorological data by the target acquisition battalion.

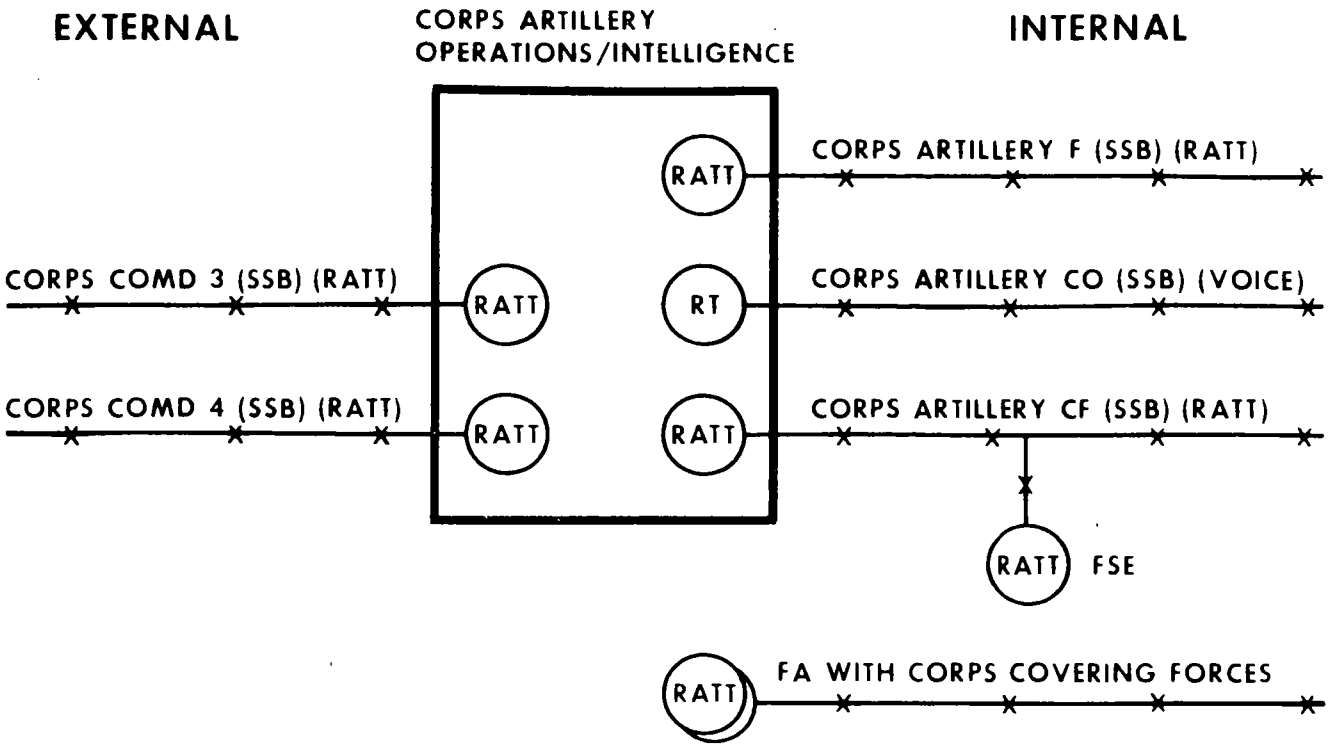


Figure 16-2. Corps Artillery Communications Interfaces, Radio.

c. Field Artillery Group Radio System. A type field artillery group radio system is shown in figure 16-3.

(1) *External nets with corps artillery.*

(a) *Corps artillery command/operations net, SSB (voice) (CO).* This net is discussed in (2)(*b*) above.

(b) *Corps artillery command/fire direction net, SSB (RATT) (CF).* This net is discussed in *b*(2)(*c*) above.

(2) *External nets with a reinforced division artillery.*

(a) *Division artillery command/fire direction net, FM (voice) (CF).* This net is discussed in (3)(*a*) above.

(b) *Division artillery command/fire direction net 2, SSB RATT (CF2).* This net is discussed in *a*(3)(*c*) above.

(3) *Internal nets.*

(a) *Field artillery group command/fire direction net, FM (voice) (CF).* This net is used for communications both within the field artillery group headquarters and with the field artillery battalions attached to the group. It is a multipurpose net used for command and administrative matters, tactical fire direction, and the collection, exchange, and dissemination of both information and intelligence.

(b) *Field artillery group command/fire direction net, SSB (RATT) (CF).* This net has the same general purposes as the CF Net, FM; however, it provides a long-range means for sending and receiving secure hard copy and perforated tapes. Since all of the artillery battalions will receive meteorological data retransmitted from the field artillery group on this net, the perforated tape provides a rapid input of the data into the FADAC of each battalion.

16-13. Field Artillery Cannon Battalion Intra-unit Communication Modules

a. Battalion Nerve Centers—the Fire Direction Center/Operations Center.

(1) *Direct support battalion.* Direct support battalion radio nets are shown in figure 16-4.

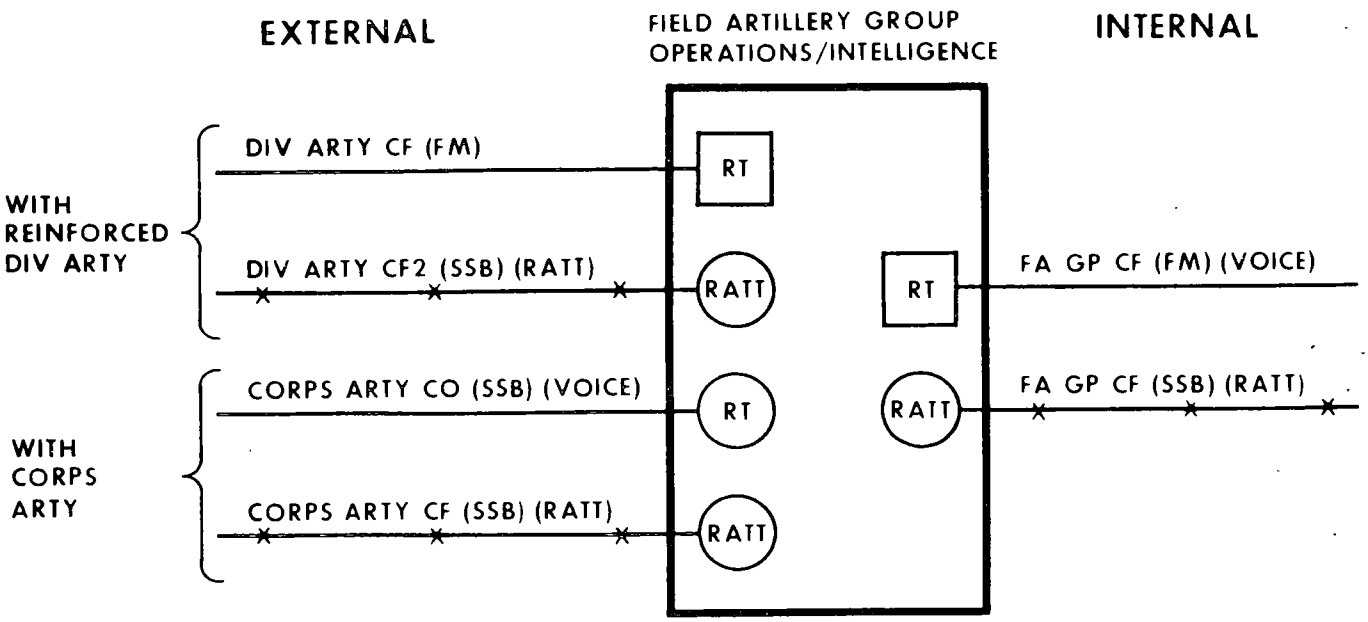


Figure 16-3. Field artillery group communication interfaces, radio.

(a) *Mission: direct support.*

1. External nets (battalion under a division artillery).

(a) Division artillery command/fire direction net, FM (voice).

(b) Division artillery command/fire direction net 1, SSB (RATT).

(c) Division artillery command/fire direction net 2, SSB (RATT). (Not all of the direct support battalions, by TOE, presently have the capability to operate in this net, because of the unavailability of the additional radioteletypewriter required.)

2. External nets (if battalion is normally assigned to a supported maneuver brigade.).

(a) Brigade command net, FM (voice).

(b) Brigade command net, SSB (RATT).

(c) Corps artillery command/fire direction net, SSB (RATT).

3. Internal nets.

(a) Battalion command/fire direction net, FM (voice) (CF). This net is used for internal command and control of the battalion. It may be used for transmitting firing data or for other fire support coordination requirements, as necessary.

(b) Battalion fire direction nets 1, 2, and 3, FM (voice) (F1, F2, and F3). An artillery battalion with a mission of direct support normally operates three FM nets to handle fire direction traffic. These nets are used by the forward observers to transmit calls for fire to the battalion fire direction center and by the battalion and battery fire direction centers to process fire commands. Information gathered by the forward observers and fire support sections can also be processed over these nets. Operating in each net are the battalion fire direction center, which also acts as the net control station (NCS), one of the field artillery batteries, a fire support officer with a maneuver battalion, and the forward observers operating under the control of that fire support officer. When an operation requires more than three maneuver battalion fire support officers, the additional fire support officers and their forward observers will be directed to operate in one of the three established fire direction nets.

b. Mission: General Support-Reinforcing; on Order, Direct Support. This mission increases the communication requirements of the battalion and necessitates system changes in both the internal and external nets of the direct support battalion as indicated below.

(1) *External nets.* The battalion is required, because of its reinforcing mission, to establish communications with the reinforced artillery unit. It effects this by establishing a station in its battalion fire direction center on the command/fire direction net, FM (voice), of the reinforced unit.

(2) *Internal nets.* Because of the lack of a sufficient number of radios to operate in one additional external net and still maintain the entire internal system, the unit normally closes one of the three fire direction nets and directs the stations operating on that net to operate in one of the remaining two fire direction nets. Closing the net is feasible because of the reduction in time-

critical traffic originating from the forward observers and maneuver battalion fire support officers. These personnel, even though they are positioned with the supported maneuver elements in order to facilitate future operations, are not likely to generate immediate action fire missions until the brigade is committed. Upon commitment of this brigade, the direct support battalion will cease communications with the previously reinforced artillery unit and reestablish its third internal fire direction net.

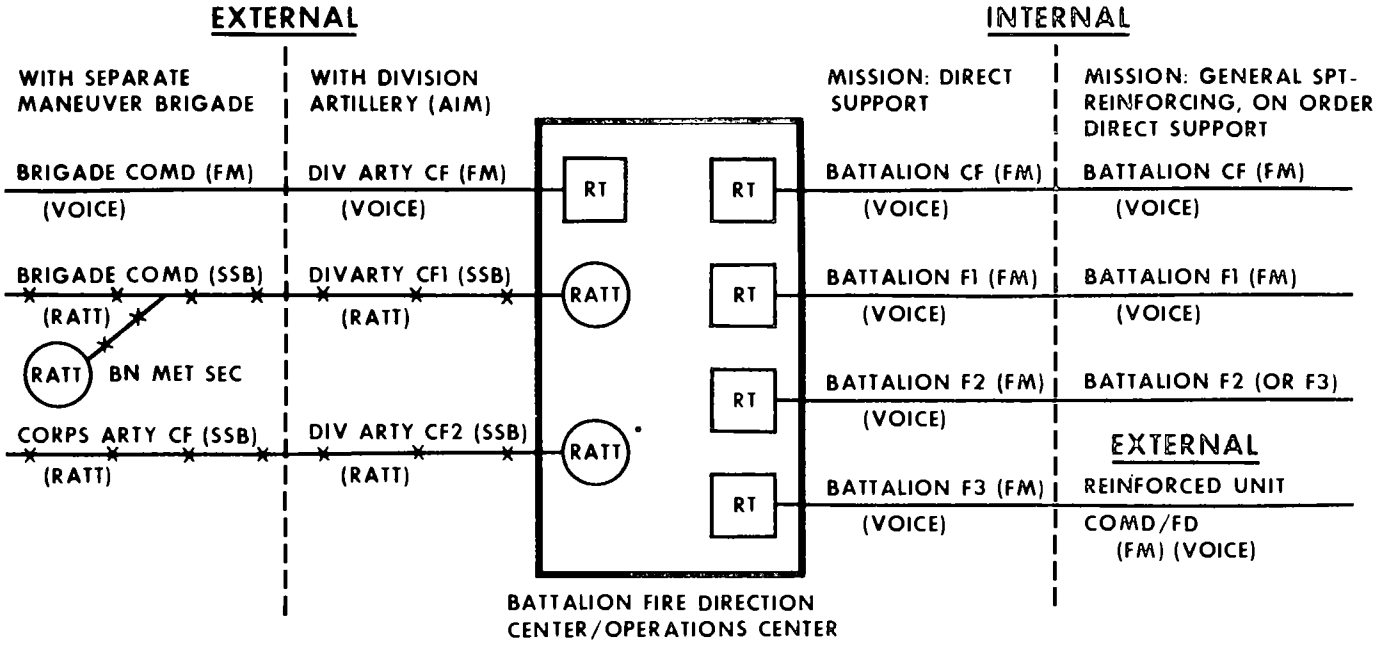


Figure 16-4. Direct support battalion FDC communication module.

(3) *General support battalion—mission: general support, reinforcing.* General support battalion radio nets are shown in figure 16-5.

(a) *External nets (battalion under a field artillery group).*

1. Field artillery group command/fire direction net, FM (voice) (CF).

2. Field artillery group command/fire direction net, SSB (RATT).

(b) *External nets (battalion under a division artillery).*

1. Division artillery command/fire direction net, FM (voice) (CF).

2. Division artillery command/fire direction net 1, SSB (RATT) (nonnuclear-capable battalion).

3. Division artillery command/fire direction net 2, SSB (RATT) (nuclear-capable battalion).

4. Reinforced battalion command/fire direction net, FM.

(c) *Internal nets.*

1. Battalion command/fire direction net, FM (voice) (CF).

2. Battalion fire direction net, FM (voice) (F).

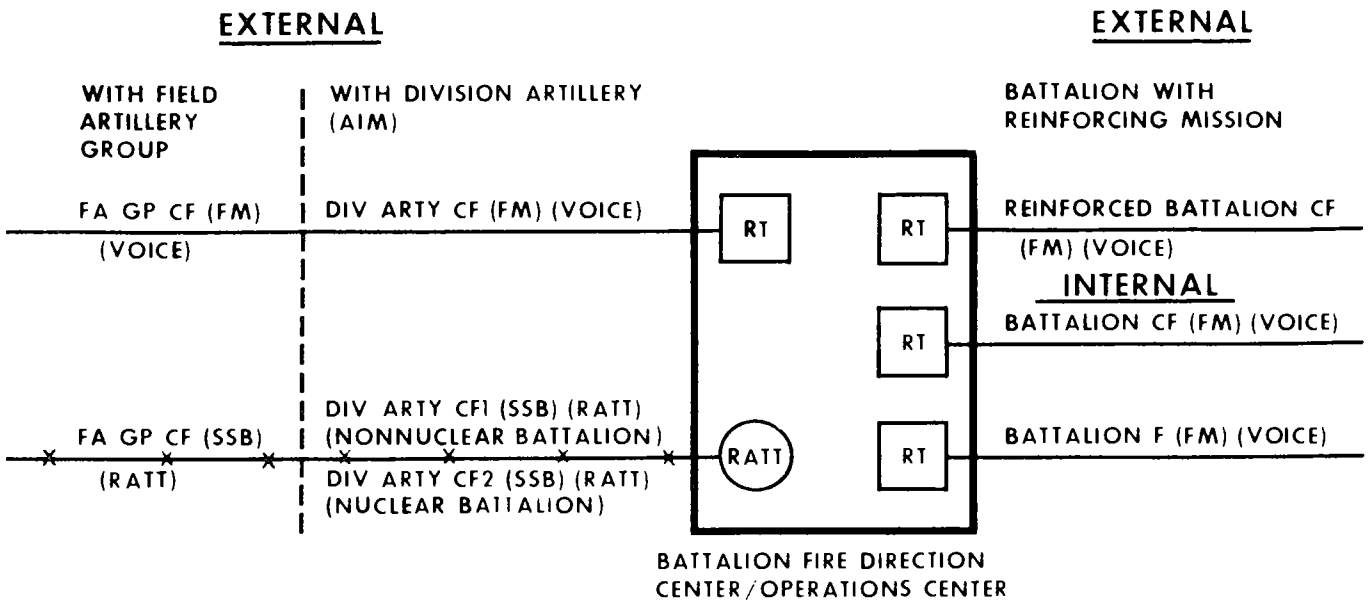


Figure 16-5. General support battalion FDC communication module.

c. Field Artillery Cannon Battery. A cannon battery does not have any internal nets of its own. As shown in figure 16-6, the battery operates on external nets belonging to the parent battalion, except as noted.

(1) It will operate in the battalion command/fire direction net, FM (voice).

(2) It will operate in the assigned battalion fire direction net, FM (voice). (In a direct support battalion, this net will be either FL, F2, or F3.)

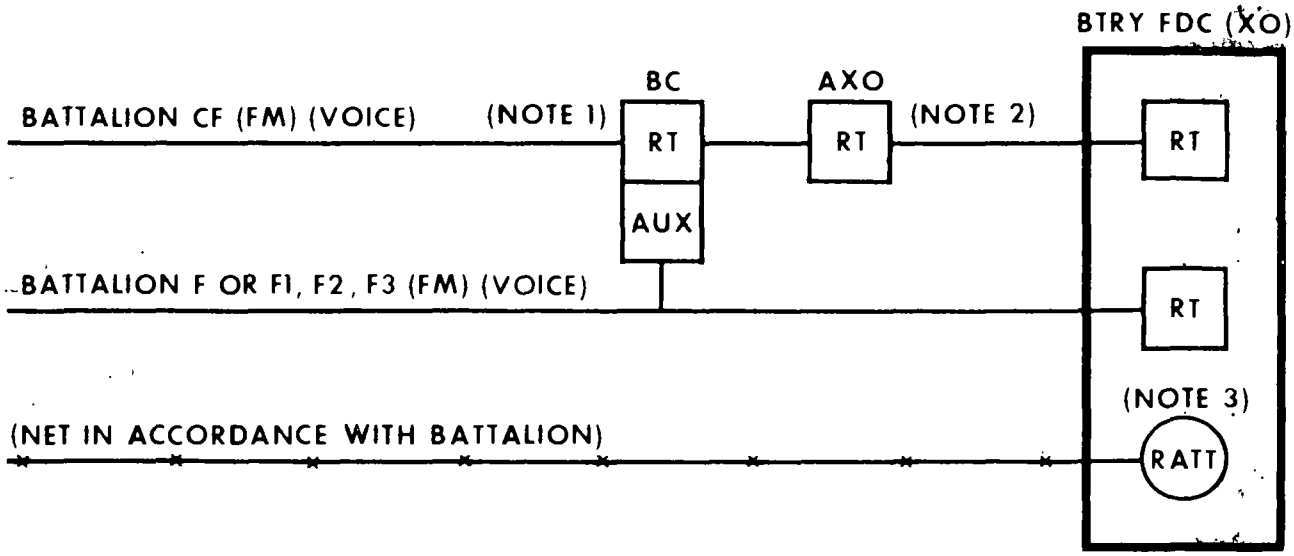
(3) Some nuclear-capable batteries will have a radioteletypewriter set, which will operate in the same command/fire direction net, SSB (RATT), as does the parent battalion headquarters.

d. Battalion Command and Control Group. The principal members of this group are the battalion commander, his executive officer, and the battalion S3, who operate in the nets indicated in figure 16-7.

e. Fire Support Officers and Forward Observers. These personnel will operate in nets as indicated in figure 16-8. If the fire support officers do not have equipment with an automatic restransmission capability, retransmission will be accomplished by voice relay.

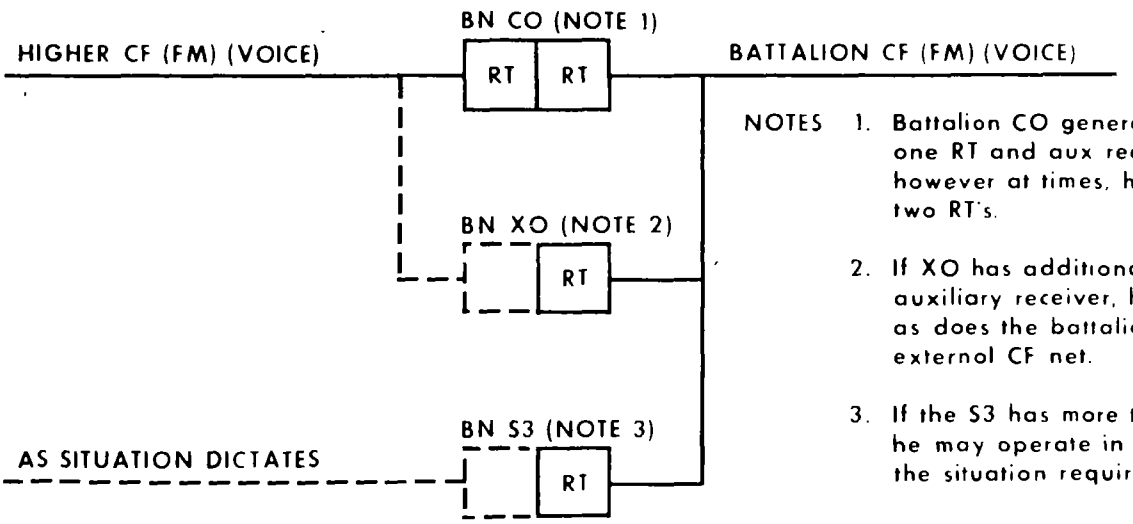
(1) The brigade FSO normally is issued equipment with a retransmission capability so that he can provide a direct link between the supported maneuver force commander and the supporting artillery battalion commander/fire support coordinator (FSCOORD).

(2) Maneuver battalion FSO's normally are issued equipment with a retransmission capability so that they can relay, automatically, calls for fire from FO's equipped with low-powered FM radios when the FO's either are out of normal communicating range from the battalion FDC or are in communication defile.



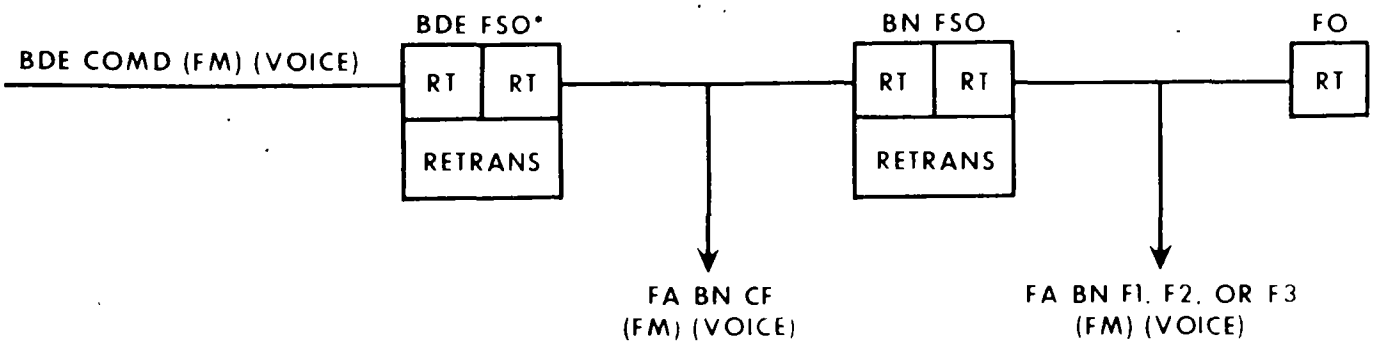
NOTES
1. Normally with one RT and one auxiliary receiver; may be configured with two RT s.
2. Within the firing battery, a radio other than those dedicated to the FDC may be found. If such is the case it may be used to enable fragmentation of the firing battery for split operations. At times, a separate vehicle is not designated for mounting this radio; however, it may be mounted on one of the howitzer prime movers or within one of the self-propelled howitzers, depending upon the type of battery.
3. If issued.

Figure 16-6. Field artillery cannon battery communication module.



NOTES
1. Battalion CO generally has only one RT and aux receiver; however at times, he may have two RT's.
2. If XO has additional RT or auxiliary receiver, he will operate, as does the battalion CO, in the externol CF net.
3. If the S3 has more than one RT, he may operate in other nets as the situation requires.

Figure 16-7. Battalion command and control group communication modules.



*NOTE Bde FSO may be issued one RT and an auxiliary receiver If so, he will ordinarily operate his RT in the FA battalion CF net (FM) and his auxiliary receiver in the brigade command net and accomplish retransmission by voice relay

Figure 16-8. Fire support officers and forward observers communication modules.

f. Liaison Officers. The main communication requirement of liaison officers is to effect communications with their parent battalion. However, if their equipment includes either an additional receiver-transmitter or an auxiliary receiver, liaison officers should also communicate with the reinforced artillery unit on its command/fire direction net. These nets are shown in figure 16-9.

Figure 16-9. Liaison officer communication module.

g. Survey Section. Members of the survey section will operate on the corps artillery survey channel, FM (voice) (fig 16-10). Since the reconnaissance/survey officer normally has only a single receiver-transmitter, he must switch his operating frequency to that of the battalion command/fire direction net in order to coordinate survey with the battalion headquarters element. Additionally, when survey teams are employed in the forward battle area, either acquiring targets or operating a flash base, they will be directed to operate on the battalion command/fire direction net.

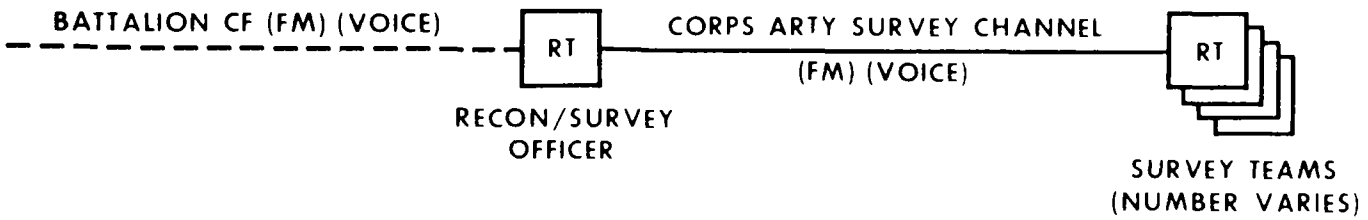


Figure 16-10. Survey section communication module.

h. Air Defense Section (Redeye). The air defense section interfaces with the battalion on the battalion command/fire direction net. Internal coordination is effected over the air defense net, FM. These nets are shown in figure 16-11.

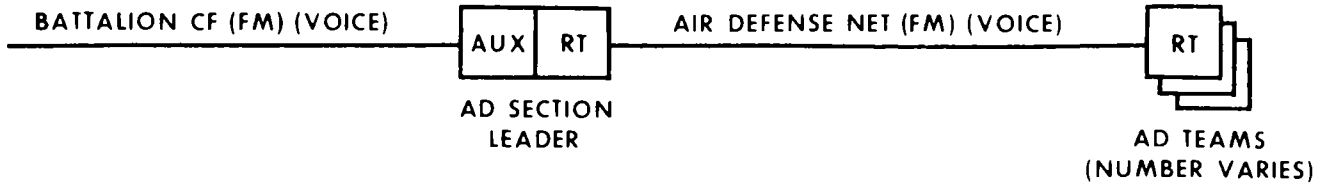


Figure 16-11. Air defense section (Redeye) communication module.

i. Communication Platoon Retransmission Unit. Within each battalion, the communications platoon will have one frequency modulated automatic retransmission unit (fig 16-22), which will be employed between net stations when such stations are either outside of normal operating range or in communication defile.

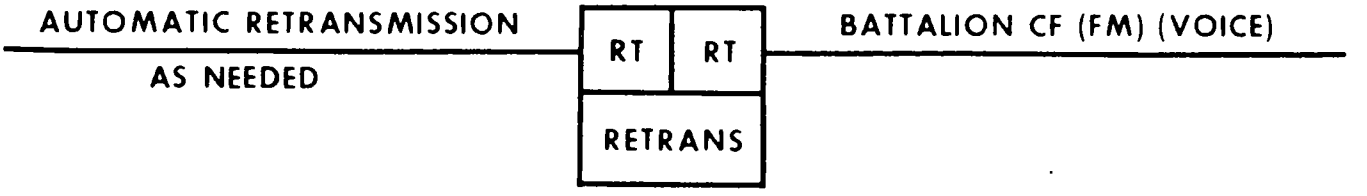


Figure 16-12. Communications platoon retransmission unit communication module.

j. Other Intrabattalion Functional Elements. All other elements equipped with frequency modulated radio equipment will operate on the battalion command/fire direction net.

16-14. Synthesis of Field Artillery Battalion Intraunit Communication Modules

In order to arrive at the actual radio system of a particular unit, using the diagram in figure 16-13, the unit TOE must be consulted and both the equipment and the personnel authorizations must be noted. A type battalion radio communication system developed through utilization of the modular concept is illustrated in figure 16-13.

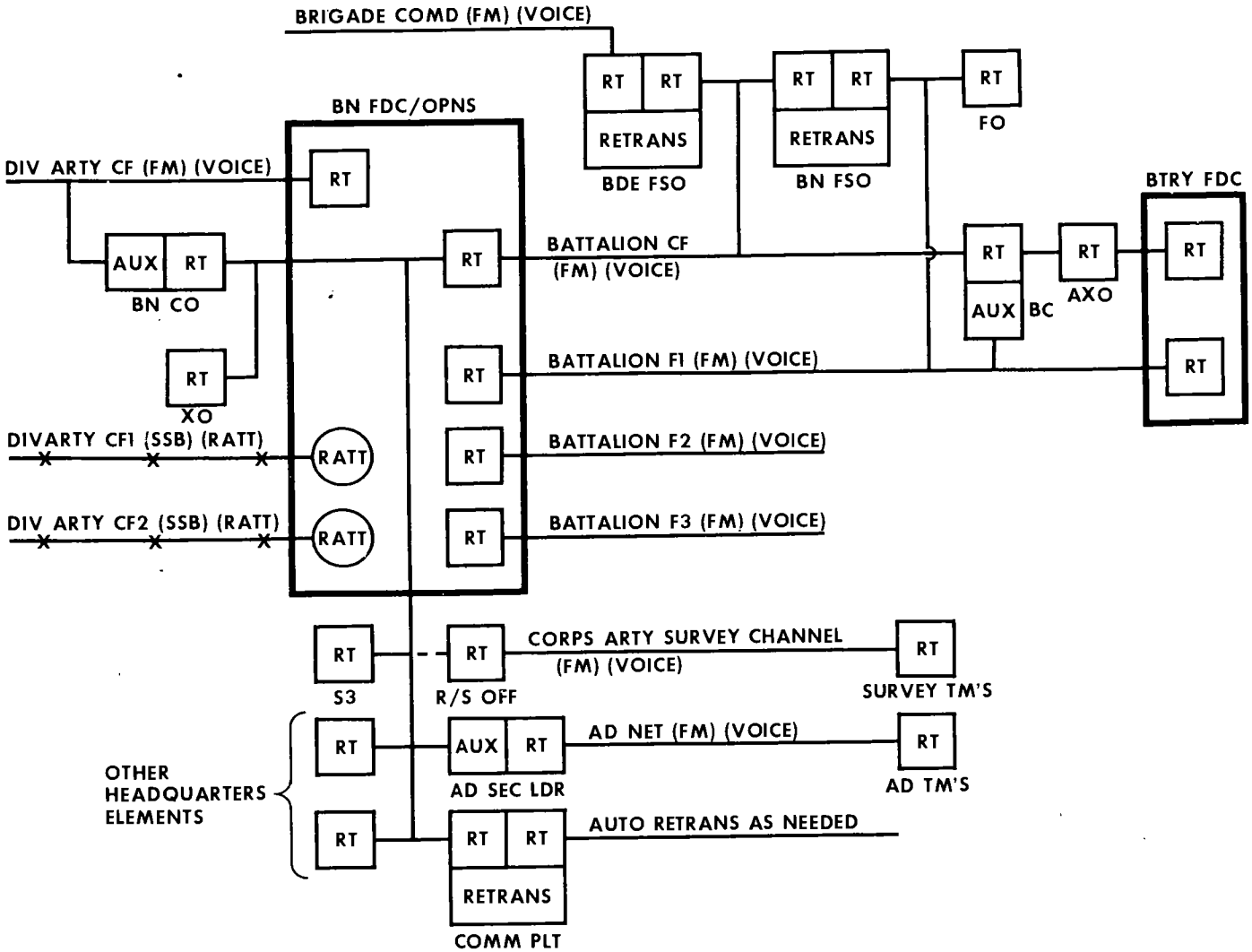


Figure 16-13. Type direct support battalion radio system.

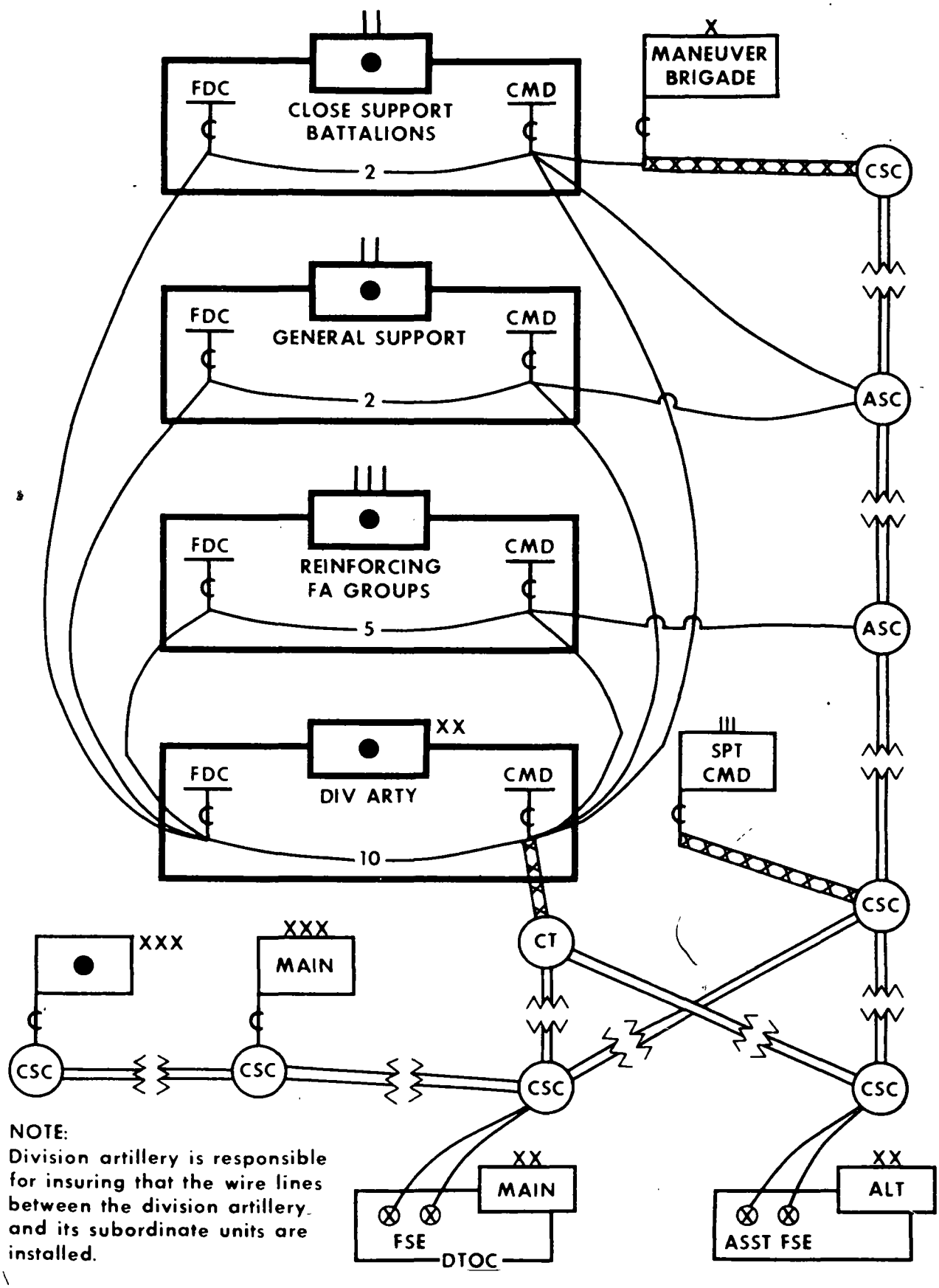
Section IV. SYNTHESIS OF UNIT COMMUNICATIONS SYSTEM—WIRE

16-15. Division Artillery Wire System

The extent of the division artillery wire system depends on the length of time a position is occupied. Priority wire lines are those used for the conduct of fire and fire support coordination. The wire system will duplicate and supplement, where possible, the radio nets utilized by the division artillery. A type division artillery wire system is illustrated in figure 16-14.

a. Division Area Communication System. The division signal battalion installs, operates, and maintains a division communication system for support of division-level functions, including command and control, intelligence, fire support coordination, and combat service support. The command operations company of the division signal battalion provides terminal sets and operating personnel at division main, division alternate, and division artillery headquarters. The command terminal installed at division artillery normally consists of one or two radio terminal sets, which are connected into the division artillery command switchboard by division signal personnel. Organic and attached units of division artillery connect into the area communications center in their vicinity as time and distance allow. The division area communication system is made up primarily of common-user circuits, which permit maximum utilization of the system. However, a limited number of sole-user circuits are allocated for command and staff use on the basis of tactical urgency and division policies. Division artillery

normally requires two sole-user circuits between the division artillery headquarters and the fire support element operating in the division tactical operations center.



NOTE:
Division artillery is responsible for insuring that the wire lines between the division artillery and its subordinate units are installed.

Figure 16-14. Type wire system, division artillery (AIM).

b. Communication with Corps Artillery. The division artillery communicates with the corps artillery through the division area communication system and the corps command system. (These are multichannel carrier systems.)

16-6. Corps Artillery Radio Carrier and Wire System

A type corps artillery radio carrier and wire system is illustrated in figure 16-15.

a. Wire System. The corps artillery headquarters is responsible for installing circuits to the target acquisition battalion and to the field artillery searchlight battery, if assigned. The headquarters wire teams also install the local circuits in the headquarters area and the trunk circuits to units directly under corps artillery control that are not furnished radio terminal equipment by the corps signal element.

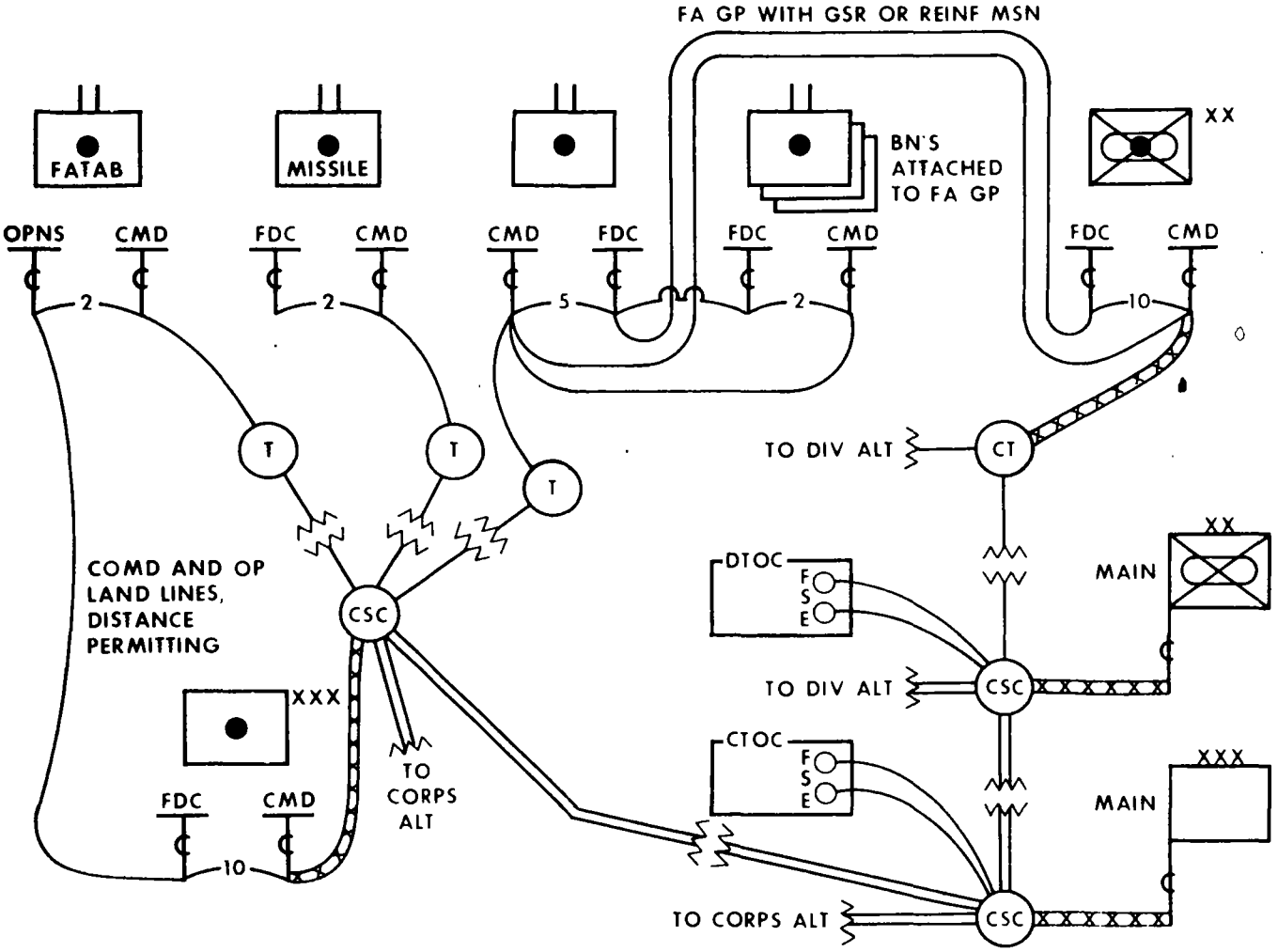


Figure 16-15. Type corps artillery radio carrier and wire system.

b. Radio Carrier System. The command artillery relay company of the corps signal element (either a battalion or a brigade) installs and operates multichannel communication facilities at the corps artillery headquarters, at the headquarters of attached field artillery group, at the target acquisition battalion, and at the corps artillery missile battalions. Other units of the corps signal element furnish additional personnel and equipment when the requirements exceed the capability of the command artillery radio relay company. The command artillery radio relay company provides the equipment and personnel to install and operate the corps artillery portion of the radio carrier and cable system shown in figure 16-15. The cable and wire platoon of the command artillery radio relay company also installs the cables required between radio terminal equipment and the headquarters of the various corps artillery units served by this system. The command artillery radio relay company is located in the general vicinity of the corps artillery headquarters.

16-17. Establishment of Priorities for Installation of Wire Circuits

Field artillery units establish both internal and external wire circuits to meet their communication requirements. These wire circuits do not replace the radio nets operated in by the battalion; instead, they complement the radio nets and thus provide a greater degree of flexibility to the entire unit communications system. Ideally, artillery units install these circuits simultaneously; however, because a unit may not have the equipment and personnel necessary to install the required wire circuits simultaneously, each unit should establish priorities for installing these circuits, as indicated in *a* through *d* below.

a. Close Support Battalion—Mission: Direct Support.

(1) *First priority.*

(a) Install the circuit from the battalion command switchboard to the supported brigade switchboard. This circuit, besides meeting the mission requirement of establishing communications with the supported unit under the principle of supporting to supported, also provides access for the field artillery battalion into the division area communications system through the brigade switchboard. The line between the brigade FSO and the battalion FDC is installed by the wire team on its return trip to the battalion.

(b) Install the circuits from the battalion FDC to the subordinate field artillery battery FDC's. The purpose of these circuits is to relieve the congestion on the battalion fire direction nets and aid in the flow of fire support/request-type traffic between the battalion FDC and the battalion forward observers. The nonmobile battery wire teams normally will be directed to assist the battalion mobile wire team in order to shorten the time required to install this circuit.

(2) *Second priority.* Install the circuits from the battalion FDC to the maneuver battalion fire support officers, with priority first to those with committed maneuver battalions.

(3) *Third priority.* Complete the installation of and improvement of the battalion internal wire system.

b. Close Support Battalion—Mission: General Support-Reinforcing; On-Order, Direct Support.

(1) First establish wire circuits interconnecting the battalion FDC with the reinforced battalion FDC; on return trip establish a wire circuit between the reinforced battalion command switchboard and the battalion command switchboard.

(2) The senior headquarters is responsible for establishing communications with subordinate units. However, because of the limited wire-laying assets of the senior artillery headquarters, the direct support battalion with a general support mission normally will be directed to install the wire circuits. If so directed, first connect the battalion FDC and the senior headquarters FDC and then connect the two command switchboards.

(3) Establish as much of the wire circuitry as feasible with the brigade and the fire support officers with the brigade to facilitate the implementation of the on-order mission of direct support.

(4) Establish both command and fire direction circuits internally within the battalion.

c. General Support Battalion—Mission: General Support, Reinforcing.

(1) First establish wire circuits interconnecting the battalion FDC with the reinforced battalion FDC; on the return trip establish a wire circuit between the reinforced battalion command switchboard and the battalion command switchboard.

(2) Although not responsible for establishing communications with its senior artillery headquarters, the battalion normally will be directed to establish wire communications, first connecting the FDC's and then connecting the command switchboards. This is because of the limited wire-laying assets at the higher artillery headquarters.

d. Field Artillery Battery. The standard device interconnecting the battery FDC, the executive officer's post, and the guns is the telephone connecting and switching group MX-155-GT. A hot loop circuit should be employed only if the switching group is not available or as an alternate means.

16-18. Establishment of Interconnecting Trunk Lines Between Switchboards

In order to increase the flexibility of artillery wire systems, artillery units at each organizational level habitually install trunk lines linking the command switchboard with the FDC switchboard. The minimum numbers of such trunk circuits are listed below.

a. Corps artillery: 10.
b. Field artillery group: 5.
c. Division artillery: 10.
d. Battalion: 2.
e. Battery: 1.

A type field artillery wire system is shown in figure 16-16; the actual installations established by a battalion will depend on the organization, employment, and mission of the battalion.

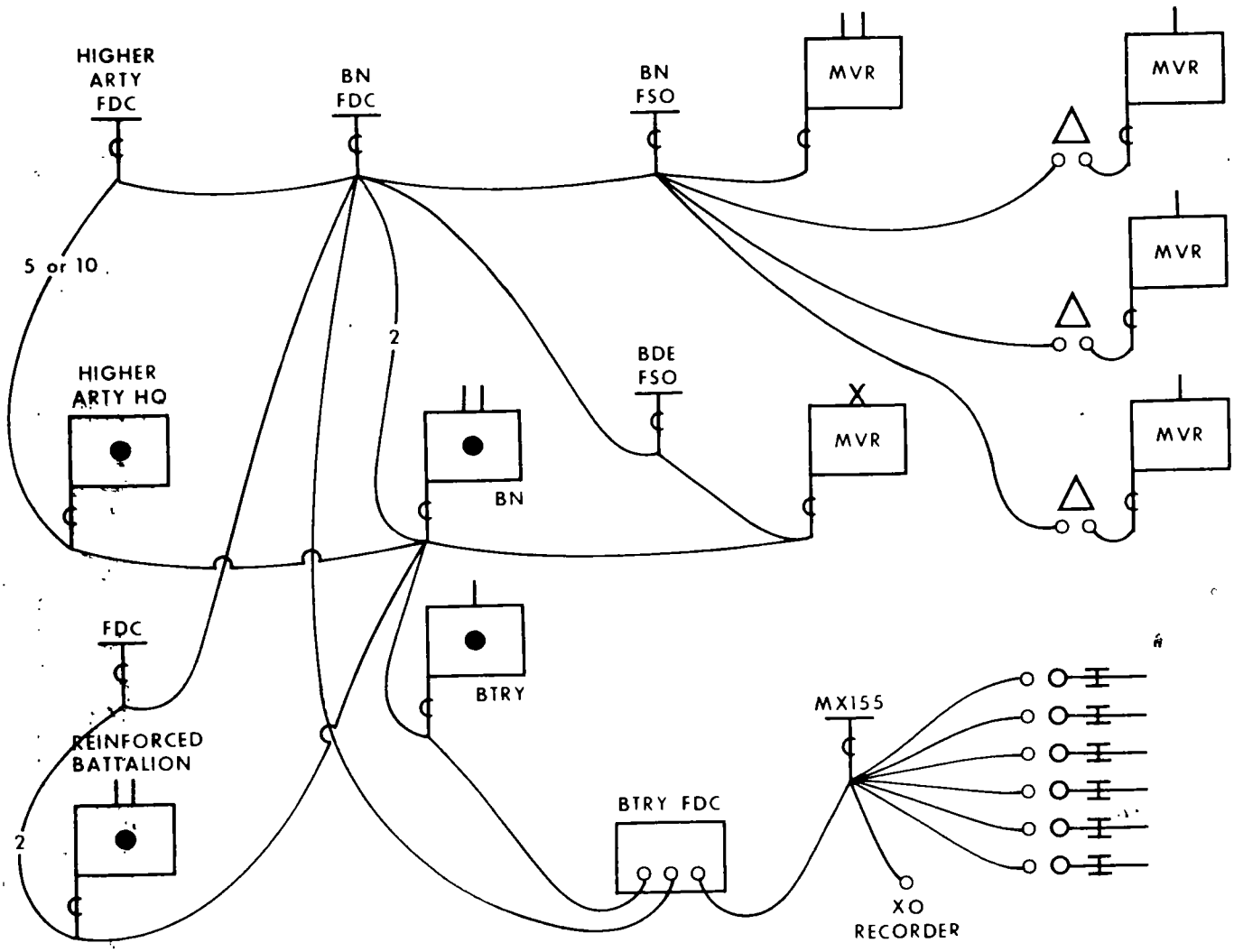


Figure 16-16. Field artillery battalion wire system.

APPENDIX A

REFERENCES

A-1. Allied Communication Publications (ACP)

(C) ACP-121 ( )	Communication Instructions, General (U).
(C) ACP-122 ( )	Communication Instructions, Security (U).
(C) ACP-124 ( )	Communication Instructions Radiotelegraph Procedures (U).
ACP-125 ( )	Communication Instructions Radiotelegraph Procedure.
ACP-125 ( ) US Supp2	Radio Telephone Procedure for the Conduct of Artillery and Naval Gunfire.
(C) ACP-126 ( )	Communication Instructions Teletypewriter Procedure (U).
ACP-134 ( )	Telephone Switchboard Operating Procedure.

A-2. Department of Defense Publications

National Security Agency (S-Crypto)	
KAG-31 ( )/TSEC	Tactical COMSEC Planning Guide for Manual Crypto Systems (U).

A-3. Army Regulations (AR)

(C) 105-2	Electronic Counter-Countermeasures (ECCM) (U).
(C) 105-3	Reporting Meaconing, Intrusion, Jamming and Interference of Electromagnetic Systems, Reports Control Symbol: JCS 1066 (Min) (U).
(C) 105-5	Electromagnetic Cover and Deception (EC&D) (U).
105-31	Message Preparation.
(C) 105-87	Electronic Warfare (U).
310-25	Dictionary of U. S. Army Terms.
310-50	Authorized Abbreviations and Brevity Codes.
340-18-1 through 340-18-15	Office Management and Filing Systems.
380-5	Department of the Army Supplement to DOD 5200.1-R (DODISPR).
380-26	Policy for Use of Encrypt-For-Transmission Only (EFTO) Procedure.
(C) 380-40	Department of the Army Policy for Safeguarding COMSEC Information (U).
380-41	Control of COMSEC Material.
(C) 530-4	Control of Compromising Emanations (U).
(C) 380-52	Cryptosystems and Authentication Systems (U).
604-5	Clearance of Personnel for Access to Classified Defense Information and Material.
725-50	Requisitioning, Receipt and Issue System.
710-2	Materiel Management for using units, support units and installations.
750-1	Army Materiel Maintenance Concepts and Policies.

A-4. Joint Army, Navy, Air Force Publications

(C) JANAP 201 ( )	Status of Noncryptographic JANAP's and ACP's (U).

A-5. DA Pamphlets (Indexes for Military Publications) (DA Pam)

108-1	Index of Army Motion Pictures and Related Audio-Visual Aids.
310-1	Index of Administrative Publications, Regulations, Circulars, Pamphlets, Posters, Joint Chiefs of Staff Publications, and General.
310-3	Index of Doctrinal, Training, and Organizational Publications (Field Manuals, Reserve Officers' Training Corps Manuals, Training Circulars, Army Training Programs, Army Subject Schedules, Army Training Text, Firing Tables and Trajectory Charts, Tables of Organization and Equipment, Type Tables of Distribution and Tables of Allowances).

310-4	Index of Technical Manuals, Technical Bulletins, Supply Manuals, (Types 7, 8, and 9) Supply Bulletins, and Lubrication Orders.
310-6	Index of Supply Catalogs and Supply Manuals (Excluding types 7, 8, and 9).
310-7	US Army Equipment Index of Modification Work Orders.
(C) 310-9	Index of Communications Security (COMSEC) Publications (U).

A-6. DA Supply Bulletins (SB)

11-131	Vehicular Radio Sets and Authorized Installations.
11-602	Oscillator 0-574/GRA (5820-082-4049) for Use with Certain Applications of AN/GSA-7.
700-20	Army Adopted/Other Items Selected for Authorization/List of Reportable Items.

A-7. Field Manuals (FM)

6-20	Field Artillery Tactics and Operation.
6-40	Field Artillery Cannon Gunnery.
6-140	Field Artillery Organizations.
11-50	Communications in Armored, Infantry, Infantry (Mechanized) Division.
11-57	Signal Battalion, Airborne Division.
11-92	Corps Signal Communications.
21-5	Military Training Management.
21-6	Techniques of Military Instruction.
21-30	Military Symbols.
21-60	Visual Signals.
22-100	Military Leadership.
24-1	Tactical Communications Doctrine.
24-16	Signal Orders, Records and Reports.
24-17	Tactical Communications Center Operation.
24-18	Field Radio Techniques.
24-19	Communications-Electronics Reference Data.
24-20	Field Wire and Field Cable Techniques.
(C) 32-5	Signal Security (SIGSEC) (U).
32-6	SIGSEC Techniques.
(S) 32-15	Broadcast Countermeasures (U).
(C) 32-20	Electronic Warefare (U).
61-24	Division Communications.
101-5	Staff Officers' Field Manual Staff Organization and Procedure.

A-8. Technical Manuals (TM)

5-2805-203-14	Operator, Organizational, DS, and GS Maintenance Manual: Engine, Gasoline Models 4A032-1 and 4A032-2.
5-6115-271-14	Operator, Organizational, DS and GS Maintenance Manual: Generator Set Gasoline Engine, 3 KW, AC, 400 Hertz (Less Engine).
9-1290-325-12/1 and 12/2	Operator and Organizational Maintenance Manual Radar Chronograph M36.
9-1290-326-12	Operator's and Organizational Maintenance Manual: Reproducer, Signal Data, AN/GSQ-64.
9-1290-326-20P	Organizational Maintenance Repair Parts and Special Tool Lists: Reproducer, Signal Data, AN/GSQ-64.
9-1427-381-14	Operator, Organizational, DS and GS Maintenance Manual, Battery Control Central AN/MSW-8 and Type II Repair Parts Shop.
9-4931-204-12/1	Operator and Organizational Maintenance Manual: Test Set, Computer Logic Unit AN/GSM-70.
9-4931-204-12/2	Operator and Organizational Maintenance Manual: Test Set, Computer Logic Unit AN/GSM-70.
9-4931-204-20P	Organizational Maintenance Repair Parts and Special Tool Lists for Test Set, Computer Logic Unit AN/GSM-70.

11-286	Radio Sets AN/VRC-8, AN/VRC-9, and AN/VRC-10.
11-287	Radio Sets AN/VRQ-1, AN/VRQ-2, and AN/VRQ-3.
11-381	Cable Assembly CX-1065/G, Telephone Cable Assemblies CX-1606/G and CX-1512/U, Telephone Loading Coil Assembly CU-260/G, Electrical Connector Plugs U-176/G and U-226/G and Maintenance Kit, Cable Splicing MK-640/G.
11-486-6	Electrical Communications System Engineering: Radio.
11-611	Radio Sets AN/VRC-16, AN/VRC-17 and AN/VRC-18.
11-678	Fundamentals of Telephony.
11-2059	Telephone TP-9 and Telephone TA-264/PT.
11-2134	Manual Telephone Switchboard SB-86/P: Installation and Operation.
11-2240	Wire Dispenser, MX-306A/G.
11-3895-207-10	Operator's Manual: Reeling Machine, Cable, Motor Driven RL-172/G and RL-172A/G.
11-3895-209-12	Operator's and Organizational Maintenance Manual: Reeling Machine, Cable, Engine Driven, RL-207/G.
11-5038	Control Group AN/GRA-6.
11-5805-201-12	Operator and Organizational Maintenance Manual: Telephone Set, TA-312/PT.
11-5805-243-12	Operation and Organizational Maintenance, Telephone Set TA-1/PT.
11-5805-254-15	Operator's, Organizational, Field and Depot Maintenance Manual: Terminal Telegraph-Telephone AN/TCC-14.
11-5805-262-12	Operator's and Organizational Maintenance Manual: Switchboards Telephone Manual SB-22/PT and SB-22A/PT.
11-5805-303-20P	Organizational Maintenance Repair Parts and Special Tools List Connecting and Switching Kit MX-155/GT.
11-5805-356-12	Operator and Organizational Maintenance Manual: Terminal, Telegraph-Telephone AN/TCC-29.
11-5815-200-12	Organizational Maintenance Manual: Including Repair Parts and Special Tool List Teletypewriter Set AN/UGC-4.
11-5815-204 series	Radioteletypewriter Sets AN/GRC-46, -46A, and 46B and AN/VRC-29.
11-5815-206-12	Operator's and Organizational Maintenance Manual: Teletypewriter Sets, AN/PGC-1, TT-4( )/TG, TT-335/TG and TT-537/TG.
11-5815-238-12	Organizational Maintenance Manual: Teletypewriter Sets AN/GGC-3( ) and AN/GCC-3A and Teletypewriter Reperforator, Transmitters TT-76( )/GGC. TT-76A/GGC, TT-76B/GGC, and TT-76C/GGC.
11-5815-334-12	Operator and Organizational Maintenance Manual: Radioteletypewriter Sets AN/GRC-142, and AN/GRC-122, AN/GRC-142A, AN/GRC-142B, AN/GRC-122A and AN/GRC-122B.
11-5820-222 series	Radio Set AN/VRC-24.
11-5820-292 series	Radio Sets AN/PRC-8, -8A, -9, -9A, -10, -10A.
11-5820-295 series	Radio Set AN/GRC-19.
11-5820-398 series	Radio Set AN/PRC-25.
11-5820-401 series	Radio Sets AN/VRC-12 and AN/VRC-43, -44, -45, -46, -47, -48, and 49.
11-5820-477-12	Organizational Maintenace Manual: Radio Set Control Groups AN/GRA-39 and AN/GRA-39A.
11-5820-498-12	Operator's and Organizational Maintenance Manual: Radio Set, AN/VRC-53, AN/VRC-64, AN/GRC-125, AN/GRC-160 and Amplifier—Power Supply Groups OA-3633/GRC and OA-3633A/GRC.
11-5820-520-34P-1	Direct Support and General Support Maintenance Repair Parts and Special Tools Lists (Including Depot Maintenance Repair Parts and Special Tools): for Radio Set AN/GRC-106 (FSN 5820-167-8003).
11-5820-549-12	Operator and Organizational Maintenance Manual: Receiving Set, Radio AN/PRR-9, Transmitting Sets, Radio AN/PRT-4 and AN/PRT-4A.

11-5820-590-12-1	Operator and Organizational Maintenance Manual: Radio Sets AN/PRC-74B and AN/PRC-74C.
11-5820-667-12	Operator and Organizational Maintenance Manual: Radio Set AN/PRC-77.
11-6625-496-12	Operator and Organizational Maintenance Manual: Test Set, Radio AN/VRM-1.
11-6625-514-12	Operator and Organizational Maintenance Manual: Test Set, Electronic Circuit Plug-in Unit AN/GRM-55.
38-750	The Army Maintenance Management Systems (TAMMS).
11-6625-1686-15	Operator, Organizational, DS, GS and Depot Maintenance Manual: Radio Frequency Power Test Set TS-2609/U.

A-9. Common Table of Allowances (CTA)

50-970	Expendable Items (Except Medical, Class V Repair parts and Heraldic Items).

APPENDIX B

SYMBOLS

B-1. Short Titles for Radio Nets

The short titles shown in figure B-1 are used in conjunction with artillery radio net diagrams and the discussions of radio nets. Frequency modulated (FM) nets are shown by a solid line, amplitude modulated (AM) nets are shown by a solid line on which a series of X's are superimposed at convenient intervals. Suffix numbers are added to the short titles if more than one net is used for the same purpose; i.e., F1, F2, F3 if a unit has three fire direction nets.

B-2. Metric Notations

Terra 10^{12}	1,000,000,000,000
Giga 10^{9}	1,000,000,000
Mega 10^{6}	1,000,000
Kilo 10^{3}	1,000
Hecto 10^{2}	100
Deca 10^{1}	10
Unit 10^{0}	1
Deci 10^{-1}	0.1
Centi 10^{-2}	0.01
Milli 10^{-3}	0.001
Micro 10^{-6}	0.000,001
Nane 10^{-9}	0.000,000,001
Peco 10^{-12}	0.000,000,000,001

FM Nets	Purpose	AM Nets
CF	Command Fire Direction	CF
F	Fire Direction	F
CI	Command Intelligence	CI
CL	Command Light Direction	
R	Sound Ranging	
T	Flash Ranging	
S	Survey	
	Meteorological	M
LN	Liaison	LN
CO	Command Operations	CO
	Alternate Net (or net of secondary interest)	

Figure B-1. Short titles for radio nets.

B-3. Radio Symbols and Wire Symbols

The radio symbols (fig B-2) and wire symbols (fig B-3) are used in conjunction with artillery radio net diagrams. For a complete list of communications symbols, see FM 21-30.

RADIO SYMBOLS

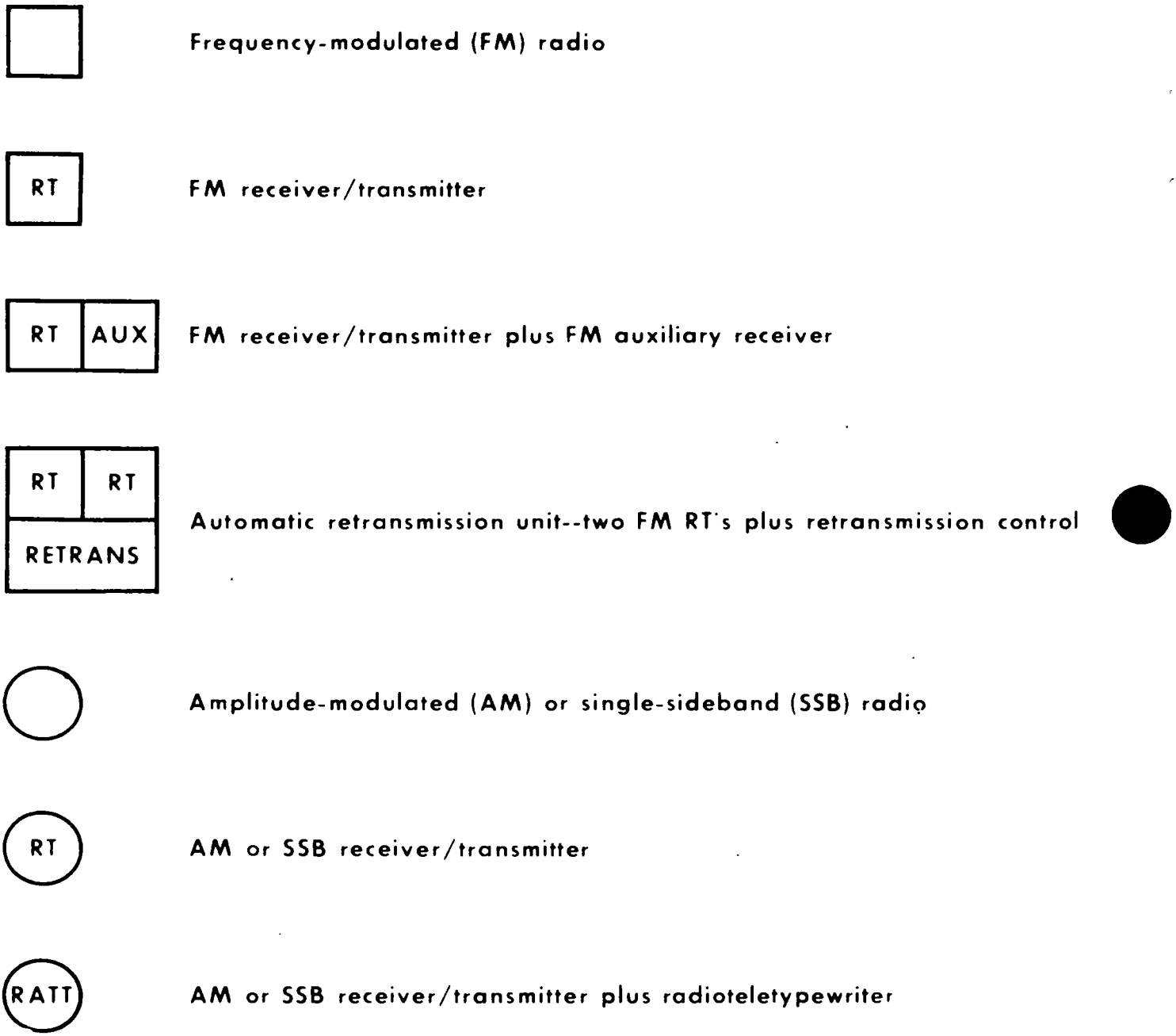


Figure B-2. Radio symbols.

WIRE SYMBOLS

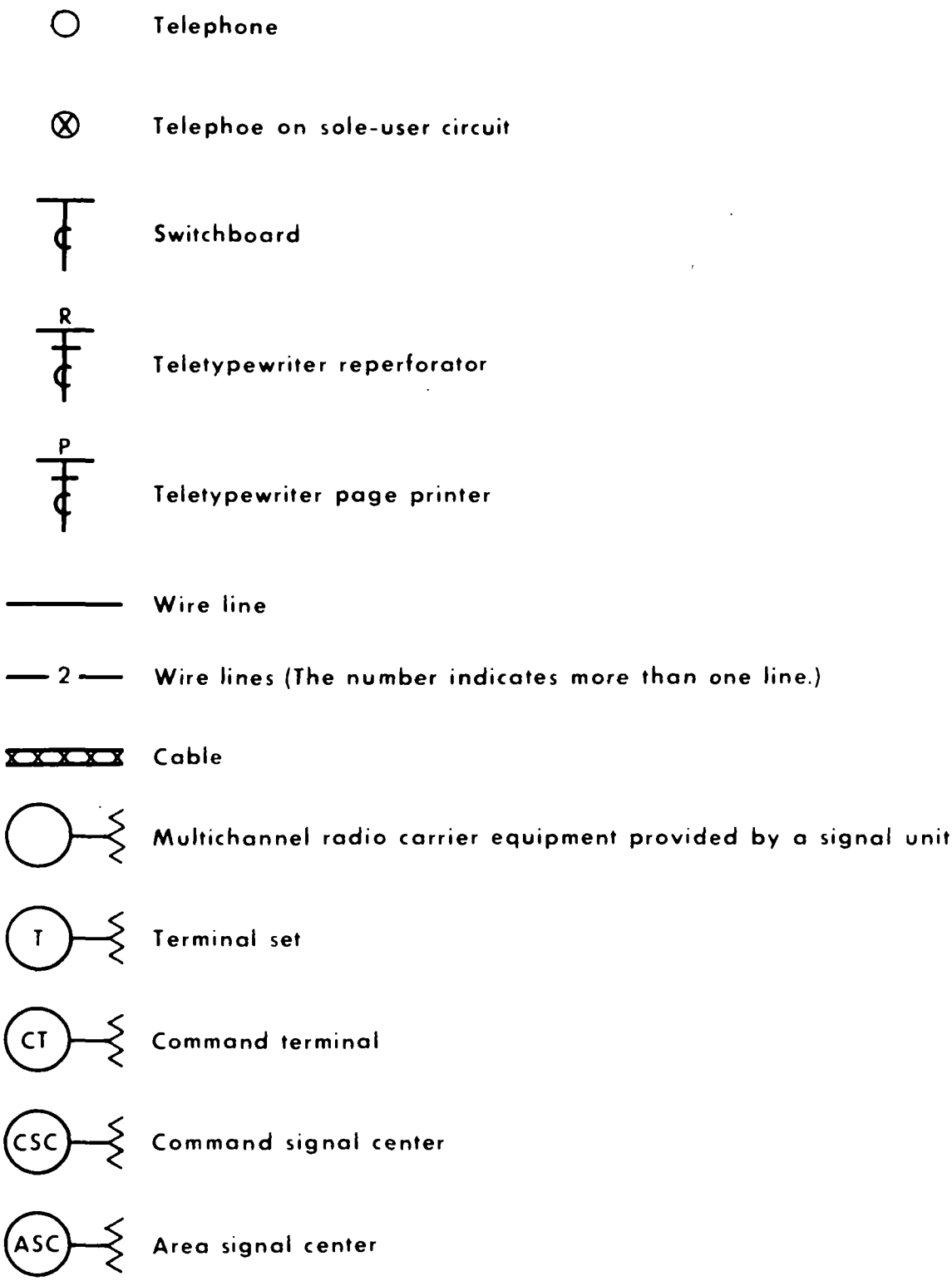


Figure B-3. Wire symbols.

APPENDIX C

TABULATION AND DESCRIPTION OF COMMUNICATIONS-ELECTRONICS EQUIPMENT

Table C-1. Old FM Radios

Radio set	Receiver / transmitter	Frequency (MHx)	Operation modes	Range (KM)	Channels Total	Channels Preset	Power requirement	Reference manual	Remarks
AN/GRC-3	R-108/RT-66/RT-70	20.0-27.9	Voice	16-24	80	2	12/24 VDC	TM 11-284	3 preset channels on aux receiver; set utilizes AM-65 AF amplifier.
-5	R-109/RT-67/RT-70	27.0-38.9			120	2			
-7	R-110/RT-68/RT-70	38.0-54.9			170	2			
AN/GRC-4	RT-66/RT-70	20.0-27.9	Voice	16-24	80	2	12/24 VDC	TM 11-284	Set utilizes AM-65 AF amplifier.
-6	RT-67/RT-70	27.0-38.9			120	2			
-8	RT-68/RT-70	38.0-54.9			170	2			
AN/VRC-8	RT-66	20.0-27.9	Voice	16-24	80	2	12/24 VDC PP-109/GR(12V) PP-112/GR(24V)	TM 11-286	
-9	RT-67	27.0-38.9			120	2			
-10	RT-68	38.0-54.9			170	2			
AN/VRC-13	RT-66	20.0-27.9	Voice	16-24	80	2	12/24 VDC	TM 11-291	Set utilizes AM-65 AF amplifier.
-14	RT-67	27.0-38.9			120	2			
-15	RT-68	38.0-54.9			170	2			
AN/VRC-16	R-108/RT-66	20.0-27.9	Voice	16-24	80	2	12/24 VDC PP-448(6 volt) PP-281(12 volt) PP-282(24 volt)	TM 11-611	3 preset channels on aux receiver.
-17	R-109/RT-67	27.0-38.9			120	2			
-18	R-110/RT-68	38.0-54.9			170	2			
AN/VRC-20	R-108/RT-66	20.0-27.9	Voice	16-24	80	2	12/24 VDC	TM 11-642	3 preset channels on aux receiver; set utilizes AM-65 AF amplifier.
-21	R-109/RT-67	27.0-38.9			120	2			
-22	R-110/RT-68	38.0-54.9			170	2			
AN/VRQ-1	2 RT-66	20.0-27.9	Voice	16-24	80	2	12/24 VDC	TM 11-287	Provides automatic re-transmission capability. Can also be used for duplex operation.
-2	2 RT-67	27.0-38.9			120	2			
-3	2 RT-68	38.0-54.9			170	2			
AN/VRC-7	RT-70	47.0-58.4	Voice	1.6	115	2	6/12/24 VDC & 6 V PP-448/GR	TM 11-285	Set utilizes AM-65 AF amplifier.
AN/PRC-6	RT-196/PRC-6	47.0-55.4	Voice	1.6	43	1	BA-270	TM 11-296	Can use long-life BA-4270/U FSN 6135-390-0031

AN/PRC-8 -9 -10	RT-174/PRC-8 RT-175/PRC-9 RT-176/PRC-10	20.0-27.9 27.0-38.9 38.0-54.9	Voice	5-8	80 120 170	Continuous tuning.	BA-279/U or 24 VDC w/AM-598/U	TM 11-4065	AM-598/U is an amplifier, power supply. (BA-2279/U for arctic operation).

Table C-2. New FM Radios

Radio set	Receiver transmitter	Frequency (MHz)	Operation modes	Range (KM)	Channels Total	Channels Preset	Power requirement	Reference manual	Remarks
AN/PRC-25	RT-505/PRC-25	30.00-52.95 53.00-75.95	Voice	8	920	2	Dry btry BA-386/U mag btry BA-4386 FSN 6135-926-8322.	TM 11-5820-398-12	Replaces AN/PRC-8, -9, and -10 for manpack only.
AN/PRC-77	RT-841/PRC-77	30.00-52.95 53.00-75.95	Voice & 150-Hz tone.	8	920	2	BA-386/PRC-25 or BA-398/U.	TM 11-5820-667-12	X-mode for security device BA-398/U is for arctic operation.
AN/VRC-53	RT-505/PRC-25	30.00-52.95 53.00-75.95	Voice & 150-Hz tone.	8	920	2	24 VDC vehicular battery.	TM 11-5820-398-12	Vehicular configuration of AN/PRC-25.
AN/VRC-64	RT-841/PRC-77	30.00-52.95 53.00-75.95	Voice & 150-Hz tone.	8	920	2	24 VDC vehicular battery.	TM 11-5820-667-12 and C 1 of TM 11-5820-498-12.	Vehicular configuration of AN/PRC-77.
AN/GRC-125	RT-505/PRC-25	30.00-52.95 53.00-75.95	Voice & 150-Hz tone.	8	920	2	Dry btry or vehicular battery.	TM 11-5820-498-10	On/off vehicular configuration of AN/PRC-25.
AN/GRC-160	RT-841/PRC-77	30.00-52.95 53.00-75.95	Voice & 150-Hz tone.	8	920	2	Dry btry or vehicular battery.	TM 11-5820-667-12 and C 1 of TM 11-5820-498-12.	On/off vehicular configuration of AN/PRC-77.
AN/GRC-163	1 AN/VRC-47 *1 AN/TCC-70	30.00-52.95 53.00-75.95	Voice & 150-Hz tone.	15-50 Using 2 antennas Log periodic for long range.	920	2	PP-2953B/U 110-220 VAC, 60- to 400-Hz, to 24 VDC & gasoline engine generator 1.5-kw, 120 V.	TM 11-5820-713-15	This terminal set provides voice and teletype communication by using the multiplexer AN/TCC-70. For point-to-point communication. Requires two frequencies per link.
AN/VRC-12	RT-246/VRC R-442/VRC	30.00-75.95	Voice	40	920	10	24 VDC	TM 11-5820-401-10	Replaces AN/VRC-16, -17, and -18.

Table C-2. New FM Radios—Continued

Radio set	Receiver transmitter	Frequency (MHz)	Operation modes	Range (KM)	Channels Total	Channels Preset	Power requirement	Reference manual	Remarks
AN/VRC-43	RT-246/VRC	30.00-75.95	Voice	40	920	10	24 VDC	TM 11-5820-401-10	Replaces AN/VRC-8, -9, and -10.
AN/VRC-44	RT-246/VRC 2 R-442/VRC	30.00-75.95	Voice	40	920	10	24 VDC	TM 11-5820-401-10	No previous configuration having this capability.
AN/VRC-45	2 RT-246/VRC	30.00-75.95	Voice	40	920	10	24 VDC	TM 11-5820-401-10	Replaces AN/VRQ-1, -2, and -3.
AN/VRC-46	RT-524/VRC	30.00-75.95	Voice	40	920	0	24 VDC	TM 11-5820-401-10	Replaces AN/VRC-8, -9, and -10.
AN/VRC-47	RT-524 VRC R-442/VRC	30.00-75.95	Voice	40	920	0	24 VDC	TM 11-5820-401-10	Replaces AN/VRC-16, -17, and -18.
AN/VRC-48	RT-524/VRC 2 R-442/VRC	30.00-75.95	Voice	40	920	0	24 VDC	TM 11-5820-401-10	No previous configuration having this capability.
AN/VRC-49	2 RT-524/VRC	30.00-75.95	Voice	40	920	0	24 VDC	TM 11-5820-401-10	Replaces AN/VRQ-1, -2, and -3.
AN/PRC-88 Squad Radio.	AN/PRT-4 transmitter.	47.00-57.00	Voice & tone.	1.6 .5	200	2	BA-399/U	TM 11-5820-549-12 SB 11-622	Compatible with AN/VRC-12 and AN/PRC-25 series. Channel alinement indicator ID-1189/PR is required since radio is crystal controlled. Has 50-kHz spacing. Transmitter AN/PRT-4 may be operated on either of 2 channels which may be separated up to 1MHZ in frequency.
	AN/PRR-9 receiver.	47.00-57.00		Provided with earphone H-264/PRR-9.	200 usable channels depend on crystals made available.	1	BA-505/U or BA-4505/U (Magnesium).		

Note. AN PRT-4A is the same as AN PRT-4 except that 150 Hertz Tone has been added

* Multiplexer Set AN TCC-70 is a lightweight tactical equipment. It provides four telephone traffic channels for voice or data, one order wire channel, and two telegraph channels. It operates with another distant multiplexer over a four-wire cable or a radio circuit, using radio receiver R-442/VRC and radio receiver-transmitter RT-246/VRC or RT-524/VRC The telegraph channels are compatible with telegraph terminals TH-5/TG and TH-22/TG Remarks: TM 11-5805-413-12; TM 11-5805-413-34; Traffic capccity—4 telephone channels: 2 simultaneous full-duplex telegraph channels plus order wire with provision for 2 additional telegraph channels on a plug-in basis

AN/GRT-13 radio transmitting set (site marking device).	AN/GRT-13 development item.	45.0-54.8	Tone-modulated omni-directional signal (on 6 sec, off 4 sec).	NA	50	50 (one at a time).	BA-386/PRC (15 volt).	TM 11-5820-608-12 (when published).	Used in conjunction with organic FM equipment to form a homing system for the purpose of locating airdropped supply bundles. Radio set AN/PRC-10 or AN/PRC-25 equipped with homing loop antenna AT-784/PRC is used.

Table C-3. AM Radios

Radio set	Receiver / transmitter	Frequency (MHz)	Operation modes	Range (KM)	Channels Total	Channels Preset	Power requirement	Reference manual	Remarks
AN/PRC-47	RT-671/PRC-47	2 to 11.999 in 1-kHz increments	CW & upper sideband voice & FSK	Planning range 80 km	10,000		BB-451/U or vehicular battery	TM 11-5820-509-12	Used in airmobile operations. Portable by rucksack (requiring 2 men) using battery power, or vehicular mounting, using vehicular battery. In fixed station operation can use 115 volts single phase, 400 Hz. Uses antenna AS-1320/PRC-47 (15-ft whip) & AS-1321 (long-wire).
AN/GRC-19	R-392/URR T-195/GRC-19	0.5-32.0 1.5-20.0	Voice CW	80	Manual	7 XMTR	28.0 VDC 44 amps	TM 11-5820-295-10	Part of AN/GRC-46, AN/VRC-29, and AN/VSC-1. Being replaced by AN/GRC-106.
AN/GRC-46	R-392/URR T-195/GRC-19	0.5-32.0 1.5-20.0	Voice CW, FSK simul-taneous voice & FSK	80	Manual	7 XMTR	28.0 VDC 100 amps	TM 11-5815-204-10	Mounted in shelter S-89 or S-144. Standard B item, being replaced by AN/GRC-142. Has on-line security capability.
AN/GRC-26 (A, B, & C) D	2 R-388/URR 1 BC-610 (A, B, C) 2 R-390/URR 1 T-368/URT	0.5-30.5 2.0-18.0 0.5-32.0 1.5-20.0	Voice CW, FSK simul-taneous voice & FSK	160 voice 400 CW & FSK	Contin-uous manual control		115 VAC 50-60 Hz 5 kw approx	TM 11-5820-202-10 & TM 11-5820-256-10	Has full duplex capability. Provides on-line secure communication. Extended ranges with doublet antenna.

Table C-3. AM Radios—Continued

Radio set	Receiver / transmitter	Frequency (MHz)	Operation modes	Range (KM)	Channels Total	Channels Preset	Power requirement	Reference manual	Remarks
AN/URC-4	RT-159/URC-4	120.0-130.0 & 240.0-260.0	Voice MCW tone	16/32/64 w/aircraft at 1,000, 5,000, & 10,000 ft	2 fixed	1	BA-1264/U	TM 11-510	Emergency aviator's radio for rescue situations, dropped in survival kit or carried on person in a vest.
AN/URC-10	RT-278/URC-10	238.0-263.0	Voice & tone	56 line of sight	1 fixed		16 V dry btry BA-1387/URC-10	TM 11-5820-640-15	Replaces AN/URC-4 personnel rescue radio set.
AN/VRC-24	RT-323/VRC-24	225.0-399.9	Voice	48 at 1,000 ft; 160 at 10,000 ft	1750	19	24 VDC	TM 11-5820-222-series	Ground-to-air communication. Compatible with AN/ARC-27, AN/ARC-55 or AN/ARC-51. Can retransmit from PRC-9 to VRC-14 and from AM-65 to VRC-24.
AN/VRC-29									AN/GRC-46 *less shelter*. Configuration for mounting in tanks and APC's.
AN/VRC-34	RT-77/GRC-9	2.0-12.0	Voice CW MCW	Voice 16-24 CW 24-48	Continuous or 6 crystal freq		6/12 VDC w/DY-88/GRC-9 24 VDC w/DY-105/GRC-9	TM 11-263	Vehicular version of AN/GRC-9. AN/GRC-87 when not mounted. Uses DC gen GN-43 or GN-58, & battery BA-317/U.
AN/VSC-1	R-392/URR T-195/GRC-19	0.5-32.0 1.5-20.0	Voice CW FSK	80		7 XMTR	27.5 VDC 100 amps	TM 11-5815-204-series	AN/GRC-46 air-droppable version (mounted in ¼ ton), less shelter, reperforator-teletype, and on-line security equipment.
AN/PRC-41 (UHF receiver-transmitter)	RT-695/PRC-41	225.0-399.9	Voice (AM)	48 at 1,000 ft, 160 at 10,000 ft, also depending on antenna	1750 crystal control (100-kHz channel spacing)		BB-451/U; PP-3700/PRC-41 (fixed station) or vehicular btry	TM 11-5820-510-12	Can operate from 115-230 volts, 50 to 400 Hz. Permits manpack, fixed station, or vehicular operation. Uses either directional antenna AS-1405/PRC-41 or omnidirectional antenna AS-1404/PRC-41. Used for ground-to-air communication, such as forward air controller. On TOE of airmobile division.

AN/PRC-90 (Navy and Air Force Transmitter)	242-245 281-284	Voice Tone	85 Nautical miles from water surface	2	BA-156810	Publication Pending		Dual channel rescue transceiver crystal controlled (airplane survival gear) Replaces AN/URC-4-10-11 and -14. Requires test set AN/PRM-32 (GO NOGO)

Table C-4. Single Sideband Radios

Radio set	Receiver transmitter	Frequency (MHz)	Operation modes	Range (KM)	Channels Total	Channels Preset	Power requirement	Reference manual	Remarks
AN/GRC-106	*RT-662/GRC	2.0-29.999	Voice CW	80 ground wave 2,400 skywave	28,000		28 VDC veh btry or PP-4763/GRC	TM 11-5820-520-series & TM 11-5820-765-12	Replacement for AN/GRC-19. May be mounted on ¼-ton vehicle.
AN/GRC-142	*RT-662/GRC & Modem MD-522A	2.0-29.999	Voice, CW, FSK, voice & FSK simul-taneously	80 ground-wave, 2,400 skywave	28,000		28 VDC 100-amp high capacity gen PV -620 if without air conditioner, PV-677 if with airconditioner	TM 11-5820-520-series, TM 11-5805-387-15-1 & -2, TM 11-5815-334-12	Replacement for AN/GRC-46. On-line security capability. Half duplex operation. Shelter mounted (S-318) ¾-ton. Can use PP-4763/GRC (28 VDC at 50 amps from 115 VAC).
AN/GRC-122	*2 RT-662/GRC & Modem MD-522A	2.0-29.999	Same as AN/GRC-142	80 ground-wave, 2,400 skywave	28,000		28 VDC 100 amp high capacity generator or 10-kw generator	TM 11-5820-520-series, TM 11-5805-387-15-1 & -2; & TM 11-5815-334-12	Same as AN/GRC-142, except for additional RT-662 and auxiliary equipment for full duplex operation. Can use PP-4763/GRC (28 VDC at 50 amps from 115 VAC).
AN/GRC-108	2 RT-662/GRC w RF amplifier AM-3399 & modem MD-522A	2.0-29.999	Same as AN/GRC-142	160 ground-wave, wave, 2,400 skywave	28,000		115-230 V trailer-mounted 10-kw gen	Non Pub-lished	Replacement for AN/GRC-26 shelter mtd. Full duplex with on-line security. Initially mounted on 2½-ton truck, but will ultimately be mounted on ¾-ton truck.
AN/VSC-2	RT-662/GRC & modem MD-522A	2.0-29.999	Same as AN/GRC-142	80 ground-wave, 2,400 skywave	28,000		**27.5 VDC 28 to 115 V inverter SS-688 to provide AC for TT operation	TM 11-5808-387-15-1 & -2, TM 11-5815-331-14	Replacement for AN/VSC-1. Same as AN/GRC-142 less reperforator. Mtd in ¼-ton veh for airborne operations.

See footnotes at end of table.

Table C-4. Single Sideband Radios—Continued

Radio set	Receiver transmitter	Frequency (MHz)	Operation modes	Range (KM)	Channels Total	Channels Preset	Power requirement	Reference manuel	Remarks
AN/VSC-3	RT-662/GRC & modem MD-522A	2.0-29.999	Same as AN/GRC-142	80 ground-wave, 2,400 skywave	28,000		28 VDC high capacity veh generator	TM 11-5815-332-15 (when published) TM 11-5805-387-15-1 & -2	Replacement for AN/VRC-29. Mounted in M577 vehicle.
AN/PRC-74B	RT-794/PRC-74	2.0-17.999	Voice & CW	40 ground-wave	Vernier controlled detent tuning in 1 kHz steps		70 BA-30 or 2 BA-386 or PP-4514/PRC-74 is 110/220-volt power is available	TM 11-5820-590-12-1	Half-duplex capability. Can use 12 volt nickel-cadmium wet cell battery.
AN/TRC-133	5 KWM-2A radio sets (RT-7181 FRC-93) one amplifier radio frequency, AM 3979/FRC-93	3.4-5.0 6.5-30.0	Voice & CW	80 ground-wave 2,400 skywave	Continuous tuning		Trailer mounted PV-614 two 10 KW generators	No TM. See POMM 11-5820-610-15	5KW M-2A radio sets used in Pershing units, mounted in shelter 5-280 and trailer with two 10KW generators. Two radio sets are capable of mobile communication and remote operation of all sets from remote console through 1500 foot cable.
AN/MRC-95	RT-698/ARC-102 (Collins type) (618T-3)	2.0-29.999	Voice CW FSK	80 ground-wave	28,000		Vehicular power 28-volt generator system + power converter 770B-1	TM 11-5820-514-12	Mounted in ¼-ton vehicle. Can provide ground-to-air communication with aircraft using radio set AN/ARC-102 or other sets in the 2.0-29.9 MHz frequency range. Used in airmobile units as an interim item until the AN/VSC-2 becomes available.

Notes.

* PP-4763 is used when commercial power is utilized (TM 11-5820-765-12)

* * Uses PU-675 for fixed or semifixed operation (3 kw, 28-volt DA gen ⁻ battery) mounted in ¼-ton trailer M146, requires 25-ft cable between PU-675 and VSC-2.

Table C-5. Army Aircraft Radios

Radio set	Receiver transmitter	Frequency (MHz)	Operation modes	Range (KM)	Channels Total	Channels Preset	Power requirement	Reference manuel	Remarks
AN/ARC-44	RT-294/ARC-44	24.0-51.9	FM Voice CW for homing.	Line of sight (see note).	280 preset		27.5 VDC	TM 11-5821-204-series.	Air-to-ground communication. Compatible with old series of FM radios. 100-kHz channel spacing. Replaced by AN/ARC-54 or AN/ARC-131.

AN/ARC-45	RT-295/ARC	225.0-399.9	VHF/UHF AM voice.	(see note)	1750 12 preset	27.5 VDC	TM 11-5821-299-series.	Air-to-air & air-to-ground communication. Replaces AN/ARC-60.
AN/ARC-51	RT-650/ARC-51	225.0-399.9	VHF/UHF AM voice.	(see note)	1750 18 preset	27.5 VDC	TM 11-5821-242-series.	Replaces AN/ARC-55 for traffic control communication. Operational ceiling is 70,000 feet.
AN/ARC-54	RT-348/ARC-54 (built-in-retransmission using 2 AN/ARC-54).	30-69.96	FM voice visual read-out for homing.	Line of sight (see note).	800 20 preset	27.5 VDC	TM 11-5821-244-series.	Air-to-ground communication. 50-kHz spacing. Replaces AN/ARC-44. Compatible with first 800 channels of AN/PRC-25 & AN/VRC-12 series.
AN/ARC-51Bx	RT-702/ARC-51Bx	22.50-399.9	Same		3500	27.5 VDC	TM 11-5820-518-20	
AN/ARC-55	RT-349B/ARC-55	225.0-399.9	VHF/UHF AM voice or tone.	(see note)	1750 18 preset	27.5 VDC	TM 11-5821-225-series.	Modified AN/ARC-27 air-to-air and air-to-ground communication. Operates at 25,000 feet. Replaced by AN/ARC-51.
AN/ARC-73	T-17L-7A R-51X-2B	T-116.0-149.95 R-108.0-151.95	VHF/UHF AM voice.	(see note)	T: 680 R: 880	27.5 VDC	TM 11-5821-217-series.	General purpose air-to-air and air-to-ground communications. Replaces AN/ART-34 and AN/ART-35.
AN/ARC-95	RT-651/ARC-95	2.0-15.0	AM voice	(see note)	22	27.5 VDC	TM 11-5821-247-series.	Replaces AN/ARC-59. Air-to-air & air-to-ground communications.
AN/ARC-98	Under development	2.0-29.999	AM SSB	240 (see note).	28,000	27.5 VDC	Not published	1 kHz spacing. Compatible with GRC-106 and -108. Will replace AN/ARC-95 and AN/ARC-102.
AN/ARC-102	RT-698/ARC-102	2.0-29.999	AM voice CW SSB.	(see note)	28,000	27.5 VDC	TM 11-5821-248-series.	1 kHz spacing. Compatible with GRC-106 and -108. Air-to-air and air-to-ground.
AN/ARC-114	Electronically tunable main receiver & transmitter.	30.00-75.95	FM, clear voice, X-mode.	15,000 ft (max).	920	27.5 VDC	TM 11-5821-259-20	Airborne VHF, FM receiver-transmitter compatible with VRC-12 series. Has homing capability. Guard receiver is fixed tuned in the 40.0-41.0 MHz frequency range. Weight 6.5 lbs. For light aircraft.

Table C-5. Army Aircraft Radios—Continued

Radio set	Receiver transmitter	Frequency (MHz)	Operation modes	Range (KM)	Channels Total	Channels Preset	Power requirement	Reference manuel	Remarks
AN/ARC-115	Developmental	116.0-149.95 Guard Receiver 121.5	AM voice	(see note)	1360 (25 kHz spacing)		27.5 VDC		A proposed lightweight multichannel airborne radio set (10 lbs). Retransmission and self-contained guard channel receiver are included. Specifically designed for operation in light observation helicopters. Will be completely solid state. The AN/ARC-115 is to replace the AN/ARC-73; the AN/ARC-116 is to replace the AN/ARC-51X.
AN/ARC-116	Developmental	225.0-399.95 Guard Receiver 243.0	AM voice	(see note)	3500 (50 kHz spacing)		27.5 VDC		
AN/ARC-131	RT-832/ARC-131 (Replacement for AN/ARC-54.)	30-75.95	FM voice CW, homing retrans-mission is possible if second set is available.	(see note)	920		24-29 VDC	TM 11-5820-670-12	The ARC-54 (800 channels) and the AN/ARC-131, which is fully compatible with the ground radios of the VRC-12 series (920 channels), are interchangeable. ARC-54 is standard B, ARC-131 is standard A.

Note. Range will vary considerably according to the terrain, atmospheric conditions and altitude of the aircraft.

Table C-6. Airborne Command Facilities

Equipment	FM sets	SSB VHF or UHF sets	Associated equipment	Remarks
AN/ASC-5 (Airborne tactical operations center).	3 AN/VRC-46	1 AN/VRC-24 1 AN/ARC-102	7 intercom stations (C-1611A/AIC).	May be installed in or removed from aircraft in about 20 minutes.
AN/ASC-6 (Airborne communications center).	2 AN/ARC-54 or 2 AN/ARC-131	1 AN/ARC-51	6 operator stations (C-1611).	Console includes controls for wiring in the aircraft radios (UHF AN/ARC-51, VHF AN/ARC-73, HF SSB AN/ARC-102). A second AN/ARC-51 can be connected into the console, if desired.
AN/ASC-10 (V) (Airborne communications center).	2 AN/ARC-54 or 2 AN/ARC-131 Uses 1 KY-8 or 2 KY-28.	1 AN/ARC-73A or 1 AN/ARC-51BX	6 intercommunication stations C-1611A/AIC 1 KY-8 or 2 KY-28 speech security equipments.	Space is provided to install an HF-SSB AN/ARC-102 control head in the console, Associated antennas, interconnecting cables, and a power cable are provided. Replaces AN/ASC-6. TM 11-5821-276-15.

AN/ASC-11 Airborne communications central; two AN/ASC-11's can be installed in a helicopter UH-1B or UH-1D.	2 VRC-46. Uses 1 KY-8 or 2 KY-28.	AN/ARC-102 of aircraft can be wired into console.	6 intercommunication stations C-1611A/AIC-1-control indicator C-8156/ARC; 2-control indicators C-8157/ARC	Formerly known as the AN/ASC-122. Total weight 225 lbs per unit. TM 11-5821-279-15 (when published). Installed in UH-1B and UH-1D helicopters. One KY-8 with C-8156/ARC, or 2 KY-28 with 2 C-8157/ARC may be installed.
AN/ARC-121 (Airborne relay station).	6 VRC-46		For retransmission	Can retransmit 3 separate net simultaneously.
AN/ARC-122 (Airborne communication control).			3 intercom sets (Airborne CP).	

Table C-7. Antenna Equipment

Equipment	Purpose and description	Reference manual	Remarks
AN/GRA-12	Portable half-wave antenna (center-fed Hertz) assembly designed for transmission and reception of radio signals between 1.5 and 18 MHz. It may be used with sets having a power output of less than 500 watts and a characteristic impedance of 52 ohms.	TM 11-2651	Approximate weight: 229 lb
AN/GRA-50	Lightweight doublet antenna kit for transmitters and receivers with a frequency range of 1.5 to 20 MHz not exceeding 100 watts. Uses existing terrain features for supports.	TM 11-5820-467-series	Approximate weight: 12 lb
AN/GRA-4	Portable half-wave antenna assembly designed for transmission and reception of radio signals between 1.5 and 18 MHz. For sets with transmitter output of less than 100 watts. Characteristic impedance of 72 or 500 ohms. Includes two mast assemblies of 16 mast sections each.	TM 11-2651	Approximate weight: 170 lb
RC-292	Elevated wide band modified ground plane antenna designed to operated with and extend range of FM radios operating in frequency range of 20-76 MHz.	TM 11-5820-348-series	Can increase operating range from 50 to 200 %.
AT-791 AS-1537 or later developments.	New elevated omnidirectional half-wave antenna being designed to extend range of new family of FM radios. Although several designations for antennas appear as developmental items on current TOE, nomenclature has not yet been firmed up. When standardized, this new antenna is expected to replace the present RC-292.	None published	
AT-984/G	Directional long-wire antenna used to extend range of tactical FM radio sets operating between 30- and 76-MHz frequency range. Also used to overcome electronic jamming. Length is 150 ft (46 meters).	None published (see page 6-4 TM 11-5820-398-12, Nov 65).	Approximate weight: 12 oz.

Table C-7. Antenna Equipment—Continued

Equipment	Purpose and description	Reference manual	Remarks
AS-1729/VRC	10-ft center-fed whip antenna with automatic matching unit. Component of new family of vehicular-mounted FM radios. An improved version of the AT-912/VRC. Matching unit automatically adjusts electric length of antenna to selected operating frequency.	TM 11-5820-402-series	Replacement for AT-912A/VRC
AT-784/PRC	This is a homing loop antenna. It is used for the detection and location of radio signals in the 30- to 76-MHz range.	TM 11-5895-284-15	
Log-periodical antenna.	A special antenna designed for a specific frequency band to obtain a high quality radiation pattern and impedance characteristics which are essentially uniform throughout its entire operating band. Such an antenna can be constructed for omnidirectional use, or the antenna array can be designed to conform to a specific and preselected degree of directional angularity.	None	This type antenna is used with AN/GRC-163 when long range (50 km) operation is desired.
AB-903/G mast	Mast AB-903/G is a lightweight, telescopic, cable-driven mast which provides the means to raise such antennas as antenna AS-1729/VRC to 30 feet above ground level. The retracted height of the mast is 72 inches. The mast may be set up on the ground or may be mounted on vehicles. It may be raised to full height by hand cranking.	TM 11-5985-263-12	Consists of six concentric tubes sliding on low friction brushings. Mast is raised or lowered by a cable system operated by a gear-driven winch.

Table C-8. Communications Security Equipment

Equipment	Purpose and description	Remarks
TSEC/KL-7 (electro-mechanical literal cipher machine).	An off-line electromechanical, portable, keyboard operated, tape printing cipher machine which encrypts literal and digital text.	Requires 24 volts DC or 115/230 volts AC for operation.
TSEC/KW-7 (electronic tactical teletypewriter security equipment)	An on-line, electronic, portable, synchronous, half-duplex, teletypewriter security equipment used for securing tactical point-to-point or netted communications.	Requires 21-31 volts DC or 115/230 volts AC for operation.
KLX-7/TSEC (keyboard adapter)	A keyboard adapter which, together with the TSEC/HL-1, provides the KL-7 with an automatic encryption or decryption capability from punched teletypewriter tape.	No power required. Employed where requirement exists for handling large volumes of KL-7 encrypted traffic.
TSEC/HL-1 (electro-mechanical tape reader for literal cipher machine)	An electromechanical off-line tape reader converter which, together with the KLX-7, provides the KL-7 with an automatic encryption or decryption capability from punched teletypewriter tape.	Requires 115/230 volts AC for operation. Employed where the requirement exists for handling large volumes of KL-7 encrypted traffic.
TSEC/KY-8 speech security equipment	Used with FM radio equipment.	
TSEC/KY-28 speech security equipment	Used with FM radio equipment mounted in aircraft.	

TSEC/KY-38.. speech security equipment	Used with FM radio equipment in certain configurations.		
TSEC/KG-30 series	Used to encrypt and decrypt digital data signals over wire or HF radio.		TM 11-5810-271-12P used with Tacfire system.

Table C-9. Remote Control Devices

Equipment	Purpose and description	Distance limitation	Power requirement	Reference manual
Radio set control group AN/GRA-6	Can be used to perform the following functions: 1. Controlling and operating old FM sets from a distance. 2. Controlling AM SSB radio sets and voice portion of AM SSB radio teletypewriter equipment. 3. Two-way telephone communication between remote and local operators. 4. Local control of radio sets.	Approximately 3 km with WD-1/TT wire	4 BA-30, 1 BA-414/U	TM 11-5038
Radio set control group AN/GRA-39	A transistorized battery operated, remote control system providing duplex telephone operation and two-way signaling for the operation of the AN/VRC-12 and AN/PRC-25 series of FM radio sets from a remote location. Built-in loudspeaker and audio power amplifier.	Approximately 3 km with WD-1/TT wire	6 BA-30 for each unit	TM 11-5820-477-12
Radio set control group AN/GSA-7	A small, lightweight, electronic switching unit which can be used as follows: 1. Provides electronic switching for use in integrated radio/wire system. 2. Connects radios with local battery telephone equipment on a push-to-talk basis. 3. Interconnects two push-to-talk radio sets for automatic relay (two sets required). 4. Provides operator facilities for listening, signaling or talking to either or both ends of the circuit. Note. Cable CX-7474-U must be used to make the AN / GSA-7 compatible with the VRC-12 series of radios. This cable interconnects the 10-pin and 5-pin cable connectors.	Approximately 16 km, using WD-1/TT wire	24 VDC 115 or 230 VAC self-contained	TM 11-5135-15
Radio set control group OA-1754 GRC	Radio set control group OA-1754/GRC is designed to permit remote CW operation of the radio set AN/GRC-19 and remote CW and FSK (teletype) operation of the radio teletypewriter sets AN/GRC-46 and AN/VRC-29. This device is used in conjunction with control group AN/GRA-6. The OA-1754/GRC consists of a local unit and a remote unit.	1.6 km	Furnished by set to which this equipment is connected	TM 11-5820-389-12P, C-1
Oscillator, audio frequency, O-574/GRA	The oscillator, audio frequency O-574/GRA is a selfcontained 1600-Hz signal generator. It may be used in conjunction with the AN/GSA-7 to permit a radio set operator to signal a telephone that is connected to an unattended AN/GSA-7. When used with		4 BA-1312/U	TM 11-5135-15 C-3

Table C-9. Remote Control Devices—Continued

Equipment	Purpose and description	Distance limitation	Power requirement	Reference manual
	the new series radios, a cable CX-7474/U must be used which converts the 10-pin contacts on one end to 5-pins on the other end. Used for radio/wire integration.			
Radio control group AN/GRA-74	This equipment is comprised of a local unit, C-4846( )/GRA-74 and a remote unit, C-4847( )/GRA-74. This permits operation of the radio sets from a remote site of 1.6 km. The units provide a four wire communication link with transmit and receive facilities of SSB, CW and AM between the remote unit and the radio set. Used with AN/GRC-106, 108, 122, and 142, and AN/VSC 2 and 3.	1.6 km		Developmental item to replace the AN/GRA-6 now used with SSB radio sets.

Table C-10. Switchboards

Equipment	Number of lines accommodated	Type of operation	Power requirements	Major components	Reference manual	Remarks
AB-933/GT	6	Manual local battery	None	1 MT-2156/GT 7 U-184/GCT	TM 11-5805-294-15	Emergency switching center, uses visual signaling.
SB-22/PT and SB-22A/PT	12	A portable, local, battery, monocord switchboard, capable of connecting 12 local battery telephone circuits, remote controlled radio circuits, or voice frequency teletypewriter circuits. Uses magneto signaling.	4 BA-30	1 SB-22/PT 1 MX-230/PT (3 spare line packs) (MX-2915/PT for SB-22A)	TM 11-5805-262-12	SB-22A differs from SB-22 in contents of accessory kit. The kit for SB-22A (MX-2915/PT) contains 2 line packs, 1 trunk pack. By stacking 2 or 3 SB-22 switchboards, the number of circuits can be increased to 29 or 46, respectively.
SB-86/P	30, including 2 civilian trunks	A complete, transportable, single-position, nonmultiple, local battery tactical switching central capable of terminating 30 magneto or common battery signaling lines or trunks, two of which may be automatic one-way ring-down trunks to civilian exchanges. Can be used for voice frequency teletypewriter circuits. Includes a switchboard section, jack field switchboard signal assembly TA-207/P, and power supply PP-990/G.	4 BA-30, 10 BA-200/U	1 SB-248/P 1 TA-207/P 1 PP-990/G	TM 11-2134 TM 11-4134	Expansible to 60 lines with the addition of switchboard signal assembly TA-207/P. Cannot be used directly for radio/wire integration; for this purpose a switchboard, SB-22 is used in conjunction with the SB-86.

SB-223/GR (switchboard signal assembly)	12 microphone lines, 6 recorder channels, 4 telephone lines	Manual, no ringing on switchboard	BB-53 or other source of 12 VDC	SB-223/GR	TM 11-2149	Used by sound ranging platoon of target acquisition battery. Connects 2 soundbases to sound ranging set GR-8.
MX-155/GT telephone connecting and switching group	Total of 10 (1 circuit of 2, 1 circuit of 8)	Manual	None	1 jack panel SB-16/GT, 7 reel brackets, 7 jacks U-17/GT, 15 cords CX-231/GT	TM 11-2546	Provides conference telephone circuits among battery XO, assistant XO, and 6 howitzer or gun sections.

Table C-11. Radio Terminal Sets and Associated Equipment

Equipment	Purpose and description	Reference manual	Remarks
AN/TRC-80 radio terminal set	Mobile, air-transportable, tropospheric scatter radio terminal set: 1 transmitter: Amplifier-modulator group OA-3832/TRC-80 2 receivers: Radio receiver group OA-3831/TRC-80 1 Power Unit: (built-in) 120/208 VAC, 3-phase, 400-hertz, 10-kw Bogue 5380A1200 Frequency range, 4,400-5,000 MHz (SHF) FM voice & teletype Planning range: 160 km using diversity, 110 km using nondiversity. channels 50 KHZ spacing	TM 11-5820-469-series	Peculiar to field artillery Pershing battalion for internal communications. Uses inflatable parabolic antenna, 96 inches in diameter.
AN/TSA-15 telegraph-telephone switchboard group	Mobile switching facility capable of interconnecting 5 half-duplex, 2-wire voice frequency teletype circuits and 29 telephone circuits: 1 shelter S-141 on 2½-ton vehicle 3 SB-22 switchboards (stacked) 4 teletypewriters TT-4/TG 2 teletypewriters TT-76 GGC 1 generator set PU-619/M (2 units of 10 kw each) 6 telegraph terminals TH-5/TG 6 signal converters TA-182/U 1 patch panel Rack & cabling for 5 sets of on-line security equipment (5 TSEC KY-7's are used with but are not part of this equipment)	TM 11-5805-352-15 (1067)	Used at Pershing Battalion Headquarters Battery to terminate all AN/TRC 80B and area system voice frequency teletypewriter circuits.
AN TRC-24	Transportable, multichannel, VHF-UHF radio set used at division, corps, and army level to provide high quality, high capacity tactical communication. Intended to replace wire where quick installation is required. A basic unit in various configurations of terminal and repeater sets in radio relay systems. Frequency range is divided into 7 separate bands, ranging from 50 to 1875 MHz. Planning range is 48 km. Will eventually be replaced by AN GRC-50 (V).	TM 11-5830-287-series	Major components: 1 R-417/TRC-24 1 T-302/TRC-24
AN/GRC-50 (V)	Mobile UHF radio transmitting and receiving equipment for use with multichannel carrier telephone terminal apparatus such as terminal telephone AN/TCC-7; FM, covers 2 frequency bands: 600 to 1000 MHz and 1350 to 1850 MHz. Used with 4-, 12-,	TM 11-5820-461-series	Replaces AN/TRC-24 radio set in many applications of area system components.

Table C-11. Radio Terminal Sets and Associated Equipment—Continued

Equipment	Purpose and description	Reference manual	Remarks
	or 24- channel frequency division multiplex (FDM) or 12- or 24-channel time division multiplex (TDM) equipment (pulse code modulation) to provide telephone, teletypewriter, data, or facsimile circuits. Multiplex equipment used with this set will determine the number of channels. Planning range is 48 km. Consists of the following: Transmitter T-893(P)/GRC Receiver R-1148(P)/GRC Power supply PP-2054/GRC Power supply PP-2054/GRC Voltage regulator GN-514/GRC Power unit PU-294/G (consists of 2 PU-286/G, 5 kw)		
AN/MCC-6 telegraph-telephone terminal	Mobile telegraph terminal, 24 channels of carrier telephone or 22 carrier telephone and two 8-channel telegraph systems. (Other combinations of voice and teletype utilization are possible). Components: 1 shelter S-185/MCC-6 1 telephone terminal TCC-7 1 telephone terminal TCC-50 8 filters F-98/U 2 telegraph terminals TCC-4 1 telegraph terminal TH-5/TG 1 teletypewriter TT-4/TG 28 signal coverters TA-182/U 1 set trailer-mounted gas engine generator PU-474M (2 units of 10 kw each)	TM 11-5805-285-15	Used in division, corps, and army area communication systems.
AN/MGC-17 central office teletypewriter	Mobile central office, containing facilities for two full-duplex or half-duplex teletypewriter circuits including one secure circuit, and switching facilities for 12 subscriber lines. Two sets of on-line security equipment can be used. The components are as follows: 1 shelter S-169/MGC-17 1 switchboard SB-22A/PT 3 telegraph terminals TH-5/TG 6 signal converters TA-182/U 2 teletypewriters TT-4A/TG 2 teletypewriters TT-76B/GGC 1 trailer mounted gas engine generator set, PU-617M	TM 11-5815-205-15	Used in division area communication system. Used by HQ Btry of corps arty and Sergeant Bn. Used in each btry of Pershing bn. Security equipment is not part of this set.
AN/TSC-58 terminal telegraph	A mobile telegraph terminal, providing three full-duplex or six half-duplex secure voice frequency teletypewriter circuits or providing six nonsecure full-duplex or six non-secure half-duplex voice frequency teletypewriter circuits. Consists of the following: 1 shelter S-348/TSC-58 8 terminals telegraph, TH-22/TG 1 telephone TA-312 1 interphone set LS-147/FI 6 teletypewriters TT-76/GGC 6 teletypewriters TT-98/GF 1 switchboard SB-22/PT 2 air conditioners 9,000 BTU 1 generator set, gas engine PU-619M (2 each 10 kw units)	TM 11-5895-462-15 (when published)	Will replace the old telegraph terminal AN/MSC-29.
AN/MSC-29 terminal telegraph.	A mobile telegraph terminal providing 8 full-duplex or 12 half-duplex nonsecure voice frequency teletypewriter circuits or providing 2 full-duplex or 4 half-duplex secure circuits. Also provides switching facilities for 16 subscriber telegraph circuits.	TM 11-5895-205-12	Used in division, corps, and army area communication systems. Also used in FDC of corps arty. Security equipment is not part of

	Consists of: 1 shelter S-176/MSC-29 1 switchboard SB-22A/PT 8 signal converters TA-182/U 4 filters F-98/U mounting racks, & cabling for on-line security equipment 4 teletypewriters TT-4A/TG 8 teletypewriters TT-76B/GGC 12 telegraph terminals TH-5/TG 1 trailer-mounted gas engine generator PU-294 (2 PU-286, 5 kw each)		this set. Will be replaced by an improved model, AN/TSC-58.
AN/MRC-69 (V) radio terminal	Mobile radio relay terminal set operating in frequency band of AN/TRC-24 or AN/GRC-50. Provides two 12-channel radio relay terminals or one 12-channel radio relay terminal and one 12-channel land line carrier terminal. FM, line of sight, planning range 48 km. Components: 1 shelter S-141 or S-178/MRC-69 2 radio sets AN/TRC-24 or AN/GRC-50 (V) 2 telephone terminals TCC-7 24 signal converters TA-182/U 12 filters F-98/U 1 gasoline engine generator PU-474/G (two 10-kw sets mounted on trailer)	TM 11-5820-204-15	Provides trunking facilities in a division area communication system. Commercial power can be used. Frequency ranges are— *AN/TRC-24* A-band 50- 100 MHz B-band 100- 225 MHz C-band 225- 400 MHz D-band 400- 600 MHz F-band 790- 925 MHz J-band 1350-1875 MHz *AN/GRC-50* Low band 601.5-999.5 MHz High band 1350.5-1845.9 MHz
AN/MRC-115 (V) radio terminal set	The radio terminal set AN/MRC-115 (V) is an interim configuration of the low capacity subsystem of the army area communication system (AACOMS). It is an assemblage which provides a dual 6/12 channel terminal mounted on a ¼-ton trailer V-397( )/MRC-115. It can be used as a single terminal, double terminal, or a radio repeater as required. As a radio terminal, it is capable of terminating two 12-channel systems, and as a radio repeater, it is used in a single 12-channel system. The assemblage will be moved by a ¼-ton vehicle and powered by two 1.5-kw gasoline engine generators, mounted on a pallet, and carried in the ¼-ton vehicle. The major components of the terminal set are as follows: 2 radio sets AN/GRC-103 2 multiplexers TD-660/G 2 converters, signal, telephone CV-1548/G 1 trailer V-397( )/MRC-115 Radio set AN/GRC-103 is a VHF/UHF radio set which is capable of operating with its associated PCM multiplex unit to provide 6/12 voice channels over one relay. The AN/GRC-103 consists of receiver R-1329, transmitter T-983, order wire RT-773, mast AB-952, and antenna AS-1852. Frequency range is 220 to 1000 MHz in three bands (total of 2160 channels). Planning range is 32-48 km.	TM 11-5895-585-15	This terminal set is intended for use by forward area units at division level down to bde and in the field army air defense artillery units. Lightweight and small size make this system uniquely suitable for air-transportable units. Weight of assemblage in trailer is 1,830 lb. Weight of power unit (2 generators) is 280 lb. The letter "(V)" indicates that variations of the radio equipment components are available to the user.
AN/MRC-68 (V) radio terminal set	Mobile radio terminal set installed in a S-144/G shelter which is mounted on a ¾-ton vehicle. Provides one 4-channel radio relay or two 4-channel radio terminals or provides two 4-channel radio-telephone carrier terminals or two 4-channel carrier terminals. Components: 3 AN/GRC-10 radio sets (2 in use, 1 spare) 2 terminals AN/TCC-3 9 signal converters TA-182 U 1 PU 322 G (2 each PE 75)	TM 11-5820-505-15	For use in army mobile communication systems. This system is capable of being airborne. 54.0 to 70.9 MHz, 170 channels, 100 kHz spacing.

Table C-11. Radio Terminal Sets and Associated Equipment—Continued

Equipment	Purpose and description	Reference manual	Remarks
AN/MRC-54 (V) radio repeater set	Mobile VHF-UHF radio relay repeater set, operating in the frequency range of the AN/TRC-24 or AN GRC-60 (V). Can be used in conjunction with AN MCC 6 as terminal set. Planning range is 48 km. Components: 1 shelter S-177 MRC-54 (V) 3 radio sets AN/GRC-50 (V) or AN TRC-24 (1 spare) 1 set trailer mounted gasoline engine generator PU-474 G (two 10-kw sets)	TM 11-5820-203-15	Used in division, corps and army area systems.
AN/MRC-73 (V) radio terminal set	An air- or vehicular-transportable radio terminal set, VHF-UHF, that can provide 12 channels of carrier telephone or 11 channels of carrier telephone and 4 channels of carrier telegraph over spiral-4 cable or radio. Uses AN TRC-24 or AN GRC-50 radio set. Planning range is 48 km. Components: 1 shelter S-181 MRC-73 1 radio set AN TRC-24 or AN GRC-50 (V) 1 telephone terminal TCC-7 1 telephone terminal TCC-20 1 telegraph terminal TH-5 TG 1 teletypewriter TT-4A TG 12 signal converters TA-182 U 1 gasoline engine generator PU-474 G (two 10-kw sets)	TM 11-5895-221-15	Used in corps and army radio-relay communication.
AN/GRC-103 (V) 1	Radio set AN/GRC-103 (V) 1 is a transportable radio relay set that provides facilities for multichannel radio transmission and reception of pulse-code modulation signals. The radio set operates in the frequency range of 220 to 404.5 MHz in any one of 370 radio frequency channels selectable in 0.5-MHz increments. The radio set will accommodate up to 24 telephone channels when used with the appropriate PCM multiplex equipment. Planning range is 80 km. Components: 1 transmitter, radio T-983(P)/GRC-103(V), with amplifier-frequency multiplier AM-4320. 1 receiver, radio R-1329(P)/GRC-103(V), with amplifier-converter AM-4316 1 antenna AS-1852/GRC-103(V) 1 receiver-transmitter, order wire, RT-773/GRC-103(V) Power requirements: 115 volts AC, single phase, 47 Hz to 420 Hz	TM 11-5820-540-12	Forward area radio-relay equipment. Can also operate in frequency bands 395 to 705 and 695 to 1000 MHz.
AN/MRC-102 radio terminal set.	The AN/MRC-102 is a radio carrier assemblage used to provide radio relay, carrier telephone, and carrier telegraph facilities in an area type communication system. It has the same capabilities as, and may be used in place of the AN/MRC-73. The major components are— 1 shelter, elec equipment S-306/MRC-102 (modified S-141/G) 2 radio sets AN/GRC-50 1 terminal, telephone AN/TCC-7 1 terminal telegraph AN/TCC-20 12 converters, tg-tel signal, TA-182/U 1 telephone set TA-312/PT 1 teletypewriter TT-4A/TG 1 terminal, telegraph TH-5/TG 1 intercom set LS-147/FL	TM 11-5895-357-14	Mounted on truck cargo 2½-ton, M35 or M211. Requires 5452 watts, furnished by trailer-mounted gas engine generator set PU-474M. Used by the command artillery radio relay company of the corps sig bn in support of corps artillery.

AN/MRC-103 radio repeater set.	The AN/MRC-103 as a radio repeater provides retransmission facilities for 12 channels of radio-telephone communication when used with radio terminal set AN/MRC-102, terminal telegraph-telephone AN/MCC-6 and terminal telephone AN/TCC-7. It has the same capabilities as, and may be used in place of the AN/MRC-54. The major components are as follows: 1 shelter, elec equipment S-307/MRC-103 (modified S-141/G) 3 radio sets, AN/GRC-50 3 antenna sets for AN/GRA-50 1 telephone set TA-312/PT 1 intercom set LS-147/FL	TM 11-5820-539-14	Mounted on truck cargo 2½-ton, M35 or M211. Requires 5340 watts, furnished by trailer-mounted gasoline engine generator set PU-474M. Used by the command artillery radio relay co of the corps sig bn in support of corps artillery.

Table C-12. Teletypewriter Equipment

Equipment	Purpose and description	Reference manual	Remarks
TT-4( )/TG teletypewriter.	This teletypewriter is used to transmit teletypewriter messages in the form of direct current teletypewriter signals and to convert received dirct current signals into messages, printed on a roll of recording paper (one-, two-, or three-ply).	TM 11-5815-206-12	Used in tactical military communication systems.
AN/PGC-1	The AN/PGC-1 is a lightweight transportable unit. It consists of teletypewriter TT-4( )/TG, connecting cables, and a bag of spare parts.	TM 11-5815-206-12	Same as TT-4 ( )/TG. In a typical voice frequency system, telegraph terminal TH-5/TG or TH-22/TG must be used at both ends.
TT-335/TG	This teletypewriter is the same as the TT-4( )/TG except that in the TT-4( )/TG, 105 or 125 volts DC or AC (50-60 hertz) single-phase is required, whereas the TT-335/TG is powered for 108 to 132 volts, 396 to 404 hertz, single-phase.	TM 11-5815-206-12	Used in each AN/TRC-80B terminal set.
TT-537/G	In a typical FADAC system, low voltage signals from the computer are applied to the receive circuits of the teletypewriter TT-537/G where they are amplified to the level required to operate the selector magnet in the teletypewriter receive mechanism. The motor of this teletypewriter is designed for operation with 108 to 132 volts, 396 to 404 hertz alternating current.	TM 11-5815-206-12 (C-8)	Used as a printout in conjunction with FADAC. Replacement for teletypewriter TGC-14 now shown on some TOE's.
AN/UGC-4 teletypewriter.	Page printing, sending and receiving machine. Operates from 110 volts AC, single phase, 60 hertz. The AN/UGC-4 consists of teletypewriter TT-98( )/FG and power supply PP-978/FG.	TM 11-5815-200-10	Used in tactical radio teletypewriters (also part of AN/GRC-26 radio set).
TT-76/GGC reperforator-transmitter.	The TT-76/GGC is a lightweight transportable teletypewriter that may be used to send and receive over direct current wire lines, carrier, or radio systems in association with telegraph terminal TH-5/TG or TH-22/TG. Messages are printed and perforated on a paper tape. It provides facilities for manual transmission direct from keyboard and for tape transmission from the transmitter-distributor. Operates on 115 or 230 volts AC.	TM 11-5815-238-12	Used in fixed or tactical military teletypewriter stations.
AN/GGC-3	The AN/GGC-3 consists of a reperforator-transmitter TT-76( )/GGC, a table FN-52/GGC, and a case CY-1100/GGC.	TM 11-5815-238-12	Used in fixed or tactical military teletypewriter stations.

Table C-12. Teletypewriter Equipment—Continued

Equipment	Purpose and description	Reference manual	Remarks
AN/TCC-14 telegraph-telephone terminal.	Consists of three separate components, the combination of which permits simultaneous transmission of telegraph pulses and speech over a voice frequency circuit. The three components, which can be used separately for various applications are as follows: *Telegraph terminal TH-5/TG* Modulates DC teletype pulses to 1225- and 1325-Hz frequencies and back to DC pulses at the other end of the circuit. It provides only one-way reversible operation. *Telegraph-telephone signal converter TA-182/U* Modulates 20-Hz ringing signals either to 1225 Hz for teletype signaling or to 1600 Hz for telephone circuits. The unit at the far end of the circuit reverses this process. *Filter assembly F-98/U* The band-pass and band-stop sections of the filter separate the teletypewriter and telephone conversation. This permits simultaneous transmission of teletype and telephone messages over the same pair of wires without mutual interference.	TM 11-5805-254-15 11-5805-247-10 11-5805-246-10	The AN/TCC-14 can be used in point-to-point, network, switched, or remote control radio system. Will be replaced by the fully transistorized AN/TCC-29. The components of both systems are fully compatible.
AN/TCC-29 telegraph-telephone terminal.	The AN/TCC-29 serves the same purpose as the AN/TCC-14 described above. Its components are as follows: Telegraph terminal TH-22/TG Telegraph-telephone signal converter CV-425/U Filter assembly F-316/U	TM 11-5805-356-12	Transistorized version of the AN/TCC-14. Will replace the AN/TCC-14 and its 3 components. Components of old and new systems are interchangeable and fully compatible.

Table C-13. Power Units

Equipment	Power output	Mounting	Weight (lb)	Remarks
PU-26A	10-kw 120/240 VAC, 60-Hz 3-phase	skid	1,250	
PU-286( )/G	5-kw, 120 VAC, 60-Hz, single-phase phase	skid	769	
PU-290/MR	10-kw, 120 VAC, 60-Hz, single-phase	1½-ton trailer	4,000	One 10-kw generator set mounted in a 1½-ton cargo trailer.
PU-294	5-kw, 120 VAC, 60-Hz, single-phase	1½-ton trailer	4,400	Two power units PU-286( )/G mounted in a 1½-ton cargo trailer. Load can be shifted from one PU-286 to the other without interruption.
PU-378	10-kw, 120/240 VAC, 60-Hz, 3-phase	1½-ton trailer	3,650	Two power units PU-26A mounted in a 1½-ton cargo trailer.
PU-407/M	45-kw, 120/240 VAC, 50-60 Hz, 1- or 3-phase.	2½-ton trailer	7,500	One 45-kw power unit mounted on chassis trailer, 2½-ton M200A1 (diesel).
PU-408/M	45-kw, 120/240 VAC, 50-60 Hz, 1- or 3-phase.	Truck, cargo, 5-ton	27,560	One generator set PU-407 (diesel) mounted on a 5-ton cargo truck M54.

PU-409	5-kw, 120 VAC, 60-Hz, single-phase	¾-ton trailer	2,065	One power unit PU-286( )/G mounted in a ¾-ton trailer.
PU-450/G	3-kw, 120/240/208 VAC, 400-Hz, 1- or 3-phase.	skid	215	Provides power for communication or radar equipment.
PU-456	5-kw, 120 VAC, 60-Hz, single phase	¾-ton trailer	2,800	Two power units PU-286( )/G mounted in a ¾-ton cargo trailer.
PU-474	10-kw, 120/240 VAC, 60-Hz, 1- or 3-phase	1½-ton trailer	8,770	Two 10-kw power units mounted in a 1½-ton trailer.
PU-332A/G	1-10 kw unit	¾-ton trailer	3,400	Used with AN/TRC-112.
PU-405	1-15 kw unit	2½-ton trailer	5,465	Used with AN/TRC-121.
PU-618/M	2-5 kw units	1½-ton trailer	4,600	Used with AN/TRC-110, AN/TRC-117.
PU-619/M	2-10 kw units	1½-ton trailer	6,160	Used with AN/MGC-19A (operations central teletypewriter). AN/TRC-133A and AN/TSA-15
PU-623/VRC-59	2-1½ kw units and ancillary items for VRC-59.	¼-ton M416 trailer	1,825	Used with AN/VRC-59.
PU-625/G	2-3 kw units	¾-ton trailer	2,900	Used with AN/TRC-113, AN/TRC-145.
PU-626( )/G	2-3 kw units and ancillary units	¾-ton trailer	2,900	Used with AN/TRC-108, AN/TRC-109, AN/TRC-143.
PU-628( )/G	2-3 kw units	¾-ton trailer	2,900	Used with AN/MTC-7A (central office, telephone, manual).
PU-629( )/G	2-5 kw units	1½-ton trailer	5,000	Used with telephone terminal AN/TCC-61, AN/TCC-62, AN/TCC-63.
PU-631( )/G	2-5 kw units	1½-ton trailer	5,500	Used with AN/TRC-111, AN/TRC-138, AN/TRC-139, AN/TRC-140.

Note. The following are additional power units for new army area communications system.

PV-620	2-5 KW units	¾- on trailer	2,620	Used with AN / GRC-142 without airconditioner.
PV-677 / M	2-10 KW units	1½-ton trailer	6,000	Used with AN / GRC-142 with airconditioner.
PV-617 / M	2-3 KW units	¾-ton trailer	2,175	Used with AN / MGC-17

Table C-14. Reeling Equipment

Equipment	Purpose and description	Reference manual	Remarks
RL-27-B-C, or D axle, cable reel.	An 8-pound machined-steel bar, 2½ feet long with 2 knurled handles. It is used to recover and lay short wire circuits by hand.	TM 11-3895-201-13P	
RL-31( ) reeling machine, cable, hand.	A rugged, lightweight portable unit for laying and recovering telephone cable, using cable reel RL-159 (1-mile capacity).	TM 11-362	Can be mounted in a vehicle or hand-carried.

Table C-14. Reeling Equipment—Continued

Equipment	Purpose and description	Referencemanual	Remarks
RL-39 reeling machine, cable, hand.	Reeling machine, cable, hand, RL-39, is used with cable reel DR-8 (¼-mile capacity).		
RL-172/G reeling machine, cable, motor driven.	RL-172/G is a transportable wire-laying and recovering machine that can be mounted on a motor vehicle. The reeling machine is normally mounted vertically on the tailgate of a truck. May also be operated horizontally from the bed of a truck.	TM 11-3895-207-10	Vehicle battery provides the power to operate the 24-volt direct current motor of the machine. Also has handle for manual operation.
RL-207/G reeling machine cable, engine driven.	RL-207/G is a two-cylinder gasoline engine driven reel unit mounted in a ¾-ton truck or larger vehicle to pay out or recover telephone cable or spiral-4 cable.	TM 11-3895-209-12	The machine has 2 axles; each axle will accommodate 2 RL-159, 1 DR-5, or 1 DR-15 reel.

Table C-15. Basic Items of Test Equipment

Equipment	Purpose and description	Reference manual	Remarks
AN/GRM-55 test set, electronic circuit plug-in unit	The radio test set is a compact, lightweight, waterproof instrument designed to make tests at all available test points of receiver-transmitter RT-505/PRC-25 and to isolate a failure to a particular module. The AN/GRM-55 is issued for use by radio mechanics.	TM 11-6625-514-12	Cannot be used with AN/PRC-77 (RT-841).
ME-26( )/U multimeter	Multimeter ME-26( )/U is an electron tube instrument (voltmeter-ohmmeter) that is used to measure direct current voltage, resistance, and alternating current voltage at frequencies from 20 Hz to 700 MHz. When used as a voltmeter, the high input impedance of the multimeter permits measurements to be made without affecting either the voltage being tested or the operation of the equipment under test.	TM 11-6625-200-12	The voltage ranges are—7 scales for DC voltage from 0 to 100 volts, 6 scales for AC voltage from 0 to 300 volts. The resistance range is from 0 to 500 megohms.
TS-352( )/U multimeter	The TS-352( )/U is a volt-ohm milliammeter that uses self-contained batteries (3 BA-31 and 1 BA-30). It measures alternating current voltages (0 to 1000) and direct current voltages (0 to 5000) and measures resistance from 0 to 10,000,000 ohms. It also measures direct current in microamperes and milliamperes to a maximum current of 10 amperes.	TM 11-6625-366-15	Multiplier kit MX-815( )/U is part of the TS-352 and extends the range of the instrument to allow measurement of the higher DC voltages.
TV-7( )/U test set electron tube	Test set, electron tube TV-7( )/U is a portable tube tester of the dynamic mutual conductance type. It is used to test and to measure performance capabilities and to determine rejection limits for electron tubes used in receivers, low-powered transmitters, and much other electronic equipment.	TM 11-6625-274-12	Tubes can be tested for continuity, dynamic mutual conductance, emission, gas, noise, and shorts.
AN/VRM-1 test set, radio	Test set AN/VRM-1 is a portable equipment for testing the plug-in modules of receiver-transmitters RT-246/VRC and RT-524/VRC and the receiver R-442. This instrument is used by organizational maintenance personnel responsible for maintaining the components of radio set AN/VRC-12 and radio sets AN/VRC-43 and through 49.	TM 11-6625-496-12	This test equipment is designed to operate on a simple GO and NO GO basis—a green light indicates a serviceable module; a red light, a defective module.

AN/URM-105 multimeter	Multimeter AN/URM-105 consists of multimeter ME-77/U and 4 test clips. It requires 2 BA-58/U; and 2 BA-261/U for proper operation. The instrument measures direct current and alternating current voltage from 0 to 1000 volts and resistance from 0 to 20,000,000 ohms.	TM 11-6625-203-12	Meter can be used for making other measurements, provided external shunts are used: MX-1471/U for current measurements up to 10 amp, MX-1472/U for voltage measurements up to 10,000 volts, MX-2005/U for voltage measurements up to 50,000 volts.

Table C-16. Major Components for New Army Communication System (AACOMS)

Equipment	Purpose and description	Remarks
AN/TRC-108 radio terminal set.	Radio terminal set AN/TRC-108 is an air- or vehicular-transportable radio carrier assemblage used to provide terminal telephone multiplexing facilities 12-channel pulse-code modulation for use by airborne corps and corps artillery communications systems. (¾-ton vehicle).	Uses 2 radio sets AN/GRC-50(V) 1 and power unit PU-626( )/G. (TM 11-5820-537-15).
AN/TRC-109 radio repeater set.	Radio repeater set AN/TRC-109 is an air- or vehicular-transportable assemblage used to provide radio and cable communications facilities for use by airborne corps communications systems. The assemblage may be used in 12- or 24-channel pulse-code modulation systems as a cable repeater, a radio repeater, or a radio terminal or in special applications. The AN/TRC-109 can be used with other equipments, such as telephone terminal AN/TCC-60. (¾-ton vehicle).	Uses radio set AN/GRC-50(V) 2 and power unit PU-626( )/G. (TM 11-5820-536-14).
AN/TRC-110 radio repeater set.	Radio repeater set is an air- or vehicular-transportable assemblage used to provide radio and cable communications facilities for corps and army command systems. The assemblage may be used in 12-or 24-channel pulse-code modulation systems as a radio repeater, a radio terminal, or a cable repeater. (2½-ton vehicle, 6 x 6 LWB).	Uses radio set AN/GRC-50(V) 4 and power unit PU-618M. (TM 11-5820-535-14).
AN/TRC-111 radio repeater set.	The AN/TRC-111 is a 48-96 channel radio repeater or a triple 48/96 channel radio terminal assemblage. Sufficient auxiliary equipment is provided for a high capacity radio relay or radio terminal facility. (2½-ton truck, 6 x 6 LWB).	Uses radio set AN/GRC-147 (which consists of 1½ AN/GRV-68 radio sets having a total of 3 transmitters and 3 receivers and power unit PU-631( )/G. (TM 11-5820-546-15).
AN/TRC-112 radio terminal set.	The AN/TRC-112 is an extended-range radio terminal. It can transmit 24 PCM voice channels for distances ranging up to 160 kilometers and single-channel voice plus teletypewriter up to 320 kilometers. It also provides 1-kw RF output, dual space and angle diversity, low noise receivers, and two 10-feet quick erection antennas carried in a separate 1¼-ton M705 vehicle. Operates in the troposcatter mode. (2 trucks, cargo 1¼-ton).	Uses radio sets AN/GRC-143 and AN/GRC-106 (for alinement of tropo) and power unit PU-332A/G. (TM 11-5820-556-15).

Table C-16. Major Components for New Army Communication System (AACOMS)—Continued

Equipment	Purpose and description	Remarks
AN/TRC-113 radio repeater set.	The AN/TRC-113 is a radio relay repeater to extend the range of a radio circuit employing two radio sets AN/GRC-103. It also contains one extra, or spare, radio set AN/GRC-103. It may also be used as a radio terminal to provide three radio circuits. A 6/12 channel radio repeater. (1 truck, cargo 1¼-ton).	Uses three radio sets AN/GRC-103 power unit PU-625/G. (TM 11-5820-562-15).
AN/TRC-117 radio terminal set	Radio terminal set AN/TRC-117 is an air- or vehicular-transportable assemblage used to provide dual 12- or 24-channel pulse code modulation for use by army and corps command systems. (1 truck, cargo, 2½-ton, 6 X 6 LWB).	Uses radio set AN/GRC-50(V) 2 and power unit PU-618/M. (TM 11-5895-366-14).
AN/TRC-121 radio terminal set	Radio terminal set AN/TRC-121 is a dual extended-range radio terminal. It is capable of terminating two 24-channel PCM voice systems for distances ranging up to 192 kilometers. It also provides 1-kw RF output, dual space diversity, low noise receivers, and two 10-ft antenna systems, carried in a separate 2½-ton M35 vehicle. For a complete terminal, telephone terminals AN/TCC-60 or AN/TCC-61 must be used with this set. Uses tropospheric scatter mode. (2 trucks, cargo, 2½-ton, 6 X 6 LWB).	Uses two radio sets AN/GRC-143 and 1 AN/GRC-106 (for alinement of tropo) and power unit PU-405. (TM 11-5820-602-15).
AN/TRC-138 radio repeater set	The AN/TRC-138 is a 48/96 channel radio repeater or a triple 48/96 channel radio terminal assemblage. Sufficient ancillary equipment is provided for a high capacity radio relay or radio terminal facility. (1 truck, cargo, 2½-ton, 6 X 6 LWB).	Uses three radio sets AN/GRC-144 and power unit PU-631( )/G.
AN/TRC-139 radio terminal set	The radio terminal set AN/TRC-139 is a 48/96 channel combined radio and multiplex telephone terminal. It is intended for use in the area system where a requirement exists for 48 channel lateral trunks. (1 truck, cargo, 2½-ton, 6 X 6 LWB).	Uses three radio sets AN/GRC-144 and power unit PU-631( )/G.
AN/TRC-140 radio terminal set	The radio terminal set AN/TRC-140 is a dual 48-channel combined radio and multiplex telephone terminal. It is intended for use in an area system to provide 48-channel trunking in two directions or 96-channel trunking in one direction. With backup radio. (1 truck, cargo, 2½-ton, 6 X 6 LWB).	Uses two radio sets AN/GRC-144 and power unit PU-631( )/G.
AN/TRC-143 radio terminal set	Radio terminal set AN/TRC-143 is an air- or vehicular-transportable radio carrier assemblage used to provide terminal telephone multiplexing facilities 12-channel pulse code modulation for use by airborne corps and corps artillery communications sytems. (1 truck, cargo, 1¼-ton).	Uses radio set AN/GRC-50(V) 1 and power unit PU-626( )/G.
AN/TRC-145 radio terminal set.	The AN/TRC-145 is a dual 6/12 channel combined radio/multiplex terminal assemblage. Sufficient ancillary equipment is provided for a complete low capacity dual radio/multiplex terminal. (1 truck, cargo, 1¼-ton).	Uses two radio sets AN/GRC-103 and power unit PU-625/G.

AN/GRC-68 radio relay repeater set.	The AN/GRC-68 is a radio relay repeater set, consisting of two basic radio sets AN/GRC-66 for a dual terminal repeater for 12/24 or 48/96 channels by appropriate pulse-code modulation multiplexers. Includes two masts AB-621, two 4½-ft diameter antennas and two 65-ft transmission lines. Operating frequency range is 4400-5000 MHz; planning range is 48 km (line of sight).	Uses receiver R-878 and transmitter T-681.
AN/GRC-103 radio relay set	The AN/GRC-103 is a forward area radio relay set intended to replace the AN/GRC-10, AN/TRC-27, and AN/TRC-24 in the forward areas. A complete 12-channel terminal, capable of being mounted in a ¼-ton, or two complete 12-channel terminals mounted in a ¾-ton shelter. Frequency range is 220 to 1000 MHz in 3 bands. Planning range is 32 km (line of sight).	Provides 1576 RF channels with 500 kHz channel spacing.
AN/GRC-143 radio relay set.	Radio set AN/GRC-143 is a compact, lightweight, 1-kilowatt tropospheric scatter radio relay set. It is used in conjunction with the pulse-code modulation multiplexer family of components to transmit up to 24 voice channels at ranges of 160 kilometers. Multihop systems may be established between two terminals. Operates in the 4400- to 5000-MHz frequency range. Used in extended range radio relay systems for the field army to provide long-haul point-to-point circuits.	Provides 600 RF channels. Is used by AN/TRC-112, AN/TRC-120, and AN/TRC-121.
AN/GRC-144 radio set.	Radio set AN/GRC-144 is a super high frequency (SHF), completely solid state radio which is intended for use in the high-traffic army area communications system (AACOMS). It provides, in conjunction with the 48- and 96-channel pulse-code modulation multiplex equipment, multichannel voice communication. This SHF set is an outgrowth of the tropo system, radio set AN/GRC-143. Frequency range is 4400-5000 MHz; planning range is 48 kilometers.	Main components are receiver R-1287, transmitter T-961, and mast AB-621.
AN/GRC-147 radio set.	The AN/GRC-147 provides for multichannel, line-of-sight, two-way radio communication in the super high frequency range of 4.4 to 5 GHz (1000 MHz = 1 GHz). It can handle up to 96 channels of data, using pulse-code modulation techniques, or up to 12 channels, using high frequency division multiplexing (FDM) techniques. An order wire channel is also provided in addition for service communication. Consists of three complete transmitters (T-1024/GRC) including wire, three complete receivers (R-878/GRC), and three antenna systems. This set is intended primarily for use as a radio relay station between two radio terminals of a communication network. The third receiver and transmitter are maintained in an operational standby condition and can be switched into the system on demand in the event of equipment failure to prevent interruption of service.	Used in AN/TRC-111 system. TM 11-5820-568-12. One complete receiving and transmitting system is maintained on a standby status when the set is used as a radio relay station.

APPENDIX D

JOINT COMMUNICATIONS-ELECTRONICS TYPE DESIGNATION SYSTEMS

D-1. Description of System and Use of Term Hertz

a. All Army, Navy, Air Force, and Marine Corps communication-electronics equipment may be identified by the nomenclature system described in figure D-1. The letters "AN" appearing as the first two letters of the nomenclature are the system indicator and mean that the joint system was used in arriving at the term and that the item is a complete end item. The letters which follow the system indicator describe the installation, the type of equipment, and the purpose of the equipment. The numbers which follow the letters indicate the model number of the equipment.

b. The National Bureau of Standards has officially adopted the term "hertz (HZ)" for cycles per second. The chart below provides the equivalents of the unit/quantity terms and the list of approved abbreviations that will be used in technical manuals and other publications, (TM 11-5985-326-20).

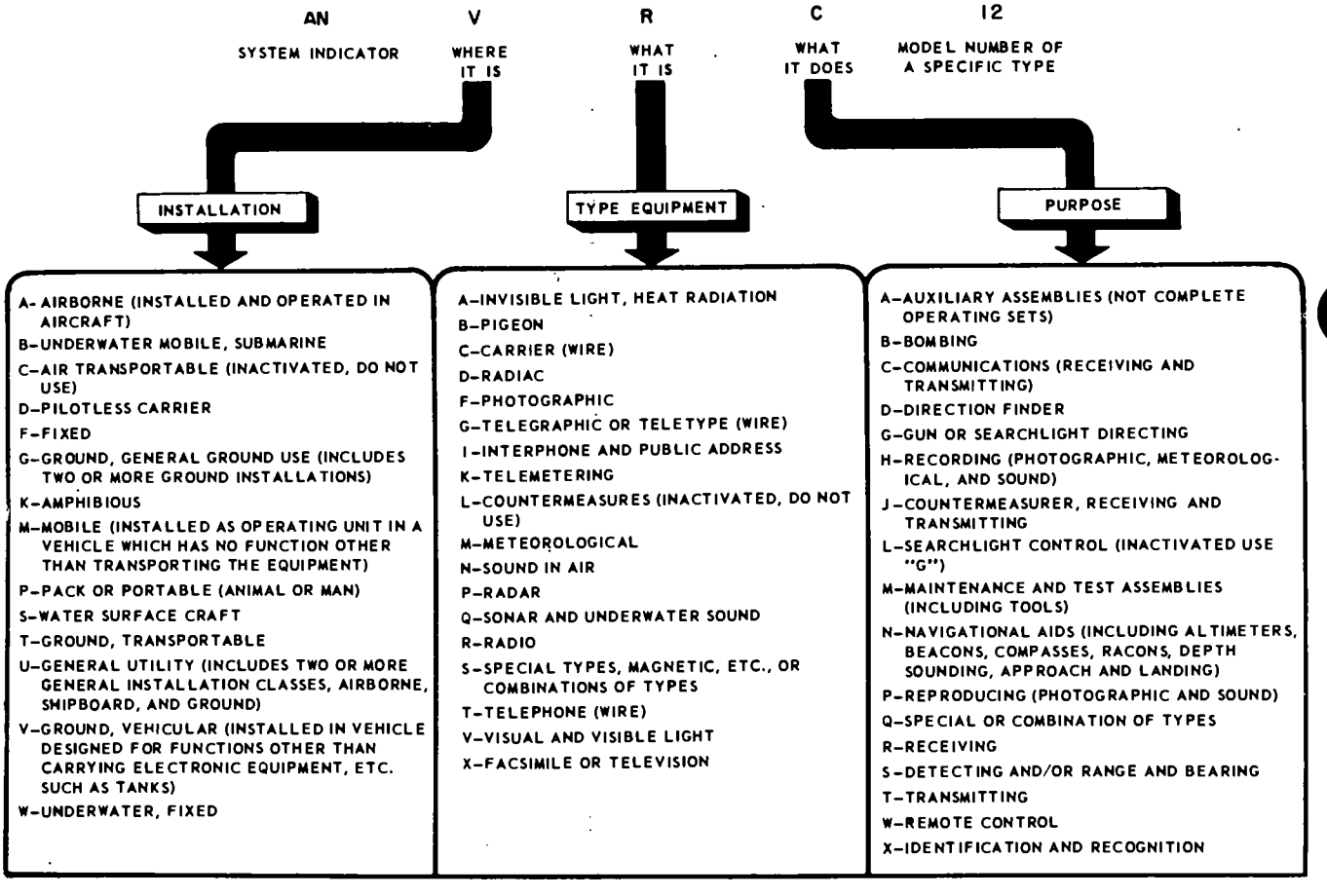


Figure D-1. Joint Communications-Electronics Type Designation System.

Unit quanity	Old term	Old abbreviation	New term	New abbreviation
Frequency	Cycles per second	cps	hertz	Hz
10^3 cycles per second	Kilocycles per second	kc	kilohertz	kHz
10^6 cycles per second	Megacycles per second	Mc	Megahertz	MHz
10^9 cycles per second	Gigacycles per second	Gc	gigahertz	GHz

D-2. Component Indicators and Types of Emission

a. Table of Component Indicators.

Component indicator	*Family name*	*Example*
		(Not be construed as limiting the application of the component indicator to these items.)
AB	Support, antenna	Antenna mounts, mast bases, mast sections, towers, etc.
AM	Amplifier	Power, audio, interphone, radio-frequency, video servo (nonrotating), etc.
AS	Antenna assembly	Complex: arrays, parabolic type, masthead, etc.
AT	Antenna	Simple: whip or telescopic loop, dipole, reflector: also transducer, etc. (see H.)
BA	Battery, primary type	B-Batteries, battery packs, etc.
BB	Battery, secondary type	Storage batteries, battery packs, etc.
BZ	Signal device, audible	Buzzers, gongs, horns, etc.
C	Control article	Control box, remote tuning control, etc.
CA	Commutator assembly sonar	Peculiar to sonar equipment.
CB	Capacitor bank	Used as a power supply.
CG	Cable and transmission line. RF	RF cables, waveguides, etc. with terminals.
CK	Crystal Kit	A kit of crystals with holders.
CM	Comparator	Analyzes or compares two or more input signals.
CN	Compensator	Electrical or mechanical compensating, regulating, or attenuating apparatus.
CP	Computer	A mechnaical or electronic mathematical calculating device.
CR	Crystal	Crystal in crystal holder.
CU	Coupling device	Impedance coupling devices, directional couplers, etc.
CV	Converter (electrical	Electronic apparatus for changing the phase, frequency, or amplitude of the signal from one medium to another.
CW	Cover	Cover, bag, roll, cap, radome, nacelle, etc.
CX	Cord	Cord with terminals; also composite cables of RF and non-RF conductors.
CY	Case	Rigid and semirigid structure for housing or carrying equipment.
DA	Antenna, dummy	RF test loads.
DT	Detecting head	Magnetic pickup device, search coil, hydrophone, etc.
DY	Dynamotor	Dynamotor power supply.
E	Hoist assembly	Sonar hoist assembly, etc.
F	Filter	Band-Pass, noise, telephone, wave traps, etc.
FN	Furniture	Chairs, desks, tables, etc.
FR	Frequency-measuring device	Frequency meters, echo boxes, etc.
G	Generator	Electrical power generators without prime movers (See PU and PD.)
GO	Gonimeter	Goniometers of all types.
GP	Ground rod	Ground rods, stakes, etc.
H	Head, hand, and chest sets	Include earphone.
HC	Crystal holder	Crystal holder less crystal.
HD	Air-conditioning apparatus	Heating, cooling, dehumidifying, pressure, vacuum devices, etc.
ID	Indicating device	Calibrated dials and meters, indicating lights, etc. (See IP).
IL	Insulator	Strain, standoff, feedthrough, etc.
IM	Intensity-measuring device	Includes standing wave ratio (SWR), gear, field intensity and noise meters, etc.
IP	Indicator, cathode-ray tube	Azimuth, elevation, plan position indicator (PPI), panaromic, etc.
J	Junction device	Junction, jack, and terminal boxes; connector panels, etc.
KY	Keying device	Mechanical, electrical, and electronic keyers, coders, interrupters, etc.
LC	Tool, line construction	Includes special apparatus such as cable plows.
LS	Loudspeaker	Separately housed loudspeakers.
M	Microphone	Radio, telephone, throat, hand, etc.
MD	Modulator	Device for varying amplitude, frequency, or phase.
ME	Meter, portable	Multimeters, volt-ohm-milliameters, vacuum tube voltmeters, power meters, etc.
MK	Maintenance kit or equipment	Radio, telephone, general utility, etc.
ME	Meteorological device	Barometer, hygrometer, thermometer, scales, etc.
MT	Mounting	Mountings, racks, frames, stands, etc.
MX	Miscellaneous	Equipment not otherwise classified. (Do not use if better indicator is available).

Component indicator	*Family name*	*Example*
O	Oscillator	Master frequency, blocking, multivibrators, etc. (For test oscillators, see SG.)
OA	Operating assembly	Assembly of operating units not otherwise covered.
OC	Oceanographic device	Bathythermographs, etc.
OS	Oscilloscope, test	Test oscilloscopes for general test purposes.
PD	Prime driver	Gasoline engines, electric motors, diesel motors, etc.
PF	Fitting, pole	Cable hanger, clamp, protectors, etc.
PG	Pigeon article	Container, loft, vest, etc.
PP	Power supply	Nonrotating machine-type, such as vibrator pack, rectifier, thermoelectric.
PT	Plotting equipment	Except meteorological. Boards, maps, plotting table, etc.
PU	Power equipment	Rotating power equipment (except dynamotors), motor-generator, *etc.*
R	Receiver	All types of receiver except telephone.
RD	Recorder and reproducer	Tape, facsimile, disk, magnetic, etc.
RE	Relay assembly	Electrical, electronic, etc.
RF	Radio-frequency component	Composite component of RF circuits. (Do not use if better indicator is available.)
RG	Cable and transmission line, bulk RF	RF cable, waveguides, etc., without terminals.
RL	Reel assembly	Antenna, field wire, etc.
RP	Rope and Twine	Nonelectrical cord, etc.
RR	Reflector	Target, confusion, etc., except antenna reflectors. (See AT.)
RT	Receiver and transmitter	Radio and radar transceivers, composite transmitter and receiver, etc.
S	Shelter	House, tent, protective shelter, etc.
SA	Switching device	Manual, impact, motor driven, pressure-operated, etc.
SB	Switchboard	Telephone, fire, control, power, panel, etc.
SG	Generator, signal	Includes test oscillators and noise generators, (see O).
SM	Simulator	Flight, aircraft, target, signal, etc.
SN	Synchronizer	Equipment to coordinate two or more functions.
ST	Strap	Harness, straps, etc.
T	Transmitter	All types of transmitters except telephone.
TA	Telephone apparatus	Miscellaneous telephone equipment.
TD	Timing device	Mechanical and electronic timing devices, range devices, multiplexers, electronic gates; etc.
TF	Transformer	Transformers when used as separate items.
TG	Positioning device	Tilt or train assemblies.
TH	Telegraph apparatus	Miscellaneous tool assemblies.
TK	Tool kit or equipment	Miscellaneous tool assemblies.
TL	Tool	All types except line construction. (See LC.)
TN	Tuning unit	Receiver, transmitter, antenna, etc.
TS	Test equipment	Test and measuring equipment.
TT	Teletypewriter and facsimile apparatus	Miscellaneous tape, teletype, facsimile equipment, etc.
TV	Tester, tube	Vacuum tube tester.
U	Connector, audio and power	Unions, plugs, sockets, adapters, etc.
UG	Connector, RF	Unions, plugs, sockets, choke couplings, adapters, elbows, flanges, etc.
V	Vehicle	Carts, dollies, trucks, trailers, etc.
VS	Signaling equipment, visual	Flag sets, air panels, signal lamp equipment, etc.
WD	Cable, two-conductor	Includes non-RF wire, cable, and cordage in bulk.
WF	Cable, four-conductor	Includes non-RF wire, cable, and cordage in bulk.
WM	Cable, multiple-conductor	Includes non-RF wire, cable, and cordage in bulk.
WS	Cable, single-conductor	Includes non-RF wire, cable, and cordage in bulk.

b. Types of Emission

Type of modulation or emission	Type of transmission	Supplementary characteristics	Symbol
1. Amplitude	Absence of any modulation		AO
	Telegraphy without the use of modulating audio frequency (on-off keying).		A1
	Telegraphy by the keying of a modulating audio frequency or frequencies or by the keying of the modulated emission. (Special case: an unkeyed modulated emission.)		A2
	Telephony	Double sideband, full carrier	A3
		Single sideband, reduced carrier	A3a
		Two independent sidebands, reduced carrier	A3b
	Facsimile		A4
	Television		A5
	Composite transmissions and cases not covered by the above.		A9
	Composite transmissions	Reduced carrier	A9c
2. Frequency or phase	Absence of any modulation		FO
	Telegraphy without the use of modulating audio frequency (frequency-shift keying).		F1
	Telegraphy by the keying of a modulating audio frequency or frequencies or by the keying of the modulated emission. (Special case: an unkeyed emission modulated by audio frequency.)		
	Telephony		F3
	Facsimile		F4
	Television		F5
	Composite Transmissions and cases not covered by the above.		F9
3. Pulses emissions	Absence of any modulation intended to carry information.		PO
	Telegraphy without the use of modulating audio frequency.		P1
	Telegraphy by the keying of a modulating audio frequency or frequencies or by the keying of the modulated pulse. (Special case: an unkeyed modulated pulse.)	Audio frequency or frequencies modulating the amplitude of the pulse.	P2d
		Audio frequency or frequencies modulating the width of the pulse.	P2e
		Audio frequency or frequencies modulating the phase of position of the pulse.	P2f
	Telephony	Amplitude modulated pulse	Ped
		Width modulated pulse	P3e
		Phase or position modulated pulse	P3f
	Composite transmission and cases not covered by the above.		P9

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FRED C. WEYAND
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