



**NONRESIDENT
TRAINING
COURSE**

July 1997



Electronics Technician

Volume 3—Communications Systems

NAVEDTRA 14088

Although the words “he,” “him,” and “his” are used sparingly in this course to enhance communication, they are not intended to be gender driven or to affront or discriminate against anyone.

PREFACE

By enrolling in this self-study course, you have demonstrated a desire to improve yourself and the Navy. Remember, however, this self-study course is only one part of the total Navy training program. Practical experience, schools, selected reading, and your desire to succeed are also necessary to successfully round out a fully meaningful training program.

COURSE OVERVIEW: After completing this course, you should be able to: recall the basic principle and the basic equipment used for rf communications; recognize frequency bands assigned to the Navy microwave communications, the single audio system (SAS), and the basics of the Navy tactical data system. Analyze the operation of the Navy's teletypewriter and facsimile system, the basics of the TEMPEST program, and the basic portable and pack radio equipment used by the Navy. Identify basic satellite communications fundamentals, fleet SATCOM subsystem, shore terminals, and basic SATCOM equipment and racks. Identify the composition of the Link-11 system, and problems in Link-11 communications. Recognize the functions of the Link 4-A systems, new technology in data communications, and local-area networks.

THE COURSE: This self-study course is organized into subject matter areas, each containing learning objectives to help you determine what you should learn along with text and illustrations to help you understand the information. The subject matter reflects day-to-day requirements and experiences of personnel in the rating or skill area. It also reflects guidance provided by Enlisted Community Managers (ECMs) and other senior personnel, technical references, instructions, etc., and either the occupational or naval standards, which are listed in the *Manual of Navy Enlisted Manpower Personnel Classifications and Occupational Standards*, NAVPERS 18068.

THE QUESTIONS: The questions that appear in this course are designed to help you understand the material in the text.

VALUE: In completing this course, you will improve your military and professional knowledge. Importantly, it can also help you study for the Navy-wide advancement in rate examination. If you are studying and discover a reference in the text to another publication for further information, look it up.

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Sailor's Creed

"I am a United States Sailor.

I will support and defend the
Constitution of the United States of
America and I will obey the orders
of those appointed over me.

I represent the fighting spirit of the
Navy and those who have gone
before me to defend freedom and
democracy around the world.

I proudly serve my country's Navy
combat team with honor, courage
and commitment.

I am committed to excellence and
the fair treatment of all."

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SUMMARY OF THE ELECTRONICS TECHNICIAN TRAINING SERIES

This series of training manuals was developed to replace the *Electronics Technician 3 & 2 TRAMAN*.

The nine volumes in the series are based on major topic areas with which the Electronics Technician should be familiar. Volume 1, *Safety*, provides an introduction to general safety as it relates to the ET rating. It also provides both general and specific information on electronic tag-out procedures, man-aloft procedures, hazardous materials (i.e., solvents, batteries, and vacuum tubes), and radiation hazards. Volume 2, *Administration*, discusses COSAL updates, 3-M documentation, supply paperwork, and other associated administrative topics. Volume 3, *Communications Systems*, provides a basic introduction to shipboard and shore-based communication systems. Systems covered include man-pac radios (i.e., PRC-104, PSC-3) in the hf, vhf, uhf, SATCOM, and shf ranges. Also provided is an introduction to the Communications Link Interoperability System (CLIPS). Volume 4, *Radar Systems*, is a basic introduction to air search, surface search, ground controlled approach, and carrier controlled approach radar systems. Volume 5, *Navigation Systems*, is a basic introduction to navigation systems, such as OMEGA, SATNAV, TACAN, and man-pac systems. Volume 6, *Digital Data Systems*, is a basic introduction to digital data systems and includes discussions about SNAP II, laptop computers, and desktop computers. Volume 7, *Antennas and Wave Propagation*, is an introduction to wave propagation, as it pertains to Electronics Technicians, and shipboard and shore-based antennas. Volume 8, *Support Systems*, discusses system interfaces, troubleshooting, sub-systems, dry air, cooling, and power systems. Volume 9, *Electro-Optics*, is an introduction to night vision equipment, lasers, thermal imaging, and fiber optics.

INSTRUCTIONS FOR TAKING THE COURSE

ASSIGNMENTS

The text pages that you are to study are listed at the beginning of each assignment. Study these pages carefully before attempting to answer the questions. Pay close attention to tables and illustrations and read the learning objectives. The learning objectives state what you should be able to do after studying the material. Answering the questions correctly helps you accomplish the objectives.

SELECTING YOUR ANSWERS

Read each question carefully, then select the BEST answer. You may refer freely to the text. The answers must be the result of your own work and decisions. You are prohibited from referring to or copying the answers of others and from giving answers to anyone else taking the course.

SUBMITTING YOUR ASSIGNMENTS

To have your assignments graded, you must be enrolled in the course with the Nonresident Training Course Administration Branch at the Naval Education and Training Professional Development and Technology Center (NETPDTC). Following enrollment, there are two ways of having your assignments graded: (1) use the Internet to submit your assignments as you complete them, or (2) send all the assignments at one time by mail to NETPDTC.

Grading on the Internet: Advantages to Internet grading are:

- you may submit your answers as soon as you complete an assignment, and
- you get your results faster; usually by the next working day (approximately 24 hours).

In addition to receiving grade results for each assignment, you will receive course completion confirmation once you have completed all the

assignments. To submit your assignment answers via the Internet, go to:

<http://courses.cnet.navy.mil>

Grading by Mail: When you submit answer sheets by mail, send all of your assignments at one time. Do NOT submit individual answer sheets for grading. Mail all of your assignments in an envelope, which you either provide yourself or obtain from your nearest Educational Services Officer (ESO). Submit answer sheets to:

COMMANDING OFFICER
NETPDTC N331
6490 SAUFLEY FIELD ROAD
PENSACOLA FL 32559-5000

Answer Sheets: All courses include one “scannable” answer sheet for each assignment. These answer sheets are preprinted with your SSN, name, assignment number, and course number. Explanations for completing the answer sheets are on the answer sheet.

Do not use answer sheet reproductions: Use only the original answer sheets that we provide—reproductions will not work with our scanning equipment and cannot be processed.

Follow the instructions for marking your answers on the answer sheet. Be sure that blocks 1, 2, and 3 are filled in correctly. This information is necessary for your course to be properly processed and for you to receive credit for your work.

COMPLETION TIME

Courses must be completed within 12 months from the date of enrollment. This includes time required to resubmit failed assignments.

PASS/FAIL ASSIGNMENT PROCEDURES

If your overall course score is 3.2 or higher, you will pass the course and will not be required to resubmit assignments. Once your assignments have been graded you will receive course completion confirmation.

If you receive less than a 3.2 on any assignment and your overall course score is below 3.2, you will be given the opportunity to resubmit failed assignments. **You may resubmit failed assignments only once.** Internet students will receive notification when they have failed an assignment--they may then resubmit failed assignments on the web site. Internet students may view and print results for failed assignments from the web site. Students who submit by mail will receive a failing result letter and a new answer sheet for resubmission of each failed assignment.

COMPLETION CONFIRMATION

After successfully completing this course, you will receive a letter of completion.

ERRATA

Errata are used to correct minor errors or delete obsolete information in a course. Errata may also be used to provide instructions to the student. If a course has an errata, it will be included as the first page(s) after the front cover. Errata for all courses can be accessed and viewed/downloaded at:

<http://www.advancement.cnet.navy.mil>

STUDENT FEEDBACK QUESTIONS

We value your suggestions, questions, and criticisms on our courses. If you would like to communicate with us regarding this course, we encourage you, if possible, to use e-mail. If you write or fax, please use a copy of the Student Comment form that follows this page.

For subject matter questions:

E-mail: n315.products@cnet.navy.mil
Phone: Comm: (850) 452-1001, Ext. 1713
DSN: 922-1001, Ext. 1713
FAX: (850) 452-1370
(Do not fax answer sheets.)
Address: COMMANDING OFFICER
NETPDTC N315
6490 SAUFLEY FIELD ROAD
PENSACOLA FL 32509-5237

For enrollment, shipping, grading, or completion letter questions

E-mail: fleetservices@cnet.navy.mil
Phone: Toll Free: 877-264-8583
Comm: (850) 452-1511/1181/1859
DSN: 922-1511/1181/1859
FAX: (850) 452-1370
(Do not fax answer sheets.)
Address: COMMANDING OFFICER
NETPDTC N331
6490 SAUFLEY FIELD ROAD
PENSACOLA FL 32559-5000

NAVAL RESERVE RETIREMENT CREDIT

If you are a member of the Naval Reserve, you may earn retirement points for successfully completing this course, if authorized under current directives governing retirement of Naval Reserve personnel. For Naval Reserve retirement, this course is evaluated at 9 points. (Refer to *Administrative Procedures for Naval Reservists on Inactive Duty*, BUPERSINST 1001.39, for more information about retirement points.)

Student Comments

Course Title: Electronics Technician, Volume 3—Communications Systems

NAVEDTRA: 14088 **Date:** _____

We need some information about you:

Rate/Rank and Name: _____ SSN: _____ Command/Unit _____

Street Address: _____ City: _____ State/FPO: _____ Zip _____

Your comments, suggestions, etc.:

Privacy Act Statement: Under authority of Title 5, USC 301, information regarding your military status is requested in processing your comments and in preparing a reply. This information will not be divulged without written authorization to anyone other than those within DOD for official use in determining performance.
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NETPDTC 1550/41 (Rev 4-00)

CHAPTER 1

FUNDAMENTALS

INTRODUCTION

Communications in general, and especially in systems, covers a broad spectrum, from a simple single-channel voice circuit, to the fastest growing field of electronics—satellite communications. This training manual will provide you with knowledge applicable to questions and situations that arise on the job. Chapter 1 is a refresher course in basic communications systems and terminology. Chapters 2 and 3 will lead you through many of the systems and equipments in use today. Chapter 4 will discuss the Link-11 system, chapter 5 will cover the Link-11 Fault Isolation, chapter 6 will discuss Link 4-A, chapter 7 will introduce you to the new technology in data communications and the Link-16 system, and chapter 8 will discuss local-area networks.

The Electronics Technician rating is extremely diverse. Many ETs never get the opportunity to work in the communications field. Those who do are often locked into one particular system for many years. This assignment pattern sometimes causes ETs to feel overwhelmed or lost in their career. The massive amount of information ETs can be questioned on and expected to know can be frustrating. But the goal **YOU** and every ET must have is to become as knowledgeable as possible to be better. prepared for all future challenges.

After completing this chapter, you should be able to:

- **Identify the basic principles of rf communications**
- **Recognize the basic equipment used for rf communications**
- **Determine the frequency spectrum allocated to rf communications**

RADIO COMMUNICATIONS

Navy ships, planes, and shore bases operate as a team working together to accomplish a specific task. Radio equipment is used to coordinate the activities of the many fleet units by linking them with each other and with shore stations.

Radio can be defined as the transmission and reception of electronic impulses or signals through space by means of electromagnetic waves. Usually, the term is used in referring to the transmission of intelligence code and sound signals, although television and radar also depend on electromagnetic waves.

At one time, the term *radio communications* brought to mind telegraphy (CW), voice (AM), and possibly teletype communications. Today's radio communications has become a highly sophisticated field of electronics. You, the technician, need to become familiar with the diverse systems in use today.

The primary means of communicating between ships and between ships and stations is known as *telecommunications*. Telecommunications refers to communications over a distance and includes any

transmission, emission, or reception of signals, writing, images, and sounds. Intelligence produced by visual or oral means or by wire, radio, or other electromagnetic systems is also included. Electrical, visual, and sound telecommunications are all used by the Navy. In this volume we will discuss electrical types of telecommunications.

COMMUNICATIONS SYSTEMS

A communications system consists of two or more units, each having its own separate identity, arranged and interconnected to perform a circuit operation that cannot be performed by one of the individual units alone. Navy communications systems vary from simple to very complex, depending upon the circuit operations involved. Each system requires the integrated use of various types of equipment, so flexibility is of the utmost importance. This flexibility is provided through a complex arrangement of interconnections that allow the physically separated sets, groups, and units to be selectively switched (patched) into the different circuit configurations.