



NONRESIDENT TRAINING COURSE

April 1997



Fire Controlman

Volume 3—Digital Data Systems

NAVEDTRA 14100

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: In completing this nonresident training course, you will demonstrate a knowledge of the subject matter by correctly answering questions on the following subjects regarding computers and their peripherals:

- fundamentals and operations,
- configurations and hardware,
- operator controls and controlling units,
- components and circuits,
- central processing units and buses,
- memories,
- input/out and interfacing,
- instructions and man/machine interfaces,
- magnetic tape storage,
- magnetic disk storage,
- CD-ROM storage,
- printers,
- data conversion devices, and
- switchboards.

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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Published by
NAVAL EDUCATION AND TRAINING
PROFESSIONAL DEVELOPMENT
AND TECHNOLOGY CENTER

**NAVSUP Logistics Tracking Number
0504-LP-026-7670**

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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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: n311.products@cnet.navy.mil
Phone: Comm: (850) 452-1503
DSN: 922-1503
FAX: (850) 452-1370
(Do not fax answer sheets.)
Address: COMMANDING OFFICER
NETPDTC N311
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 divided into two units, evaluated at 21 points.

Unit 1: 12 points upon satisfactory completion of assignments 1 through 8.

Unit 2: 9 points upon satisfactory completion of assignments 9 through 14.

(Refer to *Administrative Procedures for Naval Reservists on Inactive Duty*, BUPERSINST 1001.39, for more information about retirement points.)

Student Comments

Course Title: Fire Controlman, Volume 3—Digital Data Systems

NAVEDTRA: 14100 **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 AND OPERATIONS OF COMPUTERS

INTRODUCTION

The computer is the heart and soul of any data system. It can be packaged in many sizes and configurations. It may be a general- or special-purpose type. It may handle analog or digital data, or both. It may be referred to as a mainframe, minicomputer, or microcomputer. Regardless of what it is called or how it is configured, it will share certain common fundamental concepts and principles with all other computers. All computers gather, process, store, disseminate, and display data and information. Each computer is housed in a frame or cabinet. Each has a central processing unit (CPU), memory, input/output (I/O) section, and a power supply. How these are assembled in each computer will vary from unit to unit.

How much computing power a computer has is defined by the technology it uses and NOT by its physical size. A more powerful computer means greater speed, greater capacity and capability to store information, and a greater facility to accommodate additional peripheral (external) equipment. Our objective is to teach you the basic fundamentals and concepts of a computer, no matter what type you maintain.

- **After completing this chapter, you should be able to:**
- **Describe the functions and purposes of a computer**
- **Differentiate between computer types based on their hardware characteristics**
- **Recognize the uses of computers and their functional operation**
- **Describe the types of computers used with tactical, tactical support, and non tactical programs**
- **Differentiate between full capability, reduced capability, and battle short mode in terms of computer operation and performance**
- **Compare the operational modes of computers including modes used in operation and maintenance**
- **Describe the security requirements associated with computers**

Before you begin study of how a computer operates, let's take a look at the fundamentals and operations of computers in general. These include their functions, the different types of computers, and their functional operation. Also included are their operational uses, configurations/setups, and modes of operation.

TOPIC 1—COMPUTER FUNCTIONS AND TYPES

The computers the Navy uses vary from mainframes to microcomputers. Regardless of the types of computers and their operational uses, their functions are basically the same. Depending on the type of computer and the operational use, the methods will vary. First, we discuss the functions of computers, the different ways computers handle data, and the methods they use to accomplish this. Then we discuss the functional operation of computers.

COMPUTER FUNCTIONS

All computers must be able to gather, process, store, disseminate, and display data.

Gather Data

All computers, no matter what their size, must gather data before they can process the data. The operational program will dictate how the data is gathered—manually, automatically, or a combination of both.

Manually, an operator or technician will input the data to the computer. This can be done either directly or by a device external to the computer. The following are commonly used input devices:

- Keyboards
- Display consoles
- Data terminals
- Computer maintenance panels
- Storage devices (magnetic tape units, disk drive units, and paper tape units)

As an example, an operator at a console will input data via the console to the computer and the computer will process the data for storage, dissemination, or display depending on the functions of the operational program. Data may be input from a console using pushbuttons, switches, toggles, or a combination of these.

Automatically gathering data means the computer receives data from another system, subsystem, or equipment. The computer monitors for external requests through a series of programmed requests and acknowledges. The computer first sees the gathered data when it comes through the input section of the input/output section of the computer. Then depending on the operational program, the computer will either react immediately or store the data for future use. The following are examples of the sources from which computers gather the data automatically:

- Systems such as the fire control system
- Subsystems such as the combat direction system
- Data processing systems (another computer and conversion devices)
- Display systems via sensors (radar)
- Communication systems such as data links and local-area networks (LANs)

Many computer systems are designed to gather data using a combination of both the manual and automatic methods.

Process Data

Processing data is the main function and the purpose of the computer. There are other systems, subsystems, and equipment that will work with the computer to help gather, store, disseminate, and display data; but processing the data is exclusively the computer's function. The heart of the computer—the place where the data is processed in a computer—is called the central processing unit (CPU). Figure 1-1 shows the basic configuration of a digital computer.

After the data is processed, it can be stored, disseminated, or displayed.

Store Data

The computer can store data either internally or externally. Internally, the computer uses memory

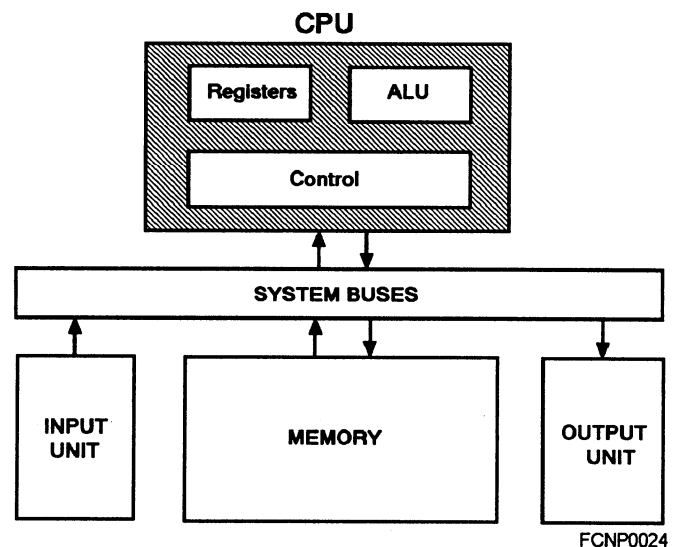


Figure 1-1.—A basic functional composition of a digital computer.

banks. These memory banks can hold instructions and both processed and unprocessed data. Memory access time and memory capacity are the other main factors that determine how powerful a computer is.

Externally, computers can store data on magnetic disks (hard and floppy), magnetic tape, or paper tape. Disk drive units offer quicker access to the data than magnetic or paper tape units. On some systems, the disks can store more data than the internal memory of a computer. The amounts of each will depend on the design and requirements of the data system. Some systems internally store and process the data. Others depend heavily on the disks to hold and store the data, bringing the data into memory for processing, and then storing the results back onto disk.

Disseminate Data

After the computer has processed the data, it can send it to the I/O section or an I/O unit for immediate or future dissemination to various equipments. The data will exit the output section of the computer's input/output section. It can be sent to an output device such as a printer, or to one of many storage devices such as a magnetic tape or disk unit. It can also be sent to a subsystem, such as a display system, via its associated equipment.

Display Data

Computer systems display two general types of data—data related to the mission of the system and status information related to operation of the system and hardware performance. The computer relies on peripheral equipment, such as printers and display units, to display the processed data—the mission related output of the operational program. Your interest in output generally relates to whether the data is sent properly by the computer and is displaying properly. In other words, you want to know the computer system is functioning properly. The content of the data is usually a secondary interest to you and a primary interest to the user/operator.

The other type of data/information that can be displayed relates to the operation of the system. This includes operator information, system error messages, and indications of system problems. You will be particularly interested in this information. The maintenance panels and data terminals can display real-time data and provide you with current status of the operational program. For example, the maintenance panels of some computers have registers where the presence or absence of indicator lamps can indicate to the technician if the computer is communicating with a

subsystem such as a display or communication subsystem. This is a very useful tool when you are performing maintenance, both preventive and corrective. Figure 1-2 is an example of a maintenance console panel. Notice the indicator lights for the I/O controller, I/O timing, Mode, Central Processor Register, and soon. These will provide you with status information. For example, you can monitor the I/O controller register to see if the computer is interfacing with a particular subsystem such as display or communications. Look to see if the indicator of that channel is illuminated (either flashing or constantly lit). Or, you could look at the contents of a particular register in the CPU by selecting that register while installing a patch to a program using an inspect and change procedure or utility.

TYPES OF COMPUTERS

In general terms, computers can be classified into three categories: mainframe computers, minicomputers, and microcomputers. A computer's power is determined by the technology it uses, NOT its physical size. Greater speed, greater capability and capacity to store information, and greater facility to accommodate additional peripheral (external) equipment will make one computer more powerful than another regardless of their overall physical sizes. We do not go into detail on each of the different types of computers. Rather, we identify examples of each and point out their physical and internal differences. This will prove valuable when you are maintaining them. Let's take a look at the types of computers you will maintain in the Navy. Later in this manual, you will study the internal workings of computers—their basic functional operation.

Mainframe Computers

Mainframe computers are physically the largest computers you will maintain. Their ruggedness makes them better suited than microcomputers and minicomputers to handle the mechanical shock and vibration, salt spray, temperature and humidity found aboard Navy vessels. The mainframes you will maintain are general-purpose, digital data computers with multiprocessing capability.

Mainframe computers are considered the heart of the afloat and ashore tactical and tactical support data systems. These mainframe computers are big, fast, multiprocessor computers with correspondingly large memories and multiple I/O channel capabilities. They process large volumes of data and require a lot of program flexibility. Their operational programs are

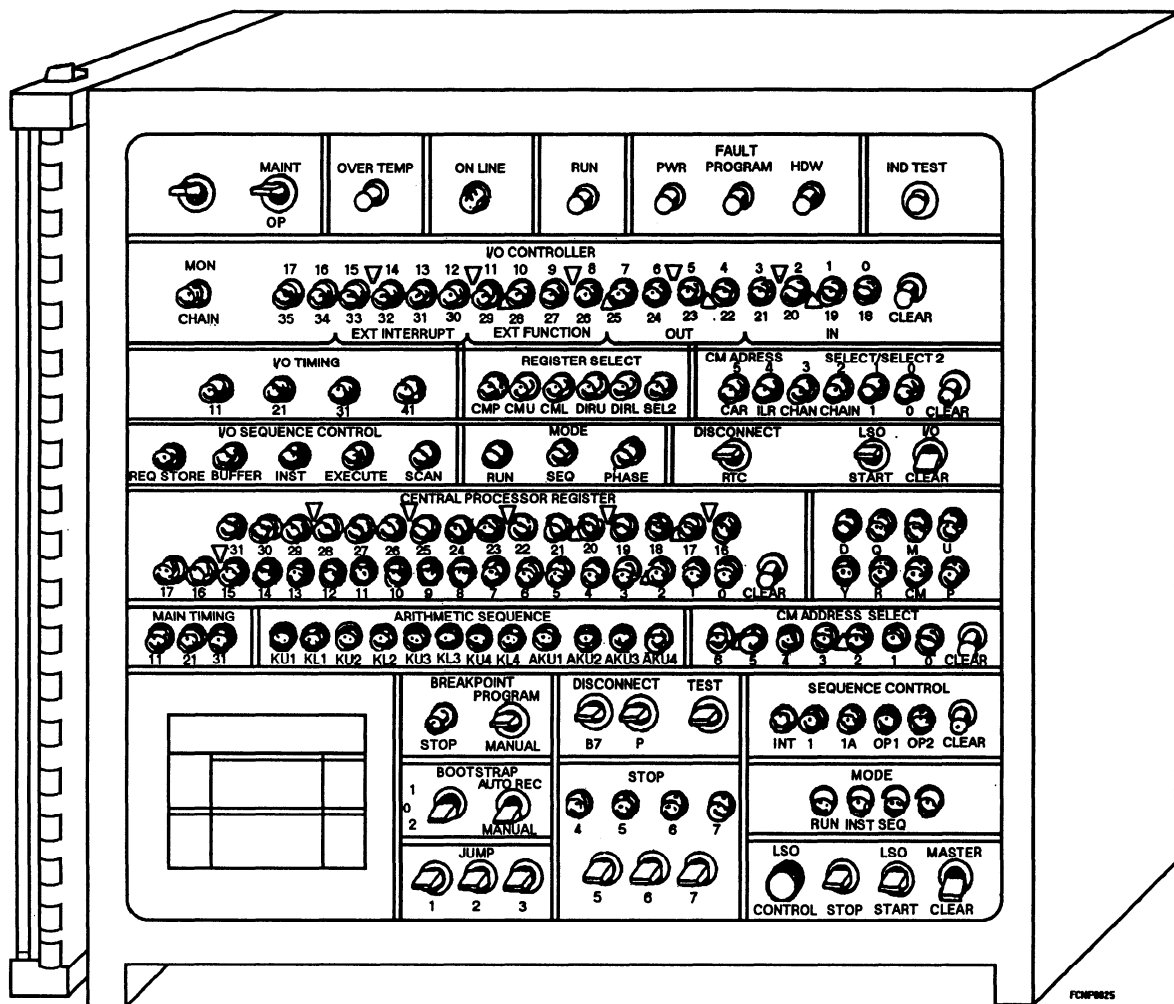


Figure 1-2.—Example of a maintenance console panel of a digital computer.

complex, and as systems are updated, the programs must be revised to meet the new demands of the fleet. Operational programs for mainframe computers are supported by technical teams external to the command. Two examples of mainframes are the AN/UYK-7(V) and the AN/UYK-43(V) computers. They are general-purpose, militarized, digital data computers with large-scale memories, I/O capabilities, and multiprocessing capabilities that allow a number of CPUs to operate simultaneously in the same system. They interface with other mainframes and peripherals in the data processing subsystem, the display subsystem, and the communication subsystem. Training is obtained through formal C schools and is NEC producing. Figure 1-3 is an example of one of the Navy's mainframe computers.

Some physical features of mainframe computers are highlighted as follows:

- Large rugged frame or cabinet —Contains individual modules or units; central processor unit (CPU), memory modules, input/output controller

and/or adapter unit with I/O connectors, heat exchangers for each module or unit, power supply unit(s), and blower motors for cooling.

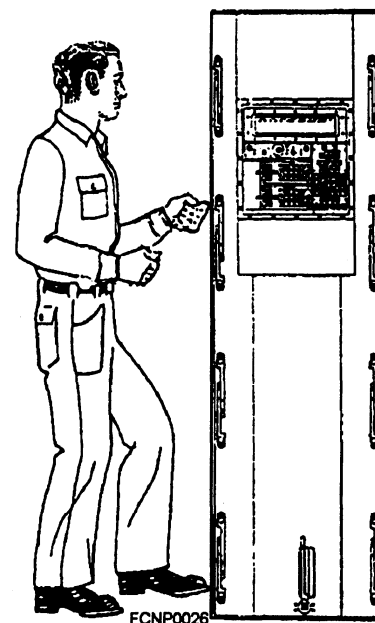


Figure 1-3.—Example of a mainframe computer.