



**NONRESIDENT  
TRAINING  
COURSE**

July 1997



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# **Fire Controlman**

## **Volume 5—Display Systems and Devices**

**NAVEDTRA 14102**

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.

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# 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:

- the basic operation of the cathode-ray tube and its use as a digital data display device;
- the operation of video display monitors used with personal computers;
- the operation of various input devices used with video display terminals;
- the operation of the Data Display Group AN/UYA-4(V);
- the operation of the Computer Display Set AN/UYQ-21(V)

**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.

*1997 Edition Prepared by  
DSCS(SW/AW) Robert M. Maynard  
FCCS(SW) Edwin L. Rodriguez*

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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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# 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 evaluated at 5 points. (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 5—Display Systems and Devices

**NAVEDTRA:** 14102 **Date:** \_\_\_\_\_

**We need some information about you:**

Rate/Rank and Name: \_\_\_\_\_ SSN: \_\_\_\_\_ Command/Unit \_\_\_\_\_

Street Address: \_\_\_\_\_ City: \_\_\_\_\_ State/FPO: \_\_\_\_\_ Zip \_\_\_\_\_

**Your comments, suggestions, etc.:**

|                                                                                                                                                                                                                                                                                                                                                |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>Privacy Act Statement:</b> 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.</p> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

NETPDTC 1550/41 (Rev 4-00)

## CHAPTER 1

# BASIC DISPLAY DEVICES AND SYSTEMS

### INTRODUCTION

Data display devices are those digital equipments designed to project, show, exhibit; or display soft-copy information. The information displayed can be alphanumeric, graphic, or a combination of both formats. Some display devices are limited in capability to just alphanumeric display.

Display devices provide an interface between the human operator and the digital computer system (the man-machine interface). They allow the operator to view computer data, make decisions and modify the data, enter new data, and enter commands to be processed. Data entry is accomplished in a variety of ways. Personal computers and data terminal sets usually have a keyboard for entry and may have a mouse, pointer, or touch-sensitive screen. The display systems used in the Navy use a ball tab that is moved around the screen with a trackball.

Information displayed on the display device is not permanent. That is where the term **soft-copy** comes from. The information is available for viewing by the operator only as long as it is on the screen of the display. Most display devices use some type of cathode-ray tube (CRT) as the display medium; although other types of displays, such as liquid crystal display (LCD), are common in laptop personal computers.

**After completing this chapter you should be able to:**

- Describe the operation of a cathode-ray tube (CRT).
- Describe the operation of *electromagnetic* and *electrostatic* deflection systems used in CRTs.
- Describe the operation of *interlaced scan*, *noninterlaced scan*, and *radar-scan* methods used to display images on a CRT.
- Describe the function and characteristics of the Data Display Group AN/UYA-4(V) and the Computer Display Set AN/UYQ-21(V).

## CATHODE-RAY TUBES

Most display devices currently in use employ a cathode-ray tube (CRT) for the display screen. The following information is a review of the functions and operation of CRTs.

### ELEMENTS OF A CRT

The CRT is a large glass envelope that contains three basic elements: an *electron gun*, a *deflection system*, and a *phosphor screen*. These elements convert electronic signals into visual displays. In our discussion of CRTs, we will first cover monochrome CRTs then we cover color CRTs.

All the air in the glass tube must be evacuated to form a vacuum. This is necessary for three reasons:

- Air molecules disrupt the electron beam as it travels from the anode to the cathode,
- Gases tend to ionize when subjected to high voltages and are conductive, which would short out the CRT, and
- Oxygen in the CRT would cause the filament to burn up.

Figure 1-1 shows the three basic components: the **phosphor screen**, the **electron gun**, and a **deflection system**.

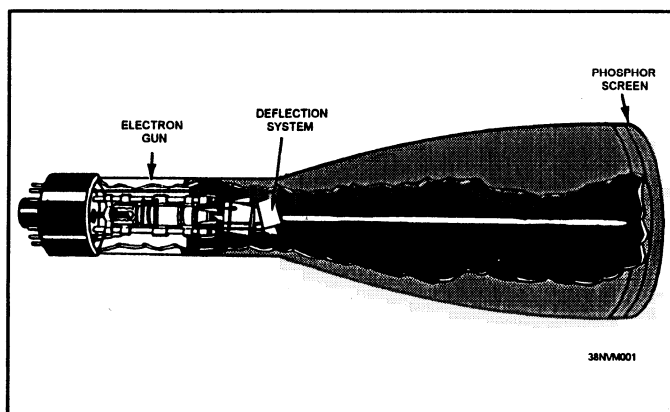


Figure 1-1.—A cathode-ray tube (CRT).

### The Phosphor Screen

The inside of the large end, or face, of a CRT is coated with phosphor. Phosphor is a material that displays luminescence when excited by electrons or other sources of radiation. In other words, electrons (beta radiation) striking the phosphor will cause it to glow for a short period of time. The length of time or duration that the display remains on the screen after the phosphor has been hit with electrons is known as **persistence**. When the electrons are formed into a beam and directed at the phosphor, the beam produces a dot. The intensity, or **brightness**, of the dot is directly proportional to the intensity of the electron beam.

### The Electron Gun

The electron gun is located in the narrow neck of the CRT. The gun acts as the source of the electron beam. Figure 1-2 illustrates the components of the electron gun.

A small ac voltage is applied to the filament to heat the cathode. Heating the cathode causes vast

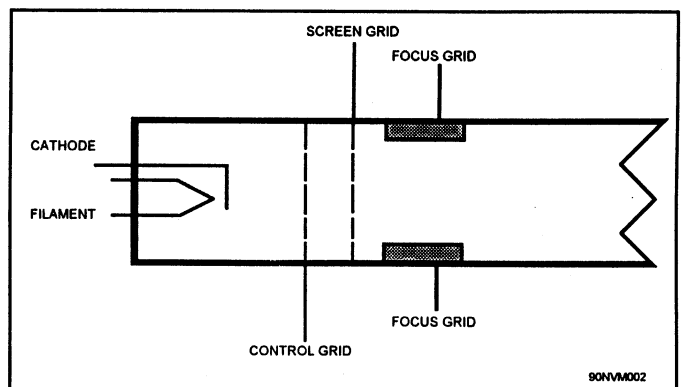


Figure 1-2.—A CRT electron gun.

numbers of electrons to be freed from the cathode. When the voltage of the control grid is more positive than the cathode, the beam is turned on, or **unblanked**, and the electrons are drawn to the anode (phosphor screen). When the control grid is negative with respect to the cathode, the beam is turned off, or **blanked**. In a monochrome CRT, the beam is either on or off and has a uniform brightness. In a black and white CRT that displays varying shades of gray, the