NONRESIDENT TRAINING COURSE

July 1997

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.

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.

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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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NONRESIDENT TRAINING COURSE follows the index

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
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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:

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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:

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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**: ____________________

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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 incapability 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 fictions 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.**

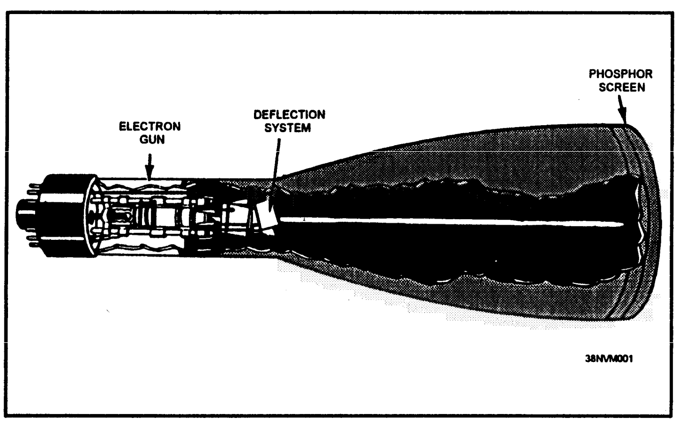


Figure 1-1.–A cathode-ray tube (CRT).

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

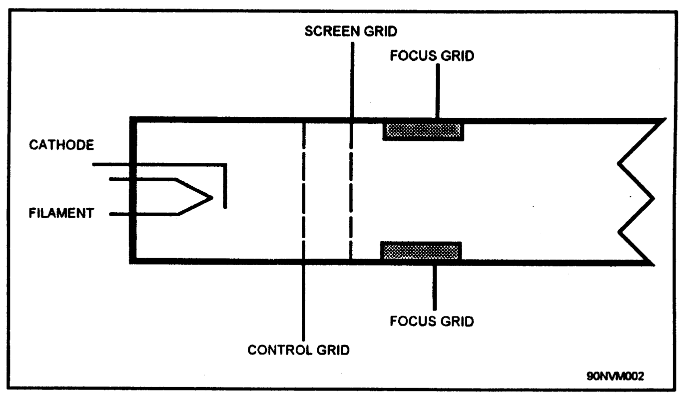


Figure 1-2.–A CRT electron gun.

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 voltage of the control grid varies to control the strength of the beam. The stronger the beam, the brighter the display is on the phosphor screen.

The screen grid voltage remains constant and acts as an accelerator for the beam. A negative charge on the focus grid shapes the electrons into a beam. Varying the charge of the focus grid causes the diameter of the beam to vary to determine optimum focus.

Deflection Systems

The deflection system in a CRT moves the beams to create the display. Two common types of deflection systems are used in CRTs. These are **electromagnetic deflection** and **electrostatic deflection.**

ELECTROMAGNETIC DEFLECTION.– Electromagnetic deflection uses a magnetic field generated by four coils to move the beam across the CRT. Electromagnetic deflection is commonly found on CRTs that use a raster-scan type display.

Current flows through the electron beam as it moves from the electron gun (cathode) to the phosphor face (anode) of the CRT. This current develops a circular magnetic field. By introducing an external magnetic field, the beam can be deflected. Controlling the polarity and strength of this external field controls the amount and direction of the beam deflection.

The magnetic field is introduced into the CRT by the yoke assembly. The yoke consists of four coils of wire mounted at 90-degree increments. The yoke is mounted around the neck of the CRT. Current flowing through the coil produces a magnetic field at a right angle to the coil. The magnetic field will cause the electron beam to deflect.

ELECTROSTATIC DEFLECTION CRT'S.– Electrostatic-type deflection CRTs are generally used in radar and oscilloscopes. In the electrostatic deflection CRT, four deflection plates are located inside the CRT. The top and bottom plates control vertical deflection of the beam and the right and left plates control the horizontal deflection of the beam. An electrical charge is applied to these plates to direct the beam to the proper area of the CRT. To move the beam to the right, a positive charge is applied to the right plate to pull the beam while a negative charge is applied to the left plate to push the electron beam to the proper position. The amount of the charge applied to the plates controls the amount of deflection.

CRT SCANNING METHODS

The creation of a display is known as a scan. Two types of scanning systems are currently in use in CRTs: **raster scanning** and **vector scanning.** Raster scan CRTs are commonly used with electromagnetic deflection CRTs. Vector scan CRTs are commonly used with electrostatic deflection systems, although either deflection system can be used with either scanning system.

Raster Scanning

A raster scan CRT develops the display or picture by painting a series of horizontal lines across the face of the CRT. The electron beam is pulled from left to right. The beam is then turned off and the horizontal deflection voltage returns the beam to the left side, and the vertical deflection voltage pulls the beam down one line space.

The left to right motion is the horizontal frequency and is much greater than the top to bottom motion or vertical frequency. The time it takes for the beam to return to the left or top of the screen is known as *retrace time.* During retrace the beam is blanked.

By dividing the horizontal frequency by the vertical frequency, we can determine the maximum number of lines in the raster. Standard television uses 15,750 Hz for the horizontal frequency and 60 Hz for the vertical frequency. Using this formula, we find that the maximum number of lines is 262.5; but some lines are not available because of the time required for vertical retrace.

The lines are spaced close enough to each other so the eye cannot detect any variation of intensity. *Resolution* is the number of lines per inch at the

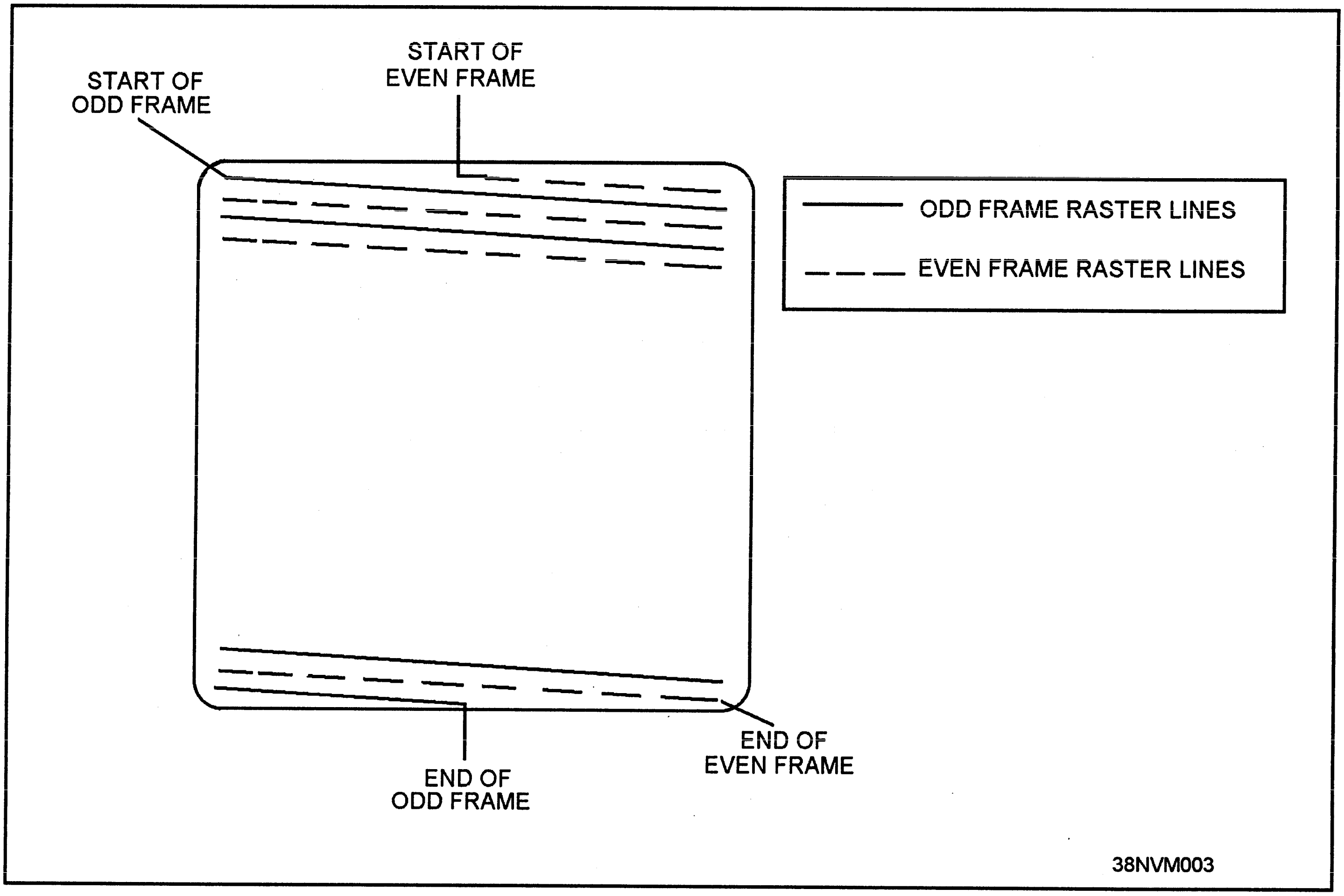


Figure 1-3.-Interlaced scan of a CRT.

merge point. Two methods are used to increase the resolution of CRTs. These are **interlaced scan** and **noninterlaced scan.**

INTERLACED SCAN.– Interlaced scanning makes it possible to double the number of horizontal lines in a picture. Figure 1-3 illustrates the principle of interlaced scanning in which two scans are required to display the full picture. The odd raster starts in the top left corner of the CRT, while the even raster starts in the top center of the CRT. The two complete scans paint the entire picture. By interlacing the odd and even lines of a picture, resolution can be increased without a noticeable flicker on the screen. Interlaced scanning is used with standard television and some computer monitors. It increases the maximum number of lines per frame to 525. Because of the vertical retrace time, the number of visible lines is 512.

Interlaced scan CRTs are fine for television transmissions and alphanumeric displays, but can cause a visible flicker when displaying fine digital graphics because of the abrupt changes in the levels of intensity required. To solve this problem, most computer monitors use noninterlaced scan.

NONINTERLACED SCAN.– Noninterlaced scanning paints the entire frame of data from top to bottom. Figure 1-4 illustrates the noninterlaced scanning method of painting a single frame. To paint an entire frame without a noticeable flicker, the horizontal frequency is increased, which increases the number of lines per frame. The vertical frequency is also decreased from 60 Hz to 50 Hz in most monitors, which further increases the number of lines.

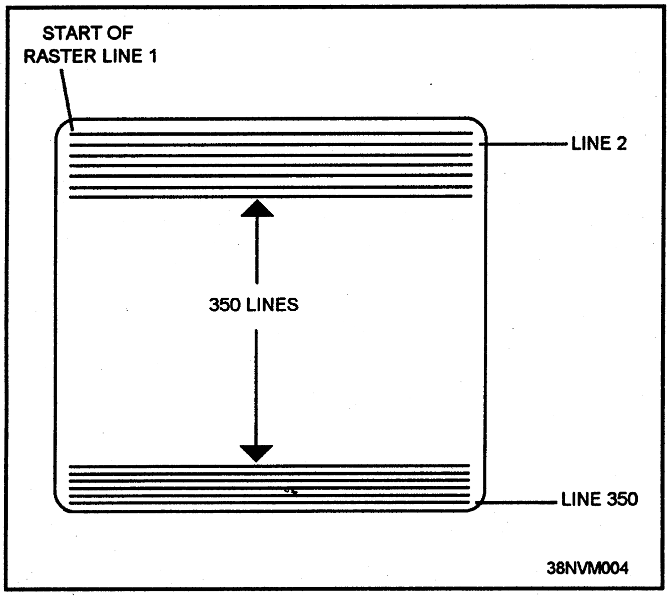


Figure 1-4.—Noninter1aced scan of a CRT.

Vector Scan

Vector scan CRTs are used extensively in the Data Display Group ANK/UYA-4(V) plan position indicators (PPIs). The circular display screens provide control and display of conventional radar sweep and video data and computer-generated symbology. The CRTs used in the PPIs use electrostatic deflection The methods used to develop the deflection and unblinking signals for radar sweep and video are similar because the same CRT beam is used to develop both presentations. However, the methods used to develop the radar sweep and video are different from the two methods used to develop symbology.

In the following paragraphs, you will learn how the X/Y coordinate system is used to position the CRT beam.

The X/Y coordinate system uses a grid as a frame of reference. Figure 1-5 illustrates the concept of the X/Y coordinate system. The horizontal line is the X axis, and the vertical line is the Y axis. The intersection of the two lines is the origin of all deflection signals. The origin is normally located at the center of the CRT, but may be offset from the center by operator action.

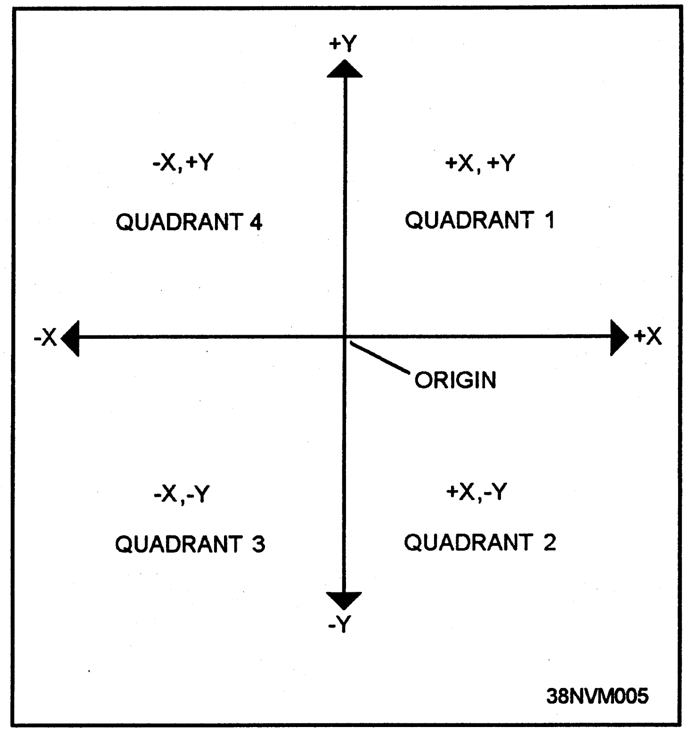


Figure 1-5.—The X/Y coordinate system.

The origin is the starting point for measuring along both axes. To the right of the origin, values on the X axis are positive; to the left, values are negative. The values above the origin on the Y axis are positive; below the origin, they are negative.

A point anywhere on the screen of the CRT may be defined by two values: an X coordinate and a Y coordinate. The X coordinate is used to develop the horizontal deflection of the CRT beam. A positive X value will move the beam to the right of the origin; a negative X value will move the beam to the left of the origin.

Vertical deflection is derived from the Y coordinate value. A positive Y value will deflect the beam upward from the origin, and a negative value will move the beam down. The appropriate X and Y values can be used to position the beam to any point on the CRT. The combination of positive and negative X and Y signals divides the CRT into the four quadrants illustrated in figure 1-5.

A third signal is required to control the blanking of the electron beam. The **Z (unblank)** signal is used in the generation of symbology, for sweep retrace, and so forth.

We take you through a detailed look at how the vector scan CRT uses these signals to paint the display on the CRT later in this chapter.

COLOR CRT'S

Thus far our discussion has been about monochrome CRTs. Color CRTs offer a variety of colors and are used extensively with personal computers, simulators, and other training devices. Most color CRTs use a raster-scan type deflection.

The major differences between color and monochrome CRTs are in the phosphor coating of the CRT, the electron gun(s), and the high voltage requirements.

The phosphor coating of a color CRT is made up of small dots that contain a dye so they radiate one of the three primary colors of light (red, green, or blue). These dots are arranged in groups called **triads.** Figure 1-6 illustrates a typical grouping of triads.

The size of the phosphor dots is often used as a measure of the CRT's resolution. Newer monitors have CRTs with dots of .20 mm and smaller. The dots are the smallest addressable element of a picture. These picture elements are called *pixels* or *pels,* depending on the manufacturer. Both terms have the same meaning.

Three electron beams are required to properly strike the different colored phosphor dots. Some color CRTs use three electron guns, known as a delta gun CRT. The beams pass through a shadow mask that is designed so that only the red gun strikes the red dots, the blue gun strikes the blue dots, and the green gun strikes the green dots.

Newer color CRTs have combined all three electron beams into a single gun, as shown in figure 1-6. The single-gun CRT does not need convergence alignments and greatly reduces the amount of circuitry required in a color monitor. This design is common in almost all of the newer color monitors.

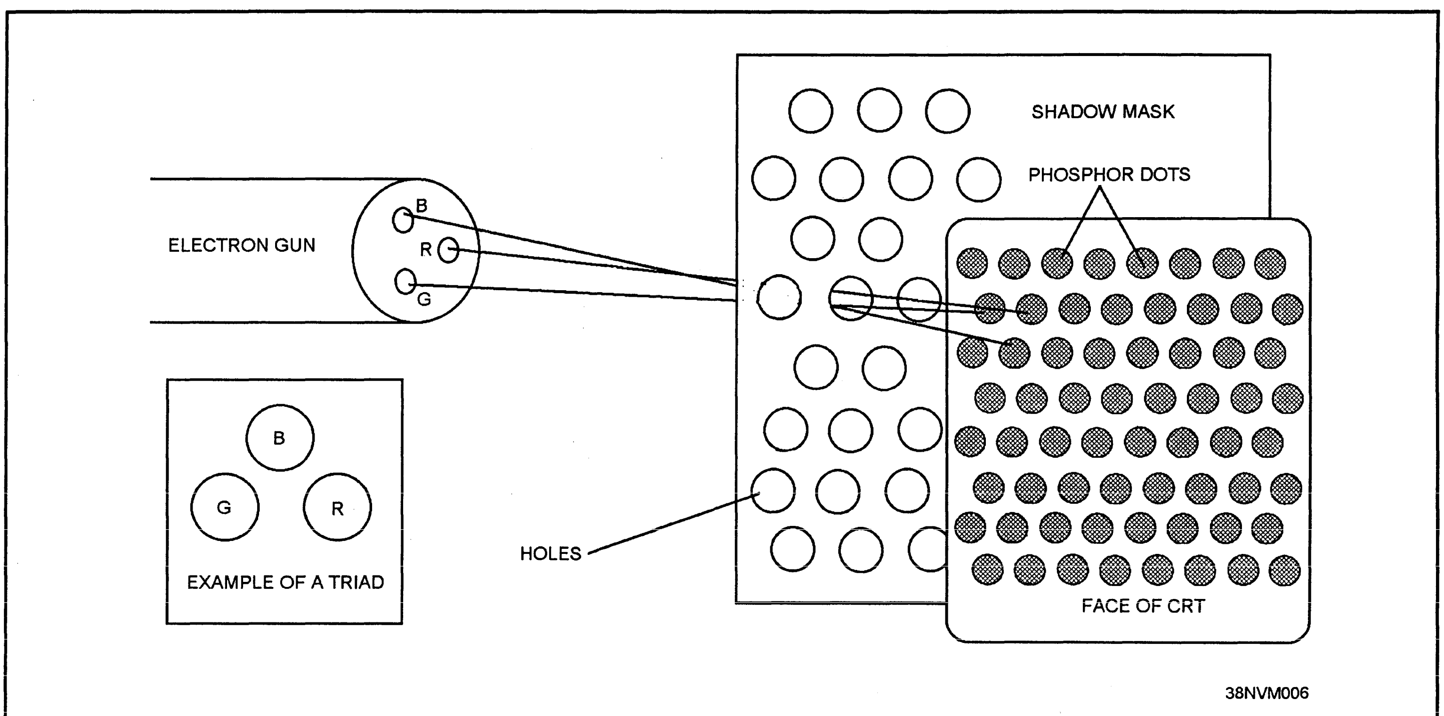


Figure 1-6.—A typical color CRT.

DISPLAYING RADAR SWEEP, VIDEO, AND SYMBOLS

In the following sections, we cover the steps involved in displaying radar sweep, video, and symbols on the PPI used in the Data Display Group AN/UYA-4(V).

RADAR SWEEP AND VIDEO

The PPI scan or sweep originates in the center of the circular screen. The sweep progresses (traces) outward until the edge of the screen or the end of sweep is reached. One sweep occurs for each radar pulse transmitted. The angle of the sweep varies as the position of the rotating radar antenna varies, resulting in a clockwise or counterclockwise rotation of the sweep on the screen. As the antenna is rotated, the sweep rotates around the CRT in synchronism with the antenna position.

The PPI provides real-time range and bearing display of radar, sonar, or IFF/SIF returns. The sweep trace is intensified (brightened) by video signals that indicate the range of the return. The angle of the sweep on the screen indicates the bearing of the return.

The PPI console sweep and video display is generated from data received from the radar, sonar, or IFF. Ancillary equipment converts the data into a format that can be used by the PPI console. The PPI console receives the following information from the conversion equipment:

- Digital sweep (digital $\Delta X/\Delta Y$ pulse trains)
- Sign of X and sign of Y
- Sweep timing (end-of-sweep and range-mark signals)
- Video

Digital Sweep

The digital sweep pulse trains ($\Delta X/\Delta Y$) are used to control the deflection of the CRT electron beam. They indicate the changing sweep coordinates for the display of the rotating sweep.

Sign of X and Sign of Y

The sign of X and the sign of Y determine the quadrant in which the sweep and video will be displayed.

Sweep Timing

Sweep timing signals include range-mark signals and the end-of-sweep signal. The zero-mile range mark is used to start the sweep deflection outward from the center of the screen. Other range-mark signals are displayed as intensified rings on the CRT so that a relationship between the radar video and range may be established.

The end-of-sweep signal causes the CRT beam to be blanked and retraced to the center of the CRT. The end-of-sweep signal also resets various counters in preparation for the next sweep.

Video

Radiation reflections from the radar, sonar, or IFF/SIF are received as video signals. The video signals are displayed as an intensification of the sweep.

SYMBOL GENERATION

The generation of display symbology is integrated with the development of the sweep and video. Symbols are generated from data words outputted by the computer. The following steps are required to paint a symbol:

1. Blank the sweep
2. Move the CRT beam to the symbol coordinates
3. Paint the symbol
4. Blank the CRT beam
5. Move the beam back to sweep position

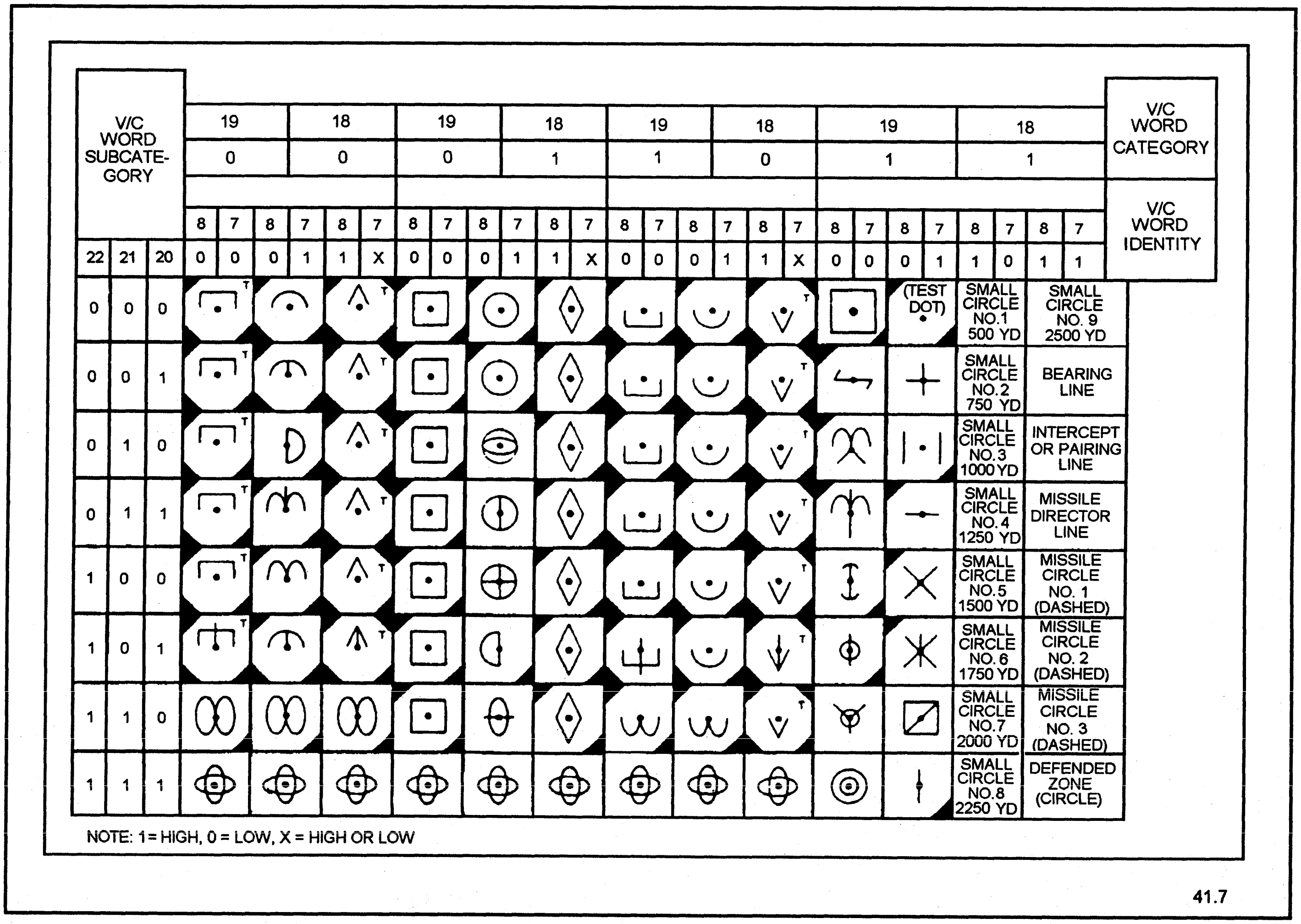


Figure 1-7.—The AN/UYA-4(V) symbol set.

Two different methods of painting symbols are currently in use in the AN/UYA-4(V) display group. They are the **analog waveform** and the **digital stroke methods.** The symbols being generated are the same in either case, only the methods used to generate the symbols differ. Figure 1-7 shows the symbol set used in the AN/UYA-4(V) display group.

The AN/UYQ-21(V) computer display set has an expanded symbol set and develops sweep and symbols using both the digital stroke method and raster-scan CRTs, depending on the type of console. Figure 1-8 shows the AN/UYQ-21(V) symbol set.

Analog Waveform Symbol Generation

To help you to fully understand the analog waveform generation process, we look at the equipments required and the procedure that takes place.

Analog symbols are formed by applying harmonious waveforms to the deflection plates of a CRT. For example, if two sine waves of equal amplitude and 90-degrees out of phase are applied to the X and Y axes of a CRT, a circle will be displayed on the CRT. By adding the Z, or unblinking signal, we can control what part of the circle is actually displayed and thus form the symbol. Ellipses are formed when the amplitudes of the two sine waves are unequal.

Using the same principle with two trapezoid waveforms that are 90-degrees out of phase, a square will be formed.

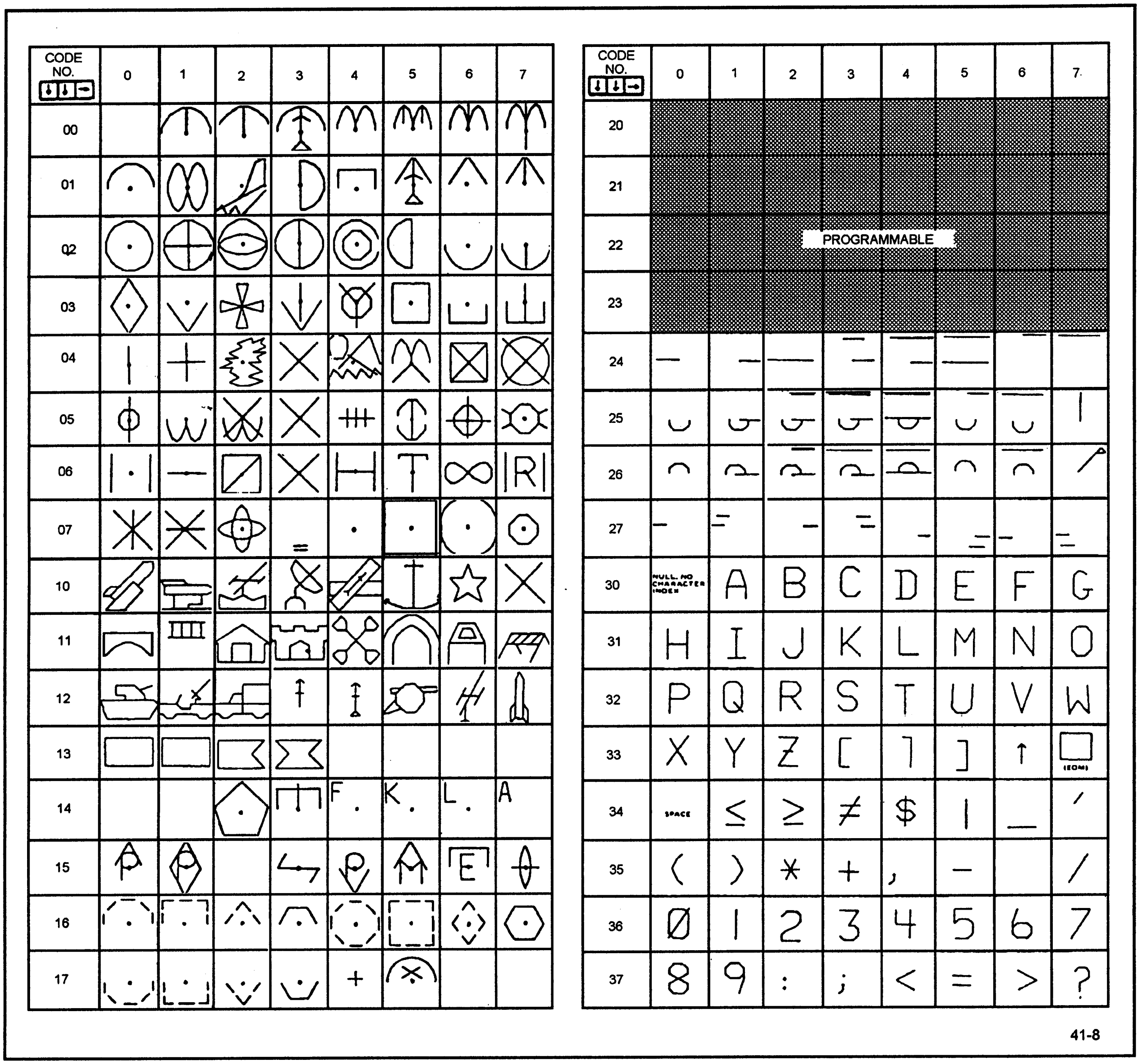


Figure 1-8.—The AN-UYQ-21(V) symbol set.

Symbols are defined by computer words. The computer, using data input by the operator, determines what symbol to display and where to display it on the X/Y grid. It then puts together a digital message and transmits it to a piece of ancillary display equipment called a pulse amplifier/symbol generator (PA/SG). Figure 1-9 illustrates how the pulse amplifier interfaces the computer with the symbol generator and the display consoles. It amplifies and distributes the computer output data to the symbol generator and the display consoles. The pulse amplifier also receives computer input data from the display consoles and sends it to the computer.

When a symbol message is sent to the display equipment, the console takes control of the CRT electron beam from the radar scan logic. It positions the blanked CRT beam to the coordinates of the symbol to be displayed and waits for the symbol waveforms from the symbol generator.

The symbol generator develops the symbol waveforms and timing pulses for the mechanization (display) of the symbol. The timing pulses synchronize the console's painting of the symbol. Each symbol is composed of the following three

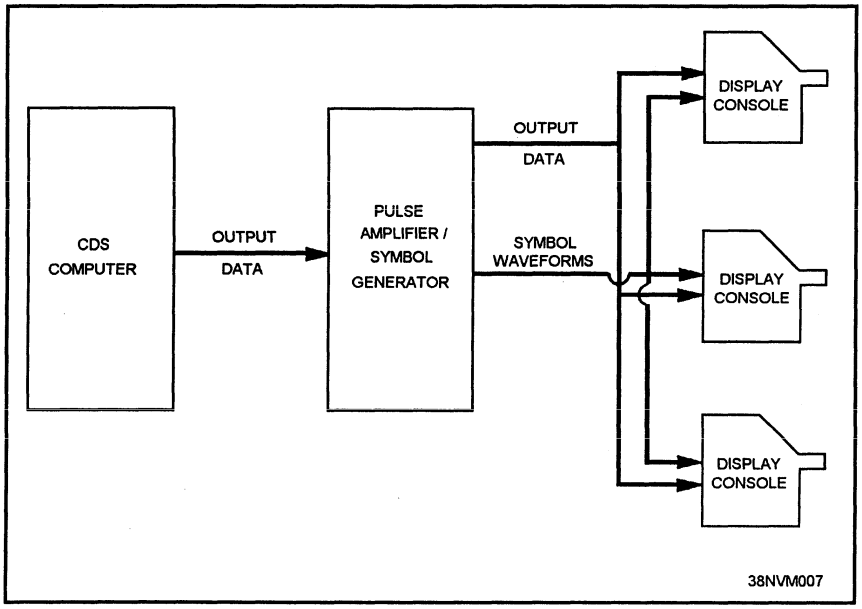


Figure 1-9.—The waveform symbol equipments (PA/SG) interface path,

signals: **X-axis waveforms, Y-axis waveforms,** and **Z (unblinking) signals.**

The symbol is painted in a timing period called **P-time.** The symbol generator, using a series of P-time interval signals, develops the proper waveforms to be sent to the CRT deflection amplifiers and video amplifiers. When the symbol generator starts its P-time counter, a signal is sent to the display console that starts an identical counter in the console. This ensures that both equipments are synchronized. Figure 1-10 shows the development of a symbol using the X, Y, and Z waveforms. The symbol is formed during the unblanked P-time intervals. The symbol shown in figure 1-10 is actually a combination of three symbols: air unknown, rocker, and full upper bar. The unblank times have been given reference letter designations to aid you in following the mechanization process.

During unblank time A, the rocker is formed. Figure 1-11 illustrates this process on an X/Y plot. When the unblank signal is high, the X sine wave is at its negative point and transitions to its positive point. At the same time, the Y waveform is at zero and transitions its negative cycle, and returns to zero. During unblank B, the Y waveform provides the proper position for the upper bar, while the X waveform transitions from negative to positive. The unknown air symbol is formed during unblank time C.

Note that with the trapezoid waveform, X remains at a constant negative level, while Y goes from zero to the positive level. This draws the left vertical side of the symbol. When Y reaches its positive level, X starts a transition from negative to positive to draw the top of the symbol. The right side of the symbol is formed when the Y waveform goes in a negative direction to zero, while X remains at a constant positive level. The dot is formed at unblank time D by unblinking X and Y at the zero level. At the completion of the P-time, the console returns control of the CRT beam to the radar scan logic.

The symbol remains displayed on the screen as long as the persistence of the screen phosphor permits. For the symbols to remain flicker free, they must be periodically refreshed, or repainted, by repeating the process just described. Symbols are refreshed 15 to 20 times per second.

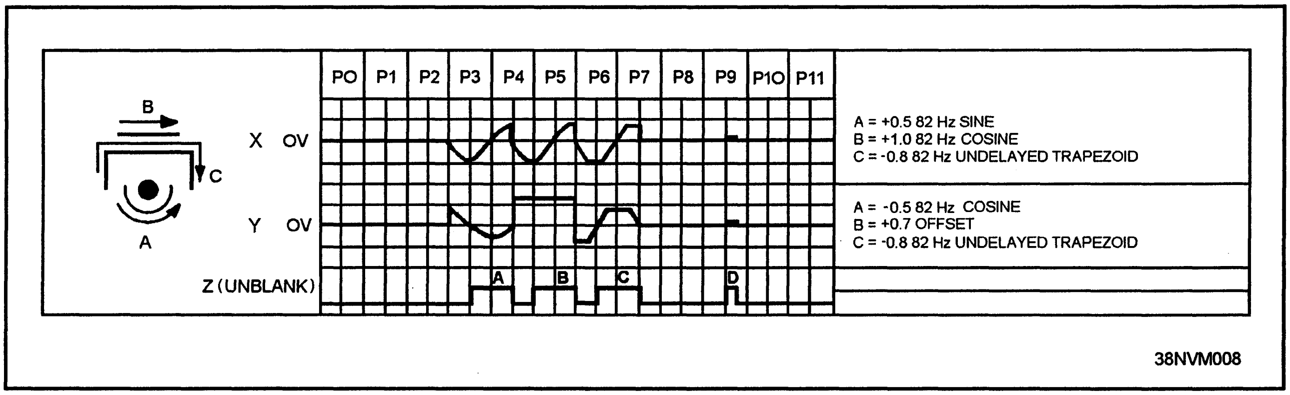


Figure 1-10.—Development of an analog waveform symbol.

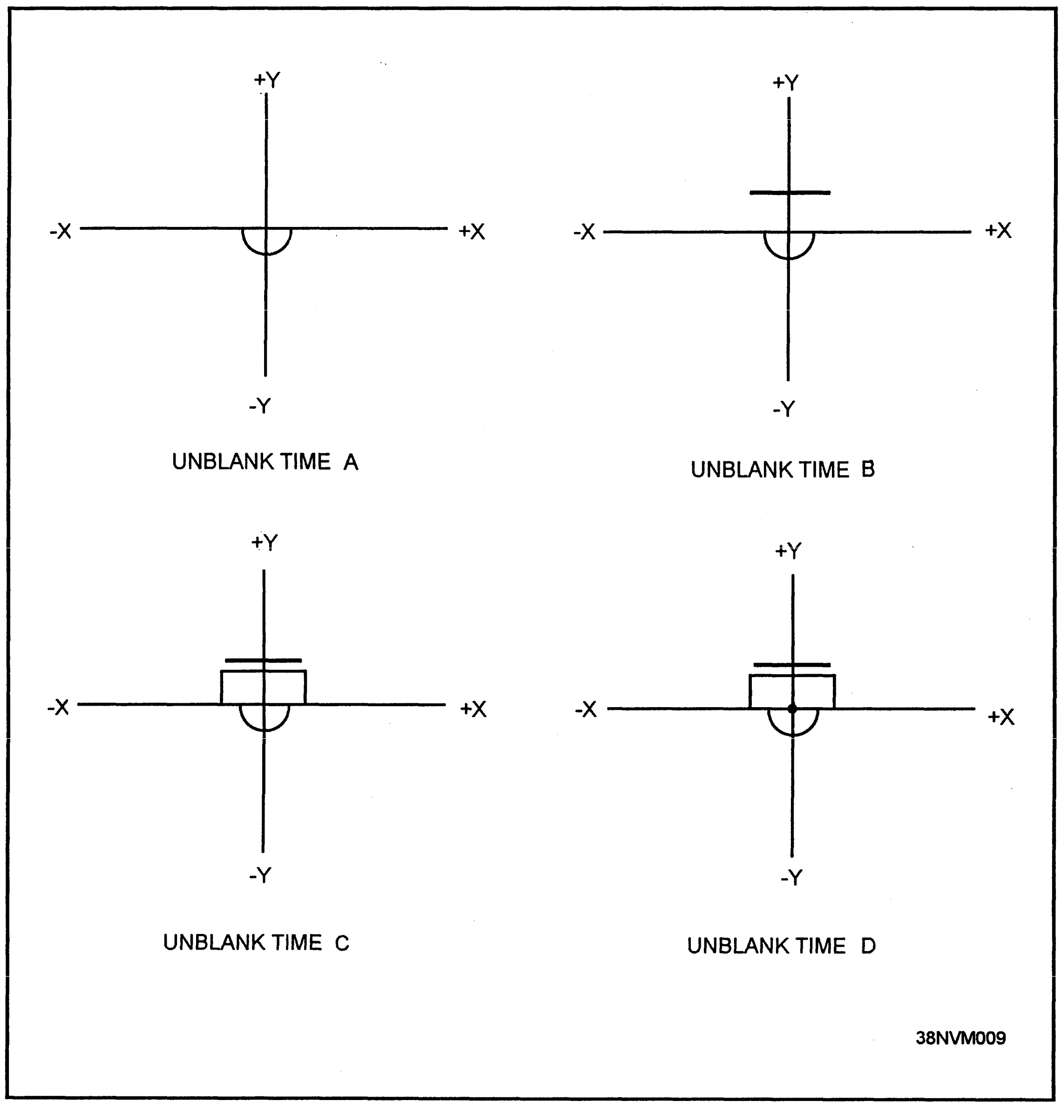


Figure 1-11.—The mechanization of an analog waveform symbol.

Digital Stroke Symbol Generation

The digital stroke method of symbol generation is used in some AN/UYA-4(V) display groups that use the console internally generated and refreshed symbols (CIGARS) modifications of the digital stroke symbol generator. The CIGARS modified console eliminates the need for a separate symbol generator because each console contains its own symbol generation circuitry.

The digital stroke symbol generator stores all symbols as digital codes in a group of read-only-memory (ROM) chips or programmable read-only-memory (PROM) chips. In this example, we assume that a PROM is the device that stores the symbol. The computer sends a message to the display group indicating what symbol needs to be painted. The message is translated and the data bits that were used to identify the symbol in the analog symbol generator are sent to the stroke control logic and are used to access stroke codes from a PROM.

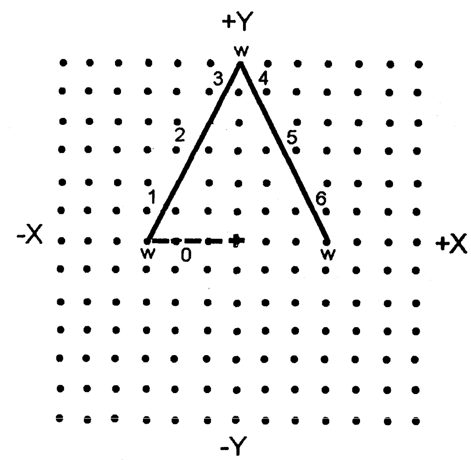
There are eight distinct routine states or time periods in the symbol routine process as shown in table 1-1. During each routine time, a component of the symbol to be displayed is mechanized. At the start of the symbol generation process, the CRT beam is moved to the location where the symbol is to be painted.

Table 1-l.-Symbol Routine States

ROUTINE TIME	SYMBOL MECHANIZATION ROUTINE
0	Dot time
1	Symbol time
2	Upper bars modifier time
3	Raid size modifier time
4	Lower bars modifier time
5	Missile rocker modifier time
6	Threat modifier time
7	TSLO modifier time

The stroke symbol generator paints the dot first, then accesses the PROM to get the symbol strokes. The PROM has eight outputs for each address. Each output performs a particular function in the generation of the symbol component. The eight output lines used to mechanize the symbol are as follows:

- Sign X, X, 2X
- Sign Y, Y, 2Y
- Z (unblank)
- W (wait)



STROKE PROM ADDRESS	536	537	538	539	540	541	542	543
SIGN X	●							
X	●	●	●	●	●	●	●	
2X	●							
SIGN Y					●	●	●	
Y								
2Y		●	●	●	●	●	●	
Z (UNBLANK)		●	●	●	●	●	●	
W (WAIT)	●			●			●	
STROKE	0	1	2	3	4	5	6	7

38NVM010

Figure l-12.—The symbol grid and stroke PROM addresses.

Figure 1-12 shows the mechanization grid for the hostile air symbol. A dot in the grid indicates the function is active. The sign bits control the direction of the beam. If the sign bit is active, the beam is moved in a negative direction. The X, 2X, and Y, 2Y bits combine to determine the amount of deflection:

zero, one, two, or three grid points. The Z (unblank) signal unblanks the beam when active. The W (wait) output is used to ensure the completion of a stroke before the start of the next stroke. The W fiction is normally used to ensure the CRT beam is in the proper position before the beam is unblanked, blanked, or makes a major change in direction. This prevents distortion of the symbol that could result if the beam has not completely finished a stroke or has not been completely repositioned.

Referring to figure 1-12, the PROM is addressed and the output is translated. In this example, the first stroke (stroke zero) positions the CRT beam three grid spaces in the -X direction and the beam is blanked. Upon completion of this stroke, the next address is read and translated. Strokes one, two, and three each cause the beam to be deflected one grid space in the +X direction and two grid spaces in the +Y (up) direction while the beam is unblanked. At the end of stroke three, there is a pause (W) so the beam can finish the stroke before changing direction.

Strokes four, five, and six each cause the beam to move one grid space in the +X direction and two grid spaces in the -Y (down) direction. Again at the end of stroke six, there is a pause (W) to ensure that the beam deflection is complete.

When the PROM address for stroke seven is read, no outputs are found active. This condition signals the logic that the symbol is complete, and the symbol generator moves to the next fictional time period, as shown in table 1-1.

DISPLAY SYSTEMS

The combat direction systems (CDS) in use on most ships evolved from the original NTDS systems. These systems developed the standards for several digital computer protocols, and the term NTDS is still used to define several of these protocols. The display sub-system is the largest part of the CDS system.

Two major tactical display systems are currently used in the fleet. These are the Data Display Group AN/UYA-4(V) and the Computer Display Set AN/UYQ-21(v). Within each system different versions are tailored for each class of ship, according to the mission of the ship.

DATA DISPLAY GROUP AN/UYA-4(V)

The Data Display Group AN/UYA-4(V) is the most widely used system currently in the fleet. It was developed to refine the limitations of the AN/SYA-4(V) and the AN/UYA-1(V) systems. The AN/UYA-4(V) display group uses third generation electronics (integrated circuit) for all logic functions.

The function of the Data Display Group AN/UYA-4(V) is to provide a real-time visual picture of the tactical situation. To perform this requirement, the systems must be able to accomplish several tasks including the following:

- Sensor data distribution and display
- Tactical data distribution and display
- System simulation and testing

Figure 1-13 illustrates a typical AN/UYA-4(V) display group. Sensor position data is received from the ship's sensor platforms (radar and sonar) and sent to a converter for conversion into a form that can be used by the display console. The converted position data is routed to the display console through a distribution switchboard. Sensor video data is routed to the display consoles through the same switchboard.

Tactical data is digital data received from or transmitted to the system computer. Tactical data from the computer is used by the display system to generate symbol displays and alert/switch indications on the display consoles. Tactical data sent to the computer is the result of some type of operator action at the display console.

System test is accomplished with the system computer and the video signals simulator (VSS). As illustrated in figure 1-13, the VSS can simulate a radar input to the switchboard to aid the technician in fault isolation or provide simulated data for operator training. The tactical data paths can be tested using the various software programs (POFA, PEFT, etc.) designed to run with the system on your ship.

COMPUTER DISPLAY SET AN/UYQ-21(V)

The Computer Display Set AN/UYQ-21(V) is the latest display system in the Navy. It is installed on the newer ships and is replacing older AN/UYA-4(V) systems as part of the new threat upgrade. The AN/UYQ-21(V) system is also configured according to the mission of the ship. A typical configuration could include tactical display consoles, display control consoles, and large screen projection displays. The system also offers expanded symbol sets and locally generated programmable symbols.

As with the AN/UYA-4(V) system, the AN/UYQ-21(V) system provides a real-time picture of the tactical situation.

SUMMARY-BASIC DISPLAY DEVICES AND SYSTEMS

In this chapter, you were introduced to the basic element of most display systems, the CRT. You were also introduced to the two display systems the Navy is currently using. The following information summarizes some of the important points you should have learned.

CATHODE-RAY TUBE (CRT)— The cathode-ray tube (CRT) is the focal point in most display devices. It provides a visual display of data for the operator to interface with the computer. The CRT has three functional areas: a phosphor coated screen, an electron gun, and a deflection system.

PHOSPHOR SCREEN— The screen or face of the CRT is coated with phosphor, which glows when bombarded with electrons.

ELECTRON GUN– The electron gun in a CRT is the source of the electron beam. The electron gun also contains the control circuitry for the unblinking and focusing of the beam.

CRT DEFLECTION SYSTEMS– Electromagnetic deflection and electrostatic deflection are the

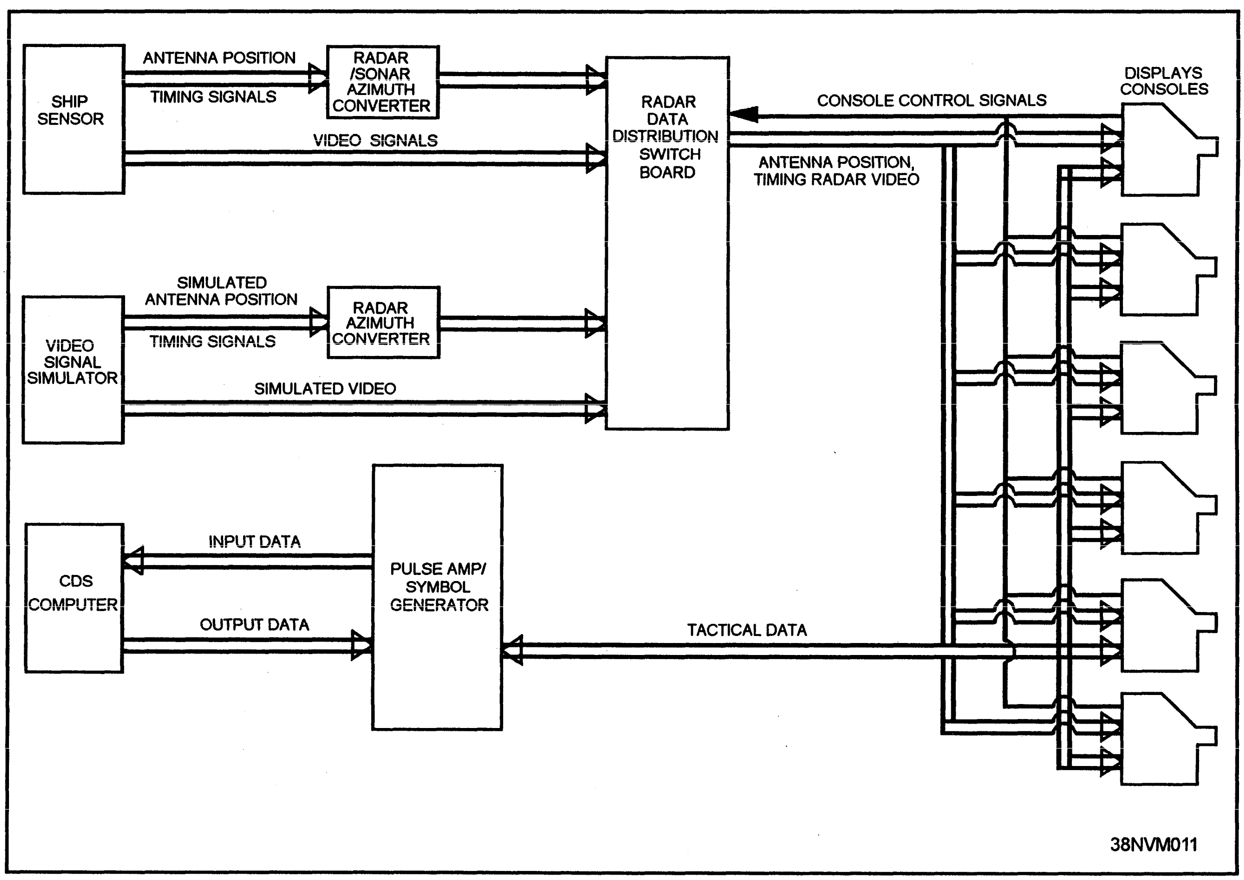


Figure 1-13.—The AN/UYA-4(V) data display system (typical).

two major types of deflection systems used to move the electron beam around the face of the CRT. Electromagnetic deflection systems use a series of coils mounted on a yoke to generate a magnetic field. The strength and polarity of the magnetic field cause the beam to deflect. Electrostatic deflection systems use four deflection plates mounted inside the CRT to move the beam. A voltage is applied to each plate. The polarity and strength of the voltage determine the amount and direction the beam is moved.

CRT SCANNING– CRT scanning moves the electron beam around the face of the CRT to create the display. The two methods of CRT scanning are raster scanning and vector scanning.

RASTER SCANNING— Raster scanning develops the display by painting a series of lines across the CRT. There are two types of raster scan: interlaced scan and noninterlaced scan. Interlaced scan uses a method of painting all the even lines of a frame from top to bottom, then returning to the top of the CRT and painting the odd frames. It is used in television and low resolution digital monitors. Noninterlaced scan paints each frame as a series of consecutive horizontal lines and is used with most digital monitors. Noninterlaced scan is used to increase the resolution of the display.

VECTOR SCANNING– Vector scan CRTs have the ability to move the electron beam to any desired point on the CRT at any time. They are used in oscilloscopes and many radar display consoles. The electron beam is moved to the desired location by using an X/Y coordinate system that defines the exact location of the beam.

COLOR CATHODE-RAY TUBES– The color CRT works in a very similar manner to the monochrome CRT. The major difference is that the color CRT has three electron beams that are synchronized to strike dyed phosphor dots on the face of the CRT. These dots are red, blue, and green, the primary colors of light.

DISPLAYING RADAR SWEEP, VIDEO, AND SYMBOLS– The AN/UYA-4(V) data display group uses vector scan CRTs in the plan position indicator (PPI). The PPI is usually under the control of the radar sweep logic and switches to symbol display logic when a message is received from the computer.

RADAR SWEEP AND VIDEO– Radar sweep originates in the center of the CRT and travels outward until the edge of the CRT or the end-of-sweep signal is reached. The radar azimuth is developed by ΔX and ΔY pulse trains developed by a piece of ancillary equipment. Video returns are displayed as intensified sweep.

SYMBOL GENERATION– Symbols are generated from data messages outputted by the computer. Two methods of painting symbols are used in the AN/UYA-4(V) system: the analog waveform method and the digital stroke method. The analog waveform method uses a separate piece of equipment called a symbol generator. The symbol generator decodes the computer messages and generates X, Y, and Z waveforms to paint the proper symbo1. The X and Y waveforms are applied to the CRT deflection plates, while the Z waveform controls the unblinking of the electron beam. The digital stroke method stores the symbol in ROMs or PROMS as digital codes. The digital stroke symbols are generated by each console when the console is equipped with the console internally generated and refreshed symbols (CIGARS) modification or by a type of symbol generator.

DISPLAY SYSTEMS– The Navy currently uses two major display systems in the fleet: the Data Display Group AN/UYA-4(V) and the Computer Display Set AN/UYQ-21(V). Both systems are designed to provide a real-time display of the tactical picture using ship's sensor data and tactical data from the CDS computer.

CHAPTER 2

PERSONAL COMPUTER VIDEO DISPLAYS AND INPUT DEVICES

INTRODUCTION

The video display is one of the versatile pieces of equipment in a computer system. When used in a large system, it displays the status of computer operations and displays the results of maintenance programs. When used with a personal computer, the video monitor is the primary output device the computer uses to communicate with the user.

In addition to having a video monitor as an output device, most computers also have at least one input device, such as a keyboard. The input devices enables the user to control the computer.

After completing this chapter, you should be able to:

- **Describe the operation of video display monitors used with personal computer systems**
- **Describe the operation of MDA, CGA, EGA, VGA, SVGA, and XGA graphics adapters used to drive video monitors**
- **Describe the operation of flat screen displays using liquid crystal display technology**
- **Describe the operation of various input devices used with video display terminals**

VIDEO DISPLAY MONITORS AND ADAPTERS

The video display monitor is the primary output device that interfaces the user to the computer. In this section, we cover the different types of video displays used with personal computers.

Video displays have two main components: the video monitor and a video adapter. The video adapter is plugged into the PC's motherboard.

VIDEO DISPLAY MONITORS

Video display monitors come in a variety of shapes, sizes, and capabilities. They can be color or monochrome, use interlaced or noninterlaced scan, and require either analog or digital (cathode-ray tube [CRT]) drive signals.

Composite video monitors are the simplest type of monitor. The video signal is combined on a single line with the horizontal and vertical timing signals before being sent to the monitor. The monitor electronics separate the video signals and the horizontal and vertical timing signals. Composite monitors can be either monochrome or color.

RGB (red, green, blue) monitors are color monitors that use a separate input for each color. They have greater resolution than the composite video monitors.

EGA (Enhanced Graphics Adapter) and **VGA** (Video Graphics Array) monitors are RGB monitors that have even greater resolution. Both EGA and VGA monitors display sharper characters and graphics than does the RGB monitor. EGA monitors can display 43 lines of text instead of the standard 25 lines of the RGB monitor. VGA monitors can display up to 50 lines of text.

VGA monitors are designed to use analog signals rather than digital signals to drive the CRT guns. Digital signals limit the maximum number of colors that can be displayed to 16. By using variable (analog) signals to drive the CRT guns, current video adaptersand monitors are capable of displaying over 256,000 colors. The super VGA and XGA monitors also use analog signals. If you are upgrading your monitor, be sure that the display adapter is compatible with the new monitor.

Also, there are multiscan or multisync monitors that can be used with a variety of video cards. These monitors detect the rate that data is being received and adjust their scan rates to match the input.

As you can see, the type of monitor you have must be compatible with the type of video card in the computer. You can literally burn up a monitor by plugging it into the wrong type of video card.

Video monitors require very little preventive maintenance. They should be cleaned periodically to remove any dust that has collected on the components. Repair of a failed monitor is difficult because the monitor diagrams are hard to obtain from the manufacturer. Also, the price of the repair parts often exceeds the cost of a new monitor.

VIDEO DISPLAY ADAPTERS

The video display adapter is a circuit card that plugs into the personal computer to drive the monitor. Video adapter cards play a major role in how many colors are displayed and the speed with which the display is updated. Common video adapters are:

- MDA (Monochrome Display Adapter)
- CGA (Color Graphics Adapter)
- EGA (Enhanced Graphics Adapter)
- VGA (Video Graphics Array)
- SVGA (Super Video Graphics Array)
- XGA (Extended Graphics Array)

Monochrome Display Adapter (MDA)

The monochrome display adapter (MDA) was the first display adapter available. It is designed to work with a monochrome **transistor-transistor logic** (TTL) monitor. It is a text-only system that cannot display graphics or color. The MDA uses a 9 x 14 dot character box that provides clean sharp characters. Because most of the software packages developed today, even word processing and spreadsheets, use graphics to some extent, the MDA is generally considered obsolete.

Color Graphics Adapter (CGA)

The color graphics adapter (CGA) was, at one time, the most common graphics adapter available. It supports an RGB monitor with a maximum resolution of 640 x 200 pixels. The CGA card has two modes of operation: alphanumeric (A/N) and all points addressable (APA). In both modes, the basic character set is formed with a resolution of 8 x 8 pixels. The CGA card displays either 40 or 80 columns with 25 lines of text. In the A/N mode, the CGA card can display up to 16 colors.

The all points addressable mode of operation can address each pixel individually. The CGA APA mode supports two resolutions on the screen: medium and high. The medium resolution is capable of addressing 320 x 200 pixels with 4 colors. The high resolution is capable of a 640 x 200 display using 2 colors. Because of these limitations, the CGA adapter is generally considered obsolete.

Enhanced Graphics Adapter (EGA)

The enhanced graphics adapter (EGA) superseded the CGA adapter and drives an RGB monitor. The EGA provides 16 colors at a resolution of 320 x 200 or 640 x 200. The character box for text is 8 x 14 instead of the 8 x 8 used with the CGA card.

The EGA card comes with 64K of video memory that is expandable to 256K using a graphics memory expansion card. This card adds an additional 64K of video memory. The EGA card also uses 128K of RAM from the computer's RAM. The video is stored just above the 640K boundary. Video memory is used to refresh the display, freeing up the CPU chip for other operations.

Video Graphics Array (VGA)

The video graphics array (VGA) adapter card overcame the limitations earlier adapters had in displaying high quality color. The earlier adapters used digital signals to control the three electron guns of the CRT. Each gun was either turned on or off by these signals and limited the display to 8 colors. By adding a high and a low intensity signal, the number of colors that could be displayed was doubled to 16.

The VGA card generates analog signals to control the electron guns and, therefore, can control the intensity of each gun at varying levels. Current VGA cards are capable of displaying 256 colors and generating 262,144 (256K) colors. Since the VGA generates analog signals, be sure the monitor is capable of accepting these signals.

The VGA card displays text in a 9 x 16 character box and has a resolution of 640 x 480.

Super Video Graphics Adapter (SVGA)

Super video graphics array (SVGA) is a term used to describe graphic adapters that have exceeded those of the VGA system. As of now, there is no set standard for SVGA. Resolutions for SVGA vary by manufacturer but 800 x 600 and 1024 x 780 are common. Some SVGA cards work on a 60-Hz vertical scan rate and some use 70 Hz. Once an SVGA card is installed, a software driver that describes the specifications of that card needs to be installed.

Extended Graphics Array (XGA)

The extended graphics array (XGA) is a refinement of the VGA standard. The XGA system provides a 32-bit bus master for micro channel-based systems. The bus master has its own processor that allows it to operate independently of the motherboard, freeing the main processor.

The XGA system also provides greater resolution and more colors than the VGA system. The XGA can hold up to 1M of video memory. Resolution is variable, depending on the mode selected. Maximum resolution is 1024 x 768, with the capability of displaying 256 colors from a palette of 262,144 colors. The XGA can also display 65,536 colors at a resolution of 640 x 480, providing almost photographic quality color.

Video Adapter Maintenance

As with the monitor, maintenance of video driver cards is generally limited to replacement of the card. Special test equipment is available for component level repair of some video drivers.

LIQUID CRYSTAL DISPLAYS

The development of laptop and notebook computers required a high resolution flat screen display with low power consumption. The most popular are passive and active matrix liquid crystal displays (LCDs).

Liquid crystals have been used for digital calculators and watches for years, but the size required had made them impractical for computer use. Recent improvements in LCD technology reduced the size of the LCD pixel to compare with the size of a CRT pixel.

Liquid crystal displays operate on the principle of scattering the light from an outside source to provide the desired pattern. The display from a liquid crystal is usually gray or black, but color can be achieved through the use of filters or dyes. They require low power and low voltage, making them ideal for laptop and notebook computers.

In manufacturing LCDs, a clear, conductive material is deposited on the inside surfaces of two sheets of glass. This material acts as one electrode. The liquid crystal material is then deposited on the glass in the desired pattern. This pattern can be segmented (watches and calculators), dot matrix (graphic and computer screens), or a custom layout for special purposes. A terminal conductor is connected to an external terminal to control each liquid crystal. The two sheets of glass are then hermetically sealed at the edges.

Passive Matrix Liquid Crystal Displays

Passive matrix liquid crystal displays are used in most monochrome and color laptop computers today. The LCDs are arranged in a dot matrix pattern. Resolution of 640 columns by 480 rows is not uncommon. Characters are formed by addressing each row and column.

Color passive matrix LCDs use three layers of crystals each separated by a color filter. Color is achieved by energizing one, two, or all three LCDs for each pixel.

Passive matrix LCDs have some distinct disadvantages. They have low contrast. This lack of contrast has required the addition of a backlight to aid the user in viewing the screen. The response time to turn the pixels on and off is too slow for full-motion video and can produce a ghosting effect when changing full-screen displays. Color passive matrix LCDs are limited to displaying 16 colors simultaneously, even though the VGA adapter can have a palette of 262,144 colors.

Active Matrix Liquid Crystal Displays

Active matrix liquid crystal displays closely emulate the capabilities of the full-color CRT. The perfection of the thin film transistor (TFT) is largely responsible for the development of the active matrix LCD. Active matrix LCDs offer a brighter screen, provide response times fast enough to accommodate full-motion video, and can display 256 colors simultaneously.

In manufacturing an active matrix display panel, each pixel consists of three crystals, one each for red, green, and blue. Three TFTs control each pixel, one for each color. The TFT technology allows for entire logic circuits, driver circuits, and even microprocessors to be deposited transparently on the glass plates, increasing the brightness, speed, and color quality of the display.

INPUT DEVICES

The displays discussed in this chapter are output devices. They display information from the computer for the user. To allow the user to act on the information being displayed, some type of input device is required. The most common input device is a keyboard. Increasing in popularity are cursor pointing devices such as the mouse or trackball.

KEYBOARD

The keyboard is the basic input device for personal computers. There are several styles of keyboards available, but the most common one today is the 101-key enhanced keyboard.

Keyboard Layout

The 101-key enhanced keyboard made several improvements over the 84-key keyboard. Two new function keys, F11 and F12, were added. The function keys were moved from the left side of the keyboard to the top of the keyboard. A group of dedicated cursor and screen control keys were added and the CTRL and ALT keys were duplicated and placed on each side of the space bar.

The 101-key enhanced keyboard has four functional areas:

- Typing area
- Numeric keypad
- Functions keys
- Cursor and screen controls

The typing area is the main section of the keyboard and is setup similar to a standard typewriter keyboard. The CTRL and ALT keys, located on either side of the space bar, allow the programmer to add additional meaning to standard keys. For example, when working with a word processing program, depressing the *CTRL* and *I* keys simultaneously may cause a macro program to run that will turn the *italics* font on or off.

The numeric keypad is located on the right side of the keyboard. It contains the 10 numeric keys (0 - 9), the keys required for addition (+), subtraction (-), multiplication (*) and division (/). An additional ENTER key was added to the numeric keypad to ease operation. Just like the 84-key keyboard, the numeric keypad can also be used for cursor and screen control when not in the NUMLOCK (number lock) mode.

The function keys are located in groups of four across the top of the typing area of the keyboard. The escape (ESC) key is in the top left corner and dedicated PRINTSCRN/SYSREQ, SCROLL LOCK, and PAUSE/BREAK keys are provided for these commonly used functions.

The cursor and screen control keys are located between the typing area and the numeric keypad. The cursor control keys are located on the bottom in an inverted T pattern. Above the cursor control keys are the INSERT, HOME, PAGE UP, DELETE, END, and PAGE DOWN keys.

Keyboard Operation

Two types of switches are used in keyboards. Most keyboards use microswitches for each key position. Depressing a switch sends the position data of that switch to the computer.

The other type of keyboard switch is the capacitive keyboard. The bottom of the keyboard is one large capacitor. Pushing a key switch pushes a paddle into the capacitive module, changing the capacitance of the module. This signal is interpreted by the keyboard microprocessor and sent to the computer.

Keyboard Compatibility

The original IBM PC and XT computers came equipped with an 83-key keyboard. When IBM introduced the AT computer, it came with a new 84-key keyboard. Later, the 101-keyboard was introduced with newer AT computers and has become the industry standard. The 84-key keyboard uses a different keyboard microprocessor than its 83-key predecessor and is not interchangeable. Many third party keyboard manufacturers have overcome this problem by enhancing the keyboard microprocessor and adding a switch on the bottom of the keyboard. This switch, marked AT/AX selects the system with which the keyboard is to be used. The keyboard microprocessor then executes the proper routines. Many 101-key keyboards are also equipped with an AT/XT SELECT switch. A computer that was originally equipped with an 84-key keyboard should accept a 101-key enhanced keyboard. If a 101-key keyboard is installed on a computer that was originally equipped with an 84-key keyboard and the new keys (Fl1, F12, etc.) do not function, then the ROM BIOS needs to be upgraded.

Keyboard Maintenance

Maintenance of keyboards consists of periodically cleaning the keyboard. Turn the keyboard over and gently shake it to dislodge any loose dirt. The keyboard can also be blown out with dry compressed air. If a microswitch-type keyboard has a key that is sticking, the key can be removed and cleaned or replaced.

MOUSE

The mouse is quickly becoming a very popular input device. Some programs, especially graphic user interface (GUI) programs, virtually require a mouse.

Mice are available in several shapes and sizes, but all operate in about the same way. The mouse case is plastic and designed to fit your hand. On the top of the mouse are two or more buttons. These buttons are used to indicate to the computer that an action is desired at the current location of the pointer. For example, one popular GUI program will activate a program when the cursor pointer is placed over a program icon and the left mouse button is pushed twice.

If you turn the mouse over, you will see a small rubber ball. As you move the mouse across the desk top, this ball rolls and moves the encoders inside the mouse. Remove the access plate and remove this ball and you will see two or three rollers. These are the position encoders that send movement data to the computer.

Mouse Connections

A mouse can be connected to the computer in several ways. These are the mouse port, a serial mouse, and a bus mouse.

The mouse port is the simplest way to interface the mouse with the computer. A special, dedicated port is built into the motherboard of the computer. The mouse is plugged directly into this port.

The serial mouse is plugged into one of the computer's serial ports. When the computer is booted, the mouse driver searches the ports to determine which port the mouse is connected to.

The bus mouse is for users that do not have a free serial port. The mouse is plugged into a special interface board that is installed into one of the computer's expansion slots. The mouse then communicates with the computer across the main bus.

Recently, some manufacturers have introduced the cordless mouse. The cordless mouse requires a special interface card that plugs into one of the expansion slots. The mouse is equipped with a small, low-power radio transmitter that transmits mouse movements to the interface card. The receiver on the interface card decodes the signal and sends it to the mouse driver program.

Mouse Maintenance

A mouse requires very little maintenance. About the only maintenance is to clean the mouse if the pointer movement is erratic or jerky. To clean the mouse, turn off the computer and remove the rubber ball. Clean the ball with a mild detergent and water. Clean the encoder rollers with a lint-free swab and a cleaning solvent such as denatured alcohol. Be sure the ball is completely dry before reinstalling it and applying power to the computer.

TRACKBALL

The trackball, used with personal computers, is another pointer device that can be used instead of the mouse. A trackball is basically a mouse turned over and the ball exposed. The user rolls the ball, moving the pointer on the screen. The trackball operates the same way the mouse does. Many laptop computers are being manufactured with a trackball installed in the keyboard, eliminating the need for an external mouse. Full-size keyboards are also available with a built-in trackball.

SUMMARY-PERSONAL COMPUTER VIDEO DISPLAYS AND INPUT DEVICES

This chapter has presented material about video display monitors, video adapters, and their input devices. The following information summarizes important points you should have learned.

VIDEO DISPLAY MONITORS– Video display monitors come in several sizes and styles. They can be monochrome or color. They can be driven by digital or analog signals. Analog signals are able to present a higher quality picture.

VIDEO DISPLAY ADAPTERS– Video display adapters provide the signals to the monitor to display the picture. Video adapters can generate monochrome or color displays. It is extremely important that the monitor be compatible with the video adapter. A digital monitor connected to an analog adapter could cause serious damage to the monitor and computer. Several video adapters cannot generate graphic displays. Resolution of the display can be controlled by some video adapters. Many video adapters contain some random access memory (RAM) for refreshing the display.

INPUT DEVICES— Common input devices used with personal computers are the keyboard, mouse, and trackball. The 101-key enhanced keyboard is the most common keyboard and considered the standard keyboard. A mouse is a pointer device that allows the user to quickly move the cursor about the screen. The trackball functions in the same way as the mouse.

CHAPTER 3

THE DATA DISPLAY GROUP AN/UYA-4(V)

INTRODUCTION

The majority of maintenance actions performed on the Combat Direct System (CDS) involve the tactical display system. Tactical display systems have been in use as part of the Naval Tactical Data System (NTDS) since the late 1950s. During this time, the design of the tactical display system has evolved and undergone many modifications and improvements. This chapter will introduce you to the Data Display Group AN/UYA-4(V).

After completing this chapter you should be able to:

- **State the purpose of the Data Display Group AN/UYA-4(V)**
- **Describe the relationship between the Data Display Group AN/UYA-4(V) and the Combat Direction System**
- **Describe the sensor data signal flow in the Data Display Group AN/UYA-4(V)**
- **Describe the basic operation of the radar azimuth converter**
- **Describe the function of the radar data distribution switchboard**
- **Describe the signal flow of tactical data between the Combat Direction System computer and the Data Display Group AN/UYA-4(V)**
- **Describe the purpose and operation of the pulse amplifier/symbol generator**
- **Describe the functional operation of the plan position indicator**
- **Describe the functional operation of the video signals simulator**
- **Describe the function of the test message generator**

The overall requirement of any tactical display system is to provide a visual display of the real-time deployment of ships and aircraft, the tactical situation, and the geographical area of the situation.

To perform this requirement, the display system must be able to accomplish several functions. These system functions include:

- Sensor data distribution and display
- Tactical data distribution and display
- Data display group simulation and testing

The Naval Tactical Data System (NTDS) has evolved into the Combat Direction System (CDS). Through this evolution, the function and design of the tactical display system has remained fairly constant. On ships with the AN/UYA-4(V) display group, the basic equipment and signal flow are as shown in figure 3-1.

The block diagram can be split into three functions: sensor data, tactical data, and simulated data. Each of these functions ties together at the display console. In the this chapter, we look at each function and how it affects the picture on the display console.

SENSOR DATA DISTRIBUTION AND DISPLAY

Sensor data originates with the ship's sensors (radar, sonar, and IFF) and is ultimately displayed as sweep and video on the display console as shown in figure 3-1. Sensor data normally consists of two types of data: **antenna position** and **video signals.**

Antenna position data as it originates from the ship's sensors must be converted to a form usable by the AN/UYA-4(V) display consoles. Conversion of the sensor antenna position data is accomplished by radar azimuth converters (RACs) or sonar azimuth converters (SACS). In this chapter, we only discuss the operation of a RAC. One converter is required for each of the ship's sensors. The RAC outputs the timing signals and X/Y quantities necessary to generate that radar sweep display. The sweep data is fed from the RAC to the radar data distribution switchboard (RDDS) for distribution to the consoles.

Video signals are fed from the sensor or sensors to the RDDS and then to the consoles. The sweep generation logic of the consoles and timing signals from the RAC ensure that the intensified video is displayed at the proper range on the plan position indicator (PPI) sweep.

RADAR AZIMUTH CONVERTER (RAC)

The radar azimuth converter, or RAC, converts position data from each of the ship's radars into a digital quantity usable by the display console and the computer. The antenna position data coming into the RAC maybe in synchro or digital form, depending on the characteristics of the radars installed on the ship. The RAC develops a series of signals known as ΔY and ΔY pulse trains and the sign of ΔX and sign of ΔY to send to the display console to paint the sweep in the proper position. The RAC also develops a digital data word that contains the azimuth of the antenna that is transferred to the CDS computer. This data word is known as digital theta and is represented by the Greek letter theta (θ).

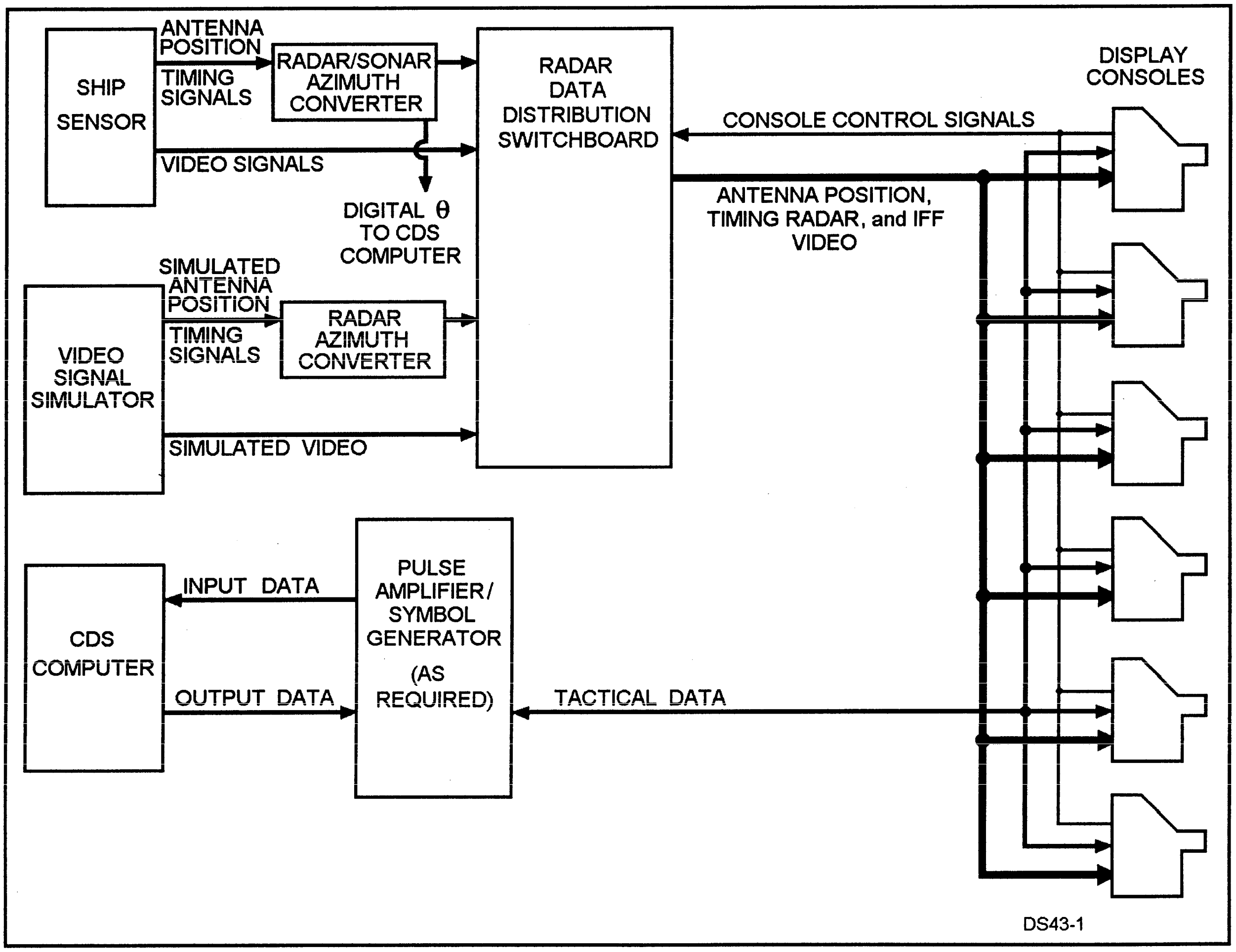


Figure 3-1.—The AN/UYA-4(V) data display system.

The ΔX and ΔY pulse trains are generally developed by using the sine and cosine of the antenna angle. The sine and cosine of the antenna angle will define the angle in a 90-degree quadrant. The sign bits (sign of ΔX, sign of ΔY) will determine in which quadrant the sweep will repainted. The quadrants and required sign bits are illustrated in figure 3-2.

The ΔX and ΔY pulse trains are sent to the display console where they cause a pair of digital counters to increment one time for each pulse. The number of pulses between the zero mile range mark (start of sweep) and the end of sweep signal denotes the radar sweep angle, and the spaces between pulses indicate the range of the sweep. For example, the sine and cosine of 45 degrees are equal to each other. To paint a sweep at 45 degrees, the sign of ΔX and the sign of ΔY will both be positive indicating quadrant one. In developing the ΔX and ΔY pulse trains, the number of pulses for each would be equal. This will increment

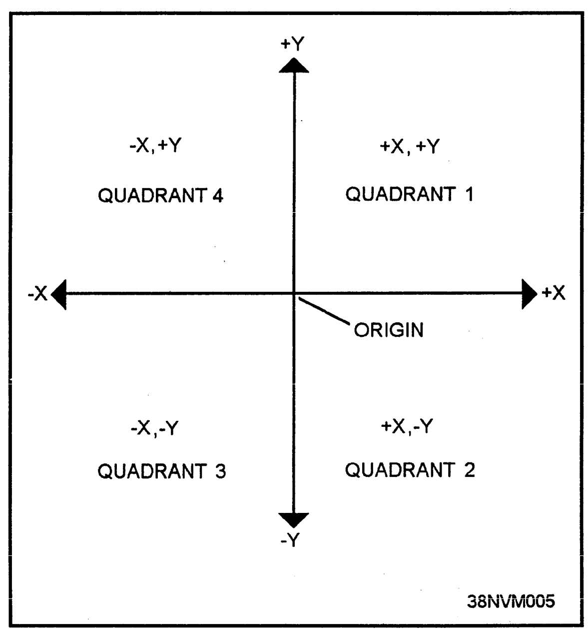


Figure 3-2.—The X/Y quadrants of a CRT.

the sweep counters in the display console at the same rate. The output of the sweep counters is continuously fed to the deflection circuitry, and the beam will be deflected at 45 degrees.

Figure 3-3 shows the front panel of a typical RAC. The RACs installed on your ship may not look exactly like this one. On this particular RAC panel, internal testing is accomplished by using the MODE SELECTOR switch. Most RACs have a similar MODE SELECTOR switch that operates in the same basic manner. When the MODE SELECTOR switch is in the OPERATE position, the RAC operates with its radar. The other switch positions of the front panel are used for maintenance and troubleshooting as shown in table 3-1.

The RACs are combined together into a cabinet or cabinets called the radar azimuth converter group. The cabinets provide a common power supply and mountings for several RACs. The output of the RACs are fed to the radar data distribution switchboards (RDDSs).

RADAR DATA DISTRIBUTION SWITCHBOARD (RDDS)

The radar data distribution switchboard (RDDS) routes radar and sonar antenna position data and timing signals from the sensor RACs to the display consoles. It also receives up to four separate video signals (video levels) directly from each sensor.

Table 3-1.—The MODE SELECTOR Switch Functions

MODE SELECTOR Switch Position	Function
OPERATE	Normal mode, RAC is driven by external sensor signals.
Δθ STEP	RAC increments one Δθ every time the Δθ RESET CP (clock pulse) pushbutton is depressed.
RESET	Resets the RAC bearing to zero when the Δθ RESET CP pushbutton is depressed.
CP STEP	RAC generates one clock pulse every time the Δθ RESET CP pushbutton is depressed.
CONTINUOUS	RAC will generate a continuous simulated radar sweep, independent of radar signals.

The RDDS provides the display consoles access to all the sensors connected to the switchboard. The RDDS can accept inputs from 11 radar or sonar sensors and provide outputs to display consoles on 10 output channels, one standard display console per

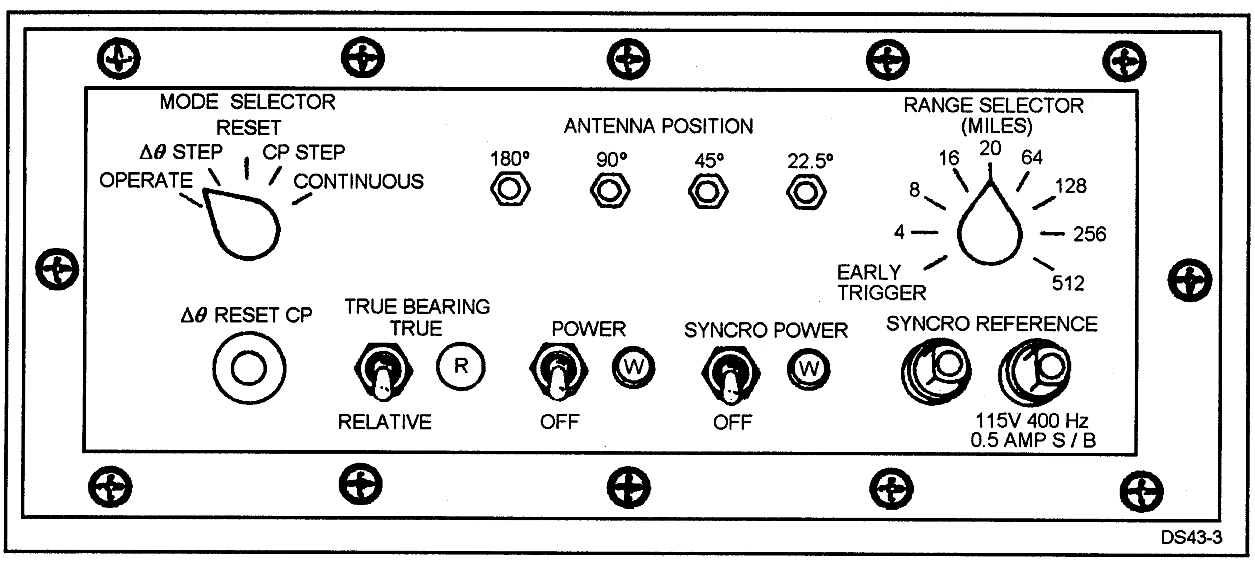


Figure 3-3.—A typical RAC front panel.

channel. Each of the ship's sensors can be connected, in parallel, to four switchboards to provide sufficient outputs for each display console in the system.

Figure 3-4 shows the front panel of the RDDS. When the VIDEO SELECT or RADAR SELECT switches are in the REMOTE position, switching circuits within the RDDS allow the display console on an output channel to select any of the sensors inputting to the RDDS as the source of its sensor display. The display consoles select the sensor (radar/sonar) and video level by sending control signals to the RDDS. In the event of a console control signal problem, manual selection of sensor and video may be performed at the RDDS front panel.

TACTICAL DATA DISTRIBUTION AND DISPLAY

Tactical data is digital data received from or transmitted to the CDS computer. Tactical data from the computer (output data) is used by the display system to generate symbol displays and alert/switch indications on the display consoles and alphanumeric displays on the digital display indicator (DDI), also called the auxiliary cathode readout (ACRO). Tactical data going to the computer (input data) results from operator actions (switch depressions, trackball movement, and so forth) at the display consoles.

Figure 3-5 illustrates the data path of tactical data. This data path can vary depending on the type of system installed on your ship. Systems using the console internally generated and refreshed symbols (CIGARS) modification will not have a separate symbol generator. Systems using the direct computer interface (CDI) CIGARS consoles will not have the pulse amplifier/symbol generator.

In this section, we examine the format of the different data words and messages used by the CDS system. This is followed by' a brief description of some of the equipment used to display tactical data.

COMPUTER DATA WORD FORMATS

This section describes the contents and functions of the computer words outputted to the display

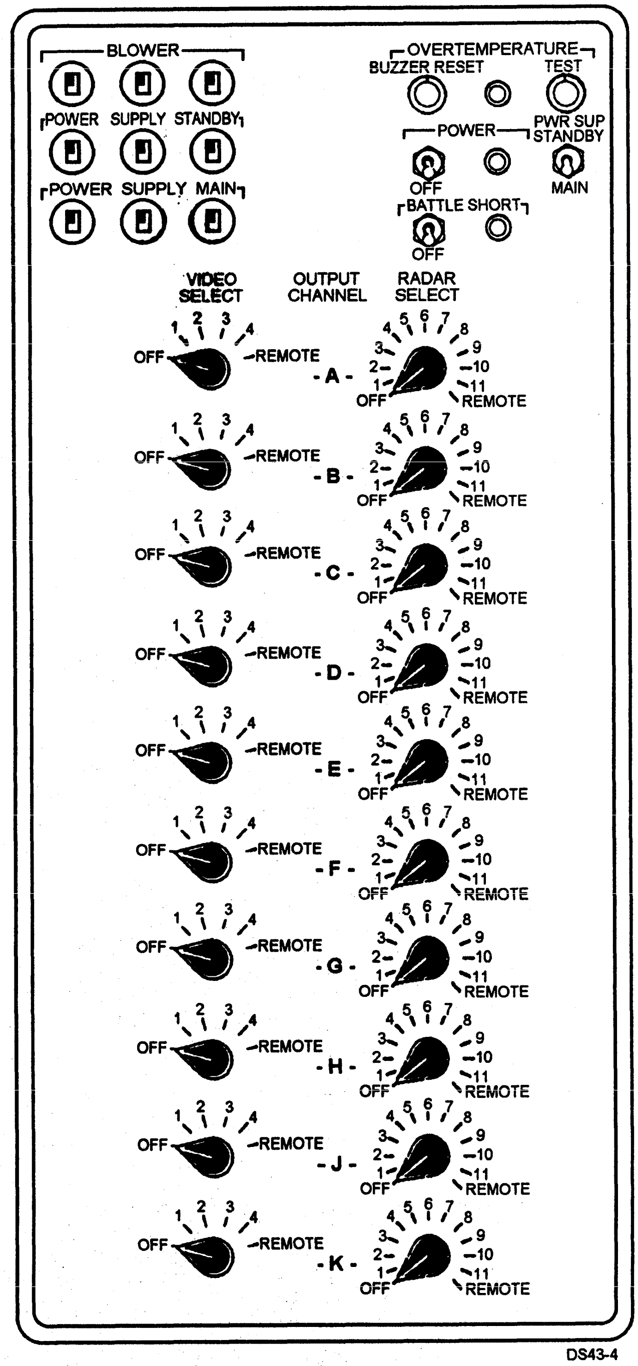


Figure 3-4.—The RDDS front panel.

consoles.

External Function (EF) Word

The external function (EF) word is used to interrogate the addressed console for input data. In addition, for CIGARS consoles, portions of the word

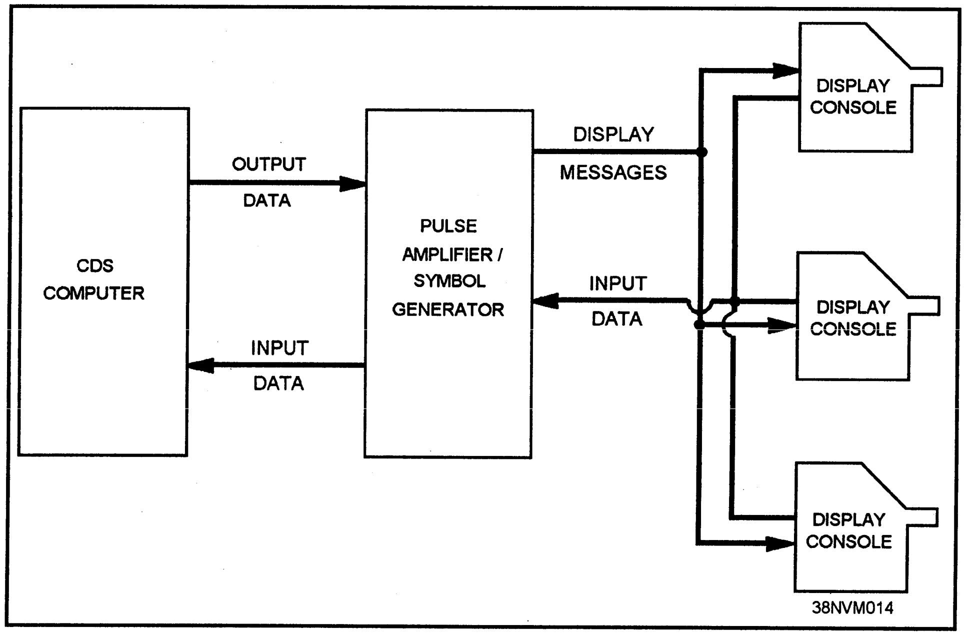


Figure 3-5.—The tactical data path.

are used for CIGARS memory load commands. The format of the external function word is shown in figure 3-6.

Input Data Words

The input data words are formed by the display console logic based upon operator actions. Most operator switch closures or changes will result in the generation of an input word. When the console receives an interrogation EF, the console inputs the input data word to the computer via the pulse amplifier (PA) or direct computer interface (DCI).

Each data word sent to the computer consists of a six-bit function code (lower six bits) with the remainder of the word dedicated to data amplifying the function as shown in figure 3-7. For instance, a function code of 00 (binary coded octal) with all zeros in the amplifying data indicates no new data since the last interrogation (no operator switch actions since the last interrogation). A function code of 01 indicates the trackball is enabled. The amplifying data indicates the coordinates of the trackball and range selection of the console.

Input data words are developed for the console display control panel and communication panel switch closures, for the trackball and its control switches, and for the digital data entry unit (DDEU) and computer-controlled action entry panel (CCAEP) switches.

Output Data Word Types

The contents and functions of the computer words generated by the CDS computer and outputted to the

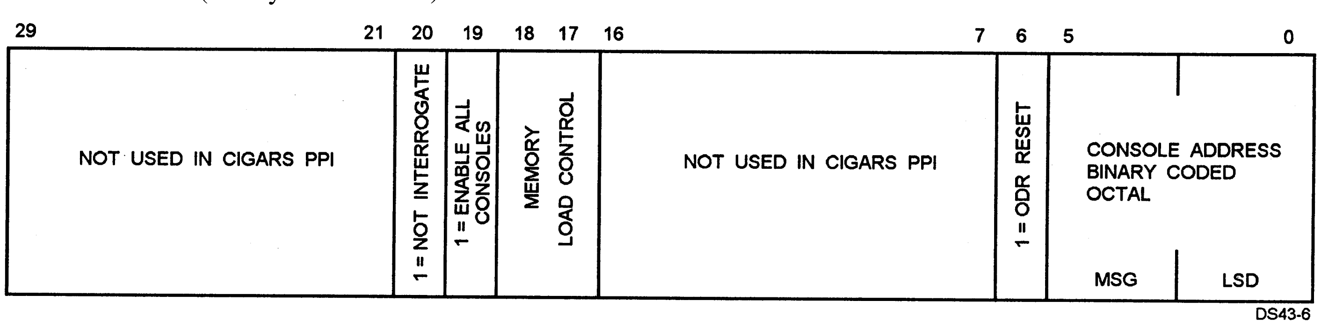


Figure 3-6.—The external function (EF) word format.

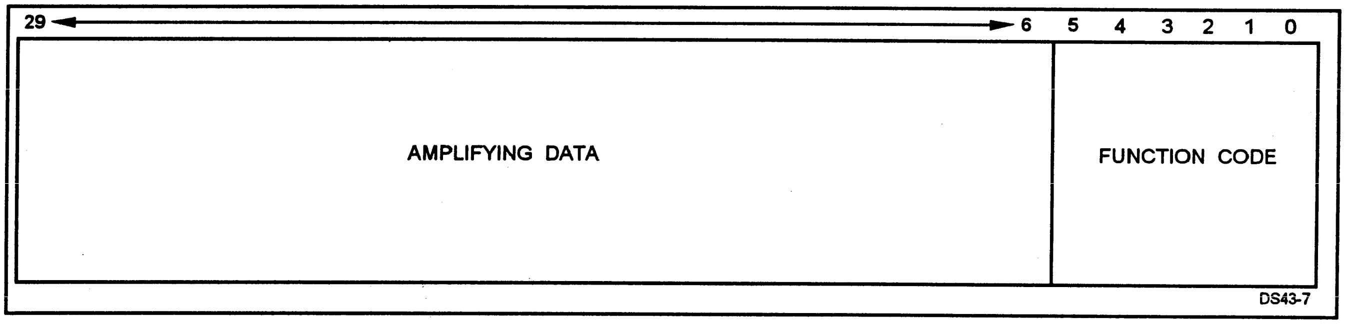


Figure 3-7—The input data word format.

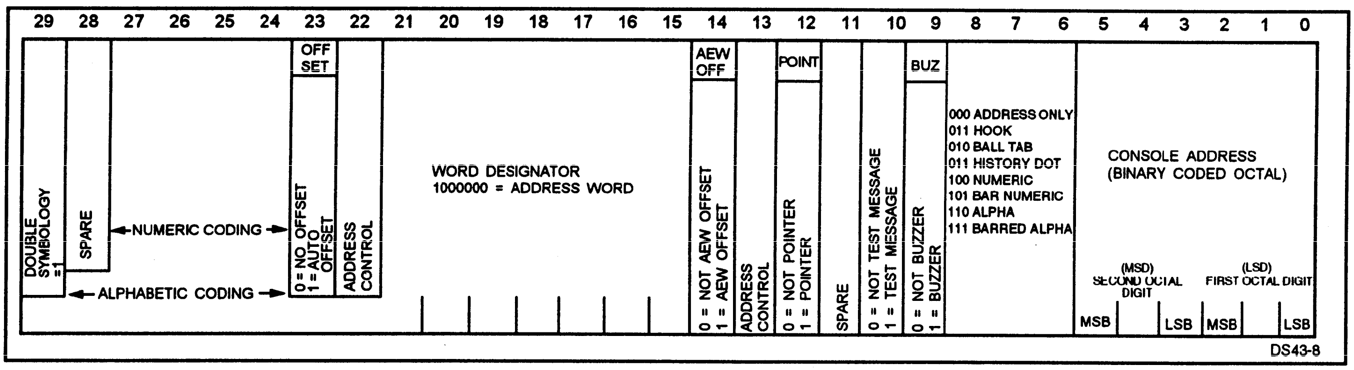


Figure 3-8.—The address word format.

display group are described in the following paragraphs.

ADDRESS WORD.— The address word performs two major functions. It addresses or excludes a particular console from acting on the following message data, and it forms the first word of addressed display messages.

The address word format is shown in figure 3-8 and contains the address word designator (bit $2^{21}=1$ and bits 2^{20} to $2^{15}=0$), the console address of the console (bits 2^{5} through 2^{0}) to be addressed or excluded, symbol type definition, PPI buzzer commands, auto offset commands, and double symbology commands.

VELOCITY/CATEGORY (V/C) WORD.— The velocity/category (WC) word identifies the type of symbol, line, or circle to be displayed. For symbols, the length and type of velocity leader (indicating direction and speed of movement) are specified. One inch of leader indicates 1,080 knots speed for an air track or 33.8 knots for a sea (surface/ subsurface) track.

The V/C word format is shown in figure 3-9. It contains the word designator, velocity leader data including scale factor, type (air/sea), X/Y velocity, and symbol data. The symbol data includes category/subcategory, auto/manual and local/remote status, threat, identity, and engagement status.

When the V/C word is used-to define a line, the word will indicate if the line is to be solid or dashed.

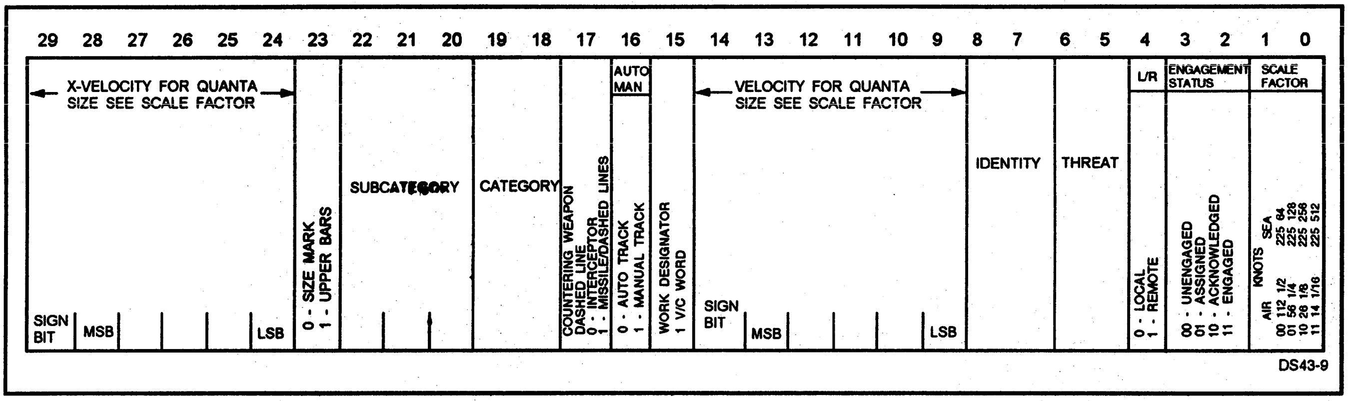


Figure 3-9.—The velocity/category word format.

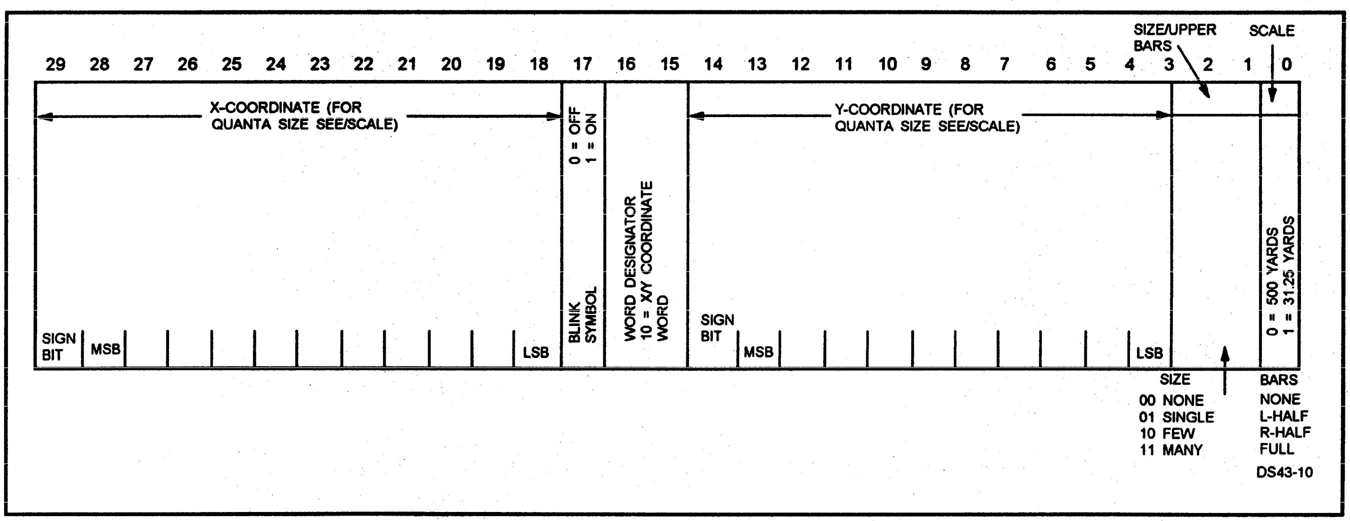


Figure 3-10.—The X/Y coordinate word format.

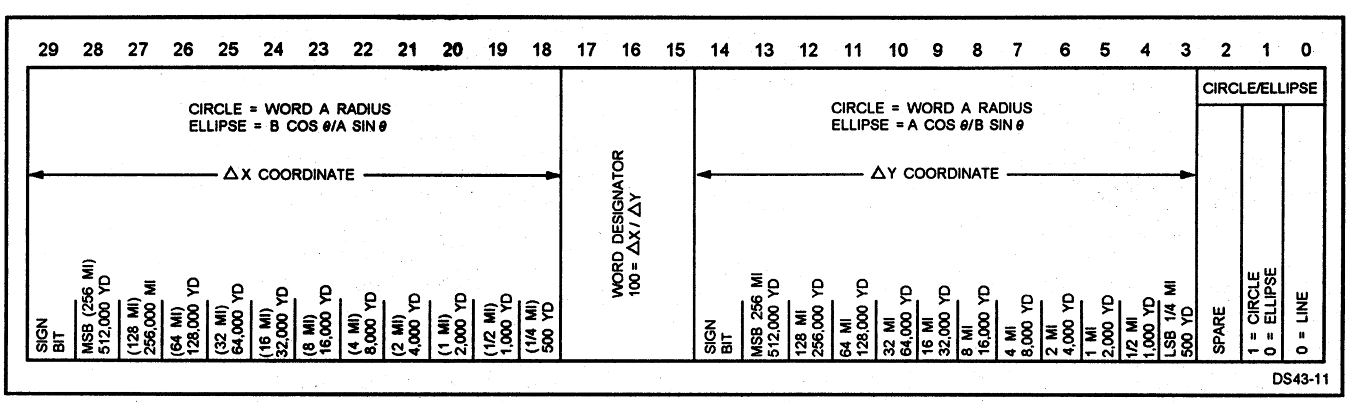


Figure 3-11.—The ΔX/ΔY coordinate word format.

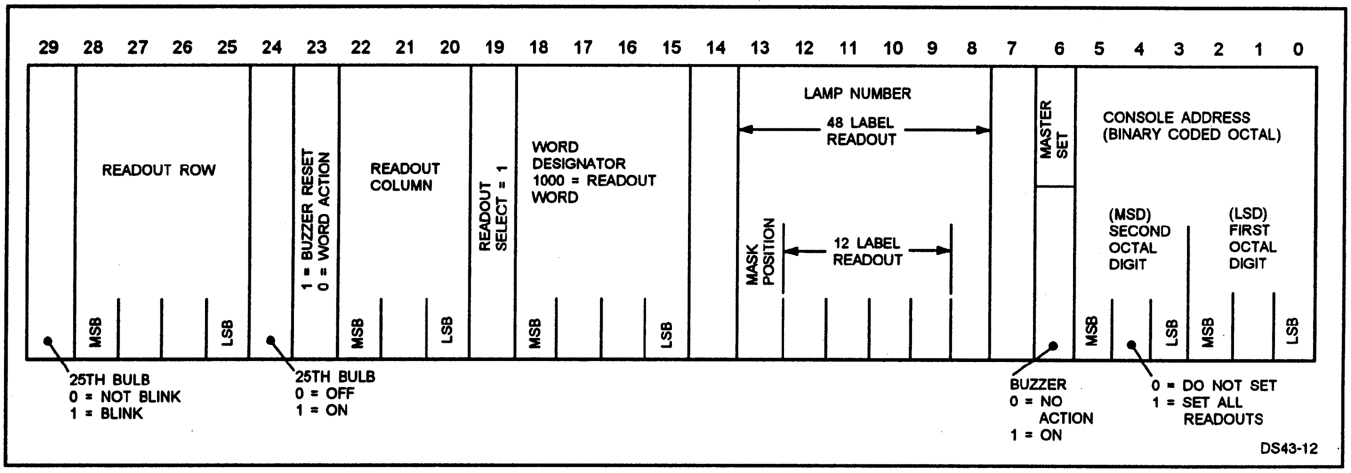


Figure 3-12.—The 48-label readout word.

X/Y COORDINATE WORD.— The X/Y coordinate word format is shown in figure 3-10. It is used to define a point on the CRT X/Y grid. This point may be one of the following: the center point of a symbol or circle, the starting point of a line, or the amount of offset in the display. In addition, the word provides symbol modifier (size/upper bar position) and blink (2Hz) commands.

ΔX/ΔY WORD.— The ΔX/ΔY word is shown in figure 3-11 and is used with lines and circles/ellipses. When used with lines it defines the length and direction of the line. When used with circles/ellipses it defines the major and minor axis radii.

48 LABEL READOUT WORD.— The 48 label readout word is shown in figure 3-12 and is used to illuminate the computer controlled action entry panel (CCAEP) 48 label readouts. It defines the switch row and column, and the lamp number. It may also be used to energize or reenergize the PPI buzzer.

Message Format

Output messages to the display consoles are composed of one or more of the computer words we have already discussed. Each message is designed to define a particular display function. Figure 3-13 lists the display message types and indicates the computer words, in order, that compose the particular messages.

NORMAL MESSAGE.— This message is generated by the computer to locate and describe a particular track symbol and velocity leader to all the consoles. The X/Y coordinate word provides the information to position the symbol on the CRT. The V/C word provides the velocity, category, identity, and engagement status of the symbol, As the message is not addressed to any particular console, the console category selection switching is used to control the symbol display.

ADDRESSED NORMAL MESSAGE.— This message is the same as a normal message except that it is preceded by an address word to address the message to a particular console.

ALPHANUMERIC, HOOK, BALLTAB, HISTORY DOT, AND POINTER MESSAGES.— These addressed messages consist of an address word and an X/Y coordinate word. They are designed to display the particular alphanumeric, bar alphanumeric, or indicated symbol on the addressed console only.

LINES MESSAGE.— This message is designed to draw a line on the PPI display. The message consists of a ΔX/ΔY coordinate word to define the slope and length of the line, an X/Y coordinate word to specify the starting point, and a V/C word to identify the type of line.

ADDRESSED LINES MESSAGE.— This message (not shown) is the same as the lines message except that it is preceded by an address word to address the message to a particular console.

STANDARD CIRCLES MESSAGE.– This message is used to display one of the 13 types of standard circles. The X/Y coordinate word specifies the center of the circle and the V/C word defines the type of circle and therefore its diameter. The standard circles message may be addressed to a particular console.

PROGRAMMABLE CIRCLES AND ELLIPSES MESSAGE.— This message generates up to 512 different diameter circles and ellipses. The circle message consists of a circle word (modified ΔX/ΔY coordinate word) which defines the A and B radius of the circle, an X/Y coordinate word that defines the center of the circle, and a V/C word that defines the type of circle.

The ellipse message consists of two ellipse words that define the major and minor axis and angle of inclination of the ellipse, an X/Y coordinate word that defines the center of the ellipse and a V/C word that defines the type of ellipse.

Both programmable circle and ellipse messages may be addressed to a particular console.

OFFSET MESSAGE.– The offset message offsets the display of sweep and symbols to any position on the CRT if the console operator has selected OFFSET on his console. The X/Y coordinate word indicates the amount of offset to the addressed console.

PULSE AMPLIFIER/SYMBOL GENERATOR (PA/SG)

The PA/SG is actually two pieces of equipment in one cabinet. Several different configurations of this equipment are available and the one installed with your system is dependant on the type of display consoles on the ship. The basic AN/UYA-4(V) system uses the PA/SG configuration. Systems with the CIGARS modification installed will have the pulse amplifier but not the symbol generator. Systems with CIGARS and direct computer interface (DCI) will not have a PA/SG.

- NORMAL MESSAGE
  - X/Y coordinate word
  - V/C word
- ADDRESSED NORMAL MESSAGE
  - Address word
  - X/Y coordinate word
  - V/C word
- ALPHANUMERIC, HOOK, BALL TAB, HISTORY DOT, and POINTER MESSAGES
  - Address word
  - X/Y coordinate word
- LINES MESSAGE
  - ΔX/ ΔY coordinate word
  - X/Y coordinate word
  - V/C word
- STANDARD CIRCLES MESSAGE
  - X/Y coordinate word
  - V/C word
- PROGRAMMABLE CIRCLES MESSAGE
  - ΔX/ ΔY coordinate word
  - X/Y coordinate word
  - V/C word
- PROGRAMMABLE ELLIPSES MESSAGE
  - ΔX/ ΔY coordinate word
  - X/Y coordinate word
  - V/C word
- OFFSET MESSAGE
  - X/Y coordinate word

DS43-13

Figure 3-13.—Display messages.

Pulse Amplifier

The pulse amplifier (PA) provides for the amplification and distribution of computer input and output data between the display consoles and the

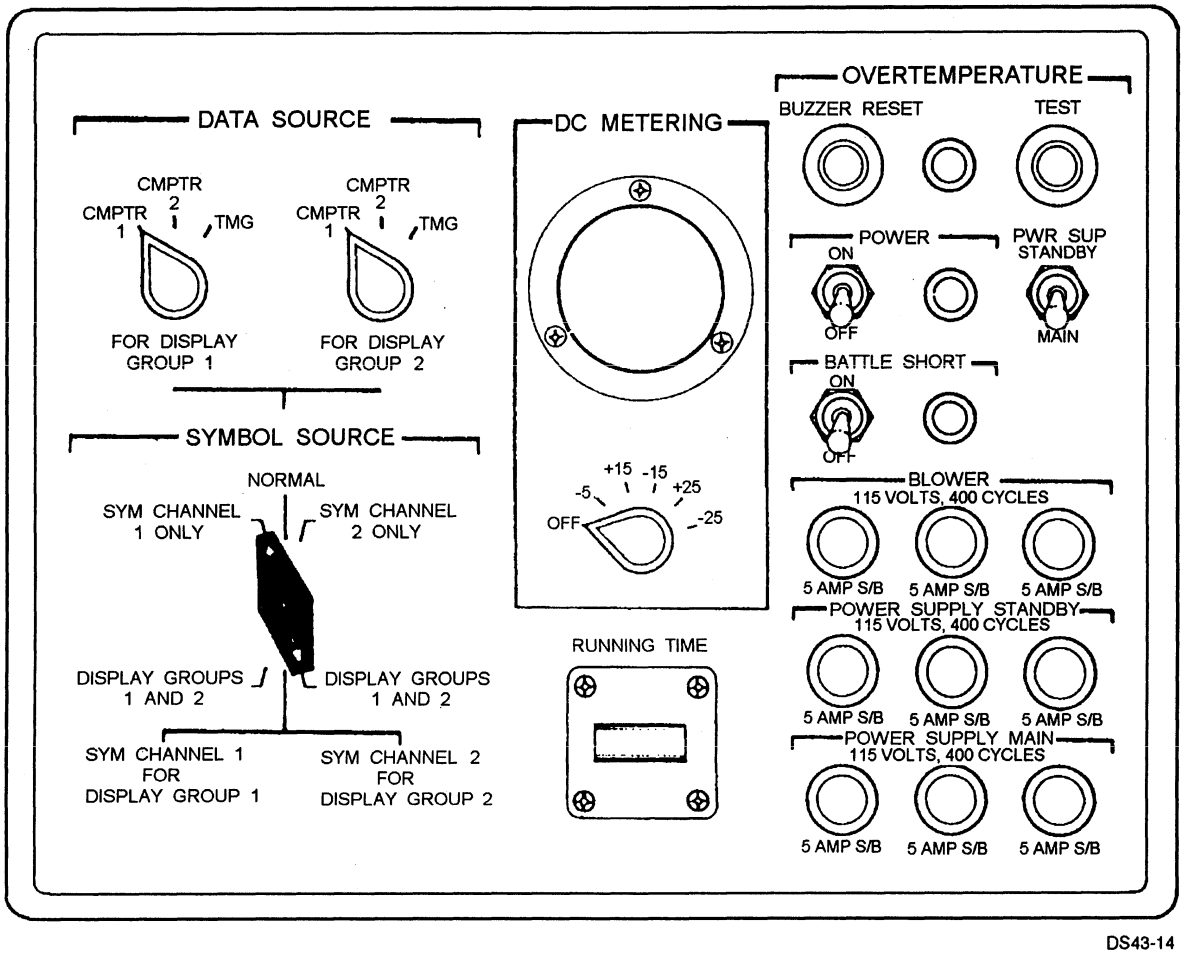


Figure 3-14.—The PA/SG front panel.

CDS computer. Display consoles in tactical systems are divided into two or more display groups, with up to ten consoles in each group.

PAs come in three configurations: single channel, dual channel, or 4-channel. A single channel CPA can interface with one computer and one display group. A dual channel CPA interfaces two computers with two display groups, and a 4-channel CPA interfaces up to 4 computers with 4 display groups.

Symbol Generator

For those systems using waveform symbol generators, there is one SG for each output channel of the PA. A single symbol generator can drive two display groups in the event of malfunctions. In a dual channel PA either computer channel or SG can be used to control both display groups. This switching arrangement allows the display to be divided for maintenance (one group for normal operations, and one group for testing) or controlled from one computer for normal operations or system level testing.

Figure 3-14 shows the front panel controls for a dual channel PA/SG. The DATA SOURCE switches control the computer and TMG (test message generator) selection for the two display groups (1 or 2). The SYMBOL SOURCE switch controls the configuration of the symbol generators. In the NORMAL position, each of the two SGs drive one display group.

The symbol generator can uses analog waveforms or digital strokes to generate symbols. The methods of symbol generation (analog or digital) are covered in chapter one of this training manual.

PLAN POSITION INDICATOR (PPI)

The plan position indicator (PPI), or display console, is the heart of the tactical display system. The PPI console allows its operator to view the inputs from the ship's sensors (radar/sonar/IFF) and tactical symbology, to operate in the desired program mode, and to communicate by voice with other consoles, ship's spaces, or remote ships and aircraft.

The PPI display consoles you will encounter in the fleet come in several system and design variations. The PPI console shown in figure 3-15 is a typical PPI. Although we highlight the features of several different consoles in this section, some areas discussed may not be applicable to the consoles on your ship.

The display console provides an operator (seated) with up to a 2,000-symbol tactical display on a 10.7-inch-diameter CRT. Amplifying alphanumeric information is provided by up to two IP-1304 DDIs mounted on top of the console.

Each water-cooled console contains its own high-voltage and low-voltage power supplies. The high-voltage power supply (hvps) provides the voltages necessary to drive the 10.7-inch CRT. The low-voltage power supply (Ivps) provides for the logic power and lamp indicators. The console microprocessors and other logic are located in the card box beneath the console bullnose.

Front Panel Controls and Indicators

The console control panels are shown in figure 3-16. The display, CRT controls, and data entry devices are located for ease of use and maximum flexibility in the console operation.

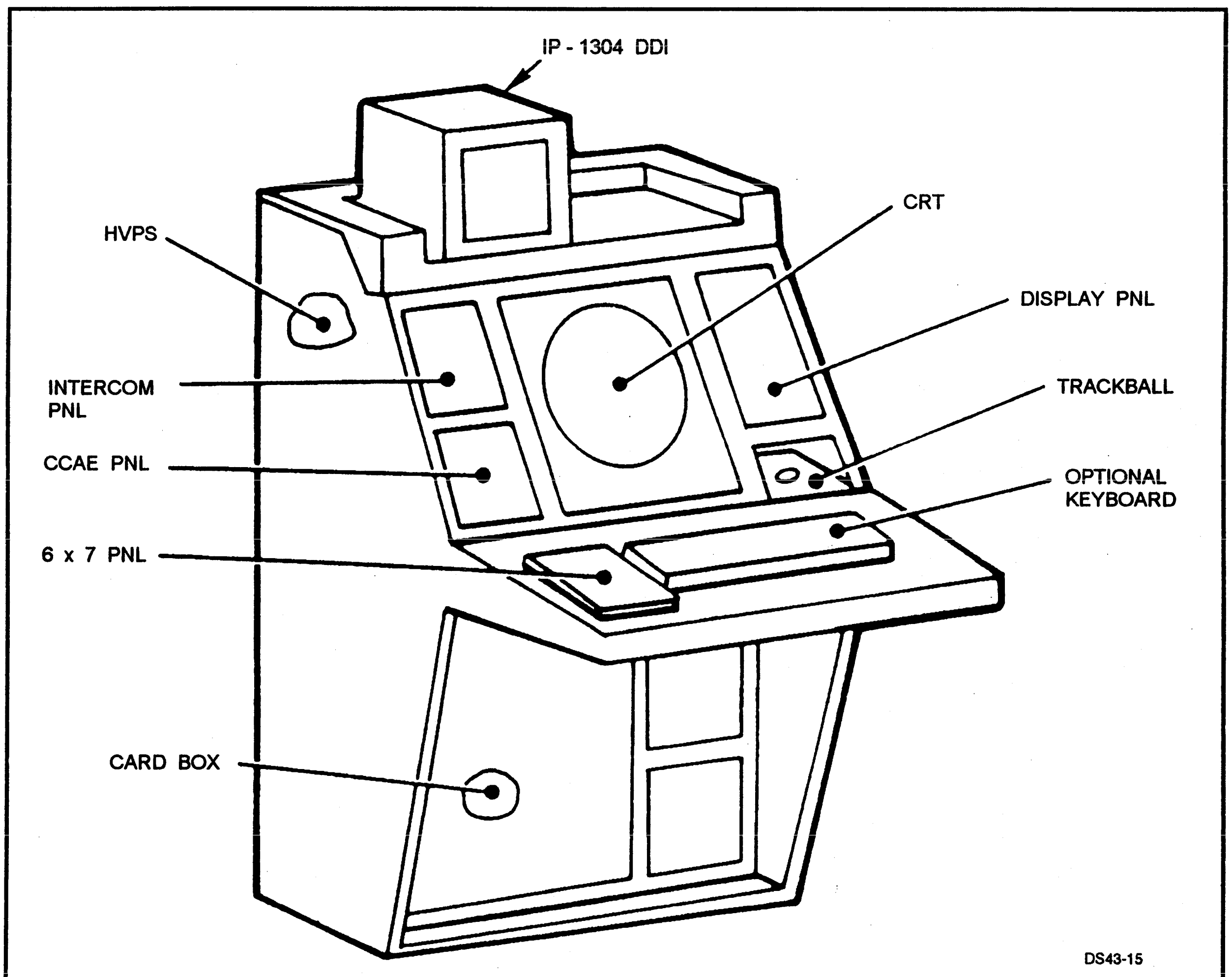


Figure 3-15.—A typical PPI display console.

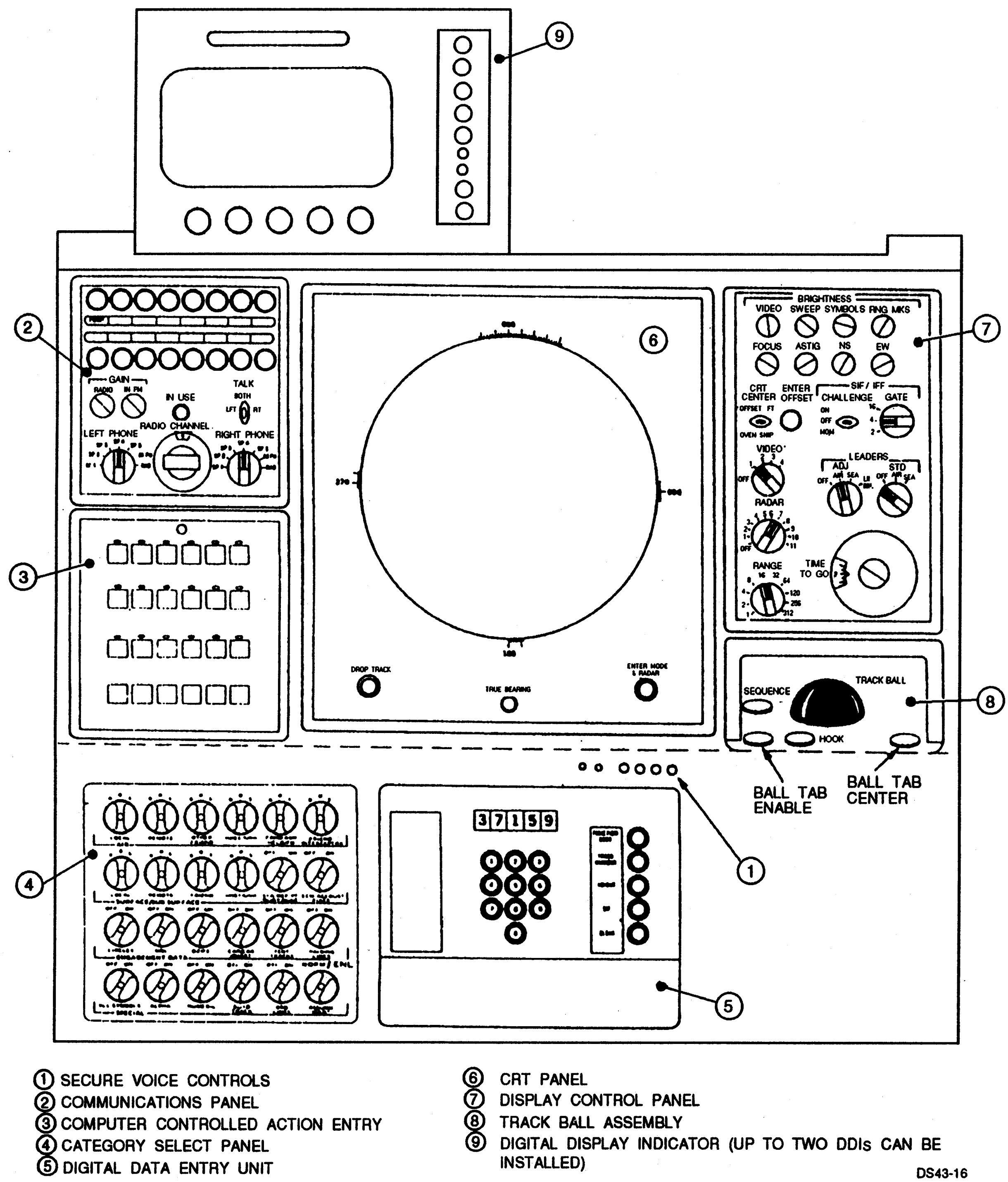


Figure 3-16.—PPI console control panels.

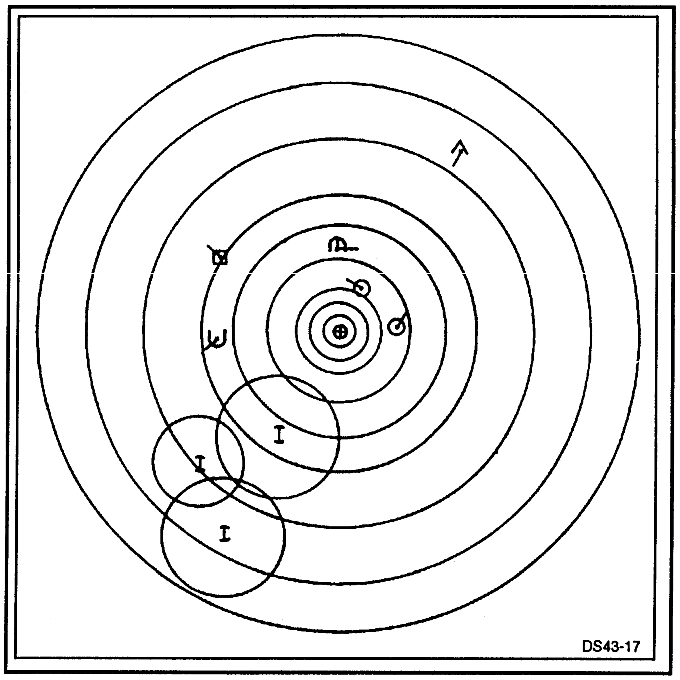


Figure 3-17.—A PPI tactical symbology display.

CRT CONTROL PANEL.— The CRT control panel contains the CRT, optional plotting board, and some of the controls for the console. The CRT displays tactical symbology as shown in figure 3-17. The CRT display of sensor data and symbology is controlled from the display control panel.

DISPLAY CONTROL PANEL.— The display control panel is located to the right of the CRT and contains the switches and controls to regulate the CRT display as shown in figure 3-18. The BRIGHTNESS section of the panel contains a potentiometer to control the display of video, sweep, symbols, and range marks. It also contains the potentiometer to control the CRT focus, astigmatism, and the centering adjustments.

Additionally, the display control panel contains the switches to select the radar, range of the radius of the CRT, select offset, and control symbol leaders.

DATA ENTRY PANELS.— For data entry purposes, the console is equipped with a computer-controlled action entry panel (CCAEP), and may be equipped with either a 6 by 7 panel or category select switch panel, a digital data entry unit, or an optional alphanumeric keyboard and a trackball unit. Figure 3-19 shows a console with the 6 by 7 panel and the alphanumeric keyboard. The trackball is recessed in the trackball well along with the ball tab enable, ball tab center, hook, and sequence pushbuttons.

Computer-Controlled Action Entry Panel (CCAEP).— The computer-controlled action entry panel (CCAEP) provides greater flexibility than its predecessor, the mode roller. CCAEPS consist of 24 switches arranged in 4 rows of 6 as shown in figure 3-20. The bottom row of six switches has fixed labels and functions. Each of the remaining 18 switch positions has 48 possible labels, or functions, independently controlled by computer output data and an auxiliary LED indicator.

The computer program controls the selection of a

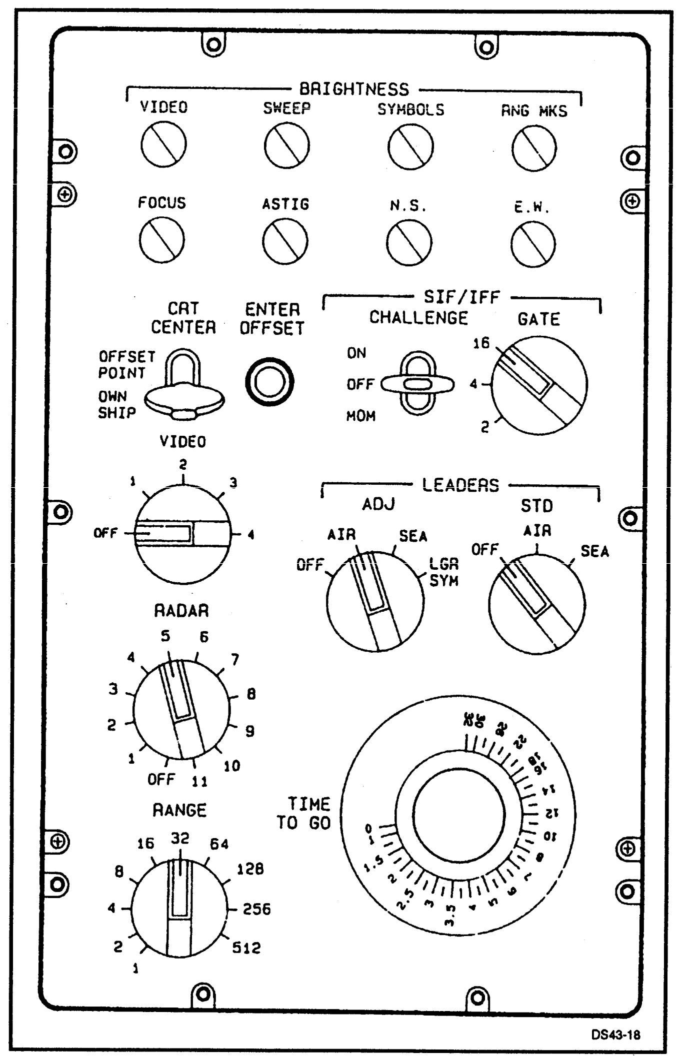


Figure 3-18.—A PPI display control panel.

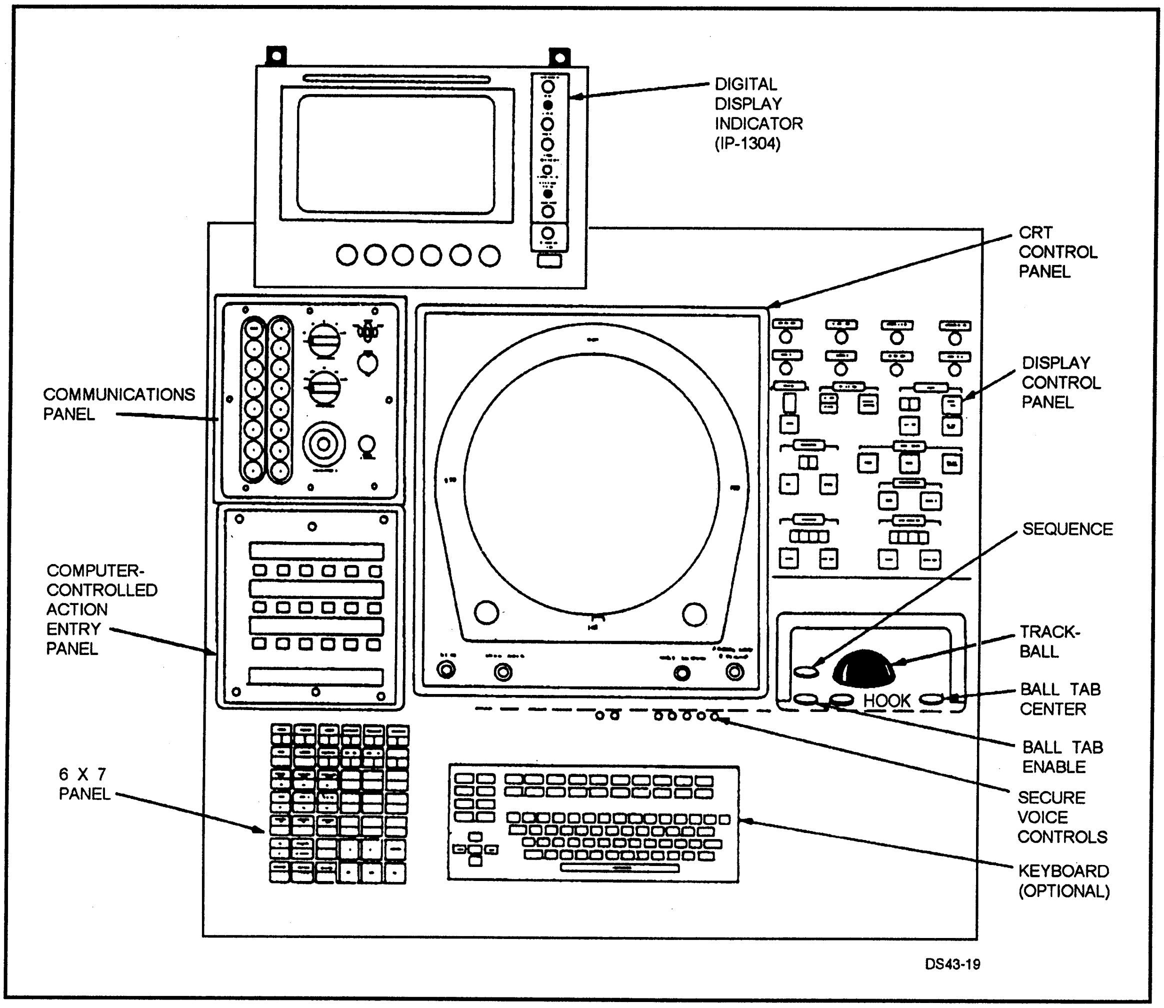


Figure 3-19.—A PPI equipped with a 6 x 7 panel and a keyboard.

label for each switch position on an individual basis. When depressed, each switch position generates a specific function code for computer input. A single LED indicator at the top of the panel is lighted to cue operator responses or to indicate reception of switch function codes.

A 6 by 7 Panel.— A 6 by 7 panel consists of 7 rows of 6 switches as shown in figure 3-21. When depressed, each of the 42 switches generates a specific function code for computer input. The 6 by 7 panel is used for category selection and as a data entry unit for numeric data. The top two rows of switches and the first three switches on the left in the remaining rows are used for category selection. The remaining switches are used as a number entry unit.

The category selection switches provide for independent console control of the symbology displayed at that console. The console operator can select the category of the symbols to be displayed on the console.

The number entry unit consists of a 10-digit keypad, a clear button, and four special-purpose buttons. Numerical entries from the keypad are displayed on the console CRT until one of the special-purpose buttons is depressed and the number entered is accepted by the computer program.

Alphanumeric Keyboards.— The alphanumeric keyboard installed in some consoles is a series of switches that inputs a code to the computer when a switch is depressed

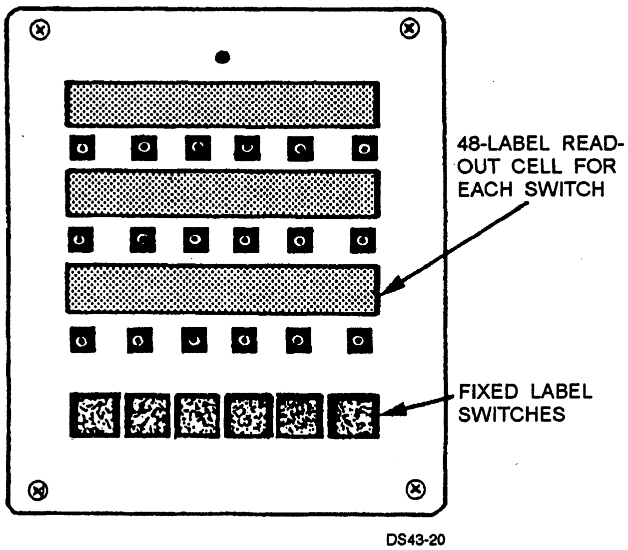


Figure 3-20.—Computer-controlled action entry panel.

Category Select Panel and Digital Data Entry Unit (DDEU).— Some display consoles use a category select panel and separate digital data entry unit. The category select panel is mounted on the left side of the bullnose and contains the 24 switches to control the display of symbols. The DDEU is mounted in the center of the bullnose and is used for numeric entry as described above for the 6 by 7 panel.

CONSOLE COMMUNICATIONS.— The console is provided access to three communications systems-interphone, sound-powered phone, or radio-via the console communications panel and the headset. The console communications panel is shown in figure 3-22.

Interphone.— Interphone links up to 15 consoles with voice and pointer symbol communications. This

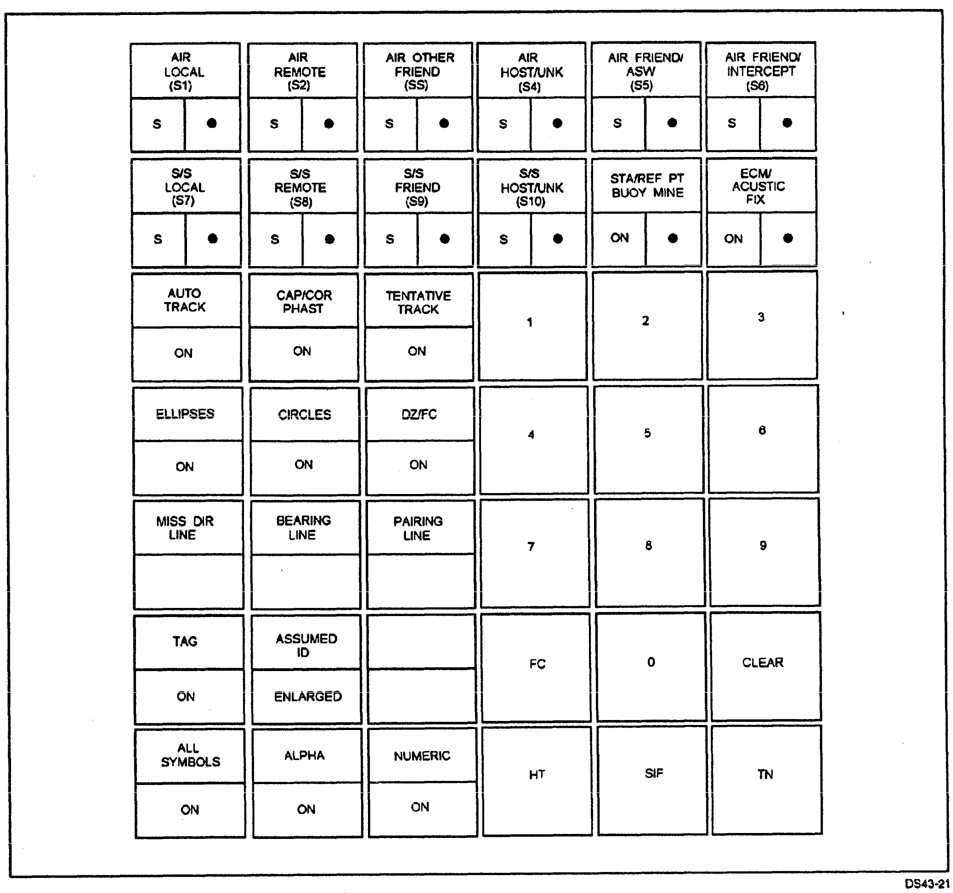


Figure 3-21.-A 6 x 7 panel.

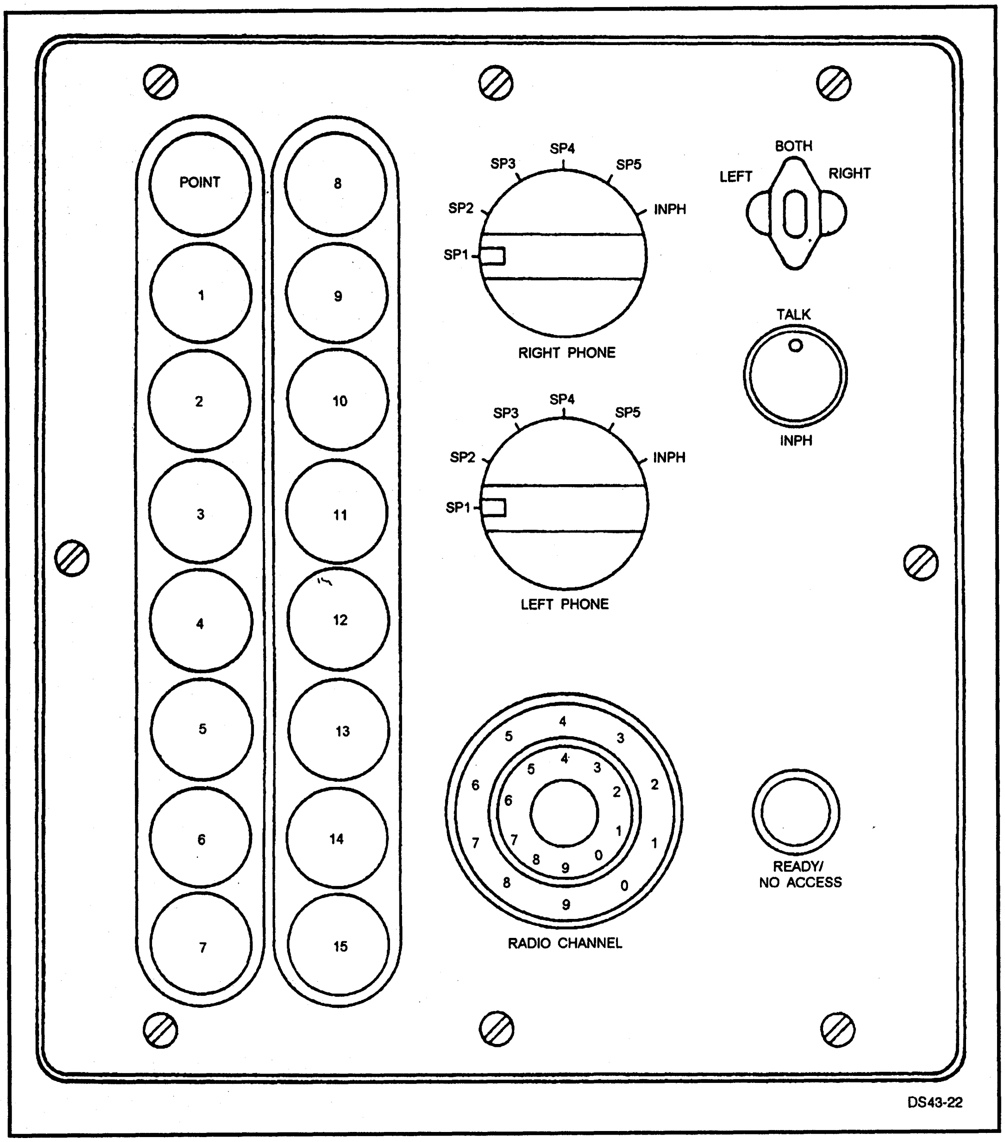


Figure 3-22.—A PPI console communications panel.

allows the console operators to communicate by voice with each other and identify locations or events on the CRT to each other using the pointer symbol.

Sound-Powered Phone.— Sound-powered phones tie the consoles into the ship's sound-powered communications network.

Radio.— Radio provides for ship-to-ship or ship-to-aircraft secure or nonsecure radio communication.

Console Functional Description

The display console is divided into two major functional areas: the digital area and the analog area. The digital area interfaces the console to the computer and the console operator. The analog area contains the deflection control logic and the intensity and focus control logic that drive the CRT display.

DIGITAL AREA.— The digital area receives computer output data, processes it, and outputs deflection and intensity (stroke) commands to the analog area. It also monitors console panel switch status and builds input words as switch status

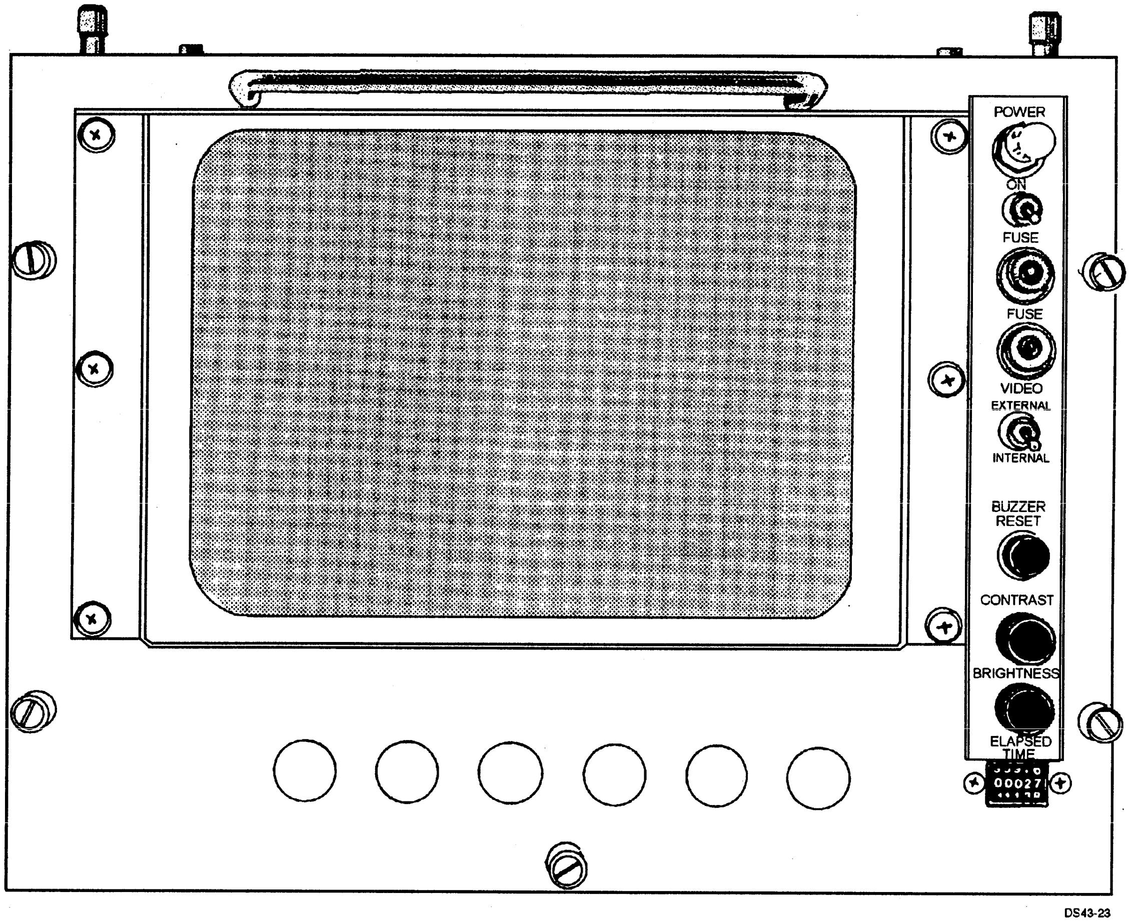


Figure 3-23.—Digita1 display indicator.

changes. It then transmits the input words to the CDS computer in response to interrogations.

ANALOG AREA.— The analog area receives ΔX and ΔY pulse trains, range marks, end-of-sweep, and video from the RDDS. This data is used to generate the sensor sweep and video display. The digital area of a CIGARS-equipped console provides the symbol control signals (SIGN X, X, 2X, SIGN Y, Y, 2Y, Z, and W) and offset data for sweep and symbology. In systems that use a symbol generator, symbol waveforms and unblinking signals are inputted directly into the analog section.

Digital Display Indicator (DDI)

The IP-1304/UYA-4(V) digital display indicator (DDI) shown in figure 3-23 is also called digital data indicator. It is a raster scan formatted video monitor. It accepts computer-generated alphanumeric (ASCII) and line display data, stores the data in an internal refresh (video) memory, and converts the stored data into monochrome raster scan video signals.

The DDI is capable of displaying sixteen 64-character lines (1,024 characters) in the internal video mode. The DDI is also designed to produce a 525-line TV display, from an external TV source, in the external video mode.

The DDI is an independent air-cooled, addressable monitor. It is may be mounted on top of the display console or in a stand-alone configuration as an auxiliary cathode readout (ACRO or CRO). It accepts data directly from the computer (DCI) or through the PA. When mounted on a console, the DDI is daisy chained with the console. The computer output data is routed through the DDI before going to the console digital area.

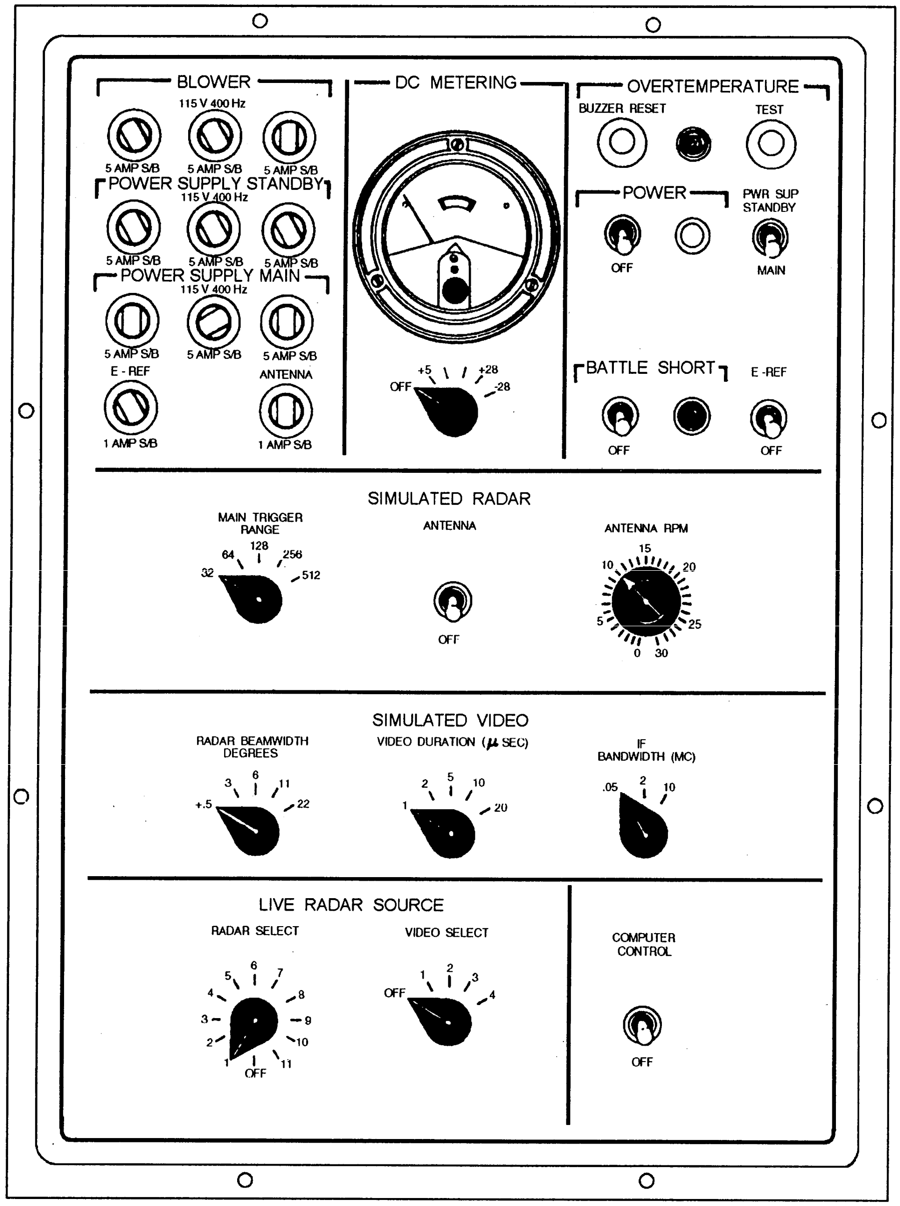


Figure 3-24.—VSS front panel.

DISPLAY SYSTEM SIMULATION AND TESTING

Most tactical display systems are able to simulate radar video and sweep signals for testing, troubleshooting, and operator training on the PPI consoles. In addition, there are computer programs (POFA/PEFTs) specifically designed to exercise the display consoles and verify their proper operation.

This section covers the devices and software used in tactical display systems to simulate the ship's radars and to test and troubleshoot the tactical display system.

VIDEO SIGNALS SIMULATOR (VSS)

The VSS develops simulated radar video and sweep signals for use in tactical display system testing, troubleshooting, and operator training. The VSS is used in place of or in conjunction with an operating two-dimensional radar. Simulated video and sweep signals of variable characteristics are used in the testing of RACs, RDDS, PPI consoles, and the operations summary console (OSC).

Use of the VSS makes it possible to monitor operator tracking accuracy. When used in conjunction with the operational program, the VSS can develop simulated tracking and tactical situations that resemble actual operations. Data extracted during these simulated exercises can be used to verify the accuracy of operator tracking and system operation.

The VSS is a computer-controlled device capable of generating antenna position data and triggers (sweep data), and radar video signals including simulated tracks, IFF/SIF, receiver noise, and sea clutter. Only the generation of video signals may be computer controlled; all other VSS functions are controlled from the VSS front panel, shown in figure 3-24.

Radar Sweep Simulation

The VSS can generate its own antenna position data or use a ship's radar as a source. If a ship's radar is used, the LIVE RADAR SOURCE switches are used to select the source radar and video level. The VSS then receives antenna position data and triggers from that radar's RAC via the RDDS. The antenna position data (digital azimuth) and triggers are used to determine the generation times for video signals.

The VSS contains its own synchro assembly, which generates synchro azimuth and triggers to the VSS RAC. The output of the VSS RAC is in turn fed back to the VSS via the RDDS for coincidence comparisons. The VSS simulated antenna rotation (RPM) and timing signals are controlled from the SIMULATED RADAR switches. To activate the servo assembly, both the E-REF and ANTENNA switches must be on.

Radar Video Simulation

The VSS receives video control data from the computer in message form. The output data defines the simulated video azimuth (bearing), range, and intensity. The VSS stores the output data in its track storage and compares the data with the digital azimuth and sweep data received from the RDDS. When the simulated video data and the digital sweep data are coincident, the VSS generates the ordered video signals and transmits them to the RDDS. Console selection of the VSS radar and video level allows display of VSS video and sweep.

The video output of the VSS is made up of three types of video: live video, live and simulated (mixed) video, and simulated video. The live video output is isolated from the simulator. The live and simulated output is made up of simulated tracks intermixed with live video passing through the VSS. Simulated video is made up of computer-generated video only.

Manual control of the simulated video characteristics is provided by the SIMULATED VIDEO switches. These switches allow the generated video to display characteristics that are similar to live radar video. The VIDEO DURATION (μSEC) switch controls the intensity (pulse length) of the simulated video return. The sharpness of the return is controlled by the IF BANDWIDTH switch. The sector width of the return is controlled by the RADAR BEAMWIDTH DEGREES control.

TEST MESSAGE GENERATOR (TMG)

The test message generator (TMG), shown in figure 3-25, is used to generate simulated computer output data for testing and troubleshooting display equipments. Normally contained in the PANG cabinet, the TMG is removable for its testing and troubleshooting role. The TMG maybe connected to the equipment under test by a jumper cable. This permits greater freedom of action for maintenance personnel in troubleshooting individual devices, such as a PPI console.

The TMG can simulate any desired computer output data message up to four data words in length. Coding of TMG data is controlled by word group switches on the TMG control panel.

The TMG is capable of operating in five different modes. The mode selection allows for great flexibility when testing or troubleshooting the display suite equipment.

Free Run Mode

The free run mode of operation repeats an operator-selected four-word message approximately every 400 microseconds. In this mode, the TMG may be used with any display equipment.

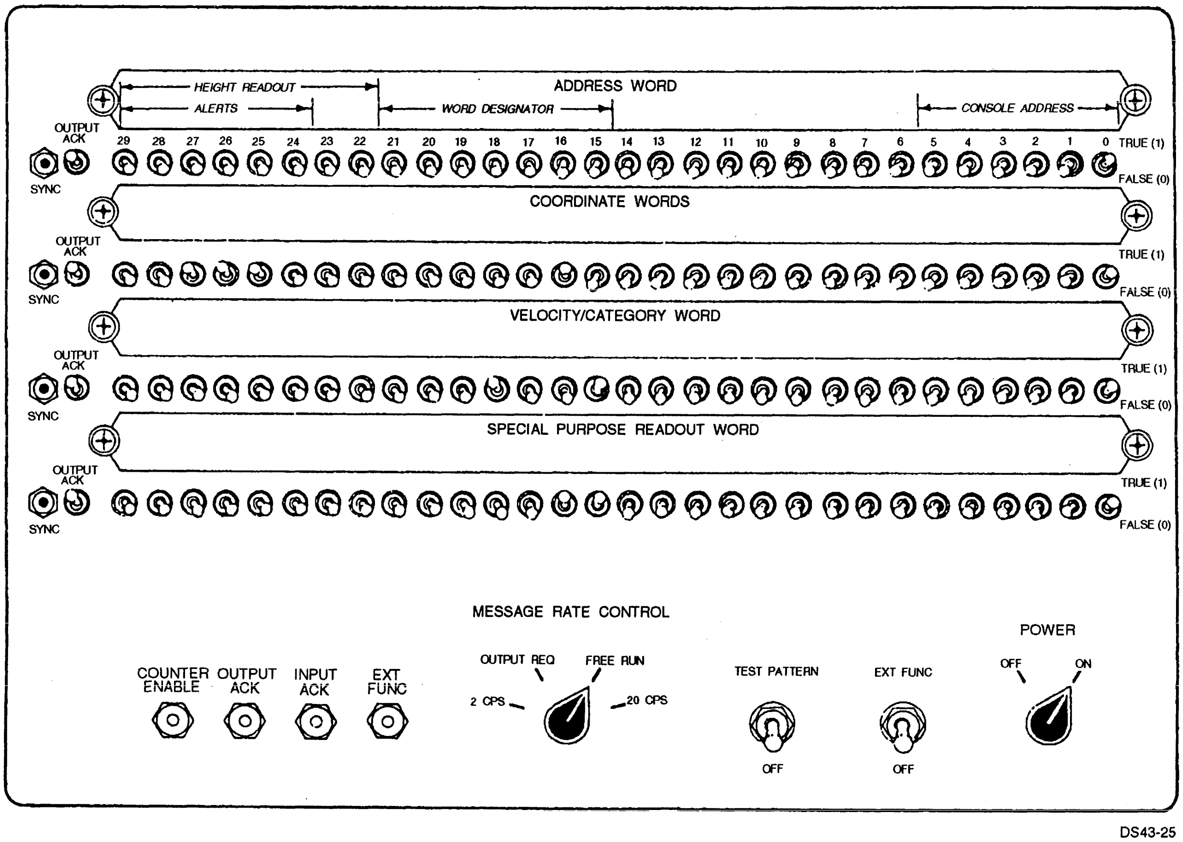


Figure 3-25.—Test message generator.

Test Pattern Mode

The test pattern mode of operation, used only when the TMG is installed in the PA cabinet, displays two symbols repeated every 90 degrees for a total of eight symbols. All the word designator bits and the TEST PATTERN switch must beset too btain this display. The test pattern is normally output to one group of consoles at a time.

Output Data Request (ODR) Mode

The output data request (ODR) mode of operation generates one data word in response to each ODR received from the equipment undervest. ODR mode is used when testing the PA, VSS, or consoles with DCI.

The 2/20 Cycles-Per-Second (CPS) Modes

The 2/20 cycles-per-second modes are a variation of the free run mode. The two-cycle mode repeats up to a four-word message twice a second (every 500 milliseconds). The 20-cycle mode repeats the message 20 times a second (every 50 milliseconds).

DISPLAY POFA/PEFT

A tactical display system is a somewhat complicated combination of equipments. The sheer number of consoles (PPIs), radar distribution switchboards, radar azimuth converters, pulse amplifier/symbol generators or PA/CIGARS or DCI/CIGARS tends to present a formidable maintenance task.

One of the primary tools available to the maintenance technician is the display programmed operational functional appraisal (POFA) and on some classes of ships, the display peripheral equipment functional test (PEFT).

Display POFA

The display POFA grouping of tests is designed to be loaded and run in the computer in lieu of the operational program. Display POFA subtests are designed to check particular functions of the display consoles and VSS. The display POFA is normally run on a group of consoles as part of the fault isolation process or as required by the planned maintenance system (PMS).

The display POFA subtests will vary from system to system, depending on the equipment configuration of the display suite. There are, however, several common functions normally tested. Switch function codes are checked; test patterns of symbols are displayed; the trackball/ball tab coordinates are verified; and various panel operations are exercised. The display POFA is designed to completely check all display capabilities.

Display PEFT

The display PEFT grouping of subtests is contained in the operational program. The display PEFT allows the operator or technician to verify the operation of a single console independent of the operational program in progress.

The display PEFT subtests are similar to the display POFA. However, the range of subtests is more limited in the PEFT. The display PEFT is designed to be run on a console in the event a console malfunctions during normal operations.

ELECTRONIC PLUG-IN CIRCUIT TEST SET

Tactical display systems are equipped with an electronic plug-in circuit test set. The test set, shown in figure 3-26, provides the technician with the facilities to test and repair faulty plug-in assemblies used in the display suite equipments.

The test set simulates normal operating conditions by providing operating power and loads to the assemblies under test. In addition, the test set provides test signals and monitoring facilities, which enable the technician to troubleshoot, test, and align faulty assemblies. Portable test equipment (oscilloscopes, vacuum tube voltmeters, and so forth) is used in conjunction with the test set.

SUMMARY—THE DATA DISPLAY GROUP AN/UYA-4(V)

This chapter has introduced you to the Data Display Group AN/UYA-4(V). The following information summarizes the important points you should have learned.

DATA DISPLAY GROUP— The purpose of any display system is to present a visual picture of the tactical situation. This allows the operator to make various decisions and take action. The heart of the display system is the plan position indicator (PPI), or display console. The PPI receives analog inputs from the ship's sensors (radar and sonar), digital or tactical data from the CDS computer, and simulated data from the video signals simulator (VSS) and test message generator (TMG). The simulated data from the VSS can be used for system testing or operator training.

SENSOR DATA DISTRIBUTION— Sensor data from the radar is received by the radar azimuth converter (RAC) and distributed to the PPIs by the radar data distribution switchboards.

RADAR AZIMUTH CONVERTER (RAC)— The RAC converts antenna position data to a form that the PPI can use. The azimuth data is sent to the PPI console as ΔX and ΔY pulse trains. The number of pulses in the pulse train represents the angle of the antenna, and the spaces between the pulses represent the range of the radar.

RADAR DATA DISTRIBUTION SWITCHBOARD (RDDS)— The RDDS provides amplifications of the radar video received from the radar and the azimuth data received from the RAC and distributes them to the PPI consoles.

TACTICAL DATA DISTRIBUTION AND DISPLAY— Tactical data is data generated by the CDS computer. Tactical data can be symbol data or amplifying information about a symbol. Depending on the system installed on your ship, the tactical data may be distributed through several different routes.

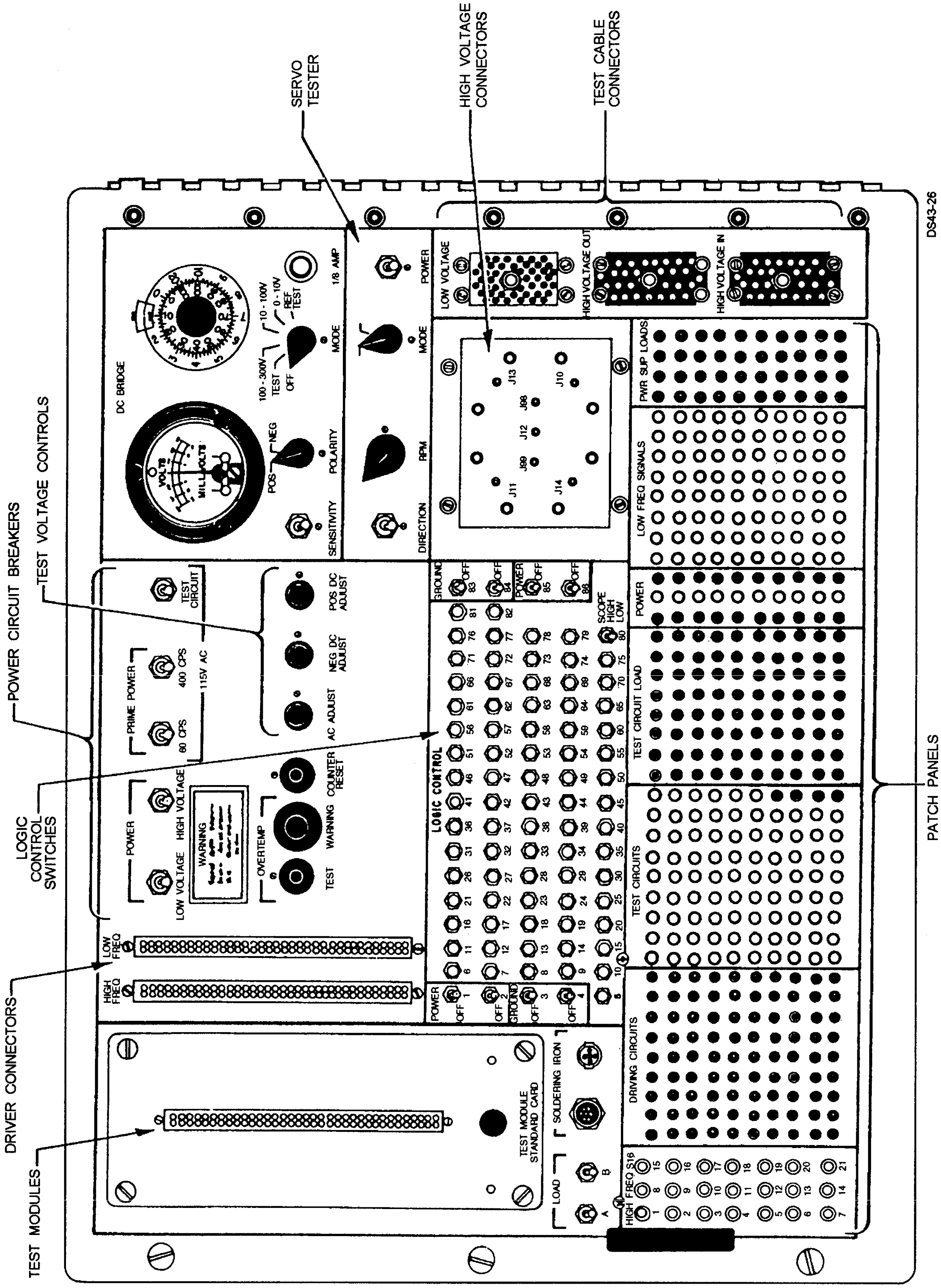


Figure 3-26.—An electronic plug-in test set.

PULSE AMPLIFIER/SYMBOL GENERATOR (PA/SG)— The PA/SG is really two pieces of equipment in one cabinet. The pulse amplifier provides amplification and distribution of computer data to the PPI consoles. The pulse amplifier also receives data from the PPI consoles for input to the computer. The symbol generator decodes data from the CDS computer and generates the symbol waveforms or stroke code to paint a symbol. Systems with PPI consoles that have the console internally generated and refreshed symbols (CIGARS) modification installed will not have a separate symbol generator. In these systems only, the pulse amplifier is installed. Systems with CIGARS modified PPI consoles that also have the direct computer interface (DCI) will not have either the pulse amplifier or symbol generator.

PLAN POSITION INDICATOR (PPI)— The PPI receives data from the RDDS and CDS computer and creates a visual display on a CRT. There are several models of the AN/UYA-4(V) PPI. The PPI also allows the operator to input data to the CDS computer.

DATA DISPLAY GROUP SIMULATION AND TESTING— The data display group allows for the generation of simulated video and radar signals using the video signals simulator (VSS) and offline testing of most equipment using the test message generator. Circuit card repair and alignment is accomplished using the electronic plug-in test set.

VIDEO SIGNALS SIMULATOR (VSS)— The VSS generates simulated video and radar signals for operator training and system troubleshooting. The VSS can generate simulated video using inputs from a ship's radar system and can mix simulated video with actual live video.

TEST MESSAGE GENERATOR (TMG)— The TMG allows the maintenance technician to input up to four computer words to paint symbols on the PPI consoles. This allows the operator to perform offline tests on each individual CIGARS equipped console or one display group.

ELECTRONIC PLUG-IN TEST SET— The electronic plug-in test set allows the technician to troubleshoot and align circuit cards and assemblies of the Data Display Group AN/UYA-4(V). Special adapters and cables allow the technician to control the signals applied to each pin of the card under test to isolate the faulty circuit.

CHAPTER 4

THE COMPUTER DISPLAY SET AN/UYQ-21 (v)

INTRODUCTION

The Computer Display Set AN/UYQ-21(V) is installed on CV/CVNs, LHDs, AEGIS, and New Threat Upgrade Platforms. Because the AN/UYQ-21(V) is a modular system, its elements can be combined in a variety of configurations to meet the mission requirements of the user. If the user's requirements change, the configuration can be changed with the addition of new elements.

In this chapter, you will learn about the basic configurations and functions of the Computer Display Set AN/UYQ-21(V).

After completing this chapter, you should be able to:

- **State the purpose of the Computer Display Set AN/UYQ-21(V)**
- **Describe the functions and operations of the central equipment group (CEG) components**
- **Describe the function and operation of the sensor data distribution switchboard (SDDS)**
- **Describe the function and operation of the different types of display consoles used in the AN/UYQ-21(V) system**
- **Describe the function and operation of the television converter group (TVC) equipment**

The AN/UYQ-21(V) display system provides for the display of tactical information to enhance combat systems performance. Three types of tactical information can be displayed by the AN/UYQ-21(V) system. These are computer-generated data, sensor data (radar, sonar, IFF, etc.), and television data. The operators use this data for the following purposes:

- Detection, tracking, identification, and evaluation of contacts
- Assignment and control of onboard weapons systems
- Assignment and control of other weapons systems (such as aircraft) via radio and data links

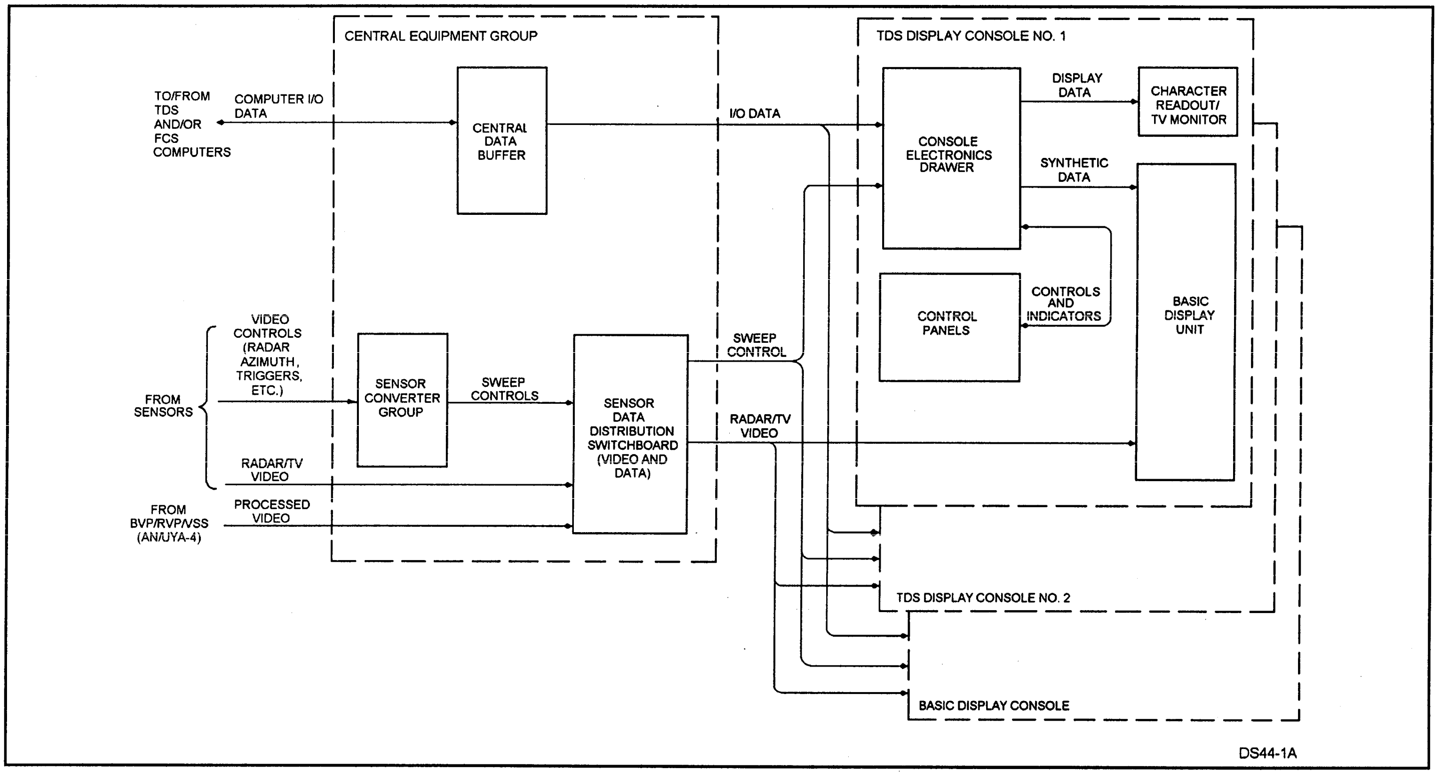


Figure 4-1.–An AN/UYQ-21(V) tactical system configuration block diagram.

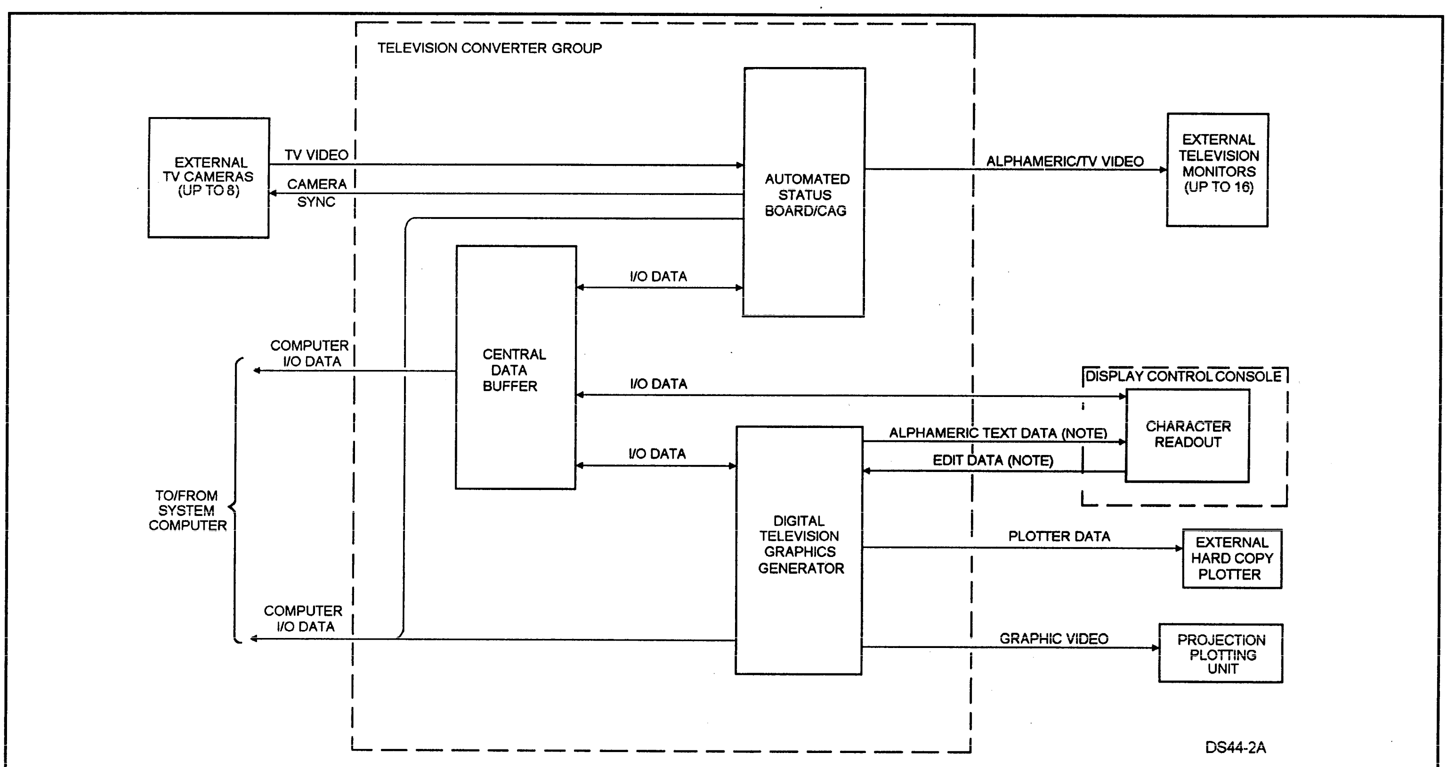


Figure 4-2.–An AN/UYQ-21(V) command system configuration block diagram.

The Computer Display Set AN/UYQ-21(V) can also display remote tracks from other ships and aircraft obtained through data links. Though much of the information is computer controlled, the display console provides the operator with the necessary interface for decision making. The Computer Display Set AN/UYQ-21(V) can be configured to operate as part of a tactical data system (CDS, ACDS), command and control system, or antisubmarine warfare (ASW) system. The ship's mission determines the complement of equipment required.

Figures 4-1, 4-2, and 4-3 show typical configurations for a tactical system, a command system, and an acoustic system, respectively. The different systems can be combined to meet the requirements of the particular platform. The configurations for each system are slightly different. We selected the tactical configuration to discuss in this chapter.

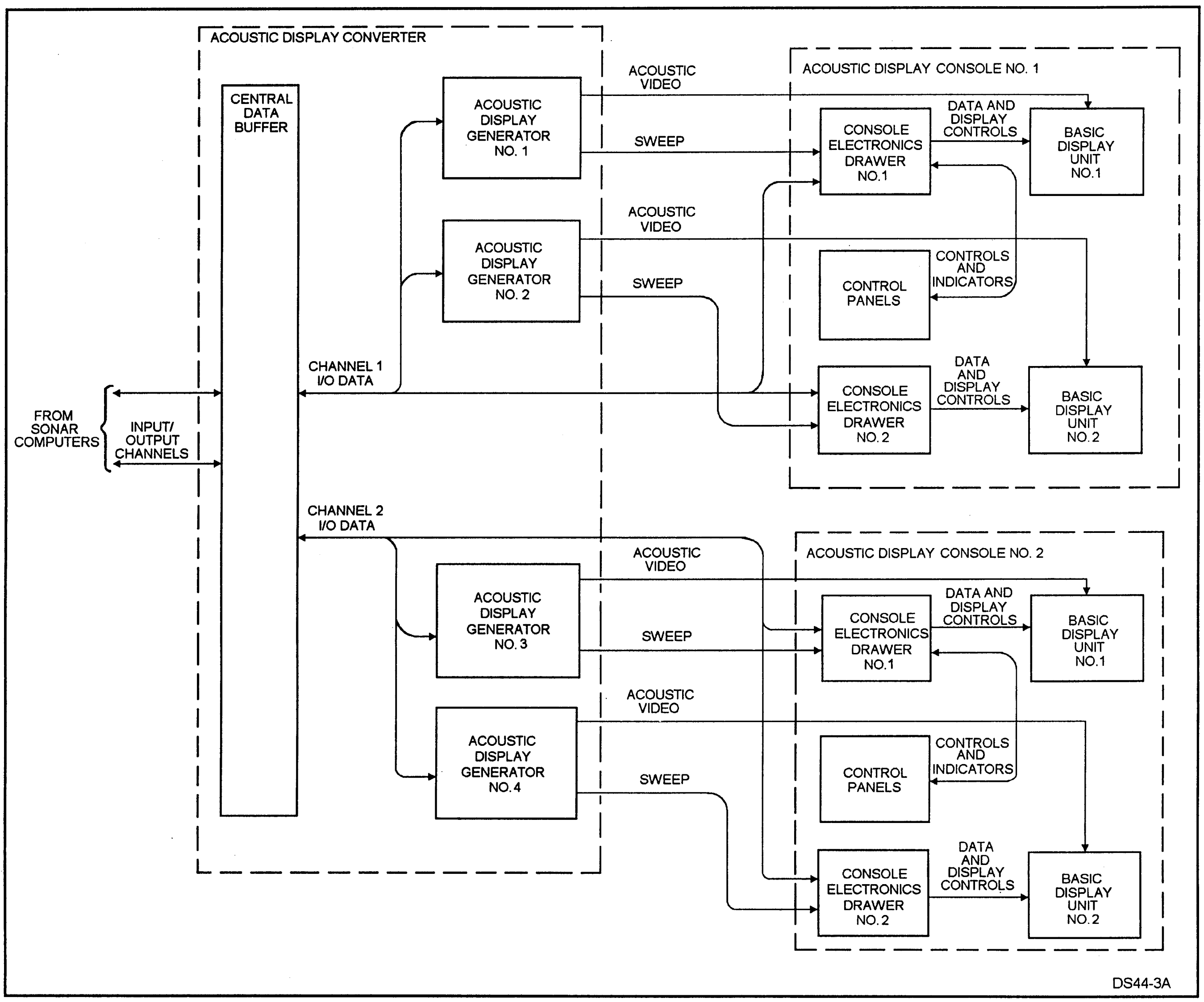


Figure 4-3.—An AN/UYQ-21(V) acoustic system configuration block diagram.

CENTRAL EQUIPMENT GROUP (CEG)

The Central Equipment Group (CEG) is composed of a basic cabinet and power supply that can accommodate up to five equipment modules. Typical equipment modules contained in the CEG are the central data buffer (CDB), the sensor converter group (SCG), the sensor data distribution switchboards (SDDSs), and the analog switchboard. A typically configured CEG, housed in the basic AN/UYQ-21 equipment cabinet, is shown in figure 4-4. One CEG is capable of driving up to 16 tactical data system (TDS) display consoles; converting sensor azimuth, elevation, and range data into a digital X- and Y-sweep data format; and switching sensor data from up to 24 inputs to 40 display units.

CENTRAL DATA BUFFER (CDB)

The central data buffer (CDB) provides the interface between the computer and the display groups. The CDB converts parallel computer data to serial data for use by the display consoles. The CDB distributes data from the computer to the display groups in real time using high-speed multiplexing.

The CDB has three functional areas as shown in figure 4-5. They are the computer interface unit (CIU), the scanner control circuits, and the display multiplexer unit (DMU). One CIU is required for each computer in the system. A fully configured CDB can have four DMUs.

Computer Interface Unit

The computer interface unit (CIU) provides the interface between the system computers and the DMUs. Conversion of the parallel computer data to serial data for use by the display consoles is accomplished in the CIU. The CIU also receives serial data from the display consoles, via the DMU, converts the data to parallel, and sends it to the computer. The CIU can be simultaneously connected to all four DMUs by the system computer (auto mode) or manually from the front panel control switches.

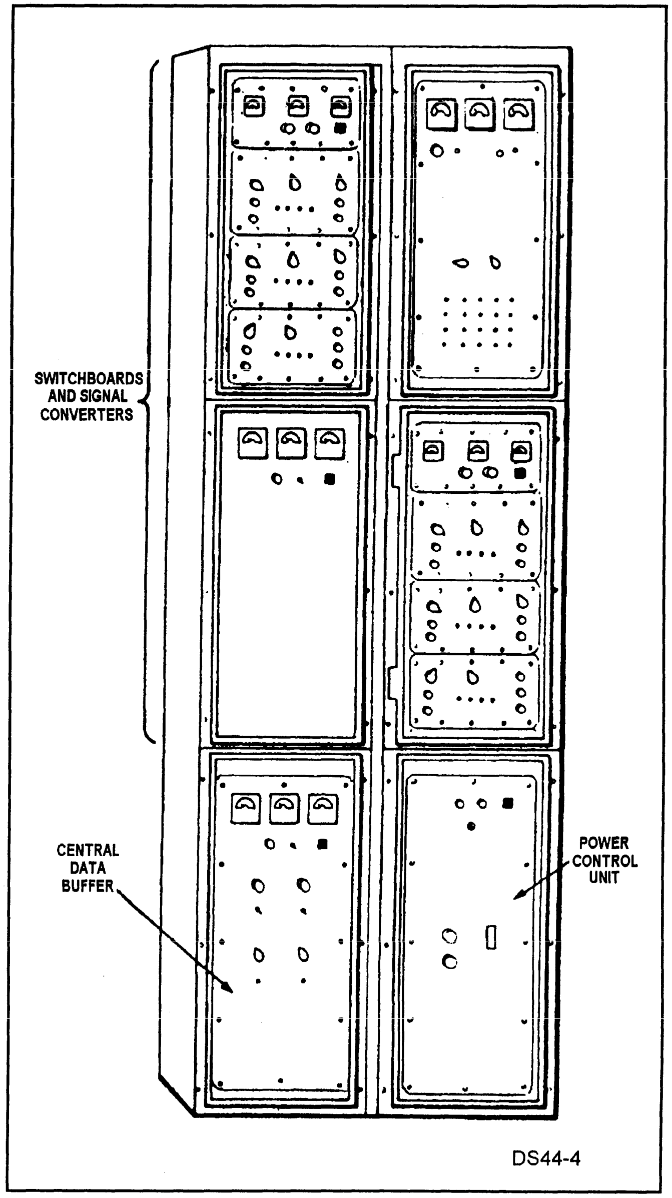


Figure 4-4.–A typically configured central equipment group (CEG).

Display Multiplexer Unit (DMU)

The display multiplexer unit (DMU) transfers serial data between the CIU and the display consoles. Computer output data is received from the CIU in serial form and buffered to provide final drive to the display consoles. Serial data from the display consoles is buffered by the DMU and transferred to the CIU.

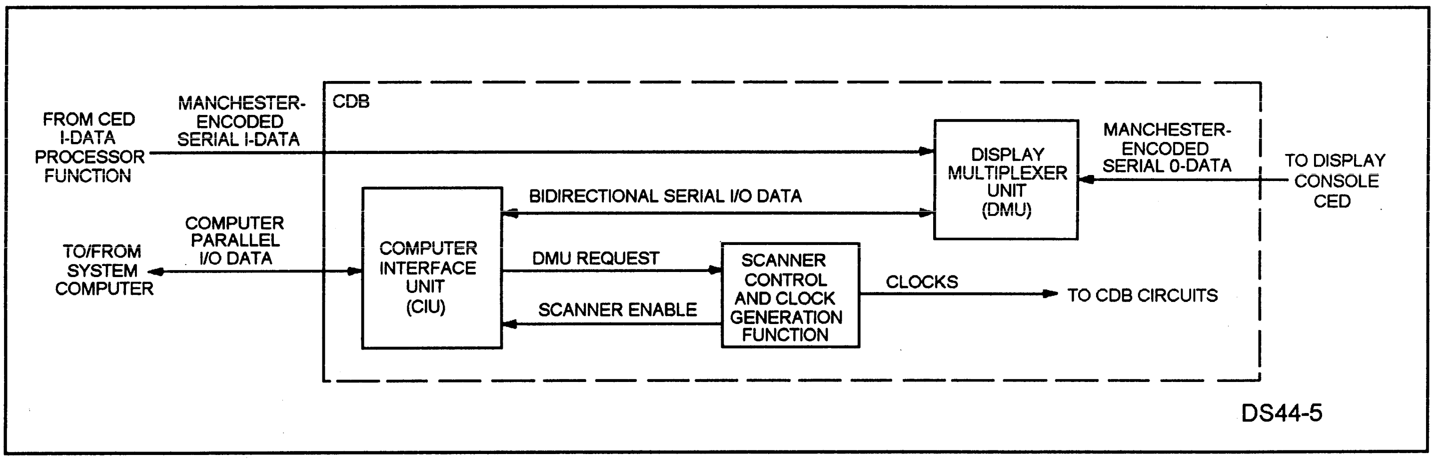


Figure 4-5.—Central data buffer (CDB) functional block diagram.

Scanner Control and Clock Generation

The scanner control and clock generation function provides the controls to connect the CIU to a DMU. A scanner enable signal is generated and sent to a CIU. If the CIU needs to be connected to a DMU, it generates a DMU request. The scanner and clock generation function will connect the requested DMU to the requesting CIU for data transfer. The scanner and clock generation function also generates all system clocks used by the CDB.

CDB Front Panel

The CDB front panel is shown in figure 4-6. The front panel provides the power control and monitoring. The four display channel switches are used to select the display source data. In the AUTO position, any computer can automatically interface with the CDB. If the switch is set to select a particular computer, that computer will be the only data source. The CDB can be tied to six computers; therefore, the computer 7 and the computer 8 positions are not used.

Display channels 1 and 2 can be tied to the same data source when required by placing the DATA SOURCE SELECT switch in the BACKUP position. If you want display channel 1 to use the same data source as display channel 2, place the display channel 1 DATA SOURCE SELECT SWITCH in the BACKUP position. For display channel 2 to use display channel 1's data source, place the DISPLAY

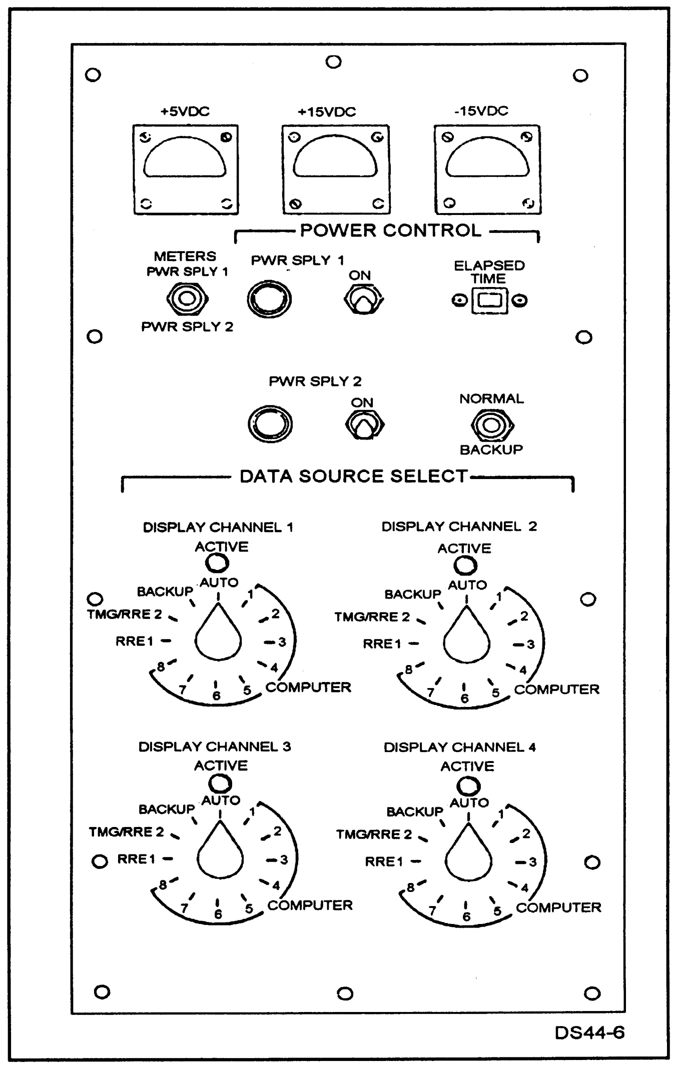


Figure 4-6.—Central data buffer (CDB) front panel.

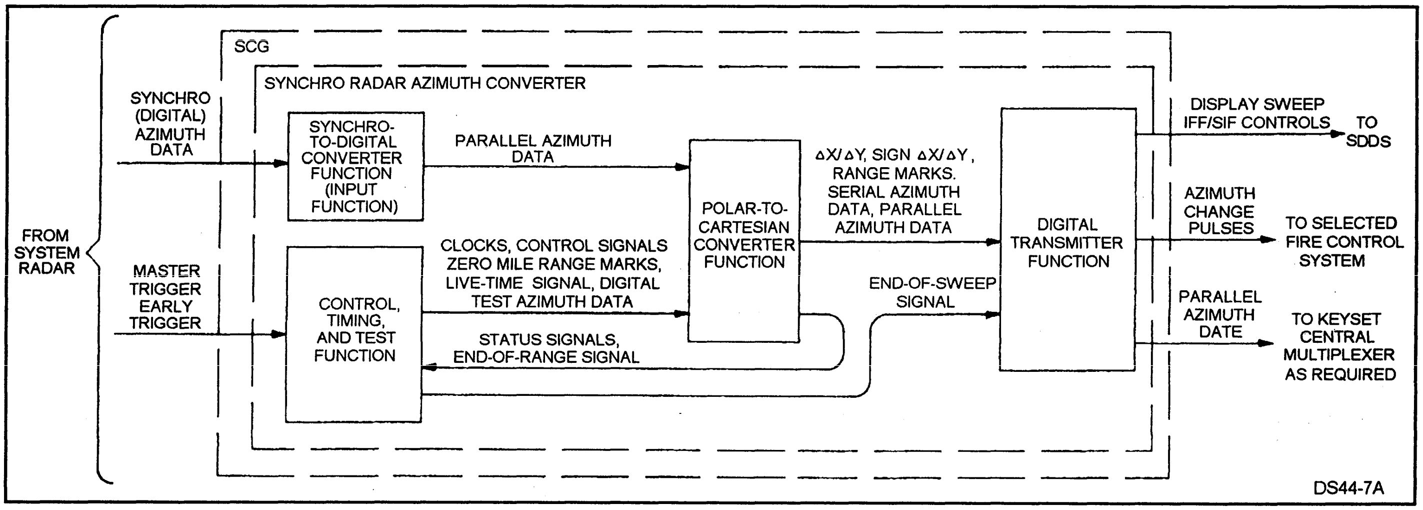


Figure 4-7.–Radar azimuth converter functional block diagram.

CHANNEL 2 DATA SOURCE SELECT switch in the BACKUP position. Display channels 3 and 4 are tied together in the same way.

SENSOR CONVERTER GROUP (SCG)

The sensor converter group (SCG) of the CEG is the main interface between the system radars and the display consoles. The SCG consists of three synchro radar azimuth converters (SRACs) or two SRACs and one digital radar azimuth converter (DRAC), located in one drawer of the CEG.

Each SRAC or DRAC provides the interface for one radar. The SRAC receives azimuth data and triggers from a synchro radar and generates the signals required to display sweep and range marks on the display console. The DRAC performs the same function with signals from a digital radar. The SRAC consists of four fictional areas as shown in figure 4-7. These fictional areas are:

- synchro-to-digital converter
- control, timing, and test circuits
- polar-to-Cartesian converter
- digital transmitter

The DRAC is similar to the SRAC except the synchro-to-digital converter is replaced with the input functional area.

Synchro-to-Digital Converter Function

The synchro-to-digital converter receives 60-Hz or 400-Hz synchro azimuth data from the radar and converts it to a 12-bit digital value that is sent to the polar-to-Cartesian converter.

INPUT FUNCTION.– The input function, used only in the DRAC, receives digital azimuth data from a digital radar and converts it to TTL levels. The azimuth data consists of 11 bits representing the absolute value of sin θ/ cos θ and 1 bit representing the sign. The input function retransmits the azimuth data received back to the radar for error checking.

CONTROL, TIMING, AND TEST FUNCTION.– The control, timing, and test fiction produces the signals that control the operation of the polar-to-Cartesian conversions, provides the system clocks for the converter, and produces digital test azimuth for the self-test functions.

POLAR-TO-CARTESIAN CONVERTER FUNCTION.– The polar-to-Cartesian converter function converts the parallel azimuth data from the synchro-to-digital converter to ΔX and ΔY pulse trains and sign of ΔX/ sign of ΔY. The 10 LSBs of the azimuth data are decoded for $\Delta X/\Delta Y$ position and the 2 MSBs are decoded for quadrant data to form the sign of ΔX/ sign of ΔY. In self-test mode, the azimuth data is generated by the control, timing, and test function. The polar-to-Cartesian converter also produces range marks.

DIGITAL TRANSMITTER FUNCTION.— The digital transmitter function transmits the sweep data to the sensor data distribution switchboard. This data is the $\Delta X/\Delta Y$ pulse trains, sign of ΔX and sign of ΔY, range marks, end-of-sweep, and analog azimuth signals. The digital transmitter function also sends parallel azimuth data to the system's computer via a multiplexer.

SRAC CONTROL PANEL.— The SRAC control panel allows the operator to monitor and control the operation of the SRAC. Figure 4-8 shows the SRAC control panel. For normal operation, the MODE switch must be in the OPERATE position. If the MODE switch is in the CONTINUOUS position, timing and azimuth data are generated by the control, timing, and test function. Sweep rotation is

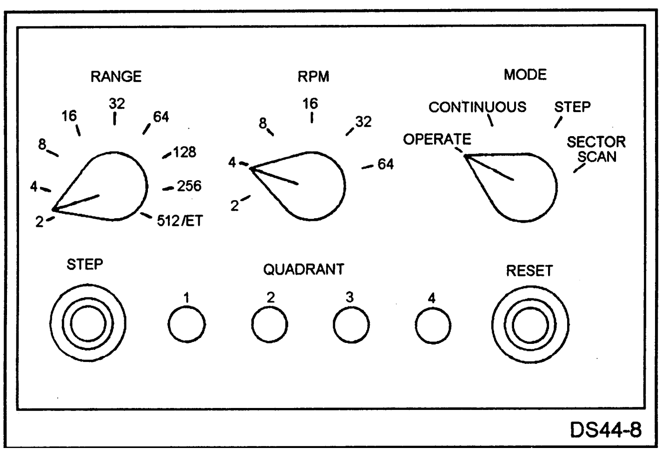


Figure 4-8.—The SRAC control panel.

continuous and clockwise. Speed of the simulated sweep is controlled by the RPM switch. The STEP mode enables use of the STEP pushbutton. The azimuth of the simulated sweep is incremented one time for every depression of the STEP pushbutton. In the SECTOR SCAN mode, a 45-degree simulated sweep is generated that alternately scans clockwise and counter-clockwise. The RANGE switch is normally in the 512/ET position, but maybe placed in the desired range to generate an internal end-of-sweep signal. The control panel for the DRAC is identical to the control panel for the SRAC.

SENSOR DATA DISTRIBUTION SWITCHBOARD (SDDS)

The sensor data distribution switchboard (SDDS) distributes azimuth data from the RAC and video from the radar to the display consoles. The SDDS occupies two drawers in the CEG. One drawer is the sweep/passive or sweep/IFF SDDS. The other drawer is the video SDDS. The SDDS can route inputs from up to 12 sensors to 20 display consoles. The SDDS can be expanded to provide outputs to 40 display consoles by installing two of each drawer in the CEG. A block diagram of the SDDS is shown in figure 4-9.

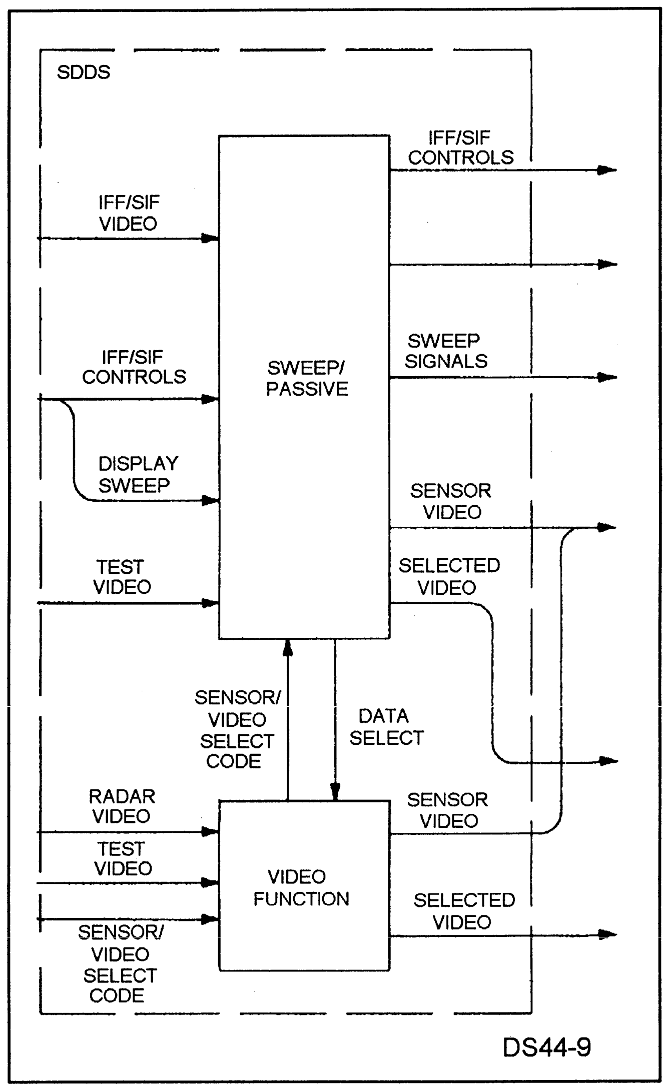


Figure 4-9.–The sensor data distribution switchboard.

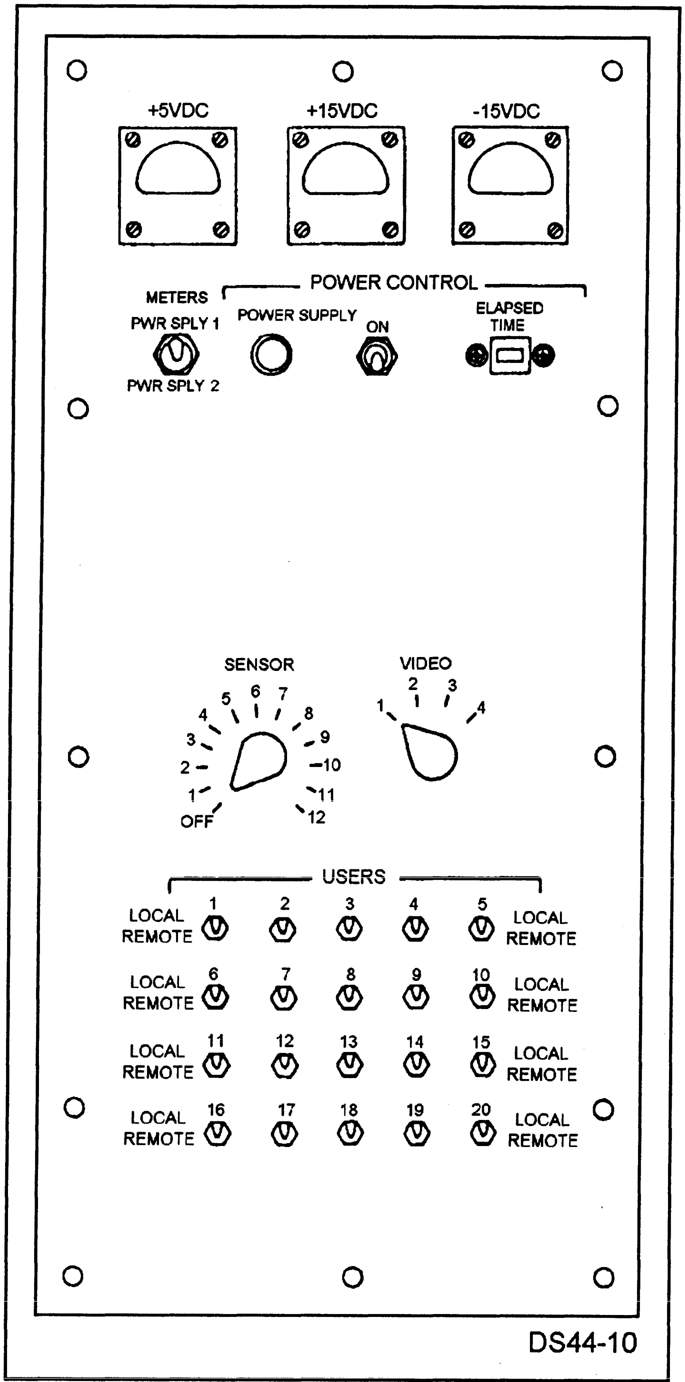


Figure 4-10.—The front panel for a sweep/passive sensor data distribution switchboard (SDDS).

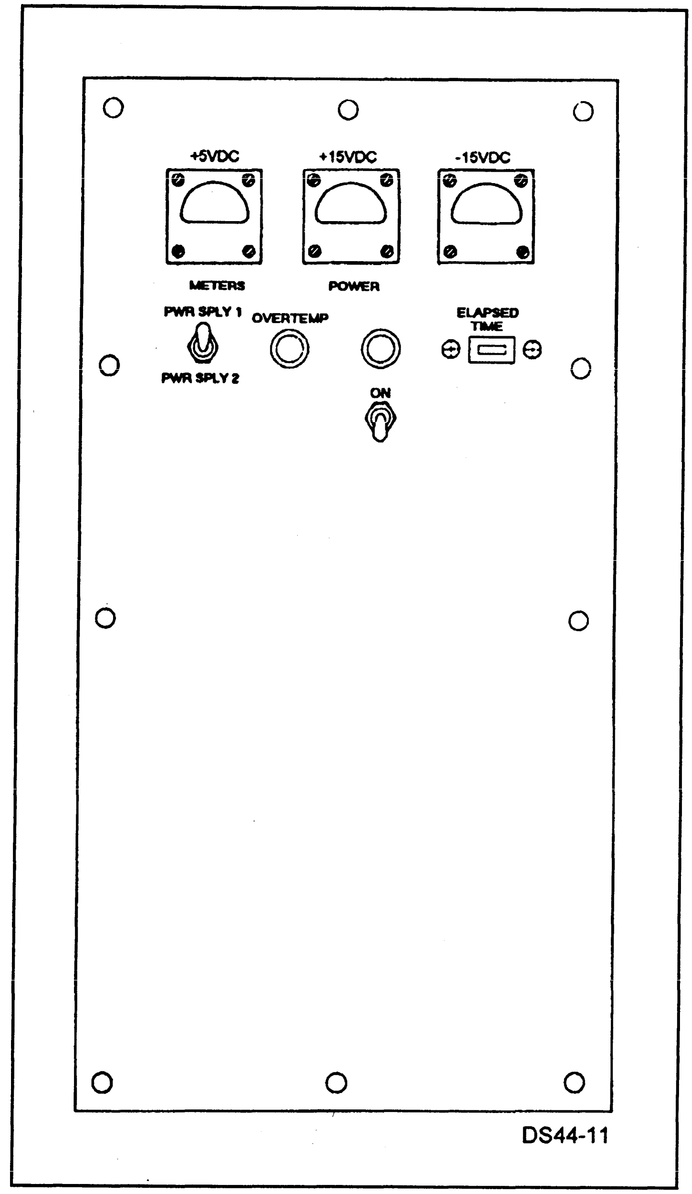


Figure 4-11—The front panel of the sweep/IFF SDDS.

Sweep/Passive and Sweep/IFF Functions

The sweep/passive function of the SDDS receives radar and video select signals from the display consoles via the video drawer, and receives sweep data from the SCG. The sweep/IFF function receives the same inputs as the sweep/passive drawer and also receives identification, friend or foe/selective identification feature (IFF/SIF) video and control signals. The operation of both the sweep/passive function and the sweep/IFF function is similar. The sweep/passive function decodes the radar and video select signals from the display consoles or the CEG front panels and routes the proper radar sweep and IFF/SIF video back to the console. The sweep/passive function also sends the radar and video select signals to the video function SDDS as the data select signal.

Video Function

The video function receives composite video from the selected sensor, and routes it to the requesting display console. The video function amplifies the video signals to the proper level to drive the video through a maximum of 1,000 feet of cable for each output.

SDDS Front Panels and Controls

The sweep/passive function SDDS front panel is shown in figure 4-10. The front panel contains three power meters to allow for monitoring of the power supply outputs. The 20 user toggle switches allow the operator or technician to locally select the sensor and video that are routed to a particular display console or group of consoles. When the toggle switch is in the LOCAL position, the associated console will receive sweep and video data selected by the SENSOR and VIDEO rotary switches. When the toggle switch is in the REMOTE position, sensor and video selection is controlled by the switches on the display console. The front panel for the video function SDDS is very similar to the passive/sweep function front panel. The front panel for the sweep/IFF function SDDS is shown in figure 4-11. All switches for the sweep/IFF function drawer are controlled by the video function drawer.

DISPLAY CONSOLES

The Computer Display Set AN/UYQ-21(V) can use several different types of display consoles, depending on the function of the console and the system in which the console is installed. The consoles include the TDS Display Console OJ-45l(V)/UYQ-21(V), the Display Control Console OJ-535(V)/UYQ-21(V), and the large screen Display Projection Plotting Unit PT-525/UYQ-21(V).

TDS DISPLAY CONSOLE OJ-451(V)/UYQ-21(V)

The TDS display console is the basic operator interface with the operational program. The TDS console is capable of displaying symbols, graphics, and sensor sweep and video. There are several versions of the TDS display console. The one we are using as a training model is the OJ-451(V)9/UYQ-21(V). It is shown in figure 4-12. It is important to remember that the information in this training manual is designed only to give you a

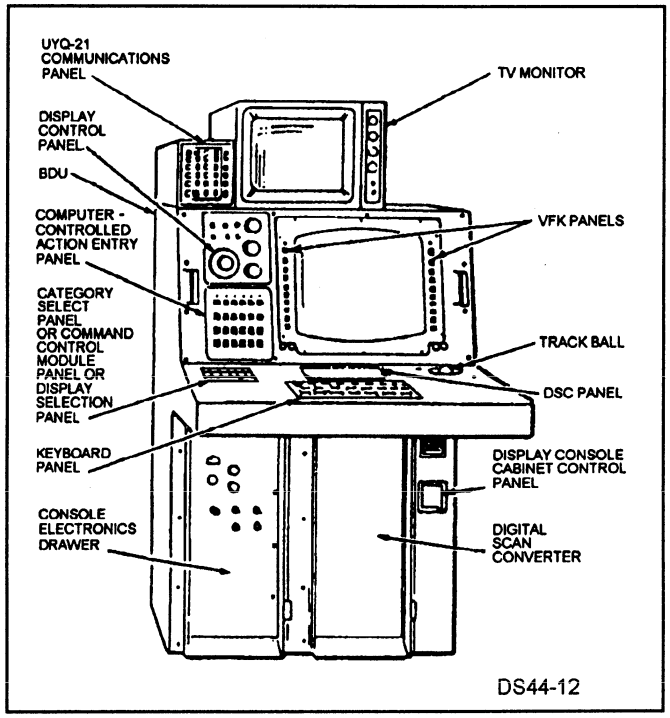


Figure 4-12.—The TDS Display Console OJ-451(V)/UYQ-21(V).

basic understanding of the equipment and is not intended to replace-the technical ‘manuals.

The TDS display console consists of the computer display console, a basic display unit (BDU), a TV monitor (CRO), and a communications station. The computer display console consists of the operator control panels and the console electronic drawer (CED), which contains the circuitry to control the operation of the console. The BDU is common is all versions of the TDS display console and serves as a display device for computer-controlled symbols and sensor sweep and video. The TV monitor displays alphanumeric data.

Computer Display Console

The computer display console is the main operator interface for displaying sensor data and communicating with the operational program. The computer display console receives sensor data from the SDDS or the digital scan converter (DSC). It receives symbol, graphic, and alphanumeric data, in encoded serial format, from the system computer via the CDB. The display console can also be configured to receive parallel data directly from the system computer. The display console converts the symbol, graphic, and sensor data into coordinate data and sends this data to the BDU for display on the CRT. The alphanumeric data is converted into a composite video data for display on the TV monitor. The computer display console consists of the following 15 functions:

- O-data receiver function
- Input/output processor function
- Memory sort processor function
- System memory function
- Graphics processor function
- Display generator function
- Panel processor function
- Sweep and raster function
- Digital deflection function
- Clock generator function
- TV monitor display generator function
- Computer-controlled action entry panel (CCAEP) function
- I-data storage and control function
- I-data transmitter function
- Diagnostic function

The four processor functions contain microprocessors. When power is turned on, each microprocessor runs a diagnostic check of its respective functions, then downloads its program to system memory. The processors receive and store data, communicate with each other, and transfer data via system memory and buses. Only one processor function at a time can access the system buses.

O-DATA RECEIVER FUNCTION.— The O-data receiver function interfaces the display console with the CDB. It receives the encoded serial data from the CDB, decodes it to serial data, and sends the data to the I/O processor function. Parallel data received from the system computer is buffered and sent to the I/O processor.

INPUT/OUTPUT (I/O) PROCESSOR FUNCTION.— The input/output processor function controls all communications with the system computer. It receives data from the O-data receiver function and distributes the data throughout the display console. It also buffers the O-data and sends the buffered O-data to the BDU.

MEMORY SORT PROCESSOR FUNCTION.— The memory sort processor function controls the operation of the system memory. It provides memory management by sectioning the refresh memory, checking the refresh memory for changes, clearing memory, and checking for page enabling and end-of-page codes. The memory sort processor function also updates trackball data and commands the graphics processor function.

SYSTEM MEMORY FUNCTION.— The system memory function is used for storage of the processor programs and for temporary storage of data. The system memory contains 128K of RAM for use by the display console. The system memory function also controls the use of the data buses by the other functions of the console.

GRAPHICS PROCESSOR FUNCTION.— The graphics processor function converts processed refresh memory data, from the system memory, into display data. This display data is sent to the display generator.

DISPLAY GENERATOR FUNCTION.— The display generator controls the display of all types of symbols on the basic display unit. Display data from the graphics processor is received by the display generator and decoded. The appropriate deflection, intensity, and timing signals are generated and sent to the BDU. The display generator can display symbols, circles, ellipses, and lines in four intensities and four colors.

PANEL PROCESSOR FUNCTION.— The panel processor function monitors and controls the various operator panels on the display console. It receives data from various switches and forms the I-data words. The panel processor function also lights the various lamps in the 6 x 7 switch panel, variable function key (VFK) panel, and system keyboard. It accumulates trackball data for proper positioning of the ball tab. The panel processor converts the X/Y coordinates of the trackball to range and bearing data (R- If the operator activates range and bearing display, the console will display range and bearing of the ball tab from the point that the ball tab was enabled. During diagnostics, the panel control processor generates diagnostic controls and flags. It compiles graphics data and generates sweep and display control signals.

SWEEP AND RASTER FUNCTION.— The sweep and raster function generates the signals necessary for the proper display of sensor sweeps. It receives display sweep signals from the SDDS. The sweep and raster function also receives offset data, range settings, sensor selected, sensor mode, and video level selected from the panel processor. The sweep and raster function generates the sweep and raster intensity controls for the BDU. It also generates sensor and video codes for the SDDS, and sweep deflection control and offset coordinates for the digital deflection function.

DIGITAL DEFLECTION FUNCTION.— The digital deflection function develops X and Y analog deflection voltages for use by the BDU. Digital X and Y symbol coordinates are stored in the X/Y symbol counters. The output of the symbol counters are sent to the X and Y modified monobit digilogs for conversion to an analog voltage. Sweep deflection data is generated by the X and Y sweep counters. The sweep counter receives and counts the ΔX and ΔY pulses. If the sweep is to be offset, the X and Y sweep counters are preset to the offset coordinates. The outputs of the X and Y sweep counters are also sent to the modified monobit digilogs for conversion to analog deflection voltages. The sweep symbol select multiplexer controls whether the sweep coordinates or symbol coordinates are input to the modified monobit digilogs.

CLOCK GENERATOR FUNCTION.— The clock generator function generates the system clock for use by the display console. Clocks are generated from 40-MHz and 24-MHz oscillators. The clock generator function also generates the power-on reset signals at power-on or when the RESET switch is depressed.

TV MONITOR DISPLAY GENERATOR FUNCTION.— The TV monitor display generator function generates analog composite video used to display alphanumeric data on the digital data indicator.

COMPUTER-CONTROLLED ACTION ENTRY PANEL (CCAEP) FUNCTION.— The computer-controlled action entry panel (CCAEP) function interfaces the CCAEP with the display console. When an operator activates a CCAEP switch, the switch data is processed by the CCAEP function into computer I-data. CCAEP O-data from the computer is decoded to generate row and column enables and to light readout lamps.

I-DATA STORAGE AND CONTROL FUNCTION.— The I-data storage and control function forms computer I-data from the various functions and sends data to the system computer in response to an interrogation. Data is received by the I-data storage and control function from the other functional areas of the display console and converted into serial data if a CDB is used in the system. If a CDB is not used, then the I-data is in parallel form and transferred directly to the computer.

I-DATA TRANSMITTER FUNCTION.— The I-data transmitter function converts console I-data from the I-data storage and control function to the levels required for transfer to the system computer. If the data to be transferred is in serial format, the I-data transmitter function converts the serial data

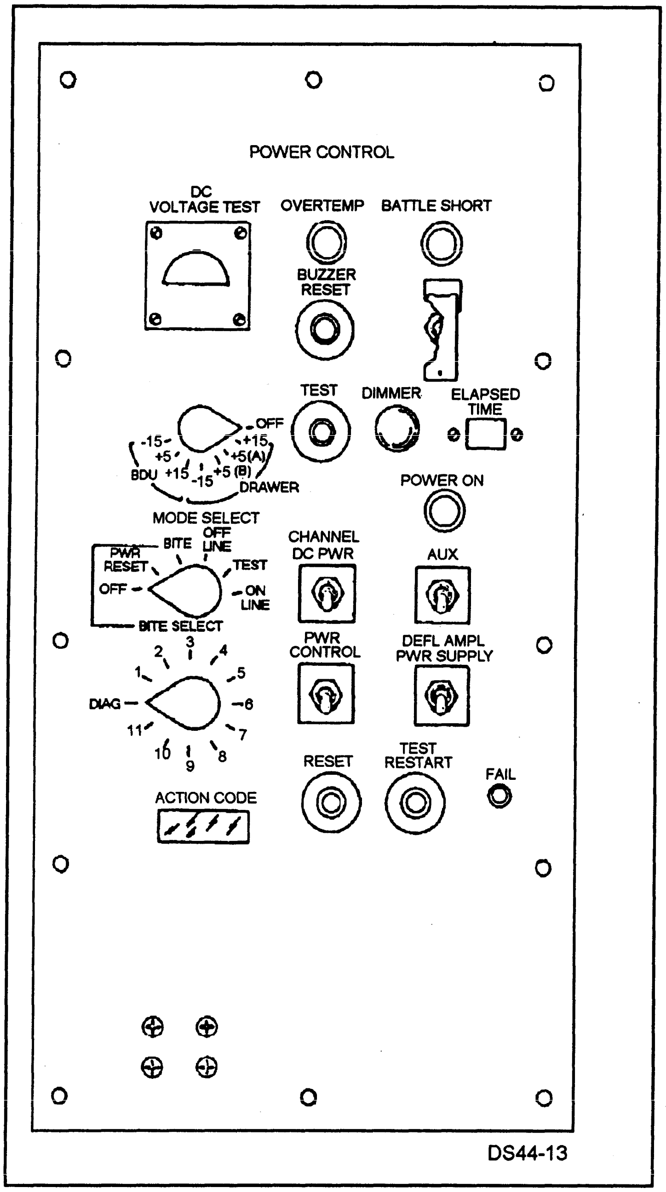


Figure 4-13.—A console electronics drawer power control panel.

into Manchester encoded serial data before transferring it to the CDB. If the data is in parallel format, the parallel data drivers provide the proper level shifting and gating to the system computer.

DIAGNOSTIC FUNCTION.— The diagnostic function controls the running of the various built-in self tests. There are three levels of diagnostic testing. Level I tests are run automatically when the power is turned on. Level I tests are basic checks of the system clocks, memory timing, and operation of the four processors. If no errors are detected during level I tests, the level II tests are run. Level II tests are more detailed and check the system RAM, processor support subfunctions, refresh memory, display memory, and processor interfaces. Level III tests are detailed interactive tests. Level III tests are controlled by the technician and can be run when the power control panel MODE SELECT switch is in the BITE (built-in test equipment) position. Figure 4-13 shows a typical console electronics drawer power and control panel. There are several different power and control panels, but all have similar controls and indicators. If a fault is detected during level I or II testing, the FAIL indicator on the CED power control panel will light. Internal fault indicators, located on the circuit cards, may also be lighted if a level I or II test fails. A numerical code may be displayed in the ACTION CODE readout on the CED power panel for level I, II, or III test failures. For exact operating procedures and fault isolation codes, you should refer to the *Maintenance Instruction Manual for Computer Display Set AN/UYQ-21(V),* Volume 2, SE685-AF-MMM-020/UYQ-21(V).

POWER DISTRIBUTION.— The power distribution function converts the ac input power into +5, +15, and -15vdc for use in the console. The power distribution function also monitors the operating temperature and provides an over-temperature alarm when the console operating temperature reaches 150°F. If the console temperature reaches 170°F, an unsafe condition is present and the console will automatically shut down. The automatic shutdown can be overridden by the BATTLE SHORT switch.

Basic Display Unit

The basic display unit (BDU) is used to display sensor data and computer-controlled symbology. Data input to the computer is accomplished by variable function keys around the CRT. Figure 4-14 illustrates the BDU. The BDU consists of an 11" x 13" vector scan CRT and seven functional areas to support the display, as shown in the block diagram (figure 4-15). The functional areas of the BDU are:

- Input/output function

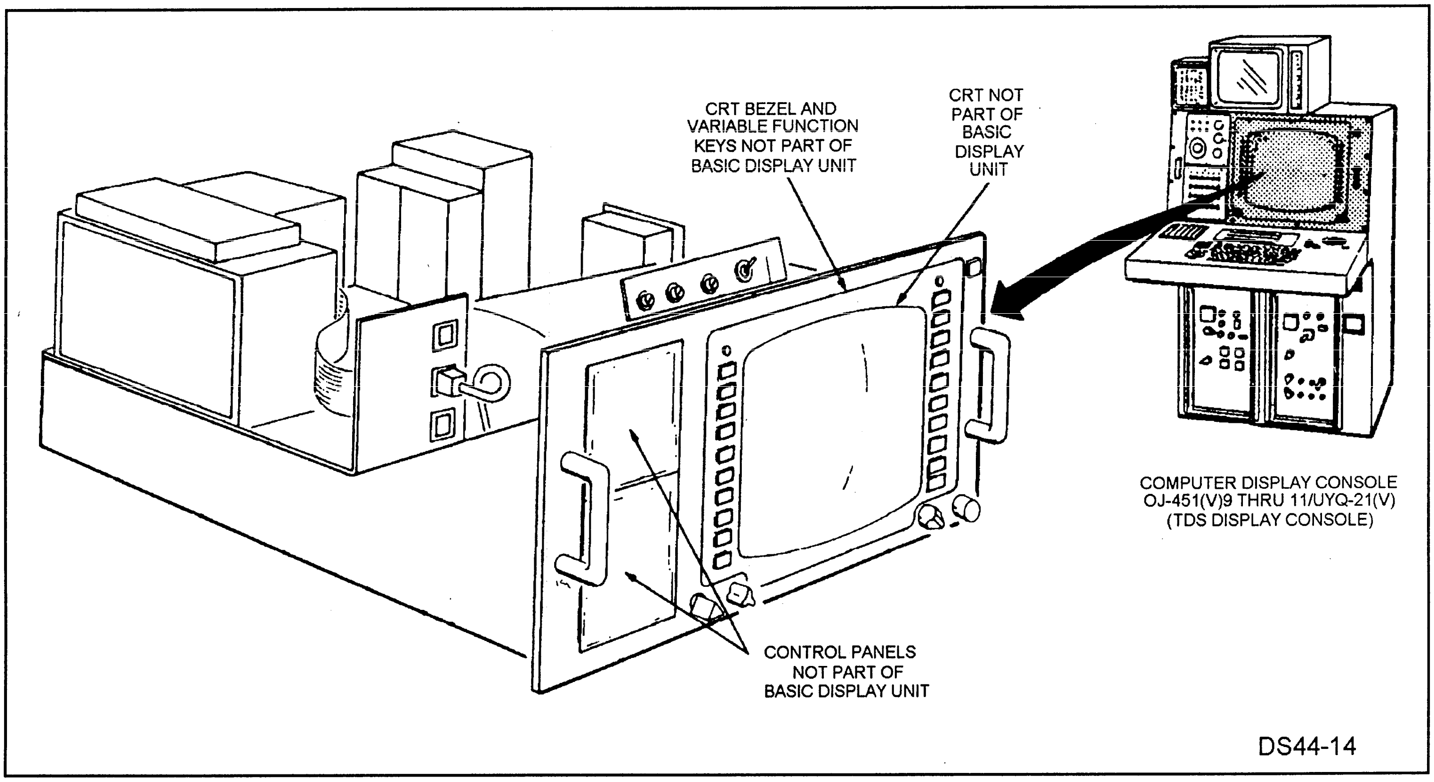


Figure 4-14.—The basic display unit (BDU).

- Symbol generator function
- Conies generator function
- Circular sweep control function
- Analog deflection function
- Intensity control function
- Power distribution function

INPUT/OUTPUT FUNCTION.— The input/output (I/O) function is the interface between the basic display console and the BDU. The I/O function has two subfunctional areas: the input subfunction and the output subfunction.

The input subfunction consists of digital and coax line receivers. The receivers provide for impedance matching and buffering of the input signals. The input function also routes input data to other fictions of the BDU.

The output subfunction of the BDU consists of digital drivers to send symbol status signals back to the display console.

SYMBOL GENERATOR FUNCTION.— The symbol generator function contains the circuitry to generate the symbology and alphanumerics for display on the CRT. Symbols are generated using the stroke method described in chapter 1 of this manual.

CONICS GENERATOR.— The conies generator develops the signals required to display circles and ellipses. Circle radius can be from 16 to 1,023 deflection units in increments of 1 deflection unit. The circle and ellipse data is received from the I/O function. Size of the circle or ellipse is determined and scaled to match the range setting of the display console. Deflection voltages, consisting of sine and cosine waveforms or conies radius, are sent to the analog deflection control function.

CIRCULAR SWEEP CONTROL FUNCTION.— The circular sweep control function develops the signals required to display circular sweep. The function receives the ΔX and ΔY pulse

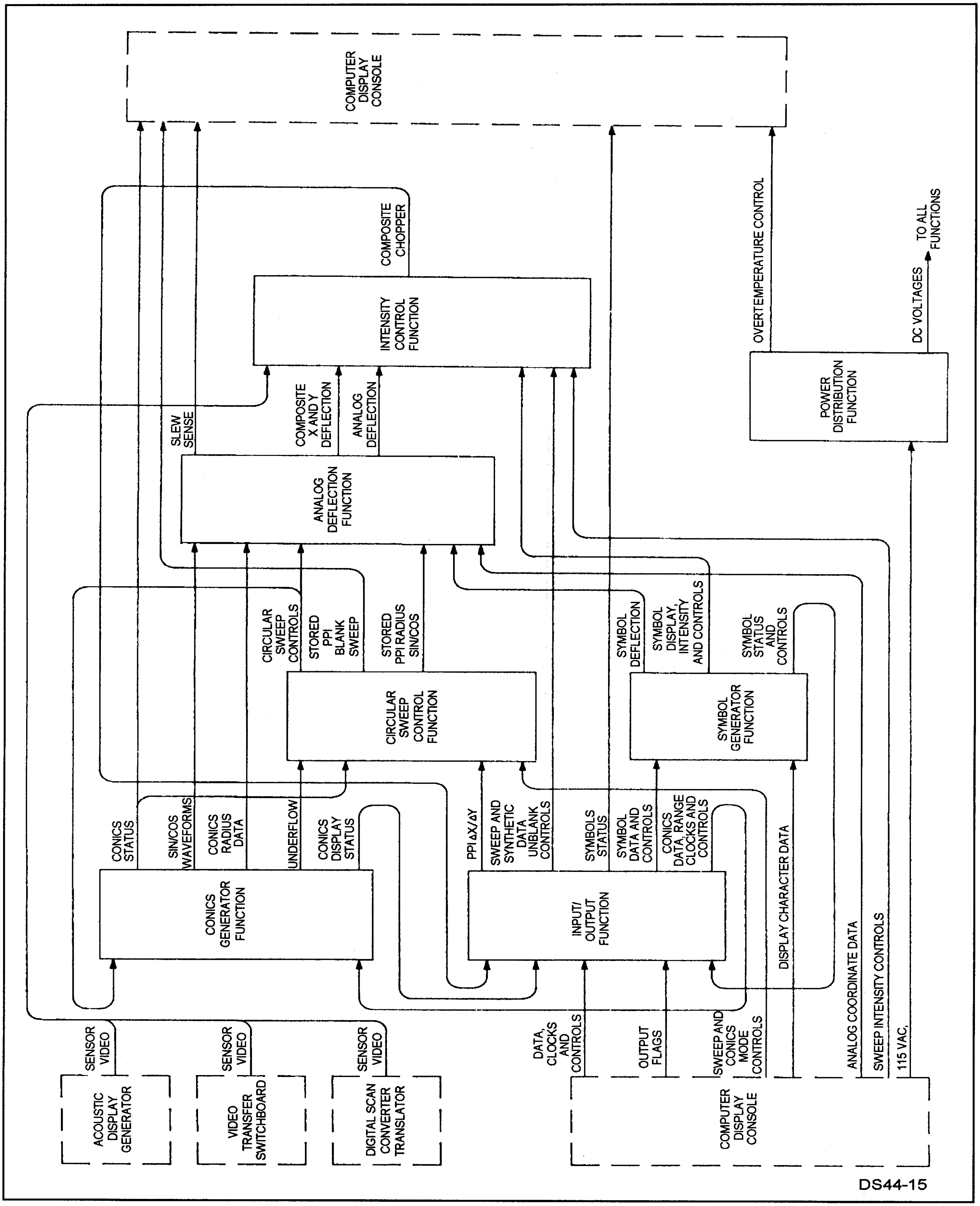


Figure 4-15.—The functional block diagram of the basic display unit.

trains from the RAC, counts the pulses, and develops the deflection voltages required for generating the sweep circular raster.

ANALOG DEFLECTION FUNCTION.— The analog deflection function controls the movement of the CRT beam via the yoke on the neck of the CRT. Major position data is received from the display console and summed with the symbol waveforms from the symbol generator or circle/ellipse waveforms from the conies generator.

INTENSITY CONTROL FUNCTION.— The intensity control function controls the blanking and unblinking of the CRT beam and the brightness of the display. The intensity control function also contains compensation circuitry to ensure the intensity of the display is uniform because of changes in the write time of the display.

POWER DISTRIBUTION FUNCTION.— The power distribution function contains the power supplies to convert the input ac voltage to the levels required by the BDU. Depending on the version of the BDU in use, there are six or seven power supplies in the power distribution function that develop the following voltages: +5, +6.3, +15, -15, +30, +100, +110, +600, +18,000, -26, -30, and -110.

TV Monitor

The TV monitor is a 7" x 9", 525 line, interlaced monochrome monitor mounted to the top of the BDU. It is shown in figure 4-16. The TV monitor has two input channels and displays composite video. The composite video may be computer-generated alphanumeric data, video from another monitor, or a picture from an external video camera. The TV monitor also has a video loop through connection to allow the same information to be displayed on up to five additional monitors. Figure 4-17 shows the block diagram of the TV monitor.

VIDEO CONTROL FUNCTION.— The video control function receives signals from the control panel that allow the operator to control the brightness and contrast of the raster and select which of the two video sources will be displayed on the CRT. The TV monitor control panel is shown in figure 4-18.

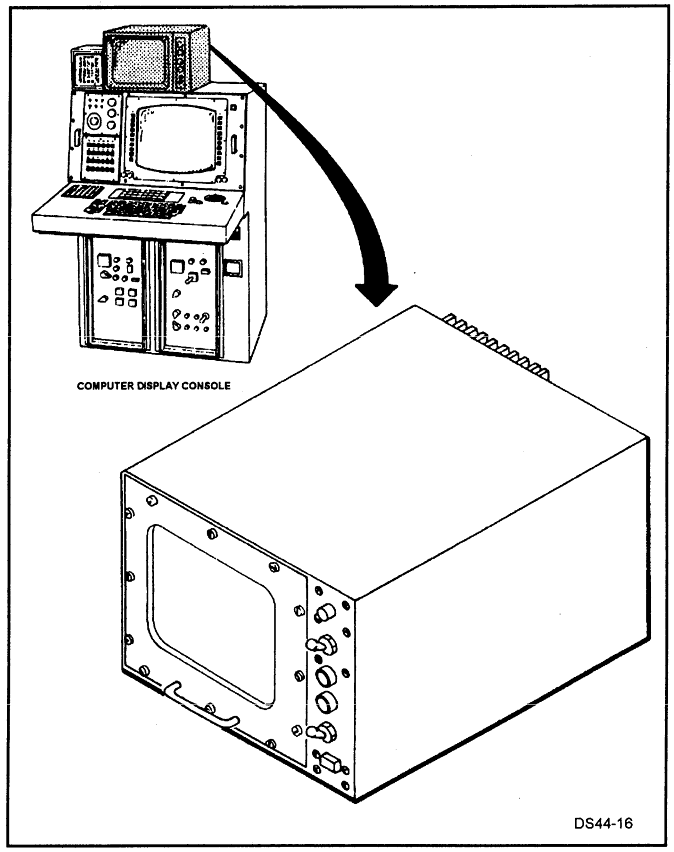


Figure 4-16.–The TV monitor.

The raster control signals and the composite video input signals are used by the video control function to generate the CRT drive signals. The horizontal and vertical blank signals from the sweep generator provide the timing for the video function to blank the CRT during horizontal and vertical retrace.

SWEEP GENERATOR FUNCTION.— The sweep generator function develops the signals to drive the horizontal and vertical deflection yokes and generates timing signals required by the video control function.

DISPLAY CONTROL CONSOLE OJ-535(V)/UYQ-21(V)

The display control console (DCC) OJ-535(V)/UYQ-21(V) is a high resolution graphics console that provides a man-to-machine interface for the display and control of command and control data. Figure 4-19 shows one configuration of the

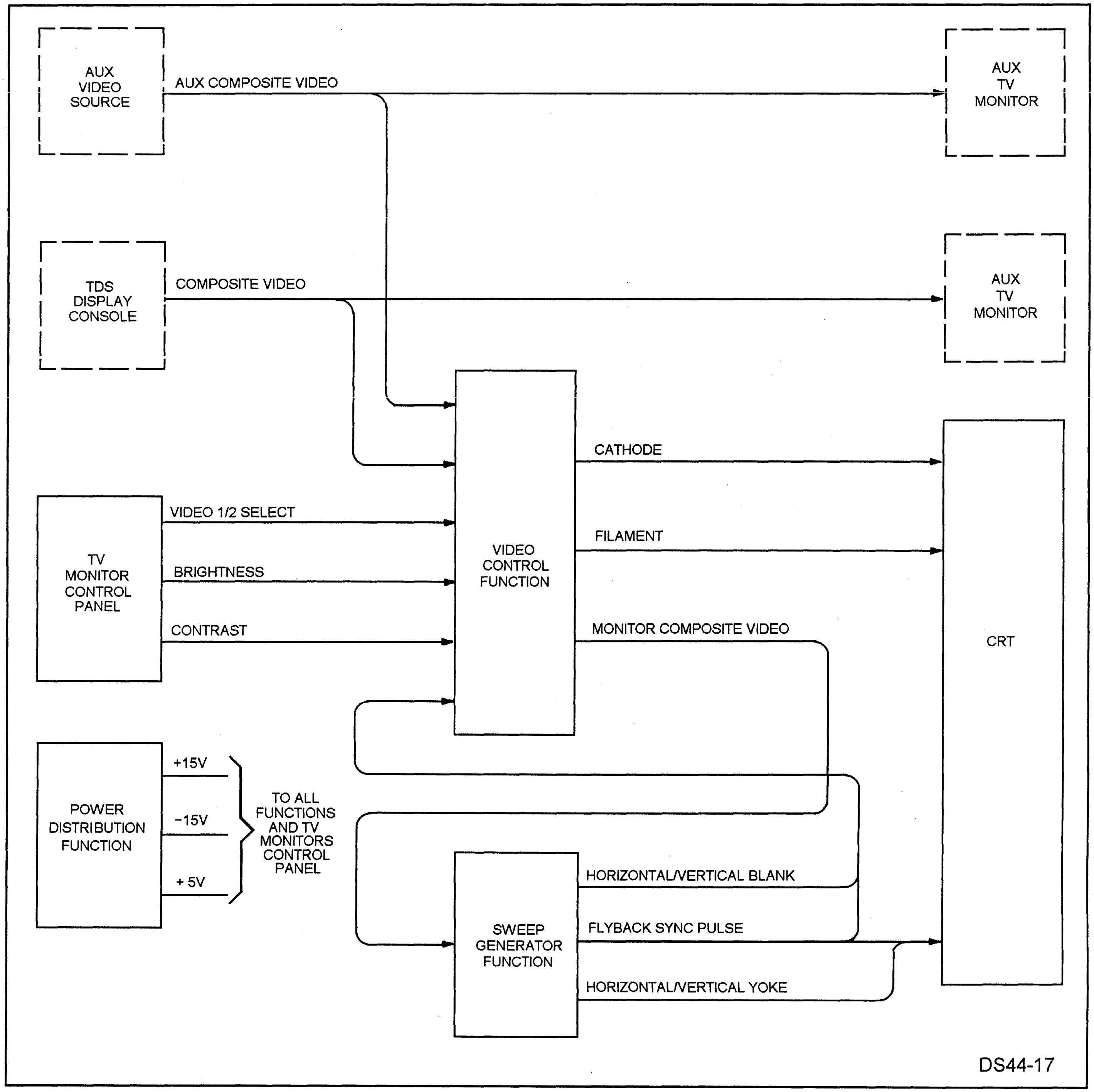


Figure 4-17.—The TV monitor block diagram,

OJ-535(V)/UYQ-21(V). The display control console consists of three modules. The modules are the digital display indicator (CRT display module), the graphics display shelf (bullnose), and the control panel module.

The DCC interfaces with the system computer through a television converter. The television converter can be either the common digital television graphics generator (C-DITEG), the television scan converter (TVSC), or the tactical DITEG module (TDM). These converters are covered later in this chapter. We assume an interface with the C-DITEG in our discussion of the DCC. Figure 4-20 shows the system block diagram of the DCC interface.

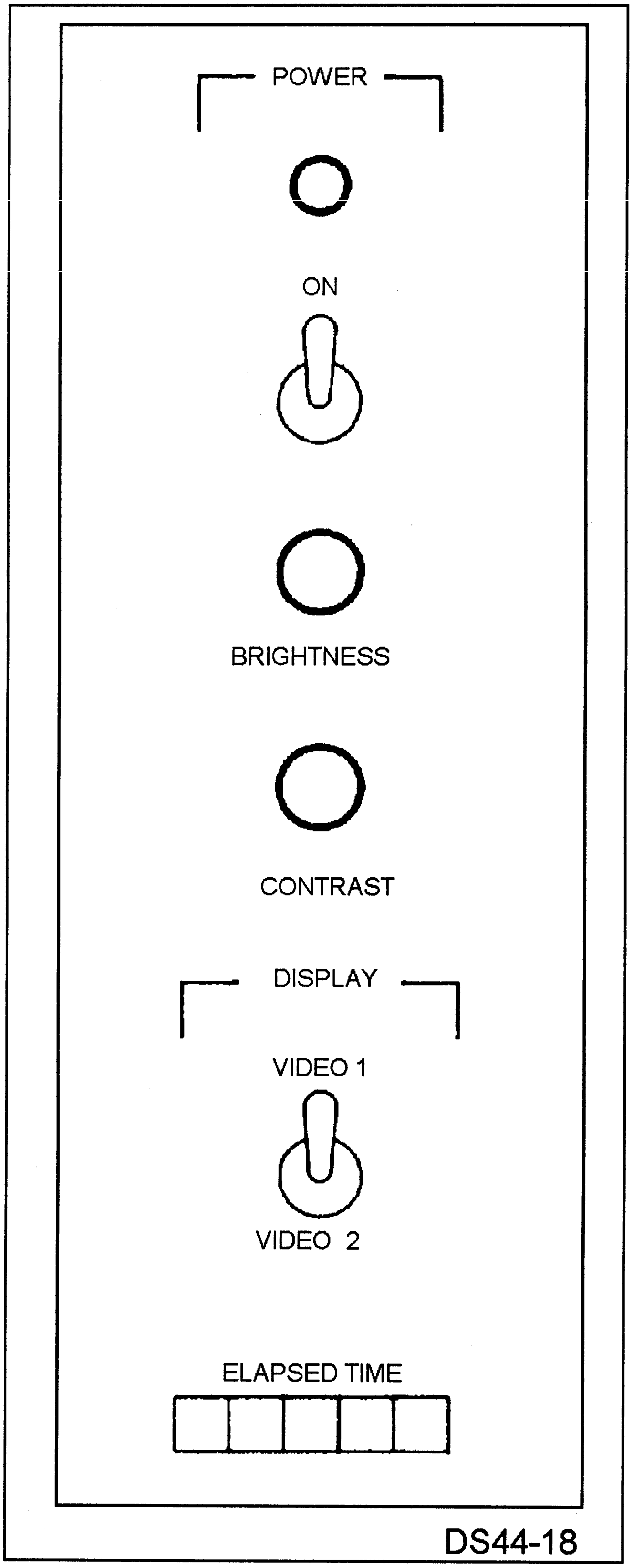


Figure 4-18.–The TV monitor control panel.

DIGITAL DISPLAY INDICATOR.— The digital data indicator is a high resolution video monitor with

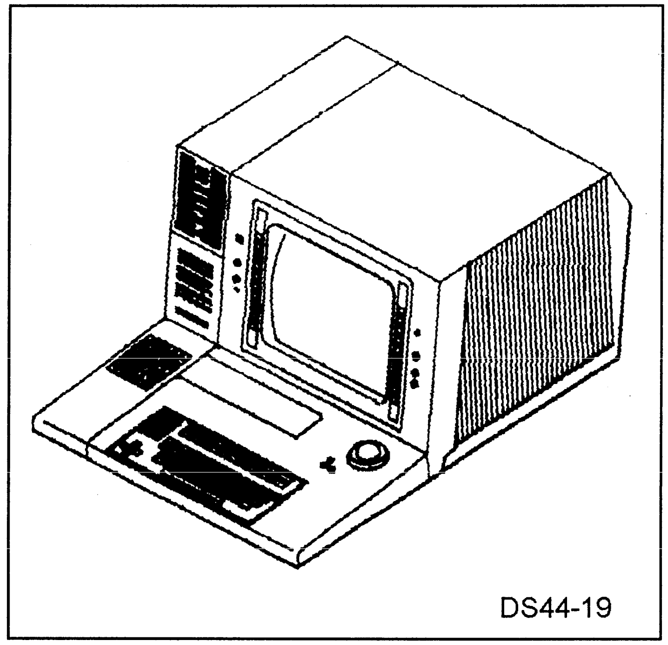


Figure 4-19.—A Display Control Console (DCC) OJ-535(V)/UYQ-21(V).

a 10" x 13" CRT. The digital display indicator displays alphanumeric data from either a computer or a keyboard and composite video graphics generated by the C-DITEG. The graphics monitor can display video in either a 525-line TV format or a 1075-line TV format. The graphics monitor has either 20 or 22 variable function keys (VFKs) to send data to the system computer. The graphics monitor has four functional areas: the monitor interface function, the monitor deflection function, the video amplifier function, and the power distribution function.

Monitor Interface Function.— The monitor interface function controls the communications between other functional areas of the graphics monitor, controls the interface between external equipments, and processes and distributes brightness, contrast, and video selection from the front panel controls.

The monitor interface function is controlled by the interface microprocessor. The interface microprocessor controls the two-way exchange of serial data between the graphics monitor and the C-DITEG. It also monitors the front panel switches and controls. If a VFK is depressed, the interface microprocessor forms the serial input word for

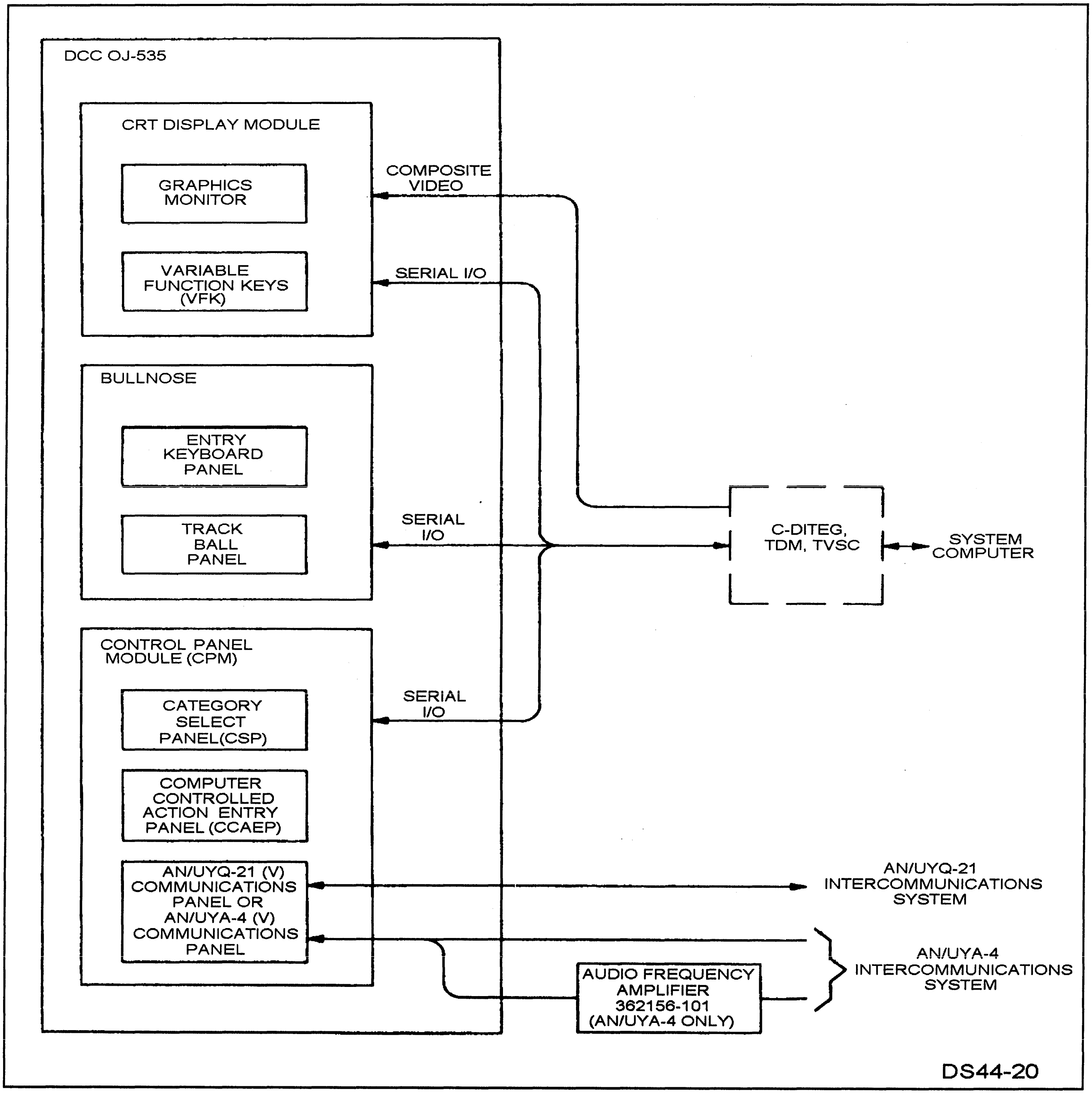


Figure 4-20.—The display control console interface block diagram.

transmission to the C-DITEG at the next interrogation.

Composite video from the C-DITEG or external video is processed by the monitor interface function. Video is selected by the VIDEO SELECT switch. The selected video is sent to the video preamp and amplified before being sent to the video amplifier function. The sync processor of the monitor interface function separates the horizontal and vertical components of the composite signal, detects the scan rate (525 or 1075 lines), and controls the aspect ratio.

Monitor Deflection Function.— The monitor deflection function of the DCC receives the vertical and horizontal sync signals from the monitor interface sync processor. These signals are used to develop the voltages necessary to drive the vertical and horizontal deflection coils on the CRT yoke. The monitor deflection function also produces dynamic focus voltages to control the focus of the CRT beam.

Video Amplifier Function.— The video amplifier function receives the selected video signal and develops the voltages necessary to drive the CRT cathode and control grid (grid 1).

GRAPHICS TERMINAL SHELF.— The graphics terminal shelf is located in the bullnose of the DCC and contains the trackball assembly and the data entry keyboard. The trackball and keyboard functions are controlled by the bullnose microprocessor and interface with the system computer through the C-DITEG. The bullnose microprocessor monitors the switches (trackball and keyboard) for any operator action, develops a serial I-data word, and sends it to the C-DITEG. The microprocessor program also receives O-data from the C-DITEG and processes it. The O-data contains commands to light various keys on the entry keyboard.

CONTROL PANEL MODULE.— The control panel module is located on the left side of the graphics monitor. Depending on the configuration and system, the control panel module can contain a variety of switch panels. There can be one or two CCAEPs, a 6 x 7 category select panel, and a communications station.

The control panel module also contains a microprocessor that controls the communication with the C-DITEG. The microprocessor program monitors the switches in the various panels for activity, stores any action, creates an I-data word, and transmits the I-data to the computer via the C-DITEG.

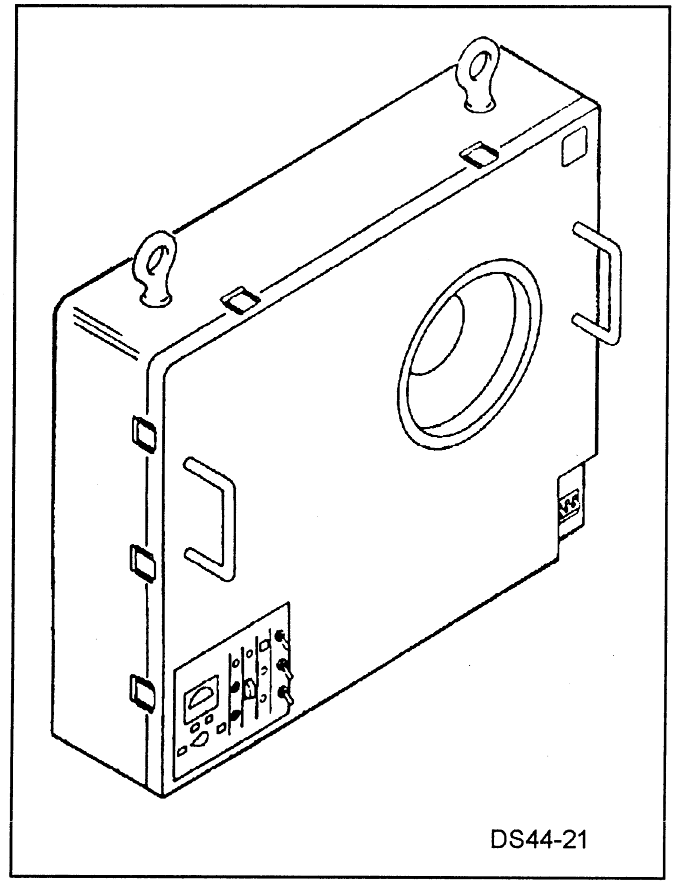


Figure 4-21.—The Projection Plotting Unit PT-525/UYQ-21(V).

PROJECTION PLOTTING UNIT PT-525/UYQ-21 (LARGE SCREEN DISPLAY)

Large screen display capability for the AN/UYQ-21(V) system is provided by the projection plotting unit (PPU), either the PT-525/UYQ-21(V) or

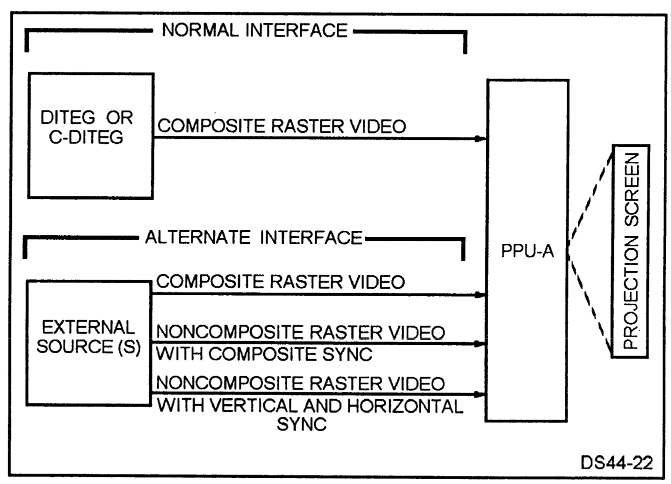


Figure 4-22.–The PPU interface options.

the PT-525A/UYQ-21(V). For our training purposes, we are using the PT-525/UYQ-21(V). The PPU is a large screen projection display device that projects a visual image onto a 42" x 42" screen. The presentation consists of yellow characters on a blue background. Display resolution can be 525, 729, or 1075 lines per frame. Figure 4-21 shows the PT-525/UYQ-21(V) unit.

The PPU receives composite video from the DITEG or C-DITEG. The PPU is also capable of displaying raster video from an external source if separate horizontal and vertical sync signals are provided. The PPU can also display random stroke video supplied by an OJ-451(V)2,3/UYQ-21 that is equipped with the display signal amplifier option. Figure 4-22 illustrates the interface options available.

The PPU consists of the following five functional areas:

- Video processing function
- Sweep and deflection function
- CRT function
- Projection function
- Power distribution function

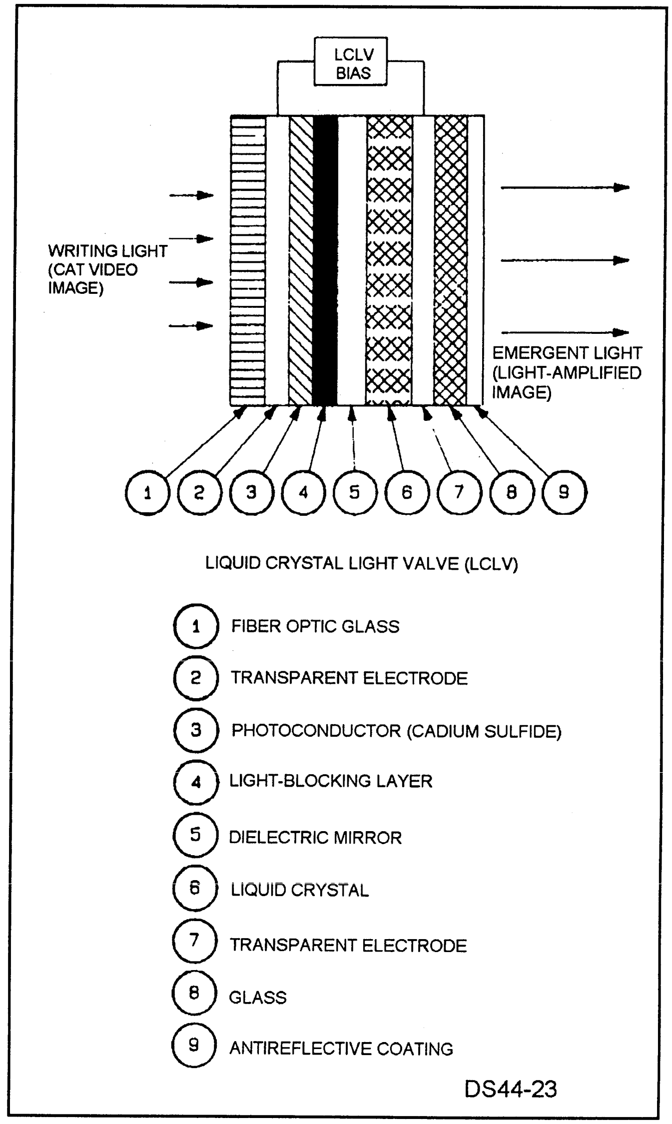


Figure 4-23.–A cross section view of the liquid crystal light valve.

Video Processing Function

The video processing function receives the incoming video and develops the video and blanking signals required to control the electron beam of the CRT. The video input can be composite video, noncomposite video with separate horizontal and vertical sync, or random stroke video. The video signal is amplified and used to drive the CRT cathode. The sync signals are processed to form the horizontal and vertical retrace blanking signals.

Sweep and Deflection Function

The sweep and deflection function develops the signals required to move the CRT electron beam. Raster deflection voltages are generated from the horizontal and vertical sync signals received from the video processor function. Random stroke deflection voltages are received from the TDS display console in the form of X and Y major (position) deflection voltages and X and Y minor (symbol) signals. The deflection voltages are used to drive the yoke of the CRT.

CRT Function

The CRT function uses the video and deflection voltages to create a visual image. The CRT in the PPU is a 2.25-inch diameter, high resolution electron tube. The video output of the CRT is a fiber-optic faceplate. The faceplate is in physical contact with the fiber-optic substrate of the liquid crystal light valve (LCLV) in the projection function. The fiber-optic substrate of the LCLV acts as the interface between the CRT and the LCLV.

Projection Function

The projection function receives the visual image from the CRT, amplifies it, and projects it to a large screen. A 500-watt xenon arc lamp provides a high intensity light source to the LCLV. Figure 4-23 shows a cross section of a LCLV. The LCLV bias is a variable ac voltage used to align the liquid crystal molecules. When no light is present on the fiber-optic plate, the bias voltage drop is primarily across the photoconductor layer and not the liquid crystal layer. When a point of light hits the fiber-optic plate, the impedance of the photo conductor at that point will drop and the ac voltage will be applied to the corresponding point on the liquid crystal layer. A voltage drop on the liquid crystal causes the liquid crystal molecules to rotate and polarizes the light. The light emitted by the LCLV is polarized (rotated) in areas that had light applied to the LCLV and unaltered where there is no liquid crystal molecular rotation. This light is then processed by a series of optic lenses and prisms and projected onto the screen.

Power Distribution Function

The power distribution function develops and distributes the voltages required by the PPU. The low-voltage power supply develops regulated +5, +15, and -15 vdc. The medium voltage power supply develops +31, -31, +100, +110, and -110 vdc. The medium-voltage power supply also develops the +6.3 vac for the CRT filament.

The arc lamp power supply and lamp igniter provide the starting and operating voltages for the arc lamp. When power is applied, the arc lamp power supply sends +100 vdc to the arc lamp igniter. This voltage is used to start the arc lamp igniter, which steps up the 115 vac input voltage to a 24 kv, which is then sent to the arc lamp. If the arc lamp ignites, the +100 volts drops to 20 volts to maintain a constant current through the lamp. If the arc lamp does not ignite, the 24-kv ignition pulse will be repeated up to a maximum of 12 times. If ignition fails after 12 attempts, a lockout circuit will inhibit further attempts and light the lockout indicator on the power supply. The lockout circuit must be manually reset.

TELEVISION CONVERTER GROUP

The television converter group develops the composite video signals required to display graphics and alphanumerics on the OJ-535(V)/UYQ-21(V), the large screen displays, and the automated status boards (ASTABs). The television converter group can also be configured to drive hard-copy printer-plotters.

Depending on the ship's configuration, the television converter group will contain one or more of the following equipments:

1 Common digital television graphics generator (C-DITEG)

- Digital television graphics generator (DITEG)
- Dual television scan converter (dual TVSC)
- Tactical DITEG module (TDM)
- Central ASTAB generator

In our study of the television converter group, we look at the C-DITEG in detail and follow it with a brief description of the functions and capabilities of the other types of converters.

COMMON DIGITAL TELEVISION GRAPHICS GENERATOR (C-DITEG)

The common digital television graphics generator (C-DITEG) is used to generate the text, graphics, and symbols used in displays and hard-copy printer-plotters. The C-DITEG is a multichannel device that can drive up to 14 displays and 2 hard-copy printer-plotters. Of the 14 displays, 8 are graphic display units and 6 are text-only units. The 8 graphic displays are 6 display consoles, (OJ-535(V)/UYQ-21(V)), and 2 large screen displays (PT525/UYQ-21(V)). The

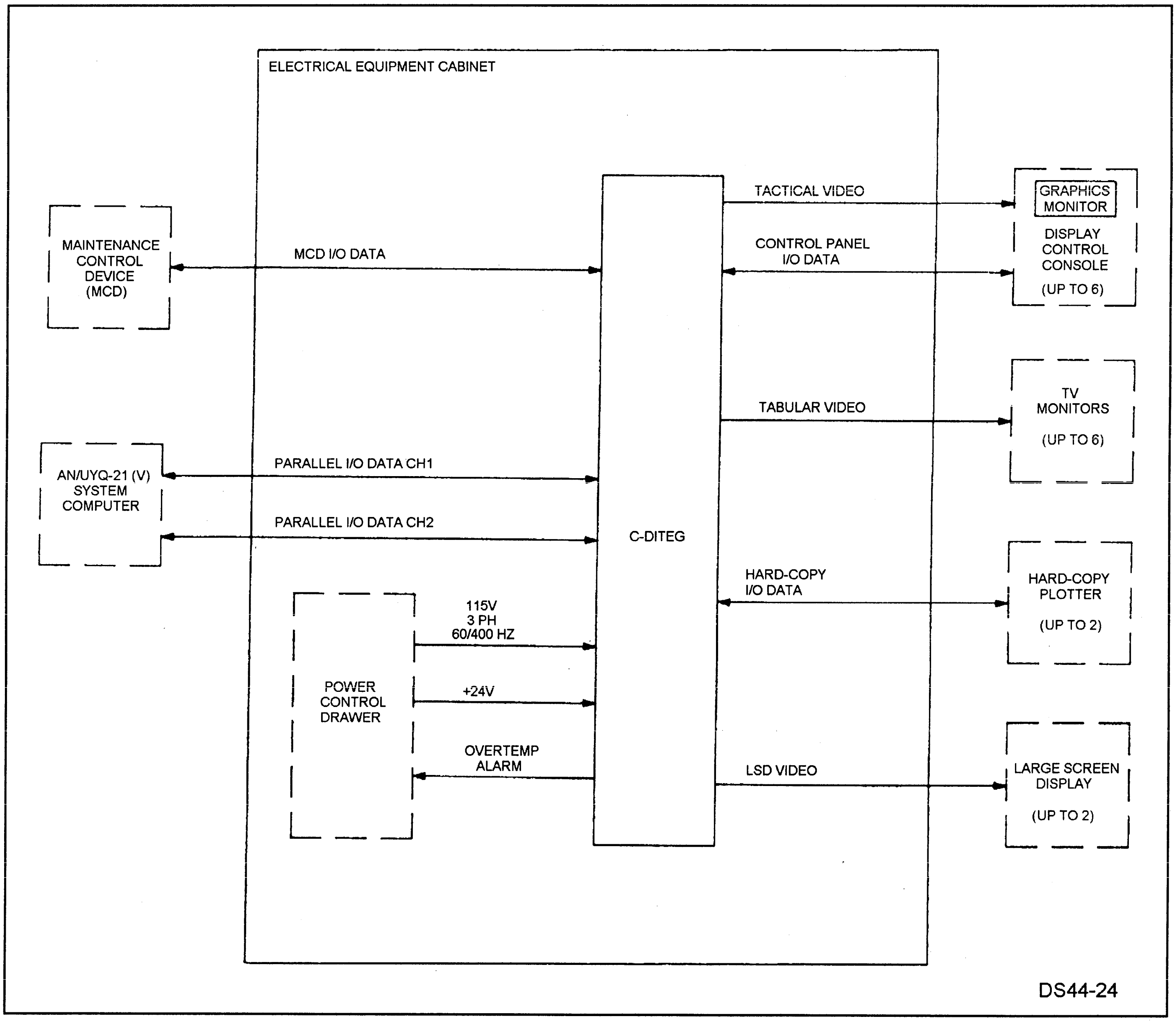


Figure 4-24.—C-DITEG interface options.

CRT screens of all 14 of the displays can be copied onto either of the hard-copy printer-plotters. The C-DITEG also provides the interface between the system computer and the DCC switch panels. The C-DITEG cannot generate radar sweep and video for display on the CRT. Figure 4-24 illustrates the interface options of the C-DITEG.

The C-DITEG consists of two AN/UYQ-21(V) electronics drawers. These are the processor drawer and the video drawer. The drawers must be mounted adjacent to each other, either horizontally or vertically, in a standard six-drawer electronics cabinet or in a two-drawer electronics cabinet.

C-DITEG Processor Drawer

The C-DITEG processor drawer provides the interface between the system computer and the display consoles, converts computer data into display data and commands, generates tabular video, and processes the bit map memory addresses for the video drawer. The processor drawer consists of the following functions:

- O-data receivers
- Input/output (I/O) controller
- Control synchronizer
- System memory
- Peripheral input/output
- Formatter
- Function generator
- Tabular video generator
- I-data transmitters

O-DATA RECEIVERS.— The O-data receivers accept 32 bits of parallel computer data, provide the proper level shifting, and send the computer data to the I/O controller.

INPUT/OUTPUT CONTROLLER.— The input/output (I/O) controller manages the communication with the system computer. The I/O controller receives computer data through the O-data receivers and sends data to the computer through the I-data transmitters. There are two identical I/O channels in the C-DITEG, although only one maybe active at any time. Channel 0 is the default channel; and if the active channel fails, the normally idle channel will become active.

The I/O controller decodes incoming computer data for C-DITEG control words or display data words. Display data is sent to system memory.

CONTROL SYNCHRONIZER.— The control synchronizer uses four crystal oscillators to generate the system clocks. The crystal oscillators generate 40-MHz, 27-MHz, 24-MHz, and 16-MHz clocks. The 40-MHz clock is divided by two and four to generate 50-nanosecond and 100-nanosecond clock pulses. The 27-MHZ clock is divided by 16 to become the universal asynchronous receive/transmit clock. The 24-MHz and 16-MHz clocks are divided by two to become the video format pixel clocks.

The control synchronizer also produces the synchronization and timing signals for the three tabular (text only) video formats. These video formats are: 40 x 80 x 9 (40-line x 80-column x 9-pixel character width), 40 x 80 x 8, and 16 x 48 x 9.

SYSTEM MEMORY.— The system memory fiction consists of 512K of random access memory (RAM) and 192K of erasable, programmable read-only memory (EPROM). The RAM is used for temporary data storage (file memory). The EPROM contains the operational firmware required by the C-DITEG. If the C-DITEG has field change 3 installed, the RAM is increased to 1M.

PERIPHERAL I/O FUNCTION.— The peripheral I/O (PIO) function interfaces the external peripherals with the C-DITEG. The peripherals are up to two hard-copy printer-plotters, up to six TV monitors, up to six display control consoles (DCCs), and up to two large screen displays (LSDs). The PIO function also generates data and control signals for the tabular video generator. The PIO function also interrogates the display control consoles for any switch actions. If a switch action has occurred, the switch data is received from the DCC by the PIO, reformatted, and transferred to the system computer, via the system memory, by the I/O controller. The PIO also sends the signals to control the lighting of the lamps on the DCC control panels.

When a hard-copy printout is requested, the PIO obtains the data from the video drawer's bit mapped memory, reformats the data for the printer-plotter, and sends the data to the printer plotter.

FORMATTER.— The formatter generates formatted display data for the display control console graphics display, large screen display, and the hard-copy printer-plotter from file memory data. The formatter also produces the control signals for the function generator of the processor drawer and the bit map memory of the video drawer.

FUNCTION GENERATOR.— The function generator creates display data consisting of conies (circles and ellipses), vectors, and characters from formatted data received from the formatter. This display data is sent to the video drawer in the form of pixel data for the generation of DCC and large screen displays.

TABULAR VIDEO GENERATOR.— The tabular video generator forms the composite video signals to display text data on six TV monitors. The tabular video generator can create video in one of three video formats. The video formats are 40 x 80 x 9, 40 x 80 x 8, and 48 x 16 x 9. The character information to be displayed is received from the PIO data and address buses, converted to a video bit stream and then to the analog composite video signal that is sent to the TV monitors.

I-DATA TRANSMITTERS.— The I-data transmitters interface the system computer with the I/O controller. The I-data transmitters receive computer input data from the I/O controller and level shift the data for transmission over the system I/O cables.

C-DITEG Video Drawer

The C-DITEG video drawer receives the formatted video data from the processor drawer and generates the composite video signals for the display control console and large screen displays. Display data for hard-copy display is sent from the video drawer to the processor drawer. The video drawer is capable of driving six display control consoles and two large screen displays. The video drawer consists of the following functional areas:

- Timing synchronizer
- Bit map memory and control function
- Video multiplexer
- Tactical video generator

TIMING SYNCHRONIZER.— The timing synchronizer generates the clocks, sync signals, blanking signals, and shift controls needed by the video drawer for video generation.

BIT MAP MEMORY AND CONTROL FUNCTION.— The bit map memory and control function consists of 44 or 48 1024 x 1024-bit Cartesian coordinate memory planes. Video drawers with field change 2 installed have 48 memory planes. These memory planes store the images that are to be displayed on the DCC and LSD. Images are written on the memory plane by the processor drawer using the same coordinates as if they were being displayed on a screen. The display data is read out of the memory planes as serial bit streams and sent to the video multiplexer for eventual display.

VIDEO MULTIPLEXER.— The video multiplexer receives the 48 bit streams from the bit map memory and creates serial data streams for use by the tactical video generator. The video multiplexer also provides the data for a hard-copy printout to the processor drawer.

TACTICAL VIDEO GENERATOR.— The tactical video generator converts the data streams from the video multiplexer into composite video. The tactical video generator can generate color video for six color tactical display channels and two monochrome large screen display channels. Color is not currently used in the AN/UYQ-21(V) system and the six tactical color outputs normally drive the OJ-535(V)/UYQ-21(V) display control consoles.

Pixel data from the data streams and sync signals from the timing synchronizer are combined in the tactical video generator to produce a composite video output. The video output is modified for 1075 lines per screen with 1024 displayable lines. There are two modes of video output for the tactical video channels: 1024 pixels per line or 1280 pixels per line. In the 1280 pixel per line mode, the additional 256 pixels are used to paint the VFK labels on the DCCs. The LSD video is always output in the 1024 pixel per line mode.

DIGITAL TELEVISION GRAPHICS GENERATOR (DITEG)

The digital television graphics generator (DITEG) is an electronics drawer that provides the circuitry required to display graphics data on a single PPU or DCC. One DITEG can drive one PPU. In addition, the DITEG provides the interface for ball tab information from a DCC to be displayed on the DITEG display screen. The DITEG generates the composite video for display on the PPU in a manner similar to that described for the C-DITEG.

DUAL TELEVISION SCAN CONVERTER (DUAL TVSC)

The dual television scan converter (dual TVSC) mixes radar sweep and video with graphics video to provide the DCC with aradar and tactical symbol display. The dual TVSC is housed in a single standard AN/UYQ-21(V) electronics drawer. Each dual TVSC is capable of driving two DCCs and there are two-dual TVSCs per six-drawer electronics cabinets. Additional cabinets are added as dictated by system requirements.

The dual TVSC receives radar sweep and video data directly from the SDDS. The radar azimuth, range, and video data is processed by the dual TVSC into a high resolution composite video signal. Composite video from the C-DITEG is received by the dual TVSC, synchronized, and merged with the radar video to produce a single high resolution raster scan output for display on the DCC.

TACTICAL DITEG MODULE (TDM)

The tactical DITEG module (TDM) contains the features of the TVSC and C-DITEG and is designed to drive one OJ-535(V)/UYQ-21(V) display control console, one TV monitor, and one hard-copy printer-plotter.

The DITEG module of the TDM receives data from the system computer and processes the symbol data into a high resolution composite video signal that is sent to the TVSC function. Tabular, or text data, is processed into a low resolution composite video signal for display on the TV monitor. The DITEG module also contains the circuitry required to drive a hard-copy printer-plotter.

The TVSC module of the TDM receives radar video, azimuth, and range data from the SDDS and tactical composite video data from the DITEG module. The TVSC converts the radar data into a raster scan composite video signal, merges it with the tactical composite video, and sends it to the DCC for display.

CENTRAL AUTOMATED STATUS BOARD GENERATOR (CAG)

The central automated status board generator (CAG) converts computer-supplied alphanumeric data into a low-resolution (525 line) composite video signal for display on a standard TV monitor. The CAG can simultaneously drive 16 monitors. The data displayed on the automated status board (ASTAB) monitors is selectable from a display console or a remote keypad mounted near the ASTAB monitor.

The CAG can also accept video inputs from a maximum of eight TV cameras. The CAG generates the horizontal and vertical synchronizing signal or composite video signals needed to control the external cameras.

SUMMARY-COMPUTER DISPLAY SET AN/UYQ-21(V)

This chapter has presented material on the Computer Display Set AN/UYQ-21(V). The following information summarizes important points you should have learned.

CENTRAL EQUIPMENT GROUP (CEG)— The CEG contains the central data buffer (CDB), sensor converter group, and the sensor data distribution switchboard (SDDS). These equipments interface the tactical display consoles with the computer and ship's sensors.

CENTRAL DATA BUFFER (CDB)— The CDB converts parallel data from the computer to serial data, and distributes the data to the TDS display console. The CDB receives serial data from the consoles, converts the data to parallel, and sends it to the system computer.

SENSOR CONVERTER GROUP–The sensor converter group is the main interface between the ship's sensors and the display consoles. Common converters are the synchro radar azimuth converter (SRAC) and the digital radar azimuth converter (DRAC). These converters generate the signals required to display sweep and range marks on the display console.

SENSOR DATA DISTRIBUTION SWITCHBOARD (SDDS)— The SDDS consists of two drawers in the CDB, the sweep drawer and the video switching drawer. The SDDS can route sensor data from 12 sensors to 20 display consoles.

DISPLAY CONSOLES— The Computer Display SET AN/UYQ-21(V) uses several types of display consoles, depending on the configuration of the system in which the consoles are installed. These consoles include the TDS Display Console OJ-451(V)/UYQ-21(V), the Display Control Console OJ-535(V)/UYQ-21(V), and the Projection Plotting Unit PT-525/UYQ-21(V).

TDS DISPLAY CONSOLE OJ-451(V)/UYQ-21(V)— The TDS display console is the main operator interface with the operational program in a tactical system. The TDS display console can display sweep, video, and computer-generated symbols. The TDS display console consists of the computer display console, the basic display unit, and a TV monitor. The TDS display console uses a vector scan CRT.

DISPLAY CONTROL CONSOLE (DCC) OJ-535(V)/UYQ-21(V)— The DCC is the main operator interface in the command and control subset of the AN/UYQ-21(V) system. The DCC consists of three modules: the digital data indicator (CRT display module), graphics display shelf (bullnose), and the control panels. The DCC interfaces with the system computer through a television converter. The DCC CRT is a raster scan CRT. Sensor sweep and video are not normally displayed on the DCC.

PROJECTION PLOTTING UNIT (PPU) PT-525/UYQ-21(V)– The PPU is a large screen display that projects computer-generated symbols on a 42 x 42-inch screen.

TELEVISION CONVERTER GROUP— The television converter group develops the composite signals needed to display graphics and alphanumerics on the DCC, PPU, and automated status boards. The television converter group can also drive the hard-copy printer-plotters used in the AN/UYQ-21(V) system. Depending on the system configuration, the television converter group will have one or more of the following: common digital television graphics generator (C-DITEG), digital television graphics generator (DITEG), dual television scan converter (Dual TVSC), tactical DITEG module (TDM), and a central automated status board generator (CAG).

COMMON DIGITAL TELEVISION GRAPHICS GENERATOR (C-DITEG)— The C-DITEG is a multichannel device that can drive up to six DCCs, two PPUs, eight text-only displays, and two hard-copy printer-plotters. The C-DITEG generates the composite video required to display symbols, graphics, and text on the DCC and PPU. The C-DITEG develops a tabular video for text-only display (TV monitor). It also provides the interface between the DCC switch panels and the system computer.

DIGITAL TELEVISION GRAPHICS GENERATOR (DITEG)— The DITEG provides the display for a single PPU or DCC. The DITEG operates in a manner similar to the C-DITEG in the generation of the tactical video for display on the PPU or DCC.

DUAL TELEVISION SCAN CONVERTER (DUAL TVSC)— The DUAL TVSC mixes radar sweep and video signals with the tactical symbols into a single raster scan composite video signal for display on the DCC.

TACTICAL DITEG MODULE (TDM)— The TDM combines the features of the dual TVSC and the C-DITEG to drive one display control console, one TV monitor, and one hard-copy printer-plotter.

CENTRAL AUTOMATED STATUS BOARD (ASTAB) GENERATOR (CAG)— The CAG converts computer-generated alphanumeric data into a composite video signal. The CAG can drive up to 16 TV monitors simultaneously.

APPENDIX I

LIST OF ACRONYMS

ACDS— advanced combat direction system.

ACRO. (or CRO)— auxiliary cathode readout.

ALT key— alternate key.

A/N— alphanumeric.

APA— all points addressable.

ASCII— American Standard Code for Information Interchange.

ASTAB— automated status board.

ASW— antisubmarine warfare.

BDU— basic display unit.

BITE— built-in test equipment.

CAG— central automated status board generator.

CCAEP— computer-controlled action entry panel.

CDB— central data buffer.

C-DITEG— common digital television graphics generator.

CDS— combat direction system.

CED— console electronic drawer.

CEG— central equipment group.

CGA— color graphics adapter.

CIGARS— console internally generated and refreshed symbols.

CIU— computer interface unit.

CONICS— ircles and ellipses.

CP— clock pulse.

CPS— cycles per second.

CRO— TV monitor.

CRT— cathode-ray tube.

CTRL— control.

DCC— display control console.

DCI— direct computer interface.

DDEU— digital data entry unit.

DDI— (1) digital data indicator; (2) digital display indicator.

DITEG— digital television graphics generator.

DMU— display multiplexer unit.

DRAC— digital radar azimuth converter.

DSC— digital scan converter.

EF word— external function word.

EGA— enhanced graphics adapter.

EPROM— erasable, programmable read-only memory.

ESC key— escape key.

GUI— graphic user interface.

HVPS— high voltage power supply.

HZ— hertz.

I/O— input/output.

IFF/SIF— identification, friend or foe/selective identification feature.

LCD— liquid crystal display.

LCLV— liquid crystal light valve.

LED indicator— light-emitting diode indicator.

LSD— large screen display.

LVPS— low voltage power supply.

MDA— monochrome display adapter.

NTDS— naval tactical data system.

ODR— output data request.

OJT— on-the-job training.

OSC— operations summary console.

PA/SG— pulse amplifier/symbol generator.

PC— personal computer.

PEFT— peripheral equipment functional test.

PIO— peripheral I/O.

PIXEL— picture element.

PMS— planned maintenance system.

POFA— programmed operational functional appraisal.

PPI— plan position indicator.

PPU— projection plotting unit.

PROM— programmable read-only memory.

RAC— radar azimuth converter.

RAM— random access memory.

RDDS— radar data distribution switchboard.

RGB— red, blue, green.

ROM BIOS— ready-only memory basic input output system.

ROM— read-only memory.

SAC— sonar azimuth converter.

SCG— sensor converter group.

SDDS— sensor data distribution switchboard.

SG— symbol generator.

SRAC— synchro radar azimuth converter.

SVGA— super video graphics array.

TDM— tactical DITEG module.

TDS— tactical data system.

TFT— thin film transistor.

TMG— test message generator.

TSLO— third salvo lock out.

TTL— transistor-transistor logic.

TVC— television converter group.

TVSC— television scan converter.

V/C word— velocity/category word.

VDT— video display terminal.

VFK panel— variable function key panel.

VGA— video graphics array.

VSS— video signals simulator.

XGA— extended graphics array.

APPENDIX II

REFERENCES USED TO DEVELOP THIS TRAMAN

NOTE: Although the following references were current when this TRAMAN was published, their continued currency cannot be assured. Therefore, you need to be sure that you are studying the latest revision.

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Seidman, Arthur H., *The Handbook of Computers and Computing,* Van Nostrand Reinhold Company Inc., New York, NY, 1984.

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Chapter 3

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Technical Manual for Plan Position Indicator Display consoles OJ-194(V)3/UYA4(V) and OJ-194(V)4/UYA-4(V) with Console Internally Generated and Refreshed Symbols, NAVSEA SE686-BV-MMO-120/UYA-4(V), Naval Sea Systems Command, Washington, DC, 1991.

Chapter 4

Detailed Functional Theory and Reference Manual for Basic Display Unit, NAVSEA SE685-AF-MMM-070/UYQ-21(V), Naval Sea Systems Command, Washington, DC, 1989.

Detailed Functional Theory and Reference Manual for Computer Display Consoles OJ-450(V)/UYQ-21(V), OJ-451(V) 1 Thru 8/UYQ-21(V) and OJ-452(V)/UYQ-21(V), NAVSEA SE685-AF-MMM-050UYQ-21(V), Naval Sea Systems Command, Washington, DC, 1988.

Detailed Functional Theory and Reference Manual for Computer Display Consoles OJ-451(V)9, 10/UYQ-21(V), NAVSEA SE685-AF-MMM-060/UYQ-21(V), Naval Sea Systems Command, Washington, DC, 1987.

Detailed Functional Theory and Reference Manual for Digital Data Indicator IP-1357/UYQ-21(V), NAVSEA SE685-AF-MMM-100/UYQ-21(V), Naval Sea Systems Command, Washington, DC, 1986.

Detailed Functional Theory and Reference Manual for Digital Display Indicator IP-1429/UYQ-21(V), NAVSEA SE685-AF-MMM-120/UYQ-21(V), Naval Sea Systems Command, Washington, DC, 1989.

Detailed Functional Theory and Reference Manual for Display Control Console OJ-535(V)/UYQ-21(V), NAVSEA SE685-AF-MMM-080/UYQ-21(V), Naval Sea Systems Command, Washington, DC, 1987.

Detailed Functional Theory and Reference Manual for Projection Plotting Unit PT-525/UYQ-21(V), NAVSEA SE685-AF-MMM-190/UYQ-21(V), Naval Sea Systems Command, Washington, DC, 1989.

Detailed Functional Theory and Reference Manual for Projection Plotting Unit PT-525A/UYQ-21(V), NAVSEA SE685-AF-MMM-400/UYQ-21(V), Naval Sea Systems Command, Washington, DC, 1988.

Detailed Functional Theory and Reference Manual for Radar Signal Switchboard SB-4177(V)/UYQ-21(V), NAVSEA SE685-AF-MMM-300/UYQ-21(V), Naval Sea Systems Command, Washington, DC, 1988.

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INDEX

Assignment Questions

Information: The text pages that you are to study are provided at the beginning of the assignment questions.

ASSIGNMENT 1

Textbook Assignment: "Basic Display Devices and Systems", chapter 1, pages 1-1 through 1-15, "Personal Computer Video Displays and Input Devices", chapter 2, pages 2-1 through 2-7.

1-1. Information available for viewing only as long as it remains on the screen of the display is known as what type of information?

1. Soft copy
2. Hard copy
3. Temporary
4. Nonpermanent

1-2. Which of the following is the best description of the function of a cathode-ray tube (CRT)?

1. Converts light into a visual display
2. Converts digital signals into a magnetic signal
3. Converts electronic signals into a visual display
4. Converts operator entered inputs to a visual display

1-3. A CRT must contain a vacuum for which of the following reason?

1. Air molecules could interfere with the electron beam
2. Gases could ionize and short out the CRT
3. Oxygen could cause the CRT filament to burn up
4. Each of the above

1-4. The inside of the face of the CRT is coated with which of the following materials?

1. Phosphor
2. Phosphorus
3. Phosphene
4. Phosphate

1-5. The time that a display produced by an electron beam remains on the screen is known by which of the following terms?

1. Scan
2. Persistence
3. Focus
4. Blanking

1-6. Which component of a CRT acts as a source for the electron beam?

1. Deflection system
2. Control grid
3. Electron gun
4. Phosphor screen

1-7. Applying a small ac voltage to the filament of a CRT causes which of the following events to occur?

1. The beam is blanked
2. The beam is unblanked
3. Electrons are attracted to the cathode
4. Electrons are freed from the cathode

1-8. When the voltage applied to the control grid is negative in respect to the cathode, which of the following occurs?

1. The electron beam is turned on
2. The electron beam is unblanked
3. The electron beam is blanked
4. The electron beam is focused

1-9. The intensity of light generated by the phosphor coating of the CRT is dependant on which of the following factors?

1. The strength of the electron beam
2. The voltage applied to the focus grid
3. The voltage applied to the screen grid
4. The voltage applied to the phosphor screen

1-10. A change in which of the following voltages will result in a change in the diameter of the electron beam?

1. Cathode filament voltage
2. Focus grid voltage
3. Control grid voltage
4. Screen grid voltage

1-11. Which of the following elements of a CRT moves the electron beam to create the display?

1. Electron gun
2. Control grid
3. Focusing grid
4. Deflection system

1-12. A CRT that uses current flowing through an external yoke assembly to deflect the electron uses what type of deflection?

1. Electrostatic deflection
2. Electromagnetic deflection
3. Internal deflection
4. External deflection

1-13. The yoke assembly of a CRT contains how many coils?

1. One
2. Two
3. Three
4. Four

1-14. Current flowing through a single coil of a yoke produces a magnetic field at what angle to the coil?

1. 0°
2. 30°
3. 60°
4. 90°

1-15. Which of the following is a description of electro-static deflection in a CRT?

1. Current flowing through an external coil creates a magnetic field that moves the beam
2. Current flowing through an internal coil creates a magnetic field that move the beam
3. An electrical charge applied to plates inside the CRT moves the beam
4. An electrical charge applied to plates outside of the CRT moves the beam

1-16. All raster scan CRTs use electromagnetic deflection.

1. True
2. False

1-17. Developing the display or picture on a CRT by using a series of horizontal lines across the face of a CRT is known as what type of scanning?

1 Raster scan
2 Vector scan
3 Interlaced vector scan
4 Noninterlaced vector scan

1-18. Interlacing the picture displayed on a CRT increases the resolution of the picture by increasing the number of lines per frame by what factor?

1. 1
2. 2
3. 3
4. 4

1-19. What, if anything, is a disadvantage of using an interlaced scan CRT for graphic digital displays?

1. Decrease in resolution
2. Visible flicker when displaying fine graphics
3. Increase in the time required to refresh the display
4. Nothing; there is no disadvantage in using interlaced scan

1-20. To display a frame of data on a CRT that uses noninterlaced scan, the number of lines displayed is increased by __(a)__ the horizontal frequency and __(b)__ the vertical frequency.

1. (a) Increasing (b) decreasing
2. (a) Increasing (b) increasing
3. (a) Decreasing (b) decreasing
4. (a) Decreasing (b) increasing

1-21. A vector scan CRT uses what coordinate system to position the electron beam?

1. Polar
2. Rectangular
3. Spherical
4. X/Y

1-22. With respect to the origin, where will a positive X value and a positive Y value position the CRT beam?

1. To the right and above
2. To the right and below
3. To the left and above
4. To the left and below

1-23. With respect to the origin, where will a negative X value and a positive Y value position the CRT beam?

1. To the right and above
2. To the right and below
3. To the left and above
4. To the left and below

1-24. Which of the following vector scan CRT functions is controlled by the Z signal?

1. Vertical deflection
2. Horizontal deflection
3. Focus of the electron beam
4. Blanking of the electron beam

1-25. How many phosphor dots are in a triad?

1. One
2. Two
3. Three
4. Four

1-26. The phosphor dots of a triad are dyed to emit what colors when struck by an electron beam?

1. Red, blue, and yellow
2. Red, blue, and green
3. Red, yellow, and green
4. Blue, green, and white

1-27. The resolution of a color CRT is measured by which of the following standards?

1. The size of the CRT
2. The area of the CRT
3. The size of each triad
4. The size of each pixel

1-28. How many electron beams are use in a color CRT?

1. One
2. Two
3. Three
4. Four

1-29. Which of the following alignment is NOT required when using a single gun, three beam CRT?

1. High voltage
2. Low voltage
3. Convergence
4. Focus

1-30. The quadrant in which the sweep is displayed is determined by which of the following signals?

1. Range marks
2. End-of-sweep
3. Digital sweep
4. Sign of X and Y

1-31. The sweep deflection outward from the center of the CRT screen is started by which of the following signals?

1. End-of-sweep
2. Zero mile range mark
3. Sign of X and Y
4. Intensified

1-32. The CRT beam retrace to the center of the CRT screen is caused by which of the following signals?

1. End-of-sweep
2. Zero mile range mark
3. Sign of X and Y
4. Intensified video

1-33. To display a radar reflection from a contact, which of the following signals is used?

1. End-of-sweep
2. Zero mile range mark
3. Sign of X and Y
4. Intensified video

1-34. To paint a symbol on the PPI console, the CRT beam is momentarily deflected from the radar sweep, used to paint the symbol, and then returned to continue the sweep.

1. True
2. False

1-35. What geometric shape is displayed on a CRT if two sine waves of equal amplitude and 90° out of phase are applied to the X and Y axes?

1. Square
2. Circle
3. Rectangle
4. Diamond

1-36. Symbols painted on a PPI CRT are defined by which of the following equipment?

1. Pulse amplifier
2. Symbol generator
3. Computer
4. PPI console

1-37. For the generation of analog waveform symbols, which of the following equipment is required?

1. Computer, pulse amplifier, and CIGARS console (console internally generated and refreshed symbols)
2. Computer, pulse amplifier/symbol generator (PA/SG), and console(s)
3. Computer, symbol generator, and console(s)
4. PA/SG and console(s)

1-38. Which of the following equipment uses computer output data to position the blanked CRT beam to the coordinates of the symbol?

1. Console
2. PA
3. SG
4. Computer

1-39. The timing period during which the analog waveform symbol is mechanized is known as

1. X-time
2. Y-time
3. Z-time
4. P-time

1-40. What is the source of the analog symbol waveforms received by the console deflection amplifiers?

1. SG (symbol generator)
2. PA (pulse amplifier)
3. CIGARS console
4. Computer

1-41. What action, if any, must take place to prevent flicker of the displayed Symbology?

1. The persistence of the CRT must be decreased
2. The persistence of the CRT must be increased
3. The symbol must be refreshed periodically by repainting the symbol
4. None, symbols do not flicker

1-42. The digital strike symbol generator stores symbol stroke codes in what type of memory ?

1. Random access memory (RAM)
2. Read-only-memory (ROM)
3. Programmable read-only-memory (PROM)
4. Either 2 or 3 is correct, depending on configuration

1-43. What signal output is used to ensure the completion of a stroke prior to the start of a new stroke?

1. Sign X, X, 2X
2. Sign Y, Y, 2Y
3. z
4. w

1-44. What signal controls the vertical movement of the CRT beam when a symbol is painted using the digital stroke method?

1. Sign X, X, 2X
2. Sign Y, Y, 2Y
3. z
4. w

1-45. What signal unblanks the CRT beam when a symbol is painted using the digital stroke method?

1. Sign X, X, 2X
2. Sign Y, Y, 2Y
3. z
4. w

1-46. What signal controls the horizontal movement of the CRT beam when the digital stroke method is used?

1. Sign X, X, 2X
2. Sign Y, Y, 2Y
3. z
4. w

1-47. What is the maximum amount the CRT beam can be deflected during a single stroke address?

1. One stroke space
2. Two stroke spaces
3. Three stroke spaces
4. Four stroke spaces

1-48. When a symbol is painted using the digital stroke method, what PROM output indicates that the symbol is complete?

1. All 8 outputs active
2. All 8 outputs inactive
3. End of symbol signal active

1-49. What is the main function of the Data Display Group AN/UYA-4(V)?

1. To provide recorded data of tactical information
2. To provide an alpha-numeric display of operator actions
3. To provide a real-time visual picture of the tactical situation
4. To provide a means of low visibility navigation

1-50. All video monitors need analog signals as inputs.

1. True
2. False

1-51. The composite video monitor has which of the following features?

1. Its timing and video inputs are on separate input lines
2. Its timing and video inputs are combined on the same input line
3. It is capable only of color display
4. It has extremely high resolution

1-52. The RGB monitor has which of the following characteristics?

1. A separate input for each color (red, green, and blue)
2. A single input that combines all three colors
3. Lower resolution than that of the composite video monitor
4. Only monochrome picture display capability

1-53. What maximum number of text lines can be displayed on the EGA monitor?

1. 25
2. 33
3. 43
4. 50

1-54. Which of the following design features allows VGA monitors to display over 256,000 colors?

1. The use of digital input signals
2. The use of better CRTs
3. The use of a composite video signal
4. The use of analog input signals

1-55. A multisync monitor has which, if any, of the following advantages?

1. It uses only one type of video adapter
2. It can detect the rate that data is received and adjust to several types of video adapters
3. It accepts only analog video signals
4. None

1-56. Which of the following characteristics is/are determined by the video adapter installed in a personal computer?

1. The number of colors that can be displayed only
2. The speed at which the video display is updated only
3. Both 1 and 2 above
4. The resolution of the monitor

1-57. For which of the following reasons is the monochrome display adapter generally considered obsolete?

1. It generates a text only display
2. It generates a low quality graphics display
3. It generates low resolution color display
4. It uses TTL logic

1-58. Which of the following is the resolution of the basic alphanumeric character set developed by the CGA adapter?

1. 8 x 14 pixels
2. 8 x 8 pixels
3. 9 x 14 pixels
4. 9 x 9 pixels

1-59. How many colors can the CGA card display when set for the all points addressable, high resolution mode?

1. 1
2. 2
3. 16
4. 4

1-60. The EGA card is capable of displaying ___(a)___ colors with a maximum resolution of ___(b)___.

1. (a) 4 (b) 320 x 200
2. (a) 4 (b) 640 x 200
3. (a) 16 (b) 320 x 200
4. (a) 16 (b) 640 x 200

1-61. The VGA card can generate 262,144 colors by which of the following methods?

1. Using analog signals to control the CRT electron guns
2. Using digital signals to control the CRT electron guns
3. Using analog signals to control the CRT anode
4. Using digital signals to control the CRT anode

1-62. The SVGA graphic adapters conform to a strict set of standards.

1. True
2. False

1-63. The XGA system communicates with the CPU using what type of data bus?

1. 8-bit bus master
2. 16-bit bus master
3. 32-bit bus master
4. 64-bit bus master

1-64. The XGA system can provide near photographic quality color using which of the following resolution modes?

1. 256 colors at 1024 x 768
2. 256 colors at 640 x 480
3. 65,536 colors at 1024 x 768
4. 65,536 colors at 640 x 480

1-65. Liquid crystal displays (LCDs) are ideal for use with laptop and notebook computers for which of the following reasons?

1. They have low power consumption only
2. They require low voltages to operate only
3. Both 1 and 2 above
4. They are unbreakable

1-66. Which of the following is a disadvantage of a color passive LCD?

1. Slow response time
2. Ability to display only 262,144 colors
3. High contrast
4. High power consumption

1-67. Which of the following devices is responsible for the development of the active matrix LCD display?

1. Thin film memory
2. Thin film transistor
3. Field effect transistor
4. Semi-conductor transistor

1-68. In an active matrix LCD how many LCD crystals are required for each pixel?

1. One
2. Two
3. Three
4. Four

1-69. What is the primary operator input device used with personal computers?

1. Trackball
2. Mouse
3. Keyboard
4. Monitor

1-70. Which of the following keys was/were repositioned on the 101-key keyboard?

1. Fll, F12
2. CTRL
3. ALT
4. ENTER

1-71. The CTRL and ALT keys of a keyboard are used for which, if any, of the following functions?

1. To control the program
2. Allow the programmers to assign addition meanings to the standard keys
3. Allow the programmer to debug the program
4. None of the above

1-72. A mouse is virtually required when which of the following types of programs is used?

1. Word processing
2. Data base
3. Spreadsheet
4. Graphic user interface (GUI)

1-73. What type of mouse is installed in a special interface board and communicates with the computer across the main bus?

1. Serial
2. Parallel
3. Trackball
4. Bus

1-74. A personal computer trackball emulates which of the following input devices?

1. Keyboard
2. Mouse
3. Monitor
4. Disk drive

1-75. Which of the following devices is a pointing device that can be used in place of the mouse?

1. Tab key
2. Shift key
3. Ctrl key
4. Trackball

ASSIGNMENT 2

Textbook Assignment: "The Data Display Group AN/UYA-4(V)", chapter 3, pages 3-1 through 3-24.

2-1. Which of the following is NOT a function of the Data Display Group AN/UYA-4(V)?

1. Sensor data distribution and display
2. Transmission of data to remote platforms
3. Tactical data distribution and display
4. Data display group simulation and testing

2-2. Sensor data is made up of which of the following types of data?

1. Ship's heading
2. Video signals only
3. Antenna position only
4. Both 2 and 3 above

2-3. In the AN/UYA-4(V) display system, what is the correct path for radar antenna position data?

1. RAC, radar, RDDS, consoles
2. Radar, RDDS, RAC, consoles
3. Radar, RAC, RDDS, consoles
4. Consoles, RDDS, RAC, radar

2-4. In the AN/UYA-4(V) display system, what is the correct path for radar video signals?

1. Radar, RDDS, consoles
2. Radar, RAC, RDDS, consoles
3. Radar, RDDS, RAC, consoles
4. Consoles, RAC, radar

2-5. What is the function of a radar azimuth converter?

1. To convert radar azimuth to synchro signals
2. To convert digital radar azimuth to synchro radar azimuth
3. To convert radar azimuth data to radar video signals
4. To convert radar antenna position to the digital format used by the AN/UYA-4(V) display consoles.

2-6. Which of the following signals is/are used to create the sweep display on the AN/UYA-4(V) display consoles?

1. ΔX and ΔY pulse trains only
2. Sign of ΔX and ΔY only
3. Both 1 and 2 above
4. Digital

2-7. Which of the following signals is/are used to determine the quadrant in which the sweep will be displayed on the AN/UYA-4(V) display consoles?

1. ΔX and ΔY pulse trains only
2. Sign of ΔX and ΔY only
3. Both 1 and 2 above
4. Digital

2-8. Which of the following signals is/are sent to the CDS computer as a digital data word?

1. ΔX and ΔY pulse trains only
2. Sign of ΔX and ΔY only
3. Both 1 and 2 above
4. Digital

2-9. The ΔX and ΔY pulse trains are normally developed from what trigonometric function?

1. Sine of the antenna angle only
2. Cosine of the antenna angle only
3. Both 1 and 2 above
4. Tangent of the antenna angle

IN ANSWERING QUESTIONS 2-10 AND 2-11, REFER TO FIGURE 3-3 AND TABLE 3-1 IN THE TEXT.

2-10. Using the illustrated RAC, in what position should the MODE SELECTOR switch be placed for normal operation?

1. OPERATE
2. $\Delta\theta$ STEP
3. RESET
4. CONTINUOUS

2-11. Using the illustrated RAC, in what position should the MODE SELECTOR switch be placed to generate a continuous simulated radar sweep?

1. OPERATE
2. $\Delta\theta$ STEP
3. RESET
4. CONTINUOUS

2-12. What device receives output from the radar azimuth converter?

1. RAC
2. RDDS
3. Radar
4. Console

2-13. What total number of separate video signals may the RDDS receive from a sensor?

1. One
2. Two
3. Three
4. Four

2-14. What total number of sensors can input into the RDDS?

1. 6
2. 10
3. 11
4. 24

2-15. What total number of standard AN/UYA-4(V) display consoles can receive output from an RDDS?

1. 6
2. 10
3. 11
4. 24

2-16. Which of the following RDDS outputs can be selected by remote control from the display console?

1. Symbology
2. Sensor only
3. Video level only
4. Both 2 and 3 above

2-17. In the event of a AN/UYA-4(V) display console control signal casualty, which of the following console inputs can be manually selected at the RDDS?

1. Symbology
2. Sensor only
3. Video level only
4. Sensor and video level

2-18. Tactical data is digital data transmitted to or received from the CDS computer by the display system.

1. True
2. False

2-19. Which of the following data words identifies the type of Symbol, line, or circle to be displayed?

1. EF
2. Address
3. v/c
4. X/Y Coordinate

2-20. Which of the following data words defines the center point of a symbol?

1. EF
2. Address
3. v/c
4. X/Y Coordinate

2-21. Which of the following data words is used to interrogate display consoles?

1. EF
2. Address
3. v/c
4. X/Y Coordinate

2-22. Which of the following data words identifies a particular console to receive message data?

1. EF
2. Address
3. v/c
4. X/Y Coordinate

2-23. Which of the following data words is used to generate speed and direction leader for symbols?

1. $\Delta X/\Delta Y$
2. Range/bearing
3. X/Y Coordinate
4. Velocity/category

2-24. For an air track symbol, 1 inch of leader indicates what speed?

1. 1080 mph
2. 33.8 mph
3. 1080 knots
4. 33.8 knots

2-25. Which of the following data words is used to define the length and direction of a line?

1. $\Delta X/\Delta Y$
2. Range/bearing
3. X/Y Coordinate
4. Velocity/category

2-26. The 48-label readout word is used to perform which of the following functions?

1. To light the CCAEP switch labels only
2. To energize/deenergize the PPI buzzer only
3. Both 1 and 2 above
4. To define DDI data to be displayed

2-27. Display messages to be sent to a particular console must be preceded by which of the following data words?

1. $\Delta X/\Delta Y$
2. Address
3. X/Y Coordinate
4. 48-label readout

2-28. Output messages to the display consoles are composed of how many computer words?

1. 1 only
2. 2 only
3. 10 only
4. 1 or more, depending on the type of message

2-29. To display a symbol and leader on all consoles, which of the following display message should be outputted by the computer?

1. Lines message
2. Normal message
3. Addressed lines message
4. Addressed normal message

2-30. To display a line on a particular console, how many data words will be in the output message?

1. 1
2. 2
3. 3
4. 4

2-31. In a standard circle message, which of the following data words defines the diameter of the circle?

1. Velocity/category
2. $\Delta X/\Delta Y$ coordinate
3. X/Y coordinate
4. Address

2-32. When programmable circle and ellipse messages are used, how many different diameter programmable circles and ellipses may be generated?

1. 256
2. 512
3. 1024
4. 2048

2-33. When an offset message is outputted, which of the following data words indicates the amount of offset in the sweep and the symbols of the addressed console?

1. X/Y coordinate
2. $\Delta X/\Delta Y$ coordinate
3. Address
4. Offset coordinate

2-34. Display consoles are normally divided into 2 or more groups with what maximum number of consoles per group?

1. 6
2. 8
3. 10
4. 12

2-35. In a display system that uses a waveform symbol generator, what is the total number of symbol generators installed?

1. One for the whole system
2. Two for the whole system
3. Four for the whole system
4. One for each pulse amplifier output channel

IN ANSWERING QUESTIONS 2-36 AND 2-37, REFER TO FIGURE 3-14 IN THE TEXT .

2-36. With the DATA SOURCE switch in the position shown, what are the sources of the display groups' tactical data?

1. Display groups 1 and 2 from computer 1
2. Display groups 1 and 2 from computer 2
3. Display group 1 from computer 1 and display group 2 from computer 2
4. Display group 1 from computer 2 and display group 2 from computer 1

2-37. With the SYMBOL SOURCE switch in the position shown, what are the sources of display groups 1 and 2 symbol waveforms?

1. Display group 1 and 2 from symbol generator 1
2. Display group 1 and 2 from symbol generator 2
3. Display group 1 from symbol generator 1 and display group 2 from symbol generator 2
4. Display group 1 from symbol generator 2 and display group 2 from symbol generator 1

2-38. On a plan position indicator (PPI), what is the maximum number of symbols that may be display on a 10.7-inch CRT?

1. 1,000
2. 1,500
3. 2,000
4. 2,500

2-39. The CRT presentation of sensor data and symbology is controlled from which of the following panels?

1. The display control panel
2. The DDI front panel
3. The 6-by-7 panel
4. The CRT control panel

2-40. On the CCAEP, what total number of switches have fixed labels?

1. 3
2. 6
3. 18
4. 24

2-41. On the CCAEP, what total number of switch positions have 48-label readouts?

1. 3
2. 6
3. 18
4. 24

2-42. On the CCAEP, which of the following actions or functions controls what label will be lighted for the 48-label readout switches?

1. Console operator action
2. The computer program
3. The PPI firmware
4. The symbol generator

2-43. The function codes generated by the 6-by-7 panel vary with the console mode.

1. True
2. False

2-44. The 6-by-7 panel provides which of the following functions?

1. Ball tab control
2. Category selection only
3. Numeric data entry only
4. Both 2 and 3 above

2-45. The console can provide the operator access to what maximum number of communications systems?

1. One
2. Two
3. Three
4. Four

2-46. When the interphone is used, what total number of consoles may be linked together for voice and pointer communications?

1. 6
2. 10
3. 12
4. 15

2-47. Which of the following console communications devices accesses the console into the ship's sound-powered communications networks?

1. Radio
2. Interphone
3. Sound power phone
4. Secure voice communications switchboard

2-48. Which of the following console communications devices provides the operator access to ship-to-ship and ship-to-aircraft communications?

1. Radio
2. Interphone
3. Sound power phone
4. Right or left earphone

2-49. Which of the following is a function of the display console digital area?

1. Converts operator actions into input data words
2. Generates sensor sweep and video display
3. Receives symbol waveforms from the symbol generator
4. Generates intensity and deflection control voltages

2-50. The DDI can display what total number of ASCII characters?

1. 16
2. 64
3. 1, 024
4. 2, 000

2-51. In the internal video mode, the DDI displays a 525-line TV display.

1. True
2. False

2-52. The video signals simulator (VSS) provides which of the following simulated signals?

1. Video only
2. Sweep only
3. Video and sweep only
4. Video, sweep and symbols

2-53. Which of the following VSS functions are controlled by the computer?

1. Generation of video signals
2. Selection of antennal rotation speed
3. Selection of source radar and video level
4. Generation of synchro azimuth and triggers

2-54. The VSS is used in place of or in conjunction with a shipboard two-dimensional radar.

1. True
2. False

2-55. When a ship's radar is used as a source of antenna position data and triggers, the VSS receives the signals from which of the following devices?

1. RDDS
2. Radar's RAC
3. Radar directly
4. Radar's RAC via the RDDS

2-56. Which of the following groups of switches controls the synchro azimuth and trigger output of the VSS?

1. Simulated video
2. Simulated radar
3. Computer control
4. Live radar source

2-57. Output data from the computer defines which of the following simulated video characteristics?

1. Azimuth only
2. Azimuth and range only
3. Azimuth, range and intensity only
4. Azimuth, range, intensity, and bandwidth

2-58. Under which of the following conditions does the VSS send the simulated video signal to the RDDS?

1. When the simulated video data is being received from the computer
2. When the digital sweep data is received form the RAC
3. When the stored simulated video data matches the digital sweep data
4. When the simulated radar antenna switch is on

2-59. Which of the following VSS video outputs is made up of simulated tracks intermixed with live video?

1. Live video
2. Mixed video
3. Simulated video

2-60. Which of the following VSS video outputs is isolated from the simulator?

1. Live video
2. Mixed video
3. Simulated video

2-61. Which of the following VSS video outputs is made up of computer generated video only?

1. Live video
2. Mixed video
3. Simulated video

QUESTIONS 2-62 THROUGH 2-65 PERTAIN TO VSS SWITCHES.

2-62. Which switch is used to control the sharpness of the simulated video return?

1. SIMULATED VIDEO
2. VIDEO DURATION
3. IF BANDWIDTH
4. RADAR BEAMWIDTH DEGREES

2-63. Which switch is used to control the pulse length of the simulated video return?

1. SIMULATED VIDEO
2. VIDEO DURATION
3. IF BANDWIDTH
4. RADAR BEAMWIDTH DEGREES

2-64. Which switch is used to provide manual control of the simulated video characteristics?

1. SIMULATED RADAR
2. SIMULATED VIDEO
3. COMPUTER CONTROL
4. LIVE RADAR SOURCE

2-65. Which switch is used to control the sector width of the simulated video return?

1. SIMULATED VIDEO
2. VIDEO DURATION
3. IF BANDWIDTH
4. RADAR BEAMWIDTH DEGREES

2-66. The TMG can operate in what total number of operating modes?

1. Three
2. Five
3. Seven
4. Nine

2-67. What is the maximum length display message that the TMG can simulate?

1. One word
2. Two words
3. Three words
4. Four words

2-68. The TMG is permanently installed the PA/SG cabinet.

1. True
2. False

QUESTIONS 2-69 THROUGH 2-72 PERTAIN TO TMG MODES.

2-69. Which mode repeats a four word (or less) message twice or twenty times a second?

1. Free run
2. Test pattern
3. Output data request
4. 2/20-cycles per second

2-70. Which mode generates one data word in response to each ODR?

1. Free run
2. Test pattern
3. Output data request
4. 2/20-cycles per second

2-71. Which mode repeats a four word (or less) message every 400 milliseconds?

1. Free run
2. Test pattern
3. Output data request
4. 2/20-cycles per second

2-72. Which mode displays 2 symbols repeated every 90-degrees?

1. Free run
2. Test pattern
3. Output data request
4. 2/20-cycles per second

2-73. The electronic plug-in circuit test set allows a technician to simulate normal operating conditions of AN/UYA-4(V) display system circuit assemblies during trouble-shooting, testing, alignment, or repair procedures.

1. True
2. False

2-74. Which of the following software programs can-aid a technician in locating a fault in a display console?

1. Display console POFA only
2. Display console PEFT only
3. Display console POFA and PEFT
4. VSS POFA

2-75. Which of the following functions is/are normally tested by POFA?

1. Switch Functions only
2. Test patterns only
3. Trackball coordinates only
4. All the above

ASSIGNMENT 3

Textbook Assignment: The Computer Display Set AN/UYQ-21(V), chapter 4, pages 4-1 through 4-26.

3-1. The AN/UYQ-21(V) display system's modular construction allows it to be easily adapted to the specific requirements of the user.

1. True
2. False

3-2. Which of the following types of data is NOT displayed by the AN/UYQ-21(V) display system?

1. Computer-generated tactical data
2. Sensor data
3. Television data
4. Computer status and control data

3-3. The central equipment group (CEG) can accommodate up to what number of equipment modules?

1. Three
2. Four
3. Five
4. Six

3-4. One CEG is capable of driving what number of TDS display consoles?

1. 8
2. 16
3. 24
4. 32

3-5. The central data buffer (CDB) provides which of the following functions?

1. Interface between the radar and the display groups
2. Interface between the computer and the display groups
3. Interface between the radar and the computer
4. Generation of symbol waveforms for display

3-6. A fully configured CDB can have what number of display multiplexer units?

1. One
2. Two
3. Three
4. Four

3-7. The computer interface unit (CIU) of the CDB performs which of the following data conversions?

1. Serial data to parallel data for use by the display group only
2. Parallel data to serial data for use by the display group only
3. Serial data from the display console to parallel data for use by the computer only
4. Parallel data into serial data for use by the display group and serial data from the display consoles to parallel data for use by the computer

3-8. The DMU is used for which of the following functions?

1. To buffer computer output data to the display consoles only
2. To buffer computer input data from the display consoles only
3. To buffer computer output data to the display consoles and computer input data from the display consoles
4. To provide timing and control signals to the display group

3-9. A DMU request is generated by which of the following functional areas?

1. CEG
2. CIU
3. DMU
4. Scanner control and clock generator

IN ANSWERING QUESTIONS 3-10 AND 3-11, REFER TO FIGURE 4-6 IN THE TEXT .

3-10. If all of the DATA SOURCE SELECT switches are in the AUTO position, which of following computers will be used for the data source?

1. Computer 1 only
2. Computer 2 only
3. Any system computer

3-11. If the DATA SOURCE SELECT switch for DISPLAY CHANNEL 1 is placed in the BACKUP position, what will be the data source for display channel 1?

1. Display channel 2
2. Display channel 3
3. Display channel 4

3-12. What number of SRACs can be contained in a single drawer of the CEG?

1. One
2. Two
3. Three
4. Four

3-13. Each SRAC provides the interface for what number of radars ?

1. One
2. Two
3. Three
4. Four

3-14. The synchro-to-digital converter function of the SRAC converts the synchro azimuth signal to which of the following values?

1. ΔX and ΔY pulse train
2. 12-bit digital value of the azimuth
3. Sine and cosine of the azimuth angle
4. Sign of ΔX/ sign of ΔY

3-15. The polar-to-Cartesian converter function produces which of the following signals?

1. ΔX and ΔY pulse trains only
2. Sign of ΔX/ sign of ΔY only
3. Range marks only
4. ΔX and ΔY pulse trains, sign of ΔX/ sign of ΔY, and range marks

3-16. The signs of ΔX and ΔY are developed from which of the following signals?

1. The sine of the azimuth data
2. The cosine of the azimuth data
3. The 2 MSBs of the azimuth data
4. The 2 LSBs of the azimuth data

3-17. The RPM switch of the SRAC control panel is used to control what rotation speed(s)?

1. The rotation speed of the ship's radar only
2. The rotation speed of the simulated sweep only
3. Both 1 and 2 above

3-18. The SDDS can receive inputs from what number of sensors?

1. 12
2. 18
3. 20
4. 24

3-19. Which of the following is not part of the TDS display console?

1. Computer display console
2. Large screen display
3. Basic display unit only
4. TV monitor

3-20. Which of the following is a function of the computer display area of the TDS display console?

1. To convert symbol, graphic, and-sensor data into coordinate data for display on the BDU only
2. To convert alphanumeric data into composite video for display on the TV monitor only
3. To convert symbol, graphic and sensor data for display on the BDU and convert alphanumeric data into composite video for display on the TV monitor
4. To display computer symbols and sweep and sensor video

3-21. The O-data receiver function controls all communications with the system computer.

1. True
2. False

3-22. The O-data receiver function performs which of the following functions?

1. Transfers data to the I-data transmitter function
2. Transfers data to the system memory
3. Encodes serial data received from the CDB
4. Decodes serial data received from the CDB

3-23. Which of the following is a function of the input/output (I/O) processor?

1. To control output data transfers with the system computer only
2. To transmit buffered I-data to the BDU
3. To receive I-data from the O-data receivers
4. To distribute O-data to the system memory only

3-24. Which of the following is NOT a function performed by the memory sort processor function?

1. Controlling the data buses
2. Sectioning the refresh memory
3. Updating trackball data
4. Clearing memory

3-25. How much RAM is contained is the system memory function?

1. 64K
2. 128K
3. 256K
4. 512K

QUESTIONS 3-26 THROUGH 3-39 PERTAIN TO FUNCTIONAL AREAS OF THE COMPUTER DISPLAY CONSOLE.

3-26. Which functional area converts processed refresh memory data into display data?

1. Memory sort processor
2. System memory
3. Graphics processor
4. Display generator

3-27. Which functional area commands the graphics processor function?

1. Memory sort processor
2. System memory
3. I/O processor
4. Display generator

3-28. Which functional area sends deflection, intensity, and timing signals to the BDU?

1. Memory sort processor
2. System memory
3. Graphics processor
4. Display generator

3-29. Which functional area converts the X and Y coordinates of the trackball to range and bearing data?

1. Display generator
2. Panel processor
3. Sweep and raster
4. Digital deflection

3-30. Which functional area generates the sensor and video select codes sent to the SDDS?

1. Display generator
2. Panel processor
3. Sweep and raster
4. Digital deflection

3-31. Which functional area generates analog deflection voltages for use by the BDU?

1. Display generator
2. Panel processor
3. Sweep and raster
4. Digital deflection

3-32. Which functional area can display symbols, circles, ellipses, and lines in four intensities and colors?

1. Display generator
2. Panel processor
3. Sweep and raster
4. Digital deflection

3-33. Which functional area receives display sweep signals from the SDDS?

1. Display generator
2. Panel processor
3. Sweep and raster
4. Digital deflection

3-34. Which functional area compiles graphics data and generates sweep and display control signals?

1. Display generator
2. Panel processor
3. Sweep and raster
4. Digital deflection

3-35. The modified monobit digilogs in the computer display console perform which of the following conversions?

1. Analog intensity voltages to digital signals
2. Analog deflection voltages to digital coordinate signals
3. Digital intensity signals to analog voltages
4. Digital coordinate signals to analog deflection voltages

3-36. Which functional area generates the power on reset signals?

1. Clock generator
2. TV monitor display generator
3. Computer controlled action entry panel (CCAEP)
4. I-data storage and control

3-37. Which functional area processes operator CCAEP actions into computer I-data?

1. Clock generator
2. TV monitor display generator
3. CCAEP
4. I-data storage and control

3-38. Which functional area converts I-data into serial form for transfer to the system computer via the CDB?

1. Clock generator
2. TV monitor display generator
3. CCAEP
4. I-data storage and control

3-39. Which functional area generates analog composite video used to display alphanumeric data on the digital data indicator?

1. Clock generator
2. TV monitor display generator
3. CCAEP
4. I-data storage and control

3-40. Which of the following built-in diagnostic checks are controlled by the technician?

1. Level I
2. Level II
3. Level III

3-41. Which of the built-in diagnostics checks the operation of the system clocks , memory timing, and the four processors?

1. Level I
2. Level II
3. Level III

3-42. What size CRT is used in the BDU?

1. 7-inch by 9-inch rectangle
2. n-inch by 13-inch rectangle
3. 10.5-inch diameter round
4. 18-inch diameter round

3-43. What method does the BDU use to generate symbols on the CRT?

1. Analog waveform
2. Raster scan composite video
3. Stroke
4. Raster scan RGB

3-44. Which functional area of the BDU is used to develop circles and ellipses?

1. Symbol generator
2. Conies
3. Circular sweep control
4. Power distribution

3-45. What is the maximum radius of a circle, in deflections, that can be display by the BDU?

1. 16
2. 256
3. 512
4. 1023

3-46. What source provides the analog deflection function of the BDU with major symbol position data for developing analog deflection voltages?

1. The CDB
2. The system computer
3. The SRAC
4. The computer display console

3-47. What intensity circuit ensures uniform display intensity?

1. Compensation
2. CRT unblinking
3. CRT blanking
4. Brightness

3-48. The TV monitor is displays what type of video?

1. 525 line, noninterlaced composite video
2. 525 line, interlaced composite video
3. 525 line, color video
4. 1050 line, color video

3-49. The display control console interfaces with the system computer through what, if any, device?

1. Television converter
2. Central data buffer
3. Radar azimuth converter
4. None; the DCC is connect directly to the system computer

3-50. What is the resolution of the DCC graphics monitor?

1. 525 line only
2. 1075 lines only
3. 525 or 1075 lines
4. 750 lines only

QUESTIONS 3-51 THROUGH 3-53 PERTAIN TO FUNCTIONAL AREAS OF THE DCC GRAPHICS MONITOR.

3-51. Which functional area develops the voltages necessary to drive the CRT cathode and the control grid?

1. Monitor interface
2. Monitor deflection
3. Video amplifier
4. Power distribution

3-52. Which functional area detects the scan rate of the incoming composite video signal?

1. Monitor interface
2. Monitor deflection
3. Video amplifier
4. Power distribution

3-53. Which functional area produces the voltages necessary to control the focus of the CRT beam?

1. Monitor interface
2. Monitor deflection
3. Video amplifier
4. Power distribution

3-54. The graphics terminal shelf of the DCC contains which of the following assemblies?

1. Keyboard only
2. Trackball only
3. Bullnose microprocessor only
4. All of the above

3-55. The projection plotting unit (PPU) can display which of the following resolutions?

1. 525 lines only
2. 729 lines only
3. 1075 lines only
4. All of the above

3-56. The PPU can display stroke video supplied from an 0J-451(V)2/UYQ-21 equipped with the display signal amplifier option.

1. True
2. False

3-57. The light output by the PPU'S CRT is used to project an image on which of the following surfaces?

1. A fiber-optic substrate
2. A viewing screen
3. A liquid-filled prism
4. A projection lens

3-58. The light emitted by liquid crystal light valve (LCLV) of the PPU is ___(a)___ in the areas that are exposed to light and ___(b)___ in areas unexposed.

1. (a) Unaltered (b) polarized
2. (a) Unaltered (b) diffused
3. (a) Polarized (b) diffused
4. (a) Polarized (b) unaltered

3-59. When a point of light hits the fiber-optic plate, the impedance of the photoconductor will ___(a)___ causing an ac voltage to be applied to the ___(b)___.

1. (a) Increase (b) dielectric mirror
2. (a) Increase (b) liquid crystal
3. (a) Decrease (b) dielectric mirror
4. (a) Decrease (b) liquid crystal

3-60. What is the voltage of the arc lamp ignition-pulse in the PPU?

1. 20 volts
2. 100 volts
3. 115 volts
4. 24,000 volts

3-61. The C-DITEG can drive how many graphic displays?

1. 6
2. 8
3. 14
4. 18

IN ANSWERING QUESTIONS 3-62 THROUGH 3-67, SELECT FROM THE FOLLOWING LIST THE FUNCTIONAL AREA OF THE C-DITEG PROCESSOR DRAWER THAT PERFORMS THE FUNCTION DESCRIBED IN THE QUESTION. NOT ALL ITEMS IN THE LIST ARE USED.

A. Input/output controller
B. Control synchronizer
C. System memory
D. Peripheral input/output
E. Formatter
F. Function generator
G. Tabular video generator

3-62. Generates composite video signals to display text data on the TV monitors.

1. D
2. E
3. F
4. G

3-63. Generates the system clocks.

1. A
2. B
3. C
4. D

3-64. Interrogates the display control consoles for switch actions.

1. B
2. C
3. D
4. E

3-65. Contains the firmware for the C-DITEG.

1. B
2. C
3. D
4. E

3-66. Generates formatted display data for display control consoles, large screen displays, and printer plotters.

1. B
2. C
3. D
4. E

3-67. Sends display data to the system memory.

1. A
2. B
3. C
4. D

3-68. Which functional area of the C-DITEG video drawer creates serial bit streams?

1. Timing synchronizer
2. Bit map memory and control function
3. Video multiplexer
4. Tactical video generator

3-69. Which functional area of the C-DITEG video drawer converts data streams into composite video?

1. Timing synchronizer
2. Bit map memory and control function
3. Video multiplexer
4. Tactical video generator

3-70. Which of the following video modes can be used with the large screen display?

1. 1024 pixels per line only
2. 1280 pixels per line only
3. Either 1 or 2 above
4. 1075 pixels per line

3-71. What equipment provides the circuitry display graphics data on a single DCC or PPU?

1. C-DITEG
2. DITEG
3. Dual TVSC
4. CAG

3-72. What equipment converts computer supplied alphanumeric data into low resolution composite video for display on a standard TV monitor.

1. C-DITEG
2. DITEG
3. Dual TVSC
4. CAG

3-73. What equipment mixes radar sweep and video data with graphics video to provide the DCC with a radar and tactical symbol display?

1. C-DITEG
2. DITEG
3. Dual TVSC
4. CAG

3-74. The CAG can drive up to how many standard TV monitors?

1. 4
2. 8
3. 16
4. 32

3-75. The tactical DITEG module combines the features of what two equipments to drive one DCC, one TV monitor, and one printer-plotter?

1. C-DITEG and TVSC
2. C-DITEG and CAG
3. CEG and TVSC
4. CEG and CAG