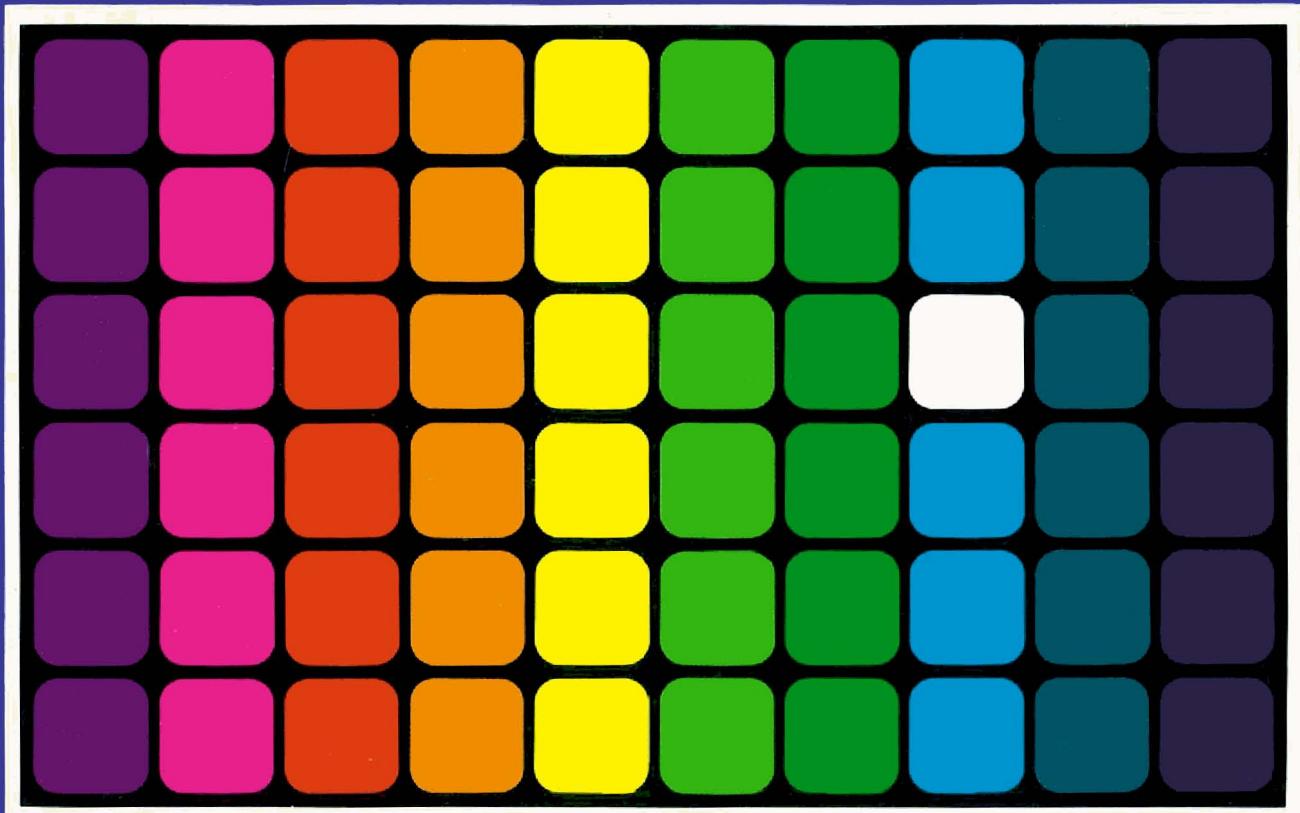


digital

# REMOTE DIAGNOSIS



KY11-R FAMILY OF ELECTRONIC CONSOLES  
USER GUIDE



**KY11-R Family  
of Electronic Consoles  
User Guide**

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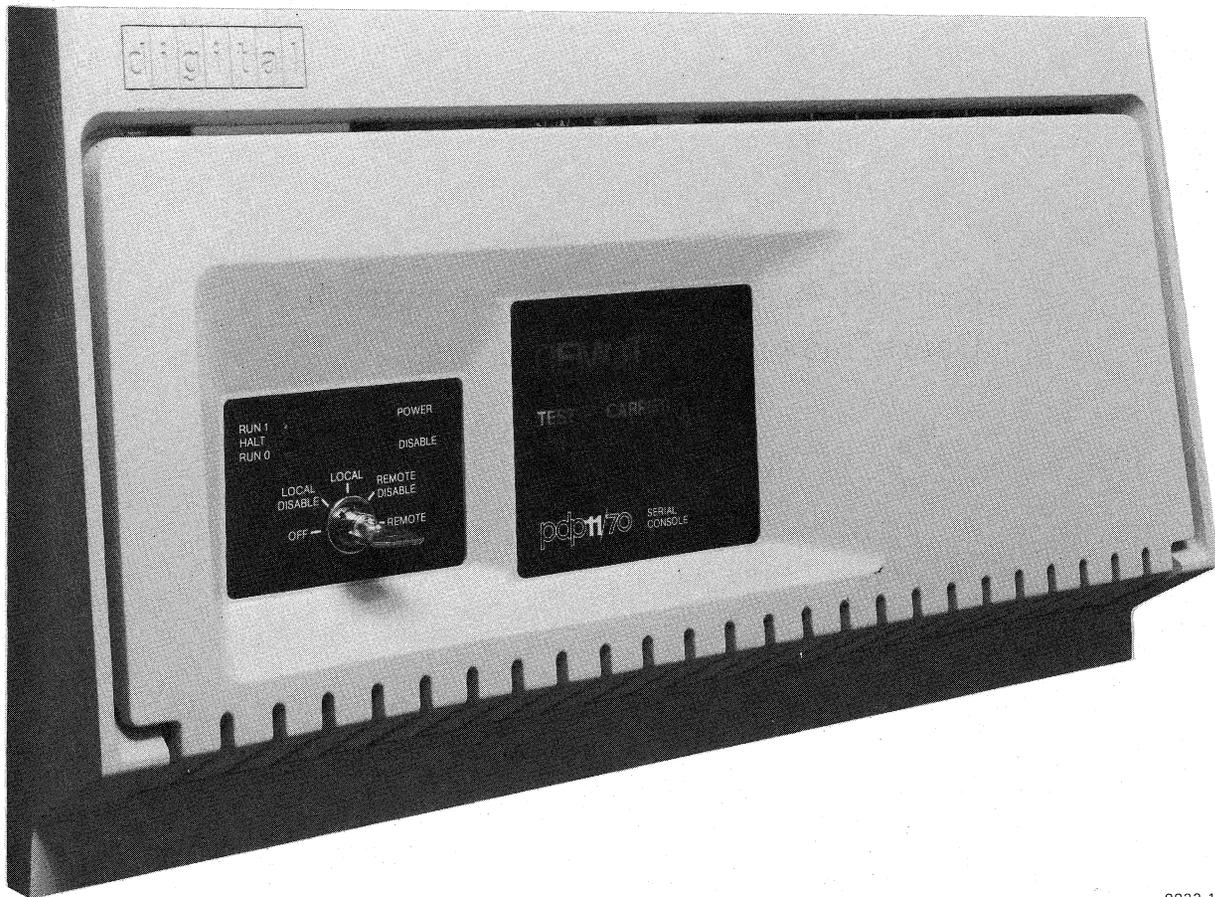
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**KY11-R Family of Electronic Consoles  
User Guide**



8822-1

PDP-11/70 Electronic Console

# CHAPTER 1 INTRODUCTION

## 1.1 GENERAL

The microprocessor-controlled KY11-R Electronic Console adds remote diagnosis capability when installed in a PDP-11/70 system. The electronic console panel replaces the traditional front panel and assumes the traditional console panel switch and indicator functions. The operator controls the system by typing commands at the system terminal. As shown in Figure 1-1, the console is inserted logically between the system terminal and the CPU.

The console is primarily a service tool which remains the property of Digital Equipment Corporation and is installed only within the terms of a Field Service Agreement.

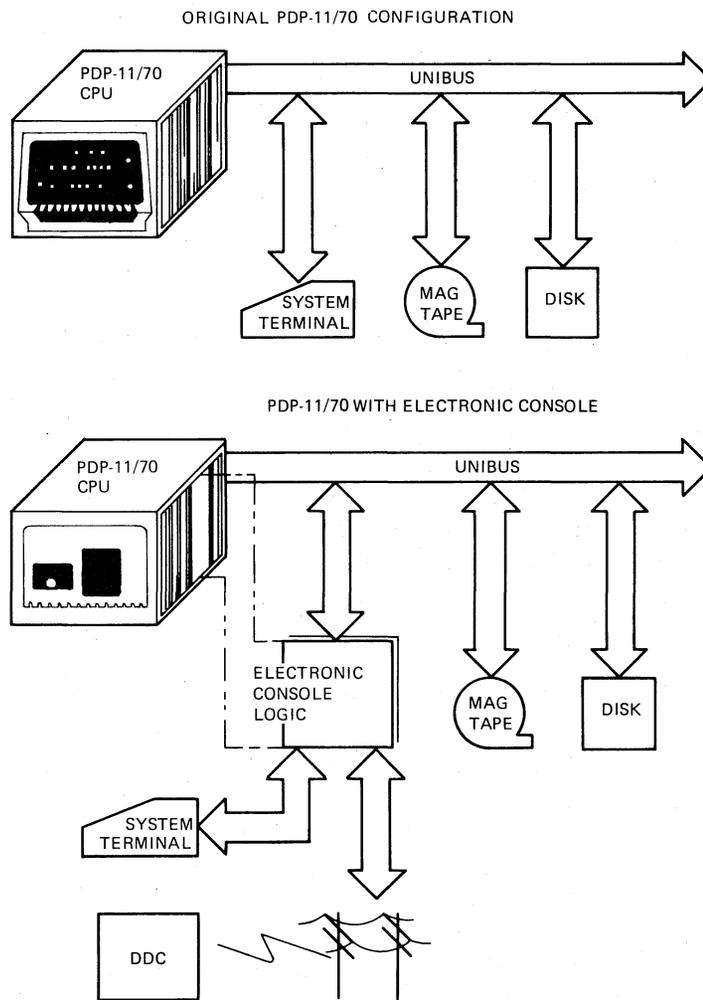
## 1.2 KY11-R COMPONENTS AND VARIATIONS

The major hardware components of the option are the electronic console front panel, two modules (a microprocessor and a multiplexer), and a modem for connection into a telephone line. Table 1-1 indicates significant details that differentiate the variants of this option.

## 1.3 MICROCODE

Microcode, resident on the M8255 microprocessor module, determines the electronic console command syntax, display formats, and indicator functions. This manual documents two different microcode versions, V01 and V02. Their differences are documented throughout this manual, and summarized in Appendix E. When using this manual with a particular system, it will be useful to know which version applies. You may determine the microcode version in any of three ways:

1. Determine the CS revision level of the M8255 microprocessor module; revision E is V01, revision H is V02.
2. If the console is installed and operative, type <CTRL/P> followed by <CTRL/E> for a system and microcode version identity message printout.
3. The Operator's Reference Summary (Appendix F) will identify the microcode version if the form has been filled out.



MA-4319

Figure 1-1 KY11-R Electric Console

Table 1-1 KY11-R Variant Summary

Feature	-R	-RB	-RC	-RE
Used on processor type	11/70	11/70	11/70	11/70
Microcode Version V01 available	X	X	X	-
Microcode Version V02 available	X	X	X	X
Kit includes a stand-alone modem	-	X	-	-
Kit includes an integral modem	X	-	X	-
Governmental authority provides modem	-	-	-	X
Kit includes a DAA	-	-	X	-

#### **1.4 REMOTE DIAGNOSIS**

A toll-free 800 number in the USA (and similar free phone service, to the extent permitted, in other countries) gives customers access to the Service Response Group (SRG). This group, which is integral to the Digital Diagnosis Center (DDC), responds to customer requests for service 24 hours a day, seven days a week.

Since all calls for service are logged through the DDC, they have access to cumulative system-specific performance records which indicate repetitive failures, ECO status, and preventive maintenance activity. Any service request for which remote diagnosis is appropriate is referred immediately to a team of highly trained and experienced engineers. The local DIGITAL branch service office is also alerted. The DDC Service Engineer, using the DDC host computer (which has system-specific configuration information and parameters), tests the customer system by running appropriate diagnostics or using other diagnostic techniques. DDC personnel use the results of these tests to advise the previously alerted DIGITAL branch service office of the specific replacement part or option repair required. The DDC may involve corporate engineering or other support assistance in the remote diagnosis process by connecting them, through the host computer, to the faulty system.

#### **1.5 OPERATING SYSTEM SECURITY**

The KY11-R does not jeopardize the security or integrity of a customer's operating system. DIGITAL's access to the system is possible only by means of a customer-controlled keyswitch. Whenever remote testing is in progress, the console panel and system terminal give the customer positive indication of DDC activity.

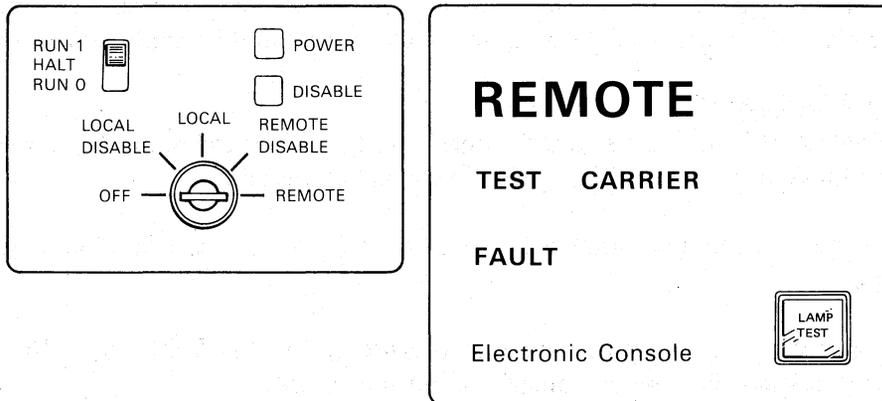
Remote telephone access to the console is restricted. The KY11-R responds only to encoded communications for diagnostic purposes, which further ensures only authorized access to the customer's system.



## CHAPTER 2 CONTROLS AND INDICATORS

### 2.1 SCOPE

This chapter defines the functions of the three switches and six indicators on the electronic console (Figure 2-1).



MA-2488

Figure 2-1 Electronic Console Panel Controls and Indicators

### 2.2 KEYSWITCH

The five-position keyswitch on the electronic console front panel replaces several “traditional console panel” functions. This switch permits the operator to:

- Turn system power on or off
- Select “panel lock” operation
- Permit or restrict DDC access to the system.

The following paragraphs describe system operation in each of the five switch positions.

#### 2.2.1 OFF

The OFF position removes power from the electronic console; in every other position power is applied. This switch is usually the system’s master power switch; however, power to certain system components may be controlled independently.

### **2.2.2 LOCAL DISABLE**

The LOCAL DISABLE position is analogous to panel lock on the traditional control panel. Access to panel control and indicator functions (console state) is disabled. The electronic console is effectively bypassed, so that all system terminal communication is dedicated to the CPU. Thus, the system is forced into the program I/O state. LOCAL DISABLE is the normal operating position if panel lock is required.

### **2.2.3 LOCAL**

The LOCAL position is used for system power-up, bootstrapping, and normal operation if panel lock is not required. Also, LOCAL provides access to the traditional panel control and indicator functions through commands typed at the system terminal keyboard. The following logical conditions are associated with LOCAL.

- Console, program I/O, or talk states may be selected.
- Data terminal ready (DTR) is cleared, thus disabling the remote serial interface.
- If a carrier signal is present, switching to LOCAL causes a carrier lost message (?CAR ER) to be printed. Printing of the message may be inhibited as explained in Paragraph 4.3.2.

### **2.2.4 REMOTE DISABLE**

The REMOTE DISABLE position sets DTR and thereby enables the remote serial interface, allowing DDC access to the system. The following, however, are disabled.

- The system terminal keyboard is disabled to prevent operator intervention during DDC testing.
- The console state is disabled, both at the site and to the DDC, since the DDC becomes a user by logging into the customer's operating system.

In REMOTE DISABLE, DDC access to the system is subject to program-imposed limitations. There is no access to any of the console control or indicator functions. This protects the customer from unpredictable DDC intervention. The DDC may perform and monitor program I/O functions in duplicating or testing for system failures. DDC and system dialog is displayed on the system terminal to permit monitoring by the site operator. Also, the DDC may set programmable option bits and thereby establish terminal communication with the site operator if desired.

### **2.2.5 REMOTE**

The REMOTE position is used exclusively to give the DDC access to the system for diagnostic or preventive maintenance purposes. All of the capabilities available at the site in LOCAL are available to the DDC in REMOTE. The DTR signal to the modem is asserted to enable the remote serial interface. In addition, although the system terminal is disabled except under DDC control, the talk state permits the DDC to print messages on, and solicit inputs from, the customer's system terminal.

### 2.3 RUN 1-HALT-RUN 0 (POWER-FAIL RESTART SWITCH)

The power-fail restart switch is a three-position slide switch mounted above the keyswitch. It allows the user to predetermine the system's response in a power-fail restart situation. Selection of the HALT position causes the system to come on in a halted state when power is restored.

Selection of RUN 1 or RUN 0 is determined by the requirements of the operating system. If the system anticipates all ones in the switch register at restart, selection of RUN 1 is appropriate. Conversely, if all zeros are expected, RUN 0 should be selected. Note that this switch determines switch register contents only at restart (power coming up); the Operator's Reference Summary (Appendix F), Paragraph 4.4.10, and Appendix B.1 (steps 2 through 5), explain how to set switch register contents as required for a power failure (power going down).

### 2.4 LAMP TEST (PUSHBUTTON SWITCH)

The lamp test switch is unidentified at its location, in the lower right corner of the status display area. Whenever power is on, pressing the switch turns on all indicators or, by exception, indicates a lamp failure.

### 2.5 POWER INDICATOR

The POWER indicator serves a dual purpose:

- To indicate that power is on within the electronic console (other system units may or may not have power on)
- In Microcode Version V02 or later, to indicate, by blinking, that the CPU is in a halted state.

Table 2-1 indicates all possible states of both POWER and DISABLE indicators.

Table 2-1 Power and Disable Indicator States

Keyswitch Position	Program State	Microcode Version V01		Microcode Version V02	
		POWER	DISABLE	POWER	DISABLE
LOCAL	Running	ON	OFF	ON	OFF
LOCAL DISABLE	Running	ON	ON	ON	ON
REMOTE	Running	ON	OFF	ON	OFF
REMOTE DISABLE	Running	ON	ON	ON	ON
LOCAL	Not Running	ON	OFF	Blinking	OFF
LOCAL DISABLE	Not Running	ON	ON	Blinking	Blinking
REMOTE	Not Running	ON	OFF	Blinking	OFF
REMOTE DISABLE	Not Running	ON	ON	Blinking	Blinking

### 2.6 DISABLE INDICATOR

The DISABLE indicator comes on whenever the keyswitch is in either LOCAL DISABLE or REMOTE DISABLE. This is also a dual purpose indicator, and, in Microcode Version V02, its continuous blinking in unison with POWER is a redundant indication that the program has halted. This redundancy is indicated in Table 2-1, which shows all possible states of both DISABLE and POWER.

The primary purpose of DISABLE is to remind the operator that a panel lock condition exists, the system is in program I/O state, and the system terminal is dedicated to program input/output.

## **2.7 REMOTE INDICATOR**

The REMOTE indicator comes on (the word REMOTE lights up) whenever the keyswitch is in either REMOTE or REMOTE DISABLE. It indicates that the remote serial interface is enabled and the DDC has access to the system.

## **2.8 CARRIER INDICATOR**

The CARRIER indicator comes on (the word CARRIER lights up) whenever the electronic console remote serial interface and modem receive a carrier-detected signal. It indicates that the DDC host computer is connected via telephone line to the electronic console.

## **2.9 TEST INDICATOR**

The TEST indicator comes on (the word TEST lights up) whenever the customer's system is connected to the DDC host computer. Also, the DDC may initiate the running of a diagnostic at the site, turn on TEST, disconnect (CARRIER will be turned off) during the test period, then reconnect later to continue the session. The keyswitch must be in either REMOTE or REMOTE DISABLE for TEST to be on. In Microcode Version V01, TEST is disabled by REMOTE DISABLE.

## **2.10 FAULT INDICATOR**

The FAULT indicator comes on (the word FAULT lights up) when the electronic console detects an error condition during a power-up self-test, a command V initiated self-test, or any operation involving the electronic console logic. An error message (?CON ER) is also displayed on the system terminal if the logic required to do so is operative. If a failure is transient in nature, the electronic console may still be operational; however, FAULT can be cleared only by a power-down, power-up sequence.

If a fault condition exists, or is suspected, contact DIGITAL's Service Response Group at the DDC as described in Chapter 5.

## **CHAPTER 3 OPERATION**

### **3.1 SCOPE**

The electronic console enhances operation and control of the computer system. It is used for starting, halting, debugging, and other basic program control. Its power switch usually serves as the master on/off switch for system power. The keyswitch and indicators on the front panel facilitate monitoring, maintenance, and system control. The electronic console simplifies the way the operator issues system commands and examines or deposits memory and register data, using the system terminal.

This chapter explains how to power up the system and how to use the system terminal for CPU control. Tutorial examples of command use are included. For the operator who is making a transition from the traditional console panel to the electronic console, notes are provided to indicate the equivalence. This chapter provides brief descriptions of operating states and commands, with emphasis on their elementary use. Chapter 4 provides a complete listing of the command set, with emphasis on definition and formatting.

### **3.2 OPERATING PROCEDURE**

System-specific factors such as configuration and programming are essential elements that must be considered in the definition of an operating procedure. Those settings and functions previously accomplished through the traditional CPU console panel are equally necessary with the electronic console.

The following operating procedure is typical for a system equipped with an electronic console.

1. Set power-fail restart switch.
2. Load media.
3. Power up and observe electronic console self-test results.
4. Perform bootstrap procedure.
5. Set switch register value for power-fail.

The paragraphs that follow explain, in general terms, the operating procedure outlined above. You will find system-specific details in the Operator's Reference Summary (Appendix F). The Operator's Summary provides the operator with the procedural details necessary to bring the system up to normal operation. The form is prepared on-site by the DIGITAL Field Service Engineer and site personnel at the time the electronic console is installed.

#### **3.2.1 Load Media**

Determine that operating system media are properly loaded as required for normal operation. The addition of an electronic console has no effect on the loading procedure.

### 3.2.2 Power Up; Observe Self-Test

Power up the system by turning the electronic console keyswitch from OFF to LOCAL. Although the electronic console keyswitch is typically wired to serve as the system master power switch, certain devices may have their power controlled independently. The electronic console microprocessor will initiate a self-test and turn on all indicators except CARRIER.

If the self-test is completed without error, all indicators (except POWER) are turned off. A successful self-test is confirmed when the message "V000377" is printed on the system terminal (Any deviation from this message indicates a console logic malfunction; see Paragraph 3.2.2.1).

Following the V000377 message, one of two possible series of events occurs.

1. If the power-fail restart switch is in the HALT position, the system will be forced into the console state (described in Paragraph 3.3.1). The prompt message CON= is printed on the system terminal. The CPU will be in a halted state.
2. If the power-fail restart switch is in either the RUN 1 or RUN 0 position, the system will be forced into the program I/O state (described in Paragraph 3.3.2). In this state, the system terminal is under CPU control and any message printed will be operating system generated. Check the Operator's Reference Summary (Appendix F) to determine that the expected terminal message (if any) was printed and/or that the system is operating correctly.

**3.2.2.1 Self-Test Error Detection** – If the electronic console self-test detects an error, or if there is a hardware malfunction, there will be an error message or indication. The nature of the failure determines the extent to which an error message or indication is possible:

- A deviation from the V000377 message
- A console error message ?CON ER
- Lighting of FAULT.

Any fault condition should be reported to the Service Response Group at the DDC as described in Chapter 5.

The electronic console detects the presence of +5 Vdc and +15 Vdc, or the transition of AC LO from low to high, and performs an internal initialization routine. The console is disabled if any of the required dc voltages are missing, but will operate with AC LO, DC LO, or INIT asserted on the UNIBUS. The self-test is a six-part exercise in which the electronic console performs (or attempts to perform) the following procedure:

1. Prints the character V on the system terminal
2. Performs an internal ROM test
3. Tests the low-order eight bits of the switch register with zeros (from which the three zeros of the printout are derived)
4. Performs an internal RAM test

5. Tests the low-order eight bits of the switch register with ones (from which the 377 of the printout is derived)
6. Performs an internal clock test.

The response of Microcode Version V01 to an internal test error may differ from version V02. Each will attempt to print out the V000377 message; version V01 *may* then attempt to light FAULT and print the console error message (?CON ER), while version V02 *will always* attempt to do so. Thus, these failure indications may occur separately or in combination.

### **3.2.3 Perform Bootstrap Procedure**

For normal system operation, perform the bootstrap procedure to load the operating system from disk or tape into memory. The Operator's Reference Summary (Appendix F) defines the system-specific bootstrap procedure. Appendix B provides a comprehensive description of applicable bootstrap procedures.

### **3.2.4 Set Switch Register**

Operating systems typically read switch register contents during both power-up and power-down. In this step, you enter the switch register contents required for a power-going-down condition. With the system in console state, type the octal switch register value, followed by commands W and Z. That value will be deposited into the switch register, and the system will be returned to program I/O state. This procedure is detailed as step 2 of the Operator's Reference Summary (Appendix F).

### **3.2.5 Set Power-Fail Restart Switch**

Set the power-fail restart switch (for power coming up) as described in Paragraph 2.3 or in the Operator's Reference Summary (Appendix F).

## **3.3 OPERATING STATES**

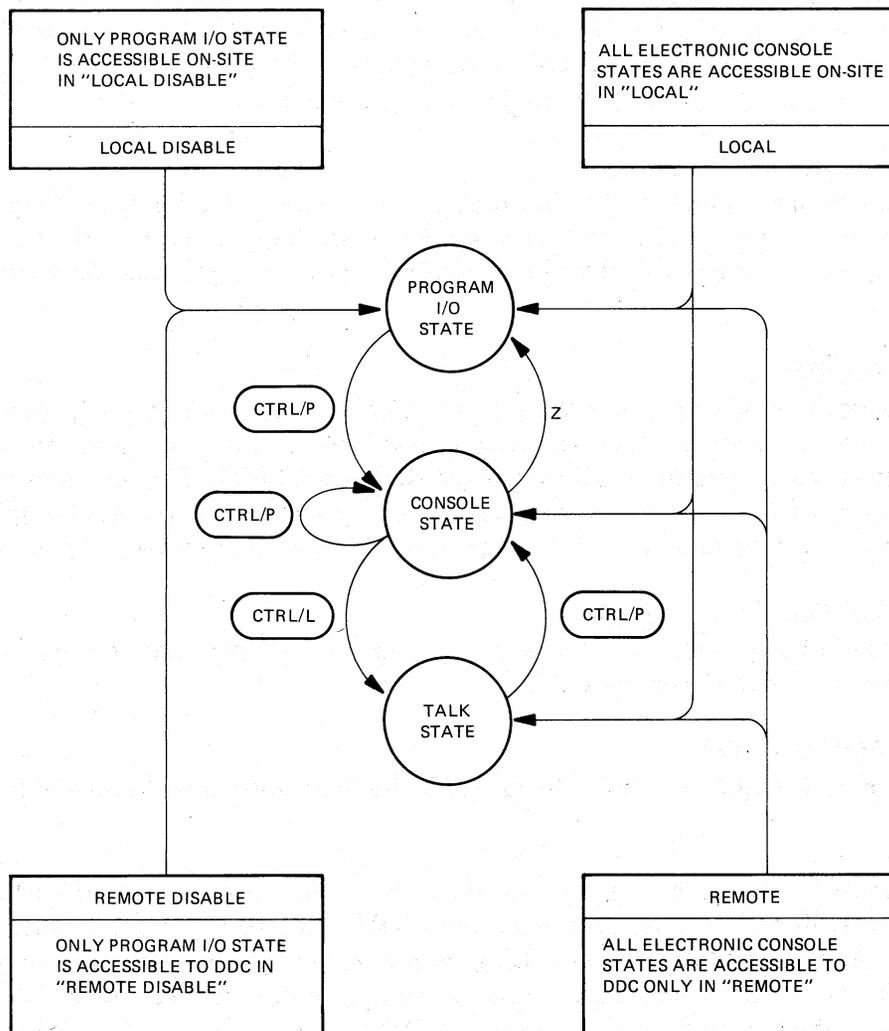
There are three operating states. (See Operating States Transition and Accessibility, Figure 3-1.)

### **3.3.1 Console State**

The console state is entered by typing <CTRL/P> on the system terminal keyboard. (To type a control character, first press and hold down the CTRL key, then type the letter.) The command is echoed on the terminal as ^ P <BELL>. Data terminal ready (DTR) is cleared, disabling the remote serial interface. The console state allows you to use the system terminal (with the keyswitch in LOCAL) to perform the traditional panel operations. With the keyswitch in REMOTE, the console state is available to the DDC. Local console state and remote console state are illustrated in Figure 3-2 and 3-3 respectively.

In the console state, normal program input/output communication between the CPU and the terminal is disabled. Both the terminal printer and the keyboard are dedicated to electronic console operations equivalent to those previously performed using the traditional panel.

There may be undesirable consequences if a program is unable to output to the system terminal (for example, if the electronic console is unintentionally left in the console state). A time-out feature in Microcode Version V02 eliminates this possibility.



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Figure 3-1 Operating States Transition and Accessibility

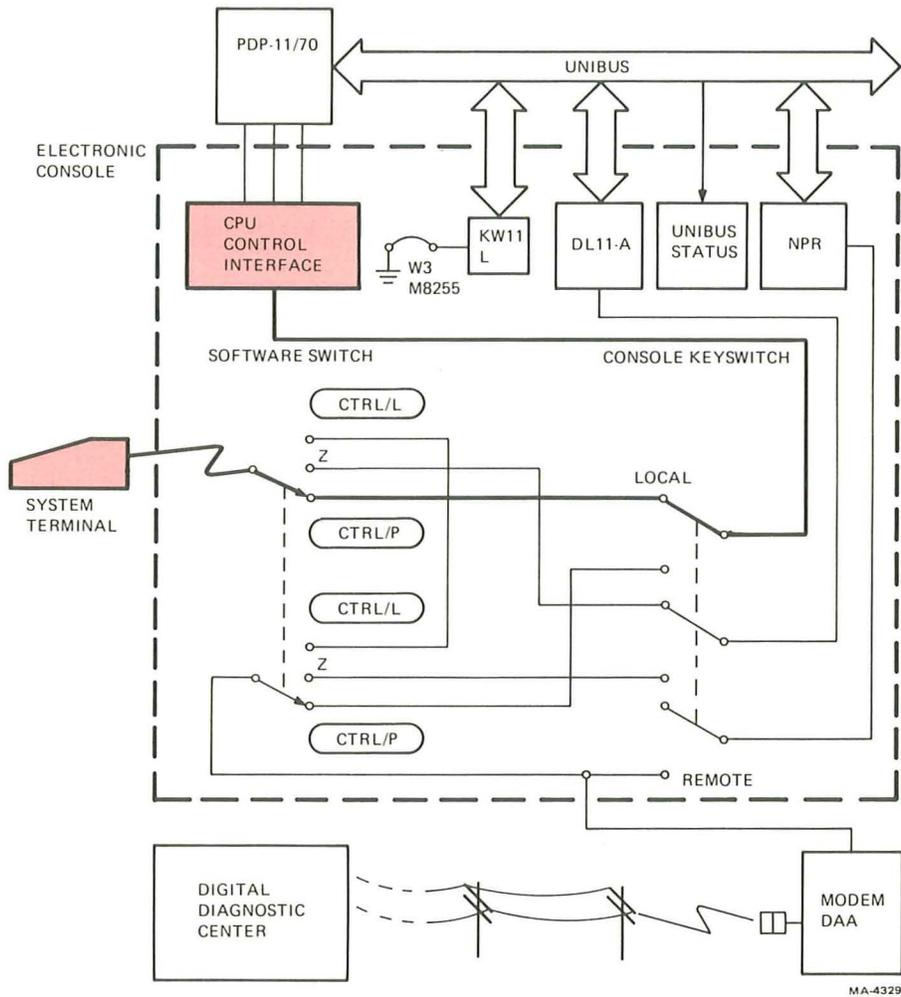


Figure 3-2 Local Console State

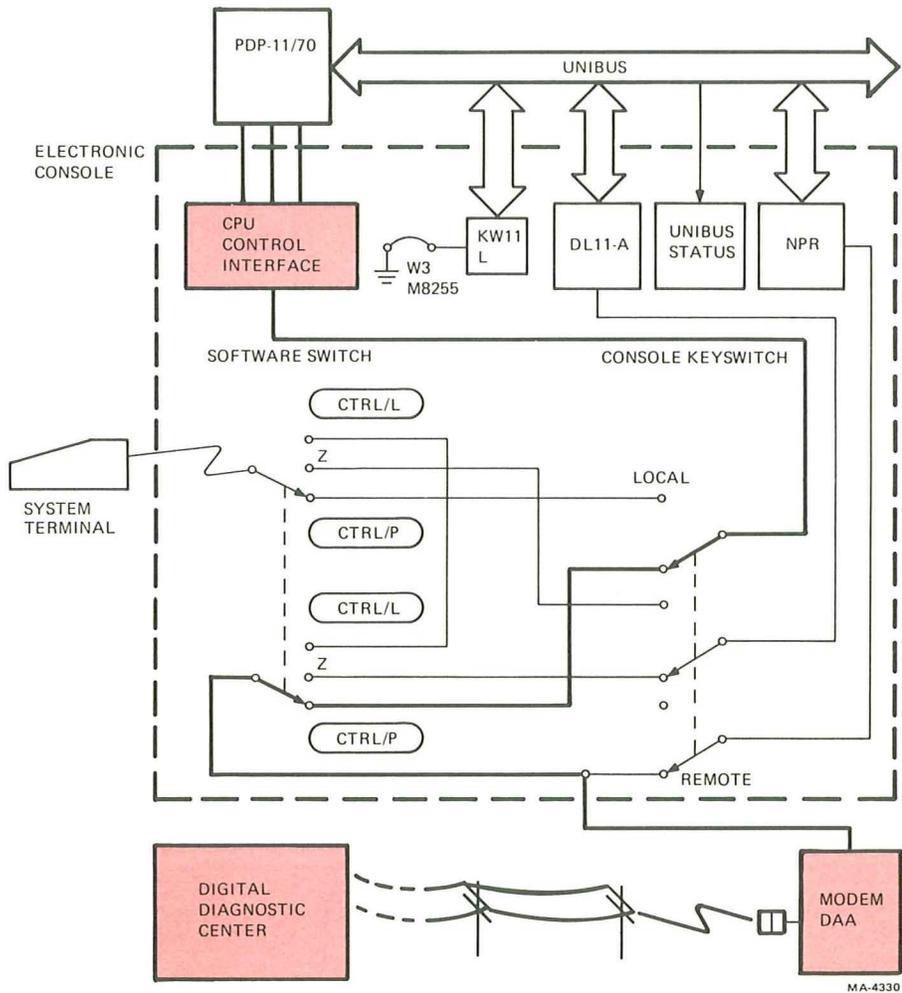


Figure 3-3 Remote Console State

**IF** these conditions exist:

- The electronic console is in the console state
- A program is running
- The program is attempting to print on the system terminal

**AND** there is no keyboard activity for twenty seconds (which allows a twenty-second timer to time out),

**THEN** console state is terminated, program I/O state is set automatically, and the system terminal is dedicated to program I/O.

To exit from the console state, you may enter either the program I/O state or talk state described below. (Also see Figure 3-1.)

### 3.3.2 Program I/O State

You may enter program I/O state (only from console state) by typing command Z. In program I/O state, the system terminal printer and keyboard are dedicated to input/output communication with a running program. The keyswitch positions LOCAL DISABLE and REMOTE DISABLE both force program I/O state logically. Local program I/O state and remote program I/O state are illustrated in Figures 3-4 and 3-5 respectively. (Also see Figure 3-1).

### 3.3.3 Talk State

You may enter talk state (only from console state) by typing the command <CTRL/L>. In talk state, DTR is set, connecting the terminal through the remote serial interface to the DDC. This state is usually controlled by the DDC and permits message interchange between the operator at the system terminal and the DDC remote operator or host computer. All characters are acceptable as text, except <CTRL/P>, which is recognized as the command for an exit into console state. Remote talk state is illustrated in Figure 3-6. (Also see Figure 3-1).

## 3.4 FAMILIARIZATION EXERCISES

The comparatively simple electronic console exercises in the following paragraphs are of value primarily to the “first-time” user. It is essential that the operator learn to use the entire command set which is itemized and described in Chapter 4.

### NOTE

**In the following examples and exercises, the operator types all characters printed in red. The expected system prompts and responses are also shown.**

Each exercise begins with a reminder that the electronic console must be in console state except as noted otherwise. Once entered, by typing <CTRL/P>, the console state remains selected until you enter another state (by typing <CTRL/L> for talk state or Z for program I/O state).

Before beginning these exercises, see Figure 4-1 for an explanation of the command string format that must be used. Understanding the format requirements will make the exercises more meaningful. Chapter 4 provides a detailed description of each electronic console command.

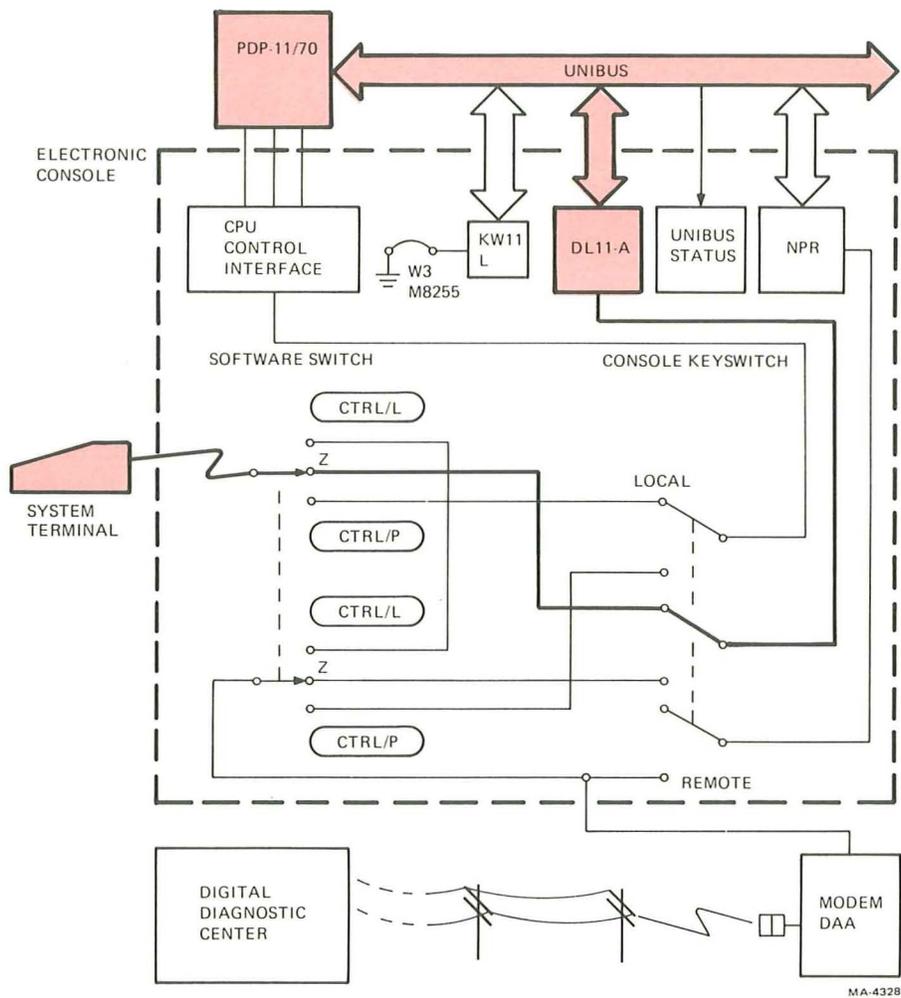


Figure 3-4 Local Program I/O State

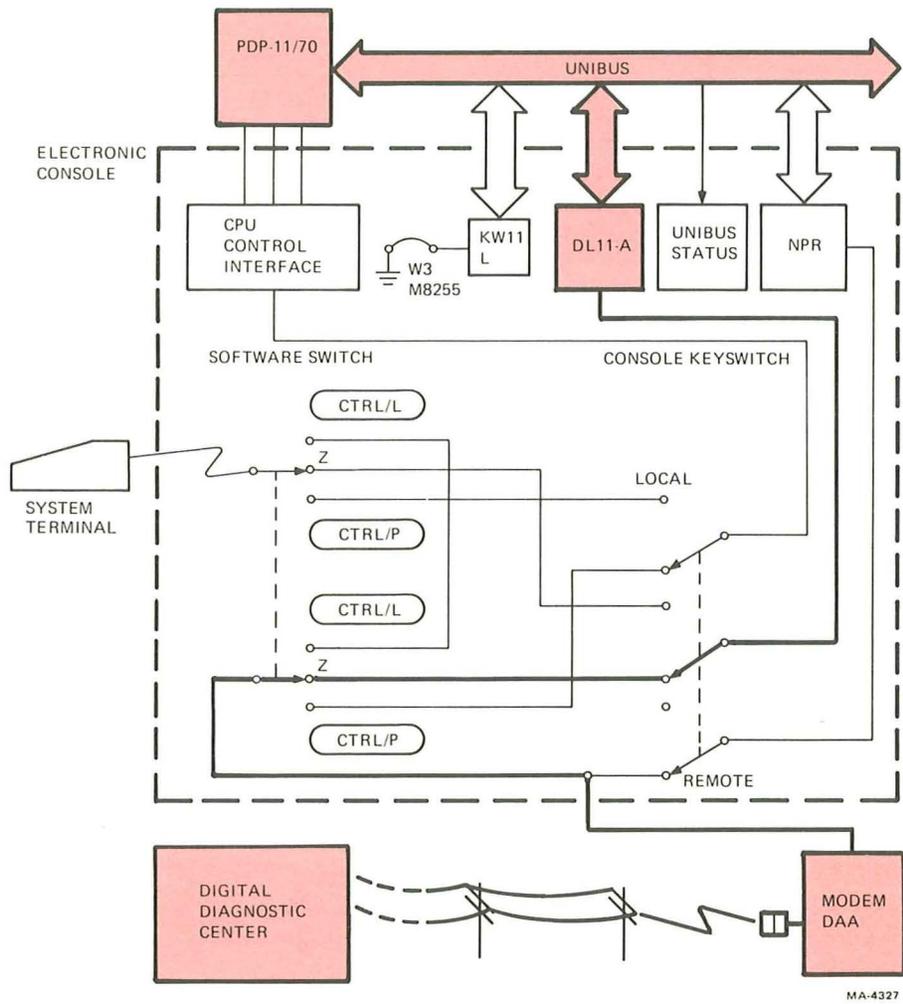


Figure 3-5 Remote Program I/O State

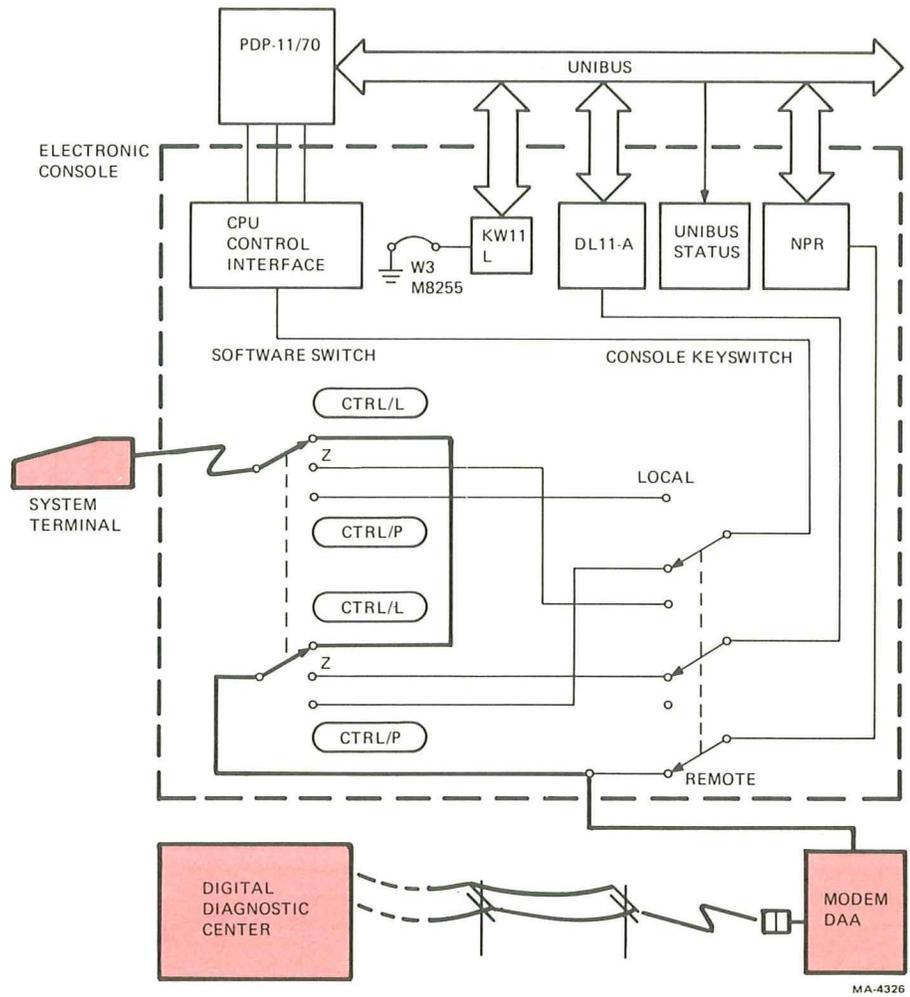


Figure 3-6 Remote Talk State

### 3.4.1 Examine Contents of a Location (Basic Commands)

Terminal Dialog:           <CTRL/P> ^P<BELL><NL>  
                          CON= 1000LΔE nnnnnn <CR> <NL>  
                          CON=

1. The prompt CON= (console state) is printed in response to <CTRL/P> (following the echo ^P <BELL>).
2. Type 1000 (the location to be examined).
3. Type the command L (load address register). The command E (examine), issued in step 5, must always be preceded by the command L.
4. The system acknowledges command L by printing a space character.
5. Type command E (examine contents of the address referenced by the address register).
6. The system responds by printing the contents of address 1000. Note that the data display is in octal notation.
7. Type <CR> to close the location. The system generates a <NL> (new line).

#### 3.4.1.1 Examine Contents of a Location (Multiple Function Command)

Terminal Dialog:           CON= 1000/nnnnnn <CR> <NL>  
                          CON=

In practice, you will more likely use the multiple function command in which the command / (open word location) is the equivalent of a command L (load address) followed by a command E (examine). Type 1000/ and the contents of address 1000 will be displayed. Type <CR> to close the location; the system generates a <NL> (new line).

#### 3.4.1.2 Examine Contents of a Location (Hexadecimal Notation)

Terminal Dialog:           CON= “Δ1000/“nnnn <CR> <NL>  
                          CON=

For a read-out of the same location in hexadecimal (Microcode Version V02 only), type command “, then the address to be opened (1000), then command / (open word location). The “ symbol which is added as a prefix to the displayed contents indicates that the hexadecimal format is selected. Type <CR> to close the location.

### 3.4.2 Change Contents of a Location (Basic Commands)

Terminal Dialog:            CON= '1000L $\Delta$ E $\Delta$ nnnnnn 12706D <CR>  
                                 CON=

1. The prompt CON= is printed in response to <CTRL/P>.
2. Type command ' to return to octal display format.
3. Type 1000 (the location to be examined).
4. Type command L (load address register). Command E (examine), issued in step 6, must always be preceded by command L.
5. The system acknowledges command L by generating a space character.
6. Type command E (examine contents of the address referenced by the address register).
7. The computer responds by printing the contents of address 1000.
8. Type 12706, the number you want deposited into location 1000.
9. Type command D (deposit).
10. The contents of location 1000 becomes 12706; type <CR> to close the location.

#### 3.4.2.1 Change the Contents of a Location (Multiple Function Command)

Terminal Dialog:            CON= 1000/nnnnnn $\Delta$ 12706 <LF>  
                                 00001002/nnnnnn <CR> <NL>  
                                 CON=

In practice, you will more likely use the multiple function command in which / (open word location) is the equivalent of a command L (load address) followed by a command E (examine).

Type 1000/ then type the number to be deposited, 12706, followed by <LF>, which performs the deposit, closes the location, then opens the next sequential location, and prints its contents.

A <CR> typed instead of <LF> also performs the deposit and closes the location, but does not open the next location.

### 3.4.3 Examine a Register

Terminal Dialog:            CON= \$3L $\Delta$ E nnnnnn <CR> <NL>  
                                 CON=

1. The prompt CON= (console state) is printed in response to <CTRL/P>.
2. Type command \$ (select a register).
3. Type 3 to specify register 3.
4. Type command L (load address register). Command E (examine) issued in step 6, must always be preceded by command L.
5. The system acknowledges command L by printing a space character.
6. Type command E (examine contents of the address referenced by the address register).
7. The system responds by printing the contents of register 3. Type <CR> to close the location.

### 3.4.4 A Simple Program Exercise

This exercise (as shown in Diagram 3-1) guides you through the loading, starting, modifying, and halting of a simple program.

The program prints a continuous string of a particular character as determined by the switch register contents. The program loading sequence uses commands explained in previous exercises.

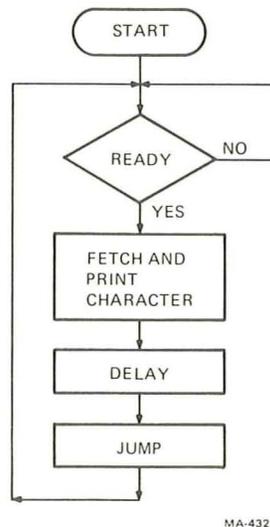


Diagram 3-1

Type **200/** to open location 200, then type **12700** followed by **<LF>** to deposit 12700 into location 200 and open location 202. Continue the procedure as indicated below.

```

<CTRL/P> ^ P <BELL>
CON= 200/nnnnnn 012700 <LF>      MOV #20, R0
00000202/nnnnnn 000020 <LF>
00000204/nnnnnn 105737 <LF>      TSTB @ #177564
00000206/nnnnnn 177564 <LF>
00000210/nnnnnn 100375 <LF>      BPL 204
00000212/nnnnnn 113737 <LF>      MOVB @ #177570, @ #177566
00000214/nnnnnn 177570 <LF>
00000216/nnnnnn 177566 <LF>
00000220/nnnnnn 012701 <LF>      MOV #-1, R1
00000222/nnnnnn 177777 <LF>
00000224/nnnnnn 077101 <LF>      SOB R1, 224
00000226/nnnnnn 077004 <LF>      SOB R0, 224
00000230/nnnnnn 000137 <LF>      JMP @ #200
00000232/nnnnnn 000200 <LF>
00000234/nnnnnn 000000 <CR>
CON=

```

Terminal Dialog: (Steps 1 through 13)

```

CON= 200L Δ I Δ 101W Δ C R00000101 Z <NL>
AAAAAAAAAAAAAAAA <CTRL/P> ^ P <BELL>
CON= H00000204/T14410
      └──┬── CPU Status (Paragraph 4.4.6)
          └── Halt Address (Paragraph 4.4.13)

```

Start the program, using basic commands, as follows:

1. Type **200L** which loads address 200.
2. The system acknowledges command **L** by generating a space character.
3. Type the command **I** (initialize the system).
4. The system acknowledges command **I** by generating a space character.
5. Type **101W**. An octal value followed by command **W** loads that octal value into the switch register. The quantity **101** in the switch register results in the letter A being printed by this program.
6. The system acknowledges command **W** by generating a space character.

**NOTE**

If you are using Microcode Version V01, proceed with the following steps and ignore the note about printing beginning automatically.

With version V02, steps 7 through 13 can be reduced to:

Type command **C** (continue), wait twenty seconds, and the printout will begin automatically. Interrupt it by typing **<CTRL/P>**.

Type **H** (halt).

7. Type command **C** (continue program instruction execution in console state, no program I/O). Be prepared to perform step 13 if printing begins automatically as explained in step 10.
8. The system acknowledges command **C** by generating a space character.
9. If the microcode is version V02, command R (read switch register) is logically forced. A prompt, R00000101, is printed. This prompt is forced whenever a command that initiates or continues program execution is issued. It reminds the operator that the switch register may require a predetermined setting for a power-going- down condition. (See Paragraph 4.4.5.)
10. The program is now running and attempting to output to the terminal, which is unavailable because the electronic console is in the console state. With Microcode Version V01 you will give the CPU access to the terminal in step 11. In version V02, if you delay twenty seconds before performing step 11, CPU access will occur automatically as explained in Paragraph 3.3.1.
11. Type command **Z** (set program I/O state), to enable program access to the terminal.
12. The system acknowledges command **Z** by generating **<NL>** (new line).
13. The program begins printing a continuous string of As, which you should interrupt by typing **<CTRL/P>** to return the terminal to console state. (The program continues running but there is no output.) Type **H** (halt). The halt address may be other than 00000204.

Terminal Dialog:

(Steps 14 through 20)

CON = R00000101 102W Δ 200G R00000102 <NL>

ABBBBBBBBBBBB <CTRL/P> ^ P <BELL>

CON = H00000204/T14410

└── CPU Status (Paragraph 4.4.6)

└── Halt Address (Paragraph 4.4.13)

14. Type command **R** (read switch register). The contents, 00000101, which you entered in step 5, are displayed.

15. Type **102W**. This changes the contents of the switch register and results in the program printing the letter B.
16. The system acknowledges command **W** by generating a space character.
17. Type **200G** to initiate program instruction execution. The R prompt is system generated following command **G** in Microcode Version V02 only.
18. The program begins printing a continuous string of Bs, which you should interrupt by typing **<CTRL/P>** to return the terminal to console state. (The program continues running but there is no output.) Note that the first character in the printed string is an A if you interrupted the previous operation while it was looping, which is probable.
19. Type the command **H** (halt program instruction execution).
20. The system responds by printing the address at which it halted and CPU status information (the halt address may be other than 00000204).

Terminal Dialog:           (Step 21)

```
CON= 101,200G R00000101 <NL>  
AAAAAAA <CTRL/P> ^P <BELL>  
CON= H00000204/T14410
```

21. You can complete steps 1 through 13 using multiple function commands as shown above. As explained in Chapter 4, the above command string consists of the switch register value (**101**), the comma (,) as an argument separator, the program starting address (**200**), and the command **G** which initiates program execution in program I/O state. The R prompt is system generated following command **G** in Microcode Version V02 only.

## CHAPTER 4 OPERATING COMMANDS

### 4.1 SCOPE

This chapter lists and describes each command used to control a PDP-11/70 with an electronic console option installed.

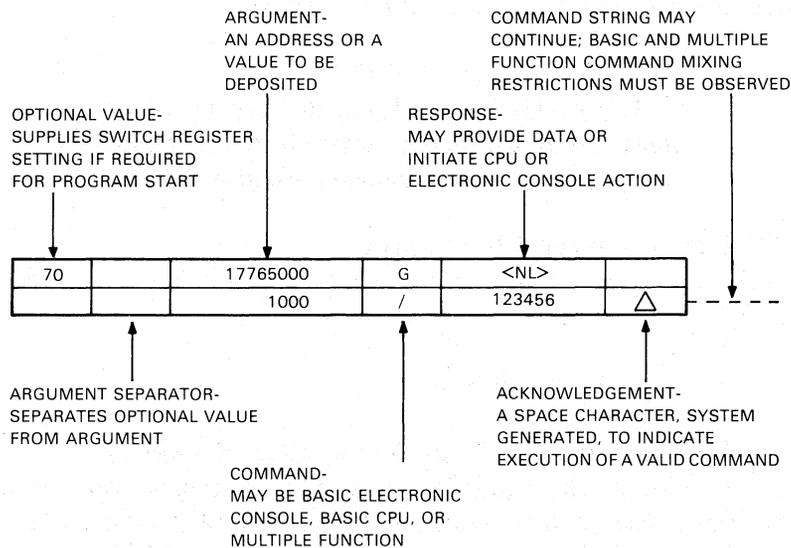
### 4.2 COMMAND FORMAT

Each command or command string must conform to the following format, shown in Figure 4-1.

[[<OPTIONAL VALUE><SEPARATOR>]<ARGUMENT>]<COMMAND>[<RESPONSE>]<ACKNOWLEDGEMENT>

#### 4.2.1 Argument Separator (,)

The electronic console command set uses the comma (,) to separate the optional value (switch register setting) from the argument (data value or address). Paragraph 4.2 contains an example of the use of this argument separator.



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Figure 4-1 Command Format

### 4.2.2 Argument

The argument, always a numerical quantity, may be an octal address or a value to be deposited. When you are typing a command string, the electronic console accumulates numerical data (not commands) in a temporary input register. You may transfer, modify, or clear the contents of this register as follows:

- Transferred (temporary input register left cleared)  
If the numerical data is intended to be a switch register value, the transfer from the temporary input register to the switch register occurs when the argument separator (,) is typed.  
  
Other data contents (such as an address or memory value) is transferred to the appropriate destination upon issuance of the command which always immediately follows that data.
- Modified (character-by-character deletion and re-entry)  
The command <DELETE>, explained in Paragraph 4.3.10, is used to delete the last previous character typed into the temporary input register. You may repeat the command and enter or delete new data as required.
- Cleared (contents disposed of)  
The command <CTRL/U>, explained in Paragraph 4.3.11, is used when you intend to clear the entire contents of the temporary input register.

## 4.3 CONSOLE CONTROL COMMANDS

Console control commands, Table 4-1, are executed within the electronic console and do not directly affect the CPU. These commands can be grouped into four categories, by function: those which control the electronic console; those which set operating states; those which define data format; and those which allow the operator to correct character type-in errors.

### NOTE

**In the following examples in this chapter, the operator types all characters printed in red. The expected system prompts and responses are also shown.**

#### 4.3.1 Command <CTRL/E>, Read CPU Identity

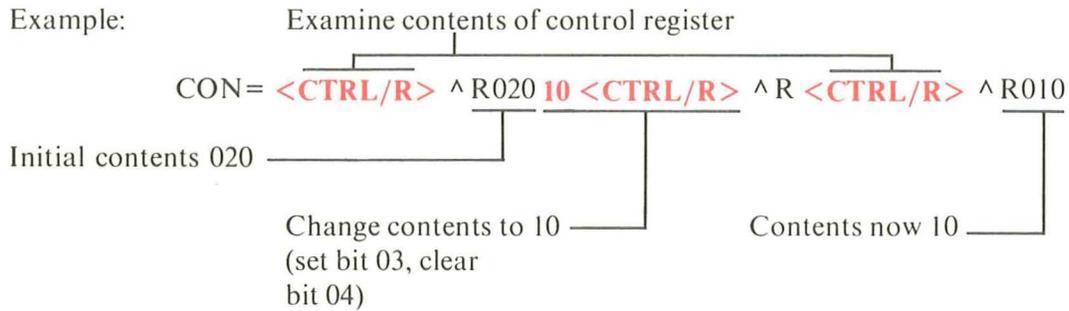
This command results in a printout that identifies both the CPU type and the electronic console microcode version in use.

Example:           <CTRL/E> 11/70 V01

#### 4.3.2 Command <CTRL/R>, Read or Load Console Control Register

This command results in either examining or changing the current contents of the console control register. If an octal value precedes the command, that value replaces the current contents of the register; if no octal value is entered, the current contents are examined but remain unchanged.

Example:



The console control register (Figure 4-2) consists of seven programmable bits. These bits are either cleared or set to predetermined conditions both at power-up and when the keyswitch is changed to LOCAL or LOCAL DISABLE. Each may be set or cleared by the DDC as required for remote diagnosis purposes. Bits 03 (expand printout), and 04 (special mode), may be set or cleared at the system terminal by the <CTRL/R> command. Table 4-2 provides a detailed description of each console control register bit.

**Table 4-1 Summary of Electronic Console Control Commands Arranged by Function**

Command Function	Command	Description	Paragraph Reference
Electronic console control	<CTRL/E>	Identify system and Microcode Version	4.3.1
	[n] <CTRL/R>	Read or change contents of console control register	4.3.2
	V	Verify electronic console logic (self-test)	4.3.3
Setting of operating states	<CTRL/P>	Set console state	4.3.4
	Z	Set program I/O state	4.3.5
	<CTRL/L>	Set talk state	4.3.6
Defining data formats	\$	Open register address	4.3.7
	'	Set octal data display format	4.3.8
	"	Set hexadecimal data display format	4.3.9
Type in error correction	<DELETE>	Delete last character typed into temporary register	4.3.10
	<CTRL/U>	Delete all characters in temporary register	4.3.11
Delimiter	,	Argument separator	4.2.1

Commands may be entered in either upper or lower case (for example, A or a).

Note that the commands listed in this table are executed within the electronic console and do not involve the CPU. The symbol [n] indicates optional data.

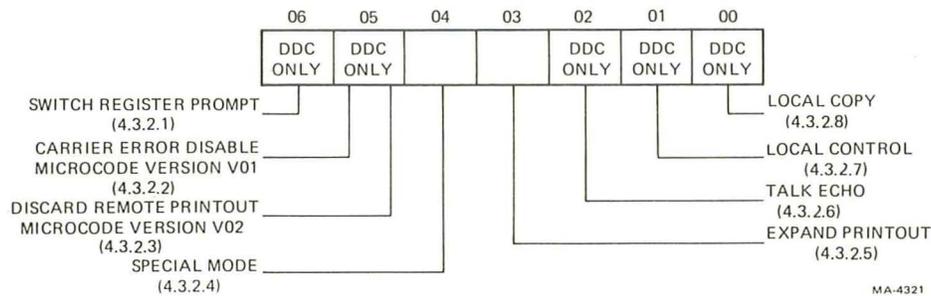


Figure 4-2 Console Control Register

Table 4-2 Console Control Register Bit Description

Bit Position	Description
0	<b>Local Copy</b> – Setting bit 0 allows the DDC to provide the system operator with an audit trail of remote activity. It enables printing, on the system terminal, of messages or commands being tested or exercised by the DDC. The system terminal keyboard is disabled to prevent operator intervention.
1	<b>Local Control</b> – Bit 1 may be set by the DDC to permit parallel system control at both the system terminal and the DDC. This allows the DDC operator to “observe” as the site operator re-creates failure circumstances at the system terminal. Setting bit 1 also forces local copy, which is equivalent to setting bit 0. Thus, all commands issued at the site are echoed and performed as if the electronic console keyswitch were in LOCAL.
2	<b>Talk Echo</b> – Bit 2 is effective only when the talk state has been selected by the DDC. Bit 2 controls the way character transmissions are echoed by the electronic console. When the remote DDC operator and the site operator communicate with (talk to) each other at their respective terminals, the electronic console returns an echo for each character typed. It also transmits the character to the receiving terminal. Bit 2 must be set by the DDC for that purpose. If, however, the DDC host computer sends a message to the site operator at his/her terminal, no echo from the electronic console would be expected. When bit 2 is cleared, which is its initialized condition, the electronic console suppresses such undesirable or redundant character echoes.
3	<b>Expand Printout</b> – Bit 3, when set, causes an automatic command M (read data display) to be executed following a command N (execute next instruction or bus cycle). Command N causes the CPU to execute a single instruction (or bus cycle), then halt and print the location. If bit 3 is set, the command M is executed automatically, printing the contents of the selected CPU data display register. This feature is particularly useful when tracing programs in single instruction mode.  Example:  <pre>&lt;CTRL/P&gt; ^ P &lt;BELL&gt; CON= 1000LΔIΔ10 &lt;CTRL/R&gt; ^ R N00001002 1M00016701</pre>
4	<b>Special Mode</b> – Bit 4 is set when system troubleshooting suggests the use of otherwise illegal command formatting. The logic ignores syntax and CPU errors, and permits abnormal operations such as entering an initialization command when the CPU is in a run state.
5	<b>Carrier Error Disable (Microcode Version V01 only)</b> – Bit 5 is set when the DDC wants the electronic console to ignore receipt of a loss-of-carrier indication. (No ?CAR ER message will be printed.)
5	<b>Discard Remote Printout (Microcode Version V02 only)</b> – Bit 5 may be set by the DDC to eliminate system terminal printout of unwanted data. For example, the DDC may initiate a diagnostic, set bit 5 to disable printout, disconnect for a period of time, then reconnect to evaluate results and continue the session.
6	<b>Force Switch Register Prompt (Microcode Version V02 only)</b> – Bit 6 is normally set and can be cleared only by the DDC. When commands C, P, S, or G (commands that initiate or continue program instruction execution) are issued with bit 6 set, a command R is forced. The current setting of the switch register is printed on the system terminal to remind the operator that the setting may require changing to the predetermined power-fail setting.

### 4.3.3 Command V, Verify Console Logic

This command allows the operator to initiate the electronic console self-test. The same self-test is always initiated by system power-up. Successful completion of the test results in the message V000377 being printed on the system terminal. The electronic console self-test is described in Paragraphs 3.2.2. Command V is illegal if issued when the processor is running.

### 4.3.4 Command <CTRL/P>, Set Console State

This command sets the electronic console to the console state, which allows the operator to issue control commands from the system terminal. In this state, the terminal communicates with the electronic console to perform functions equivalent to those previously performed using the traditional panel. Selecting console state forces several other conditions.

- Octal data display format is selected (Paragraph 4.3.8).
- Address display multiplexer position 3 (console physical) is selected (Paragraph 4.4.1).
- Memory data display multiplexer position 1 (data paths) is selected (Paragraph 4.4.14).

- **IF** in the last previous condition the keyswitch was in LOCAL,

**AND** the talk state <CTRL/L> had been entered (by which the remote interface would have been enabled),

**THEN** the remote serial interface is disabled by clearing DTR.

Although a program may be running, it will be unable to print on the system terminal. This may lead to undesirable buffer overflow conditions. In Microcode Version V02, when the electronic console is in the console state and a program is running and attempting to print out on the system terminal, keyboard activity is monitored and resets a twenty-second timer. If there is no keyboard input for a twenty-second period, a time-out occurs, console state is terminated, program I/O state is set automatically, and the terminal is returned to CPU control.

Example:

```
<CTRL/P> ^P <BELL>  
CON= T14050 (No keyboard activity for twenty seconds)  
Z <NL>  
(Terminal under CPU control)
```

Also see Figure 3-1, Operating States Transition and Accessibility.

### 4.3.5 Command Z, Set Program I/O State

This command causes the console state to be terminated and the program I/O state to be entered. The system terminal keyboard and printer are dedicated to communication with the CPU for program I/O. The keyswitch positions LOCAL DISABLE and REMOTE DISABLE both force the program I/O state logically.

Also see Figure 3-1, Operating States Transition and Accessibility.

### 4.3.6 Command <CTRL/L>, Set Talk State

This command enables person-to-person typed messages between the system terminal and the remote line. When a <CTRL/L> command is typed, the DTR (data terminal ready) signal is enabled which, in turn, enables the remote serial interface. This feature permits interconnection of the DDC and the customer's system terminal for message interchange during remote diagnosis. With the exception of <CTRL/P>, which returns the terminal to console state, all characters are interpreted as message text.

Example:

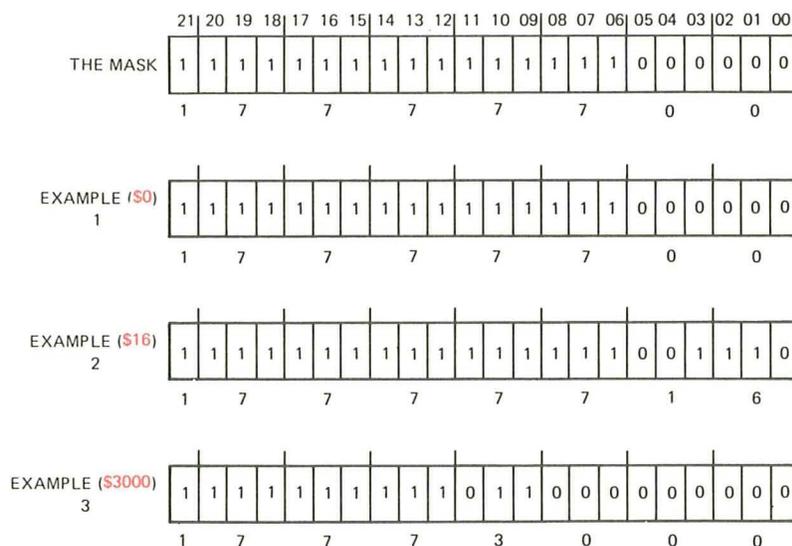
```
<CTRL/L> ^L Is drive 2 at BOT? <CR>
Checking - yes <CR>
Standby
```

Also see Figure 3-1, Operating States Transition and Accessibility.

### 4.3.7 Command \$, Set Register Address

This command is used as a prefix to the data argument that precedes load address commands L, /, or <CTRL/D> in Microcode Version V01, and commands G, S, and \ in Microcode Version V02. It masks the leading zeros in the temporary input register with ones so that the argument represents a register address rather than a memory address. Paragraph 3.4.3 provides an example of the use of command \$; Illustration 4-1 provides several examples.

When command \$ is issued, the contents of the temporary input register are masked with 17777700 before transfer to the CPU address register occurs. Thus, any register or I/O page area requiring the high-order bits to be set may be accessed readily. Comparative examples showing use of command \$ with both 16-bit words and 8-bit bytes are given in Paragraph 4.5.2. (The 8-bit byte format is available only in Microcode Version V02.)



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Illustration 4-1

- Example 1: Microcode Version V01 provides access to the low-order six bits only (you may type two octal digits maximum). In this example the command string CON= **\$0/** opens processor register 0 (address 17777700) with either Microcode Version V01 or V02.
- Example 2: In this example the command string CON= **\$16/** opens processor register 16 (address 17777716) with either Microcode Version V01 or V02.
- Example 3: Microcode Version V02 provides access to the complete range of register and I/O addresses. Note that this example is invalid for Microcode Version V01 because of its two low-order digits maximum range. The command string CON= **\$3000/** opens address 17773000, an example of command \$ providing simplified access to the I/O page area.

#### 4.3.8 Command ' (Single Quote), Select Octal Data Display Format

This command is not available in Microcode Version V01. When command ' (single quote) is issued to select octal data display format, the following data display commands produce octal displays:

E	Examine	}	Basic CPU Commands
M	Read Memory Data		
<CTRL/D>	Dump Memory		
/	Open Word Location	}	Multiple Function Commands
\	Open Byte Location		

The octal data display format is automatically selected at power-up, initialization, or by the command <CTRL/P>; it is cleared by command " (double quote). The example given in Paragraph 4.3.9 shows a useful exception to the general rule that multiple function and basic commands should not be mixed. The explanation of that aspect of the example applies equally to both the command ' (single quote) and " (double quote).

#### 4.3.9 Command " (Double Quote), Select Hexadecimal Data Display Format

This command is not available in Microcode Version V01. When command " (double quote) is issued to select hexadecimal data display format, the same data display commands listed in Paragraph 4.3.8 produce a hexadecimal display. Whenever this format is selected, the double quote (") symbol is printed as a prefix to the displayed data to remind the user that the data is in hexadecimal format. The hexadecimal data display format is cleared at power-up, by initialization, by command <CTRL/P>, or by command ' (single quote), select octal data display.

Example:

CON= 'Δ1000/177570	<CR>	<NL> (octal notation)
CON= "Δ1000/"EE78	<CR>	<NL> (hexadecimal notation)
CON= 'Δ1000/177570 "	<NL>	In Microcode Version V02, if either command ' (single quote) is issued or " (double quote is issued when a location is open, the contents will be displayed again in the format selected by the command. Thus, these two basic commands may be mixed with the multiple function command group in this single, useful exception.
1000/"EE78'	<NL>	
1000/177570	<CR>	
CON=		

#### 4.3.10 Command <DELETE>, Delete Last Character Typed

The <DELETE> key permits you to delete the last previous data digit typed. The backslash ( is printed on the terminal with each digit as it is deleted in Microcode Version V01, but with only the first and last digits deleted in Microcode Version V02. Command characters cannot be deleted using the <DELETE> command.

The examples below represent the same sequence of keystrokes and demonstrate the delete format for each microcode version. The number **1324** is typed in; the 4, the 2, then the 3 are deleted; and a **1** is typed. The temporary input register contains 11 following each exercise.

Example: (Microcode Version V01)  
CON= **1324** <DELETE>\4 <DELETE>\2 <DELETE>\3**1**

The printout will be in this format: CON= **1324**\4\2\3**1**

Example: (Microcode Version V02)  
CON= **1324** <DELETE>\4 <DELETE> 2 <DELETE> 3\b

After the **1** is typed, the final backslash is printed before the 1 is echoed.

The printout will be in this format: CON= **1324**\423\b

There is a significant difference between Microcode Versions V01 and V02 in the processing of data out of the temporary input register. V02 counts the characters typed in and those deleted; if no typed-in characters remain in the register, there is no transfer. In V01, however, the typing of the first character enables the logic, which forces a transfer of the temporary input register contents when the subsequent argument separator or command is issued. V01 does not count characters typed or deleted. The transfer of register contents occurs even though all typed-in characters have been deleted (contents all zeros). If the subsequent command is D (deposit) the location contents are changed to all zeros. For example (using Microcode Version V01), you intend to change the contents of location 1000 to 12706. After typing **1000/**, you begin to type the new contents, **12** – then realize that the address should be 1010. Typing <DELETE> <DELETE> deletes the 2 and the 1. Then, when <CR> is typed, the contents of the temporary register (all zeros) are deposited into address 1000.

```
CON= 1000/nnnnnn 12 <DELETE>\2 <DELETE> \1<CR> <NL>  
CON= 1000/000000
```

Use of command <CTRL/U> eliminates this possibility.

```
CON= 1000/nnnnnn 12 <CTRL/U> ^U <NL>  
<CR> <NL>  
CON= 1000/nnnnnn
```

### 4.3.11 Command <CTRL/U>, Delete All Characters of Current Type-In

This command deletes all characters which have been typed into the temporary input register. It terminates any data value entry and prevents a deposit into memory if it is issued before an argument separator, <LF>, <CR>, or other command is typed. If you are operating Microcode Version V01, you should develop the habit of using this command rather than <DELETE> for reasons described in Paragraph 4.3.10.

Example: You make a mistake typing 12706 to be deposited into location 1000.

```
CON= 1000/nnnnnn 1207 <CTRL/U> ^U <NL>
12706 <CR> <NL>
CON= 1000/12706
```

## 4.4 CPU CONTROL - BASIC COMMANDS

Table 4-3 summarizes the commands that you use to communicate with the CPU. Paragraphs 4.4.1 through 4.4.19 describe those commands in detail.

Table 4-3 Summary of Basic CPU Control Commands Sorted by Function

Command Function	Command	Description	Paragraph Reference
To examine data from CPU	[n]A	Display CPU address register contents	4.4.1
	n <CTRL/D>	Dump sequential memory locations	4.4.2
	E	Examine previously opened location	4.4.3
	[n]M	Read CPU memory data display register	4.4.4
	R	Read switch register setting	4.4.5
	T	Read CPU status	4.4.6
	U	Read UNIBUS status	4.4.7
To deposit data into CPU	[n]D	Deposit data in previously opened location	4.4.8
	nL	Load CPU address register	4.4.9
	nW	Write into switch register	4.4.10
Program execution control	C	Continue instruction execution in console state	4.4.11
	[n,]nG	Go; initiate instruction execution in program I/O state	4.4.12
	H	Halt program instruction execution	4.4.13
	I	Initialize system	4.4.14
	P	Continue instruction execution in program I/O state	4.4.15
	[n,]nS	Start instruction execution in console state	4.4.16
System maintenance	J	Set single bus cycle	4.4.17
	K	Clear single bus cycle	4.4.18
	[n]N	Cause next instruction to be executed	4.4.19
Delimiter	,	Argument separator	4.2.1

Commands may be entered in either upper or lower case (for example, A or a).

Note that the electronic console serves as a preprocessor for these commands which are executed by the CPU. The symbol [n] indicates optional data; n indicates required data.

#### 4.4.1 Command A, Display Address Information

This command is used to print a 22-bit address from the CPU address display register. The eight display positions (address sources) are shown in Figure 4-3. The address display multiplexer is initialized to position 3 (console physical) at system power-up and by entering the console state, <CTRL/P>. If an octal digit precedes the command A, that digit specifies a new address display position. Unless a new address display position is specified, the multiplexer remains at its current position. The switch position number is printed on the system terminal with the contents of the CPU address display register.

Example: If the address display is currently in its initialized position, 3, when command **A** is typed, system response includes that preselected switch position number:

```
CON= 3A00001024
```

Example: To display a user instruction address, switch position 7.

```
CON= 7A00113737
```

Command A can be issued while the CPU is running; however, the address display information is only valid if the command is issued when the CPU is halted.

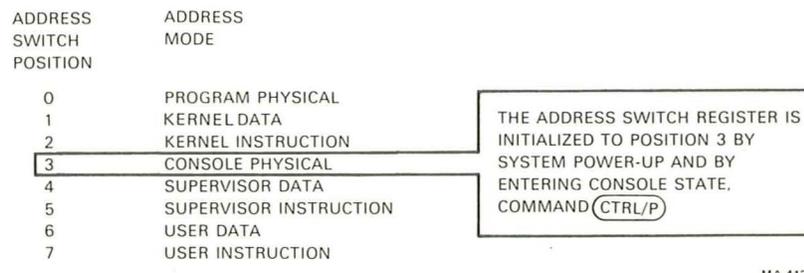


Figure 4-3 Address Display Multiplexer

#### 4.4.2 Command <CTRL/D>, Dump Memory

This command displays the contents of successive memory locations continuously. Any character typed on the keyboard terminates the dump. This command must be preceded by an octal value which defines the beginning address of the dump. This command is illegal if issued when the CPU is running.

The memory data display multiplexer is reset to position 1 (data paths) by this command; the address display multiplexer is unaffected.

Example:

```
CON= 37744 <CTRL/D> ^D <NL>
00037744/016701 000026 012702 000352
00037754/005211 105711 100376 type any character
CON=
```

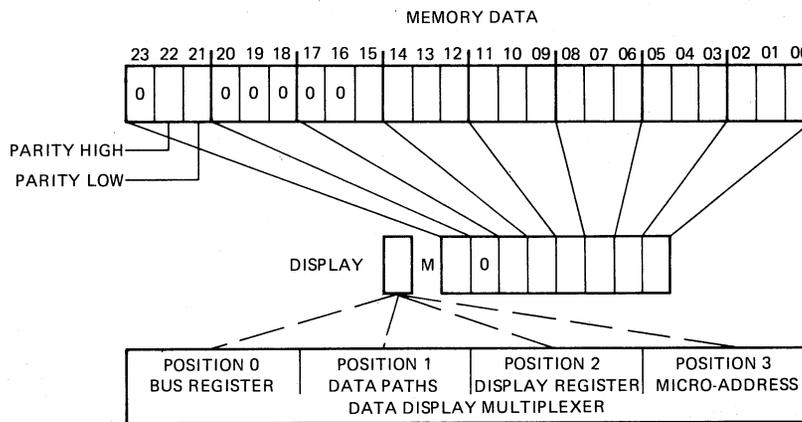
### 4.4.3 Command E, Examine Memory

This command displays the 16-bit contents of the memory location, which is referenced by the CPU address register. Command E must be preceded by a command L to open the address to be examined. Successive E commands display the contents of sequential locations.

Command E sets the memory data display multiplexer to the data paths position, 1. (See Paragraph 4.4.4.) The address display multiplexer is unaffected by command E.

### 4.4.4 Command M, Read Memory Data Display

This command displays the contents of the CPU memory data display register (Figure 4-4). The memory data display multiplexer provides access to four sources of data as shown in Diagram 4-1.



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Figure 4-4 Command M Response Format

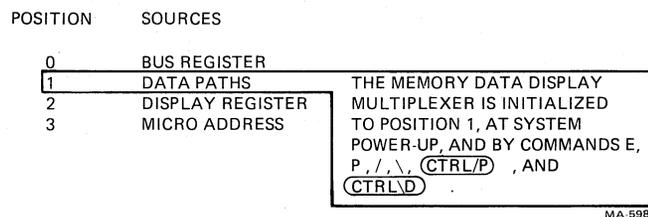


Diagram 4-1

If an octal digit precedes the command M, that digit specifies a new memory data display multiplexer position.

If no octal value precedes the command, the contents of the CPU memory data display register are printed from the currently selected multiplexer position number, which remains unchanged. The command M can be issued while the processor is running; however, the read-out will not provide useful information. The memory data display information is only valid if read when the CPU is halted.

#### 4.4.5 Command R, Read Switch Register

This command displays the current setting of the switch register. Following any command which initiates program instruction execution (C, G, P, or S), Microcode Version V02 forces a command R. This prompt reminds the operator that the switch register must be set to a predetermined, system-specific, power-fail value. The examples in Paragraph 4.4.16, and the Operator's Reference Summary (Appendix F) illustrate the command R prompt.

#### 4.4.6 Command T, Read CPU Status

This command causes processor status bits to be displayed in octal notation (Figure 4-5).

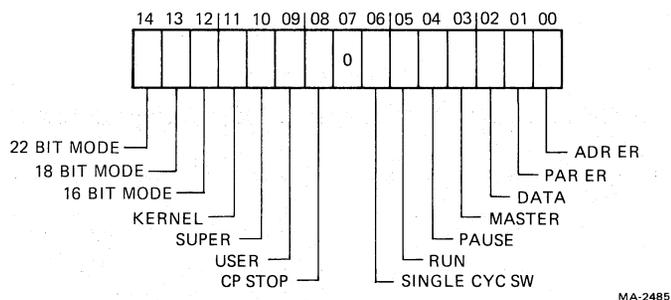


Figure 4-5 CPU Status Response Format

#### 4.4.7 Command U, Read UNIBUS Status

This command produces a display of the UNIBUS status bits in octal notation (Figure 4-6). The command U may be issued with the processor running or halted; the status displayed will always be valid if the processor is halted, but may or may not be valid if the processor is running.

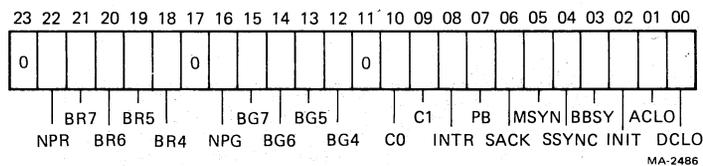


Figure 4-6 UNIBUS Response Format

#### 4.4.8 Command D, Deposit

This command causes the contents of the electronic console temporary input register to be deposited into the address referenced by the CPU address register. Successive D commands deposit new or current contents of the temporary register into sequential locations.

Command D is illegal if it is issued when the CPU is running, or if it is not preceded by a command L (unless the special mode option bit, 4, is set as described in Paragraph 4.3.2).

#### 4.4.9 Command L, Load Address

This command transfers the numerical value that precedes it from the temporary input register into the CPU address register. Command L is illegal if it is issued when the processor is running, or if the command is not preceded by octal digits. The requirement for a data argument may be overridden by setting the special mode bit (Paragraph 4.3.2). The override makes it possible to perform repetitive operations when troubleshooting load address problems.

#### 4.4.10 Command W, Write Switch Register

This command transfers the numerical value that precedes it from the temporary input register into the switch register. This command is illegal unless preceded by octal digits.

The switch register setting may be included as part of a Go or Start command string (Paragraph 4.4.12).

#### 4.4.11 Command C, Continue Program Instruction Execution

This command causes the CPU, without initialization, to resume program instruction execution at the address specified by the program counter (PC). The halt switch is cleared to permit continuous execution. Console state is retained, which disables CPU output to the system terminal. (Typically, a command Z is issued subsequently to enable CPU I/O.) This command is illegal if issued when the CPU is running. Note that command C is functionally similar to command P, except that command P sets program I/O state and clears the special mode bit in the console control register. With Microcode Version V02, command C causes a system-generated command R prompt. (See Paragraph 4.4.5.)

#### 4.4.12 Command G, Go

This command causes a system initialization and transfers the contents of the temporary input register to the program counter (PC). The halt switch is cleared and the CPU begins program instruction execution at the address specified by the PC. The switch register may be set to a new value by typing an octal value and argument separator (both optional in the command string), in addition to the address value that must precede this command. Command G is illegal if it is issued when the CPU is running, or if it is not preceded by data. The special mode bit, 4, in the console control register (Paragraph 4.3.2) is cleared by this command. Program I/O state is set, which enables CPU access to the system terminal. Note that command G is functionally similar to command S, except that command S neither clears the special mode bit nor sets program I/O state.

Example:

```
CON= 177406,17773100G <NL>  
(Terminal is under program control)
```

Set the switch register to 177406 and start program execution at 17773100. Note that Microcode Version V02 forces an R prompt (Paragraph 4.4.5) following the command G.

#### 4.4.13 Command H, Halt Program Execution

This command sets the processor to the halt state. If a program was running, the halt address followed by CPU status is printed on the system terminal.

Example:

CON= H00132564/T14410

The processor was halted by the command **H** at location 132564 and CPU status is indicated by 14410. (See Figure 4-5 for CPU status bit format.)

\*H00132564/T14410

The \* indicates that a programmed halt has occurred. A <BELL> will be system generated between the \* and the H.

If the processor is already halted when command H is issued, only the H is echoed on the system terminal.

#### 4.4.14 Command I, Initialize CPU

This command causes a system reset, which is comparable to actuating the traditional panel start switch with the halt switch on. This command is illegal if issued when the processor is running.

#### 4.4.15 Command P, Proceed

This command causes the CPU, without initialization, to resume instruction execution at the address specified by the program counter (PC). The halt switch is cleared to permit continuous execution. Program I/O state is set, which enables CPU access to the system terminal for program I/O. The special mode bit, 4, in the console control register (Paragraph 4.3.2) is cleared by command P.

This command is illegal if issued when the processor is running. Note that command P is functionally similar to command C, except that command C neither clears the special mode bit nor sets program I/O state. With Microcode Version V02, command P causes a system-generated command R prompt. (See Paragraph 4.4.5.)

#### 4.4.16 Command S, Start Program

This command causes system initialization and transfers the contents of the temporary input register to the program counter. The halt switch is cleared and the CPU begins program instruction execution at the address specified by the program counter (PC). The switch register may be set to a new value by typing an octal value and argument separator (both optional in the command string), in addition to the address value which must precede this command.

Command S is illegal if it is issued when the CPU is running, or if it is not preceded by data. Console state is maintained, which disables CPU output to the system terminal. (Typically, a command Z is issued subsequently to enable CPU I/O.) Note that command S is functionally similar to command G, except that command G clears the special mode bit in the console control register and sets program I/O state.

Example:

CON= 177406,17773100S $\Delta$ R00177406 Z <NL>

The above command string sets the switch register to 177406 and starts program execution at location 17773100 following system initialization. Microcode Version V02 prints the command R prompt as described in Paragraph 4.4.5.

The following command string starts program execution at location 17773100 without changing the switch register value. The command R prompt is forced as noted in the previous example.

```
CON= 17773100S $\Delta$ R00177406 Z <NL>
```

#### 4.4.17 Command J, Set Single Bus Cycle

This command sets the processor's single bus cycle switch to ON. The command is illegal if issued when the processor is running.

#### 4.4.18 Command K, Clear Single Bus Cycle

This command clears the processor's single bus cycle switch and allows normal operation.

#### 4.4.19 Command N, Execute Next Instruction

This command causes the CPU to execute a single cycle and then halt. (Command N is used in single instruction cycle or single bus cycle operation only.) If the single bus cycle switch is set, a single bus cycle is executed for each command N. Upon completion of the instruction or bus cycle, the contents of the CPU address display register is printed on the system terminal. The address display multiplexer may be set to a specific position by typing the position number as a prefix to the command N. This command is illegal if issued when the processor is running.

Examples:

```
CON= N00174567
```

The processor executed a single instruction and the address display contained 174567 at completion.

```
CON= N00156240  
1M20016701
```

The expand printout bit (Paragraph 4.3.2) caused the Next command to be automatically followed by a command M, display memory data.

### 4.5 MULTIPLE FUNCTION CPU COMMAND GROUP

Several of the most frequently used basic commands were combined to make this group of five multiple function CPU commands available (Table 4-4). They are useful, first, in their efficiency; fewer keystrokes are required for a given result. Second, the data display is in a much easier format to read. The commands in this group may be mixed in a command string with each other, but may not be mixed with the basic CPU commands. Appendix A.1.1 includes examples showing that syntax errors result from such mixing.

#### 4.5.1 Command / (Slash), Open a 16-Bit Word Location

This command performs a load address and examine of the 16-bit word address specified by the octal value that must precede it. This command may be modified by adding another prefix, command \$, to indicate a register examine instead (Paragraph 4.3.7). This command is illegal if issued when the CPU is running. Command / sets the memory data display multiplexer to position 1, data paths (Paragraph 4.4.4); the address display multiplexer is unaffected.

Examples:

CON= 1000/000137 <CR> (Open memory location 1000.)  
 CON=

CON= \$6/000700 @ (Perform indirect reference using contents of register 6.)  
 00000700/016701

Examples which indicate how command \$ performs when in combination with either 16-bit words or 8-bit bytes are included in Paragraph 4.5.2.

Table 4-4 Summary of Multiple Function CPU Command Group

Multiple Function Command	Equivalent Basic Commands	Description	Paragraph Reference
n/	nL E	Open a 16-bit word location	4.5.1
n\ <CR>	none [n]D	Open an 8-bit byte location	4.5.2
[n] <CR>	[n]D	Close an open location (can be used with basic commands to provide a new line, <NL>)	4.5.3
[n] <LF>	[n]D nL E	Close an open location, then open next sequential location and display its contents	4.5.4
@	[n]D nL E	Open an indirect location by using the contents of the currently open location	4.5.5

#### 4.5.2 Command \ (Backslash), Open an 8-Bit Byte Location

The command \, available only in Microcode Version V02, performs a load address and examine of the 8-bit byte at the address specified by the octal value that must precede it. Successive line feeds are used to display successive 8-bit bytes. This sequence is shown in the octal/hexadecimal comparative examples that follow. Command \ may be modified by adding another prefix, command \$, to specify that a register is to be opened (Paragraph 4.3.7). Command ` (single quote) or `` (double quote) may be used to select octal or hexadecimal display format after a location has been opened as shown in the example in Paragraph 4.3.9. When a processor register is specified (\$00 through \$17) the first byte displayed is the low-order 8-bit byte of that register.

This command is illegal if issued when the CPU is running. Command \ sets the memory data display multiplexer to position 1 (data paths) described in Paragraph 4.4.4; the address display multiplexer is unaffected.

Comparative Examples:

For these examples, assume that the three consecutive words are as shown in Illustration 4-2.

OCTAL WORD CONTENTS	HIGH-ORDER BYTE		LOW-ORDER BYTE		HIGH ORDER BYTE EQUALS	LOW ORDER BYTE EQUALS		
041101	0	1 0 0	0 0 1	0 0 1	0 0 0	0 0 1	B 102	A 101
042103	0	1 0 0	0 1 0	0 0 1	0 0 0	0 1 1	D 104	C 103
043105	0	1 0 0	0 1 1	0 0 1	0 0 0	1 0 1	F 106	E 105

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Illustration 4-2

Use of commands / and \ with command \$ to access processor registers:

16-Bit (/)

```
CON= $0/041101 <LF>
17777701/042103 <LF>
17777702/043105
```

8-Bit (\)

```
CON= $0\101 <LF>
17777700H\102 <LF>
17777701L\103 <LF>
17777701H\104
```

(Note that H or L address suffix indicates that byte is low-order or high-order.)

Use of commands / and \ to access memory data:

16-Bit (/)

```
CON= 1000/041101 <LF>
00001002/042103 <LF>
00001004/043105
```

8-Bit (\)

```
CON= 1000\101 <LF>
0000100\102 <LF>
00001002\103 <LF>
00001003\104
```

The previous examples include six-digit octal displays which represent two ASCII characters packed into a 16-bit word. The binary contents of the high-order bytes are not readily apparent in the octal displays. Further explanation and a translation table are provided in Appendix D, ASCII Character Set.

#### 4.5.3 Command <CR>, Close Location

This command closes a previously opened location. It is recognized by the electronic console for closing a location only if the location was opened with command @, /, or <LF> (multiple function commands). Any data argument typed while the location is open is deposited in that location before it is closed. This command is always echoed as <NL> (<CR> <LF>) and may be used at any time to provide a new line.

Examples:

```
CON= 1002/000137 240 <CR> <NL> 240 (NOP) is deposited in location 1002.  
CON=  
CON= 1002/000137 <CR> <NL> Location 1002 is opened and closed without  
depositing data. If no data is typed, no data is deposited. Note the Microcode Version V01  
precaution concerning Delete in Paragraph 4.3.10.
```

#### 4.5.4 Command <LF>, Open Sequential Location

When a location has been opened, this command causes any octal value typed to be deposited in that location, closes the location, opens the next sequential location, and prints the new address and its contents. This command is illegal if the location was not opened by a command @, /, or a previous command <LF>.

Example:

```
CON= 1000/000137 <LF>  
00001002/002000 <LF>  
00001004/012706
```

#### 4.5.5 Command @, Open Indirect Location

The command @ may be used only after a 16-bit word location is opened by a command /. The contents of the currently open location are used as the address of the next location to be opened. When a location is open and octal data is typed, command @ causes the data to be deposited in the current location before being used as the address of the next location to be opened. Microcode Versions V01 and V02 do not respond identically to the command @ when an I/O page address is specified.

Example: (Microcode Version V01)

```
CON= 1012/002000 @  
00002000/177742 @  
1777742/004010
```

In this example bits 13, 14, and 15 of the contents of location 2000 are ones. As a result, in CPU instruction execution or electronic console command response, bits 16 through 21 are masked with ones and I/O page address 1777742 is referenced. This is consistent with the way locations are referenced by the CPU when the I/O page is specified.

Example: (Microcode Version V02)

```
CON= 1012/002000 @  
00002000/177742 @  
00177742/102742
```

Since Microcode Version V01 does not sense the status of bits 13, 14, and 15, and no masking of bits 16 through 21 is provided, the referenced address is 00177742, not the expected I/O page address 1777742.

To examine the CPU instruction execution path, you must use the following sequence of electronic console commands instead:

```
CON= 1021/002000 @  
00002000/177742 <CR>  
CON= 1777742/004010
```

#### 4.6 SYSTEM PROGRAMMING CONSIDERATIONS

System programming is unaffected by installation of an electronic console with only two exceptions. The electronic console logic includes two peripheral devices that appear on the system's UNIBUS. One of these replaces the DL11-A serial line interface which is removed when the electronic console is installed on a system. The second device is the equivalent of a KW11-L line clock. This may be used, optionally, to replace a similar, pre-existing device on the system. Jumper W3 on the M8255 microprocessor module, if left in place, disables the M8255 clock and allows the existing system clock to continue to provide that function.

##### 4.6.1 DL11-A

As described in the *DL11-A Technical Manual* (EK-DL11-TM), the DL11-A contains four registers which are addressed on the UNIBUS:

Receiver Status Register	17777560
Receiver Data Buffer	17777562
Transmitter Status Register	17777564
Transmitter Data Buffer	17777566

A receiver interrupt causes the interrupt PC and PSW to be from locations 60 and 62 respectively. A transmitter interrupt causes the interrupt PC and PSW to be from locations 64 and 66 respectively.

The operation of the DL11-A equivalent\* electronic console option is identical to the actual DL11-A option. Three additional status bits appear in the transmitter status register (17777564) if switch five on DIP switch E19 on the 54-12781 multiplexer module is set to the OFF position. (This switch is normally ON if an LA36 is used as the system console terminal.) These bits are:

- Bit 5 Remote active is set to one if the keyswitch is in REMOTE or REMOTE DISABLE.
- Bit 4 Console state is set to one when the electronic console is in console or talk state.
- Bit 3 Console present is always one.

---

\* The electronic console provides DL11-A equivalent logic when used with DIGITAL terminals; VT100 must be operated at a transmission baud rate of 1200 or less.

### CAUTION

**Since bit state is determined by electronic console operation, programming that assumes the presence of a DL11-A option may behave unpredictably with the DL11-A equivalent in the electronic console.**

#### 4.6.2 KW11-L

The KW11-L equivalent option in the electronic console operates exactly as the KW11-L option described in the *KW11-L Technical Manual* (EK-KW11L-TM). Its control and status register is fixed at location 17777546, and a line clock interrupt causes the interrupt PC and PSW to be from locations 100 and 102 respectively. Because the KW11-L option is normally present as a system option, the KW11-L logic within the electronic console is usually disabled. This is accomplished by leaving M8255 jumper W3 in place. If the KW11-L option is not present, jumper W3 may be removed to enable equivalent logic.

## **CHAPTER 5 HARDWARE FAILURE PROCEDURES**

### **5.1 SCOPE**

This chapter provides procedures for reporting either suspected or confirmed system malfunctions to the Service Response Group (SRG) in the DIGITAL Diagnostic Center (DDC). When you call the DDC to report a hardware failure, they will begin diagnostic testing within minutes. DIGITAL's remote diagnosis services are dedicated to getting your system back on-line in the shortest possible time.

Figure 5-1 is a concise hardware failure reporting procedure, suitable for posting near the telephone that will be used to call the DDC. Sheet 1 of 3 summarizes the entire reporting and repair process and indicates that "the DDC will" guide the user through each step. Sheets 2 of 3 and 3 of 3, and the remainder of this chapter, provide general procedural information for the user who may observe, or be involved in, remote diagnostic testing.

# TO REQUEST REPAIR SERVICE CALL

THE DDC TELEPHONE NUMBER

## THE DIGITAL DIAGNOSIS CENTER

provides remote diagnosis service  
24 hours a day, 7 days a week

You should report all types of hardware failure:

Processor or Peripheral  
Identified or Suspected  
Hard or Intermittent

### WHEN YOU CALL:

- 1** The DDC will ask you to identify:
  - Yourself
  - Your company
  - The site address
  - The system type and serial number
  - A phone number where you can be reached
  
- 2** The DDC will ask you about the problem:
  - What symptoms were (or are) present?
  - What error messages were printed on the terminal?
  
- 3** The DDC will tell you:
  - How to prepare the system for remote diagnosis.
  
- 4** The DDC will:
  - Begin the appropriate test procedure almost immediately.
  - Notify the local DIGITAL office that your system is under test.
  
- 5** The DDC will inform you of test results.
  - The local DIGITAL office will complete the repair on-site.
  - The DDC will verify that the system has been restored to normal operation.

Figure 5-1 Remote Diagnosis Hardware Failure Reporting Procedure  
(Sheet 1 of 3)

Although the DDC will guide you through the various testing procedures, the following descriptions of typical sequences may be helpful.

● **IF THE CONSOLE FAULT INDICATOR IS LIGHTED**

The failure is within the remote diagnosis hardware.  
Remote test procedures are not applicable.  
On-site repair service will be scheduled.

● **THE DDC MAY REMIND YOU THAT:**

It is possible for an operating system to run normally and be unaffected by a lighted FAULT indicator.  
If the failure was transient, a power-down/power-up sequence may clear the FAULT indicator.

● **WHEN MAINTENANCE DIAGNOSTICS ARE TO BE RUN BY THE DDC:**

The DDC may ask you to:  
Dismount operating system media.  
Mount scratch media on designated devices.  
Mount DDC diagnostic volume on designated device.  
Ensure modem or DAA "NORMAL" operation is selected.  
Turn keyswitch to REMOTE position which will give DDC control of the system.  
The DDC will connect its host computer and begin testing.  
The CARRIER and TEST indicators will be turned on (and may be turned off and on at intervals). The REMOTE position of the keyswitch should not be changed until requested by the DDC.  
The DDC may "talk" to you at the system terminal.  
If the failure is intermittent, extended monitoring may be necessary to resolve the problem.  
After testing, the local DIGITAL office will complete the repair

If DDC diagnostic testing produces indeterminate results, they may request access to the operating system for on-line problem analysis.

● **WHEN DDC ACCESS TO THE OPERATING SYSTEM IS PERMITTED:**

The DDC may ask you to:  
Mount operating system media  
Boot the system  
Turn the keyswitch to the REMOTE DISABLE position; the DDC may ask that the REMOTE position be selected to permit them to do crash dumps and other operating system related data testing.  
Provide DDC with an account number and password  
The DDC will log-in and begin testing.  
The CARRIER and TEST indicators will be turned on (and may be turned off and on at intervals). The keyswitch position should not be changed until requested by DDC.  
The system terminal will echo DDC/CPU dialogue.  
The system terminal keyboard may be disabled.  
The DDC may "talk" to you at the system terminal.  
After testing, the local DIGITAL office will complete the repair.

Figure 5-1 Remote Diagnosis Hardware Failure Reporting Procedure  
(Sheet 2 of 3)

- **PREVENTIVE MAINTENANCE**

Preventive maintenance diagnostic sessions which will include DDC testing (also extended monitoring for intermittent failure) will be scheduled by the local DIGITAL office subject to constraints imposed by customer requirements.

- **DIGITAL SUPPLIED DAA s AND MODEM s**

The remote diagnosis hardware may include a DIGITAL supplied DAA or MODEM. The direct connection of these devices to a dedicated telephone line is regulated by the FCC (in the U.S.A.) or similar governmental authority.

**THE CUSTOMER IS ULTIMATELY RESPONSIBLE  
FOR COMPLIANCE WITH APPLICABLE REGULATIONS**

DIGITAL-supplied DAA s or MODEM s which fail are usually exchanged, not field repaired. Only the manufacturer or authorized agents may repair such equipment. Site personnel are responsible to ensure that the telephone company is notified when an exchange involves units which are electrically different and/or have differing FCC registration numbers.

- **FOR ADDITIONAL INFORMATION, SEE:**

The DDC section of the Site Management Guide  
KY11-R USER GUIDE, EK-KY11R-UG  
OPERATOR'S REFERENCE SUMMARY, EK-KY11R-UG, Appendix F

Figure 5-1 Remote Diagnosis Hardware Failure Reporting Procedure  
(Sheet 3 of 3)

## 5.2 ELECTRONIC CONSOLE MALFUNCTION (FAULT CONDITION)

Lighting of FAULT indicates that the electronic console has detected an error. This may occur either during the self-test initiated at power-up or at any time during normal system operation. If the failure occurs while a program is running, the program may or may not continue running normally.

When there is a failure indication, proceed as follows.

1. It is possible for a transient problem to cause a failure indication. To determine if FAULT can be cleared, you must do a power-down/power-up sequence.

### CAUTION

**Before proceeding, determine the operating state of the system and consider the consequences of such action. If the system is running normally, it may continue to do so even with FAULT lighted.**

Turn the keyswitch to OFF; all indicators will go out.

2. Turn the keyswitch to any on position (such as LOCAL); if FAULT turns on momentarily, then turns off, the malfunction has cleared and normal system operation may continue. Any indication of transient failure should be reported to the DDC so preventive maintenance testing may be scheduled if necessary.
3. If, however, FAULT lights and remains lighted, you should contact the DDC for fault analysis.
4. Within the U.S.A. but outside Colorado, dial 1-800-525-6570. Within Colorado, dial 1-800-332-7189.

Customers in Canada are requested to contact the DDC by using the procedure provided by their local DIGITAL office. In other countries, the telephone arrangements are subject to various governmental regulations and the specific procedure is detailed in the Operator's Reference Summary (Appendix F).

Provide the following information.

- Customer name (company)
  - Caller's name and phone number
  - Address and location of system
  - System type and serial number
  - Description of problem
  - Device and device number on which the diagnostic tape or disk is mounted
5. The DDC will log your call into the cumulative maintenance records for your system and then notify the appropriate local DIGITAL branch service office that a service call must be scheduled to perform corrective maintenance on the system.

### 5.3 SYSTEM MALFUNCTION (HARDWARE, HARD FAILURE)

A hard failure is an error that occurs repeatedly and cannot be cleared. If this type of failure is present, perform the following procedure.

1. If possible, determine which option or device has failed.
2. Contact the DDC.
3. The DDC will determine if remedial diagnostic testing is applicable. If it is not, they will contact the appropriate local DIGITAL branch service office, which will then schedule a service call to perform the required corrective maintenance. If, however, diagnostic testing is applicable, the DDC will probably ask you to:

- a. Remove all system software media from the system.
- b. Mount scratch media for all options or devices to be tested. In certain system crashes (such as CPU hung), the DDC may request that only the system disk media be write locked and a snapshot of the CPU and peripherals be taken.
- c. Load the system-specific DDC diagnostic volume (remote diagnosis package) on the appropriate device.
- d. If the installation uses a telephone company installed Data Access Arrangement (DAA) that includes a handset, ensure that the handset is properly cradled in the hook. Also, ensure that the DAA test switch is in the normal (not test) operating position.

If, however, the installation uses a DIGITAL-supplied DAA or stand-alone external modem, you need only ensure that switches are in their normal operating (not test) positions. The DDC always initiates the call that connects the site system with the DDC host computer.

- e. Turn the electronic console keyswitch to REMOTE; the REMOTE indicator will light.
- f. The DDC will perform diagnostic testing in an attempt to duplicate and isolate system failures. The local DIGITAL branch service office will have been alerted by the DDC that the system is being tested. During this testing, the DDC has complete control of the system. The DDC has access to console, program I/O, and talk states. The remote operator can boot the system, perform I/O functions, and, in the talk state, print information for, or solicit information from the site operator at the system terminal.
- g. When the DDC host computer is connected to the site system, CARRIER will be turned on. While diagnostic testing is in progress, TEST will be turned on.
- h. During the diagnostic testing period, CARRIER may be observed turning off and on. This is a normal condition, and no local action should be taken. The DDC may, for example, start a diagnostic running, disconnect during the testing period (which will turn off CARRIER), and then reconnect to evaluate the results and continue the session.

- i. If it becomes necessary to have user response to DDC queries, or local system operation to duplicate a failure condition, the DDC will notify the site operator by telephone to monitor the system terminal for instructions.
- j. After completion of the tests, the DDC host computer will be disconnected, and TEST and CARRIER will be turned off.
- k. The DDC will notify the local office of their determination of the problem and advise what remedial action should be taken.
- l. The local branch office will contact the customer and schedule corrective action as required.

#### **5.4 SYSTEM MALFUNCTION (INTERMITTENT OR SOFTWARE FAILURE)**

Although the procedure described in Paragraph 5.3 usually resolves intermittent hardware failures, they may not be exercised or detected by diagnostics. Also, system software may aggravate marginal hardware components or may itself cause ambiguous error symptoms. Generally, these problems are very difficult to duplicate and/or define.

Upon completion of diagnostic testing, it may be determined that the reported system fault is an intermittent or operating system related problem. Software specialists are available either at the DDC or other DIGITAL facilities to support the DDC. Depending upon the system software and the expertise available within DDC, a team effort may be applied in an attempt to duplicate the problem. Any procedure to isolate system failures by using the operating system is attempted only with the customer's authorization. If this action is to be taken the DDC will probably ask you to:

1. Turn the electronic console keyswitch to LOCAL.
2. Unload scratch media and install system-operating software media.
3. Boot the system as outlined in Paragraph 3.2 and the Operator's Reference Summary (Appendix F).
4. Turn the keyswitch to REMOTE DISABLE. The REMOTE and DISABLE indicators will light.
5. Notify the DDC that the system is ready for testing.
6. Supply the DDC with an operating system account number and password.
7. The DDC will log onto the system; CARRIER will turn on when the connection is made. TEST will remain off if the microcode version is V01; however, in V02, TEST will be on when testing is in progress.
8. With the keyswitch in REMOTE DISABLE and the system software running, the system terminal will log commands and messages received and transmitted by the DDC. The system terminal keyboard will be disabled to prevent operator intervention.

9. The DDC will give the local branch office a description of the problem and tell them whether or not the DDC was able to isolate the failure. The local branch office will schedule corrective action if required.
10. The branch office will determine (in all cases) the course of action to be followed in resolving customer requests for service.

## APPENDIX A CONSOLE AND ERROR MESSAGES

### A.1 ERROR MESSAGES

The messages described in this section are system-generated as a result of incorrectly entered commands, or faults detected by the logic.

#### A.1.1 ?SYN ER , Syntax Error

This error message is generated whenever the electronic console detects any command that does not conform to the required format.

```
[[<OPTIONAL VALUE><SEPARATOR>]<ARGUMENT>]<COMMAND>[<RESPONSE>]<ACKNOWLEDGEMENT>
```

Paragraph 4.2 describes this format in greater detail.

The syntax error message also results from an attempt to mix commands from the multiple function command group with basic CPU commands.

Example:            Attempted use of the basic command D to deposit data into a location opened by a command / (slash) – from the multiple function CPU command group – causes a syntax error message.

```
CON= 1000/041101 041102D
?SYN ER
CON=
```

Example:            If a location has been opened and examined by the basic commands L and E, an attempt to open the next sequential address using the command <LF> (from the multiple function CPU command group) causes a syntax error message.

```
CON= 1000L ΔE041101 <LF>
?SYN ER
CON=
```

#### A.1.2 ?RUN ER , Illegal (If CPU Is Running) Command Error

Certain CPU commands are illegal if issued when the processor is in the run state. The console echoes the illegal command and prints an error message. This applies to the following commands.

Commands	Command Category
<CTRL/D> , L, /, \	Load address
C, G, P, S	Start or continue instruction execution
D	Deposit data
I	Initialize system
V	Electronic console self-test

### A.1.3 ?ER/T14411, Memory Reference Error

Any command that references memory may result in an address or parity error. The illegal command is terminated immediately, and an error message which includes CPU status is printed. The two low-order bits of the CPU status response define whether address or parity error (or both) have occurred (Figure 4-5).

CON= 17777200/?ER/T14411 Attempt to reference nonexistent memory.

### A.1.4 ?CON ER, Console Logic Fault

FAULT is turned on whenever the electronic console detects an internal error condition. If the logic required to do so remains operative, the ?CON ER message will be printed on the terminal. The console performs error checking on internal bus activity continuously, and a self-check routine is invoked at power-on or by command V. A fault may be detected at power-on when all indicators, except CARRIER (but including FAULT), are on at the same time. If the logic by which the indicators are turned off is inoperative, they may all remain on.

### A.1.5 + , Serial Line Error

This error message is generated when the electronic console detects a bit format error in the serial line logic. A loose connection or typing too fast are typical causes of this error condition.

## A.2 CONSOLE MESSAGES

The messages described in the following paragraphs display electronic console or CPU status and/or test results.

### A.2.1 # , CPU Response Time-out

A CPU command typed at the system terminal is processed through the electronic console to the CPU. The CPU response is processed through the electronic console back to the terminal. If, after forwarding a command to the CPU, the electronic console does not receive a CPU response within the maximum 100 msec allowed, it will abort the command and print the # symbol followed by the CON= prompt.

For example, if the single bus cycle switch is on and a CPU command such as load address is issued, the time-out symbol will be printed. The operator would clear the single bus cycle switch by typing a command K, then reissue the command that failed.

Example:

```
CON= 200L#
CON=
```

### **A.2.2 \*H , Programmed Halt**

If the CPU executes a programmed halt, the console prints a halt message including a <BELL>, the halt address, and the CPU status. The serial line multiplexer is left in the state it was in prior to the halt (console or program I/O). A programmed halt message is printed with an asterisk (\*) prefix to distinguish it from an electronic console command H (halt). See Paragraph 4.4.13.

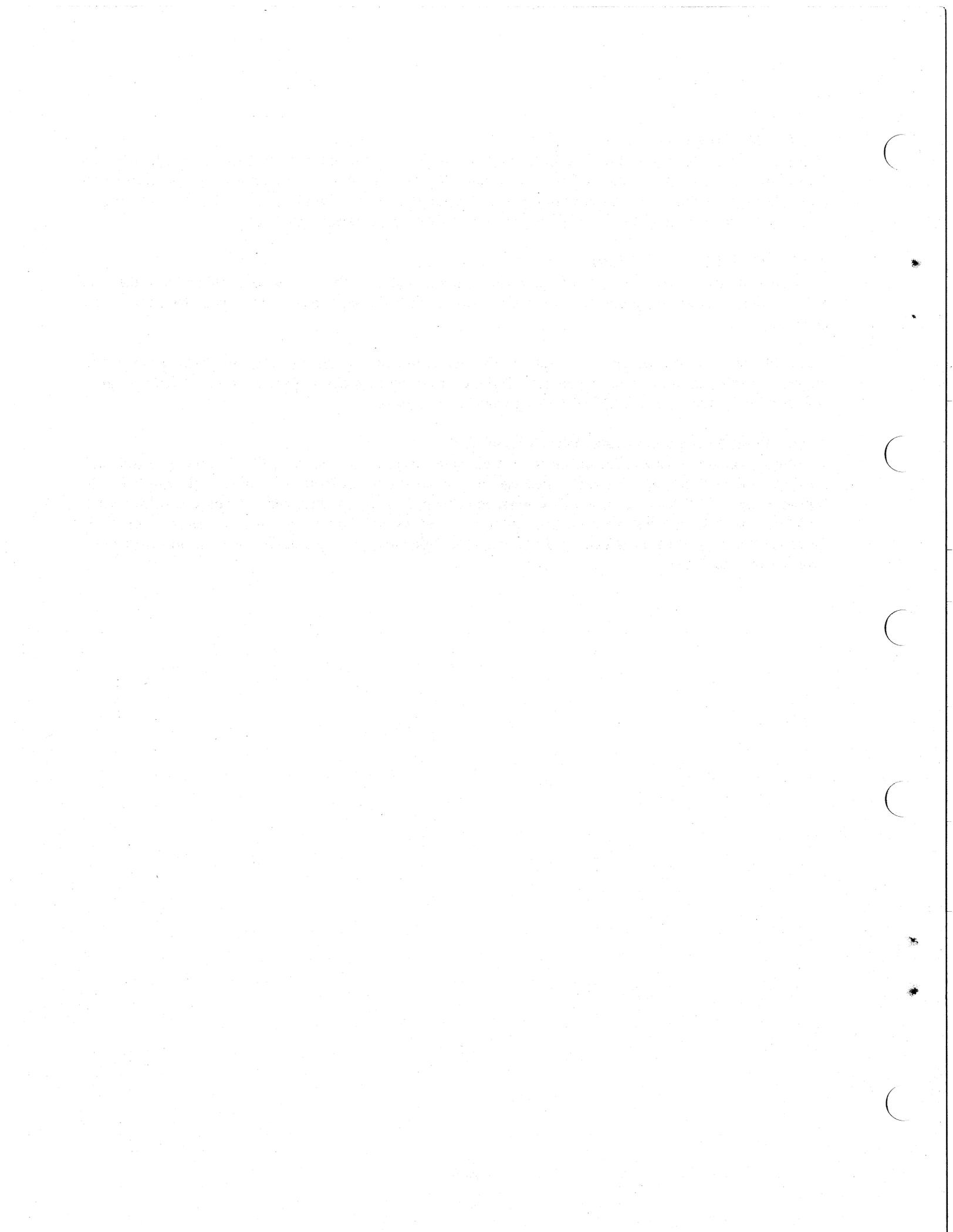
### **A.2.3 ?CAR ER , Carrier Lost**

Upon detection of carrier lost, the console will print a message on the system terminal and initialize the remote line protocol in preparation for reconnection. This message may be incidental to a DDC test session.

The DDC may initiate a diagnostic session, disconnect during the period of testing, then reconnect to evaluate results and continue the session. If the carrier lost message is printed, and CARRIER goes off, but TEST stays on, the DDC is using that test procedure.

### **A.2.4 V000377 Successful Completion of Self-Test**

During power-up initialization the electronic console forces a command V, which initiates a self-test. As described in Paragraph 3.2.2, the message indicates either successful or unsuccessful completion of segments of the self-test routine. If this message is printed with any bit error indicating a failure (such as V001377), FAULT will also be on. An unsolicited V000377 message on the system terminal is evidence that a power failure occurred; the message indicates that a successful self-test occurred when power came back on.

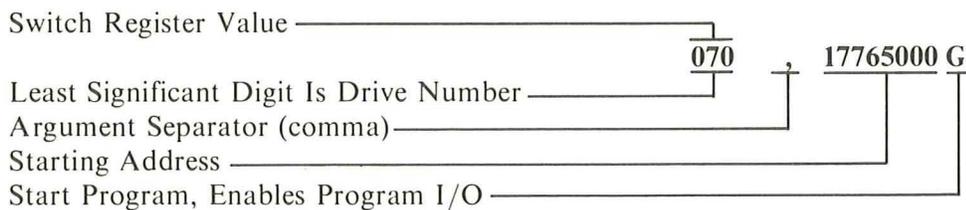


## APPENDIX B BOOTSTRAP PROCEDURES

System-specific bootstrap details are provided in the Operator's Reference Summary (Appendix F).

### B.1 M9301 BOOTSTRAP

1. Type **<CTRL/P> H** to enter console state and halt whatever program may be running.
2. From Table B-1, determine the appropriate command string for the device on which the source medium is loaded. Enter the command string, using the example below as a guide. (The example assumes RP04, drive 0.)



```

<CTRL/P> ^ P <BELL>
CON= H00153304/T14410 70,17765000G R00000070 <NL>
RSTU V06B 02 BUBU (DB0)

```

The R prompt (read switch register, Microcode Version V02 only) is printed to remind the operator that the switch register must now be set to the predetermined value which the CPU expects in a power-fail (power-going-down) situation (in this example, all ones).

3. Type **<CTRL/P>** to enter the console state.
4. Type **17777777W**, which will write all ones to the switch register.
5. As a verification that the entry was made correctly, type the command **R**, which results in a printout of the switch register setting.
6. Type the command **Z**, which selects the program I/O state and returns the terminal to program control.

```

<CTRL/P> ^ P <BELL>
CON= 17777777W Δ R17777777 Z <NL>
(Output, if any, is under program control.)

```

Table B-1 M9301 Command String Definition

M9301 Variant	Device	Command String			Go
		Switch Register Setting*	Separator	Starting Address	
-YC	TM11	010	,	17765000	G
-YC	TC11	020	,	17765000	G
-YC	RK05	030	,	17765000	G
-YC	RP02, RP03	040	,	17765000	G
-YH	RK06, RK07	050	,	17765000	G
-YC	TU16	060	,	17765000	G
-YC	RP04, 05, 06, RM03	070	,	17765000	G
-YC	RS04	100	,	17765000	G
-YC	RX01	110	,	17765000	G
-YH	PC11	120	,	17765000	G

\* Note that the least significant digit of the switch register setting is the drive number.

## B.2 BM873 AND MR11-DB BOOTSTRAPS

Table B-2 provides BM873-YA, BM873-YB, and MR11-DB bootstrap command string definitions. The switch register value is (except in four instances) assumed to be zero and is not required in the command string. In those four instances (when the drive number is other than zero), the drive number must be entered as the switch register value.

Table B-2 BM873 and MR11-DB Command String Definition

Device	BM873-YA	BM873-YB		MR11-DB
	Starting Address	Switch Register Setting (Drive Number)	Separator	Starting Address (M792-YD) (M792-YE)
KL11	773210 G	0 assumed		773510 G
PC11	773312 G	0 assumed		773620 G
RC11	773144 G	0 assumed		773212 G
RF11	773000 G	0 assumed		773136 G
RK11	773010 G	0 assumed		773030 G
RK11	-	1 through 7	,	773032 G
RP11	773100 G	0 assumed		773350 G
RP11	-	1 through 7	,	773352 G
RS04	-	0 assumed		773000 G
RS04	-	1 through 7	,	773002 G
TA11	773230 G	0 assumed		773524 G
TA11	-	1 through 7	,	773526 G
TC11	773030 G	0 assumed		773070 G
TM11	773050 G	0 assumed		773110 G
TI16	-	0 assumed		773150 G

Command String Example 1:

Assume KL11 and BM873-YA bootstrap.  
**<CTRL/P>** ^ P <BELL>  
 CON= **773210G** <NL>  
 RSTS V06B 02 BUBU (DK)

Command String Example 2:

Assume RK11, BM873-YB, and drive 4.  
<CTRL/P> ^P <BELL>  
CON= 4,773032G <NL>  
RSTS V06B 02 BUBU (DK0)

### **B.3 M9312 BOOTSTRAP**

System-specific M9312 bootstrap details are provided by the Operator's Reference Summary (Appendix F) when appropriate. The *M9312 Technical Manual* (EK-M9312-TM) provides M9312 ROM configuration details which are beyond the scope of this appendix.



## APPENDIX C SPECIFICATIONS

### C.1 SCOPE

The following are electrical and environmental specifications for the KY11-R option. These specifications and particulars are for informational purposes only and are subject to change without notice.

Power Requirements	Typical Current (Amperes, dc)	Nominal Voltage (Volts, dc)
M8255 controller module	2.30	+ 5.0
	0.20	+15.0
	0.11	-15.0
54-12781 console interface	2.35	+ 5.0
	0.06	+15.0
	0.075	-15.0
54-12498 modem (KY11-R and KY11-RC only)	0.06	+ 5.0
	0.03	+15.0
	0.03	-15.0
Total current of above items	4.710	+ 5.0
	0.290	+15.0
	0.215	-15.0
UNIBUS loading	The KY11-R presents one dc bus load.	

### Environmental Characteristics

Temperature	Operating: 10 to 40° C (50 to 104° F). Nonoperating: -40 to 66° C (-40 to 151° F).
Humidity	Operating and nonoperating: 10 to 95 percent, maximum wet bulb, 28° C (82° F) and minimum dew point 2° C (36° F).



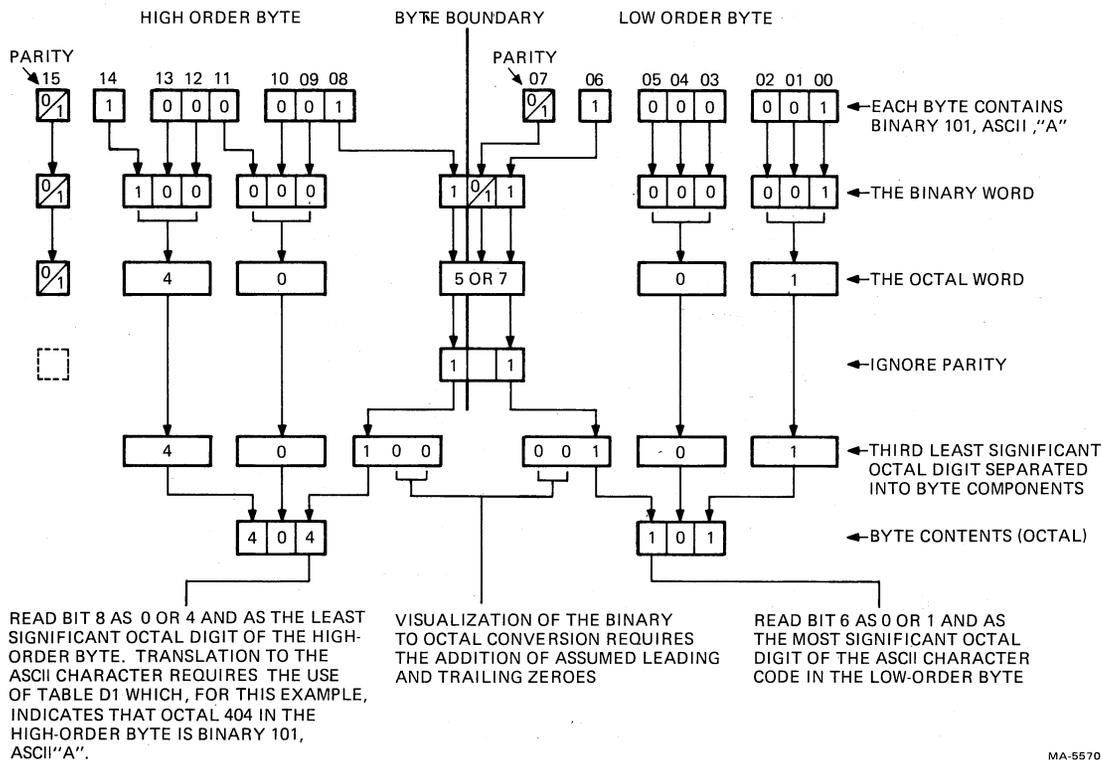
## APPENDIX D ASCII CHARACTER SET

### D.1 OCTAL DISPLAY TO ASCII TRANSLATION

An ASCII character code (seven bits without parity or eight bits including parity) can be packed in either the low-order or high-order byte of a 16-bit word. *No* unusual handling is required by hardware or software in depositing or retrieving any character code to or from either byte.

There *is* an unusual problem, however, when you attempt to identify the two ASCII codes within a word from an octal display.

As shown in Figure D-1, the byte boundary intersects the group of three binary bits which are read as the third least significant octal digit. As a result, that digit must be (at least mentally) translated back into binary and the bits assigned to the appropriate byte. It is then possible to read the low-order byte contents directly as an ASCII code. The high-order byte contents present a more complex problem which requires both binary bit manipulation and a translation table.



MA-5570

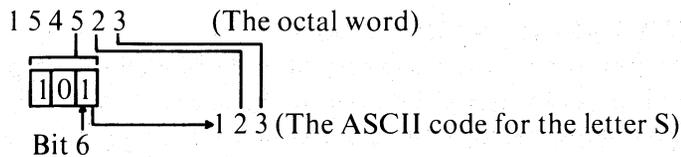
Figure D-1 Octal Display to ASCII Translation

Table D-1 provides both the ASCII character set codes and their corresponding translation to or from the high-order byte.

Given a six-digit octal word which represents two packed ASCII character codes:

1. Convert the third least significant octal digit to binary.
2. Read the least significant binary bit (bit 6) as a 0 or 1 and as the first octal digit (0 or 1) of the low-order byte ASCII character code.

Example:



3. Read the most significant binary bit (bit 8) as a 0 or 4 and as the last octal digit (0 or 4) of the high-order byte octal contents. Note that the first digit of the octal word is parity (binary bit 15), which is ignored.

Example:

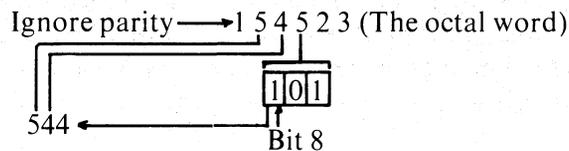


Table D-1 indicates that 544 octal, read from the high-order byte, translates to ASCII character code 131, the letter Y.

Table D-1 ASCII Character Set

ASCII Character Code	High-Order Byte Equivalent	Hexadecimal	Decimal	Character
000	000	00	000	NUL
001	004	01	001	SOH (^ A)
002	010	02	002	STX (^ B)
003	014	03	003	ETX (^ C)
004	020	04	004	EOT (^ D)
005	024	05	005	ENQ (^ E)
006	030	06	006	ACK (^ F)
007	034	07	007	BEL (^ G)
010	040	08	008	BS
011	044	09	009	HT
012	050	0A	010	LF
013	054	0B	011	VT (^ K)
014	060	0C	012	FF (^ L)
015	064	0D	013	CR
016	070	0E	014	SO (^ N)
017	074	0F	015	SI (^ O)

Table D-1 ASCII Character Set (Cont)

ASCII Character Code	High-Order Byte Equivalent	Hexadecimal	Decimal	Character
020	100	10	016	DLE (^ P)
021	104	11	017	DC1 (^ Q)
022	110	12	018	DC2 (^ R)
023	114	13	019	DC3 (^ S)
024	120	14	020	DC4 (^ T)
025	124	15	021	NAK (^ U)
026	130	16	022	SYN (^ V)
027	134	17	023	ETB (^ W)
030	140	18	024	CAN (^ X)
031	144	19	025	EM (^ Y)
032	150	1A	026	SUB (^ Z)
033	154	1B	027	ESC
034	160	1C	028	FS (^ \)
035	164	1D	029	GS
036	170	1E	030	RS
037	174	1F	031	US
040	200	20	032	SP
041	204	21	033	!
042	210	22	034	"
043	214	23	035	#
044	220	24	036	\$
045	224	25	037	%
046	230	26	038	&
047	234	27	039	'
050	240	28	040	(
051	244	29	041	)
052	250	2A	042	*
053	254	2B	043	+
054	260	2C	044	,
055	264	2D	045	-
056	270	2E	046	.
057	274	2F	047	/
060	300	30	048	0
061	304	31	049	1
062	310	32	050	2
063	314	33	051	3
064	320	34	052	4
065	324	35	053	5
066	330	36	054	6
067	334	37	055	7
070	340	38	056	8
071	344	39	057	9
072	350	3A	058	:
073	354	3B	059	;
074	360	3C	060	<
075	364	3D	061	=
076	370	3E	062	>
077	374	3F	063	?

Table D-1 ASCII Character Set (Cont)

ASCII Character Code	High-Order Byte Equivalent	Hexadecimal	Decimal	Character
100	400	40	064	@
101	404	41	065	A
102	410	42	066	B
103	414	43	067	C
104	420	44	068	D
105	424	45	069	E
106	430	46	070	F
107	434	47	071	G
110	440	48	072	H
111	444	49	073	I
112	450	4A	074	J
113	454	4B	075	K
114	460	4C	076	L
115	464	4D	077	M
116	470	4E	078	N
117	474	4F	079	O
120	500	50	080	P
121	504	51	081	Q
122	510	52	082	R
123	514	53	083	S
124	520	54	084	T
125	524	55	085	U
126	530	56	086	V
127	534	57	087	W
130	540	58	088	X
131	544	59	089	Y
132	550	5A	090	Z
133	554	5B	091	[
134	560	5C	092	\
135	564	5D	093	]
136	570	5E	094	^
137	574	5F	095	_
140	600	60	096	'
141	604	61	097	a
142	610	62	098	b
143	614	63	099	c
144	620	64	100	d
145	624	65	101	e
146	630	66	102	f
147	634	67	103	g
150	640	68	104	h
151	644	69	105	i
152	650	6A	106	j
153	654	6B	107	k
154	660	6C	108	l
155	664	6D	109	m
156	670	6E	110	n
157	674	6F	111	o

Table D-1 ASCII Character Set (Cont)

ASCII Character Code	High-Order Byte Equivalent	Hexadecimal	Decimal	Character
160	700	70	112	p
161	704	71	113	q
162	710	72	114	r
163	714	73	115	s
164	720	74	116	t
165	724	75	117	u
166	730	76	118	v
167	734	77	119	w
170	740	78	120	x
171	744	79	121	y
172	750	7A	122	z
173	754	7B	123	{
174	760	7C	124	
175	764	7D	125	}
176	770	7E	126	~
177	774	7F	127	DEL (RUBOUT)



## APPENDIX E MICROCODE DIFFERENCES

Microcode Version V02 was introduced at CS revision H of the M8255 microprocessor module. The functional differences between Microcode Versions V01 and V02 are noted throughout this manual. Table E-1 itemizes those features in which differences exist and indicates the operational consequences in summary form. The table includes references to the paragraphs of this manual in which the feature is discussed in depth.

**Table E-1 Microcode Version V01/V02 Differences**

Item	Differences	
POWER Indicator  See Paragraph 2.5	V01	On indicates that power is on.
	V02	<ul style="list-style-type: none"> <li>• On indicates that power is on and program is running.</li> <li>• Blinking indicates that power is on and program has halted.</li> </ul>
DISABLE Indicator  See Paragraph 2.6	V01	On indicates that keyswitch is in LOCAL DISABLE or REMOTE DISABLE.
	V02	<ul style="list-style-type: none"> <li>• On indicates that keyswitch is in LOCAL DISABLE or REMOTE DISABLE and program is running.</li> <li>• Blinking indicates that keyswitch is in LOCAL DISABLE or REMOTE DISABLE and program has halted.</li> </ul>
TEST Indicator  See Paragraph 2.9	V01	<ul style="list-style-type: none"> <li>• On indicates that DDC is testing.</li> <li>• Disabled in REMOTE DISABLE.</li> </ul>
	V02	On indicates that DDC is testing.
Logic Verification Message (following error detection)  See Paragraph 3.2.2.1	V01	Will attempt to print message, then <i>may</i> attempt to print console error message and turn on FAULT.
	V02	Will attempt to print message, then <i>will always</i> attempt to print console error message and turn on FAULT.
Automatic setting of Program I/O State to Prevent Print Buffer Overflow  See Paragraph 3.4	V01	Not available
	V02	Absence of keyboard activity for twenty seconds while in console state causes automatic setting of program I/O state.

**Table E-1 Microcode Version V01/V02 Differences (Cont)**

Item	Differences	
Read Switch Register Prompt (a reminder to set switch register to power-fail value)	V01	Not available.
	V02	R prompt follows any command that initiates or continues program instruction execution.
See Paragraphs 4.4.5, 4.4.16		
Delete Display Format	V01	A backslash is echoed with each character as it is deleted.
	V02	A backslash is echoed with first character deleted, but is not repeated as other characters are deleted; a final backslash is printed when a new character, delimiter, or command is typed
See Paragraph 4.3.10		
Effect of Delete on Temporary Input Register Data Transfer	V01	Typing first character enables register contents transfer even if all typed-in characters are deleted, leaving all zeros.
	V02	Logic counts characters typed-in and deleted; if no characters remain in the register, no transfer occurs.
See Paragraph 4.3.10		
Command @ Response to I/O Page Indirect Addressing	V01	Not consistent with CPU instruction execution.
	V02	Bits 16 through 21 are masked with ones to provide access to I/O page; consistent with CPU instruction execution.
See Paragraph 4.5.5		
Command \$ Masks Address to Open a Register	V01	Used to modify commands <CTRL/D>, L, and /. Mask forces all bits except six low-order bits to become ones.
	V02	Used to modify commands <CTRL/D>, L, /, \, G, and S. Only bits above most significant octal digit are masked to become ones.
See Paragraph 4.3.7		
Command ' (single quote)	V01	Not available.
	V02	Selects octal data display format.
See Paragraph 4.3.8		
Command " (double quote)	V01	Not available.
	V02	Selects hexadecimal data display format.
See Paragraph 4.3.9		
Command \ (Backslash)	V01	Not available.
	V02	Opens 8-bit byte location.
See Paragraph 4.5.2		
M8255 Microprocessor Module (CS Revision)	V01	CS Revision E
	V02	CS Revision H

# APPENDIX F OPERATOR'S REFERENCE SUMMARY

SYSTEM IDENTIFICATION:  1 1170  
ELECTRONIC CONSOLE MICROCODE VERSION:  2 \_\_\_\_\_

## ● NORMAL OPERATION

BOOTSTRAP MODULE:  3 \_\_\_\_\_  
SYSTEM VOLUME I.D.:  4 \_\_\_\_\_  
SYSTEM VOLUME RESIDES ON DRIVE:  5 \_\_\_\_\_

### 1. TURN KEYSWITCH FROM OFF TO LOCAL

6 V000377  
CON= 7 0  8 17765000 G  9 R  
 10 \_\_\_\_\_

### 2. SET SWITCH REGISTER FOR POWER-DOWN

CTRL/P ^ P <BELL>  
CON=R  11 \_\_\_\_\_  12 \_\_\_\_\_ WZ

### 3. SET KEYSWITCH TO LOCAL OR LOCAL DISABLE

13  LOCAL DISABLE ("PANEL LOCK")       13  LOCAL (NOT "PANEL LOCK")

### 4. SET SLIDE SWITCH FOR POWER-FAIL RESTART

14  RUN 1       14  HALT       14  RUN 0  
SYSTEM RESPONSE IF IN  15 \_\_\_\_\_ POSITION  16 \_\_\_\_\_  
SYSTEM RESPONSE IF IN  15 \_\_\_\_\_ POSITION  16 \_\_\_\_\_

## ● SYSTEM PROBLEM REPORTING

1. REPORT ANY HARDWARE MAINTENANCE PROBLEM  
CONTACT DIGITAL'S SERVICE RESPONSE GROUP; TELEPHONE NUMBER:  17 \_\_\_\_\_

2. LOAD DIAGNOSTIC VOLUME  
DIAGNOSTIC VOLUME I.D.:  18 \_\_\_\_\_ MOUNT ON DRIVE:  19 \_\_\_\_\_

MA-4348

## F.1 INSTRUCTIONS FOR FILLING OUT OPERATOR'S REFERENCE SUMMARY

Although the electronic console is primarily a remote diagnosis device, normal system operating procedures are affected by its installation. The Operator's Reference Summary is a convenient form for posting the new procedures with system-specific details. The form will be most useful if it is completed jointly by the DIGITAL Field Service Engineer and responsible site personnel at the time an electronic console is installed. Each of the following instructions is keyed to an item on the Operator's Reference Summary.

1. Enter any number and/or name by which the site personnel usually identify the system.
2. Type <CTRL/E> to determine the microcode version (such as V02) and enter it.
3. Enter the bootstrap module type.
4. Enter the number and/or name that identifies the system volume.
5. Enter the identification and number of the drive on which the system volume will be mounted.
6. V000377 is a system-generated verification of a successful electronic console self-test.
7. Enter the switch register setting required for system bootstrapping.
8. Enter the starting address required for system bootstrapping.
9. Microcode Version V02 and later versions will print this command R prompt (read switch register contents). Enter the same data as in step 7.
10. Enter the system response to the completion of bootstrapping and the operating system coming up.
11. **R** is the command read switch register contents. Enter the same data as in step 7.
12. Enter the switch register setting for power going down.
13. Check the one box that indicates normal operation for this system.
14. Check the one box that indicates the required setting for power coming up.
15. List the two switch positions not checked in step 14.
16. Enter the system response to each switch setting following a power-down, power-up cycle.
17. Enter the DDC telephone number here and at the top of Figure 5-1, sheet 1 of 3.
18. Enter the number and/or name that identifies the diagnostic volume.
19. Enter the identification and number of the drive on which the diagnostic volume will be mounted.

## GLOSSARY/INDEX

### A

A (Display CPU Address Register Contents Command)  
(4.4.1)

#### ACKNOWLEDGEMENT

A system-generated space character which is printed on the system terminal following successful completion of certain commands.  
(3.4.1) (3.4.2) (3.4.3) (3.4.4)

#### ADDRESS DISPLAY REGISTER (MULTIPLEXER)

CPU logic which can be set, by command A or N with a data argument, to any one of seven display modes and provides a display of CPU address information in response to command A or N.  
(4.3.4) (4.4.1) (4.4.19)

#### ADDRESS REGISTER

CPU logic in which the current address is stored.  
(4.3.7) (4.4.3) (4.4.8) (4.4.9)

#### ARGUMENT

A number, typed as a prefix to a command, representing an address, a value to be deposited, or a display multiplexer position.  
(4.2.1) (4.2.2)

#### ARGUMENT SEPARATOR

A comma used to separate the switch register setting from the data argument within a command string.  
(4.2.1) (4.2.2)

### B

#### BASIC COMMAND

(See CPU Control – Basic Commands.)

#### BM873 BOOTSTRAP

(B.2)

## BOOTSTRAPPING

Use of a comparatively simple program to load, and usually start, a larger, more complex program.

(2.2.3) (3.2) (3.2.3)

## BYTE LOCATION

Command \ opens an 8-bit byte location; <LF> or <CR> closes a byte location. (Available in Microcode Version V02 only.)

(4.3.7) (4.3.8) (4.5.2) (4.5.3) (4.5.4)

## C

C (Continue Program Instruction Execution Command)  
(4.4.11)

CR (Close an Open Location or New Line Command)  
(4.5.3)

## CARRIER

A modem signal, modulated by data and transmitted over telephone circuits, by which the DDC communicates with a system under test.

(2.2.3) (2.8) (4.3.2)

## CARRIER ERROR DISABLE

Controlled by bit 5 <040> of the console control register in Microcode Version V01; used to eliminate the printing of carrier error message when the DDC intentionally breaks telephone connection.

(4.3.2)

## CARRIER INDICATOR

Located on the electronic console front panel; the word CARRIER is lighted whenever the remote serial interface detects a carrier signal from the modem.

(2.8) (2.9) (3.2.2) (5.3)

## CARRIER LOST

The electronic console prints the message ?CAR ER when the carrier signal from the modem is lost. This may occur as a result of a malfunction; however, an intentional DDC disconnection from the telephone line is also a possible cause.

(2.2.3) (4.3.2) (A.2.3)

## COMMAND

Any character code which is recognized and processed by the electronic console microcode to provide operator-desired results.

(Chapter 4)

## COMMAND STRING

Sequence of option value, argument separator, argument, command response, and acknowledgment by which an operator controls the electronic console and/or CPU.

(3.4.4) (4.2) (4.2.2)

## COMMAND SYMBOLS

The following symbols are used as electronic console commands:

- \$ (Open Register Address)  
(4.3.7)
- ' (Single quote - Select Octal Data Display Format)  
(4.3.8)
- " (Double quote - Select Hexadecimal Data Display Format)  
(4.3.9)
- ,
- / (Slash - Open a 16-bit Word Location)  
(4.5.1)
- \ (Backslash - Open an 8-Bit Byte)  
(4.5.2)
- @ (Open an Indirect Location)  
(4.5.5)

## CON=

The prompt printed on the system terminal to indicate that the electronic console is in console state and ready to process a command.

(3.2.2)

## CONSOLE CONTROL COMMANDS

Commands that are implemented within the electronic console and do not directly affect the CPU.

(4.3)

## CONSOLE CONTROL REGISTER

A 6 or 7-bit register within the electronic console. The bits can be set, cleared, or displayed to enable or disable operational features.

(4.3.2)

## CONSOLE LOGIC FAULT

The electronic console performs continuous internal logic self-testing. If a failure is detected, FAULT is turned on and the message ?CON ER is printed on the system terminal.

(2.10) (3.2.2.1) (A.1.4)

## CONSOLE STATE

Entered by typing <CTRL/P>; allows site or remote operator to communicate with the electronic console.

(2.2.3) (2.2.4) (3.2.2) (3.3.1) (3.3.3) (3.4.4) (4.3.4) (4.3.5) (4.3.6) (4.3.8) (4.3.9) (4.4.1) (4.4.11) (4.4.16)

## CONTINUE PROGRAM INSTRUCTION EXECUTION

Command C  
(3.4.4) (4.4.11)

## CPU CONTROL - BASIC COMMANDS

Commands that are passed through the electronic console to control operation of the CPU.  
(4.4)

## CPU CONTROL - MULTIPLE FUNCTION COMMANDS

ODT - like commands that provide the equivalent functionality of two or more basic commands.  
(4.5)

## CPU IDENTITY

Command <CTRL/E>  
(4.3.1)

## CPU RESPONSE TIME-OUT

The absence of CPU response, within 100 msec, to a signal from the electronic console causes the # symbol to be printed on the system terminal as an error message.  
(A.2.1)

## CPU STATUS

CPU status is displayed when a program halt instruction or electronic console command H is executed, and in response to the command T.  
(3.4.4) (4.4.6) (4.4.13)

## D

D (Deposit Command)  
(4.4.8)

<CTRL/D> (Dump Memory Command)  
(4.4.2)

## DAA

(See Data Access Arrangement)

## DATA ACCESS ARRANGEMENT (DAA)

A device that permits connection of privately owned data communications equipment into the common carrier network (telephone lines). May be supplied by telephone company or governmental authority or privately owned; may be a stand-alone unit or incorporated into a modem.  
(1.2) (5.3)

## DATA TERMINAL READY (DTR)

A signal which, when asserted by the electronic console to the modem, enables interconnection of the electronic console to the DDC over a telephone line.  
(2.2.3) (2.2.4) (2.2.5) (3.3.1) (3.3.3) (4.3.6)

## DDC

(See Digital Diagnostic Center.)

## DELETE (Delete Last Character Typed-In Command)

(4.2.2) (4.3.10) (4.3.11)

## DEPOSIT

Command D

(3.4.2) (4.3.11) (4.4.8)

## DIGITAL DIAGNOSTIC CENTER (DDC)

A facility staffed by remote diagnosis specialists who direct host computer diagnostic testing of customer computer systems.

(1.4) (1.5) (2.2.4) (2.2.5) (2.7) (2.8) (2.9) (3.3.1) (3.3.3) (4.3.2) (4.3.6) (5.3)

## DISABLE INDICATOR

Located on the electronic console front panel; the word **DISABLE** is lighted whenever the key-switch is in **LOCAL DISABLE** or **REMOTE DISABLE**; may be blinking to indicate that the program has halted.

(2.6)

## DISCARD REMOTE PRINTOUT

Controlled by bit 5 <040> of the console control register in Microcode Version V02; used by the DDC to eliminate program output during the running of diagnostics when the DDC is not connected to the system.

(4.3.2)

## DL11-A

A PDP-11/70 serial line interface option. It is replaced by equivalent logic when an electronic console is installed; equivalence here means when used with **DIGITAL** options; VT100 must be operated at a transmission baud rate of 1200 or lower.

(4.6) (4.6.1)

## DTR

(See Data Terminal Ready.)

## DUMP MEMORY

Command <CTRL/D>

(4.3.8) (4.4.2)

## E

## E (Examine Location Command)

(4.4.3)

## <CTRL/E> (Identify System and Microcode Version Command)

(4.3.1)

## ELECTRONIC CONSOLE

PDP-11/70 remote diagnosis option (KY11-R)

(1.1) (2.2.1) (2.2.5) (2.8) (2.10) (3.2) (4.1) (4.3) (4.3.4) (4.4)

## EXAMINE

Command E

(3.4.1) (3.4.2) (3.4.3) (4.3.8) (4.4.3)

## EXPAND PRINTOUT

Controlled by bit 3 <010> of the console control register; may be set to cause an automatic display of the memory data display register following a command N (execute next instruction).

(4.3.2)

## F

### FAULT INDICATOR

An indicator on the electronic console front panel; the word FAULT is lighted whenever an internal logic failure is detected.

(2.10) (3.2.2.1) (5.5)

### FORCE SWITCH REGISTER PROMPT

Controlled by bit 6 <100> of the console control register. (See Switch Register Prompt.)

(4.3.1)

### FREE PHONE

(See Toll-Free Telephone Number.)

## G

G (Go Command)

(4.4.12)

### GO

Command G

(4.4.12)

## H

H (Halt Command)

(4.4.13)

### HALT

A CPU state in which program instruction execution is inhibited; can be asserted by program instruction or by a halt signal from the electronic console (power-fail restart switch or command H).

(2.3) (3.4.4) (4.4.11) (4.4.13) (A.2.2)

## HEXADECIMAL DATA DISPLAY

Electronic console Microcode Version V02 provides not only the usual octal display but also, in response to command " (double quote), set hexadecimal display format.  
(3.4.1) (4.3.8) (4.3.9) (4.5.2)

## HOST COMPUTER

A computer system, located at the DDC, programmed for use by remote diagnosis specialists in the testing and analysis of customer system failure.  
(1.4) (2.8) (2.9) (3.3.3) (4.3.2) (5.3)

## I

I (Initialize CPU Command)  
(4.4.14)

## INDIRECT ADDRESSING

Contents of a location are used as the address of the next instruction. When the microcode is version 02, the electronic console follows the CPU instruction path in response to command @.  
(4.5.5)

## INITIALIZE CPU

Command I  
(3.4.4) (4.3.8) (4.3.9) (4.4.12) (4.4.14) (4.4.16)

## I/O PAGE AREA

Upper page of CPU memory, physical addresses  $\geq 16000000$ ; the electronic console accesses registers and I/O page area by masking leading zeros of an address with ones, command \$.  
(4.3.7)

## J

J (Set Single Bus Cycle Command)  
(4.4.17)

## K

K (Clear Single Bus Cycle Command)  
(4.4.18)

## KEYSWITCH

A five-position rotary switch on the front panel of the electronic console that is customer controlled; used to select local or remote modes of operation.  
(1.5) (2.1 through 2.2.5) (2.6) (2.9) (3.2.2)

## KW11-L

A PDP-11/70 line clock option. The electronic console includes KW11-L equivalent logic. The system option is usually left unchanged and the redundant electronic console logic disabled.  
(4.6.2)

## KW11-L CONTROL AND STATUS REGISTER

Logic within both the electronic console KW11-L equivalent and the KW11-L option.  
(4.6.2)

## KY11-R

The option designator for the PDP-11/70 Remote Diagnosis Electronic Console.  
(See Electronic Console.)

## L

L (Load Address Command)  
(4.4.9)

<CTRL/L> (Select Talk State Command)  
(4.3.6)

## LAMP TEST SWITCH

An unmarked pushbutton switch on the electronic console front panel; used to test all panel indicator lamps simultaneously.  
(2.4)

<LF> (Open and Close Sequential Locations Command)  
(4.5.4)

## LOAD ADDRESS

Command L  
(3.4.1) (3.4.2) (3.4.3) (3.4.4) (4.4.9)

## LOCAL

A keyswitch position that allows operator access to both console and program I/O states.  
(2.2.3) (2.2.5) (3.2.2) (3.3.1) (4.3.2)

## LOCAL CONTROL

Controlled by bit 1 <002> of the console control register. Used by the DDC to enable the site system terminal to operate in parallel with the DDC terminal while the site operator re-creates a system malfunction.  
(4.3.2)

## LOCAL COPY

Controlled by bit 0 <001> of the console control register. Used by the DDC to provide the site operator with an audit trail of remote diagnostic activity.  
(4.3.2)

## LOCAL DISABLE

A keyswitch position, equivalent to traditional panel lock; operator has no access to CPU; terminal is dedicated to program I/O.  
(2.2.2) (2.6) (3.3.2) (4.3.2) (4.3.5)

## M

M (Read Memory Data Display Register Command)  
(4.4.4)

M8255  
The KY11-R microprocessor module  
(1.3) (4.6) (4.6.2)

M9301 BOOTSTRAP  
(B.1)

M9312 BOOTSTRAP  
(B.3)

### MEMORY DATA DISPLAY (MULTIPLEXER)

CPU logic that can be set to any one of four display modes by the operator and provide a read-out of memory data in response to the command M.  
(4.3.2) (4.3.4) (4.3.8) (4.4.2) (4.4.3) (4.4.4) (4.5.1) (4.5.2)

### MEMORY REFERENCE ERROR

If for any reason a memory reference cannot be successfully completed, the electronic console displays a ?ER/T14411 message. (The CPU state portion of the message reflects current status.)  
(A.1.3)

### MICROCODE

Electronic console firmware; the ROM- or PROM-stored program that determines command syntax, remote protocol, and operating characteristics; this manual documents Microcode Versions V01 and V02.  
(1.3) (2.5) (2.6) (2.9) (3.2.2.1) (3.3.1) (3.4.4) (4.3.1) (4.3.4) (4.3.7) (4.3.8) (4.3.9) (4.3.10) (4.3.11) (4.4.5) (4.4.11) (4.5.2) (4.5.5) (Appendix E)

### MICROPROCESSOR

A preprocessor; the M8255 microprocessor module.  
(1.1) (1.3)

### MODEM

A device that modulates and demodulates serial data transmitted and received over telephone lines; must be connected to the telephone line by approved DAA logic which may be integral to, or external to, the modem.  
(1.2) (2.8) (5.3)

MR11-DB BOOTSTRAP  
(B.2)

### MULTIPLE FUNCTION COMMAND

(See CPU Control-Multiple Function Command.)

## N

N (Execute Next Instruction Command)  
(4.4.19)

[n]

An optional numerical data argument; if it is not entered where indicated, a predetermined or current default condition will be asserted (for example, a current multiplexer position will be retained).

(Table 4-1) (Table 4-3) (Table 4-4)

n

A numerical data argument, required as part of a command; a syntax error message will be printed if it is not present.

(Table 4-1) (Table 4-3)

<NL>

New Line; system generated in response to commands G, C, and P, it is the equivalent of a carriage return followed by a line feed. As a result, any subsequent printout begins at the left margin on a new line; a command <CR> may be used at any time to generate a new line.

(3.4.1) (4.5.3)

## NEXT INSTRUCTION

Command N causes the next instruction to be executed. If the CPU is in single bus cycle mode, command N causes the next bus cycle to be executed; an optional octal digit prefix to command N sets the address display multiplexer.

(4.3.2) (4.4.19)

## O

### OCTAL DATA DISPLAY

The electronic console normally displays data in octal format; Microcode Version V02 provides hexadecimal format also.

(3.4.1) (3.4.2) (4.3.4) (4.3.8) (4.3.9)

### OFF

A keyswitch position; the keyswitch is usually wired to provide the system master on-off function.

(2.2.1)

### OPERATING STATES

Console state, program I/O state, and talk state; electronic console operation can always be defined as being in one of these mutually exclusive states.

(3.3)

### OPERATOR'S REFERENCE SUMMARY

A compilation of system-specific operating procedure details which can be posted at the site for an operator's use when an electronic console has been installed.

(2.3) (3.2) (3.2.1) (3.2.2) (3.2.3) (4.4.5) (Appendix F)

## OPTIONAL VALUE

An octal data argument, typed before the argument separator in a command string, that sets the switch register to that value.

(4.2.1)

## P

P (Continue Program Instruction Execution [Proceed] Command)

(4.4.15)

<CTRL/P> (Select Console State Command)

(4.3.4)

## PANEL LOCK

Associated with traditional CPU front panel; electronic console equivalent is LOCAL DISABLE; operator has no access to CPU; terminal is dedicated to program I/O.

(2.2.2) (2.6)

## POWER DOWN

To remove system power by turning keyswitch to the OFF position.

(See Power Failure.)

## POWER-FAIL RESTART SWITCH (RUN 1-HALT-RUN 0)

Located on electronic console front panel; asserts halt or sets switch register to all ones or all zeros as required by the operating system when power comes back up after a power failure.

(2.3) (3.2) (3.2.2) (3.2.5)

---

## POWER FAILURE

Loss of system power, usually unexpected; the electronic console provides for switch register setting for power going down.

(3.2) (4.3.2) (4.4.10) (5.1) (Appendix F)

## POWER INDICATOR

Located on the electronic console front panel; turned on whenever system power is on; may be blinking to indicate that CPU is in a halted state.

(2.5) (2.6) (3.2.2)

## POWER UP

To apply power to the system by turning the keyswitch from the OFF position; also, after a power failure, a power-fail restart.

(2.2.1) (2.2.3) (2.3) (2.10) (3.2) (4.3.2) (4.3.3) (4.3.8) (4.3.9) (4.4.1)

## PROCEED

Command P; causes program instruction execution to continue in program I/O state.

(4.4.15)

## PROGRAM EXERCISE (Familiarization)

(3.4.4)

## PROGRAM I/O STATE

Entered from console state by typing command Z; allows use of system terminal for program I/O.

## R

R (Read Switch Register Contents Command)  
(4.4.5)

<CTRL/R> (Read or Change Console Control Register Command)  
(4.3.2)

## REGISTER ADDRESS

Set by command \$; causes masking of leading zeros with ones, making it easier for the operator to access a register or I/O page area.  
(3.4.3) (4.3.7)

## REMOTE

A keyswitch position; allows DDC complete access to both electronic console and CPU. Program I/O, console, and talk states are accessible under DDC control.  
(2.2.5) (2.7) (2.9) (3.3.1)

## REMOTE DIAGNOSIS

A maintenance procedure by which a customer's computer is connected, by telephone line, to a DIGITAL host computer for automated fault analysis or preventive maintenance testing.  
(1.1)

## REMOTE DIAGNOSIS PACKAGE

A reel of magnetic tape, resident at the customer site, that contains system diagnostics for use by the DDC in remote diagnosis testing.  
(1.1) (5.3)

## REMOTE DISABLE

A keyswitch position; limits DDC's access to customer system to that of a logged-in user; only program I/O state is accessible.  
(2.2.4) (2.6) (2.7) (2.9) (3.3.2) (4.3.5)

## REMOTE INDICATOR

Located on the electronic console front panel; the word REMOTE is lighted whenever the key-switch is in REMOTE or REMOTE DISABLE.  
(2.7)

## REMOTE SERIAL INTERFACE

The data communications logic through which the electronic console and its associated CPU may be connected to the DDC host computer over a telephone line.  
(2.2.3) (2.2.4) (2.2.5) (2.7) (2.8) (3.3.1) (3.3.3) (4.3.4) (4.3.6)

## RESPONSE

The data printed or the action accomplished by the system in response to an issued command.  
(4.2)

## R PROMPT

(See Switch Register Prompt.)

## RUN1

(See Power-Fail Restart Switch.)

## RUN0

(See Power-Fail Restart Switch.)

## RUN ERROR

If an attempt is made to issue certain commands when the processor is running, the electronic console generates a run error message, ?RUN ER.  
(A.1.2)

## S

S (Start Program Instruction Execution Command)  
(4.4.16)

## SELF-TEST

A diagnostic exercise performed internally by the electronic console to verify its correct operation.  
(2.10) (3.2) (3.2.2) (3.2.3) (4.3.3) (5.5) (A.2.4)

## SERIAL LINE ERROR

The symbol + is printed on the system terminal whenever the electronic console receives garbled code through the serial line interface.  
(A.1.5)

## SERVICE RESPONSE GROUP

A remote service group, within the DDC, to which all customer hardware maintenance problems are reported for either DDC analysis or local branch office service, or both.  
(1.4) (2.10) (3.2.2.1) (5.2) (5.3)

## SINGLE BUS CYCLE

CPU logic that can be set (command J) and cleared (command K) to permit single-stepping a program for maintenance or debugging purposes.  
(4.4.17) (4.4.18)

## SPECIAL MODE

Controlled by bit 4 <010> of the console control register; permits the use of commands (for troubleshooting) in a manner not normally acceptable to the electronic console.  
(4.3.2) (4.4.8) (4.4.9) (4.4.12) (4.4.15)

## SPECIFICATIONS

This manual includes electronic console environmental specifications (temperature, humidity, etc.)

(D.1)

## SRG

(See Service Response Group.)

## START PROGRAM INSTRUCTION EXECUTION

Command S

(4.4.16)

## SWITCH REGISTER

A CPU location; also an electronic console register; command W writes a setting into the switch register; command R causes its contents to be displayed.

(2.3) (3.2) (3.2.3) (3.2.4) (3.4.4) (4.2.2) (4.4.5) (4.4.10)

## SWITCH REGISTER PROMPT

The automatic display of switch register contents following certain commands, as a reminder to the operator that the operating system may require a different setting for a power-going-down condition.

(3.4.4) (4.3.2) (4.4.5) (4.4.11)

## SYNTAX

The way arguments and command characters are structured to form electronic console commands and command strings. The electronic console generates syntax errors when commands are improperly formatted, or when an attempt is made to mix basic and multiple function commands.

(4.3.2) (A.1.1)

## SYSTEM TERMINAL

The keyboard and printer or video display the operator uses to communicate with the CPU.

(1.1) (2.2.2) (2.2.3) (2.2.4) (2.2.5) (2.6) (3.2.2) (3.3.2) (3.3.3) (4.3.2) (4.3.5) (4.3.6) (4.6.1)

## T

T (Read CPU Status Command)

(4.4.6)

## TALK ECHO

Controlled by bit 2 <004> of the console control register; suppresses character echo when the host computer sends messages to the site system terminal.

(4.3.2)

## TALK STATE

Entered by typing <CTRL/L>; permits the site operator and remote DDC operator to communicate with each other at their respective terminals.

(2.2.3) (2.2.5) (3.3.3) (4.3.2) (4.3.6)

#### TEMPORARY INPUT REGISTER

A 22-bit register within the electronic console in which all typed characters are stored before being transferred to the CPU.

(4.2.2) (4.3.7) (4.3.10) (4.3.11) (4.4.8) (4.4.9) (4.4.10) (4.4.12) (4.4.16)

#### TEST INDICATOR

Located on the electronic console front panel; the word TEST is lighted whenever the DDC is performing diagnostic testing; the DDC may or may not be connected to the system while testing is in progress.

(2.9) (5.3)

#### TOLL-FREE TELEPHONE NUMBER

An 800 number or other telephone service by which charges for customer calls to the DDC are billed to DIGITAL.

(1.4)

#### TRADITIONAL FRONT PANEL

The PDP-11/70 CPU console panel with switch register, control switches, and indicators which is replaced by the electronic console front panel.

(1.1) (2.2.3) (3.2) (3.3.1) (4.3.4) (4.4)

#### TRANSMITTER STATUS REGISTER

Logic within the electronic console DL11-A equivalent serial line unit.

(4.6.1)

#### TWENTY-SECOND TIMER

Monitors terminal keyboard inactivity to force program I/O state if a running program requires the terminal for output.

(3.3.1) (3.4.4, step 10) (4.3.4)

### U

U (Read UNIBUS Status Command)

(4.4.7)

<CTRL/U> (Delete All Characters of Current Type-In Command)

(4.3.10)

#### UNIBUS STATUS

Command U

(4.4.7)

### V

V (Verify Electronic Console Logic [Self-Test] Command)

(4.3.3)

V000377

The system-generated message that indicates a successful electronic console self-test.  
(3.2.2) (4.3.3) (A.2.4)

#### VERIFY CONSOLE LOGIC

Provided by command V; initiates an electronic console self-test.  
(2.10) (4.3.3)

### W

W (Write Switch Register Contents Command)  
(4.4.10)

#### WORD LOCATION

Command / opens a 16-bit word location; command <LF>, <CR> or @ closes a word location.  
(3.4.1) (3.4.2) (4.3.7) (4.3.8) (4.5.1) (4.5.3) (4.5.4)

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