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CONTROL DATA CORPORATION

CDC® 110 MICROCOMPUTER SYSTEM

SOFTWARE USER'S MANUAL

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PREFACE

This manual provides information on installing software and performing utility operations on the Control Data® 110 Microcomputer System. The software products included are the CP/M 2.2® Operating System, CBASIC® 2.38, BASIC-80® 5.20, and Pascal/M® 4.01. Essential characteristics of the system, options, and serial communications capability are also presented.

Additional copies of this manual or copies of the following related manuals may be ordered from:

Control Data Corporation
Literature and Distribution Services
308 North Dale Street
St. Paul, Minnesota 55103

Publication	CDC Publication Number
CBASIC Reference Manual	62940021
Pascal/M User's Reference Manual	62940022
CP/M 2.2 User's Guide	62940023
CP/M 2.2 Alteration Guide	62940026
CP/M 2.2 Interface Guide	62940027
An Introduction to CP/M Features and Facilities	62940028
CP/M Assembler (ASM) User's Guide	62940029
CP/M Dynamic Debugging Tool (DDT) User's Guide	62940030

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CBASIC is a registered trademark of Digital Research Inc.
BASIC-80 is a registered trademark of Microsoft Inc.
Pascal/M is a registered trademark of Sorcim Corporation.

Publication	CDC Publication Number
ED: A Context Editor for the CP/M Disk System User's Manual	62940031
BASIC-80 Reference Manual	62940039
Microsoft BASIC Reference Book	62940040
For Type 3 Terminal:	
110 Microcomputer System Owner's Manual	62940053
or the following four-volume 110 Owner's Manual:	
Volume 1 - Customer Planning Guide	62940070
Volume 2 - System Installation	62940071
Volume 3 - System General Operations	62940072
Volume 4 - System Maintenance	62940073
CDC® 721 Display Terminal Operator's Guide/ Installation Instructions	62940019
CDC 721 Display Terminal Hardware Reference Manual	62940020
For Type 1 or Type 2 Terminal:	
110 Microcomputer System User's Installation and Diagnostics Manual	62940024

The 721 Display Terminal Hardware Reference Manual may be required for supplemental programming information if a Type 3 terminal is to operate in CYBER mode under control of the CP/M operating system.

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The Control Data 110 Microcomputer System is designed to be a standalone single user computer system using the CP/M ® operating system. The terminal used in this system may be used as a part of the PLATO system. With the addition of applications software, the Control Data 110 can be used as a remote terminal for another computer system.

This manual will tell you how to use the Control Data 110 as a CP/M computer system. If you are using this system in other applications, you will have to use the manuals supplied with the application.

This manual is not intended to teach you how to use all of the capabilities of CP/M.

If you want to learn how to use CP/M, there are a number of publications available from many bookstores. Several books on CP/M are:

The CP/M Handbook by Rodnay Zaks
Published by SYBEX

Using CP/M By Judi Fernandez & Ruth Ashley
Published by Wiley

Osborne CP/M User Guide by Thom Hogan
Published by Osborne/McGraw-Hill

This manual is organized for two different types of readers and as such it uses a different style and organization in the two areas.

Sections 2 through 12 are for the system user. These sections are organized as a 'cookbook' which will give detailed directions on how to turn on your system, how to create backup disks of master disks, how to install and test software, and how to use the various Control Data-supplied utility routines. These sections will also tell you how to use some of the CP/M utility routines to do common operations.

Section 13 through the appendices is for the software writer. These sections are organized as a 'reference' manual which explains the unique features of the Control Data 110 CP/M implementation. Useful system reference material is also provided.

IDENTIFYING YOUR EQUIPMENT

Your Control Data 110 has several possible configurations. The following criteria identify which Type of equipment you have. For future reference, enter the Type designations in the spaces provided. Packed with this manual is a sheet of labels. Put the correct Type-designating label on the corporate logo on the front of the equipment.

DISPLAY TERMINAL

You have one of three possible display terminal Types:

_____ Type 1 terminal: combined keyboard-display unit which does not have a PRINT key at the left side of the keyboard.

_____ Type 2 terminal: combined keyboard-display terminal which does have a PRINT key at the left side of the keyboard.

_____ Type 3 terminal: separate keyboard and tilting display.

FLEXIBLE DISK DRIVE

You have either one or two Types of flexible disk drives:

_____ Type 1 (primary) disk drive: has a RESET button on the front of the unit.

_____ Type 2 (secondary) disk drive: does not have a RESET button on the front of the unit. If you have a Type 2 disk drive, you must have a Type 1 disk drive.

PRINTER

Two Types of printers are used with the Control Data 110:

_____ Type 1 (graphics) printer: has two buttons on the front of the unit; uses parallel channel.

_____ Type 2 (matrix) printer: has four buttons on the front of the unit. Other serial port printers can be used with the Control Data 110. When information applies only to the Type 2 printer, the Type designation is used. When information applies to other printers as well, the term "serial port printer" is used.

SYSTEM CONFIGURATION

Your Control Data 110 system consists of a terminal, one or two disk drives, and a printer. Thus you have one item from each of the following columns:

Terminal	Disk Drive	Printer
Type 1	Type 1 drive	Type 1 printer (on parallel channel)
Type 2	Type 1 and Type 2 drives	Type 2 printer (on serial channel)
Type 3		Other purchased printer (on serial channel)

HOW TO READ THIS MANUAL

You will read the sections of this manual in the order based on the configuration of your system. The key areas of difference are in what Type of terminal you have and how many disk drives you have in your system. There is repetition in the cookbook area of the manual so you will not have to flip back and forth to find the description of the procedures you are using.

Select the following paragraphs based on your system configuration.

IF YOU HAVE A TYPE 3 TERMINAL AND TWO DISK DRIVES

Read sections 2, 3, 5, 9, 10, 11, and 12.

IF YOU HAVE A TYPE 3 TERMINAL AND ONE DISK DRIVE

Read sections 2, 3, 5, 6, 7, 8, and 12.

IF YOU HAVE A TYPE 1 OR TYPE 2 TERMINAL AND TWO DISK DRIVES

Read sections 2, 4, 5, 9, 10, 11, and 12.

IF YOU HAVE A TYPE 1 OR TYPE 2 TERMINAL AND ONE DISK DRIVE

Read sections 2, 4, 5, 6, 7, 8, and 12.

KEY TERMINOLOGY

This manual uses the following symbology to indicate the pressing of a key on your terminal < >. For example:

<next>

means "press the key with NEXT printed on the top of the key."

<control S> means press the control key and the "S" key.
<control C> means press the control key and the "C" key.

See section 4 on how to handle <control key> for the Type 1 terminal.

Most software written for CP/M refers to the "CARRIAGE RETURN", "CR", or "RETURN" key in the documentation and in the display messages. For your terminal this means use the "NEXT" key.

The Control Data 110 Microcomputer System consists of a terminal (Type 1, Type 2, or Type 3) and a Type 1 (primary) flexible disk drive. An optional Type 2 (secondary) disk drive and printers are available. Figure 2-1 shows a Type 1/Type 2 terminal and a Type 1 disk drive.

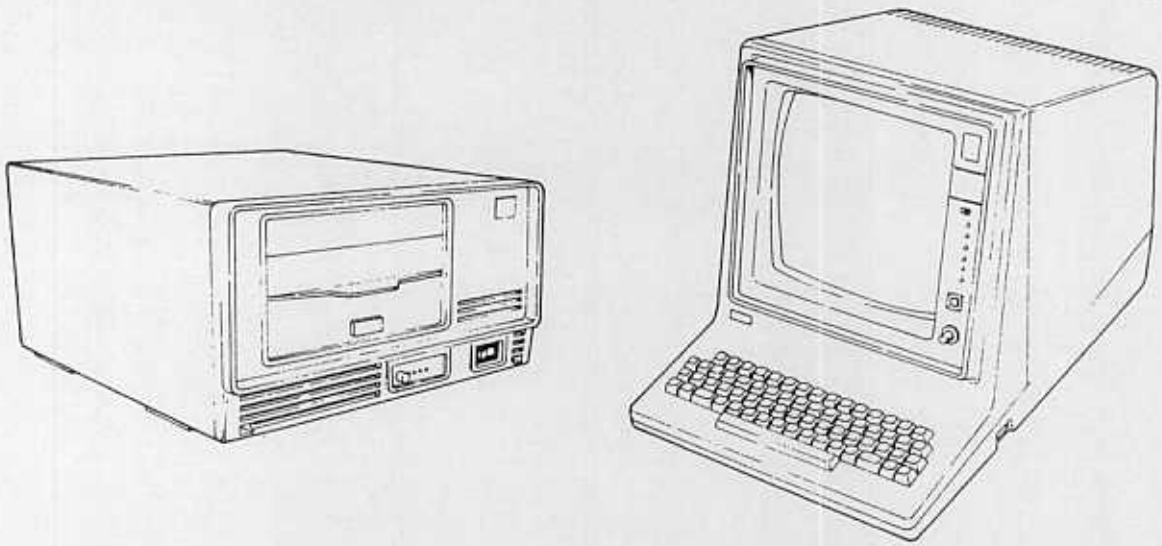


Figure 2-1. The Basic 110 System with Type 1/Type 2 Terminal

Figure 2-2 shows a Type 3 terminal and a Type 1 disk drive.

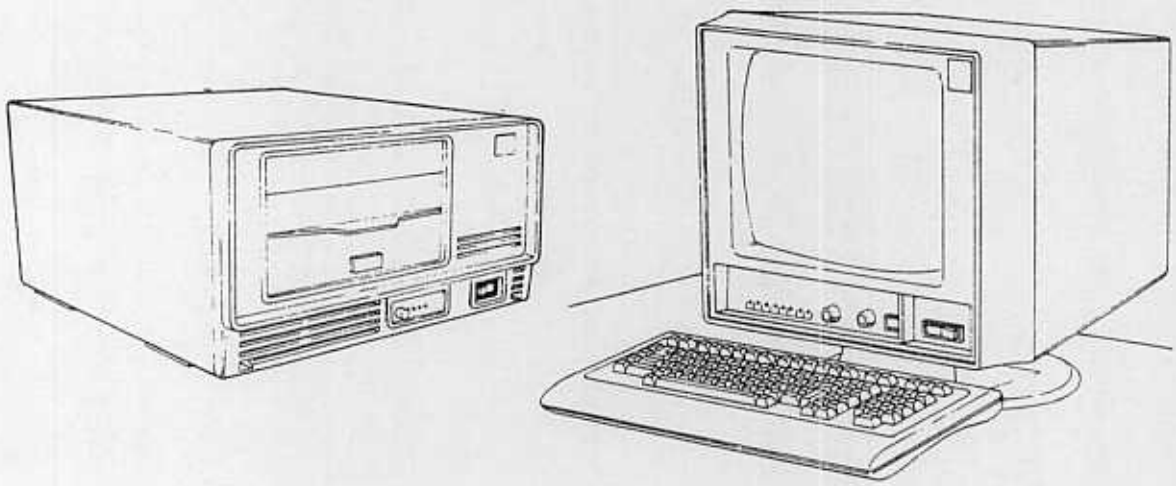


Figure 2-2. The Basic 110 System with the Type 3 Terminal

The Control Data 110 system is a standalone microcomputer. The Type 1 or Type 2 terminal may also be used as a terminal on a CDC PLATO system. The Type 2 terminal or the Type 3 terminal with graphics option may be used as a terminal on the Control Data Shared Network. The Type 2 terminal or Type 3 terminal has communications capabilities that allow operation with other computer systems in a distributed data-processing application.

The system is intended for use with application software packages available on 8-inch flexible disks. Users can, however, write their own application software. In standalone mode, application software is loaded from a flexible disk. In terminal mode, the application software is loaded from another computer. Data variables and program control commands are entered through the keyboard. Processed data can be transferred to another computer (terminal mode), stored on a flexible disk, or printed out if the system has an optional printer. Utility programs provide the capability to copy and format flexible disks, etc.

HARDWARE REQUIREMENTS AND OPTIONS

The hardware requirements for the Control Data 110 system are:

- A Type 3 terminal with parallel-channel option,

  or a Type 1 or Type 2 terminal with a 16K memory expansion package installed,

  or a Type 2 terminal with standard 64K RAM memory.
- A Type 1 disk drive with 64K of memory.

The options are:

- A Type 2 disk drive.
- A printer.
- A dual asynchronous port for Type 3 terminal (required to support an RS-232 interface printer.

A second disk drive (Type 2 disk drive) makes the copying of flexible disks much faster and more efficient. The printer can be a Type 1 printer or a printer with an RS-232 serial interface.

EQUIPMENT CHARACTERISTICS

The equipment characteristics for the disk drive, terminal, printer and computer are listed below.

DISK DRIVE

- Format - Double-density, double-sided flexible disk. Single-density, single-sided flexible disk.
- Capacity per flexible disk - 1.216 million bytes usable storage in double density. 243 thousand bytes usable storage in single density.
- System capacity - 2.432 million bytes maximum in double density. 486 thousand bytes maximum with single density.

TYPE 3 TERMINAL

- 80- or 132-column by 24- or 30-line display.
- Keyboard generates all 128 ASCII characters.
- Special keys generate multiple character sequences.
- Numeric cluster.
- Start and stop screen output from keyboard.
- Typamatic keys generate repeated output.
- PRINT causes a copy of the information on the screen to be printed.
- Inverse video may be selected by program to highlight fields.
- Touchpanel interface provided to computer programs (if the graphics/touchpanel option is included in the terminal).
- Choice of block or underline blinking or nonblinking cursor (operator selectable).
- Choice of green letters on black background, or black letters on green background (operator selectable).

TYPE 1 OR TYPE 2 TERMINAL

- Status display line.
- 80-column by 30-line display.
- Keyboard generates all 128 ASCII characters.
- Numeric cluster available.
- Screen clear function available from keyboard independent of computer program.
- Start and stop screen output from keyboard.
- Repeat key.
- ETX key.
- Shift COPY or Shift PRINT causes a copy of the information on the screen to be printed (Type 2 terminal only).
- Inverse video may be selected by program to highlight fields. (Reverse color of letters and background.)
- Touchpanel provided with interface to computer programs.
- Choice of block or underline cursor.
- Choice of white letters on a black background, or black letters on a white background.

PRINTERS

- CDC parallel channel for Type 1 printer.
- RS-232 serial interface for serial printers.

COMPUTER

- 4-megahertz Z-80 CPU.
- Internal memory of 65,536 bytes. At least 48,000 bytes available for user outside of operating system.
- Date and time clock maintained to the second.
- Serial full-duplex communications available on Type 2 and Type 3 terminals.

OPERATING MODES

The Control Data 110 is capable of multiple operating modes. These modes are described briefly below.

CP/M 2.2 Computer System	The Control Data 110 uses the CP/M 2.2 Operating System. CBASIC 2.38, BASIC-80 5.20, Pascal/M 4.01, and other applications and programs are available from Control Data and other vendors.
PLATO Terminal	The Control Data 110 is connected to the PLATO system and used as an instructional terminal.
Self-contained PLATO Station	The Control Data 110 uses PLATO flexible disks. No access to the PLATO network is required.
Control Data Shared Network Terminal (Type 2 and 3 Only)	The Type 2 or Type 3 terminal is connected to the Control Data Shared Network. All the services of this network are then available including CDC PLATO.

This manual deals primarily with the CP/M 2.2 mode of operation. If you wish to operate in a different mode, contact a Control Data sales representative.

DIFFERENCES BETWEEN TYPE 1 AND TYPE 2 TERMINALS

Type 1 and Type 2 terminals differ in the communication capability, switch settings, and keyboard. As previously mentioned, the Type 1 terminal can only be used as a network terminal in the PLATO system. Switch settings are discussed in section 4. The keyboard of the Type 1 and Type 2 terminals has brown keys, white keys, and a blue key. The brown keys are similar to a standard typewriter layout. The blue and white keys perform additional functions. The Type 1 and Type 2 keyboards differ in two respects. First, only the Type 2 terminal has PRINT and CTRL keys. On the Type 1 terminal, the PRINT and CTRL functions are performed with the COPY key and one other key. Second, the Type 2 terminal has output codes engraved on the side of certain keys; the Type 1 terminal does not. Figure 2-3 shows the keyboard. The SUPER key is highlighted to illustrate the codes on the side of the keys on the Type 2 terminal.

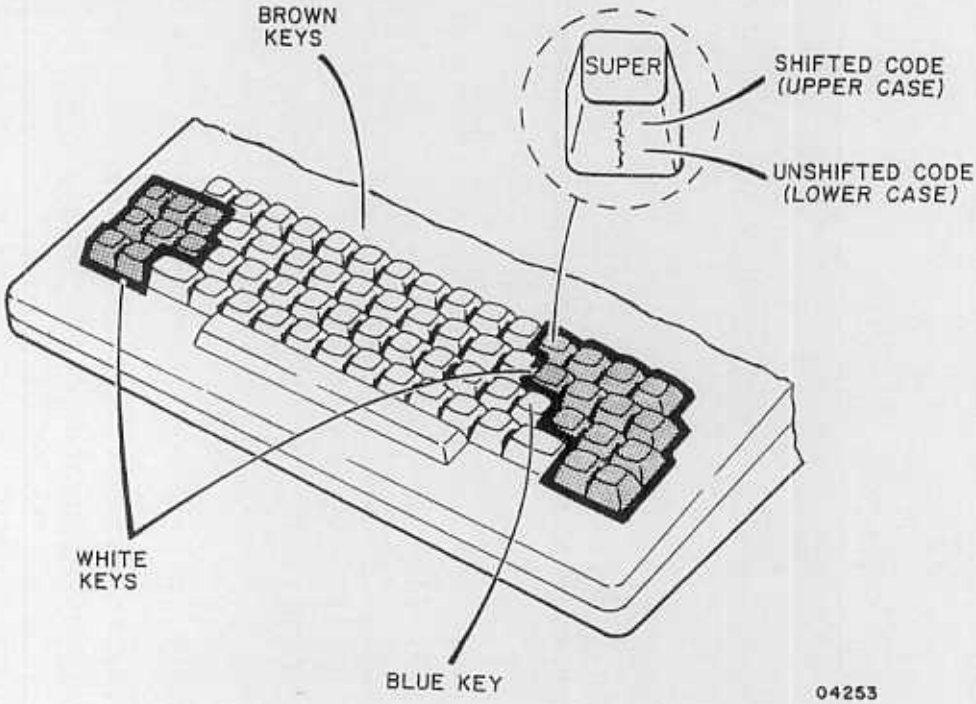


Figure 2-3. The Type 1/Type 2 Keyboard

DIFFERENCES BETWEEN TYPE 3 AND TYPE 1/TYPE 2 TERMINALS

The standard Type 3 terminal does not provide graphics or touchpanel features. Control Data 110 CP/M supports the touchpanel on the Type 3 terminal if that option is included. Any program written for the Type 1/Type 2 terminal version of CP/M will operate correctly with the Type 3 terminal. The white keys on the Type 3 terminal give different inputs from the corresponding keys of the Type 1/Type 2 terminal.

PREPARING YOUR TERMINAL FOR USE WITH CP/M

The Type 3 terminal is a multi-function/multi-mode terminal which must have CP/M mode installed using the procedure in appendix C. You may set a number of CP/M modes using the information in the operator's guide for the Type 3 terminal (refer to the Preface of this manual). In the alternate modes you can select a different line length, 24 or 30 lines per page, and the cursor characteristics.

TURNING ON SYSTEM POWER

To turn on your system, make sure that no floppy disks are in the disk drives. Press the "1" side of the red switch on the front of the terminal display to turn on terminal power. Press the "ON" switch on the front of the Type 1 and Type 2 disk drives to turn on the disk drive power.

In about a minute the display on the terminal will brighten and display the mode select blocks at the bottom of the display screen. Your system is ready to operate.

LOADING CP/M OR APPLICATION FLEXIBLE DISKS WITH CP/M

The top row of keys on your keyboard contain "Function" keys. These keys have "F" numbers marked on the base of the keyboard below each key. These keys are used to select operating modes after turning on power to the system, or after pressing the rectangular "RESET" button beneath the display screen. After power on, or "RESET", the bottom of the display shows the mode select blocks.

The Type 3 terminal is loaded with CP/M by one of two methods:

Method 1. Turn on power for the terminal and the flexible disk drives. Insert the CP/M flexible disk in the Type 1 (primary) flexible disk drive. The Type 1 disk drive proceeds with the loading process while the terminal is performing self test. When the disk drive is quiet,

press the Function key on the Type 3 terminal which corresponds to CP/M mode of operation. The sign-on message should appear. If the disk is still in the loading process, a message "DISK LOAD FAIL" appears when you press the CP/M Function key. Wait until the disk drive is quiet and press the CP/M Function key again to get the sign-on message.

Method 2. If the Type 3 terminal has been used for some other application and the disk drive has power on, insert the CP/M flexible disk in the Type 1 disk drive, close the door, and press the RESET button on the disk drive. Press the RESET button on the terminal. The terminal will perform self-test. When the disk drive is quiet, press the function key to select CP/M mode of operation. The sign-on message should appear. If the disk is still in the loading process, a message "DISK LOAD FAIL" appears when you press the CP/M Function key. Wait until the disk drive is quiet and press the CP/M Function key again to get the sign-on message.

RELOADING WITH TYPE 3 TERMINAL

This version of CP/M can determine if the terminal is loaded with software. If a program ends in a 'lock up' condition, the system can be reset by pressing the RESET button on the disk drive. CP/M determines that the terminal has operating software and bypasses the terminal load process.

SYSTEM SIGN-ON MESSAGE

The system sign-on message displayed when CP/M is bootstrapped contains vital information about the version of the BIOS routine, the version of the terminal controlware, and the available user space. If you have any problems with your system be sure to include this information from the sign-on message with any questions. The following is an example of the sign-on message with the Type 3 terminal:

```
Control Data 110 using Type 3 (Display) terminal
Copyright 1982, Control Data Corporation
Terminal Controlware Vers.  2.07

64k CP/M vers 2.2 for Control Data 110  BIOS 2.09
56k user space

A>
```

USE OF KEYS ON THE TYPE 3 TERMINAL

Your terminal keyboard has tan keys, gray keys, and white keys. The tan keys generate displayable characters. The gray keys (when not shifted) generate displayable characters. (Refer to Appendix B for the functions of the gray keys when shifted.) Some of the white keys are used by CP/M to generate special operations. The rest of the white keys generate two or three character sequences which are not used in normal CP/M operations. The following list gives the CP/M usage of the white keys.

Key	Action
NEXT	Issue Carriage return
←	Issue backspace code "BS"
⇧	When held down causes tan key to issue the uppercase character (shift key).
→|	Issues tab code "TAB".
⊖	Dual action key. Pressing once turns on red light on keycap and causes following key depressions of tan keys to be uppercase alphabetic characters. Pressing again turns off red light and allows normal operation of tan keys (similar to a shift-lock key).
CTRL	When held down with another key causes selection of the Control case value for the key.
CR	Shifted causes carriage return code to be issued.
DEL	Unshifted causes delete code "DEL" to be issued.
PRINT	Unshifted causes contents of screen to be printed on the attached printer. Shifted PRINT is not used.
SETUP	Enters the setup mode of operation to allow you to change display characteristics.

PREPARING THE SYSTEM FOR USE

Preparing the system for use consists of:

- Checking that certain external and internal switches are properly set.
- Powering the system on.
- Inserting the system flexible disk into the drive.
- Loading the system program into memory.

VERIFYING THE SWITCH SETTINGS

Certain switches on the terminal and the disk drive must be set for use with CP/M 2.2. Call a CDC Customer Engineer to verify that the switches are set as indicated below.

Type 2 Terminal	The switches referred to are located under the protective door at the upper right front of the terminal. All switches except switches 2, 3, and 9 must be set to the ON position (left side down).
Type 1 Terminal	All switches except switch 5 must be set to the ON position.
Disk Drive	The switches referred to are behind the front panel of the Type 1 (primary) drive which has a RESET switch. The rotary switch must be set to 7. Slide switches 1, 3, 4, and 5 must be up. Slide switches 2, 6, 7, and 8 must be down.†

Other switches may require setting when you use the Type 1 terminal with a printer. This is covered in section 13 of this manual.

---

†Setting the slide switches as indicated causes the diagnostics to be bypassed resulting in a faster load.

TURNING ON SYSTEM POWER

To turn on your system, make sure that no floppy disks are in the disk drives. Press the "1" or "ON" side of the switch on the side of the terminal keyboard to turn on terminal power. Press the "ON" switch on the front of the Type 1 and Type 2 disk drives to turn on the disk drive power.

In about a minute the display on the terminal will brighten and give the message "DISK LOADING FAILURE" for the Type 2 or "NOP" for the Type 1 terminal. Your system is ready to operate.

LOADING CP/M OR APPLICATION FLEXIBLE DISKS WITH CP/M

With either a Type 1 or Type 2 terminal the system is loaded by one of two methods:

Method 1. At the beginning of the day, turn on power on the terminal and the flexible disk drive. Insert the CP/M disk in the Type 1 disk drive and close the door to the drive. The system will load and display the sign-on message when the CRT warms up to display information.

Method 2. If the terminal and the disk drive already have power on, insert the CP/M flexible disk in the Type 1 disk drive and close the door. Press the RESET button on the terminal and the disk drive. If the terminal and the disk drive had been previously used with PLATO it is necessary to hold the reset buttons down for at least 7 seconds. A message "DISK LOADING FAILURE" (for Type 2 terminal) or "NOP" (for Type 1 terminal) will appear at the bottom area of the screen. This message is normal for loading CP/M. Then the system will display the sign on-message.

NOTE

If you are using a non-standard switch setting on the front panel of your terminal which gives you the option of selecting the load source, you will have to select disk load twice to load CP/M. This action is necessary since when the initial load is done to determine terminal type, the controlware restarts the bootstrap process and will require a second disk load source selection.

RELOADING WITH TYPE 1 OR TYPE 2 TERMINAL

This version of CP/M can determine if the terminal is loaded with software. If a program ends in a 'lock up' condition, the system can be reset by pressing the RESET button on the disk drive. CP/M determines that the terminal has operating software and bypasses the terminal load process.

SYSTEM SIGN-ON MESSAGE

The system sign-on message displayed when CP/M is bootstrapped contains vital information about the version of the BIOS routine, the version of the terminal controlware, and the available user space. If you have any problems with your system be sure to include this information from the sign-on message with any questions. The following is an example of the sign-on message with the Type 2 terminal:

```
Control Data 11Ø using Type 2 (Display) Terminal
Copyright 1981,1982, Control Data Corporation
Terminal Controlware Vers.  2.Ø7

64k CP/M vers 2.2 for Control Data 11Ø  BIOS 2.Ø9
56k user space

A>
```

THE TERMINAL RESET FUNCTION (ON TYPE 1/TYPE 2 TERMINAL)

The RESET switch located on the right front of the display performs two different functions, one if pressed longer than three seconds (long reset) and the other if pressed less than three seconds (short reset).

Long Reset

A long reset is required only when changing from self-contained PLATO or Control Data 110 user diagnostics to CP/M 2.2 use. Pressing the RESET switch for more than three seconds results in a check to see if the diagnostics are to be performed. After performing the diagnostics, or omitting them if so instructed, the program goes to the autoload section. There input loads into memory of the unit either via a flexible disk (standalone mode) or over the communication network (PLATO or Control Data Shared Network.

Short Reset

Pressing the RESET switch for less than three seconds reinitializes the system. A check is made to see if a previous good load had occurred. If it did not, the long master reset procedure is started. If it did, control returns to the program in memory. When a program in memory has been running, a short reset starts the load operation.

USE OF KEYS WITH THE TYPE 1/TYPE 2 TERMINAL

When entering data on the keyboard in the procedures below, keep in mind the following:

- The Print and Control functions are performed differently on the Type 1 and Type 2 terminals.
- The Carriage Return key is labeled "NEXT".

Print Function

To perform the Print function on the Type 2 terminal, press the PRINT key (shifted) or press the COPY key (shifted). On the Type 1 terminal, press the COPY key (shifted).

Control C Function

To perform this function on the Type 2 terminal, press the CTRL key (shifted or unshifted) and C simultaneously. On the Type 1 terminal, press COPY (unshifted) followed by C.

Carriage Return Function

The key which performs the Carriage Return function is labeled differently on various terminals. Prompts which require a Carriage Return contain one of the following phrases:

"type CR"
"type RETURN"

When one of these phrases appears in a prompt, press the key which is labeled CR, RETURN, or NEXT.

The following paragraphs describe characteristics of Type 1 and Type 2 terminals which cause Control Data 110 implementation on those terminals to differ from implementation on the Type 3 terminal.

KEYBOARD

The keyboard has brown and white keys and one blue key. The character codes emitted by the blue and white keys are described below. The CTRL function is also described. A numeric keypad feature is discussed.

CHARACTER CODES

Some of the white keys emit an ASCII code when pressed while others perform a non-ASCII action. Certain keys emit different codes in the shifted and unshifted modes while others emit the same code in each mode. The Type 2 terminal has the codes engraved on the side of the keys while the Type 1 does not. Refer to figure 2-2 for an illustration of the keyboard.

ASCII Keys

Table 4-1 below lists the keys which emit ASCII codes.

TABLE 4-1. KEY-ASCII CODE RELATIONSHIP

TOP ENGRAVING	SIDE ENGRAVING (IST III ONLY)	ASCII CODE (SHIFTED)	ASCII CODE (UNSHIFTED)	ASCII CONTROL CODE (SHIFTED)	ASCII CONTROL CODE (UNSHIFTED)
CR TAB	TAB	tab	tab	tab	tab
+	# +	#	+	#	+
←	~ ^	~	^	RS	RS
-	& _	&	-	&	-

TABLE 4-1. KEY-ASCII CODE RELATIONSHIP (CONTD)

TOP ENGRAVING	SIDE ENGRAVING (IST III ONLY)	ASCII CODE (SHIFTED)	ASCII CODE (UNSHIFTED)	ASCII CONTROL CODE (SHIFTED)	ASCII CONTROL CODE (UNSHIFTED)
÷	|	|	\	FS	FS
X	' (Open Quote) @	'	@	NUL	NUL
SUPER	{ }	{	}	ESC	GS
SUB	ESC	esc	esc	ESC	ESC
ERASE	ERASE	bs	bs	BS	BS
HELP		etx	etx	etx	etx
NEXT	CR	cr	cr	cr	cr
EDIT	LF	lf	lf	lf	lf
BACK	BS	bs	bs	BS	BS
DATA	DEL	del	del	US	US
STOP	BREAK	ctl S	ctl S	ctl S	ctl S

Non-ASCII Keys (Type 1 or Type 2 Terminal)

The action of the non-ASCII keys is described below.

PRINT (Type 2 Only)

Unshifted. No action.

Shifted.† Causes the contents of the display to be printed. The printer can be any printer used on the system.

†Function shown in status line.

CTRL (Type 2 Only)	Unshifted. Performs control functions when pressed simultaneously with another key. Shifted. Same as unshifted.
TERM ANS	Unshifted.† Initiates an automatic repeat of the previously struck key. The repetition is about four times per second. The automatic repeat continues until TERM ANS is again pressed. Shifted.† Same as unshifted.
COPY	Unshifted. Causes the system to interpret the next keystroke as a control character. Shifted.† Causes the contents of the display to be printed.
FONT MICRO	Unshifted.† Performs the Alpha Lock function. Uppercase alphabetic characters are generated, but lowercase non-alphabetic characters are provided. Shifted.† Performs the Shift Lock function. The keyboard responds as if the shift key is pressed.
|‾‾| |__|	Unshifted. Clears the terminal screen independently of CP/M 2.2. Shifted. Same as unshifted.
LAB	Unshifted. Causes the terminal to exit numeric keypad mode. Shifted.† Causes the terminal to enter or exit numeric keypad mode if it is enabled.

Control Function

The Control function is performed differently on the Type 2 and Type 1 terminals. On the Type 2, it is performed by pressing the CTRL key simultaneously with another key. On the Type 1, Control is performed by first pressing COPY (unshifted) and then pressing a second desired key.

THE NUMERIC KEYPAD MODE (TYPE 1/TYPE 2 TERMINALS)

The operation of the keyboard can be changed to provide a numeric keypad function. In numeric keypad mode, the codes generated by certain keys are changed. This mode is enabled by the TERMSET†† program.

---

†Function shown in status line.

††Refer to section 13, Customizing The 110 System.

When the numeric keypad function is enabled, pressing the SHIFT and the LAB (or Mode) keys simultaneously causes the keyboard to enter the numeric keypad mode. The status line (see below) then displays "KEYPAD". When in the keypad mode, pressing the LAB (or Mode) key in upper or lower case returns the keyboard to a normal configuration.

The Type 2 terminal may be ordered with the keypad keys installed, or a keycap set may be installed. The keys have the alternate codes printed on the front side of the key.

The codes listed below are generated in the numeric keypad mode.

Top Engraving	Codes Generated
7 8 9	+ - .
u i o	7 8 9
j k l	4 5 6
m , .	1 2 3
Space Bar	0
±	±
÷	/
x	*
⇐	No Action
TERM ANS	No Action

The blue NEXT key and all other white keys operate as in the normal mode of operation in CP/M.

THE STATUS LINE (TYPE 1/TYPE 2 TERMINALS)

A status line is located at the bottom of the screen. The status line identifies the mode in which the terminal is operating. It displays KEYPAD, ALPHA LOCK, SHIFT LOCK, REPEAT, and PRINTING or a combination of these.

Your Control Data 110 system uses 8-inch flexible disks. The system uses double-sided, double-density flexible disks for all normal operations. The system will also accept single-sided, single-density flexible disks which are used for interchange with other CP/M systems which use 8-inch flexible disks. Software purchased from other vendors comes in this single-density, single-sided format.

WRITE PROTECT

Most 8-inch disks come with a write-protect slot punched in the lower edge of the flexible disk. (IBM diskettes do not have this slot). This slot must be covered with opaque tape to allow the flexible disk to be written on. Be sure to cover this slot before you use any flexible disk in this system whether to format it or write on it.

You may be familiar with a system which uses 5-inch flexible disks. The handling of the write protect slot (on the side of the 5-inch flexible disk) is the reverse of the above.

FLEXIBLE DISK FORMAT

The Control Data 110 uses a unique format to get maximum capacity from the double-sided, double-density flexible disk. You must hardware format any double-sided, double-density flexible disks before writing data on them in this system. This hardware formatting is done by the FORMAT utility program. The operation of the program is described later in this manual.

HANDLING AND INSERTING FLEXIBLE DISKS

Care should be taken in handling flexible disks. Recommendations are:

- When not in use, keep a flexible disk in its envelope.
- Store loosely in a vertical position, not stacked.

- Do not let flexible disk touch metal when stored. Information can be lost.
- Do not touch flexible disk surface exposed by the jacket slot.
- Do not attempt to clean flexible disk in any manner.
- Write on flexible disk jacket label before applying it to flexible disk. Use a felt tip pen, no pencil or ball point pen in order not to damage the flexible disk.
- Do not fasten paper clips to flexible disk jacket edges.
- Keep flexible disk away from magnetic fields and from ferromagnetic materials that may be magnetized. Magnetized clips used to hold paper can cause errors on a flexible disk.
- Protect flexible disk from liquids, dust, ashes, and metallic substances.
- Do not keep flexible disks where excessive heat may occur. Examples are window sills and cars.

To place a flexible disk in the disk-drive unit, refer to figure 5-1 and take the following steps.

1. Apply power to disk subsystem.

CAUTION

The drive must be powered on before inserting or removing a flexible disk or the disk may be damaged.

2. Press door latch (pushbar just below door) to open access door.
3. Remove flexible disk from storage envelope.

NOTE

If information is to be written onto flexible disk, write-protect notch must be covered with opaque tape.

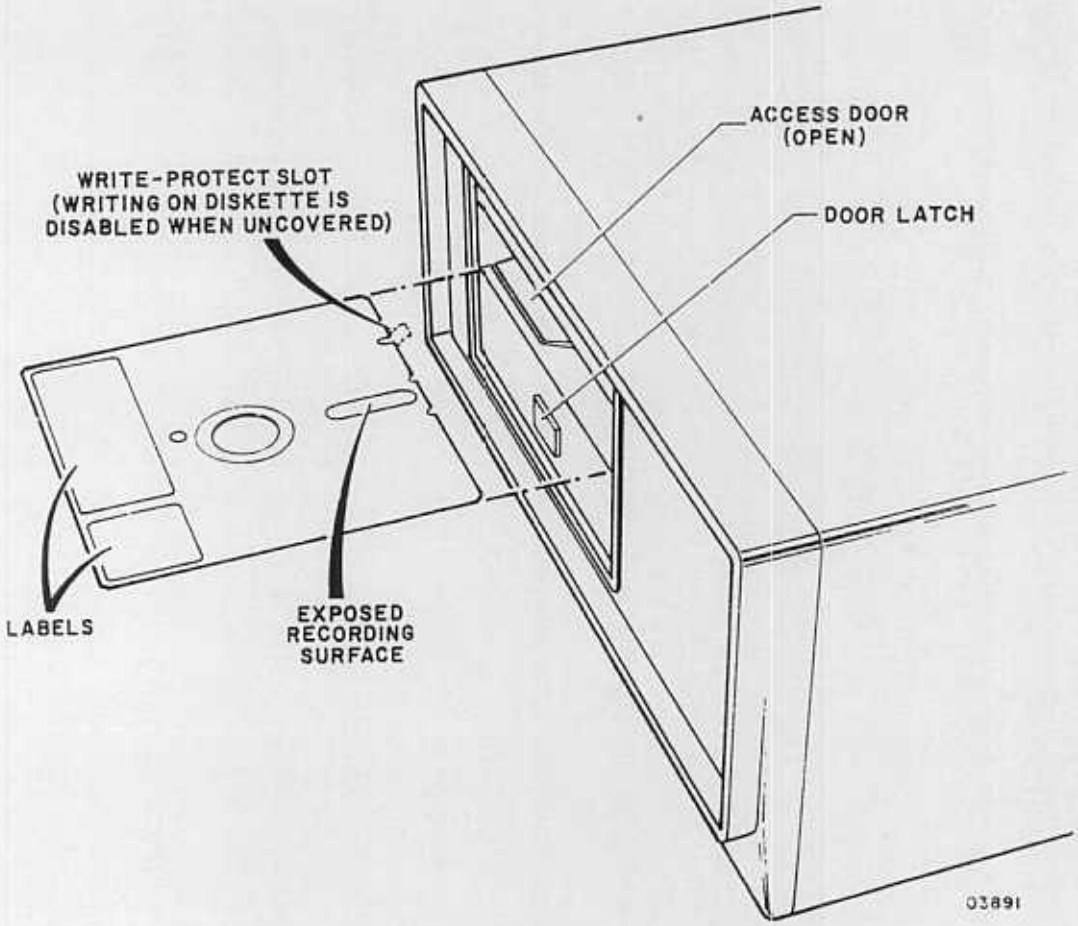


Figure 5-1. Inserting the Flexible Disk

4. Hold flexible disk so that label side is up and slide flexible disk into drive unit until solidly seated.

5. Close drive access door by pressing down on lip of door until door latches.

6. To remove flexible disk, press door latch to open door and remove disk from drive. Place disk in storage envelope. Close access door.

TYPE OF FLEXIBLE DISK TO USE

Your disk drive is designed to use CDC model 425 double-density, double-sided flexible disks or equivalent. If you can not get CDC model 425 flexible disks, the following IBM Diskette 2D disks or equivalent are recommended:

IBM Part Number	Description
1766872	Double-Density Diskette 2 (256 bytes/sector)
1669044	Double-Density Diskette 2 (512 bytes/sector)
1669045	Double-Density Diskette 2 (1024 bytes/sector)

You can use any of the above formats since you will be reformatting them to use on your Control Data 110 system.

FORMATTING YOUR DOUBLE-DENSITY FLEXIBLE DISK

You must format your purchased double-density flexible disks before you use them in your Control Data 110 system. The utility FORMAT, supplied on your CP/M flexible disk allows you to format your new flexible disks using either the Type 1 (primary) disk drive or the Type 2 (secondary) disk drive.

To format your flexible disk follow the steps below:

1. Apply power to your Control Data 110 system if it is not already on. See procedure in section 3 if you have a Type 3 terminal or procedure in section 4 if you have a Type 1 or Type 2 terminal.

2. Be sure you have covered write-protect slot on bottom of your flexible disks to be formatted with an opaque tape (supplied with your flexible disks if they have a write-protect slot). Some suppliers do not provide a write-protect slot.

3. Load your CP/M flexible disk if it is not already loaded. See procedure in section 3 if you have a Type 3 terminal or procedure in section 4 if you have a Type 1 or Type 2 terminal.

4. Get a system prompt displayed by pressing "NEXT" key. System prompt appears on your display as:

   A>

5. Type: FORMAT <next>†
   or: format <next>

---

†<next> means press "NEXT" key on your terminal.

6. You will see the following display:

```
Control Data 110
Diskette Formating Routine
Version 2.1

Which drive do you want to format on?
( Ø - Primary   1 - Secondary )
```

7. If you have a single disk drive or you want to format your flexible disk on the Type 1 drive, use this procedure. If you have a two-drive system, go to step 8.

7A. Type: 0

You will see the following display:

```
Control Data 110
Diskette Formating Routine
Version 2.1

Which drive do you want to format on?
( Ø - Primary   1 - Secondary )
Ø

Remove system disk and place disk to be formatted in
Primary drive and type any key to continue.
```

7B. Remove your CP/M flexible disk from Type 1 drive. Press space bar. You will see the following display:

```
Control Data 110
Diskette Formating Routine
Version 2.1

Which drive do you want to format on?
( Ø - Primary   1 - Secondary )
Ø

Remove system disk and place disk to be formatted in
Primary drive and type any key to continue.

 Type the number of the format you want.

1. Single density, single sided
2. Double density, double sided
```

7C. Place flexible disk to be formatted in the Type 1 drive and shut access door. Type: 2

7D. Your flexible disk will be formatted. This takes about a minute and then you will see the following display:

```
Control Data 110
Diskette Formating Routine
Version 2.1

Which drive do you want to format on?
( 0 - Primary   1 - Secondary )
0

Remove system disk and place disk to be formatted in
Primary drive and type any key to continue.

 Type the number of the format you want.

1. Single density, single sided
2. Double density, double sided

2
Type "f" to format again or be sure system disk is on the
primary drive and type any key to return to CP/M.
```

7E. To format more flexible disks type: f
and follow prompts on display.

7F. To return to CP/M place system flexible disk in Type 1 drive and press space bar. You will then see the CP/M prompt as:

```
A>
```

8. If you have a two-drive system do the following:

8A. Type: 1

8B. You will see the following display:

```
Control Data 110
Diskette Formating Routine
Version 2.1

Which drive do you want to format on?
( Ø - Primary   1 - Secondary )
1

Type the number of the format you want.

1. Single density, single sided
2. Double density, double sided
```

8C. Place flexible disk to be formatted in Type 2 drive and shut access door. Type: 2

8D. Your flexible disk will be formatted. This takes about a minute and then you will see the following display:

```
Control Data 110
Diskette Formating Routine
Version 2.1

Which drive do you want to format on?
( Ø - Primary   1 - Secondary )
Ø

Remove system disk and place disk to be formatted in
Primary drive and type any key to continue.

 Type the number of the format you want.

1. Single density, single sided
2. Double density, double sided


Type "f" to format again or be sure system disk is on the
primary drive and type any key to return to CP/M.
```

8E. To format more flexible disks type: f
and follow prompts on display.

8F. To return to CP/M place system flexible disk in Type 1 drive and press space bar. You will then see the CP/M prompt as:

```
A>
```

MAKING BACKUP COPIES OF YOUR MASTER FLEXIBLE DISKS

The CP/M flexible disk which you received with your Control Data 110 system is a valuable resource and you should protect it from being damaged by making a backup copy of the flexible disk and then use the backup copy for all further use in your system. This is also true of any other software you purchase for your system whether purchased from Control Data Corporation, or any other vendor.

If you have a two-drive Control Data 110 system, you can use the utility DSKUTIL to create your backup copy. If you have a one-drive system you must use the utility FILECOPY to create your backup copy. See the section on Utilities to use these routines for purchased software.

The sections on installing software give detailed directions on how to create your backup copies of CP/M and other CDC-supplied software.

NOTE

After creating a backup copy of any purchased software, be sure to store the original in a safe place away from magnetic fields and only use the original when necessary to replace damaged copies of the software.

Installing CP/M 2.2 software on your Control Data 110 consists of loading the master system flexible disk received with the system, formatting a supply of blank flexible disks, and making copies of your master CP/M flexible disk. Following the procedures below provides you with a working copy of CP/M 2.2 on a Control Data 110 system which has one disk drive.

If your system has two disk drives, don't use this section, but go to section 9 for your instructions.

FORMATTING BLANK FLEXIBLE DISKS

Take your supply of unformatted double-density, double-sided flexible disks and hardware format them using the procedure given in section 5 under "FORMATTING YOUR DOUBLE-DENSITY FLEXIBLE DISKS". When you have your flexible disks formatted, continue with the following procedures.

MAKING COPIES OF THE CP/M 2.2 MASTER FLEXIBLE DISK

Making copies on a single-drive system involves removing and inserting flexible disks for each file copied. Since the CP/M 2.2 flexible disk contains many files, copying is a time consuming process. Therefore, it is recommended that copies be made on another Control Data 110 system with two disk drives. Contact your local CDC representative for assistance.

To make copies on a one-drive system, perform the steps below. The CP/M master flexible disk must be loaded using the procedure given in section 3 or 4 depending on your type of terminal.

1. Type: SYSGEN <next>

2. SYSGEN program starts and display shows the following:

```
A>sysgen
CDC SYSGEN for CP/M 2.2
version 1.00

Source drive ? (or RETURN to skip)
```

3. Type: A

   Display shows the following:

```
A>sysgen
CDC SYSGEN for CP/M 2.2
version 1.00

Source drive ? (or RETURN to skip)a
Put source disk on A, then type RETURN
```

4. Type: <next>

   Program will operate for about 10 seconds. Then display shows the following:

```
A>sysgen
CDC SYSGEN for CP/M 2.2
version 1.00

Source drive ? (or RETURN to skip)a
Put source disk on A, then type RETURN
Function completed
Destination drive ? (or RETURN to terminate)
```

5. Remove your master CP/M flexible disk from drive and set it aside. Type: A

   Display shows the following:

```
A>sysgen
CDC SYSGEN for CP/M 2.2
version 1.00

Source drive ? (or RETURN to skip)a
Put source disk on A, then type RETURN
Function completed
Destination drive ? (or RETURN to terminate)a
Put destination disk on A, then type RETURN
```

6. Insert blank, formatted flexible disk in drive.

   Type: <next>

   Program operates about 10 seconds and then display shows the following:

```
A>sysgen
CDC SYSGEN for CP/M 2.2
version 1.00

Source drive ? (or RETURN to skip)a
Put source disk on A, then type RETURN
Function completed
Destination drive ? (or RETURN to terminate)a
Put destination disk on A, then type RETURN
Function completed
Destination drive ? (or RETURN to terminate)
```

7. At this point, CP/M 2.2 Operating System has been copied from tracks 0 and 1 of master flexible disk to tracks 0 and 1 of copy flexible disk. To copy remainder of master flexible disk, continue with procedure below.

8. Remove copy flexible disk from drive and insert your master CP/M flexible disk in drive.

   Type: <next>

   This returns control to CP/M 2.2 Operating System and your display shows the following:

```
A>sysgen
CDC SYSGEN for CP/M 2.2
version 1.00

Source drive ? (or RETURN to skip)a
Put source disk on A, then type RETURN
Function completed
Destination drive ? (or RETURN to terminate)a
Put destination disk on A, then type RETURN
Function completed
Destination drive ? (or RETURN to terminate)

A>
```

9. Type: FILECOPY <next>

FILECOPY program produces the following display:

```
Control Data 110

Single disk drive file copy program
Copyright (C) 1981, Control Data Corporation

  This program copies files from one diskette
  to another utilizing only 1 disk drive.  The
  program asks for the destination and  source
  filenames in the same manner as pip, format:
  DESTINATION = SOURCE.  Drive codes are
  required and generalized filename templates
  with imbedded * and ? are legal.  The
  following are valid command lines:

        A: = A:*.*
        c:test.abc = a:test.abc
        C:x*.* = A:test*.*


    Filenames:
```

10. To start actual copying of files, type:

    a:*.*=a:*.* <next>

    Prompt and reply appear as:

    Filenames:a:*.*=a:*.*

11. Display indicates which flexible disk to insert. Type CR.† Master is source flexible disk and copy is destination flexible disk. The system checks flexible disks and prevents use of wrong flexible disk. When copying is complete, display indicates:

    Filenames:

12. Press <next>. Display indicates:†

    Insert system disk, type CR to exit

---

†Refer to Key Terminology (section 1).

13. Insert system flexible disk and press <next>. System returns to CP/M 2.2. Make a second copy by repeating steps 1 through 13.

Remove the master flexible disk from the drive and file it. The master CP/M 2.2 flexible disk provides serial number identification and proof of ownership. The master flexible disk should not be used again unless the copies are damaged.

CAUTION

File the master flexible disk in a safe place which is free from magnetic fields.

The copies made in the procedure above are exact copies of the CP/M 2.2 flexible disk. These copies should be serialized with the number on the original master flexible disk and they are subject to the conditions of the CP/M 2.2 licensing agreement. Label one copy BACKUP MASTER CP/M 2.2 and file it in a safe place. Label the other copy WORKING CP/M 2.2 and modify it as described below. Be sure to put the copyright labels supplied on both of the flexible disks.

CP/M 2.2 INSTALLATION VERIFICATION TEST†

Upon completion of CP/M installation, it is recommended that the verification test be run to assure a complete and reliable installation. Verify both the backup master and the working copy.

Load the copy of the CP/M 2.2 flexible disk before performing the installation tests.

1. Type in:

   SUBMIT CPMTSTØ1 <next>

2. Test initiates.

---

†The CP/M 2.2 test must be run prior to performing the procedure under Making a Working Copy of CP/M 2.2.

This test takes about 2-1/2 minutes to complete. At the end of a successful test, the display shows:

```
***** VERIFICATION TEST COMPLETE
ERA   CPMTST.MØ1
ERA   CPMTST.BAK
A>
```

If the test fails, the display shows CP/M 2.2 error messages.

MAKING A WORKING COPY OF CP/M 2.2

This procedure tells how to remove unnecessary material to gain working space. Before proceeding, you should perform the CP/M 2.2 Verification Test above. This test must be done before any material is erased from the disk.

Take the flexible disk which was labeled WORKING CP/M 2.2 and insert it into the drive. Then perform these steps:

1. Reboot system with <Control C>. How this is done depends on whether terminal is Type 1, Type 2 or Type 3.†

   After you type <Control C>, drive is accessed and display indicates:

   ```
   A>
   ```

   System can now write or erase files from WORKING CP/M 2.2 disk.

2. Type STAT <next> to find the space available on flexible disk.

3. Type:

   ```
   ERA *.ASM <next>
   ```

4. Excess files are erased from WORKING CP/M 2.2 flexible disk.

5. If system flexible disk contains CBASIC 2.38 and Pascal/M 4.01 as well as CP/M 2.2, continue erasing files by typing:

   ```
   ERA CONFIG.PCO <next>
   ERA CONFIG.DAT <next>
   ERA INSTALLP.SUB <next>
   ERA READ.ME <next>
   ```

---

†Refer to Key Terminology (section 1)

6. When the files are erased, A> appears on display.

7. To verify that this copy is a correct working copy, reload your new disk. If you have a Type 3 terminal, use procedure in section 3 on "Loading CP/M." If you have a Type 1 or Type 2 terminal, use procedure in section 4 on "Loading CP/M".

This section tells how to install CBASIC 2.38, Pascal/M 4.01, and BASIC-80 5.20 on a CP/M 2.2 flexible disk with a one-drive system.

These programs are delivered on double-density, double-sided, flexible disks. These flexible disks are master flexible disks and should only be used once to make a backup master. Then file the master flexible disks in a safe place free from magnetic fields.

INSTALLING CBASIC 2.38

Make a backup flexible disk of CBASIC using the FILECOPY program as described in section 8. Follow this procedure:

1. Put WORKING CP/M 2.2 flexible disk in disk drive and start disk drive.
2. Type in:

   Filecopy <next>

   Display indicates:

   Filenames:
3. Type in:

   A:*.*=A:*.* <next>
4. Follow prompts on display.

CBASIC 2.38 INSTALLATION VERIFICATION TEST

1. Type in:

   SUBMIT CBASTST1 <next>
2. Test initiates.

This test takes about 18 seconds. At the end of a successful test, the display shows:

```
A> ERA TESTCBAS.INT
A>
```

If the test fails, the display shows CP/M 2.2 error messages.

INSTALLING PASCAL/M 4.01

Make a backup flexible disk of Pascal/M using the FILECOPY program as described in section 8. Follow this procedure:

1. Put WORKING CP/M 2.2 flexible disk in disk drive and start disk drive.
2. Type in:

   filecopy <next>

   Display shows:

   Filenames:
3. Type in:

   A:*.*=A*.* <next>
4. Follow prompts on display.

PASCAL/M 4.01 INSTALLATION VERIFICATION TEST

This test is a Pascal/M 4.01 program which must be compiled and run to test the installation of Pascal/M 4.01.

1. Type:

   PRUN PASCAL TESTP <next>
2. Program is compiled.
3. Type:

   PRUN TESTP <next>
4. Test initiates.

At the end of a successful test, the display shows a list of files followed by:

A>

The display shows Pascal/M 4.01 error messages if the test fails.

INSTALLING BASIC-80 5.20

Make a backup flexible disk of BASIC-80 using the FILECOPY program as described in section 8. Perform these steps:

1. Put WORKING CP/M 2.2 flexible disk in disk drive. Start disk drive.
2. Type in:

   filecopy <next>

   Display indicates:

   Filenames:
3. Type in:

   A:*.*=A:*.* <next>
4. Follow prompts on display.

BASIC-80 5.20 INSTALLATION VERIFICATION TEST

This test must be run to test the installation of BASIC-80 5.20.

CAUTION

Follow these instructions carefully.

1. Type in:

   MBASIC <next>

   A message appears on display the last line of which is:

   OK

2. Type in:

   LOAD "RANTEST <next>

   Display shows:

   OK

3. Type in:

   EDIT 10 <next>

   Display shows:

   10

4. Press Space key to move cursor until the following appears on screen:

   OPEN "R", 1, "

5. Type in:

   cA

6. Type: <next>

7. Type in:

   EDIT 77 <next>

   Display shows:

   77

8. Repeat steps 4 through 6.

9. Type in:

   SAVE "RANTEST2 <next>

   Display shows:

   OK

10. Type in:

    SYSTEM <next>

    Display shows:

    A>

11. Type in:

    MBASIC RANTEST2 <next>

12. Test initiates.

A series of consecutive numbers appears on the display. At the end of a successful test, the display shows:

    A>

Methods of copying files and transferring software from single- to double-density flexible disks with a one-drive system are described below.

The following definitions apply:

- The source flexible disk is the flexible disk from which data is read.
- The destination flexible disk is the flexible disk to which data is written.

COPYING FILES

Copying files is a time-consuming process on a single-drive system. It is recommended that copies be made on a Control Data 110 system which has two disk drives. Or, additional copies can be purchased. Contact a Control Data sales representative for assistance. If it is necessary to copy files on a single-drive system, perform these steps:

1. Load CP/M 2.2 and type:

   FILECOPY <next>

2. FILECOPY program introduces itself and then displays:

   Filenames:

3. In response to this prompt type:

   a:*.*=a:*.* <next> (If your source is double-density)

   or

   a:*.*=C:*.* <next> (If your source is single-density)

4. Prompt and reply look like one of the following (depending on whether source is double- or single-density):

   Filenames:a:*.*=a:*.* (if source is double density)

   Filenames:a:*.*=C:*.* (if source is single density)

5. Program indicates via prompts which flexible disk to insert and when to type Carriage Return. Program checks for correct flexible disk, and prevents system from operating with wrong flexible disk.

6. When copy is complete, program displays:

   Filenames:

7. Type: <next>

   Program displays:

   Insert system disk, type CR to exit

8. Type: <next> to return control to CP/M 2.2.

For more information, refer to The FILECOPY Program in section 12.

TRANSFERRING SOFTWARE FROM SINGLE- TO DOUBLE-DENSITY FLEXIBLE DISKS

Software purchased from a source which provides standard CP/M 2.2 compatible flexible disks is recorded on 3740 formatted flexible disks. These flexible disks are single-density, single-sided disks. The flexible disks have 26 sectors of 128 bytes each on 77 tracks.

Many vendors provide these flexible disks with no formatting on track 0 and 1, therefore, no data can be stored or read from these tracks.

This software must be transferred to a formatted, double-density, double-sided flexible disk and a backup copy made Follow these steps:.

1. Load CP/M 2.2 and type: FILECOPY <next>

FILECOPY program displays:

```
Filenames:
```

2. Type your response so display appears as:

```
Filenames:a:*.*=c:*.* <next>
```

3. When program asks for a source flexible disk, remove CP/M 2.2 flexible disk and insert source single-density flexible disk in drive.

4. Type: <next>.

5. When program asks for a destination flexible disk, remove source flexible disk and insert a blank, formatted, double-density, double-sided flexible disk.

6. Insert flexible disks according to prompts until program again displays:

```
Filenames:
```

7. Type: <next>.

8. Insert CP/M 2.2 flexible disk and type: <next>.

To make another copy of the double-density flexible disk, follow the procedure described under "Copying Files" at the beginning of this section.

To examine this double-density copy disk of your purchased software, it is necessary to make it into a CP/M 2.2 flexible disk and put several CP/M 2.2 files on it. Perform these steps:

1. Put system under CP/M 2.2 control and after system prompt type:

```
sysgen <next>
```

2. Answer resulting prompts by typing: A <next> A, respectively.

3. Remove CP/M 2.2 disk and insert a blank, formatted flexible disk.

4. Write system onto blank flexible disk by typing <next>. When transfer is complete, display shows:

   Function completed

5. Remove flexible disk in drive and insert CP/M 2.2 flexible disk.

6. Type: <next> to return control to CP/M 2.2.

7. Use FILECOPY to transfer the files PIP.COM, TERMINAL.COM and STAT.COM to the new flexible disk by answering the prompts as follows:

   Filenames:a:=a:pip.com <next>

   Filenames:a:=a:stat.com <next>

   Filenames:a:=a:terminal.* <next>

   Filenames: (Type: <next> at this point)

The application flexible disk now is a CP/M 2.2 flexible disk which can be loaded and executed.

To verify that this copy is a correct working copy, reload your new disk. If you have a Type 3 terminal, use the procedure in section 3 on "Loading CP/M". If you have a Type 1 or Type 2 terminal, use the procedure in section 4 on "Loading CP/M".

It is now possible to list the directory, use PIP to list files on the printer, and use STAT *.* to see the size of the files.

Installing CP/M 2.2 software on your Control Data 110 consists of loading the master system flexible disk received with the system, formatting a supply of blank flexible disks, and making copies of your master CP/M flexible disk. Following the procedures below provides you with a working copy of CP/M 2.2 on a Control Data 110 system which has two disk drives.

If your system has one disk drive, don't use this section, but go to section 6 for your instructions.

The following definitions apply:

- The source flexible disk is the flexible disk from which data is read.
- The destination flexible disk is the flexible disk to which data is written.

FORMATTING BLANK FLEXIBLE DISKS

Take your supply of unformatted double-density, double-sided flexible disks and hardware format them using the procedure given in section 5 under "FORMATTING YOUR DOUBLE-DENSITY FLEXIBLE DISKS". When you have your flexible disks formatted, continue with the following procedures.

MAKING COPIES OF THE CP/M 2.2 MASTER FLEXIBLE DISK

The most efficient way to make a copy of your CP/M master flexible disk is to use the utility DSKUTIL. The CP/M master flexible disk must be loaded using the procedure given in section 3 or 4 depending on your type of terminal.

1. Type: DSKUTIL <next>
2. DSKUTIL program starts and display shows the following:

```
Control Data 110

DISK UTILITY
Version 2.09

This program allows you to:

  Make a verified track for track copy of a flexible disk using two disk drives.

  Verify a copy made by this program.
  Analyze a diskette for bad sectors.
*********************************************************************

Enter the number of the routine you desire.
1.     Track for track copy.
2.     Track for track verify.
3.     Disk analysis for bad sectors.
4.     Return to CP/M.  (Be sure system disk is in A)
```

3. Type: 1

   Display shows the following:

```
      Disk copy utility.

      This utility copies and verifies a disk
      Mount original on drive A (Primary disk drive)
      Mount blank copy on drive B (Secondary disk drive)
      Type character when ready.
```

4. Insert your blank formatted copy flexible disk in Type 2 disk drive. Type: <next>

   Program takes about four minutes to make and verify the copy. Then display shows the following:

```
Disk copy utility.

This utility copies and verifies a disk
Mount original on drive A (Primary disk drive)
Mount blank copy on drive B (Secondary disk drive)
Type character when ready.


Unit A: is Double Sided
Unit B: is Double Sided
Double Density Copy

ROUTINE completed  ********************************

Enter the number of the routine you desire.
1.     Track for track copy.
2.     Track for track verify.
3.     Disk analysis for bad sectors.
4.     Return to CP/M.  (Be sure system disk is in A)
```

5. Although the copy routine did a verify, you can double check that you have an exact copy by the following procedure. Type: 2

   Display shows the following:

```
Disk verify utility.

Mount original on drive A (Primary disk drive)
Mount copy on drive B (Secondary disk drive)
Type character when ready.
```

6. Type: <next>

Program operates for about three minutes and then display shows the following:

```
Disk verify utility.

Mount original on drive A (Primary disk drive)
Mount copy on drive B (Secondary disk drive)
Type character when ready.


Unit A: is Double Sided
Unit B: is Double Sided
Double Density Verify

ROUTINE completed  ********************************

Enter the number of the routine you desire.
1.     Track for track copy.
2.     Track for track verify.
3.     Disk analysis for bad sectors.
4.     Return to CP/M.  (Be sure system disk is in A)
```

The preceding procedure provides one copy of the master CP/M 2.2 flexible disk. Make a second copy by repeating the procedure. Remove the master flexible disk from the Type 1 drive and file it. The master CP/M 2.2 flexible disk provides serial number identification and proof of ownership. The master flexible disk should not be used again unless the copies are damaged.

CAUTION

File the master flexible disk in a safe place which is free from magnetic fields.

The copies made in the preceding procedure are exact copies of the CP/M 2.2 flexible disk. These copies are serialized with the number on the original master flexible disk and they are subject to the conditions of the CP/M 2.2 licensing agreement. Label one copy BACKUP MASTER CP/M 2.2 and file it in a safe place. Label the other copy WORKING CP/M 2.2 and modify it as described in the procedure below. Be sure to put the copyright labels supplied on both of the flexible disks.

CP/M 2.2 INSTALLATION VERIFICATION TEST

Upon completion of CP/M installation, it is recommended that the verification test be run to assure a complete and reliable installation. This test must be run before you remove any files from your CP/M 2.2 flexible disk. Verify both the backup master and the working copy.

Load the copy of CP/M 2.2 flexible disk before performing the installation tests below.

1. Type in:

   SUBMIT CPMTSTØ1 <next>

2. Test initiates.

This test takes about 2-1/2 minutes to complete. At the end of a successful test, the display shows:

```
***** VERIFICATION TEST COMPLETE
ERA   CPMTST.MØ1
ERA   CPMTST.BAK
A>
```

If the test fails, the display shows CP/M 2.2 error messages.

MAKING A WORKING COPY OF CP/M 2.2

This procedure tells how to remove unnecessary material from your CP/M disk to gain additional working space. Before doing this, you should perform the CP/M 2.2 Verification test above. The test will not work if you have erased any material from your CP/M disk.

Take the flexible disk which was labeled WORKING CP/M 2.2 in the procedure above and insert it into the Type 1 drive after removing the other CP/M disk. Follow these steps:

1. Reboot system with: <control C>. (See "Use of Keys" in section 3 or 4 depending on your terminal Type.)

Type 1 disk drive is selected as system disk and terminal displays:

```
A>
```

System can now write or erase files from WORKING CP/M 2.2 flexible disk.

2. Type: STAT <next>

   Amount of free disk space will be listed. You can do this any time to see how much space is available on your disk.

3. Type: ERA *.ASM <next>

   This removes excess source code files from WORKING CP/M 2.2 flexible disk.

4. If system flexible disk contains CBASIC and PASCAL/M as well as CP/M 2.2, continue erasing files by typing:

```
ERA CONFIG.PCO <next>
ERA CONFIG.DAT <next>
ERA INSTALLP.SUB <next>
ERA READ.ME <next>
```

   When the files are erased, the A> prompt appears on display.

5. You have now made maximum space available for a WORKING CP/M 2.1 disk.

6. If you need to make more copies of WORKING CP/M 2.2 disk use DSKUTIL program as described in the beginning of this section.

7. To verify that this copy is a correct working copy, reload your new disk. If you have a Type 3 terminal, use procedure in section 3 on "Loading CP/M". If you have a Type 1 or Type 2 terminal, use procedure in section 4 on "Loading CP/M.

This section tells how to install CBASIC 2.38, Pascal/M 4.01, and BASIC-80 5.20 on a CP/M 2.2 flexible disk with a two-drive system.

These programs are delivered on double-density, double-sided, flexible disks. These flexible disks are master flexible disks and should only be used once to make a backup master. Then file the master flexible disks in a safe place free from magnetic fields.

The following definitions apply:

- The source flexible disk is the flexible disk from which data is read.
- The destination flexible disk is the flexible disk to which data is written.

INSTALLING CBASIC 2.38

First make a backup copy of the master CBASIC 2.38 flexible disk as described in section 11. Then follow this procedure:

1. Put WORKING CP/M 2.2 flexible disk in Type 1 drive and backup CBASIC 2.38 flexible disk in Type 2 drive.
2. Type in:

   ```
   pip a:=b:*.* <next>
   ```

   CBASIC 2.38 files transfer to CP/M 2.2 flexible disk.

CBASIC 2.38 INSTALLATION VERIFICATION TEST

Follow these steps to verify CBASIC 2.38 installation:

1. Type in:

   SUBMIT CBASTST1 <next>

2. Test initiates.

This test takes about 18 seconds. At the end of a successful test, the display shows:

```
A> ERA TESTCBAS.INT
A>
```

If the test fails, the display shows CP/M 2.2 error messages.

INSTALLING PASCAL/M 4.01

Make a backup Pascal/M 4.01 flexible disk as described in section 11. Follow these steps:

1. Put WORKING CP/M 2.2 flexible disk in Type 1 drive and put backup Pascal/M 4.01 flexible disk in Type 2 drive.

2. Type in:

   submit B:INSTALLP <next>

   Pascal/M 4.01 files transfer to CP/M 2.2 flexible disk, and a compile and execute function of Pascal/M 4.01 test program occurs. Terminal displays general information about the Pascal/M 4.01 system.

PASCAL/M 4.01 INSTALLATION VERIFICATION TEST

This test is a Pascal/M 4.01 program which must be compiled and run to test the installation of Pascal/M 4.01.

1. Type in:

   PRUN PASCAL TESTP <next>

2. Program is compiled.

3. Type in:

   PRUN TESTP <next>

4. Test initiates.

At the end of a successful test, the display shows a list of files followed by:

```
A>
```

The display shows Pascal/M 4.01 error messages if the test fails.

INSTALLING BASIC-80 5.20

Make a backup BASIC-80 5.20 flexible disk as described in section 11. Follow these steps:

1. Put WORKING CP/M 2.2 flexible disk into Type 1 drive and backup BASIC-80 5.20 flexible disk into Type 2 drive.

2. Type in:

   pip a:=b:*.* <next>

   BASIC-80 5.20 files transfer to CP/M 2.2 flexible disk.

BASIC-80 5.20 INSTALLATION VERIFICATION TEST

Follow these steps to verify BASIC-80 5.20 installation:

1. Insert system flexible disk in Type 1 disk-drive.
2. Insert MBASIC flexible disk in Type 2 disk-drive.
3. Type in:

   B:MBASIC B:RANTEST <next>

4. Test initiates.

A series of consecutive numbers appears on the display. At the end of a successful test, the display shows:

A>

Methods of copying files with a two-drive system are discussed below. The CP/M 2.2 program must be loaded as described in section 3 if you have a Type 3 terminal, or in section 4 for a Type 1 or Type 2 terminal.

The following definitions apply:

- The source flexible disk is the flexible disk from which data is read.
- The destination flexible disk is the flexible disk to which data is written.

Three cases are considered:

- Copying files from one flexible disk to the system flexible disk.
- Copying files from a non-system flexible disk to another non-system flexible disk.
- Transferring software from single- to double-density flexible disk.

COPYING FROM A FLEXIBLE DISK TO THE SYSTEM FLEXIBLE DISK

To copy all the files from one flexible disk to the system flexible disk, perform the following steps.

1. Place source flexible disk on Type 2 disk drive and system flexible disk on Type 1 disk drive.
2. Then type:

```
pip a:=b:*.*[v] <next>
```

   This transfers all files from flexible disk in Type 2 disk drive to system flexible disk in Type 1 disk drive. In the process, any file on Type 1 disk drive with same name as a file on Type 2 disk drive is replaced.

3. To copy an individual file to system flexible disk, place source flexible disk on Type 2 disk drive and system flexible disk on Type 1 disk drive.

4. Then type in PIP A:=B: followed by the file name. For example, to copy the TERMSET.COM file, type:

   PIP A:=B:TERMSET.COM <next>

COPYING FROM A DOUBLE-DENSITY NON-SYSTEM FLEXIBLE DISK TO ANOTHER DOUBLE-DENSITY NON-SYSTEM FLEXIBLE DISK

To copy files from a double-density non-system flexible disk (such as a data flexible disk) to another double-density non-system flexible disk (such as a new, formatted flexible disk), do the following:

1. Place destination flexible disk in Type 2 disk drive and CP/M 2.2 flexible disk in Type 1 disk drive.

2. Use Control C (see "Use of Keys" in Section 3 or 4 depending on your terminal type) to introduce CP/M 2.2 to flexible disk in Type 2 disk drive.

3. Then type:

   pip <next>

4. PIP program loads and display shows prompt:

   *

5. Remove system flexible disk from Type 1 disk drive and put source flexible disk in Type 1 disk drive.

6. Then type:

   b:=a:*.*[v] <next>

7. All files on flexible disk in Type 1 disk drive transfer to flexible disk in Type 2 disk drive. System verifies transfer.

8. PIP program then displays the * prompt. Place CP/M 2.2 flexible disk in Type 1 disk drive and type <next>. Control returns to CP/M 2.2 program.

The flexible disk in Type 2 disk drive is now a copy of the flexible disk in Type 1 disk drive.

TRANSFERRING SOFTWARE FROM SINGLE- TO DOUBLE-DENSITY FLEXIBLE DISKS

Software purchased from a source which provides standard CP/M 2.2 compatible flexible disks is recorded on 3740 formatted flexible disks. These flexible disks are single-density, single-sided disks. The flexible disks have 26 sectors of 128 bytes each on 77 tracks.

Many vendors provide these flexible disks with no formatting on track 0 and 1, therefore, no data can be stored or read from these tracks.

This software must be transferred to a formatted, double-density, double-sided flexible disk and a backup copy made. Perform these steps:

1. Load system program.

2. Place a blank, formatted, double-density, double-sided flexible disk in Type 2 disk drive. Introduce this flexible disk to CP/M 2.2 with <Control C>. (See "Use of Keys" in Section 3 or 4 depending on your terminal type.) This allows CP/M 2.2 to write on flexible disk in Type 2 disk drive.

3. To transfer entire single-density application flexible disk to double-density, blank flexible disk in Type 2 disk drive, type:

   ```
   pip <next>
   ```

4. The PIP program then displays the * prompt. Remove CP/M 2.2 flexible disk from Type 1 disk drive and insert single-density applications flexible disk into Type 1 disk drive.

5. In response to the * prompt, type:

   ```
   b:=c:*.*[v] <next>
   ```

This transfers all the files on the application flexible disk to the double-density flexible disk.

File your single-density application flexible disk in a safe place and use the double-density copy as a master copy. Many application flexible disks have xxx.SUB files to be used for installation. These should operate correctly using the double-density flexible disk as the source.

To make this double-density copy into a CP/M 2.2 flexible disk which can be loaded and executed, it is necessary for you to write the system onto it. Use the following procedure.

1. Put WORKING COPY of CP/M 2.2 on Type 1 disk drive and put this double-density application disk in Type 2 disk drive. Close access door on both drives. Type: <Control C>. (See "Use of Keys" in Section 3 or 4 depending on your terminal type.)

   This introduces the new disk to the system and allows files to be written on it.

2. Type:

   ```
   SYSGEN <next>
   ```

   This starts SYSGEN program which will transfer the system to your application flexible disk.

3. Answer the questions from SYSGEN as:

   ```
   A <next>
   B <next>
   <next>
   ```

   This will read CP/M system from track 0 and 1 of Type 1 disk drive and write it to track 0 and 1 of Type 2 disk drive:

4. Transfer necessary system files using PIP by typing the following:

   ```
   PIP B:=PIP.COM <next>
   PIP B:=STAT.COM <next>
   PIP B:=TERMINAL.* <next>
   ```

Your application flexible disk is now a CP/M 2.2 flexible disk which can be loaded and executed. To verify that this copy is a correct working copy, reload your new disk. If you have a Type 3 terminal, use the procedure in section 3 on "Loading CP/M". If you have a Type 1 or Type 2 terminal, use the procedure in section 4 on "Loading CP/M".

It is now possible to list the directory, use PIP to list files on your printer, and to use STAT *.* <next> to see the size of the files.

Utility programs make it possible to transfer data from one flexible disk to another, format flexible disks, perform date and time clock operations, etc. This section contains descriptions of some utility programs and instructions for performing these utility operations.

FILECOPY

The FILECOPY program makes it possible to copy files from one flexible disk to another. The program operates with one disk drive. The following transfers are possible:

Double-density to double-density

Single-density to single-density

Single-density to double-density

Double-density to single-density

The format for destination = source input of the filenames in FILECOPY is identical to that of PIP destination = source. Filename templates utilizing asterisks and question marks are legal. This means multiple files can be copied utilizing a single filename template. The only restriction in the format is that the drive code is required. This is needed to differentiate between single- and double-density.

Perform these steps to copy files using FILECOPY:

1. Execute the FILECOPY program by typing:

   FILECOPY <next>

2. Program prompts for filename input with the following question:

   Filenames:

   The following are valid command lines:

   ```
   A: = A:*.*
   c:test.abc = a:test.abc
   C:X*.*=A:test*.*
   ```

3. Program asks that source flexible disk be inserted into drive with message:

   Insert source disk, type CR to continue

4. Type: <next>. Program responds with name of file being copied and message:

   Insert destination disk, type CR to continue

5. If file is larger than contents of one buffer, the program cycles through steps 3 and 4 until file is completely copied.

6. After all files matching input template have been copied, program recycles to the filenames query.

7. Carriage Return allows system to exit program. Before exiting, the following message is given:

   Insert system disk, type CR to exit

The program has a protection mechanism which protects against insertion of the wrong flexible disk. On the first write to the destination flexible disk, the file FCOPY.$$$ is created. On subsequent writes, the existence of that file on the destination flexible disk is verified before the write takes place. On subsequent reads, the non-existence of the file on the source flexible disk is verified.

FILECOPY error messages are:

Filename is too long

No source filename entered

Invalid - name or extension is too long

Invalid drive

Unable to complete copy - random write error

Source file not found

The wrong flexible disk has been inserted

FORMAT

The FORMAT program operates on either a one or two disk-drive system. It provides prompts to indicate when to remove the CP/M flexible disk when you are using the Type 1 (primary) disk drive to format a new flexible disk.

Before using FORMAT be sure that the write protect slot on the flexible disk to be formatted is covered with opaque tape. See figure 5-1 (Section 5) for location of this slot.

The program hardware formats single-density, single-sided flexible disks in the IBM standard format of 26 sectors of 128 bytes/sector on each of 77 tracks. It is not necessary to format these IBM type flexible disks if they were purchased in this format.

The program hardware formats double-density, double-sided flexible disks in the format used on the CDC CYBER 120 equipment which is 77 tracks, 16 sectors/track, 512 bytes per sector. You must format ALL double-density, double-sided flexible disks before using them on the Control Data 110 system.

Detailed examples of the use of FORMAT are given in section 5.

The format program is self prompting and is executed by typing:

```
FORMAT <next>
```

and then following the prompts.

The following is the prompt messages displayed on the screen to use a Type 1 disk drive which you see when using FORMAT.

```
Control Data 110
Diskette Formating Routine
Version 2.1

Which drive do you want to format on?
( Ø - Primary   1 - Secondary )
Ø

Remove system disk and place disk to be formatted in
Primary drive and type any key to continue.

 Type the number of the format you want.

1. Single density, single sided
2. Double density, double sided
```

When the desired number is chosen, formatting will start and the following will appear on the screen at the end:

```
Type "f" to format again or be sure system disk is on the
primary drive and type any key to return to CP/M.
```

The following is the prompt message displayed on the screen to use a Type 2 disk drive which you see when using FORMAT:

```
Control Data 110
Diskette Formating Routine
Version 2.1

Which drive do you want to format on?
( Ø - Primary   1 - Secondary )
1

Type the number of the format you want.

1. Single density, single sided
2. Double density, double sided
```

When the desired number is chosen, the following will appear on the screen:

```
Type "f" to format again or be sure system disk is on the
primary drive and type any key to return to CP/M.
```

SYSGEN

SYSGEN is a system copy program which transfers a CP/M 2.2 system from an existing Control Data CP/M 2.2 flexible disk to another flexible disk. The program only operates on double-sided, double-density flexible disks that have been formatted on the Control Data 110 by the FORMAT program.

Section 6 gives a detailed example on the use of this program to transfer the Control Data CP/M system from one flexible disk to another using one disk drive.

The following is an example of the display you see on transferring from one disk in Type 1 disk drive to another disk in Type 1 disk drive. Follow the prompts and select the letter A or B to specify the source and destination of the CP/M system to copy.

```
A>sysgen
CDC SYSGEN for CP/M 2.2
version 1.ØØ

Source drive ? (or RETURN to skip)a
Put source disk on A, then type RETURN
Function completed
Destination drive ? (or RETURN to terminate)a
Put destination disk on A, then type RETURN
Function completed
Destination drive ? (or RETURN to terminate)

A>
```

DSKUTIL A DISK BACKUP AND MAINTENANCE UTILITY

DSKUTIL is a general purpose utility for use on flexible disks used in a Control Data 110 CP/M system having two disk drives. The utility program is menu driven and provides you with the capability to:

1. Make and verify a track-for-track copy of either a single-sided, single-density flexible disk or a double-sided, double-density flexible disk.
2. Verify a copy made with option 1.
3. Perform surface analysis of either a single-sided, single-density flexible disk or a double-sided, double-density flexible disk. This surface analysis will report any bad sectors and tracks on the flexible disk.

OPERATING INSTRUCTIONS

To use this program reply to the system prompt as follows:

```
A>DSKUTIL <next>
```

This starts the utility. If necessary, you can then remove the system flexible disk containing this program and execute the utility services desired as indicated on the prompts. Section 9 gives examples of the use of this program.

TRACK FOR TRACK COPY AND VERIFY

This routine makes and verifies an exact copy of a single-density flexible disk onto another single-density flexible disk or an exact copy of a Control Data 110 double-density flexible disk to another formatted double-density flexible disk. Any read errors are reported.

Before making a copy you must have formatted flexible disks of the correct type. Single-sided, single-density flexible disks are normally purchased with the correct hardware format. Double-sided, double-density flexible disks must be hardware formatted using the FORMAT program to get the correct disk hardware format for operating on the Control Data 110.

The track for track copy reports any bad sectors on the display. Data is copied as recovered after ten attempts to read the bad sector.

A read error is reported as an unrecoverable read error if ten tries were made to read the data without a correct read. In this case, the bad data is copied. A "Soft" read error is reported with the number of read retries made before a successful read. The data thus read is correct.

Follow the prompts for operation of this routine. If you get bad sectors on the copy, the sector errors might be caused by a piece of dirt on the flexible disk. In this case, the reported bad sector may disappear on running the surface analysis utility on the source flexible disk several times. Once the errors do not appear on the analysis, make a copy of the flexible disk and retire it.

To recover from bad sectors you can also try using a head cleaning flexible disk on the source disk drive and then trying the copy routine again.

TRACK FOR TRACK VERIFY

The copy made by the track-for-track copy-and-verify routine may be verified by running the verify routine after making the copy. This provides a check on the quality of the copy flexible disk and proves that it can be read correctly. The verify routine only reports tracks which do not verify and should give verify errors if there were read errors on the original flexible disk.

If the original flexible disk did not show any read errors, any errors shown in the verify are probably due to a bad destination flexible disk. Replace the destination flexible disk and make a new track for track copy.

SURFACE ANALYSIS

This routine reads each sector of the single- or double-density flexible disk and reports any sector read errors. This utility only reads the flexible disk and thus can be used to check the quality of any Control Data 110 formatted and written flexible disk. You can run the surface analysis on flexible disks which were formatted using the FORMAT program. This surface analysis then checks the media quality of your new flexible disks.

This routine may also be used to 'sweep' debris from a flexible disk to attempt to correct any read errors on the flexible disk. Repeat the analysis process several times to see if the read errors disappear.

If you do analysis on a flexible disk which has read errors and the errors disappear after several analysis passes, the flexible disk is probably dirty and should be retired after you make a copy of the flexible disk.

DATTIM

The CP/M 2.2 system has a date and time clock. A time setting program is on the flexible disk. To use it type:

```
DATTIM <next>
```

Follow the program prompts to set the date and time.

The clock routine updates the time of day. It advances the date at midnight. The routine uses a 24-hour clock so PM times run from 12:00 to 23:59.

NOTE

The month and the year are not automatically updated.

THE TTY.COM COMMUNICATIONS PROGRAM

This program operates on Type 2 terminals only.

This program allows one to load the timesharing resident into the Type 2 terminal from the CP/M flexible disk. The time sharing resident makes the terminal act like a teletypewriter and allows one to communicate to the Control Data Shared Network (CDSN) or other networks.

Type:

```
A> TTY <next>
```

No further operator input is required. The sequence below demonstrates operation of the program.

The CRT first displays a list of instructions for setting switches, removing the flexible disk, and then proceeding with a carriage return.

The program then retrieves the timeshare resident from disk and loads it into the terminal. The terminal can be used to communicate to the DSN or other networks.

When the timeshare resident is loaded, pressing the CTRL and LAB keys displays the terminal characteristics on the screen. These characteristics may be changed to adjust your terminal to the proper characteristics of the system you are trying to access. This is done by touching the CRT screen on the particular characteristic you wish to change, (i.e. parity, baud rate, etc.).

After running this program, it is necessary to press the RESET button on the terminal for at least seven seconds to reboot the CP/M 2.2 system.

This section through the appendices is written for the person who is going to implement application programs on the Control Data 110 system using the CDC version of CP/M 2.2.

It is assumed that you are an experienced programmer familiar with assembly language programming. You should also have the Digital Research set of manuals on CP/M and be familiar with them.

ORGANIZATION OF CONTROL DATA 110 BIOS

The Control Data 110 is a multi-processor system consisting of the Type 1 (primary) disk drive which contains a 4 mHz. Z-80 processor with 64K of memory and one of 3 terminals (Type 1, 2, or 3).

The disk system uses a 1791 floppy disk controller chip to access up to 2 double-density, double-sided disk drives. The only communication from the disk controller is to the terminal.

The terminal provides access to the keyboard and display, and also has RS-232 ports to external equipment and a CDC parallel channel which communicates with the disk controller and the Type 1 (graphics) printer. Each of the terminals may be loaded from the disk controller with software (or controlware) which provides the unique CP/M characteristics.

The Type 3 terminal has a resident Read Only Memory which provides keyboard and screen display characteristics. The Type 1 and Type 2 terminals get all of their controlware from the downloaded data from the disk controller board.

Each of the terminals has a Z-80 processor and some internal memory for the controlware.

The Control Data 110 Basic Input/Output System (BIOS) routine is resident in both the disk controller and in the attached terminal. The disk controller portion provides the interface to user programs while the terminal controlware provides the I/O driver routines.

INPUT AND OUTPUT BUFFERING

All input to the system is interrupt driven where the received bytes are stored in an input buffer. Input buffers are 264 bytes for communications lines and 40 bytes for the keyboard and other human sources. All output is on a polled basis so that data is taken from the 40 byte output buffer when there is data available. (The screen has an 8-byte buffer)

An 8-byte stub of each buffer is contained in the disk controller while the remaining bytes of the buffer are contained in the terminal. The terminal idle loop constantly attempts to make transfers between the disk controller board buffer and the terminal buffer as data and space are available.

SYSTEM SIGN-ON MESSAGE

The system sign-on message displayed when CP/M is bootstrapped contains vital information about the version of the BIOS routine, the version of the terminal controlware, and the available user space. If you have any problems with your system be sure to include this information from the sign-on message with any questions. The following is an example of the sign-on message with the Type 2 terminal:

```
Control Data 110 using Type 2 (Display) Terminal
Copyright 1981,1982, Control Data Corporation
Terminal Controlware Vers.  2.07

64k CP/M vers 2.2 for Control Data 110  BIOS 2.09
56k user space

A>
```

TERMINAL PROGRAMS

The controlware for the Type 3 terminal is stored on the CP/M disk as file TERMINAL.COM. This is NOT a command file and should not be executed. The controlware for the Type 1 and Type 2 terminals is stored on the CP/M disk as the file TERMINAL.ALT.

These files should not be renamed and they must be resident on the CP/M disk for the system to boot. The file TERMINAL.COM can be downloaded into any of the terminals and will inform BIOS as to the terminal Type. If it is loaded in the Type 1 or Type 2 terminals, it causes BIOS to load the file TERMINAL.ALT next in order to get the correct controlware.

VERSION IDENTIFICATION

Control Data 110 CP/M 2.2 is an evolving program which is released at a number of different levels. The version is identified on your master flexible disk external label by an 'L' number. The system also identifies itself by version numbers for the BIOS and the terminal controlware when it is loaded into your Control Data 110. The following is a table of versions which exist as of the date of this manual:

'L' number	BIOS version	Terminal controlware version
L0200	1.00	1.00 (Type 1/2 terminal)
L0210	1.00	1.02 (Type 1/2 terminal)
L0240	1.00	1.04 (Type 1/2 terminal)
L0280	2.12	2.07 (Type 3 terminal)
L0280	2.12	2.07 (Type 1/2 terminal)
L0330	2.20	2.10 (Type 1/2 terminal)
L0330	2.20	3.08 (Type 3 terminal)

USER MEMORY SPACE

The sign-on message when CP/M is loaded gives available user memory space in 'k' units. This space definition includes all memory from location 0 to the start of the CP/M BDOS routine.

The exact user memory space can be calculated as in the following example:

- Sign-on gives 56K user space.
- 56 x 1024 = 57,344 bytes available.
- Subtracting 256 for low memory not usable gives:

  57,344 - 256 = 57,088 actual bytes of memory for user program.

Note that actual memory space may be less than shown here. To maintain compatibility with future updates of Control Data 110 CP/M 2.2 and also with future updates of CP/M no user should plan on using more than 48K = 48,896 bytes of actual memory. User programs should be designed to operate in this minimum amount of memory, but they can make use of additional memory as it is available in any particular system.

USE OF MOVCPM

The program MOVCPM can be used to create smaller CP/M systems for the Control Data 110. Normally you will use a 64K system to get maximum memory, but you may wish to try programs using a smaller system to guarantee future compatibility.

MOVCPM only works with BIOS version 2.00 and higher.

As an example: to generate a 60K CP/M system do the following:

```
A>MOVCPM 60 * <next>
```

The new system will be generated in memory ready to save or SYSGEN.

Immediately do a SYSGEN and don't read a system, but write it to a new flexible disk. If you write back to your system flexible disk on Type 1 disk drive, be sure to reload CP/M. Otherwise, the system will 'hang' up.

To generate a full size CP/M system do:

```
A>MOVCPM 64 * <next>
```

And then do a SYSGEN.

CAUTION

The above method is the only one which will not give system 'hang' conditions.

THE SYSGEN PROGRAM

The Control Data 110 CP/M system flexible disk is not a standard CP/M 2.2 flexible disk. SYSGEN is a system generation program that transfers a CP/M 2.2 System from an existing flexible disk to other flexible disks. It only operates on flexible disks that have been formatted by the FORMAT program to the double-density, double-sided format.

To generate a system, use this document in conjunction with the CP/M 2.2 Alteration Guide.

The following is an extract from the SYSGEN.ASM file, which describes the format-in-memory of a system which has been read by SYSGEN and this is also the format that the system must have in memory to use SYSGEN.

```
;   This program performs the SYSGEN function for the Control
;   Data 110 CP/M 2.2 system

;   The program reads the system from tracks 0 and 1 and copies
;   it to tracks 0 and 1 of the new system disk

;   Memory map of allocation of system once read into memory by
;   MOVCPM plus use of DDT to get BOOT and BIOS.

;   980h        CP/M CCP
    1180h       CP/M BDOS
    2000h       BOOT
    2200h       BIOS
    2c00h       end of BIOS


;   Disk format for double-density 512-byte sectors
;   16-sectors per track (0..15)

;                                                   logical
;   head    cylinder    track   sector  sector      routine
;   0       0           0       0       0..3        BOOT
;   0       0           0       1..7    4..27       BIOS
;   1       0           1       0..5    0..09       CCP,BDOS
```

BIOS VECTOR LOCATION AND VALUES

The location of the BIOS vector which gives you access to the BIOS routines can be found by reading the contents of memory locations 1 and 2 as a word. This location contains the address of the second vector in BIOS.

The BIOS location depends on available user memory. The user memory is listed in the sign-on message when CP/M is booted up on the Control Data 110 system with BIOS version 2.00 or greater. For BIOS version 2.04 the user memory is 56K. In this version the BIOS vector starts at 0EE00h.

If you have made a smaller CP/M system by running MOVCPM then you must look at the contents of memory location 1 and 2 to find where the BIOS is located.

The following are the Standard CP/M BIOS vectors for a 56K user memory sytem.

ADDRESS	OFFSET	Vector name	
EE00	00	CBOOT	(Don't use this entry)
EE03	03	WBOOT	Warm boot
EE06	06	CONST	Console status to A
EE09	09	CONIN	Console input to A
EE0C	0C	CONOUT	Console output from C
EE0F	0F	LIST	List output from C
EE12	12	PUNCH	Modem control output from C
EE15	15	READER	Modem status input to A
EE18	18	HOME	Set disk track to 0
EE1B	1B	SELDSK	Select Disk drive in C
EE1E	1E	SETTRK	Set track number in BC
EE21	21	SETSEC	Set sector number in C
EE24	24	SETDMA	Set DMA address from BC
EE27	27	READ	Read disk data to DMA address
EE2A	2A	WRITE	Write disk data from DMA addr.
EE2D	2D	LISTST	List status to A
EE30	30	SECTRN	Translate sector number

USING THE IOBYTE FUNCTION IN CONTROL DATA 110, CP/M 2.2

For added flexibility, CDC CP/M 2.2 has implemented the IOBYTE function which allows reassignment of physical and logical devices. The IOBYTE function creates a mapping of logical to physical devices which can be altered during CP/M processing (see the STAT command). The definition of the IOBYTE function is as follows:

A single location in memory (location 0003h) is maintained, called IOBYTE, which defines the logical-to-physical device mapping which is in effect at a particular time. The mapping is performed by splitting the IOBYTE into four distinct fields of two bits each, called the CONSOLE, READER, PUNCH, and LIST fields, as shown below:

	BITS	7 6	5 4	3 2	1 0
IOBYTE at 0003h		LIST	PUNCH	READER	CONSOLE

The value in each field can be in the range 0-3, defining the assigned source or destination of each logical device. The values which can be assigned to each field are given below with the corresponding device name which is used in STAT to set individual values.

CONSOLE (CON:) field (bits 0, 1)

0 - Console is assigned to the CRT and keyboard device (TTY:)
1 - Reserved (CRT:)
2 - Input from communications line, output to communications line (BAT:)
3 - Reserved (UC1:)

READER (RDR:) field (bits 2, 3)

0 - READER input is communications status (TTY:)
1 - READER input is from touchpanel (RDR:)
2 - Reserved (UR1:)
3 - Reserved (UR2:)

PUNCH (PUN:) field (bits 4, 5)

0 - PUNCH output is to communications control (TTY:)
1 - Reserved (PUN:)
2 - Reserved (UP1:)
3 - Reserved (UP2:)

LIST (LST:) field (bits 7, 8)

0 - LIST output is to system printer (TTY:)
1 - LIST output is to CRT screen (CRT:)
2 - LIST output is to system printer (LPT:)
3 - LIST status is comm output buffer status (UL1:)

Note that this organization of the IOBYTE function is unique to the Control Data 110 CP/M 2.2 system and is designed for use by the user programs. No standard CP/M system program makes use of the IOBYTE function except for PIP which allows access to the physical devices, and STAT which allows the logical-physical assignments to be made and/or displayed.

CAUTION

Reserved values are used to prevent the system from hanging up. These assignments are subject to change in future versions of CP/M. To guarantee forward compatibility, no user program should use the reserved values.

CUSTOMIZING THE CONTROL DATA 110 SYSTEM

The Control Data 110 CP/M 2.2 system provides for customization of terminal characteristics, printer characteristics, and communications line characteristics. Terminal characteristics are items such as number of lines per page. On the Type 1 and Type 2 terminals you can change background color, cursor type, and scrolling mode. These variables can also be changed on the Type 3 terminal. In addition, the codes of most of the white keys on the Type 3 can be altered to meet special needs. Printer characteristics are the type of printer (Type 1 or serial-port printer such as the Type 2 printer) and line size. For the serial port printer you can change transmission speed, byte size, parity checking, and feedback method. The serial communications port parameters are baud rate, byte size, and parity.

This customization information is contained in the TERMINAL programs (TERMINAL.COM for the Type 3 terminal, and TERMINAL.ALT for the Type 1 and Type 2 terminals). The customization program TERMSET is provided with CP/M to allow you to customize your system to match your peripheral equipment and operator preference.

CUSTOMIZATION PARAMETERS

The customization parameters for the Type 3 terminal are different from those for the Type 1 and Type 2 terminals. The parameters and allowable values are displayed by the utility TERMSET. The following section on the use of TERMSET shows the allowable values.

The default parameters are shown on the display by the program TERMSET.

USING TERMSET TO SET OPTIONS

The TERMSET program provides the capability to set the customization parameters for your terminal. A change may be temporary, or the files TERMINAL.COM and TERMINAL.ALT may be permanently changed so the new parameters will be used the next time the Control Data 110 System is reloaded. To use TERMSET, reply to the CP/M prompt by typing the following so the display looks like:

```
A>TERMSET <next>
```

The program is self-prompting. It asks for your terminal type and then extracts the current parameters from the appropriate TERMINAL.xxx file and displays them. If you select a parameter value out of the given range, TERMSET gives you an error indication. If you get an error, you must select a value in the legal range since the illegal values will be stored in the TERMINAL.xxx files when you update them.

The TERMSET program changes any parameters in a temporary storage area. You have the option of updating the TERMINAL.xxx file for permanent changes. You may load the revised values into the terminal without making permanent changes. This allows you to test the parameter changes without committing to a permanent change in the TERMINAL.xxx file. You may exit TERMSET without affecting the terminal or the TERMINAL.xxx files.

The initial prompt from TERMSET is shown below. You must enter 3 if your terminal is a Type 3; enter 2 if a Type 2, or enter 1 if a Type 1 terminal.

```
CONTROL DATA 110

TERMINAL customization program.
Version 3.04

This program will allow you to create a new copy of the TERMINAL program
specialized to your particular equipment.
Values given in () are the delivered parameters for the TERMINAL program.

You may make temporary changes or permanent changes in the terminal program.
The following special prompt characters have the following action:
1       Causes the current modified values to be displayed.
2       Will abort the program with no changes.
3       Will download the current changed values to the terminal
        to test the changes.
4       Will record a new file with the permanent changes.


What type terminal do you have?  (1,2,or 3).
If your terminal has a separate keyboard, you have a type 3 terminal.
```

If you entered 3 to the initial prompt, the following display of parameters appear for the Type 3 terminal.

```
Item  Value   Description
  e     0     Printer Type       (0)=Either, 1= Graphics, 2= serial, 3=None
  f     3     Printer baud       0=150, 1=300, 2=600, (3)=1200, 4=2400, 5=4800,
                                 6=9600, 7=19200
  g     1     Printer byte size          0=7 bits, (1)=8 bits
  h     0     Printer parity     (0)=None, 1=Odd, 2=None, 3=Even
  i     0     Printer feedback method    (0)=DSR, 1=X on,X off
  j     0     Printer width+1    values from 1 to 255
  k    50     Printer width+1 div 256
  l     1     Comm. baud rate    0=150, (1)=300, 2=600, 3=1200, 4=2400, 5=4800,
                                 6=9600, 7=19200
  m     1     Comm. byte size    0=7bit, (1)=8 bit
  n     0     Comm. parity       (0)=None, 1=Odd, 2=None, 3=Even
  q    30     Lines on display   (30) may have 3 to 30 lines
  s     3     Comm 2 baud        0=150, 1=300, 2=600, (3)=1200, 4=2400, 5=4800,
                                 6=9600, 7=19200
  t     1     Comm 2 byte size   0=7 bits, (1)=8 bits
  u     0     Comm 2 parity      (0)=None, 1=Odd, 2=None, 3=Even
  v     3     Comm 3 baud        0=150, 1=300, 2=600, (3)=1200, 4=2400, 5=4800,
                                 6=9600, 7=19200
  w     1     Comm 3 byte size   0=7 bits, (1)=8 bits
  x     0     Comm 3 parity      (0)=None, 1=Odd, 2=None, 3=Even
  y           Display/change Function keys
  z           Display/change White keys
Enter item to change (alpha value under 'Item') or the following command
1=display, 2=abort, 3=temp, 4=permanent
```

If you entered 1 or 2 to the initial prompt, the following display of parameters appear for the Type 1 or Type 2 terminal.

```
Item  Value   Description
  d     1     Scroll Mode          0=Page, (1)=Row scroll, 2=Column scroll
  e     0     Printer Type         (0)=Either, 1= Graphics, 2= serial, 3=None
  f     3     Printer baud         0=150, 1=300, 2=600, (3)=1200, 4=2400, 5=4800,
                                   6=9600, 7=19200
  g     1     Printer byte size           0=7 bits, (1)=8 bits
  h     0     Printer parity       (0)=None, 1=Odd, 2=None, 3=Even
  i     0     Printer feedback method    (0)=DSR, 1=X on,X off
  J     0     Printer width+1      values from 1 to 255
  k    50     Printer width+1 div 256
  l     1     Comm. baud rate      0=150, (1)=300, 2=600, 3=1200, 4=2400, 5=4800,
                                   6=9600, 7=19200
  m     1     Comm. byte size      0=7bit, (1)=8 bit
  n     0     Comm. parity         (0)=None, 1=Odd, 2=None, 3=Even
  o     0     Background color     (0)=black, 1=white
  p     1     Cursor type          0=Underline, (1)=Block cursor
  q    30     Lines on display     (30) may have 3 to 30 lines
  r     0     Numeric keypad enable      (0)=alphanumeric, 1=Numeric
Enter item to change (alpha value under 'Item') or the following command
1=display, 2=abort, 3=temp, 4=permanent
```

If you wish to make permanent changes in the TERMINAL.xxx program enter 4 in response to the "Enter item to change" prompt. The following display shows how the TERMSET display will look in this case.

```
Item  Value   Description
  d     1     Scroll Mode          0=Page, (1)=Row scroll, 2=Column scroll
  e     0     Printer Type         (0)=Either, 1= Graphics, 2= serial, 3=None
  f     3     Printer baud         0=150, 1=300, 2=600, (3)=1200, 4=2400, 5=4800,
                                   6=9600, 7=19200
  g     1     Printer byte size           0=7 bits, (1)=8 bits
  h     0     Printer parity       (0)=None, 1=Odd, 2=None, 3=Even
  i     0     Printer feedback method    (0)=DSR, 1=X on,X off
  J     0     Printer width+1      values from 1 to 255
  k    50     Printer width+1 div 256
  l     1     Comm. baud rate      0=150, (1)=300, 2=600, 3=1200, 4=2400, 5=4800,
                                   6=9600, 7=19200
  m     1     Comm. byte size      0=7bit, (1)=8 bit
  n     0     Comm. parity         (0)=None, 1=Odd, 2=None, 3=Even
  o     0     Background color     (0)=black, 1=white
  p     1     Cursor type          0=Underline, (1)=Block cursor
  q    30     Lines on display     (30) may have 3 to 30 lines
  r     0     Numeric keypad enable      (0)=alphanumeric, 1=Numeric
Enter item to change (alpha value under 'Item') or the following command
1=display, 2=abort, 3=temp, 4=permanent  4
The TERMINAL file now contains the updated parameters.
Re-boot the system to use the new parameters.
Your previous terminal program is TERMINAL.OLD.

A>
```

If you are modifying the function keys for the Type 3 terminal, enter y to operate from the main display of TERMSET.* The following display then appears.

```
The function key values are:

KEY     HEX 1   HEX 2   HEX 3   Ascii 1 Ascii 2 Ascii 3

 F1      02      00      00      ^B
 F2      06      00      00      ^F
 F3      1B      42      00      ^[      B
 F4      1B      46      00      ^[      F
 F5      01      00      00      ^A
 F6      05      00      00      ^E
 F7      10      00      00      ^P
 F8      0E      00      00      ^N
 F9      1B      56      00      ^[      V
 F10     16      00      00      ^V
 F11     00      00      00
 F12     00      00      00

Enter function key (1..12) to change, or Q)uit ?
```

A modification to function key 11 is shown in the following example. Note that if you want less than three values generated by a function key, press the CTRL and @ keys to enter a null (00) for the unused values. Any value(s) following a null are invalid.

```
The function key values are:

KEY     HEX 1   HEX 2   HEX 3   Ascii 1 Ascii 2 Ascii 3

 F1      02      00      00      ^B
 F2      06      00      00      ^F
 F3      1B      42      00      ^[      B
 F4      1B      46      00      ^[      F
 F5      01      00      00      ^A
 F6      05      00      00      ^E
 F7      10      00      00      ^P
 F8      0E      00      00      ^N
 F9      1B      56      00      ^[      V
 F10     16      00      00      ^V
 F11     00      00      00
 F12     00      00      00

Enter function key (1..12) to change, or Q)uit ? 11
Do you want to enter hex values (Y,N)? y

Please type up to 3 hex values
Press space bar between values  01 02 00
```

The following display shows the result of modifying function key 11. The display also shows how you would make entries using actual keystrokes for the function values.

CAUTION

Entries of Control C or Control Z cannot be made correctly using this mode.

---

*This means of modifying a function key affects all operating states (lowercase, uppercase, lowercase with CTRL key pressed, and uppercase with CTRL key pressed). Item z of TERMSET (display/change white keys) allows a function key to be modified for a specific operating state.

```
The function key values are:

KEY     HEX 1   HEX 2   HEX 3   Ascii 1 Ascii 2 Ascii 3

 F1      02      00      00      ^B
 F2      06      00      00      ^F
 F3      1B      42      00      ^[      B
 F4      1B      46      00      ^[      F
 F5      01      00      00      ^A
 F6      05      00      00      ^E
 F7      10      00      00      ^P
 F8      0E      00      00      ^N
 F9      1B      56      00      ^[      V
 F10     16      00      00      ^V
 F11     01      02      00      ^A      ^B
 F12     00      00      00

Enter function key (1..12) to change, or Q)uit ? 12
Do you want to enter hex values (Y,N)? n

Please enter three keystrokes for the function values
use <CONTROL @> for null value. <CONTROL C> will quit program.
```

If you are modifying the white keys for the Type 3 terminal (the function and special purpose keys), enter z while TERMSET parameters for Type 3 terminal are on the screen. This displays the following type message. The message asks for the hexadecimal value of the white key to be changed. These values are given in table 13-1, which is a few pages later in this section. In this example, the codes for function key 12 in lowercase are to be changed. Note that if you want less than three values generated by a white key, press the CTRL and @ keys to enter a null (00) for the unused values. Any value(s) following a null are invalid.

```
WHITE KEY MODIFICATION

This portion allows you to examine and change each keycode
You must use your CDC 110 CP/M User's manual with this routine
to see which keycode matches each Keycap and shift

Do you want to use default values for keycodes (Y or N)? y

Enter hexadecimal value of white key to change, or Q)uit ? 0c

The White key value is:

KEY     HEX 1   HEX 2   HEX 3   Ascii 1 Ascii 2 Ascii 3

 0C      00      00      00

Do you want to change this value (Y,N)? y
Do you want to enter hex values (Y,N)? n

Please enter three keystrokes for the White key value
use <CONTROL @> for null value. <CONTROL C> will quit program.   F12
The White key value is:

KEY     HEX 1   HEX 2   HEX 3   Ascii 1 Ascii 2 Ascii 3

 0C      46      31      32      F       1       2


Enter hexadecimal value of white key to change, or Q)uit ?
```

DYNAMIC ALTERATION OF TERMINAL PARAMETERS

The controlware loaded into the terminal allows a user program to change terminal parameters by sending the terminal an ESCape sequence. The following paragraphs describe the sequences for altering basic terminal parameters and for altering the codes of the white keys on the type 3 terminal.

ALTERING BASIC TERMINAL PARAMETERS

The ESCape sequences for altering basic terminal parameters consist of the ASCII characters ESC, ESC, letter, value. The letter is one of the lowercase ASCII characters listed below. The value is the binary value to be set for the terminal parameter. After changing the parameters, the ESCape sequence ESC, ESC, 'a', 'a' must be sent to the terminal to reinitialize the terminal and put the parameter changes in effect. This capability is provided in all terminal controlware of version 1.03 or higher. The escape sequences are as follows:

NOTE

Refer to Customization Parameters above and the display from the program TERMSET for the meaning and permissible values for 'value' in the following sequences.

ESC, ESC, 'd', value	Set scroll mode (Type 1/2 only)
ESC, ESC, 'e', value	Printer type selector.
ESC, ESC, 'f', value	Comm 1 baud rate for RS-232 interface to printer
ESC, ESC, 'g', value	Comm 1 byte size for RS-232 interface
ESC, ESC, 'h', value	Comm 1 parity for RS-232 interface
ESC, ESC, 'i', value	Printer feedback method

ESC, ESC, 'j', value	Printer width (1 - 255)
ESC, ESC, 'k', value	Printer width (Multiples of 256)
ESC, ESC, 'l', value	Comm 0 Communications baud rate
ESC, ESC, 'm', value	Comm 0 Communications byte size
ESC, ESC, 'n', value	Comm 0 Communications parity
ESC, ESC, 'o', value	Display background color (Type 1/2 only)
ESC, ESC, 'p', value	Display cursor type (Type 1/2 only)
ESC, ESC, 'q', value	Number of lines on screen (3 - 30)
ESC, ESC, 'r', value	Numeric keypad enable (Type 1/2 only)
ESC, ESC, 's', value	Comm 2 baud rate (Type 3 only)
ESC, ESC, 't', value	Comm 2 byte size (Type 3 only)
ESC, ESC, 'u', value	Comm 2 parity (Type 3 only)
ESC, ESC, 'v', value	Comm 3 baud rate (Type 3 only)
ESC, ESC, 'w', value	Comm 3 byte size (Type 3 only)
ESC, ESC, 'x', value	Comm 3 parity (Type 3 only)
ESC, ESC, 'a', 'a'	Reinitialize terminal.

The reinitialize terminal command must be output to the terminal after completing a change of parameters. Some parameters take effect without the reinitializing the terminal, but it is safer to do it.

If the screen background color is changed by a user program, it is necessary to issue a clear screen command or a home cursor command to the terminal to fully set the background color. If this is not done, the screen displays stripes. This is because new data is of the new background color and the lines between data are of the old color. This may also be done by doing a manual clear screen. With a Type 1 or Type 2 terminal, the screen clears any time the key with the square symbol is pressed. With a Type 3 terminal, the key with the square symbol clears the screen, but only when the terminal is in compatibility mode. If your system is under CP/M control (A> being displayed), the screen of Type 2 and Type 3 terminals can be cleared by pressing the CTRL and Z keys and then the NEXT key. With a Type 1 terminal, this is done by individually pressing the COPY key, the Z key, and the NEXT key.

If the number of lines on the terminal is set to 29 or less, the user program can write in the additional lines up to line number 29 (lines are numbered from 0 to 29). This is done by issuing a

cursor positioning command to the desired line and then outputting data. The data output must not contain a carriage return or a line feed.

A carriage return or line feed when the cursor is below the screen size causes the top of the screen to scroll up one line and the cursor to return to the bottom line specified in screen size. Also, output below the last line must not write to character number 79 in a line (characters are numbered 0 to 79). If this occurs, the same scrolling and return will occur.

ALTERING CODES OF WHITE KEYS ON TYPE 3 TERMINAL

A user program can alter the codes of the white function and special purpose keys on the Type 3 terminal. This is done by sending the terminal the following sequence:

ESC,ESC,'y', hex key value, number of codes, code,code,code

In this sequence, the hex key value indentifies which key is to be altered and in which operating state (lowercase, uppercase, lowercase with CTRL key pressed, or uppercase with CTRL key pressed). There are also hex key values for when a key is to generate the same altered code(s) in all operating states. The number of codes indicates how many consecutive codes are to be generated by the key in the specified operating state. This is indicated with a number 0 through 3. The code(s) at the end of the sequence (may be none or up to three) are the actual codes to be generated. The only codes which cannot be used are 00 and FF hex. Other factors governing the use of codes are that the following codes cause special actions:

Hex Code	Special Action
80	Causes the next code to be converted to the Control case value (same as if the CTRL key was in use)
81	Starts a print of the contents of the screen
82	Clears the screen

Table 13-1 lists the values for identifying the key and operating state that altered codes are to be in effect. For the default codes generated by white keys, refer to the compatibility mode keycodes listed in appendix B.

TABLE 13-1. VALUES FOR IDENTIFYING WHITE KEYS ON TYPE 3 TERMINAL

LEGENDS ON WHITE KEYS*			HEXADECIMAL KEY VALUES				
LOWER	CENTER	UPPER	LOWERCASE	UPPERCASE	LOWERCASE WITH CTRL KEY	UPPERCASE WITH CTRL KEY	ALL OPERATING STATES
	(F1)		1	21	41	61	81
	(F2)		2	22	42	62	82
	(F3)		3	23	43	63	83
	(F4)		4	24	44	64	84
	(F5)		5	25	45	65	85
	(F6)		6	26	46	66	86
	(F7)		7	27	47	67	87
	(F8)		8	28	48	68	88
	SUPER (F9)		9	29	49	69	89
	SUB (F10)		A	2A	4A	6A	8A
	MICRO (F11)		B	2B	4B	6B	8B
	FONT (F12)		C	2C	4C	6C	8C
ANS	(F13)	TERM	D	2D	4D	6D	8D
	COPY (F14)		E	2E	4E	6E	8E
	(F15)		F	2F	4F	6F	8F
	+	DOWN***	10	30	50	70	90
	-	UP***	11	31	51	71	91

TABLE 13-1. VALUES FOR IDENTIFYING WHITE KEYS ON TYPE 3 TERMINAL (CONTD)

LEGENDS ON WHITE KEYS*			HEXADECIMAL KEY VALUES				
LOWER	CENTER	UPPER	LOWERCASE	UPPERCASE	LOWERCASE WITH CTRL KEY	UPPERCASE WITH CTRL KEY	ALL OPERATING STATES
	X	FWD***	12	32	52	72	92
	÷	BKW***	13	33	53	73	93
	HELP		14	34	54**	74**	94
	ERASE		15**	35	55**	75	95
	EDIT		16	36	56**	76**	96
	BACK		17	37	57**	77**	97
	DATA		18	38	58	78**	98
	LAB		19	39	59**	79**	99
	STOP		1A	3A	5A**	7A**	9A
	PRINT		1B	3B	5B**	7B**	9B
	←|		1C	3C**	5C	7C**	9C

*White keys with codes that cannot be altered are not listed in table.

**No code is generated for this operating state of the key.

***Labeled on skirt of keycap.

THE PRINTER OPTIONS

The TERMINAL.XXX program that operates in the terminal contains the printer drivers for CP/M 2.2. Print characters are transferred from the CP/M 2.2 program in the disk drive to the terminal. The current drivers support the Type 1 printer on the parallel channel and serial printers such as the Type 2 printer on the RS-232 channel. Serial RS-232 interface printers are plugged into the RS-232 connector on the Type 1 terminal, into the SERIAL connector on the Type 2 terminal, and into the J1 connector of the dual port option board on the Type 3 terminal.

As delivered, the terminal program is set to use either type of printer. Selection of the printer is automatic. If the Type 1 printer is connected and has power on, it is selected. If there is no Type 1 printer connected, or it has power off, the serial printer is selected.

There are four options available in the terminal program. They are:

0 Use either the serial or the Type 1 printer.
1 Use Type 1 printer on parallel channel.
2 Use serial printer on RS-232 channel.
3 No printer connected.

The TERMSET program provides for enabling the printer option.

Refer to the owner's manual or user's installation and diagnostics manual for printer installation information.

TYPE 1 TERMINAL SWITCH SETTINGS TO USE SERIAL PRINTER

If the system has a Type 1 terminal, internal switches 1, 6, and 8 must be set to the on position for a serial printer to function. If there is any doubt as to whether these switches are set correctly, call a CDC Customer Engineer to verify them.

DATE AND TIME CLOCK OPERATIONS

The CP/M 2.2 system has a date and time clock. A time setting program is on the flexible disk and it is used by typing:

```
DATTIM <next>
```

Follow the program prompts to set the date and time. The program stores the date in memory as follows:

Location		Value
Decimal	Hexadecimal	
16	10	Month as two 4 bit fields
17	11	Day as two 4 bit fields
18	12	Year as two 4 bit fields
19	13	Hour as two 4 bit fields
20	14	Minute as two 4 bit fields
21	15	Second as two 4 bit fields
22	16	1/60 second counter

The CP.M 2.2 BIOS routine updates the 1/60-second counter on each transition of the ac line. The counter runs from 60 down to 1.

The clock routine updates the time of day, and advances the date at midnight. The routine uses a 24-hour clock so PM times run from 12:00 to 23:59.

All values are stored as packed BCD. For example, the value 23 is stored as hexadecimal 23 or decimal 35.

This time is accessed in Pascal/M 4.01 by built in functions. Assembly language programs can also reference time. This is done by reading the contents of the locations specified and using the time in packed BCD. Or, the packed BCD can be converted to the values required.

CBASIC programs can access time by using the PEEK function and then doing the necessary conversion.

The date and time currently set for the system can be determined by executing the DATTIM program and entering Carriage Returns at the date and time prompts. However, the DATTIM program does not advance the month and the year.

EXAMPLE PROGRAMS

The following assembly source progams and assembled binary files are included on the CP/M 2.2 flexible disk as examples of system programs and use of the Control Data 110 system under CP/M. These programs can be assembled using ASM, loaded using LOAD, and executed by typing the name of the program at the CP/M prompt line.

The interested user can examine these programs as examples only. Note, however, that these programs are neither documented nor supported by Control Data Corporation.

COMLOOP0.ASM
COMLOOP0.COM

This is an example of the method of programming communications using the host connector for connection to a remote communications device.

COMLOOP1.ASM
COMLOOP1.COM

This is an example of the method of programming communications using the serial printer connector (when you are not using the serial printer) for connection to a remote communications device.

TERMTEST.ASM
TERMTEST.COM

This demonstration program shows how to program the terminal display for the compatibility set of characteristics.

TOUCHTST.ASM
TOUCHTST.COM

This demonstration program shows how to program input from the touchpanel (if included in your terminal).

THE KEYTEST.COM ROUTINE

The program KEYTEST allows you to check the operation of the keyboard in normal and numeric keypad mode. This program

displays the character which is output and the hex code generated by the key. Note that some Type 3 terminal keys will generate up to 3 characters of output.

Control characters are displayed with their ASCII mnemonic, the hex value, and the corresponding key which is pressed simultaneously with the Control key. For example, the DC3 ASCII code is generated by pressing the 'S' or 's' key and the Control key simultaneously. It is displayed with an up arrow as ^S.

CONTROLLING SCREEN CHARACTERISTICS

The following paragraphs describe the screen characteristics for programming Type 1 and Type 2 terminals and also the 'compatibility' mode screen characteristics used for programming the Type 3 terminal.

The location of data displayed on the screen and movement of the cursor is controlled by characters output from the computer to the terminal. This section defines all legal character strings and their action on the terminal screen.

The main terminal characteristics are based on the Televideo® 920 terminal. Some of the characteristics of the Hazeltine® 1420 terminal and the Soroc® IQ 120 terminal are included. These characteristics of the Control Data 110 terminal permit configuration of purchased applications which use terminal characteristics and provide configuration programs having predefined terminals in them.

Televideo® 920 is a registered trademark of Televideo Systems Inc.
Hazeltine® 1420 is a registered trademark of Hazeltine Corp.
Soroc® IQ 120 is a registered trademark of Soroc Technology, Inc.

The listing below lists a function and the character strings which cause that action for each of the three terminals. The following abbreviations for the terminals are used:

TVI	Televideo 920
SOR	SOROC IQ 120
HAZ	Hazeltine 1420
all	All three terminals

Character strings are given as hexadecimal values of 2 digits, or as the corresponding ASCII character. A lower case d following a number denotes a decimal value.

The Hazeltine escape sequences can be preceded by the ESC or ~ (tilde).

Character String	Terminal	Function
07	all	Ring bell.
08	all	Backspace cursor.
09	all	Tab cursor to next multiple of 8 columns.
0A	all	Cursor down 1 line.
0B	TVI	Cursor up 1 line.
0C 10	TVI HAZ	Cursor foward 1 space.
0D	all	Carriage return. Cursor moves to beginning of line.
1A (TVI uses 1E,1A) 1B,1C 1B,2A	TVI HAZ SOR	Clear screen. Cursor to upper left corner.
1E 1B,12 ~,12 1E	TVI HAZ HAZ SOR	Home cursor. Cursor to upper left corner.

Character String	Terminal	Function
1B,41,ROW+20,COL+20	TVI	Set cursor to column, row.
1B,11,row(mod 32d)†,col(mod 96d)	HAZ	
~,11,row(mod 32d),col(mod 96d)	HAZ	
1B,3D,row+20,col+20	SOR	
1B,42	TVI	Clear from cursor to end of line.
1B,0F	HAZ	
~,0F	HAZ	
1B,54	SOR	
1B,59	SOR	Clear to end of screen from current cursor position.
1B,3F	TVI	Read cursor position return row+20,col+20,0D.
1B,6A	TVI	Set inverse video.
1B,6B	TVI	Clear inverse video.
~, 1A	HAZ	Insert line.
1B, 1A	HAZ	Position cursor at first column of current row. Insert a blank row. Move following rows down.
~, 13	HAZ	Delete line.
1B, 13	HAZ	Position cursor at first column of current row. Delete current row. Move following rows up.

The following pertains to the Control Data 110 system only:

1F	Cursor to beginning of next line and clear that line.
1B,43,#	# is ASCII character 0, 1, 2 used to set scrolling mode for Type 1 and Type 2 terminals.

---

†The row value must be between 0 and 31 decimal. If the value is greater than 31d, modulus 32d is taken. The modulus value is then used as the row value.

TYPE 3 TERMINAL CHARACTERISTICS

The following paragraphs discuss the Type 3 terminal keyboard, special functions of certain keys on the Type 3 terminal, and screen characteristics.

KEYBOARD

The Type 3 terminal keyboard layout and the codes generated for each keystroke are shown in appendix B. The utility routine KEYTEST may be used to display the codes generated by the keyboard if desired. You should note that the keyboard layout and the key usage for the Type 3 terminal is different from that of Type 1 and Type 2 terminals.

Special Key Functions

The PRINT and SETUP keys on the Type 3 terminal have special functions associated with Control Data 110 CP/M 2.2. These functions may be similar to functions performed differently using Type 1 and Type 2 terminals.

Print

Pressing the PRINT key or SHIFT (⇧) and COPY keys causes the printer to make a copy of the current contents of the display screen.

Setup

Pressing SETUP causes the terminal to enter the operator parameter mode where most screen characteristics can be temporarily changed (changed until terminal power is turned off or until the terminal RESET switch is pressed).

SCREEN CHARACTERISTICS

The Type 3 terminal under Control Data 110 CP/M 2.2 has two modes of operation: compatibility mode and CYBER or advanced mode.

The system begins running in compatibility mode whenever a cold bootstrap is performed. This mode gives the Type 3 terminal the screen characteristics described earlier in this section under Controlling Screen Characteristics.

The CYBER or Advanced mode can be selected by writing an ESCape sequence from a user program onto the display as described in appendix E. In this mode, the screen characteristics of the Type 3 terminal are controlled by the commands described in appendix E.

CHANGING TERMINAL CHARACTERISTICS IN TYPE 3 TERMINALS

This section describes how to change terminal display characteristics either from the operator's console, or by character output sequences from the user program.

You can select different terminal characteristics at any time while running CP/M by pressing the SETUP key. This returns you to the operator parameter mode of your Type 3 terminal through which you can change line size, characters per line, cursor type, background color, and other display-related parameters. After making the changes, press the F1 key to return to your program.

The following selections in the operator parameters should not be changed while operating in CP/M.

Setup # 1, F9 selects CYBER mode as (LARGE) or (SMALL). CP/M requires (LARGE) CYBER mode. The (SMALL) CYBER mode changes the keyboard translation so that the Carriage Return key becomes a New Line key and the code for a tab is changed. This is unacceptable to CP/M.

Setup # 2, F6 selects half-duplex or full-duplex routing of keyboard data within the terminal. You should leave this in FULL DUPLEX. Selecting HALF causes all keyboard characters to be displayed twice on the screen.

COMPATIBILITY MODE

In the Type 3 terminal, CP/M starts operation in a compatibility mode which provides terminal display characteristics identical to those found on Type 1 and 2 terminals. This mode should always be used when running the Console Command Processor (CCP) and all utility routines under CP/M.

CYBER OR ADVANCED MODE

In order to use the full display characteristics of the Type 3 terminal CYBER mode, issue an ESCape sequence to the terminal as follows:

ESC, ESC, 'b', 'b'

This sequence sets the terminal program in the CYBER mode of operation, which changes the operating characteristics of the Type 3 terminal. Appendix B lists the keycodes generated in CYBER mode, while appendix E describes the commands used in the mode and the resulting operations. Returning the terminal program to the CP/M compatibility mode is accomplished by the following sequence:

ESC, ESC, 'c', 'c'

Any user program using CYBER mode should issue the initial ESCape sequence at the beginning of execution and issue the final sequence before reloading CP/M through a jump to location 0. Do not use small CYBER mode in any program without returning to large CYBER mode before exiting to CP/M (further details are in appendix E under CYBER Submodes).

TYPE 1 AND TYPE 2 TERMINAL TOUCHPANEL

The following description of touchpanel operation on the Type 1 and Type 2 terminals applies for CP/M implementation on any Type 3 terminal which has the touchpanel option installed.

The coordinates of each touch are converted into an X and a Y value. The origin of the touchpanel is the lower left corner. X values increase left to right with values from 20 hexadecimal (hex) to 2F hex . Y values increase from bottom to top with values from 30 hex to 3F hex.

The values for each touch are stored in a 256-byte buffer where they wait for input requests from the computer. The values are stored in the buffer in the order X first and then Y. The contents of the touch buffer can be read by an assembly language program. The program uses BDOS calls to read and set the IOBYTE at location 3 in memory to a 1 for the reader selection bits. Then a call to BDOS Reader input returns the values in the touch buffer. If the buffer is empty, a 0 is returned, otherwise, the X, and then the Y value is returned.

TYPE 3 TERMINAL TOUCHPANEL

If your Type 3 terminal has a touchpanel, it operates under Control Data 110 CP/M 2.2 as does the touchpanel on Type 1 and Type 2 terminals. Note that this differs from the operation of the touchpanel when the Type 3 terminal is used as a standalone terminal or with another computer.

An example program, TOUCHTST, is provided on the flexible disk. This program provides an example of accessing the touchpanel from assembly code. The source is provided in file TOUCHTST.ASM, while the assembled code is in TOUCHTST.COM. Examine the source listing and run the program to see how this interface is used. Note that TOUCHTST is only an example program, it is neither documented nor supported by CDC.

COMMUNICATIONS ON THE CONTROL DATA 110 CP/M SYSTEM VERSION 2.00 AND UP

The Control Data 110 CP/M system provides communications driver support in the Basic Input/Output System code for asynchronous (only) communications over the DB-25 connectors in the terminal.

Depending on the terminal Type, you can support 1, 2, or 3 channels of communications. The communications channels are referred to as Comm 0, Comm 1, and Comm 2. The connector names associated with the communications channels are:

Channel	Use	Type 1	Type 2	Type 3
Comm 0	HOST	NONE	PLATO/ASCII	Host
Comm 1	PRINTER	RS-232	Serial	Dual port A
Comm 2		NONE	NONE	Dual port B

The comm 1 channel is normally assigned to a RS-232 interface printer and is driven for output only as the LIST device. If you do not use a RS-232 interface printer on your system then the comm 1 channel may be used for communications.

The Type 1 and Type 2 terminals do not have a full complement of connectors for communications. The following defaults have been included in the BIOS so all communications are satisfied.

Comm Channel	Type 1 Connector	Type 2 Connector
Comm 0	RS-232	PLATO/ASCII
Comm 1	RS-232	Serial
Comm 2	RS-232	Serial

Any writer of communications programs for the Control Data 110 should note that this is a multi-processor system. CP/M programs and memory reside in the memory of the flexible disk controller while the communications driver routines reside in the terminal with a separate Z80 CPU. Data received from a communications channel is stored in a 256-byte input buffer in the terminal. Received characters are then transferred to an 8-byte input buffer in the flexible disk unit memory where they are processed

as input. Output from the flexible disk unit memory goes to an 8-byte buffer and then is 'automatically' transferred to a 32-byte output buffer in the terminal before being transmitted on the communications channel.

Communications input and output takes place over the CONIN, CONOUT, and CONST BIOS or BDOS calls. The user program must set the IO byte in location 3 to 2 for the CON: or Console redirection. This causes all subsequent calls to CONIN, CONOUT, and CONST to receive data, send data, and check input status of the communications lines.

Selection of the comm channel is determined by the COMM byte at location 0E (hex) with the values:

COMBYTE value	Comm channel to use
0	Comm 0
1	Comm 1
2	Comm 2

The recommended programming practice is to set the COMBYTE value first, then modify the IOBYTE to access the comm devices. Then use BIOS calls to CONIN, CONOUT to transfer data and use BIOS calls to CONST to see if there is any data in the input buffers. The similar BDOS calls can be used, but note that it is then impossible to receive the character NUL or to transmit the character 0FF(hex).

COMMUNICATIONS CHANNEL SETUP

The program TERMSET allows you to set each communications channel for baud rate, byte size, and parity. All communications channels are set to use one stop bit. This presets the communications drivers so that each time CP/M is loaded in the Control Data 110 the communications are set up as specified by TERMSET.

The communications parameters can be set dynamically by outputting a series of ESC sequences to the console. This informs the terminal program of the desired communications channel charactersitics. The following are the escape sequences:

COMM 0 (host connector)

ESC, ESC, '1', value	Set baud rate
ESC, ESC, 'm', value	Set byte size
ESC, ESC, 'n', value	Set parity

COMM 1 (printer connector)

ESC, ESC, 'f', value	Set baud rate
ESC, ESC, 'g', value	Set byte size
ESC, ESC, 'h', value	Set parity

COMM 2 (Dual port B connector)

ESC, ESC, 's', value	Set baud rate
ESC, ESC, 't', value	Set byte size
ESC, ESC, 'u', value	Set parity

After sending the comm parameters you must send the sequence:

ESC, ESC, 'a', 'a'

which causes the parameters which were previously sent to be used to initialize the communications circuitry.

Values sent are binary values as follows:

BAUD RATE FOR ALL COMMUNICATIONS CHANNELS

VALUE	BAUD RATE
0	150
1	300
2	600
3	1200
4	2400
5	4800
6	9600
7	19200

BYTE SIZE (ALL CHANNELS)

VALUE	BYTE SIZE
0	7 bit byte
1	8 bit byte

PARITY (ALL CHANNELS)

VALUE	PARITY GENERATED AND CHECKED
0	None
1	Odd
2	None
3	Even

The above ESC sequences are defined as they would be written in an assembly program.

The following code would initialize comm 0 channel to 300 baud, 7 bit byte, even parity.

```
        org     100h            ;Start of transient program area
        jmp     start           ;pass initial setup

esc:    equ     01Bh            ;define ESC character
iobyte: equ     3               ;location of IO byte
combyt: equ     0Eh             ;location of Comm byte

setup:
        db      esc,esc,'1',1   ;300 Baud
        db      esc,esc,'m',0   ;7 bit byte
        db      esc,esc,'n',3   ;even parity
        db      esc,esc,'a','a'
        db      '$'             ;stopper for output

print:          ;print string at HL stopping on '$' character
        ld      a,m             ;get character
        cpi     '$'
        rz                      ;return if stopper
        inx     h               ;increment for next character
        push    hl
        mov     c,a             ;character to C for BIOS call
        call    conout
        pop     hl
        jmp     print
```

```
conout:         ;routine to make bios call to CONOUT
        lhld    1               ;get base of Bios Vector
        mvi     1,0Ch           ;offset to CONOUT
        pchl                    ;jump to BIOS routine

start:          ;start of setup code
        mvi     0
        sta     iobyte          ;set iobyte to standard output
        sta     combyt          ;set comm byte to channel 0
        lxi     h,setup
        call    print
        jmp     0               ;exit routine with comm setup.
```

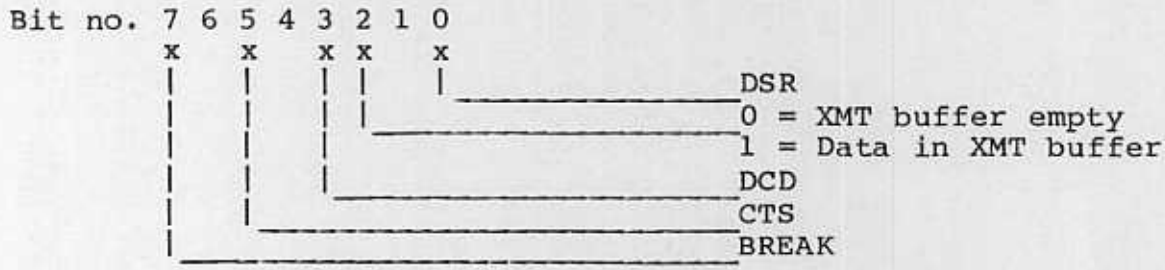
The above program can be assembled using the CP/M ASM assembler.

MODEM STATUS SIGNALS

The user program can detect certain modem status signals which appear on the RS-232 connector by doing an input from the Reader device in the BIOS with the IO byte for the Reader device set to 0. The status varies because the three Types of terminals use different communications circuits.

The status returned for the Type 1 or Type 2 terminal is:

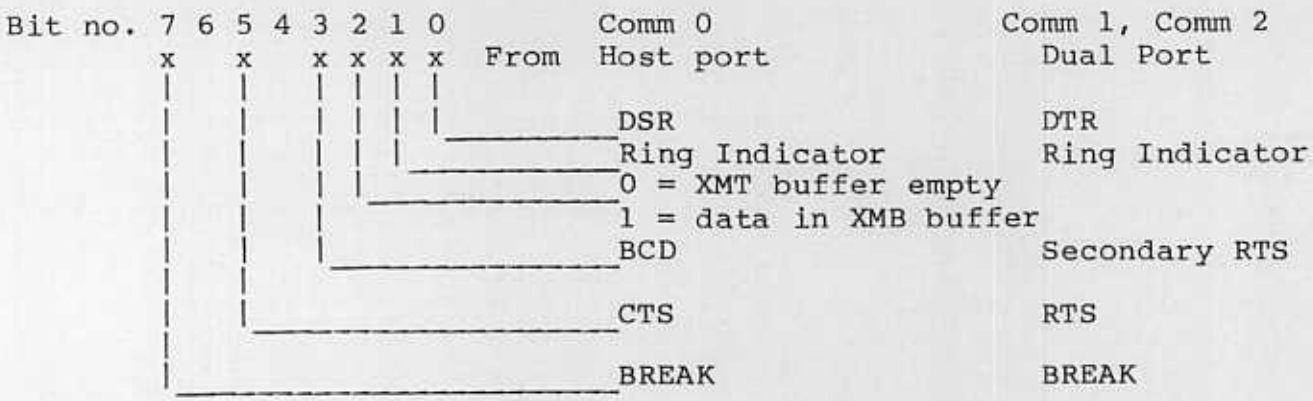
Byte returned to user program.



The status returned for the Type 3 terminal is:

The value returned on the Type 3 terminal is dependent on the channel used and is as follows:

Byte returned to user program.

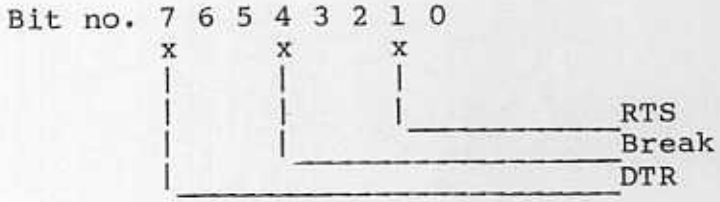


MODEM CONTROL SIGNALS

The user program can set various modem control bits by outputting a byte to the PUNCH device via BIOS with the IO byte set to 0. The Comm byte should be set to the channel desired.

The values sent to the Type 2 terminal are as follows:

Data byte consists of following bits.



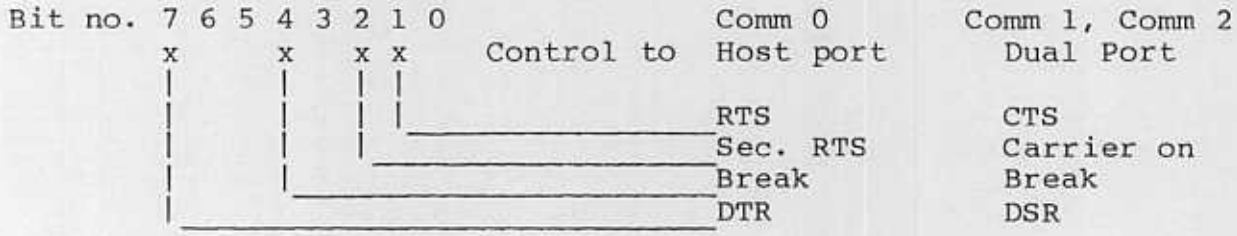
Values sent to Type 1 terminal:

It is not possible to set any of these control bits in the Type 1.

The values sent to the Type 3 terminal are:

The modem control signals which can be sent to the Type 3 terminal ports depend on the port selected and are as follows:

Data byte consists of following bits:



PROGRAMMING A BREAK

If the user program sets the Break bit in the control byte, it is up to the user program to leave the break bit set to 1 for the time necessary to generate a break condition on the communication line. The user program must then send a control byte with the break bit set to 0 to remove the break condition.

CONNECTOR CONFIGURATIONS

The pin assignments and signal directions of the DB-25 connectors on the terminals differ on the three terminal Types. The following table gives the connector location and the signal directions for the various terminal connectors.

HOST PORT TYPE 1, TYPE 2. (COMM 0)
RS-232 PORT TYPE 1, SERIAL PORT TYPE 2. (COMM1)

Signal	Pin	Signal direction	
XMT	2	------->	From terminal to device.
RCV	3	<-------	To terminal from device.
RTS	4	------->	
CTS	5	<-------	
DSR	6	<-------	
DCD	8	<-------	
DTR	20	------->	

DUAL ASYNCHRONOUS PORT TYPE 3 TERMINAL (COMM 1, COMM 2)

Signal	Pin	Signal direction	
XMT	2	<-------	From device to terminal.
RCV	3	------->	To device from terminal.
RTS	4	<-------	
CTS	5	------->	
DSR	6	------->	
DCD	8	------->	
DTR	20	<-------	

The reversal of the meaning of the signals and pins on the Type 3 terminal dual asynchronous ports is reflected in the Communications status and control commands mentioned previously. Although the Transmit (XMT) and Receive (RCV) pins have reversed directions, the data is correctly transmitted and received on the Type 3 terminal dual asynchronous ports.

COMMUNICATIONS PROGRAMMING HINTS

To access the communications channels you must set two bytes in lower memory to provide selection of communications and the desired channel. Thereafter you can use BIOS calls to transmit data, receive data, see if there is receive data available, and see if there is room in the transmit buffer. The information can be summarized:

Memory Location	Name	Function
03 (hex)	IOBYTE	Select alternate device for BIOS calls Set this byte to 0C2 (hex) for communications.
0E (hex)	COMBYT	Selects communications channel 0 = host port 1 = printer port 2 = Dual port B (Type 3 terminal)

BIOS call	vector offset	function when selected for comm.
CONST	06 (hex)	Return A reg = 0 if no char ready FFh = character ready to read
CONIN	09 (hex)	Read character to A register
CONOUT	0C (hex)	Transmit character in C register
PUNCH	12 (hex)	Set Modem control from C
READER	15 (hex)	Return Modem status in A register
LISTST	2D (hex)	Return A reg = 0 output buffer full FFh = space for another output

AUTOMATIC DISK DENSITY SENSING

The disk drives are numbered 0 for the Type 1 (primary) disk drive and 1 for the Type 2 (secondary) disk drive. The current version of Control Data 110 CP/M (identified by a BIOS version of 2.00 or greater) determines the type of flexible disk inserted in the disk drive when the drive is addressed as A: or B:. If the Type 1 drive is addressed as C: or the Type 2 drive is addressed as D: then the flexible disk is assumed to be single-density, single-sided (for compatibility with earlier versions of Control Data 110 CP/M). This determination is made on execution of a select disk command in the BIOS.

The following operating procedure should be used to insure that no errors are generated while using this feature in the Control Data 110 CP/M:

1. Whenever you replace a flexible disk in Type 2 disk drive with a different density flexible disk, be sure to warm boot CP/M by typing ETX (or control C) character after you have replaced flexible disk.

2. If you are doing a transfer of files between two different density flexible disks using PIP, use the following procedure:

   a. Place flexible disk to receive files in Type 2 disk drive.

   b. Type control C to introduce this flexible disk to CP/M and allow it to be read/write. (This step is not necessary if this is the first time you have placed a flexible disk in Type 2 disk drive.)

   c. Select Type 2 disk drive as default flexible disk by typing B: so that display looks like:

      ```
      A>B:
      ```

      Then type <next>. You receive the following prompt from CP/M:

      ```
      B>
      ```

      Then type:

      ```
      B>A:PIP <next>
      ```

      This gets PIP program which prompts:

      ```
      *
      ```

To transfer all files from source disk, remove system disk from Type 1 disk drive and insert source disk in Type 1 disk drive. Then type:

```
B:=A:*.*  <next>
```

All files will be transferred. Next insert system disk in Type 1 disk drive and type a carriage return. System operates.

3. As long as you use only double-density flexible disks, there are no special precautions required to use the system.

This appendix contains an ASCII code chart and special code charts that are only applicable to the Type 3 terminal.

ASCII CODE CHART

The ASCII code chart is shown in table A-1.

TABLE A-1. ASCII CODE CHART

2^3	2^2	2^1	2^0	COLUMN → / ROW ↓	0 (000)	1 (001)	2 (010)	3 (011)	4 (100)	5 (101)	6 (110)	7 (111)
0	0	0	0	0	NUL	DLE	SP	0	@	P	`	p
0	0	0	1	1	SOH	DC1	!	1	A	Q	a	q
0	0	1	0	2	STX	DC2	"	2	B	R	b	r
0	0	1	1	3	ETX	DC3	#	3	C	S	c	s
0	1	0	0	4	EOT	DC4	$	4	D	T	d	t
0	1	0	1	5	ENQ	NAK	%	5	E	U	e	u
0	1	1	0	6	ACK	SYN	&	6	F	V	f	v
0	1	1	1	7	BEL	ETB	'	7	G	W	g	w
1	0	0	0	8	BS	CAN	(	8	H	X	h	x
1	0	0	1	9	HT	EM	)	9	I	Y	i	y
1	0	1	0	10(A)	LF	SUB	*	:	J	Z	j	z
1	0	1	1	11(B)	VT	ESC	+	;	K	[	k	{
1	1	0	0	12(C)	FF	FS	,	<	L	\	l	|
1	1	0	1	13(D)	CR	GS	-	=	M	]	m	}
1	1	1	0	14(E)	SO	RS	.	>	N	^	n	~
1	1	1	1	15(F)	SI	US	/	?	O	_	o	DEL

04074-1

SPECIAL CODE CHARTS APPLICABLE ONLY TO TYPE 3 TERMINAL

The following tables A-2 through A-9 give the special code sets which may be used in CYBER mode under CP/M.

TABLE A-2. LINE-DRAWING SYMBOL CODES

b7 →					0	0
b6 →					1	1
BITS b5 →					0	1
b4 ↓	b3 ↓	b2 ↓	b1 ↓	COLUMN → / ROW ↓	2	3
0	0	0	0	0		
0	0	0	1	1		
0	0	1	0	2		
0	0	1	1	3		
0	1	0	0	4		
0	1	0	1	5		
0	1	1	0	6		
0	1	1	1	7		
1	0	0	0	8		
1	0	0	1	9		
1	0	1	0	10 (A)		
1	0	1	1	11 (B)		
1	1	0	0	12 (C)		
1	1	0	1	13 (D)		
1	1	1	0	14 (E)		
1	1	1	1	15 (F)		

02016-2

TABLE A-3. PLATO SYMBOL CODES

BITS B7 B6 B5 / B4 B3 B2 B1		1 Ø Ø	1 Ø 1	1 1 0	1 1 1
	COLUMN → / ROW ↓	4	5	6	7
Ø Ø Ø Ø	0		α	C̄	\
Ø Ø Ø 1	1	/	β	··	\
Ø Ø 1 Ø	2	≡	δ	□	/
Ø Ø 1 1	3	~	λ	○	/
Ø 1 Ø Ø	4	⇦	μ	◆	–
Ø 1 Ø 1	5	≠	π	×	–
Ø 1 1 Ø	6	↑	ρ	′	|
Ø 1 1 1	7	→	σ	,	|
1 Ø Ø Ø	8	↓	ω	˅	▒
1 Ø Ø 1	9	←	≤	↕	▒
1 Ø 1 Ø	10 (A)	×	≥	|	=
1 Ø 1 1	11 (B)	Σ	θ		=
1 1 Ø Ø	12 (C)	Δ	∀		◣
1 1 Ø 1	13 (D)	∪	°		◣
1 1 1 Ø	14 (E)	∩	∃		◢
1 1 1 1	15 (F)	÷	∂		◢

03415-3

TABLE A-4. UNITED KINGDOM CHARACTER CODES

b7 →					0	0	1	1	1	1
b6 →					0	1	0	0	1	1
b5 →					0	1	0	1	0	1
BITS	b4 ↓	b3 ↓	b2 ↓	b1 ↓	COLUMN → / ROW ↓	2	3	4	5	6	7
	0	0	0	0	0	SP	0	@	P	`	p
	0	0	0	1	1	!	1	A	Q	a	q
	0	0	1	0	2	"	2	B	R	b	r
	0	0	1	1	3	£	3	C	S	c	s
	0	1	0	0	4	$	4	D	T	d	t
	0	1	0	1	5	%	5	E	U	e	u
	0	1	1	0	6	&	6	F	V	f	v
	0	1	1	1	7	'	7	G	W	g	w
	1	0	0	0	8	(	8	H	X	h	x
	1	0	0	1	9	)	9	I	Y	i	y
	1	0	1	0	10(A)	*	:	J	Z	j	z
	1	0	1	1	11(B)	+	;	K	[	k	{
	1	1	0	0	12(C)	,	<	L	\	l	¦
	1	1	0	1	13(D)	-	=	M	]	m	}
	1	1	1	0	14(E)	.	>	N	^	n	¯
	1	1	1	1	15(F)	/	?	O	_	o	

02015-8

TABLE A-5. FRENCH CHARACTER CODES

BITS b7 b6 b5 →					0 1 0	0 1 1	1 0 0	1 0 1	1 1 0	1 1 1
b4 ↓	b3 ↓	b2 ↓	b1 ↓	COLUMN → / ROW ↓	2	3	4	5	6	7
0	0	0	0	0	SP	0	à	P	`	p
0	0	0	1	1	!	1	A	Q	a	q
0	0	1	0	2	"	2	B	R	b	r
0	0	1	1	3	£	3	C	S	c	s
0	1	0	0	4	$	4	D	T	d	t
0	1	0	1	5	%	5	E	U	e	u
0	1	1	0	6	&	6	F	V	f	v
0	1	1	1	7	'	7	G	W	g	w
1	0	0	0	8	(	8	H	X	h	x
1	0	0	1	9	)	9	I	Y	i	y
1	0	1	0	10(A)	*	:	J	Z	j	z
1	0	1	1	11(B)	+	;	K	°	k	é
1	1	0	0	12(C)	,	<	L	Ç	l	ù
1	1	0	1	13(D)	-	=	M	§	m	è
1	1	1	0	14(E)	.	>	N	^	n	¨
1	1	1	1	15(F)	/	?	O	_	o	

02015-1

TABLE A-6. GERMAN CHARACTER CODES

b7 → / b6 → / b5 → / BITS					0 1 0	0 1 1	1 0 0	1 0 1	1 1 0	1 1 1
b4 ↓	b3 ↓	b2 ↓	b1 ↓	COLUMN → / ROW ↓	2	3	4	5	6	7
0	0	0	0	0	SP	0	§	P	`	p
0	0	0	1	1	!	1	A	Q	a	q
0	0	1	0	2	"	2	B	R	b	r
0	0	1	1	3	#	3	C	S	c	s
0	1	0	0	4	$	4	D	T	d	t
0	1	0	1	5	%	5	E	U	e	u
0	1	1	0	6	&	6	F	V	f	v
0	1	1	1	7	'	7	G	W	g	w
1	0	0	0	8	(	8	H	X	h	x
1	0	0	1	9	)	9	I	Y	i	y
1	0	1	0	10(A)	*	:	J	Z	j	z
1	0	1	1	11(B)	+	;	K	Ä	k	ä
1	1	0	0	12(C)	,	<	L	Ö	l	ö
1	1	0	1	13(D)	-	=	M	Ü	m	ü
1	1	1	0	14(E)	.	>	N	^	n	β
1	1	1	1	15(F)	/	?	O	_	o	

02015-2

TABLE A-7. SWEDISH/FINNISH CHARACTER CODES

b7 → / b6 → / b5 → / BITS					0 0 0	0 0 1	0 1 0	0 1 1	1 0 0	1 0 1
b4 ↓	b3 ↓	b2 ↓	b1 ↓	COLUMN → / ROW ↓	2	3	4	5	6	7
0	0	0	0	0	SP	0	É	P	é	p
0	0	0	1	1	!	1	A	Q	a	q
0	0	1	0	2	"	2	B	R	b	r
0	0	1	1	3	#	3	C	S	c	s
0	1	0	0	4	¤	4	D	T	d	t
0	1	0	1	5	%	5	E	U	e	u
0	1	1	0	6	&	6	F	V	f	v
0	1	1	1	7	'	7	G	W	g	w
1	0	0	0	8	(	8	H	X	h	x
1	0	0	1	9	)	9	I	Y	i	y
1	0	1	0	10(A)	*	:	J	Z	j	z
1	0	1	1	11(B)	+	;	K	Ä	k	ä
1	1	0	0	12(C)	,	<	L	Ö	l	ö
1	1	0	1	13(D)	-	=	M	Å	m	å
1	1	1	0	14(E)	.	>	N	Ü	n	ü
1	1	1	1	15(F)	/	?	O	_	o	

02015-7

TABLE A-8. DANISH/NORWEGIAN CHARACTER CODES

b7 →					0	0	1	1	1	1
b6 →					0	1	0	0	1	1
b5 →					0	1	0	1	0	1
BITS	b4 ↓	b3 ↓	b2 ↓	b1 ↓	COLUMN → / ROW ↓	2	3	4	5	6	7
	0	0	0	0	0	SP	0	@	P	`	p
	0	0	0	1	1	!	1	A	Q	a	q
	0	0	1	0	2	"	2	B	R	b	r
	0	0	1	1	3	#	3	C	S	c	s
	0	1	0	0	4	$	4	D	T	d	t
	0	1	0	1	5	%	5	E	U	e	u
	0	1	1	0	6	&	6	F	V	f	v
	0	1	1	1	7	'	7	G	W	g	w
	1	0	0	0	8	(	8	H	X	h	x
	1	0	0	1	9	)	9	I	Y	i	y
	1	0	1	0	10(A)	*	:	J	Z	j	z
	1	0	1	1	11(B)	+	;	K	Æ	k	æ
	1	1	0	0	12(C)	,	<	L	Ø	l	ø
	1	1	0	1	13(D)	-	=	M	Å	m	å
	1	1	1	0	14(E)	.	>	N	^	n	~
	1	1	1	1	15(F)	/	?	O	_	o	

02015-10

TABLE A-9. SPANISH CHARACTER CODES

b7 → b6 → b5 → / BITS					0 0 0	0 0 1	1 0 0	1 0 1	1 1 0	1 1 1
b4 ↓	b3 ↓	b2 ↓	b1 ↓	COLUMN → / ROW ↓	2	3	4	5	6	7
0	0	0	0	0	SP	0	§	P	`	p
0	0	0	1	1	!	1	A	Q	a	q
0	0	1	0	2	"	2	B	R	b	r
0	0	1	1	3	£	3	C	S	c	s
0	1	0	0	4	$	4	D	T	d	t
0	1	0	1	5	%	5	E	U	e	u
0	1	1	0	6	&	6	F	V	f	v
0	1	1	1	7	'	7	G	W	g	w
1	0	0	0	8	(	8	H	X	h	x
1	0	0	1	9	)	9	I	Y	i	y
1	0	1	0	10(A)	*	:	J	Z	j	z
1	0	1	1	11(B)	+	;	K	¡	k	°
1	1	0	0	12(C)	,	<	L	Ñ	l	ñ
1	1	0	1	13(D)	-	=	M	ç	m	Ç
1	1	1	0	14(E)	.	>	N	^	n	~
1	1	1	1	15(F)	/	?	O	_	o	

02015-9

This appendix shows the various keycap configurations of the Type 3 terminal keyboard and lists the keyboard codes.

TYPE 3 TERMINAL KEYCAP CONFIGURATIONS

Figures B-1 through B-7 show the variety of keycap configurations that may be used with the terminal. These include the:

- Keyboard with standard English keycaps (figure B-1)
- Keyboard with United Kingdom keycap option (figure B-2)
- Keyboard with French keycap option (figure B-3)
- Keyboard with German keycap option (figure B-4)
- Keyboard with Swedish/Finnish keycap option (figure B-5)
- Keyboard with Danish/Norwegian keycap option (figure B-6)
- Keyboard with Spanish keycap option (figure B-7)

Each keycap option consists of a user-installed keycap kit. The corresponding characters are displayed by changing the factory-set language in the terminal installation parameters. For changing terminal installation parameters, refer to appendix A of the CDC 721 Display Terminal Operator's Guide/Installation Instructions Manual (publication number is listed in preface).

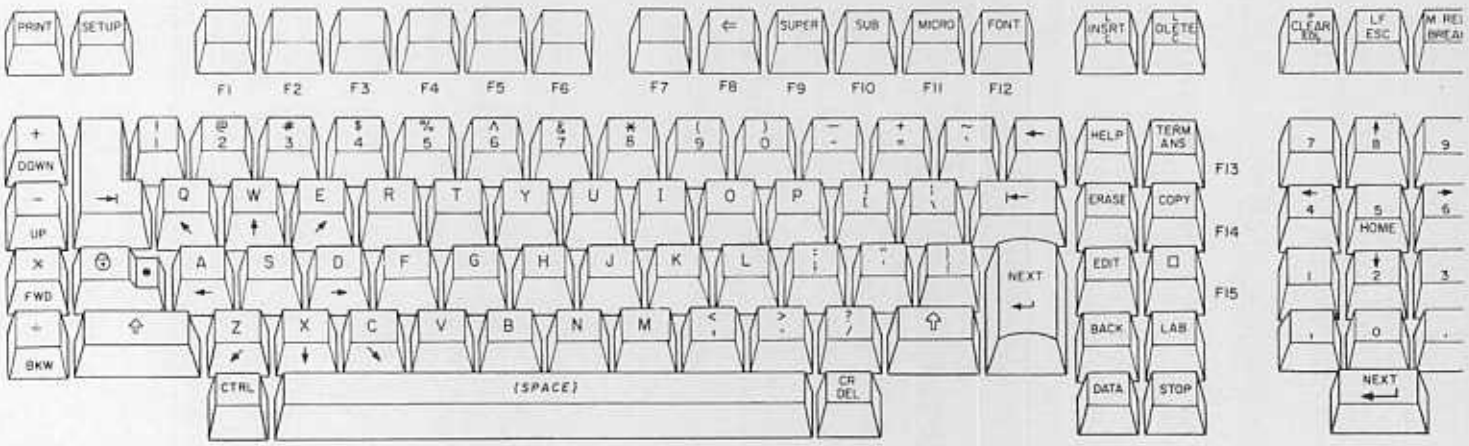
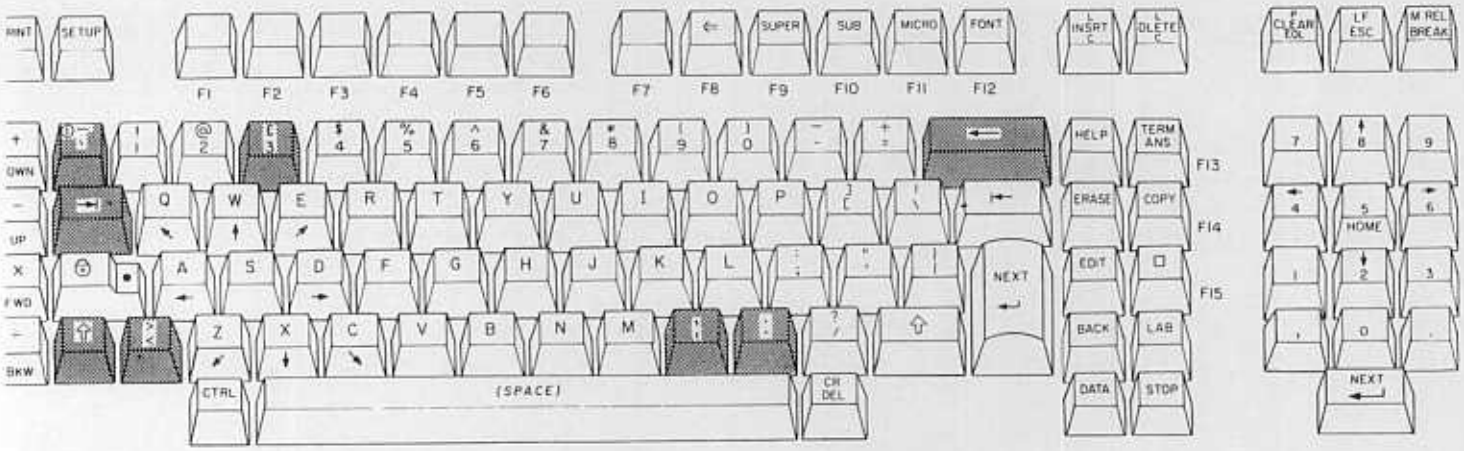


Figure B-1. Type 3 Terminal Keyboard with Standard English Keycaps

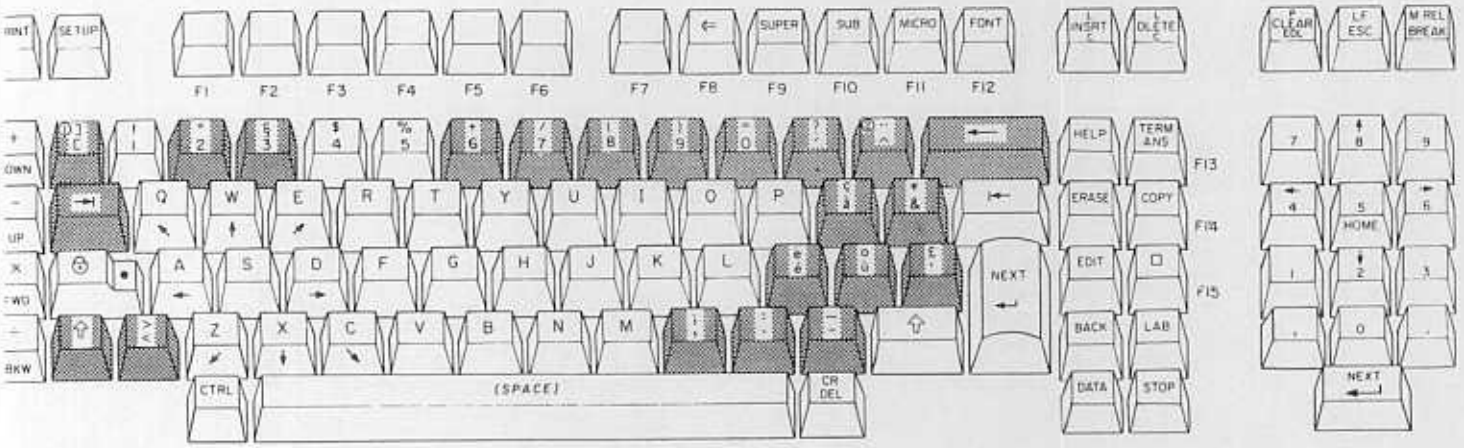


NOTES:
OPTIONAL KEYCAPS ARE SHADED FOR ILLUSTRATING PURPOSES

03942-18

① UPPER-OVER BAR
LOWER-GRAVE ACCENT

Figure B-2. Type 3 Terminal Keyboard with United Kingdom Keycap Option

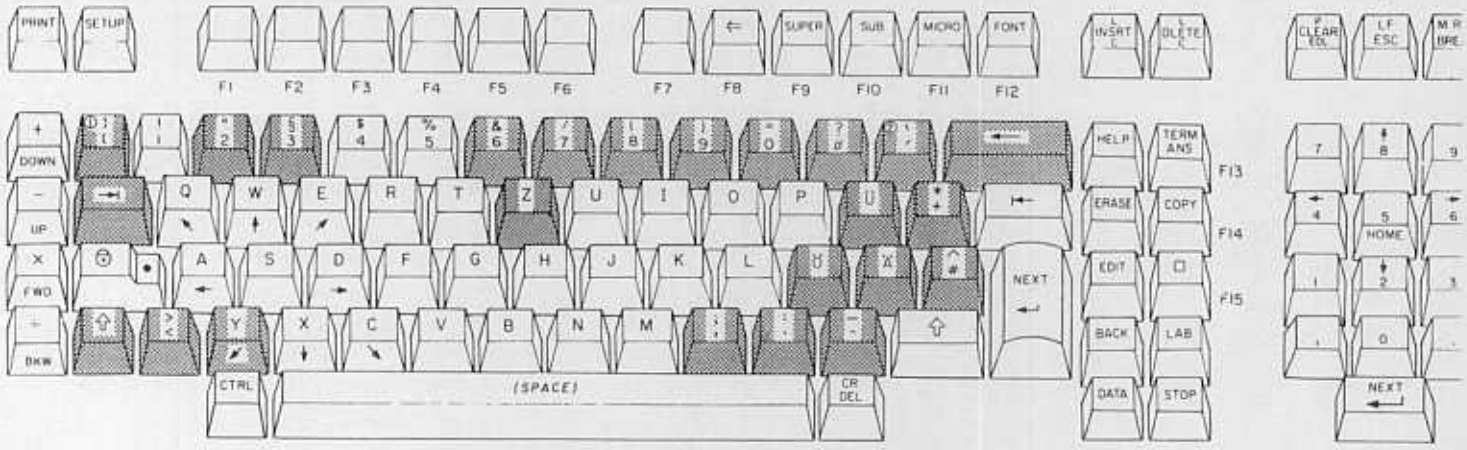


NOTES:
OPTIONAL KEYCAPS ARE SHADED FOR ILLUSTRATING PURPOSES

03942-18

① PROVIDED FOR PLATO USAGE
② UPPER-UMLAUT

Figure B-3. Type 3 Terminal Keyboard with French Keycap Option

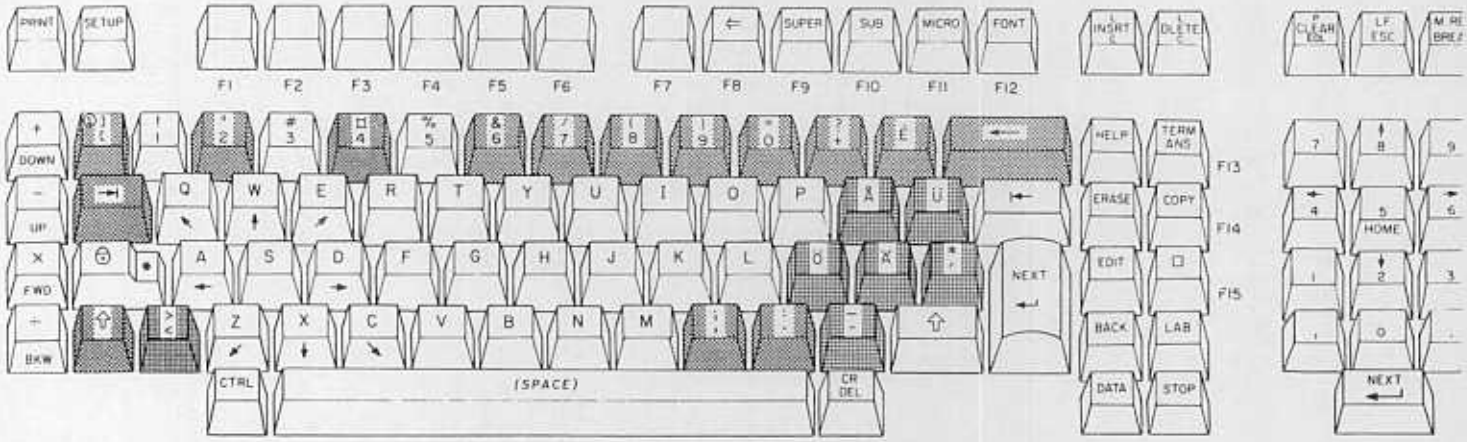


NOTES:
OPTIONAL KEYCAPS ARE SHADED FOR ILLUSTRATING PURPOSES

①PROVIDED FOR PLATO USAGE
②UPPER-GRAVE ACCENT
LOWER-APOSTROPHE, ACUTE ACCENT

03942

Figure B-4. Type 3 Terminal Keyboard with German Keycap Option

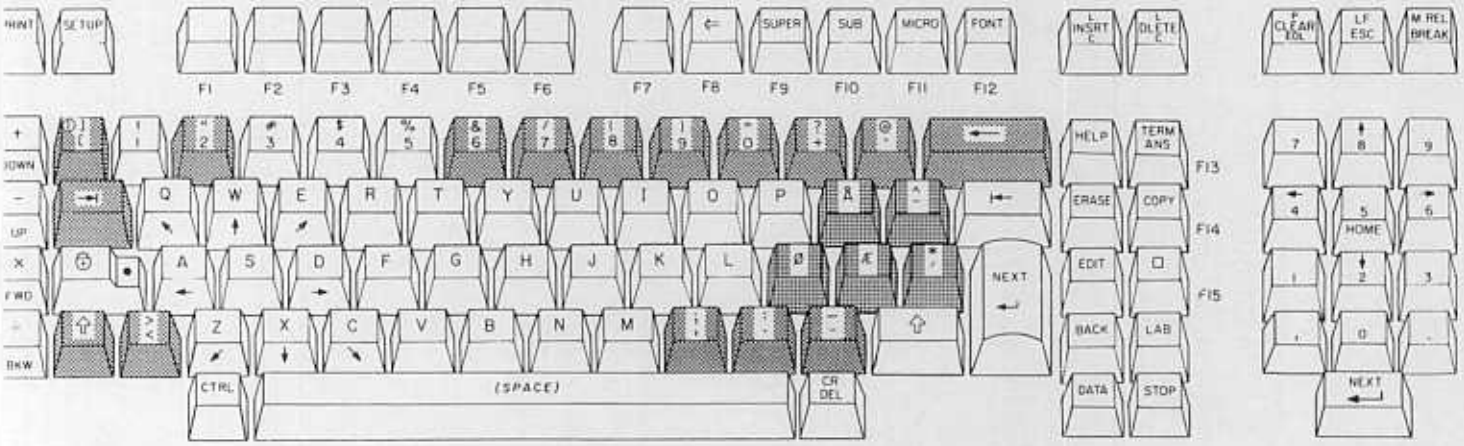


NOTES:
OPTIONAL KEYCAPS ARE SHADED FOR ILLUSTRATING PURPOSES

①PROVIDED FOR PLATO USAGE

03942

Figure B-5. Type 3 Terminal Keyboard with Swedish/Finnish Keycap Option

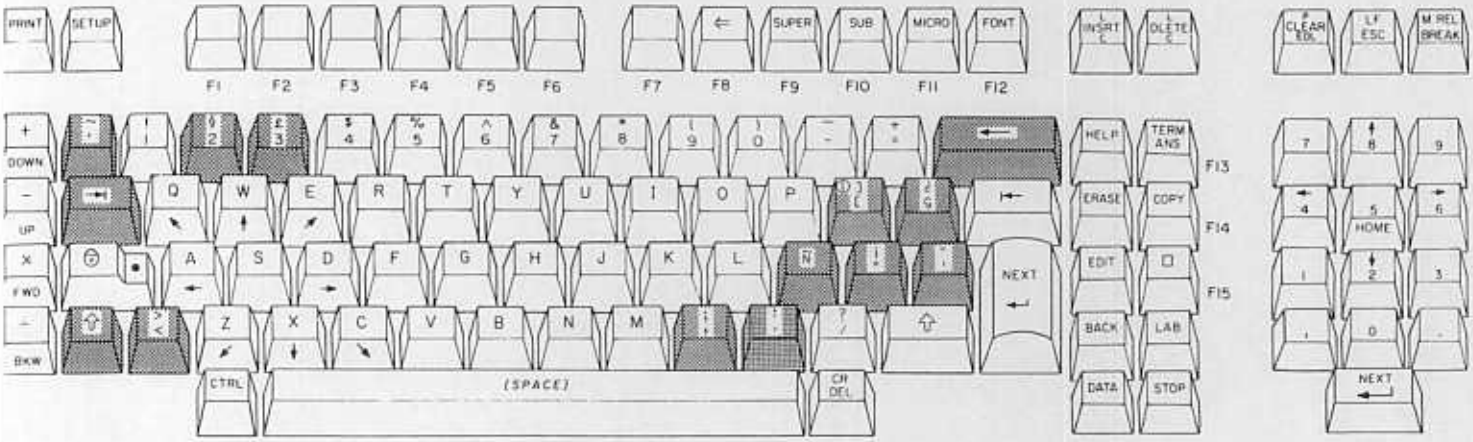


NOTES:
OPTIONAL KEYCAPS ARE SHADED FOR ILLUSTRATING PURPOSES

03942-29

①PROVIDED FOR PLATO USAGE

Figure B-6. Type 3 Terminal Keyboard with Danish/Norwegian Keycap Option



NOTES:
OPTIONAL KEYCAPS ARE SHADED FOR ILLUSTRATING PURPOSES

03942-30

⑤PROVIDED FOR PLATO USAGE

Figure B-7. Type 3 Terminal Keyboard with Spanish Keycap Option

TYPE 3 TERMINAL KEYBOARD CODES

The keystation numbers assigned to the keys of the terminal keyboard are shown in figure B-8. These keystation numbers are used in tables B-1 and B-2 to indicate the code or function of each key. Table B-1 covers the keycodes generated when in CYBER mode and table B-2 covers the keycodes generated when in compatibility mode. Each of these tables have addendums for the keycap options.

Figure B-8. Keyboard Keystation Assignments for Type 3 Terminal

TABLE B-1. CYBER MODE KEYCODES

KEY NO.	NOTES*	KEY LEGENDS			PRESSED WITH KEY ... GENERATE			
		LOWER	CENTER	UPPER		⇧	CTRL	⇧ ·CTRL
1	DS, L		PRINT					
		Small CYBER Mode			1E,11	1E,01	1E,11	1E,01
		Large CYBER Mode			1E,02	1E,01	1E,02	1E,01
2			SETUP		-	-	-	-
3	D, L		(F1)		1E,71	1E,61	1E,31	1E,21
4	D, L		(F2)		1E,72	1E,62	1E,32	1E,22
5	D, L		(F3)		1E,73	1E,63	1E,33	1E,23
6	D, L		(F4)		1E,74	1E,64	1E,34	1E,24
7	D, L		(F5)		1E,75	1E,65	1E,35	1E,25
8	D, L		(F6)		1E,76	1E,66	1E,36	1E,26
9	D, L		(F7)		1E,77	1E,67	1E,37	1E,27

TABLE B-1. CYBER MODE KEYCODES (CONTD)

KEY NO.	NOTES*	KEY LEGENDS			PRESSED WITH KEY ... GENERATE			
		LOWER	CENTER	UPPER		⇧	CTRL	⇧ ·CTRL
			←					
10	D, L		(F8)		1E,78	1E,68	1E,38	1E,28
			SUPER					
11	D, L		(F9)		1E,79	1E,69	1E,39	1E,29
			SUB					
12	D, L		(F10)		1E,7A	1E,6A	1E,3A	1E,2A
			MICRO					
13	D, L		(F11)		1E,7B	1E,6B	1E,3B	1E,2B
			FONT					
14	D, L		(F12)		1E,7C	1E,6C	1E,3C	1E,2C
15	L,D		+	DOWN **	1E,12,20	1E,12,21	1E,12,22	1E,12,23
16	R, L				-	-	-	-
17	R	1		!	31	21	31	21
18	R	2		@	32	40	00	00
19	R	3		#	33	23	33	23
20	R	4		$	34	24	34	24
21	R	5		%	35	25	35	25
22	R	6		^	36	5E	36	5E
23	R	7		&	37	26	37	26
24	R	8		*	38	2A	38	2A
25	R	9		(	39	28	39	28
26	R	0		)	30	29	30	29
27	R	-		—	2D	5F	1F	1F
28	R	=		+	3D	2B	1E	1E
29	R	`		~	60	7E	60	7E
30	R		←					
		Small CYBER Mode			19	19	19	19
		Large CYBER Mode			08	08	08	08
31	L,D		—	UP **	1E,12,24	1E,12,25	1E,12,26	1E,12,27
32	R,L,DS		→|		09	09	1E,12,57	1E,12,57

TABLE B-1. CYBER MODE KEYCODES (CONTD)

KEY NO.	NOTES*	KEY LEGENDS			PRESSED WITH KEY ... GENERATE			
		LOWER	CENTER	UPPER		⇧	CTRL	⇧ ·CTRL
33	R		Q	↖ **	71	51	11	11
34	R		W	↑ **	77	57	17	17
35	R		E	↗ **	65	45	05	05
36	R		R		72	52	12	12
37	R		T		74	54	14	14
38	R		Y		79	59	19	19
39	R		U		75	55	15	15
40	R		I		69	49	09	09
41	R		O		6F	4F	0F	0F
42	R		P		70	50	10	10
43	R	[		]	5B	5D	1D	1D
44	R	\		¦	5C	7C	1C	1C
45	R,L,DS		⇤		1E,0B	1E,0B	1E,12,58	1E,12,58
46	D,L		X	FWD **	1E,12,28	1E,12,29	1E,12,2A	1E,12,2B
47			⊖		-	-	-	-
48	R		A	← **	61	41	01	01
49	R		S		73	53	13	13
50	R		D	→ **	64	44	04	04
51	R		F		66	46	06	06
52	R		G		67	47	07	07
53	R		H		68	48	08	08
54	R		J		6A	4A	0A	0A
55	R		K		6B	4B	0B	0B
56	R		L		6C	4C	0C	0C
57	R	;		:	3B	3A	3B	3A
58	R	'		"	27	22	27	22
59	R	{		}	7B	7D	7B	7D
60	See Key 75				-	-	-	-

TABLE B-1. CYBER MODE KEYCODES (CONTD)

KEY NO.	NOTES*	KEY LEGENDS			PRESSED WITH KEY ... GENERATE			
		LOWER	CENTER	UPPER		⇧	CTRL	⇧ ·CTRL
61	D, L		÷	BKW **	1E,12,2C	1E,12,2D	1E,12,2E	1E,12,2F
62			⇧		-	-	-	-
63	R				-	-	-	-
64	R		Z	↙ **	7A	5A	1A	1A
65	R		X	↓ **	78	58	18	18
66	R		C	↘ **	63	43	03	03
67	R		V		76	56	16	16
68	R		B		62	42	02	02
69	R		N		6E	4E	0E	0E
70	R		M		6D	4D	0D	0D
71	R	,		<	2C	3C	2C	3C
72	R	.		>	2E	3E	2E	3E
73	R	/		?	2F	3F	2F	3F
74			⇧		-	-	-	-
75	L	←↵		NEXT				
		Small CYBER Mode			0A	0A	0A	0A
		Large CYBER Mode			0D	0D	0D	0D
76			CTRL		-	-	-	-
77	R		(Space)		20	20	20	20
78		DEL		CR	7F	0D	7F	0D
79	D, L		HELP		1E,5C	1E,58	1E,5C	1E,58
80	D, L	ANS	(F13)	TERM	1E,7D	1E,6D	1E,3D	1E,2D
81	DS, L		ERASE					
		Small CYBER Mode			1E,5D	1E,59	1E,5D	1E,59
		Large CYBER Mode			1F	1E,5D	1E,5D	1E,59
82	D, L		COPY					
			(F14)		1E,7E	1E,6E	1E,3E	1E,2E
83	D, L		EDIT		1E,5E	1E,5A	1E,5E	1E,5A

TABLE B-1. CYBER MODE KEYCODES (CONTD)

KEY NO.	NOTES*	KEY LEGENDS			PRESSED WITH KEY ... GENERATE			
		LOWER	CENTER	UPPER		⇧	CTRL	⇧ •CTRL
84	D, L		□					
			(F15)		1E,70	1E,60	1E,30	1E,20
85	D, L		BACK		1E,5F	1E,5B	1E,5F	1E,5B
86	D, L		LAB		1E,12,31	1E,12,32	1E,12,33	1E,12,33
87	D, L		DATA		1E,12,35	1E,12,36		
88	D, L		STOP		1E,49	1E,4A	1E,49	1E,4A
89	DS, L, R	C	INSRT	L	1E,4F	1E,52	1E,4F	1E,52
90	DS, L, R	C	DLETE	L	1E,4E	1E,51	1E,4E	1E,51
91	L	EOL	CLEAR	P	0B	0C	0B	0C
92		ESC		LF	1B	0A	1B	0A
93		BREAK		M REL	BREAK	11	BREAK	11
94	R, L,N		7		37	-	37	-
95	R, L,N	8		↑	38	17	38	17
96	R, L,N		9		39	-	39	-
97	R,L,N,	4		←				
	D	Small CYBER Mode			34	19	19	1E,19
		Large CYBER Mode			34	08	34	08
98	R,L,N,	5		HOME**				
	D	Small CYBER Mode			35	08	08	1E,08
		Large CYBER Mode			35	19	35	19
99	R,L,N,	6		→				
	D	Small CYBER Mode			36	18	18	1E,18
		Large CYBER Mode			36	18	36	18
100	R, L,N	1			31	-	31	-
101	R,L,N,	2		↓				
	D	Small CYBER Mode			32	1A	1A	1E,1A
		Large CYBER Mode			32	1A	32	1A

TABLE B-1. CYBER MODE KEYCODES (CONTD)

KEY NO.	NOTES*	KEY LEGENDS LOWER	CENTER	UPPER	PRESSED WITH KEY ... GENERATE	⇧	CTRL	⇧ •CTRL
102	R, L,N	3			33	-	33	-
103	R, L,N	,			2C	-	2C	-
104	R, L,N	0			30	-	30	-
105	R, L,N	.			2E	-	2E	-
106	L,N	↵		NEXT				
		Small CYBER Mode			0A	0A	0A	0A
		Large CYBER Mode			0D	0D	0D	0D

*Key to Notes:

N - Modified if the Numeric Pad parameter is set to SHIFT.
R - Auto repeat if TYPAMATIC is on.
L - Host loadable.
D - Delimiter. CR sent when enabled by host.
DS - Delimiter. CR sent when enabled by host in small CYBER mode.
\- - No code generated.
** - Labeled on skirt of keycap.

TABLE B-1.1. CYBER MODE KEYCODE ADDENDUM FOR UNITED KINGDOM KEYCAP OPTION

KEY NO.	KEY LEGENDS LOWER	CENTER	UPPER	PRESSED WITH KEY ... GENERATE	⇧	CTRL	⇧ •CTRL
16	`		¬	60	7E	60	7E
19	3		£	33	23	33	23
29				-	-	-	-
63	<		>	3C	3E	3C	3E
71	,		,	2C	2C	2C	2C
72	.		.	2E	2E	2E	2E

TABLE B-1.2. CYBER MODE KEYCODE ADDENDUM FOR FRENCH KEYCAP OPTION

KEY NO.	KEY LEGENDS			PRESSED WITH KEY ... GENERATE			
	LOWER	CENTER	UPPER		⇧	CTRL	⇧ ·CTRL
16	[		]	1E, 4B	1E, 4D	1E, 4B	1E, 4D
18	2		"	32	22	00	00
19	3		§	33	5D	33	5D
22	6		+	36	2B	36	2B
23	7		/	37	2F	37	2F
24	8		(	38	28	38	28
25	9		)	39	29	39	29
26	0		=	30	3D	30	3D
27	´		?	27	3F	1F	1F
28	^		¨	5E	7E	1E	1E
29				-	-	-	-
43	à		ç	40	5C	1D	1D
44	&		*	26	2A	1C	1C
57	é		è	7B	7D	7B	7D
58	ù		o	7C	5B	7C	5B
59	`		£	60	23	60	23
63	<		>	3C	3E	3C	3E
71	,		;	2C	3B	2C	3B
72	.		:	2E	3A	2E	3A
73	-		_	2D	5F	2D	5F

TABLE B-1.3. CYBER MODE KEYCODE ADDENDUM FOR GERMAN KEYCAP OPTION

KEY NO.	KEY LEGENDS			PRESSED WITH KEY ... GENERATE			
	LOWER	CENTER	UPPER		⇧	CTRL	⇧ ·CTRL
16	[		]	1E, 4B	1E, 4D	1E, 4B	1E, 4D
18	2		"	32	22	00	00
19	3		§	33	40	33	40
22	6		&	36	26	36	26
23	7		/	37	2F	37	3F
24	8		(	38	28	38	28
25	9		)	39	29	39	29
26	0		=	30	3D	30	3D
27	ß		?	7E	3F	1F	1F
28	´		`	27	60	1E	1E
29				-	-	-	-
38		Z		7A	5A	19	19
43		Ü		7D	5D	1D	1D
44	+		*	2B	2A	1C	1C
57		Ö		7C	5C	7C	5C
58		Ä		7B	5B	7B	5B
59	#		^	23	5E	23	5E
63	<		>	3C	3E	3C	3E
64		Y		79	59	1A	1A
71	,		;	2C	3B	2C	3B
72	.		:	2E	3A	2E	3A
73	-		_	2D	5F	2D	5F

TABLE B-1.4. CYBER MODE KEYCODE ADDENDUM FOR SWEDISH/FINNISH KEYCAP OPTION

KEY NO.	KEY LEGENDS			PRESSED WITH KEY ... GENERATE			
	LOWER	CENTER	UPPER		⇧	CTRL	⇧ + CTRL
16	[		]	1E, 4B	1E, 4D	1E, 4B	1E, 4D
18	2		"	32	22	00	00
19	3		#	33	23	33	23
20	4		¤	34	24	34	24
22	6		&	36	26	36	26
23	7		/	37	2F	37	2F
24	8		(	38	28	38	28
25	9		)	39	29	39	29
26	0		=	30	3D	30	3D
27	+		?	2B	3F	1F	1F
28		É		60	40	1E	1E
29				-	-	-	-
43		Å		7D	5D	1D	1D
44		Ü		7E	5E	1C	1C
57		Ö		7C	5C	7C	5C
58		Ä		7B	5B	7B	5B
59	´		*	27	2A	27	2A
63	<		>	3C	3E	3C	3E
71	,		;	2C	3B	2C	3B
72	.		:	2E	3A	2E	3A
73	-		_	2D	5F	2D	5F

TABLE B-1.5. CYBER MODE KEYCODE ADDENDUM FOR DANISH/NORWEGIAN KEYCAP OPTION

KEY NO.	KEY LEGENDS			PRESSED WITH KEY ... GENERATE			
	LOWER	CENTER	UPPER		⇧	CTRL	⇧ ·CTRL
16	[		]	1E, 4B	1E, 4D	1E, 4B	1E, 4D
18	2		"	32	22	00	00
22	6		&	36	26	36	26
23	7		/	37	2F	37	2F
24	8		(	38	28	38	28
25	9		)	39	29	39	29
26	0		=	30	3D	30	3D
27	+		?	2B	3F	1F	1F
28	`		@	60	40	1E	1E
29				-	-	-	-
43		Å		7D	5D	1D	1D
44	¯		^	7E	5E	1C	1C
57		ø		7C	5C	7C	5C
58		Æ		7B	5B	7B	5B
59	´		*	27	2A	27	2A
63	<		>	3C	3E	3C	3E
71	,		;	2C	3B	2C	3B
72	.		:	2E	3A	2E	3A
73	-		_	2D	5F	2D	5F

TABLE B-1.6. CYBER MODE KEYCODE ADDENDUM FOR SPANISH KEYCAP OPTION

KEY NO.	KEY LEGENDS			PRESSED WITH KEY ... GENERATE			
	LOWER	CENTER	UPPER		⇧	CTRL	⇧ •CTRL
16	`		~	60	7E	60	7E
18	2		§	32	40	00	00
19	3		£	33	23	33	23
29				-	-	-	-
43	]		[	1E, 4B	1E, 4D	1D	1D
44	ç		Ç	7D	5D	1C	1C
57		Ñ		7C	5C	7C	5C
58	º		¡	7B	5B	7B	5B
59	'		"	27	22	27	22
63	<		>	3C	3E	3C	3E
71	,		;	2C	3B	2C	3B
72	.		:	2E	3A	2E	3A

TABLE B-2. COMPATIBILITY MODE KEYCODES

KEY NO.	NOTES*	KEY LEGENDS			PRESSED WITH KEY ... GENERATE			
		LOWER	CENTER	UPPER		⇧	CTRL	⇧ •CTRL
1	1		PRINT		Print screen	Print screen	Print screen	Print screen
2			SETUP		-	-	-	-
3	1		(F1)		02	02	02	02
4	1		(F2)		06	06	06	06
5	1		(F3)		1B,42	1B,42	1B,42	1B,42
6	1		(F4)		1B,46	1B,46	1B,46	1B,46
7	1		(F5)		01	01	01	01
8	1		(F6)		05	05	05	05
9	1		(F7)		10	10	10	10

TABLE B-2. COMPATIBILITY MODE KEY FUNCTIONS (CONTD)

KEY NO.	NOTES*	KEY LEGENDS			PRESSED WITH KEY ... GENERATE			
		LOWER	CENTER	UPPER		⇧	CTRL	⇧ CTRL
			⇐					
10	1		(F8)		0E	0E	0E	0E
			SUPER					
11	1		(F9)		1B,56	1B,56	1B,56	1B,56
			SUB					
12	1		(F10)		16	16	16	16
			MICRO					
13	1		(F11)		No action	No action	No action	No action
			FONT					
14	1		(F12)		No action	No action	No action	No action
15	1		+	DOWN **	2B	23	2B	23
16	R				-	-	-	-
17	R	1		!	31	21	31	21
18	R	2		@	32	40	00	00
19	R	3		#	33	23	33	23
20	R	4		$	34	24	34	24
21	R	5		%	35	25	35	25
22	R	6		^	36	5E	36	5E
23	R	7		&	37	26	37	26
24	R	8		*	38	2A	38	2A
25	R	9		(	39	28	39	28
26	R	0		)	30	29	30	29
27	R	-		_	2D	5F	1F	1F
28	R	=		+	3D	2B	1E	1E
29	R	`		~	60	7E	60	7E
30	R		←		08	08	08	08
31	1		—	UP **	2D	26	2D	26
32			→|		09	09	1E,12,57	1E,12,57
33	R		Q	↖ **	71	51	11	11
34	R		W	↑ **	77	57	17	17
35	R		E	↗ **	65	45	05	05

TABLE B-2. COMPATIBILITY MODE KEY FUNCTIONS (CONTD)

KEY NO.	NOTES*	KEY LEGENDS			PRESSED WITH KEY ... GENERATE			
		LOWER	CENTER	UPPER		⇧	CTRL	⇧ ·CTRL
36	R		R		72	52	12	12
37	R		T		74	54	14	14
38	R		Y		79	59	19	19
39	R		U		75	55	15	15
40	R		I		69	49	09	09
41	R		O		6F	4F	0F	0F
42	R		P		70	50	10	10
43	R	[		]	5B	5D	1D	1D
44	R	\		¦	5C	7C	1C	1C
45	1		⊢←		08	08	08	08
46	1		X	FWD **	40	60	40	60
47			⊖		-	-	-	-
48	R		A	← **	61	41	01	01
49	R		S		73	53	13	13
50	R		D	→ **	64	44	04	04
51	R		F		66	46	06	06
52	R		G		67	47	07	07
53	R		H		68	48	08	08
54	R		J		6A	4A	0A	0A
55	R		K		6B	4B	0B	0B
56	R		L		6C	4C	0C	0C
57	R	;		:	3B	3A	3B	3A
58	R	'		"	27	22	27	22
59	R	{		}	7B	7D	7B	7D
60	See Key 75				-	-	-	-
61	1		÷	BKW **	5C	7C	5C	7C
62			⇧		-	-	-	-
63	R				-	-	-	-
64	R		Z	↙ **	7A	5A	1A	1A
65	R		X	↓ **	78	58	18	18

TABLE B-2. COMPATIBILITY MODE KEY FUNCTIONS (CONTD)

KEY NO.	NOTES*	KEY LEGENDS			PRESSED WITH KEY ... GENERATE			
		LOWER	CENTER	UPPER		⇧	CTRL	⇧ •CTRL
66	R		C	↘ **	63	43	03	03
67	R		V		76	56	16	16
68	R		B		62	42	02	02
69	R		N		6E	4E	0E	0E
70	R		M		6D	4D	0D	0D
71	R	,		<	2C	3C	2C	3C
72	R	.		>	2E	3E	2E	3E
73	R	/		?	2F	3F	2F	3F
74			⇧		-	-	-	-
75		←┘		NEXT	0D	0D	0D	0D
76			CTRL		-	-	-	-
77	R		(Space)		20	20	20	20
78		DEL		CR	7F	0D	7F	0D
79	1		HELP		03	03	03	03
80	1	ANS	(F13)	TERM	1B	1B	1B	1B
81	1		ERASE		1F	08	08	08
82	1		COPY (F14)		Control code follows	Print screen	Control code follows	Print screen
83	1		EDIT		0A	0A	0A	0A
84	1		□ (F15)		Clear screen	Clear screen	Clear screen	Clear screen
85	1		BACK		08	08	08	08
86	1		LAB		1E,12,31	1E,12,32	1E,12,33	1E,12,33
87	1		DATA		7F	7F	-	-
88	1		STOP		13	13	13	13
89	R	C	INSRT	L	1E,4F	1E,52	1E,4F	1E,52
90	R	C	DLETE	L	1E,4E	1E,51	1E,4E	1E,51
91		EOL	CLEAR	P	0B	0C	0B	0C
92		ESC		LF	1B	0A	1B	0A
93		BREAK		M REL	BREAK	11	BREAK	11
94	R,N		7		37	-	37	-

TABLE B-2. COMPATIBILITY MODE KEY FUNCTIONS (CONTD)

KEY NO.	NOTES*	KEY LEGENDS			PRESSED WITH KEY ... GENERATE			
		LOWER	CENTER	UPPER		⇧	CTRL	⇧ CTRL
95	R,N	8			38	17	38	17
96	R,N		9	↑	39	-	39	-
97	R,N	4		←	34	08	34	08
98	R,N	5		HOME**	35	19	35	19
99	R,N	6		→	36	18	36	18
100	R,N	1			31	-	31	-
101	R,N	2		↓	32	1A	32	1A
102	R,N	3			33	-	33	-
103	R,N	,			2C	-	2C	-
104	R,N	0			30	-	30	-
105	R,N	.			2E	-	2E	-
106		↵		NEXT	0D	0D	0D	0D

*Key to Notes:

1 - Codes listed reflect the default values for white keys. These values may be changed using the TERMSET utility or be changed via a user program (see Using TERMSET to Set Options or Dynamic Alteration of Terminal Parameters in section 13).

N - Modified if the Numeric Pad parameter is set to SHIFT.

R - Auto repeat if TYPAMATIC is on.

\- - No code generated.

** - Labeled on skirt of keycap.

TABLE B-2.1. COMPATIBILITY MODE KEY FUNCTION ADDENDUM FOR UNITED KINGDOM KEYCAP OPTION

KEY NO.	KEY LEGENDS			PRESSED WITH KEY ... GENERATE			
	LOWER	CENTER	UPPER		⇧	CTRL	⇧ ·CTRL
16	`		¬	60	7E	60	7E
19	3		£	33	23	33	23
29				-	-	-	-
63	<		>	3C	3E	3C	3E
71	,		,	2C	2C	2C	2C
72	.		.	2E	2E	2E	2E

TABLE B-2.2. COMPATIBILITY MODE KEY FUNCTION ADDENDUM FOR FRENCH KEYCAP OPTION

KEY NO.	KEY LEGENDS			PRESSED WITH KEY ... GENERATE			
	LOWER	CENTER	UPPER		⇧	CTRL	⇧ ·CTRL
16	[		]	1E,4B	1E,4D	1E,4B	1E,4D
18	2		"	32	22	00	00
19	3		§	33	5D	33	5D
22	6		+	36	2B	36	2B
23	7		/	37	2F	37	2F
24	8		(	38	28	38	28
25	9		)	39	29	39	29
26	0		=	30	3D	30	3D
27	´		?	27	3F	1F	1F
28	^		¨	5E	7E	1E	1E
29				-	-	-	-
43	à		ç	40	5C	1D	1D
44	&		*	26	2A	1C	1C
57	é		è	7B	7D	7B	7D
58	ù		o	7C	5B	7C	5B
59	`		£	60	23	60	23

TABLE B-2.2. COMPATIBILITY MODE KEY FUNCTION ADDENDUM FOR FRENCH KEYCAP OPTION (CONTD)

KEY NO.	KEY LEGENDS			PRESSED WITH KEY ... GENERATE			
	LOWER	CENTER	UPPER		⇧	CTRL	⇧ ·CTRL
63	<		>	3C	3E	3C	3E
71	,		;	2C	3B	2C	3B
72	.		:	2E	3A	2E	3A
73	-		_	2D	5F	2D	5F

TABLE B-2.3. COMPATIBILITY MODE KEY FUNCTION ADDENDUM FOR GERMAN KEYCAP OPTION

KEY NO.	KEY LEGENDS			PRESSED WITH KEY ... GENERATE			
	LOWER	CENTER	UPPER		⇧	CTRL	⇧ ·CTRL
16	[		]	1E, 4B	1E, 4D	1E, 4B	1E, 4D
18	2		"	32	22	00	00
19	3		§	33	40	33	40
22	6		&	36	26	36	26
23	7		/	37	2F	37	3F
24	8		(	38	28	38	28
25	9		)	39	29	39	29
26	0		=	30	3D	30	3D
27	ß		?	7E	3F	1F	1F
28	´		`	27	60	1E	1E
29				-	-	-	-
38		Z		7A	5A	19	19
43		Ü		7D	5D	1D	1D
44	+		*	2B	2A	1C	1C
57		Ö		7C	5C	7C	5C
58		Ä		7B	5B	7B	5B
59	#		^	23	5E	23	5E
63	<		>	3C	3E	3C	3E
64		Y		79	59	1A	1A

TABLE B-2.3. COMPATIBILITY MODE KEY FUNCTION ADDENDUM FOR GERMAN KEYCAP OPTION (CONTD)

KEY NO.	KEY LEGENDS			PRESSED WITH KEY ... GENERATE			
	LOWER	CENTER	UPPER		⇧	CTRL	⇧ ·CTRL
71	,		;	2C	3B	2C	3B
72	.		:	2E	3A	2E	3A
73	-		_	2D	5F	2D	5F

TABLE B-2.4. COMPATIBILITY MODE KEY FUNCTION ADDENDUM FOR SWEDISH/FINNISH KEYCAP OPTION

KEY NO.	KEY LEGENDS			PRESSED WITH KEY ... GENERATE			
	LOWER	CENTER	UPPER		⇧	CTRL	⇧ ·CTRL
16	[		]	1E,4B	1E,4D	1E,4B	1E,4D
18	2		"	32	22	00	00
19	3		#	33	23	33	23
20	4		¤	34	24	34	24
22	6		&	36	26	36	26
23	7		/	37	2F	37	2F
24	8		(	38	28	38	28
25	9		)	39	29	39	29
26	0		=	30	3D	30	3D
27	+		?	2B	3F	1F	1F
28		É		60	40	1E	1E
29				-	-	-	-
43		Å		7D	5D	1D	1D
44		Ü		7E	5E	1C	1C
57		Ö		7C	5C	7C	5C
58		Ä		7B	5B	7B	5B
59	´		*	27	2A	27	2A
63	<		>	3C	3E	3C	3E
71	,		;	2C	3B	2C	3B
72	.		:	2E	3A	2E	3A
73	-		_	2D	5F	2D	5F

TABLE B-2.5. COMPATIBILITY MODE KEY FUNCTION ADDENDUM FOR DANISH/NORWEGIAN KEYCAP OPTION

KEY NO.	KEY LEGENDS			PRESSED WITH KEY ... GENERATE			
	LOWER	CENTER	UPPER		⇧	CTRL	⇧ ·CTRL
16	[		]	1E,4B	1E,4D	1E,4B	1E,4D
18	2		"	32	22	00	00
22	6		&	36	26	36	26
23	7		/	37	2F	37	2F
24	8		(	38	28	38	28
25	9		)	39	29	39	29
26	0		=	30	3D	30	3D
27	+		?	2B	3F	1F	1F
28	`		@	60	40	1E	1E
29				-	-	-	-
43		Å		7D	5D	1D	1D
44	¯		^	7E	5E	1C	1C
57		ø		7C	5C	7C	5C
58		Æ		7B	5B	7B	5B
59	´		*	27	2A	27	2A
63	<		>	3C	3E	3C	3E
71	,		;	2C	3B	2C	3B
72	.		:	2E	3A	2E	3A
73	-		_	2D	5F	2D	5F

TABLE B-2.6. COMPATIBILITY MODE KEY FUNCTION ADDENDUM FOR SPANISH KEYCAP OPTION

KEY NO.	KEY LEGENDS			PRESSED WITH KEY ... GENERATE			
	LOWER	CENTER	UPPER		⇧	CTRL	⇧ ·CTRL
16	`		~	60	7E	60	7E
18	2		§	32	40	00	00
19	3		£	33	23	33	23
29				-	-	-	-
43	]		[	1E,4B	1E,4D	1D	1D
44	ç		Ç	7D	5D	1C	1C
57		Ñ		7C	5C	7C	5C
58	º		¡	7B	5B	7B	5B
59	'		"	27	22	27	22
63	<		>	3C	3E	3C	3E
71	,		;	2C	3B	2C	3B
72	.		:	2E	3A	2E	3A

This appendix describes how to check and set the parameters of the Type 3 terminal for running CP/M. The terminal has factory-set parameters for a typical configured terminal. The factory-set parameters have mode 3 assigned as the CP/M mode. A definition of the parameters is given in appendix A of the CDC 721 Display Terminal Operator's Guide/Installation Instructions Manual (publication number is listed in preface).

To check the parameters, do as follows:

1. Press RESET button on terminal.

2. When self-test is complete and the mode menu display appears, press both the CTRL and SETUP keys to examine the terminal configuration setup. The following values are a minimum configuration to operate with CP/M.

   F2 000010 (Flexible-disk option in)
   Additional bits may be set for other options

   F3 000100 (Parallel port option in)
   Additional bits may be set for other options

   F4 000000 (Auto select disabled)

   F5 and F6 Ignored by CP/M

   F7 0 0000 (Characters are to be displayed in English)
   A first digit other than 0 or 1 will apply if the terminal has a keycap option. The correct number for each keycap option is given in the previously mentioned operator's guide/ installation instructions manual.

   F8 and F9 Ignored by CP/M

   If no change to these parameters is required, go to step 3. If a change is required, press the F2 through F7 key that corresponds with the numbered block where the change is to be made. This moves the cursor within that block. Use the Space bar to go forward or the Backspace key to go backward and move the cursor to the digit of wrong value. Then key in the correct digit. When all changes have been made, press the COPY key to record them in nonvolatile memory before going to step 3.

3. Press the F10 key. Then press 3 and the NEXT keys to examine the parameters for mode 3 (CP/M mode). The following list gives the factory-set values for this mode.

F2 100110 (Mode enabled, load external, load from disk)

F3 000100 (Communication words of 7-data bits, odd-parity bit, and 1-stop bit)

F4 000000 (Typamatic on, home upper left, auto LF off)

F5 000000 (Pacing and bias disabled)

F6 6C25 (6 = alert soft, margin alert on, printer selected, online)
C = large CYBER, roll screen, alpha lock.
2 = cursor blink, cursor box, background dark.
5 = 30 lines, 80 char/line, full duplex.)

F7 000000 Not used

F8 000000 Not used

F9 00 6 6 Not used

If CYBER mode operations under CP/M control are to be performed, the parameters in blocks F3 and F6 for mode 3 must be changed to the following:

F3 001000 (Changes communication words to 8-data bits with the 8th bit a space and no parity)

F6 4625 (Deselects printer so printing is not immediately enabled when CP/M mode is entered)

If any changes to mode 3 parameters are to be made, follow the preceding instructions in step 2 for making changes. When changes are made, be sure to press the COPY key to record them in nonvolatile memory.

4. Press F1 key to return to mode menu display. The parameters are setup to load CP/M from the flexible disk drive when the F3 key is pressed with mode menu on the screen.

This appendix gives some notes and cautions on the operation of the Control Data 110 CP/M 2.2 system.

TECHNICAL NOTES

- SUBMIT with XSUB
  - The control P character is not allowed in a file of XSUB commands, thus one cannot echo terminal output to the printer while using SUBMIT.
  - Commands cannot be submitted to PIP. Commands submitted to ED must be terminated with a control Z character. Apparently these two programs use BDOS function 10 for input, and the CP/M 2.2 User's Guide states that programs which use function 10 cannot use XSUB as a source of input.
- DDT
  - The Control Data 110 system does not have the capability to execute an RST 7.
  - Assembly language programs can terminate with a RET statement which causes them to return to the CCP. If these programs are executed under DDT the last RET statement can cause the system to hang. This problem can be alleviated by replacing the RET with a JMP 0 or by terminating DDT before it reaches the final RET.
- CP/M 2.2 Interface Notes
  - The filename in an FCB is blank filled.
  - On initiation, CP/M 2.2 loads the checksums of the diskette in the Type 1 and Type 2 drives into memory. Each time a BDOS call is made a comparison between the diskette checksum and the checksum for that drive stored in memory is done. If the checksums do not match the drive is defined to be read only and disk interface functions that alter data on the diskette are disallowed. Thus any time a diskette in a drive is removed and a new diskette is inserted, the new diskette is defined to be read only. The status of the new diskette can be changed to read/write by rebooting the system with a control C or by calling the reset drive BDOS function.

- The Search For First and Search For Next BDOS functions place directory information into the DMA. Before the file desired can be accessed, the directory information must be loaded into the FCB for that file. Note that the drive code for the file is not contained in the directory information.

- The Search For Next function requires the original FCB with the imbedded question marks in the filename to operate correctly.

- Hazeltine Escape Sequences - The first tilde (~) is not printed out on the screen because it is a preface to an escape sequence and is used in the same manner as the ESC key.

SOFTWARE NOTES AND CAUTIONS

The Type 2 terminal may be received either with or without the numeric keypad keys installed. A keycap set is available to update early production units. The keys have the alternate coding printed on the front side of the key.

However, even without the keycap set installed, the key with the indicated top engraving generates the codes listed in the table below when operating in numeric keypad mode.

TOP ENGRAVING	CODE GENERATED
7 8 9	+ - .
u i o	7 8 9
j k l	4 5 6
m , .	1 2 3
Space Bar	0
+	+
÷	/
x	*
⇐	No Action
TERM ANS	No Action

The blue NEXT key and all other white keys operate as in the normal mode of operation in CP/M.

CAUTION

If the control P character locks the Type 1 printer in the print mode, it can be switched into the feed mode by pressing the PRINT and FEED buttons simultaneously.

This appendix contains a description of the commands used to direct the Type 3 terminal in CYBER mode and the resulting operations. However, preceding that are paragraphs that describe the CYBER submodes and the means of transferring between compatibility mode and CYBER mode.

CYBER SUBMODES

CYBER mode has two selectable submodes called large CYBER mode and small CYBER mode, which control the way the terminal translates commands. In the operator parameters of the terminal, large CYBER mode is always to be selected. When operating under CP/M, this is necessary to make terminal translation compatible with CP/M (this is described in more detail in section 13 under Changing Terminal Characteristics in Type 3 Terminals).

When CYBER mode is entered, the operator parameter selection of large CYBER causes the terminal to respond only to commands applicable in large CYBER mode (commands which apply only to large CYBER mode or small CYBER mode are indicated in table E-1 later in this appendix). However, small CYBER operations can be performed in CYBER mode by the user program issuing:

RS,DC2,'A'

As defined in table E-1, this code sequence commands the terminal to enter small CYBER mode. This overrides the large CYBER parameter selection and when small CYBER mode operations are complete, the program must issue the following command sequence to return to large CYBER mode before exiting to CP/M.

RS,DC2,'B'

TRANSFERRING FROM COMPATIBILITY MODE

Compatibility mode is in effect when the terminal is under CP/M control (the terminal characteristics in compatibility mode are discussed under Type 3 Terminal Characteristics in section 13). To transfer from compatibility mode to CYBER mode requires that the user program issue the terminal an ESCape sequence of:

ESC,ESC,'b','b'

TRANSFERRING FROM CYBER MODE

The following ESCape sequence transfers the Type 3 terminal from CYBER mode back to compatibility mode.

ESC,ESC,'c,'c'

CYBER MODE COMMANDS AND RESPONSES

Table E-1 describes the commands and responses of the Type 3 terminal while operating in CYBER mode. Some terms in these descriptions may be unfamiliar. For definitions, refer to the CDC 721 Display Terminal Hardware Reference Manual (publication number is listed in preface). That manual covers the characteristics of the terminal while operating in resident CYBER mode. Those characteristics also apply while operating in CYBER mode under CP/M control.

TABLE E-1. CYBER MODE COMMANDS AND RESPONSES

COMMAND NAME	ASCII MNEMONIC (SEE NOTE AT END OF TABLE)	HEX CODE (SEE NOTE AT END OF TABLE)	TERMINAL RESPONSE
Print Form	SOH	01	Transfers all nondimmed displayed data to printer from beginning of current line to end of page. Dimmed data is sent as space code (20). Keyboard locks, communications data is received but ignored until end of operation (not lost). Printing may be aborted by actuation of Shift/M REL. Print completion is signaled by terminal transmitting an 06 (ACK) or, if the operation is aborted by actuating SHIFT/M REL, by transmission of an 1E, 15 (RS, NAK) sequence. If there is no printer DTR when the Print Form command is received, an RS, NAK is sent in small CYBER mode. There is no completion response in large CYBER mode.
NOOP Small CYBER Mode	STX	02	No operation.
Write Cursor Address Large CYBER Mode	STX	02	See Write Cursor Address command, hex code 10.
Enable Blink	ETX	03	Blinks characters whose blink bit is set to 1 (refer to Start Blink command, hex code 0E). Following power up or page erase, blink is automatically enabled.
Disable Blink	EOT	04	Disables character blinking on display page.
Read Cursor Address	ENQ	05	Causes terminal to send cursor address header code (1F) followed by codes containing column and row address. Column position transfers first and is numbered from left to right (00 through 4F) for 80-column mode. In 132-column mode, a 7E code preceeds the column position address producing a code sequence of 7E, 00, 00 through 4F for

TABLE E-1. CYBER MODE COMMANDS AND RESPONSES (CONTD)

COMMAND NAME	ASCII MNEMONIC (SEE NOTE AT END OF TABLE)	HEX CODE (SEE NOTE AT END OF TABLE)	TERMINAL RESPONSE
Read Cursor Address (Contd)			the first 80 columns 01, 00 through 34 for columns 81 through 132. The next code is line position numbering from top to bottom (00 through 1D). Row/ column addresses may be biased to avoid codes 00 through 1F by enabling address bias parameter selection [refer to appendix A in the CDC 721 Display Terminal Operator's Guide/Installation Instructions Manual to set parameter (preface lists publication number)]. When address biasing is enabled, cursor position 00 equals 20. Addressing continues in normal binary progression through 6F for 80-column mode. The 132-column mode sequence is 7E, 20, 20 through 7E, 21, 44 for columns 0 through 132, respectively. The line position address is 20 through 3D for both 80- and 132-column modes.
NOOP Small CYBER Mode	ACK	06	No operation.
Start Underline Large CYBER Mode	ACK	06	Sets the underline attribute bit to 1.
Alarm	BEL	07	Sounds audible alarm for 250 milliseconds.
Home Small CYBER Mode	BS	08	Moves cursor to the home position selected in parameters.
Cursor Left Large CYBER Mode	BS	08	Moves cursor left one character position.
NOOP Small CYBER Mode	HT	09	No operation.
TAB Large CYBER Mode	HT	09	If protect is not enabled, causes cursor to be advanced to the first position following the next low-intensity field or next column tab

TABLE E-1. CYBER MODE COMMANDS AND RESPONSES (CONTD)

COMMAND NAME	ASCII MNEMONIC (SEE NOTE AT END OF TABLE)	HEX CODE (SEE NOTE AT END OF TABLE)	TERMINAL RESPONSE
TAB Large CYBER Mode (Contd)			(whichever comes first). If protect is enabled, causes cursor to be advanced to the next unprotected field or next column tab (whichever comes first). Cursor will move to top of page if the preceding conditions are not present. No response is sent.
New Line Small CYBER Mode	LF	0A	Moves cursor to first character position in next line.
Cursor Down Large CYBER Mode	LF	0A	Moves cursor down one line while remaining in the same position. If on the last line, screen will scroll and cursor will move to first column if roll is enabled; or cursor will move to top line if page is enabled.
EOL (Erase to End of Line)	VT	0B	Erases all unprotected characters from, and including current cursor position to end of current unprotected field or the end of that line. Enters 20 in affected positions. Modified attribute bits for all cleared character positions are cleared in character mode, set in block mode.
EP (Erase Page)	FF	0C	Erases all unprotected characters on screen. Cursor moves to home position. Enters 20 in affected positions. Clears background memory and enables blink if previously disabled. Return to enter normal data (clears enter blink, underscore, reduced intensity, dim, and blank). Modified attribute bits are cleared in character mode, set in block mode.
Carriage Return	CR	0D	Moves cursor to first character position in line that it is on. If the Auto Line Feed parameter is selected, a LF is performed.

TABLE E-1. CYBER MODE COMMANDS AND RESPONSES (CONTD)

COMMAND NAME	ASCII MNEMONIC (SEE NOTE AT END OF TABLE)	HEX CODE (SEE NOTE AT END OF TABLE)	TERMINAL RESPONSE
Start Blink	SO	0E	Sets blink bit to 1. Each succeeding displayed character received is shown blinking on the screen.
Stop Blink	SI	0F	Sets blink bit to 0. Each succeeding displayed character received is steadily illuminated.
Write Cursor Address Small CYBER Mode	DLE	10	Interprets next characters as cursor column and row address. Cursor moves to position defined by addresses. Column address is numbered from left to right (00 through 4F) for 80-column mode. In 132-column mode, a 7E code preceeds the column position address, producing a code sequence of 7E, 20, 00 through 4F for columns 0 through 80, and 7E, 21, 00 through 34 for columns 81 through 132. Line position is numbered from top to bottom (00 through 1D). If column position code is greater than 4F in 80-column mode or 01, 34 in 132-column mode, cursor control logic wraps around. Line position operates in a similar manner (e.g., 1F equals 01). Row and column addresses may be biased in same manner as described for Read Cursor Address, hex code 05.
NOOP Large CYBER Mode	DLE	10	No operation.
Page Print Small CYBER Mode	DC1	11	Transfers to printer all displayed data from current line to end of page. Keyboard is locked and received data ignored until end of operation (not lost). Printing may be aborted by pressing Shift/M REL. Print completion is signaled by terminal transmitting an 06 or, if the operation was aborted, by transmitting a RS, NAK (1E, 15) sequence. If printer is not ready when the Page Print command is received, an RS, NAK is returned.

TABLE E-1. CYBER MODE COMMANDS AND RESPONSES (CONTD)

COMMAND NAME	ASCII MNEMONIC SEE NOTE AT END OF TABLE	HEX CODE	TERMINAL RESPONSE
X-On Large CYBER Mode	DC1	11	Enables transmission to the host or initiates continuation of suspended transmission from the host (refer to X-Off command, hex code 13). For further information, refer to X-Off/ X-On in section 4 of the CDC 721 Display Terminal Hardware Reference Manual (preface lists publication number).
Roll Enable	DC2	12	Enables roll mode; screen scrolls up one line each time cursor overflows bottom line or, if a new line code is received when cursor is on bottom line, cursor moves to first character position on bottom line. Bottom line clears; top line is lost. Powering on terminal enables scroll feature.
Roll Disable Small CYBER Mode	DC3	13	Enables page mode; moves cursor to home position when new line code is received and cursor is on bottom line.
X-Off Large CYBER Mode	DC3	13	Causes the terminal to temporarily halt transmission to the host until the X-On command (hex code 11) is received. When sent to the host, means data cannot be acted upon. For further information, refer to X-Off/X-On in section 4 of the CDC 721 Display Terminal Hardware Reference Manual (preface lists publication number).
Start Underscore Small CYBER Mode	DC4	14	Sets underscore bit to 1. Each succeeding displayed character received is underlined on the screen.
NOOP Large CYBER Mode	DC4	14	No operation.
End Underscore	NAK	15	Sets underscore bit to 0. Each succeeding displayed character received is shown without underlining.
NOOP Small CYBER Mode	SYN	16	No operation.

TABLE E-1. CYBER MODE COMMANDS AND RESPONSES (CONTD)

COMMAND NAME	ASCII MNEMONIC (SEE NOTE AT END OF TABLE)	HEX CODE (SEE NOTE AT END OF TABLE)	TERMINAL RESPONSE
Roll Disable Large CYBER Mode	SYN	16	Enables page mode; moves cursor to home position when new line code is received and cursor is on bottom line.
Cursor Up	ETB	17	Moves cursor up one line while remaining in same column (character) position. Stored data is not affected.
Skip	CAN	18	Moves cursor right one character position. Stored data is not affected.
Cursor Left Small CYBER Mode	EM	19	Moves cursor left one character position. Stored data is not affected.
Home Large CYBER Mode	EM	19	Moves cursor to the home position selected in parameters.
Cursor Down	SUB	1A	Moves cursor down one line while remaining in same column (character) position. If cursor is on the last line, it will wrap around to the top. Stored data is not affected.
NOOP	ESC	1B	No operation.
Start Dim	FS	1C	Sets dim bit to 1. Each succeeding displayed character received is dimmed on the screen.
End Dim	GS	1D	Sets dim bit to 0. Each succeeding displayed character received is displayed at full intensity on the screen.
NOOP Small CYBER Mode	US	1F	No operation.
Backspace Large CYBER Mode	US	1F	Moves cursor left one position and clears the data. Protected data is not cleared.
Print Form	RS, SOH	1E, 01	See Print Form command, hex code 01.

TABLE E-1. CYBER MODE COMMANDS AND RESPONSES (CONTD)

COMMAND NAME	ASCII MNEMONIC (SEE NOTE AT END OF TABLE)	HEX CODE (SEE NOTE AT END OF TABLE)	TERMINAL RESPONSE
Tab Small CYBER Mode	RS, EOT	1E, 04	If protect is not active, this will cause the cursor to advance to the first position following next low-intensity field or next column tab (whichever comes first). If none are present, moves to top of page. If protect is active, moves to the next unprotected area or column tab (whichever comes first). If none are present, moves to top of page. Completion response is identical to Read Status response (refer to hex code 1E, 14).
NOOP Large CYBER Mode	RS, EOT	1E, 04	No operation.
Enable CR Delimiter	RS, ENQ,	1E, 05	Caused a CR delimiter (0D) to be added to certain host responses.
Home	RS, BS	1E, 08	See Home commands, hex codes 08 or 19.
Define Function or Action Key Code Sequence or Controlware Sequence	RS, HT, (V), (W) (X), (Y...), (Z)	1E, 09, (V), (W) (X), (Y...), (Z)	Allows special code sequences or controlware sequences to be generated by certain keys. For further information, refer to Host-Specified Code Sequence/ Controlware in section 4 of the CDC 721 Display Terminal Hardware Reference Manual (preface lists publication number).
Back Tab	RS, VT	1E, 0B	Moves cursor backward as follows: • With protect not enabled, to the first position following a low-intensity field or column tab, whichever is encountered first. If neither is encountered, cursor moves to upper-left position.

TABLE E-1. CYBER MODE COMMANDS AND RESPONSES (CONTD)

COMMAND NAME	ASCII MNEMONIC (SEE NOTE AT END OF TABLE)	HEX CODE (SEE NOTE AT END OF TABLE)	TERMINAL RESPONSE
Back Tab (Contd)			• With protect enabled, to the beginning of an unprotected field or to a column tab, whichever is encountered, first, If neither is encountered, cursor moves to upper-left position. After cursor movement is completed, a response identical to the Read Status response is sent to the host in small CYBER mode (refer to Read Status command, hex code 1E, 14). No response is sent in large CYBER mode.
Read Attribute	RS, SO (X), (Y)	1E, 0E (X) (Y)	Causes terminal to respond with two characters that indicate the attributes of character at cursor position. Cursor is not advanced; stored data is not affected. Data word one bit significance is 2^0 - internal program use; 2^1 - underscore bit; 2^2 - blink bit; 2^3 - reduced-intensity bit; 2^4 and 2^5 are set to a 1. If bit 2^6 is a 1, the character displayed at the current cursor position is not an alphanumeric or control character, but is a line-drawing symbol, a PLATO symbol, or a user-loaded extended character [line-drawing and PLATO symbols are shown in tables A-2 and A-3; extended characters are described under Load RAM Extended Character Generator command, hex code 1E, 53, (W), (X), (Y), (Z)]. Which type of special symbol is being displayed is determined by issuing a Read Data command (hex code 1E, 10) to read the code of the symbol. A code of 20 through 3F indicates a line-drawing symbol; a code of 40 through 7F indicates a PLATO symbol or an extended character, whichever had been in use (PLATO symbols and extended characters cannot be shown on the screen simultaneously).

TABLE E-1. CYBER MODE COMMANDS AND RESPONSES (CONTD)

COMMAND NAME	ASCII MNEMONIC (SEE NOTE AT END OF TABLE)	HEX CODE (SEE NOTE AT END OF TABLE)	TERMINAL RESPONSE
Read Attribute (Contd)			Data word two bit significance is: 2^0 - modified bit; 2^1 - protect bit; 2^2 - blank bit; 2^3 - inverse bit; 2^4 and 2^5 are set to a 1; 2^6 is set to a 0.
Read Parameter	RS, SI	1E, 0F	Causes terminal to transmit settings of terminal operating parameters. Settings are sent out in data words preceded by sequence 02, 06, 25 and, if in small CYBER mode, terminated with a Read Status response (see Read Status command, hex code 1E, 14). No response is sent in large CYBER mode. For the format of the data words sent, refer to Read Parameter Data Word Format table in section 4 of the CDC 721 Display Terminal Hardware Reference Manual (preface lists publication number).
Read Data	RS, DLE	1E, 10	Causes data word stored in memory at cursor position to be transmitted. Cursor is not advanced. Code contains seven data bits. Determining if the code represents an alphanumeric character, line drawing, extended character, or control code requires that the attribute character be read. Refer to Read Attribute command, hex code 1E, 0E.
Page Print Small CYBER Mode	RS, DC1	1E, 11	See Page Print command, hex code 11.
X-ON Large CYBER Mode	RS, DC1	1E, 11	This is not a normal sequence. With DC1 following RS, the X-On function will be performed (see X-On command, hex code 11), but the next code received will be acted upon as if an RS (1E) preceded it.
Read Parameter Small CYBER Mode	RS, DC3	1E, 13	See Read Parameter command, hex code 1E, 0F.

TABLE E-1. CYBER MODE COMMANDS AND RESPONSES (CONTD)

COMMAND NAME	ASCII MNEMONIC (SEE NOTE AT END OF TABLE)	HEX CODE (SEE NOTE AT END OF TABLE)	TERMINAL RESPONSE
X-Off Large CYBER Mode	RS, DC3	1E, 13	This is not a normal sequence. With DC3 following RS, the X-Off function will be performed (see X-Off Command, hex code 13), but the next code received will be acted upon as if an RS (1E) preceded it.
Read Status	RS, DC4	1E, 14	Causes terminal to transmit 02, 06, 06 (STX, ACK, ACK) if all preceding self-test operations were completed successfully. The response 02, 06, 15 (STX, ACK, NAK) is transmitted if any self-test failed.
Initiate Test	RS, SYN	1E, 16	Causes terminal to perform a self-test. This command is not to be used because it will cause CP/M to lose control of the terminal.
Skip	RS, CAN	1E, 18	See Skip command, hex code 18.
Backspace	RS, EM	1E, 19	See Cursor-Left command, hex code 19.
Cursor Down	RS, SUB	1E, 1A	See Cursor Down command, hex code 1A.
Line Drawing	RS, FS	1E, 1C	Causes terminal to interpret any following data words received from 20 to 3F as line drawing characters. Refer to table A-2 for codes.
Basic Character	RS, GS	1E, 1D	Causes terminal to interpret received data as normal characters.
Clear Fields:			Causes terminal to clear all unprotected data from cursor position to end of page or unprotected high- or low-intensity data as selected. No responses to I/O commands are made during the operation. Modified attribute bits for all cleared character positions are cleared. A Read Status response is transmitted to indicate the operation is complete (see Read Status command, hex code 1E, 14). No response is sent in large CYBER mode.
• Low Intensity	RS, ?	1E, 3F	
• High Intensity	RS, @	1E, 40	
• All Data	RS, P	1E, 50	

TABLE E-1. CYBER MODE COMMANDS AND RESPONSES (CONTD)

COMMAND NAME	ASCII MNEMONIC	HEX CODE	TERMINAL RESPONSE
	SEE NOTE AT END OF TABLE		
Initiate Host DLL	RS, A	1E, 41	Initiates a host-specified downline load. This command is not to be used because it will cause CP/M to lose control of the terminal.
Exit Host DLL	RS, B	1E, 42	This command and the Initiate Host DLL command (hex code 1E, 41) are not applicable for CYBER mode operations under CP/M control.
Model Report Request	RS, C,(n)	1E, 43, (n)	Terminal transmits a report message containing model and configuration information. In addition, if the n code of the command indicates a request for parameter data, the terminal includes the requested data in the message. That parameter data may be the operator parameters stored in RAM or the installation parameters stored in nonvolatile memory. For further details, refer to Model Report Request in section 4 of the CDC 721 Display Terminal Hardware Reference Manual (preface lists publication number).
Start Inverse	RS, D	1E, 44	Sets inverse bit to 1. Each succeeding received character is displayed in inverse video (dark characters on light background).
End Inverse	RS, E	1E, 45	Clears inverse bit to 0. Each succeeding received character is displayed in normal video (light characters on dark background).
Print I/O	RS, F	1E, 46	Causes terminal to direct all data to printer interface. Completion response is identical to the Read Status response (see Read Status command, hex code 1E, 14). No response is sent in large CYBER mode.

TABLE E-1. CYBER MODE COMMANDS AND RESPONSES (CONTD)

COMMAND NAME	ASCII MNEMONIC (SEE NOTE AT END OF TABLE)	HEX CODE (SEE NOTE AT END OF TABLE)	TERMINAL RESPONSE
Set All Protect Bits	RS, G	1E, 47	Disables character protect feature and sets the protect bit in the attribute code for every character position. The protect bits being set have no affect on operations until a Protect Enable command (hex code 1E, 12, 4B) is received. Note: If the Protect Enable command is issued with all protect bits set, the entire screen will be protected and no keyboard input will be possible.
Delete Character	RS, N	1E, 4E	Deletes character at current cursor position. All characters right of cursor are shifted left one position. If a Protect Enable command (hex code 1E, 12, 4B) is in effect, shift occurs only up to protected data.
Insert Character	RS, O	1E, 4F	Inserts a space character at current cursor position. Character at cursor position and characters right of cursor are shifted right one position. If a Protect Enable command (hex code 1E, 12, 4B) is in effect, shift occurs only up to protected data.
Clear All Data	RS, P	1E, 50	See preceding description in this table for Clear Fields - all data.
Delete Line	RS, Q	1E, 51	Causes all unprotected lines below cursor and within the logical page or unprotected area limits to move up one position; the current line is lost and the bottom line is cleared. The terminal will not respond to I/O commands during the operation. Completion response is identical to the Read Status response (see Read Status command, hex code 1E, 14). No response is sent in large CYBER mode. Modified attribute bits for all cleared character positions are cleared.

TABLE E-1. CYBER MODE COMMANDS AND RESPONSES (CONTD)

COMMAND NAME	ASCII MNEMONIC (SEE NOTE AT END OF TABLE)	HEX CODE (SEE NOTE AT END OF TABLE)	TERMINAL RESPONSE
Insert Line	RS, R	1E, 52	Causes unprotected data on current line to move one line down; bottom line within logical page or unprotected area is lost and the current line is cleared. The terminal will not respond to I/O commands during the operation. The response sent after completion is identical to the Read Status response (see Read Status command, hex code 1E, 14). Modified attribute bits for all cleared character positions are cleared.
Load RAM Extended Character Generator†	RS,S,(W), (X), (Y), (Z)	1E, 53,(W) (X), (Y), (Z)	Causes the terminal to interpret the characters following the RS, S, command [(W) (X), (Y), (Z)] as symbol data for the RAM character generator. This character generator generates a user-loaded symbol on the screen when directed by an Extended Character command, hex code 1E, 54, (X). Each symbol loaded requires an identifying code in word 1 (W), a start scan count in word 2 (X), thirty two codes that define the dot pattern in a group of word 3s (Y), and a termination code in word 4 (Z). These words are formatted as follows: • Word 1 (W) - Character Code. This identifying code must be between 40 through 7F. Codes outside this range cause an RS NAK to be sent to the host when the termination code is received.

†Resequence per dual hexadecimal code.

TABLE E-1. CYBER MODE COMMANDS AND RESPONSES (CONTD)

COMMAND NAME	ASCII MNEMONIC (SEE NOTE AT END OF TABLE)	HEX CODE (SEE NOTE AT END OF TABLE)	TERMINAL RESPONSE
Load RAM Extended Character Generator† (Contd)			• Word 2 (X) - Start Scan Count. Symbols are formed in a 8-dot wide by 16-dot high matrix. Bits 2^0 through 2^3 of this word specify the number of dot rows down in which the first illuminated dot is to appear within the matrix. Bit 24 must be a 0, bit 2^5 must be a 1, and bit 2^6 must be a 0. • Word 3 (Y) - Dot Pattern. The thirty two words of dot patterns are grouped in pairs. Each pair of words correspond with a row of 8 dots running left to right in the matrix. Bits 2^0 through 2^3 of the first word of each pair represent the left 4 dots and bits 2^0 through 2^3 of the second word represent the right 4 dots. If a dot is to be lit, the corresponding bit must be a 1. Bit 24 in the first word of each pair must be a 0, bit 2^5 must be a 1, and bit 2^6 must be a 0. Bit 2^6 in the second word of each pair must be a 1. • Word 4 (Z) - Termination Code CR (0D). If no errors were received, the terminal responds with an ACK (06); otherwise, an RS, NAK (1E, 15). No response is sent in large CYBER mode.
Extended Character†	RS, T,(X)	1E, 54,(X)	Causes terminal to interpret (X) as a character to be displayed from the RAM character generator [see Load Extended Character Generator command, hex code 1E, 53, (W), (X), (Y), (Z)]. X must be in the range of 40 through 7F. Codes outside of this range cause the parity-error symbol (■) to be displayed. Restriction: Extended characters cannot be simultaneously displayed with PLATO symbols.

†Resequence per dual hexadecimal code.

TABLE E-1. CYBER MODE COMMANDS AND RESPONSES (CONTD)

COMMAND NAME	ASCII MNEMONIC / HEX CODE (SEE NOTE AT END OF TABLE)		TERMINAL RESPONSE
Field Scroll Up	RS, U	1E, 55	Causes each display line in scroll field to move up one position [see Set Scroll Field command, hex code 1E, 57, (U), (L)]. The uppermost line in the scroll field is lost and the bottom line is cleared. There is no response to I/O commands during the operation. The response at completion is identical to the Read Status response (see Read Status command, hex code 1E, 14). No response is sent in large CYBER mode.
Field Scroll Down	RS, V	1E, 56	Causes each line in scroll field to move down one position [see Set Scroll Field command, hex code 1E, 57, (U), (L)]. The lowest line in the scroll field is lost and the uppermost line is cleared. There is no response to I/O commands during the operation. The response at completion is identical to the Read Status response (see Read Status command, hex code 1E, 14). No response is sent in large CYBER mode.
Set Scroll Field	RS,W,(U), (L)	1E, 57, (U), (L)	Establishes a scroll field on the screen. The word U in the command specifies the upper display line of the field and the word L specifies the lower line of the field. Line numbers outside of 1 through 30 ($1E_{16}$) automatically cause lines 1 and 30 to be selected. If address biasing is in effect (not selected in factory-set parameters), the acceptable line numbers are 33 (21_{16}) through 62 ($3E_{16}$). Note: This works in conjunction with the Field Scroll Up and Down commands, (hex codes 1E, 55 and 1E, 56).
Erase	RS, Y	1E, 59	See Erase command, hex code 1E, 5D.

TABLE E-1. CYBER MODE COMMANDS AND RESPONSES (CONTD)

COMMAND NAME	ASCII MNEMONIC SEE NOTE AT END OF TABLE	HEX CODE	TERMINAL RESPONSE
Erase	RS,]	1E, 5D	All character locations in the current unprotected field are cleared to spaces and the cursor is moved to the beginning of the unprotected field.
Blind Printer	RS, DEL	1E, 7F	Causes terminal to stop transferring received and transmitted data to printer. This is also governed by a mode installation parameter. RS (1E), DEL (7F) is transmitted to printer. The completion response is identical to the Read Status response (see Read Status command, hex code 1E, 14). No response is sent in large CYBER mode.
Enter Small CYBER Mode	RS, DC2, A	1E, 12, 41	Enter small CYBER mode of operation.
Enter Large CYBER Mode	RS, DC2, B	1E,12, 42	Enter large CYBER mode of operation.
Start Block Mode Send	RS, DC2, D	1E, 12, 44	The terminal transmits all unprotected data characters on the screen. A CR (0D) delimiter indicates the end of the operation. For the format of the transmission, refer to Block Mode Operation in section 4 of the CDC 721 Display Terminal Hardware Reference Manual (preface lists publication number).
Set 132 Character Line	RS, DC2, G	1E, 12, 47	Terminal displays 132 characters/line. If the initial line length is 80 characters per line, the display is cleared and the cursor is moved to home position.
Set 80 Character Line	RS, DC2, H	1E, 12, 48	Terminal displays 80 characters/line. If the initial line length is 132 characters per line, the display is cleared and the cursor is moved to home position.

TABLE E-1. CYBER MODE COMMANDS AND RESPONSES (CONTD)

COMMAND NAME	ASCII MNEMONIC (SEE NOTE AT END OF TABLE)	HEX CODE (SEE NOTE AT END OF TABLE)	TERMINAL RESPONSE
Start Protect	RS, DC2, I	1E, 12, 49	Sets protect bit in attribute code for each succeeding character received.
Clear Protect	RS, DC2, J	1E, 12, 4A	Clears protect bit in attribute code for each succeeding character received.
Enable Protect	RS, DC2, K	1E, 12, 4B	Characters with the protect bit set in their attribute codes are protected from operator action. Only the host can make changes to the protected data.
Disable Protect	RS, DC2, L	1E, 12, 4C	Disables protection of data. Operator input in previously protected character positions is allowed. Protect bits for characters are unaffected.
Disable Keyboard	RS, DC2, M	1E, 12, 4D	Disables keyboard entries until an Enable Keyboard command (hex code 1E, 12, 4E) is received or RESET switch is pressed. (Pressing RESET switch will cause CP/M to lose control of the terminal.)
Enable Keyboard	RS, DC2, N	1E, 12, 4E	Enables keyboard entries.
Disable Display	RS, DC2, O	1E, 12, 4F	Disables changes to the display memory. All incoming data is ignored until a Enable Display command (hex code 1E, 12, 50) is received.
Enable Display	RS, DC2, P	1E, 12, 50	Enables normal display operation.
Disable Touchpanel	RS, DC2, Q	1E, 12, 51	Disables input from the touchpanel until an Enable Touchpanel command (hex code 1E, 12, 52) is received or RESET switch is pressed. (Pressing RESET switch will cause CP/M to lose control of the terminal.)
Enable Touchpanel	RS, DC2, R	1E, 12, 52	Enables input from the touchpanel. For further information, refer to Touch-panel Operation in section 4 of the CDC 721 Display Terminal Reference Manual (preface lists publication number).

TABLE E-1. CYBER MODE COMMANDS AND RESPONSES (CONTD)

COMMAND NAME	ASCII MNEMONIC (SEE NOTE AT END OF TABLE)	HEX CODE (SEE NOTE AT END OF TABLE)	TERMINAL RESPONSE
Mode Select	RS, DC2, S, (n)	1E, 12, 53, (n)	This command is not applicable for CYBER mode operations under CP/M control.
PLATO Character	RS, DC2, T, (X)	1E, 12, 54, (X)	Causes terminal to interpret (X) as PLATO character to be displayed. X must be in the range of 40 through 7F (see table A-3). Codes outside this range will cause the display of a parity-error symbol (■). Restriction: PLATO characters and extended characters [see Extended Character command, hex code 1E, 54, (X)] cannot be displayed simultaneously.
Select Bi-directional Port N	RS, DC2, U, (N)	1E, 12, 55, (N)	This command is only applicable if an optional dual asynchronous-interface board is installed in the terminal. The command causes data from the host to be transferred to the specified port and data from the port to be transferred to the host. The word N a 0 specifies port A (connector J1); N a 1 specifies port B (connector J2). All transferred data is ignored by the terminal and the keyboard is locked to prevent entries. A RS (1E), DC2 (12) code sequence returns the terminal to normal operation. For further information, refer to Host Select Bidirectional Port in section 4 of the CDC 721 Display Terminal Reference Manual (preface lists publication number).
Write New Mode Parameters	RS, DC2, V, (Y), (Z)	1E, 12, 56, (Y), (Z)	Writes parameter changes into RAM. This command is not to be used because it will cause CP/M to lose control of the terminal.
Set Column Tab	RS,DC2,W,	1E, 12, 57	Causes the terminal to set a column tab for the current column
Clear Column Tab	RS,DC2,X,	1E, 12, 58	Causes the terminal to clear the column tab position of current column.

TABLE E-1. CYBER MODE COMMANDS AND RESPONSES (CONTD)

COMMAND NAME	ASCII MNEMONIC	HEX CODE	TERMINAL RESPONSE
	SEE NOTE AT END OF TABLE		
Clear All Tabs	RS,DC2,Y	1E, 12, 59	Clears all column tabs.
Disable CR Delimiter	RS, DC2, Z	1E, 12, 5A	Disables transmission of the CR (0D) delimiter in multiple code and control-ware sequences.
Start Blank	RS,DC2,[	1E, 12, 5B	Sets the blank attribute bit. Each succeeding received character is stored but not displayed.
End Blank	RS,DC2,	1E, 12, 5C	Clears the blank attribute bit for each succeeding character received.
Select 24 lines	RS,DC2,]	1E, 12, 5D	Terminal uses 24 lines for displaying characters. If 30 lines were being used, the display is cleared and the cursor is moved to home position.
Select 30 lines	RS,DC2,	1E, 12, 5E	Terminal uses 30 lines for displaying characters. If 24 lines were being used, the display is cleared and the cursor is moved to home position.
Enter Block Mode	RS, DC2, a	1E, 12, 61	Terminal stops character-by-character transmission of keyboard entries. Instead, entries are stored for a block transmission of all unprotected data on the screen. The only exceptions to this are the uppercase use of the L/INSRT/C key and the L/DLETE/C key. The codes for these keys are separately transmitted and their insert/delete line function is not performed until the transmitted code is echoed or sent back by the host. A block transmission is started by pressing any one of the F1 through F15 function keys or one of the special keys HELP, EDIT, BACK, DATA, +/DOWN, -/UP, X/FWD, or -/BKW. A Start Block Mode Send command (hex code 1E, 12, 44) also starts a block transmission. For the format of the transmission, refer to Block Mode Operation in section 4 of the CDC 721 Display Terminal Hardware Reference Manual (preface lists publication number).

TABLE E-1. CYBER MODE COMMANDS AND RESPONSES (CONTD)

COMMAND NAME	ASCII MNEMONIC (SEE NOTE AT END OF TABLE)	HEX CODE (SEE NOTE AT END OF TABLE)	TERMINAL RESPONSE
Exit Block Mode	RS, DC2, b	1E, 12, 62	Terminal returns to transmitting keyboard entries character by character.
Turn On Indicator	RS, DC2, e, (N)	1E, 12, 65, (N)	Turns on the indicator specified by (N). N = 30: ALERT indicator N = 31: PROGRAM indicator 1 N = 32: PROGRAM indicator 2 N = 33: PROGRAM indicator 3 N = 34: MESSAGE indicator
Turn Off Indicator	RS, DC2, f, (N)	1E, 12, 66, (N)	Turns off the indicator specified by (N). N = 30: ALERT indicator N = 31: PROGRAM indicator 1 N = 32: PROGRAM indicator 2 N = 33: PROGRAM indicator 3 N = 34: MESSAGE indicator
Driver Request	RS, DC2, h	1E, 12, 68	This command is not applicable for CYBER mode operations under CP/M control.
Enable Typamatic	RS, DC2, i	1E, 12, 69	Data-entry and control keys begin repeating after being pressed for longer than a second (refer to table B-1 for affected keys).
Disable Typamatic	RS, DC2, j	1E, 12, 6A	Disables data-entry and control keys from repeating (refer to table B-1 for affected keys).
Shift Numeric Pad	RS, DC2, k	1E, 12, 6B	Causes the numeric keypad to operate as if the shift key were always in use.
Normal Numeric Pad	RS, DC2, l	1E, 12, 6C	Returns the numeric keypad to normal operation.
Start Validation	RS, DC2, m	1E, 12, 6D	Sets validation attribute bit to 1 for each succeeding character received from the host. For further information, refer to Validation Bits and Host Specified Code Sequence/Controlware in section 4 of the CDC 721 Display Terminal Hardware Reference Manual (preface lists publication number).

TABLE E-1. CYBER MODE COMMANDS AND RESPONSES (CONTD)

COMMAND NAME	ASCII MNEMONIC (SEE NOTE AT END OF TABLE)	HEX CODE (SEE NOTE AT END OF TABLE)	TERMINAL RESPONSE
End Validation	RS, DC2, n	1E, 12, 6E	Sets validation attribute bit to 0 for each succeeding character received from the host. For further information, refer to Validation Bits and Host Specified Code Sequence/Controlware in section 4 of the CDC 721 Display Terminal Hardware Reference Manual (preface lists publication number).
Store Mode Parameters in NVM	RS, DC2, o	1E, 12, 6F	Writes parameters stored in RAM into nonvolatile memory. This command is not to be used because it will cause CP/M to lose control of the terminal.
Host Execute Loaded Controlware	RS, DC2, p thru DEL	1E, 12, 70 thru 7F	If the host has loaded controlware for the 70 through 7F code in the command, the terminal begins executing the instruction stored at the assigned starting memory address. If no controlware has been loaded for the code, no operation is performed. For further information, refer to Host-Specified Code Sequence/Controlware in section 4 of the CDC-721 Display Terminal Hardware Reference Manual (preface lists publication number).

Note:

Codes are listed in hexadecimal order. Unlisted codes cause no operation except codes 20 through 7F. Those codes display the characters or symbols of the code set which is in effect. The normal code set is the language character set established in block F7 of terminal installation parameters (appendix C outlines the parameters, and tables A-1 and A-4 through A-9 in appendix A contain the code sets for the various languages). Line-drawing symbols, PLATO symbols, or extended characters become the effective code set through the Line-Drawing command (hex code 1E, 1C); the PLATO-Character command [hex code 1E, 12, 54, (X)]; or the Extended-Character command [hex code 1E, 54, (X)]. Those commands are defined in this table and the code sets for the line-drawing and PLATO symbols are in tables A-2 and A-3 in appendix A. The code set and symbols for extended characters are user defined.

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