SPERRY
UTS 30 CP/M Plus™

Programmer Guide Supplement

PRELIMINARY

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PUBLICATIONS RELEASE

UTS 30

SPERRY®
UTS 30 CP/M Plus™

Programmer Guide
Supplement

PUP-10697

This library memo announces the release and availability of "SPERRY UTS 30 CP/M Plus Programmer Guide Supplement," PUP-10697. It is a Standard Library Item (SLI).

The SPERRY Universal Terminal System (UTS) 30 CP/M Plus program product and the associated hardware optional features enable the UTS 30 to load and operate the CP/M Plus operating system. This allows a wide variety of CP/M Plus applications programs available from designated independent software vendors to run on a UTS 30.

This manual is a supplement to the SPERRY UTS 4000 CP/M Plus Programmer's Guide, UP-9849, and contains programming information for the SPERRY UTS 30 system. It is designed for experienced programmers who are writing applications software in the CP/M Plus environment.

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PREFACE

This manual is a supplement to the SPERRY UTS 4000 CP/M Plus Programmer's Guide, UP-9849, and contains programming information for the SPERRY Universal Terminal System 30 (UTS 30) CP/M Plus*. This manual does not describe basic UTS 30 or CP/M Plus operating characteristics; it is designed for experienced programmers who are writing applications software in the CP/M Plus environment.

This book is organized into the following chapters:

Chapter 1.	A review of UTS 30 CP/M Plus software and hardware characteristics and operating components.
Chapter 2.	A description of UTS 30 CP/M Plus screen functions.
Chapter 3.	A description of UTS 30 hardware and communications characteristics for CP/M Plus applications programming.
Chapter 4.	A description of UTS 30 CP/M Plus interrupt interface information.
Chapter 5.	A description of I/O port bit definitions.

This manual assumes that you are already familiar with CP/M Plus and that you have the following CP/M Plus documentation available for review or reference.

o SPERRY UTS 4000 CP/M Plus User's Guide, UP-9847

o SPERRY UTS 30 CP/M Plus User's Guide Supplement, UP-10696

o SPERRY UTS 4000 CP/M Plus Programmer's Guide, UP-9849

o SPERRY UTS 4000 CP/M Plus Programmer's Utilities Guide, UP-9848

o SPERRY UTS 4000 CP/M Plus Symbolic Instruction Debugger (SID) Reference Manual, UP-9844

o SPERRY UTS 4000 CP/M Plus Symbolic Instruction Debugger (SID) Command Summary, UP-9867

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1. INTRODUCTION

This chapter provides an overview of the CP/M Plus operating system with an emphasis on specific features of the SPERRY UTS 30 CP/M Plus applications programming environment.

Refer to the UTS 4000 programmer's guide, UP-9849, for a complete discussion of the components of the CP/M Plus operating system. The programmer's guide also provides a detailed description of each operating system function and an explanation of the use of CP/M Plus to perform various I/O and disk management functions.

This manual discusses the Basic Input/Output System (BIOS) of the CP/M Plus operating system and includes the following information: UTS 30 hardware and communications characteristics, screen message functions, interrupt interface information, and I/O port definitions in CP/M Plus mode.

1.1. CP/M PLUS SOFTWARE REVIEW

The SPERRY UTS 30 CP/M Plus system provides a wide variety of CP/M-based software packages that allow you to use numerous computer program development languages as well as utilities for the creation, storage, and editing of application programs.

The standard CP/M Plus utilities include the following features:

o File transfer between peripherals

o Unattended batch processing

o A string-oriented text editor

o An *Intel-compatible 8080 assembler

o A hexadecimal display of file contents

o Time and date stamping

o Password protection

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*Intel is a registered trademark of Intel Corporation.

The SPERRY UTS 30 hardware provides additional utilities for the following features:

o Diskette preparation and copying

o Configuration of UTS 30 peripheral devices for use with CP/M Plus

o Generation and loading of limited graphics and custom character sets

o Reassignment of default keyboard functions

The UTS 30 hardware requirements necessary to use CP/M Plus software are discussed in the following paragraphs.

1.2. UTS 30 CP/M PLUS HARDWARE REQUIREMENTS

The following hardware must be installed for SPERRY UTS 30 CP/M Plus system operation:

o A programmable UTS 30 terminal

o An 8439 double-sided diskette subsystem with at least one drive

o The optional loadable character set hardware (if custom character sets are to be generated and loaded)

The following SPERRY printers are supported with the UTS 30 CP/M Plus system:

o The 0797 serial dot matrix printer

o The 0798 serial dot matrix printer

o The Model 15 serial dot matrix printer

o The Model 25 serial dot matrix printer

o The Model 31 correspondence quality printer

o The Model 35 graphics printer

Instructions on configuration of peripheral devices for use with CP/M Plus are provided in the UTS 30 CP/M Plus user's guide supplement, UP-10696. The following paragraphs provide an overview of the interaction between the UTS 30 hardware components and the CP/M Plus operating system components.

2. CP/M PLUS SCREEN FUNCTIONS

2.1. INTRODUCTION

This chapter provides SPERRY escape sequences and ANSI (American National Standards Institute) sequences used for UTS 30 CP/M Plus screen function programming applications. The following screen information and functions are discussed:

o Cursor positioning sequences

o Basic screen control functions

o Special emphasis functions

The following paragraphs review the major differences between the escape and ANSI sequences and the use of each sequence. For additional information on cursor positioning and screen control escape and ANSI sequences, refer to Appendix A. Appendix B defines the various elements used within the escape and ANSI sequences.

2.1.1. Escape vs. ANSI Sequences

The ANSI sequences (CSI sequences) are an industry standard code, whereas the escape sequences are specific Sperry codes. Although these sequences can be used interchangeably in many instances, the ANSI sequences are more specific and flexible. For example the escape sequence ESC A is used to scan up one line at a time. In contrast, the ANSI sequence CSI Pn A can be used to scan up as many lines as is specified for the parameter Pn.

2.1.2. Screen Display Format

The standard CP/M Plus screen display format is 24 rows by 80 columns, for a total of 1920 character positions. A 25th row is used to display status messages, keyboard character set names, and CRT character font names. (Refer to Section 2.5 for escape codes that allow you to access the status line.)

Characters received from the keyboard are evaluated by the CP/M Plus system console command processor (CCP) or by a user program. The terminal places a character on the screen at the position occupied by the cursor, and the cursor is then advanced one position. Each position is uniquely addressable.

2.2. CURSOR POSITIONING

All text transmitted to the terminal from the CP/M Plus system CCP or from a user program is placed on the screen starting at the designated cursor position. The cursor positioning sequences are discussed in the following paragraphs.

2.2.1. Direct Cursor Address Sequence

The direct cursor address sequence allows you to position the cursor directly at any specified point on the screen according to row and column coordinates. Appendix C contains a row and column grid for direct cursor positioning.

ESC Y Pr Pc -- This escape sequence positions the cursor at the row and column codes represented by Pr and Pc. (Refer to Appendix C for row and column grids for direct cursor positioning.) The codes are derived from the ASCII character code representations of hexadecimal numbers 20 through 6F. (Refer to the ASCII chart in Appendix E.)

CSI Py;Px H or CSI Py; Px f -- These ANSI sequences position the cursor at the horizontal row (y) and vertical column (x) specified by Py and Px (Appendix C). Py and Px are the actual decimal coordinates of the row and column positions. (Refer to Appendix B for definitions of the elements of the ANSI sequences.)

2.2.2. Cursor-to-Home

ESC H -- This escape code moves the cursor to the home position, the first character position of the first line in the upper-left corner of the screen (row 1, column 1).

CSI H -- This ANSI code moves the cursor to the home position.

2.2.3. Cursor Return

CR -- This code returns the cursor to the first character on the current line.

2.2.4. Reverse Line Feed

ESC I -- This escape code moves the cursor up one line in the same column. If the cursor is at the top margin, an insert line function is performed.

2.2.5. Line Feed

LF -- This code moves the cursor down one line in the same column.

2.2.6. Scan Up

ESC A -- This escape code moves the cursor up one line in the same column.

CSI Pn A -- This ANSI code moves the cursor upward within the same column. The number of lines moved is determined by the parameter Pn. If the parameter is 0 or 1, the cursor moves one line upward. If the parameter value is n, the cursor moves n lines upward. If no parameter value is specified, a default value of 1 is assumed.

2.2.7. Scan Down

ESC B -- This escape code moves the cursor down one line in the same column.

CSI Pn B -- This ANSI code moves the cursor downward within the same column. The number of lines moved is determined by the parameter Pn. If the parameter value is 0 or 1, the cursor moves one line downward. If the parameter value is n, the cursor moves n lines downward. If no parameter value is specified, a default value of 1 is assumed.

2.2.8. Scan Right

ESC C -- This escape code moves the cursor one character position to the right. If the cursor is in the last position of a line, it moves to the first character position of the following line. If the cursor is in the last position of the last line, the screen is scrolled up one line and the cursor is moved to the first position of the last new line.

CSI Pn C -- This ANSI code moves the cursor to the right. The distance moved is determined by the parameter Pn. A parameter value of n moves the cursor n positions to the right. If the parameter moves the cursor past the end of a line, the cursor moves to the first character position of the next line and continues to the right until the cursor has moved a total of n spaces. If no parameter value is specified, a default value of 1 is assumed.

2.2.9. Scan Left

ESC D -- This escape code moves the cursor one character position to the left. If the cursor is in the first position of a line, it moves to the last character position of the previous line. If the cursor is in the first position of the first line, the screen is scrolled down one line and the cursor is moved to the last position of the new first line.

CSI Pn D -- This ANSI code moves the cursor to the left. The distance moved is determined by the parameter Pn. If the parameter moves the cursor past the beginning of a line, the cursor moves to the last character position of the previous line and continues to the left until the cursor has moved a total of n spaces. If no parameter value is specified, a default value of 1 is assumed.

2.3. BASIC SCREEN CONTROL FUNCTIONS

CP/M Plus provides the user with many types of screen control capabilities. The screen control function codes presented in the following paragraphs allow you to clear various portions of your screen, and to insert and delete lines and characters.

2.3.1. Clear Screen

ESC E -- This escape code erases the entire screen, resets the scroll range to lines 1 through 24, and places the cursor in the home position.

2.3.2. Clear in Screen

ESC J -- This escape code erases all characters from the cursor (including the cursor position) to the end of the screen.

CSI Pn J -- This ANSI code erases all or some of the characters in the display according to the parameter Pn. The default value for Pn is 1.

Pn Value	Meaning
0	Erases from the cursor to the end of the line, including the cursor position.
1	Erases from the beginning of the line to the cursor, including the cursor position.
2	Erases the display; all lines are erased and the cursor does not move.

2.3.3. Clear in Line

ESC K -- This escape code erases from the cursor (including the cursor position) to the end of the line.

CSI Pn K -- This ANSI code erases some or all characters in the current line according to the parameter Pn, as follows. The default value for Pn is 1.

Pn Value	Meaning
0	Erases from the cursor to the end of the line, including the cursor position.
1	Erases from the beginning of the line to the cursor, including the cursor position.
2	Erases the entire line; the cursor does not move.

2.3.4. Delete Line

ESC L -- This escape code deletes the line that the cursor is in, moves the following lines up one line, and adds a blank line at line 24.

CSI Pn M -- This ANSI code deletes the line that the cursor is in, moves the following lines up one line, and adds a blank line at line 24. If Pn is greater than 1, the procedure is repeated Pn times. Otherwise, the procedure is executed only once. The default value for Pn is 1.

2.3.5. Delete Character

ESC M -- This escape code deletes the character at the cursor position, shifts existing text to the right of the cursor (on the cursor line) one position to the left, and adds a blank character at column position 80 of the current line.

CSI Pn P -- This ANSI code deletes the character at the cursor position, shifts existing text to the right of the cursor (on the cursor line) to the left, and adds blank characters at the end of the line. If Pn is greater than 1, the procedure is repeated Pn times. Otherwise, the procedure is executed only once. The default value for Pn is 1.

2.3.6. Insert Line

ESC N -- This escape code inserts a new blank line by moving the line that the cursor is in, and all following lines, down one line. The cursor is moved to the beginning of the new blank line.

CSI Pn L -- This ANSI code inserts a new blank line by moving the line that the cursor is in, and all following lines, down one line. If Pn is greater than 1, the procedure is repeated Pn times. The cursor is moved to the beginning of the new blank line. The default value for Pn is 1.

2.3.7. Insert Character

ESC 0 -- This escape code inserts a blank character at the cursor position by shifting existing text on the current line one character position to the right. The cursor does not move.

CSI Pn @ -- This ANSI code inserts one or more blank characters at the cursor position by shifting existing text on the current line one character position to the right. If Pn is greater than 1, existing text is shifted Pn character-positions to the right, and the cursor does not move. As each blank is inserted, the character at the end of the current line is lost. If Pn is not greater than 1, only one blank space is inserted, as in ESC 0. The default value for Pn is 1.

2.4. SPECIAL EMPHASIS FUNCTIONS

The character sequences described in this section can be used to transmit special emphasis characters to the screen. The emphasis functions can be sent separately, or in combination with each other.

2.4.1. Normal Display

ESC P @, ESC Q, CSI 0 m, or **CSI m** -- These escape and ANSI sequences place a bright character on a dark background.

2.4.2. Reverse-Video Display

ESC P H or **CSI 7 m** -- These escape and ANSI sequences place an underline beneath a character. The underline is the full width of the character and connects with adjacent underlines to form a continuous line.

2.4.3. Underline

ESC P B or CSI 4 m -- These sequences place an underline beneath a character. The underline is the full width of the character and connects with adjacent underlines to form a continuous line.

2.4.4. Strike-through

ESC P D or CSI 21 m -- These sequences place a horizontal line through the middle of a character. The strike-through is the full width of the character and connects with adjacent strike-throughs to form a continuous line.

2.4.5. Column Separator

ESC P P or CSI 20 m -- These sequences place a vertical line to the left of a character. This line is the full length of the character. A continuous vertical line can be created by using column separators in the same column of the following lines.

2.4.6. Blink

ESC P I or CSI 5 m -- These sequences place a blinking character on the background.

2.4.7. Combining Special Emphasis

ESC P <emphasis> -- This escape sequence is used for both single emphasis and for combining special emphasis. The <emphasis> is represented by an ASCII character or hexadecimal code. Refer to Table D-1 in Appendix D for a complete list of the ASCII, hexadecimal, and binary codes associated with each possible sequence.

CSI Pl;...;Pn m -- This ANSI sequence uses a list of the decimal codes for each of the single emphasis functions described in the previous section. The numeric parameters Pl to Pn can be substituted for one or more of the following codes:

    0   =   no emphasis
    4   =   underline
    5   =   blink
    7   =   reverse video
    20 =   column separator
    21 =   strike-through

NOTE: Each code is separated by semi-colons as delimiters.

2.4.8. Changing Special Emphasis

You can change any special emphasis by sending a new emphasis sequence to the terminal, or you can send one of the following escape sequences:

ESC a <emphasis> -- This escape sequence will set a specified emphasis.

ESC b <emphasis> -- This escape sequence will clear a specified emphasis.

Replace the <emphasis> parameter with the one-byte binary code that represents the desired emphasis. Figure 2-1 illustrates the use of the eight-bit binary code. Refer to Appendix D for the binary codes for each type of special emphasis.

NOTE: The ESC P @, ESC Q m, and CSI 0 m sequences clear all special emphasis functions. No other escape codes are necessary.

2.4.9. Expanded Special Emphasis Byte

The example in Figure 2-1 shows the escape code used for combining a column separator and an underline (ESC P R). The ASCII and hexadecimal codes shown are determined by the status of the eight bits in the one-byte binary code. Each bit is assigned a function. A bit set to one enables, or changes, an emphasis; a bit set to zero disables the corresponding emphasis (or leaves it unchanged).

Escape Code Example -- ESC P R

ASCII Character	Hex Code	Binary Code	Meaning
R	52	01010010	Column separator and underline

Bit Definitions for ESC P R

Bit	7	6	5	4	3	2	1	0
Bit Setting	0	1	0	1	0	0	1	0

--------- Underline
-------------- Strike-through
-------------------- Reverse video
-------------------------- Column separator
-------------------------------- Blink

Figure 2-1. Example of an Expanded Special Emphasis Byte

NOTE: In the binary representation of all ASCII special emphasis characters, bit 7 is always 0 and bit 6 is always 1.

2.5. OTHER SCREEN FUNCTIONS

The following functions are additional Sperry escape sequences available with the UTS 30.

2.5.1. Cursor Disable

ESC R -- This escape code turns off the cursor. If the cursor is already turned off, the sequence has no effect.

2.5.2. Cursor Enable

ESC S -- This escape code turns on the cursor. If the cursor is already turned on, the sequence has no effect.

2.5.3. Save Cursor Position

ESC W -- This escape code saves the current cursor position,

2.5.4. Restore Cursor to Last Saved Position

ESC X -- This escape code restores the cursor to the last saved cursor position. The code has no effect if a save escape sequence was not previously sent to the terminal. A restore sequence repeatedly restores the same save sequence until another save sequence is sent to the terminal.

2.5.5. Screen Alignment Display

ESC T -- This escape code fills the entire screen with uppercase E's for screen focus and alignment.

2.5.6. Set Top and Bottom Margins

ESC Pt Pb -- This escape code sets the top and bottom margins to define the scrolling region. The first parameter (Pt) is the ASCII character row code that represents the first line in the scrolling region; the second parameter (Pb) is the ASCII character row code that represents the bottom line in the scrolling region. (Refer to Appendix C for character position assignments.)

The minimum allowable size of the scrolling region is two lines. In other words, the top margin must be less than the bottom margin. The cursor is always placed in the first position of the scroll area.

2.5.7. Reset Top and Bottom Margins

ESC V — This escape code resets the top margin to 1 and the bottom margin to 24. The cursor is placed in the home position.

2.5.8. Clear Status Line

**ESC ** — This escape code blanks out the first 40 positions on the 25th line (the status line). The status line always appears in the original foreground and background configuration, regardless of the special emphasis changes made in lines 1 through 24.

2.5.9. Enter Data on Status Line

ESC] — This escape code enters characters (up to 40) on the status line, starting in column 1. The previous cursor position is saved, so that when you enter a carriage return, or when the 40th character on the status line is received by the terminal, the cursor is returned to its saved position.

2.6.0. Select Alternate Character Set

ESC F — This escape code initiates the alternate character set. (Refer to the UTS 30 CP/M Plus user's guide supplement, UP-10696, for information on alternate character sets.) ESC F automatically disables strike-through if it is set, but saves the strike-through status in memory. The previous status of the strike-through emphasis can then be restored with the ESC d code.

2.6.1. Return to Standard Character Set

ESC d — This escape code can only be used after an ESC F has been sent. ESC d returns you to the standard character set and restores the previous strike-through emphasis, if it was set and saved with the ESC F code.

ESC G — This escape code can only be used after an ESC F has been sent. ESC d returns you to the standard character set without restoring strike-through emphasis, if it was set and saved with the ESC F code. If you want to use strike-through after ESC G, use the appropriate special emphasis code.

3. HARDWARE AND COMMUNICATIONS CHARACTERISTICS

3.1. INTRODUCTION

This chapter summarizes the UTS 30 hardware and communications characteristics necessary for CP/M Plus applications programming. The following information is discussed:

o UTS 30 hardware specifications

o UTS 30 memory configuration specifications

o UTS 30 communications specifications

o Auxiliary RS-232 synchronous interface

3.2. UTS 30 HARDWARE SPECIFICATIONS

Many aspects of the CP/M Plus implementation are dependent on specific hardware characteristics of the UTS 30 terminal. Table 3-1 provides a summary of UTS 30 hardware functions and specifications. The table is designed as a reference list only.

Table 3-1.   UTS 30 Hardware Specifications Summary (Part 1 of 2)

Function	Specification
Microprocessor	Z80 CPU (2892668), 4.000 MHz clock No-wait states for local memory Vectored interrupts for peripherals Reset or parity-generated NMI
Memory	*128K RAM accessed via address-dependent pages 8K ROM overlay 256 nibbles non-volatile RAM Loadable 512-character generator with all 10 x 16 dots addressable

*These specifications are discussed in subsequent sections of this chapter.

Table 3-1.   UTS 30 Hardware Specifications Summary (Part 2 of 2)

Function	Specification
Display memory	24 addressable 80-character rows that can be located anywhere in memory 8-bit read/write register for character attribute manipulation
Display attributes	7 visual character attributes for each character of the display
Display format	80 columns by 25 lines Standard characters -- 7 by 9 in a 10 by 15 character matrix
Indicators	Display separator (dotted horizontal line) Audio alarm with programmable frequency
Peripheral LSI	*78530 (2893610) serial communications controller (SCC) *MK3801 (2893942) serial/timer/interrupts (STI) HD6845 (2893939) CRT controller
Peripherals	Serial interface keyboard *Serial communications channel -full duplex -asynchronous or synchronous -terminal multiplexer 5000 feet max -direct connect 200 feet max -baud rates to 19.2K baud Three Z80 bus interface connections -one for full PC board (graphics) -two for small features *Auxiliary RS-232 (DCE end), up to 9600 baud async, full duplex RS-232 standard DCE pinout subset
Keylock	3-position keylock input for terminal and parameter locking

*These specifications are discussed in subsequent sections of this chapter.

3.3. UTS 30 MEMORY CONFIGURATION SPECIFICATIONS

The main memory consists of 128K bytes of dynamic RAM. The Central Processing Unit (CPU) has access to all 128K of memory in a page-swapping scheme. The memory is divided into a system bank and a transient program area bank. The memory paging is controlled by CP/M Plus and is not accessible to a user program. Refer to the UTS 4000 CP/M Plus programmer's guide, UP-9849, for more information on CP/M Plus memory configuration specifications.

3.4. UTS 30 COMMUNICATIONS SPECIFICATIONS

Host communications functions are supported by serial communications controller (SCC) and serial/timer/interrupt (STI) integrated circuits (ICs). Three types of serial communications are supported: modem communications, terminal multiplexer, and direct connect.

3.4.1. Receivers and Drivers

There are two basic types of receivers: differential line receivers, and lower grade RS-232 receivers.

The critical lines (receive data, transmit and receive clock, and clear-to-send B and A) are serviced by differential line receivers to reduce noise and improve sensitivity for terminal multiplexer operations. The differential receivers are not biased so that a float results in an indeterminate output.

The rest of the signals are lower grade RS-232 receivers. The RS-232 receivers bias the signals to the off state, even though some noise susceptibility exists.

All of the drivers, except the transmit data driver, are RS-232. The transmit data driver is assisted to improve capacitive drive capability for long distances on a multiplexer connection.

Direct connect is achieved by switching drivers onto the transmit and receive clock lines via a mechanical relay. The direct connect drivers do not have extensive drive capability, but should handle 1000 feet of shielded cable. The interface is specified at 200 feet. Longer distances may be permitted in some cases, but it may not operate with an adequate error rate unless the baud rate is reduced.

3.4.2. Serial Communications

The serial communications controller (SCC) is a flexible device, similar to
the Z80 SIO used on the UTS 20 and UTS 40, but with added capabilities.
(Refer to Zilog Corporation vendor literature for additional information.)
The SCC integrated circuit (IC) uses channel A for host communications.

The serial/timer/interrupt (STI) uses channel B of the SCC to handle the
serial keyboard data. The communications section of the STI handles the
auxiliary RS-232 interface for devices.

NOTE: Because the SCC and STI ICs form an intimate peripheral control group,
they are discussed concurrently in the following section on modem
communications.   Where reasonable, signals that interface to the ICs are
titled by the IC pin name; while the actual details of the manipulation of
the pins and signals are defined in the specification for that particular IC.

3.4.3. Modem Communications Overview

Most of the modem communications functions are handled by the SCC channel A.
The SCC operates in synchronous or asynchronous mode.   The following
considerations should be noted.

o When asynchronous mode is used, the internal baud rate generator is used.

o The basic clock frequency is 4.00 MHz.

o The internal receiver divider should be set to the highest value consistent
   with the baud rate generator.

o The maximum asychronous baud rate is 19.2K, achieved by setting the baud
   rate generator to divide by 13 and the receiver to divide by 16. The
   small frequency error is of little consequence.

o A division by 16 can result in higher error rates than 32 or 64.

3.4.4. Modem Communications Signals

Modem communications signals are supported via the communications cables
(features F8209,   F8201,   and F8211),   and are discussed in the following
paragraphs.

Transmit to Host -- The transmit data signal, CCITT-103, is routed to the SCC TxDA pin 15. Depending upon whether the mode is synchronous or asynchronous, the clock can be programmed to come from the host modem or internally.

Receive from Host -- The receive data signal, CCITT-104, is routed to the SCC RxDA pin 13.

Request-to-Send -- The Request-to-send (RTS) signal, CCITT-105, is routed to the SCC RTSA pin 17.

Clear-to-Send -- The clear-to-send (CTS) signal, CCITT-106, is routed to the communications status register port 41, bit 0. The register must be strobed by an I/O read or write of port 42. The status is then read via I/O port 41. CTS is also routed to STI interrupt 5.

Carrier Detect -- The carrier detect (CD) signal, CCITT-109, is routed to the communications status register port 42, bit 1. This line (CD) is logically ORed with CTS and routed through a 30 microsecond delay. This delay generates a high true input at the STI interrupt 7 (pin 15) input. Thus, 30 microseconds after the assertion of CTS or CD, an interrupt occurs.

The delay also strobes the register at port 42, latching all the bits. This interrupt function is used primarily for terminal multiplexer handshaking, but can also serve modem operation. A positive interrupt at STI interrupt 7 occurs when CD or CTS asserts (after 30 microseconds); a negative interrupt 7 occurs when CD and CTS negate (with negligible delay, the 30 microsecond delay does not operate on negation).

Data-Set-Ready -- The data-set-ready signal, CCITT-107, is routed to input port 42, bit 7.

Transmit Clock -- The transmit clock signal, CCITT-114, is routed to the SCC TRxCA pin 14. This is a bidirectional line. When in the input mode, it receives the timing for transmit data. It is used in the output mode for direct connect mode, and generates both transmsit and receive clocks. This line is XORed with the output of I/O port 49, bit 3, for use with the RS-232/ V.24 test adapter 2826629.

The clocks generated for direct connect mode are out of phase and are used for loopback with the test adapter. The clock must be inverted via I/O port 49, bit 3, in order to generate the proper clock polarity at the SCC.

Receive Clock -- The receive clock signal, CCITT-115, is routed to the SCC RTxCA pin 12. When in direct connect mode, this line is driven indirectly by the TRxCA pin.

Data Terminal Ready -- The data terminal ready (DTR) signal, CCITT-108.2, is routed to I/O port 49, bit 4. This port bit also turns on an amber light, visible from outside the terminal, that indicates the terminal is operational. Turning off the line will extinguish the light and make the operator aware of a fault condition. This bit and all bits in the port are reset when any reset occurs; therefore, DTR is negated by the reset switch, and some modems are disconnected. The DTR signal also goes to the DTR timer. The timer is not activated until DTR is asserted and port 49, bit 3, is equal.

When these conditions are met, the timer remains set for 128 cycles of the vertical synchronous from the CRTC; then asserts at the CTS A pin on the SCC and inhibits DTR, the light, and RTS A. The timer is retriggered, or kept running, by any interrupt acknowledge by the CPU (IORQ-M1 cycle) that prevents timeout. This system provides for the event that the microcode ceases to function when operating in an interrupt environment, and the DTR is asserted.

Microcode should provide a timer that prevents the RTS and DTR lines from being active too long, and locking up the communication system or the telephone line. The DTR timer is provided to back up the microcode timer. The DTR timer does not function if port 9, bits 3 or 4, are negated; or if the CRTC is not generating synchronous pulses. The CRTC must be activated (and vertical synchronous generated) when DTR is asserted and the timer is required.

Ring Indicator -- The ring indicator (RI) signal, CCITT-125, is routed to the STI interrupt 0. This interrupt should be enabled only when RI is expected, since modems and other equipment generate spurious signals on this line.

Data Rate Select -- The data rate select signal, CCITT-112, is routed to the SCC TR/REQA pin 16. It serves as the RTS-B signal on the SPERRY terminal multiplexer interface. No other CCITT signals are supported on this interface except grounds 101 and 102. The RS-232 and V.24 cables provide for proper routing of the signals on this interface. The use of other cables is not necessarily nonfunctional, but may cause erratic operation on some equipment. The terminal multiplexer cable is suitable for communications with the SPERRY terminal multiplexer.

3.5. AUXILIARY RS-232 ASYNCHRONOUS INTERFACE

The auxiliary RS-232 asynchronous interface is connected to both the SCC channel B control lines and the STI serial channel. The STI does not buffer data, so it is not used for the keyboard which sends bytes in pairs. When the STI receiver is operating, it is important to read the data from the receive register before the next byte is assembled or data is lost. Thus, it may be necessary to force the keyboard to wait if the STI receiver is operating. The keyboard internally buffers up to eight keystrokes if the SCC channel B receiver still has data in it.

The asynchronous clock input to STI pins 36 and 39 is driven by SCC TRxCB pin 26. Thus the SCC internal baud rate generator for channel B serves as the generator for the STI channel. The maximum baud rate for this channel is 9600, since the input to the STI cannot be driven at twice that speed.

Other auxiliary data routings and characteristics are as follows:

o Aux transmit data (from the device) is routed to the STI serial input pin 38.

o Aux receive data (to the device) is routed to the STI serial output pin 37.

o Aux request-to-send data is routed to the SCC input DCDB pin 22.

o Aux clear-to-send data is routed to the SCC output RTSB pin 23.

o Aux data-set-ready is routed to the SCC output DTR/REQB pin 24. This line must be negated prior to power off to prevent the printer from accumulating garbage in its buffer. The power-fail interrupt can be used to negate the line.

o Aux data terminal ready is routed to the SCC input SYNCB pin 29.

o Aux K-ready is routed to the SCC input CTSB pin 22. Aux carrier detect is not supported.

4. INTERRUPT INTERFACE INFORMATION

4.1. INTRODUCTION

CP/M Plus uses interrupts to control keystroke cycling, keyboard input, synchronous communications, the system timer, and peripheral devices. The interrupt routine is the code to process the interrupt and a return. This chapter describes the use of interrupts with CP/M Plus on the UTS 30.

Interrupts in the CP/M Plus system run in Z80 interrupt mode 2, with the interrupt address register in the Z80 set to memory page OFFH (hex).

CAUTION: The mode and the page address must not be changed under any circumstances.

4.2. INTERRUPT ADDRESSES AND CONTROLLERS

In order for an interrupt to be trapped, the interrupt vector must be saved. The interrupt vectors are found at memory locations OFF40H to OFF6FH. You may change any of the 24 vectors. The entry point address of the desired routine should be substituted in an address location associated with the interrupt vector addresses shown in Table 4-1. The controllers that drive the interrupts for each of the following system characteristics are also included in Table 4-1.

o   Keyboard input is driven by interrupts from SCC channel B.

o   Asynchronous communications are driven by interrupts from SCC channel A.

o   The system timer is driven by interrupts from STI timer A.

o   The printer interrupts are driven by interrupts from STI receive buffer full.

Table 4-1. Interrupt Vector Table

Address	Controller	Function
OFF40H	SCC B	Transmit buffer empty
OFF42H	SCC B	External/status change
OFF44H	SCC B	Keyboard input
OFF46H	SCC B	Keyboard input error
OFF48H	SCC A	Communications -- transmit buffer empty
OFF4AH	SCC A	External/status/change
OFF4CH	SCC A	Communications input
OFF4EH	SCC A	Communications input error
OFF50H	STI I0	Modem ring indicator
OFF52H	STI I1	Port B interrupt
OFF54H	STI I2	Port C interrupt
OFF56H	STI I3	Cursor blink period (x8=time)
OFF58H	STI	Timer D drives RTxC A (if enabled)
OFF5AH	STI	Timer C 16x field blink, 8x cursor
OFF5CH	STI I4	Positive vertical sync.
OFF5EH	STI I5	Modem CTS
OFF60H	STI	Timer B audio (reset to 0)
OFF62H	STI	Peripheral transmit error
OFF64H	STI	Peripheral transmit buffer empty
OFF66H	STI	Peripheral receive error
OFF68H	STI	Peripheral receive buffer full
OFF6AH	STI	Timer A system timer
OFF6CH	STI I6	Port A interrupt
OFF6EH	STI I7	CTS assertion (check port 062H9)

4.3. OPERATING SYSTEM INTERACTION

All interrupts are first handled by the operating system; consequently, interrupts are disabled and the registers AF, BC, DE, and HL are saved. The TPA bank is selected prior to entering the interrupt handler. After the interrupts have been processed, the interrupt handler restores registers AF, BC, DE, and HL, and then returns control to the operating system. The operating system then handles the remainder of the interrupt process; it turns on the interrupts and returns back to the interrupted routine.

Since the operating system uses interrupts, an interrupt handler should return control to the operating system no later than 30 milliseconds after gaining control. The system timer interrupts every 34 milliseconds. Interrupt mode 2 is in effect while CP/M Plus is loaded.

The operating system turns on interrupts when the user interrupt routine is complete.

4.4. USER TIMERS

The BIOS contains five countdown timers that are available to the user. Table 4-2 shows the addresses of these timers. If the timer count is set to a non-zero value, it is decremented by 1 every 34 milliseconds (a count of 255 max is a time of 8.67 seconds).

Although the user timers are decremented by the BIOS timer interrupt, they do not generate interrupts themselves. The applications program must check to see if they have decremented to zero.

Table 4-2. Special System Addresses

Address	Function
0FF34	User timer 1
0FF35	User timer 2
0FF36	User timer 3
0FF37	User timer 4
0FF38	User timer 5
0FF39	Warm boot trap address

4.5. WARM BOOT TRAP

The warm boot trap (location OFF39) can be set at any time by applications programs to do clean up or restoration of interrupt vectors. The applications program should set the contents of the warm boot trap address to the clean-up routine address at program termination.

When the applications program aborts for any reason, the warm boot routine in the BIOS gets control. If you modify the contents of the warm boot trap address from 0000H, the warm boot clears the address location and jumps to the new address. When the clean-up portion of the routine is completed, the applications program should jump back to address 0000H so that the normal warm boot process can continue.

4.6. RESTRICTIONS

The following restrictions apply to the interrupt interface:

o Address OFFH is contained in Z80 register I.

o Interrupt mode 2 is in effect.

o BDOS and BIOS cannot be called while the system is in interrupt routine.

o When you terminate the program containing the interrupt routine, the vector table must be returned to the state that was in effect before the program was executed. (Refer to Section 4.4.)

o When using registers IX, IY, or the alternate Z80 register set in the interrupt handler, you must save and restore the register contents.

o You may not turn interrupts on when the system is in another interrupt routine.

o To return control to the system from an interrupt routine, you must use the instruction RET. Do not use RETI, which returns control to the BIOS interrupt handler.

5. I/O PORT DEFINITIONS

5.1. I/O PORT BIT ASSIGNMENT SUMMARY

This chapter contains the necessary information to change the UTS 30 input/output characteristics. Table 3-1 summarizes the I/O port bit assignments.

Table 5-1. I/O Port Bit Assignments (Part 1 of 4)

I/O Port Address	Direction	Function
00/04/08/0C	In/Out	SCC channel B control registers DTR line drives DSR (AUX) RTS line drives CTS (AUX) DCD line driven by RTS (AUX) CTS line driven by K-ready (AUX) SYNC line driven by DTR (AUX) TRxC line drives printer clock into STI RTxC line driven by 615.38KHz keyboard clock (9600x64) REQ/READY drives keyboard enable (ready-receive mode) (keyboard inhibited if receive buffer not empty)
01/05/09/0D	In/Out	SCC channel B keyboard data

NOTE: Ports 00 and 01 do not use address bits 2 or 3.

Table 5-1. I/O Port Bit Assignments (Part 2 of 4)

I/O Port Address	Direction	Function
03/07/0B/0F	In/Out	SCC channel A communications data
10	In/Out	STI control registers; actual addresses are 10 through 1F corresponding to register addresses 0 through F Clock input is 615.38KHz Timer outputs are half the channel interrupt rate **Timer Output** A - Not used (input intrpt 4 vert sync) B - Audio (reset to 0 after beep or click) C - 16x field register 9 (OE)-character field size, default to 15 D - Drives RTxC A (if enabled) **Interrupts:** 0 - Modem ring indicator 1 - 0=port B interrupt 2 - 0=port C (graphics) interrupt 3 - Cursor blink (8x cursor) 4 - Positive vertical synchronization 5 - Modem CTS 6 - 0=port A interrupt 7 - CTS assertion, check port 42

NOTE: Port 03 does not use address bits 2 or 3.

Table 5-1. I/O Port Bit Assignments (Part 3 of 4)

I/O Port Address	Direction	Function

41/49	Out	Communications control port, cleared by power on
		
		Data Bit Status:
		Bit 0 1=TRxC A driven by keyboard clock (19.2Kx32)
		       0=TRxC A driven by line receiver
		Bit 1 1=Select long distance receiver hysteresis (multiplexer, DC)
		Bit 2 1=Select direct connect clock driver
		Bit 3 0=Invert Xmit clock receiver for loopback plug; inhibit punt timer
		Bit 4 1=Data terminal ready (modem), and maintenance light
		Bit 5 1=RTxC A driven by STI channel D output
		       0=RTxC A driven by line receiver
		Bit 6 1=Enable peripheral ports 1 and 2
		       0=Reset ports
		Bit 7 1=Invert RAM write parity, reset cursor counter (test)

62/6A	In	Communications status, latches terminal multiplexer handshake lines Strobed by assertion of CTS A, CTS B, or port 42 **Data Bit Status:** Bit 0 1=CTS A — modem CTS or terminal multiplexer handshake lines Bit 1 1=CTS B — modem CD or terminal multiplexer handshake lines Bit 2 1=Send clock — modem TxC or terminal multiplexer handshake lines Bit 3 1=Set up enabled keylock position

NOTE: Port 62/6A does not use address bit 3.

Table 5-1.   I/O Port Bit Assignments (Part 4 of 4)

I/O Port Address	Direction	Function
		Bit 4 1=Terminal locked keylock position Bit 5 1=Reset switch caused last system reset (0=power on) Bit 6 AHR parity bit Bit 7 1=Modem data set ready

NOTE: The functions of bits 1 and 7 switch if a T-mux cable is connected to a modem. Bit 7 may not be active if a modem cable is used.

5.2. BIT DEFINITIONS FOR PORT 41/49

Port 49 controls the parity generator and other communications parameters. This section contains a detailed description of the bit definitions for port 49.

Bit 0 -- Bit 0 determines the driver of the TRxC A pin of the SCC IC.

When bit 0 = 0, the TRxC A pin is driven by the line receiver for online synchronous communications.   This bit is not used when bit 2 of this port is set (direct connect mode).

Bit 1 -- Bit 1 is used to select the receiver sensitivity to control noise susceptibility: 1=long distance; 0=short distance cable less than 50 feet.

When bit 1 = 0, it reduces the receiver sensitivity on some lines, improving noise immunity. Bit 1 is dependent only on cable length, not on communications mode.

Bit 2 -- Bit 2 is used to select the direct connect clock driver.

When bit 2 = 1, it selects direct connect.   The TRxC A pin of the SCC drives both the transmit and receive clocks on the communications interface.   Bit 2 must be set prior to setting the TRxC A pin to output, or driver conflict (because of noise generation) may cause the system to malfunction.

Bit 3 -- Bit 3 controls the polarity of the transmit clock receiver.

When bit 3 = 0, the receiver is inverted for loopback testing with the loopback adapter, 2832471. In loopback, the transmit clock is inverted from the receive clock to reduce cable crosstalk.

Bit 3 also serves to disable the punt timer which is active when RTS is active. The punt timer serves no purpose in asynchronous applications so this bit can be left 0.

When bit 3 = 1, it allows normal reception of the transmit clock signal and is used for synchronous communications. It also enables the RTS timer causing DTR and RTS to be negated, if interrupts are ignored for longer than about 2 seconds.

Bit 4 -- Bit 4, when set to 1, activates DTR and lights the maintenance indicator on the top edge of the card.

This light should be on whenever the terminal is operating to indicate to a service operator that the system is operational. However, if the terminal is connected to an auto-answer modem, the DTR line should only be active when a connection can be made. POC should not activate DTR except under special conditions.

Bit 5 -- Bit 5 determines the driver source for the SCC RTxC A pin.

If bit 5 = 0, the pin is driven by the communications receive clock line receiver. If bit 5 = 1, the pin is driven by the STI channel D output. This configuration prevents the use of timer D for system uses, but provides for dual asynchronous baud rates for transmit and receive during the video-text application.

Bit 6 -- Bit 6 resets the peripheral ports.

If bit 6 = 0, it resets peripheral ports A and B. If bit 6 = 1, it enables the ports.

Bit 7 -- Bit 7, when set, is a test bit that causes RAM-write parity to be inverted and presets the cursor counter for more effective testing.

If bit 7 = 0, normal even parity is operating, and the cursor counter operates.

APPENDIX A.   SCREEN CONTROL SUMMARY

Table A-1 summarizes the cursor positioning and screen control escape and ANSI sequences.

Table A-1.   Escape and ANSI Screen Control Sequence Summary (Part 1 of 2)

Function	Escape Sequence	ANSI Sequence
Cursor Positioning		
Direct cursor address	ESC Y Pr Pc	CSI Py; Px H
		CSI Py; Px f
Cursor-to-home	ESC H	CSI H
Cursor return	CR	CR
Scan up	ESC A	CSI Pn A
Scan down	ESC B	CSI Pn B
Scan right	ESC C	CSI Pn C
Scan left	ESC D	CSI Pn D
Line feed	LF	LF
Reverse line feed	ESC I	--
Basic Screen Control		
Clear screen	ESC E	--
Clear in screen	ESC J	CSI Pn J
Clear in line	ESC K	CSI Pn K
Delete line	ESC L	CSI Pn M
Delete character	ESC M	CSI Pn P
Insert line	ESC N	CSI Pn L
Insert character	ESC O	CSI Pn @
Special Emphasis		
Emphasis character	ESC P <emphasis>	CSI P1;...;Pn m
Normal display	ESC P@ or ESC Q	CSI 0 m or CSI m
Reverse-video display	ESC P H	CSI 7 m
Underline	ESC P B	CSI 4 m
Strike-through	ESC P D	CSI 21 m
Column separator	ESC P P	CSI 20 m
Blink	ESC P I	CSI 5 m

Table A-1. Escape and ANSI Screen Control Sequence Summary (Part 2 of 2)

Function	Escape Sequence	ANSI Sequence
Other Screen Functions		
Cursor disable	ESC R	--
Cursor enable	ESC S	--
Save cursor position	ESC W	--
Restore cursor to last save position	ESC X	--
Screen alignment display	ESC T	--
Set top and bottom margins	ESC U Pt Pb	--
Reset top and bottom margins	ESC V	--
Clear status line	ESC \	--
Enter data on status line	ESC]	--
Select alternate character set	ESC F	--
Return to standard character set	ESC d	--

NOTE: Each of the sequences listed in Table A-1 is described in detail in Chapter 2.

APPENDIX B.   SCREEN CONTROL DEFINITIONS

Table B-1 defines the elements that form the screen control sequences.

Table B-1.   Screen Control Sequence Definitions (Part 1 of 2)

Element	Definition
ESC	Escape -- A prefix used to introduce an escape sequence; generated by pressing the FUNCTION key and the [(left bracket) key simultaneously.
CSI	Control Sequence Indicator -- An ANSI sequence used to provide supplemental controls; generated by pressing the FUNCTION key and the [(left bracket) key followed by an additional [.
H or f	Characters used to designate the end of an ANSI cursor address sequence.
m	A character used to designate the end of an ANSI special emphasis sequence.
;	A delimiter -- a character used to separate data strings or series of codes.
Pn	A general parameter that represents a decimal number.

Table B-1.   Screen Control Sequence Definitions (Part 2 of 2)

Element	Definition
P(x,y,r,c,t,b)	Parameters that represent coordinates used in escape and ANSI sequences. All of the following parameters are derived from the row and column grid in Appendix C. x = a decimal number representing the row coordinate in the ANSI direct cursor positioning sequence. y = a decimal number representing the column coordinate in the ANSI direct cursor positioning sequence. r = an ASCII character representing the row coordinate in the escape sequence for direct cursor positioning. c = an ASCII character representing the column coordinate in the escape sequence for direct cursor positioning. t = an ASCII character (corresponding to Pr) used to set the top margin (row) of the scrolling region. b = an ASCII character (corresponding to Pr) used to set the bottom margin (row) of the scrolling region.

Pr
ROW CODE ▼

X COORDINATE
(COLUMN POSITION)

Pc   COLUMN
      CODE ▶

Y COORDINATE
(ROW OR LINE POSITION)

END OF
12-LINE
DISPLAY ▶

END OF
16-LINE
DISPLAY ▶

END OF
64-COLUMN
DISPLAY
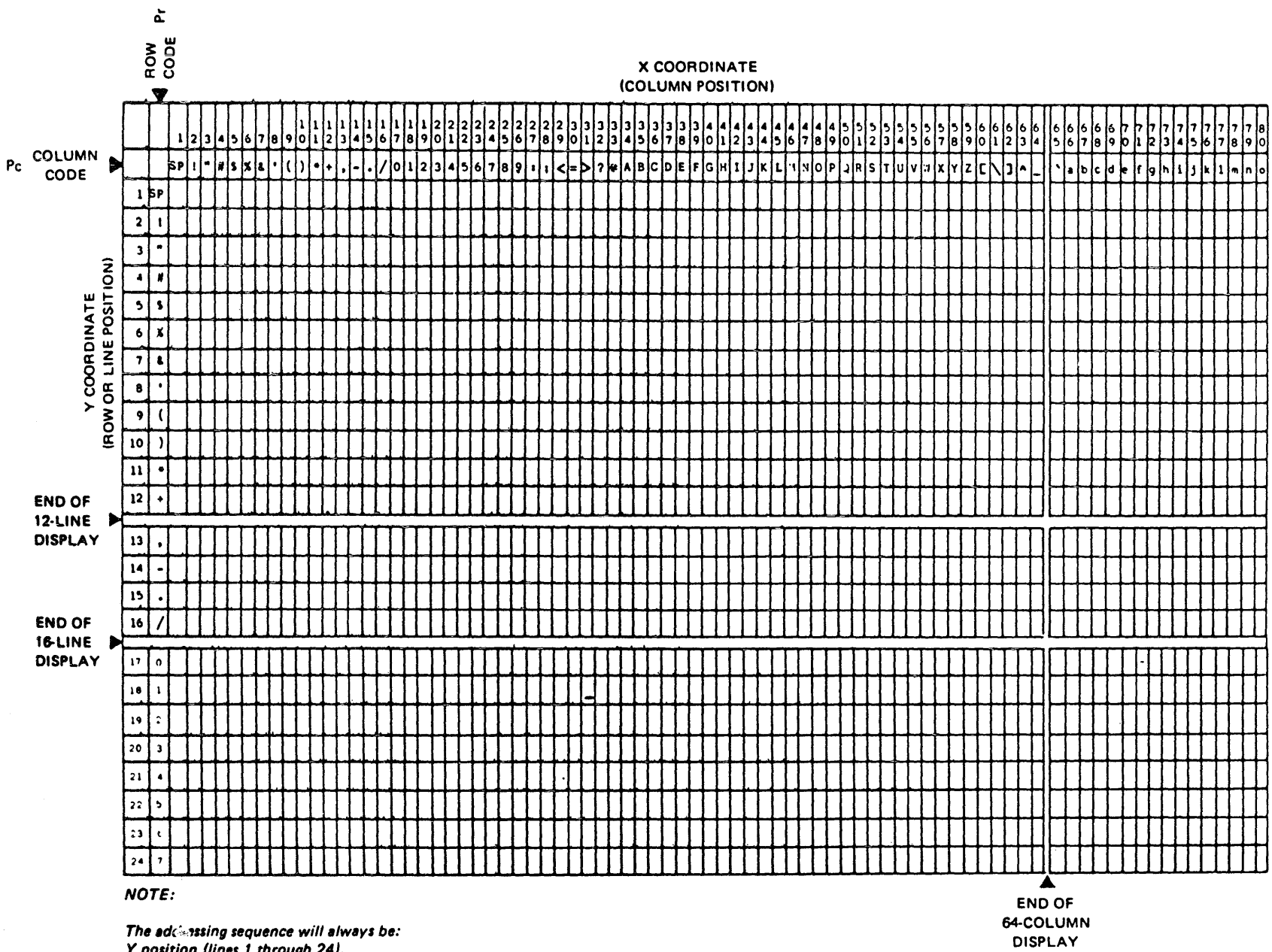
NOTE:

The addressing sequence will always be:
Y position (lines 1 through 24),
then X position (columns 1 through 80).

Figure C-1.   Direct Cursor Positioning for Screen Display

9136-25A

APPENDIX D. SPECIAL EMPHASIS SEQUENCES

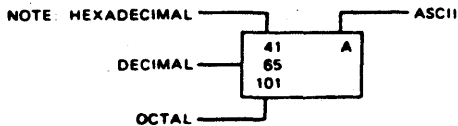Table D-1. Special Emphasis Screen Control Sequences (Part 1 of 2)

ASCII Character	Hexadecimal Character	Binary Code 6543210	Special Emphasis
@	40	1000000	Normal intensity
A	41	1000001	Low intensity
B	42	1000010	Underline
C	43	1000011	Underline and low intensity
D	44	1000100	Strike-through
E	45	1000101	Strike-through and low intensity
F	46	1000110	Underline and strike-through
G	47	1000111	Underline, strike-through, and low intensity
H	48	1001000	Reverse video
I	49	1001001	Dim background
J	4A	1001010	Reverse video and strike-through
K	4B	1001011	Dim background and underline
L	4C	1001100	Reverse video and strike-through
M	4D	1001101	Dim background and strike-through
N	4E	1001101	Reverse video, strike-through, and underline
O	4F	1001111	Dim background, strike-through, and underline
P	50	1010000	Column separator
Q	51	1010001	Column separator and low intensity
R	52	1010010	Column separator and underline
S	53	1010011	Column separator, underline, and low intensity
T	54	1010100	Column separator and strike-through
U	55	1010101	Column separator, strike-through, and low intensity
V	56	1010110	Column separator, strike-through, and underline
W	57	1010111	Column separator, strike-through, underline, and low intensity

Table D-1. Special Emphasis Screen Control Sequences (Part 2 of 2)

ASCII Character	Hexadecimal Character	Binary Code 6543210	Special Emphasis
X	58	1011000	Column separator and reverse video
Y	59	1011001	Column separator and dim background
Z	5A	1011010	Column separator, reverse video, and underline
[	5B	1011011	Column separator, dim background, and underline
j	5D	1011101	Normal intensity
^	5E	1011110	Normal intensity
—	5F	1011111	Low intensity

APPENDIX E. ASCII CHART

CONTROL CHARACTERS				DATA CHARACTERS							7 6 5/4 3 2 1
				64 CHARACTERS UPPERCASE				32 CHARACTERS LOWERCASE			
00 / 00 / 000 NUL	10 / 16 / 020 DLE	20 / 32 / 040 SP	30 / 48 / 060 0	40 / 64 / 100 ●	50 / 80 / 120 P	60 / 96 / 140 `	70 / 112 / 160 p				0 0 0
01 / 01 / 001 SOH	11 / 17 / 021 DC1	21 / 33 / 041 !	31 / 49 / 061 1	41 / 65 / 101 A	51 / 81 / 121 Q	61 / 97 / 141 a	71 / 113 / 161 q				0 0 0 1
02 / 02 / 002 STX	12 / 18 / 022 DC2	22 / 34 / 042 "	32 / 50 / 062 2	42 / 66 / 102 B	52 / 82 / 122 R	62 / 98 / 142 b	72 / 114 / 162 r				0 0 1 0
03 / 03 / 003 ETX	13 / 19 / 023 DC3	23 / 35 / 043 #	33 / 51 / 063 3	43 / 67 / 103 C	53 / 83 / 123 S	63 / 99 / 143 c	73 / 115 / 163 s				0 0 1 0
04 / 04 / 004 EOT	14 / 20 / 024 DC4	24 / 36 / 044 $	34 / 52 / 064 4	44 / 68 / 104 D	54 / 84 / 124 T	64 / 100 / 144 d	74 / 116 / 164 t				0 1 1 0
05 / 05 / 005 ENQ	15 / 21 / 025 NAK	25 / 37 / 045 %	35 / 53 / 065 5	45 / 69 / 105 E	55 / 85 / 125 U	65 / 101 / 145 e	75 / 117 / 165 u				0 1 0 1
06 / 06 / 006 ACK	16 / 22 / 026 SYN	26 / 38 / 046 &	36 / 54 / 066 6	46 / 70 / 106 F	56 / 86 / 126 V	66 / 102 / 146 f	76 / 118 / 166 v				0 1 0 1
07 / 07 / 007 BEL	17 / 23 / 027 ETB	27 / 39 / 047 '	37 / 55 / 067 7	47 / 71 / 107 G	57 / 87 / 127 W	67 / 103 / 147 g	77 / 119 / 167 w				1 1 1 1
08 / 08 / 010 BS	18 / 24 / 030 CAN	28 / 40 / 050 (	38 / 56 / 070 8	48 / 72 / 110 H	58 / 88 / 130 X	68 / 104 / 150 h	78 / 120 / 170 x				1 0 0 0
09 / 09 / 011 HT	19 / 25 / 031 EM	29 / 41 / 051)	39 / 57 / 071 9	49 / 73 / 111 I	59 / 89 / 131 Y	69 / 105 / 151 i	79 / 121 / 171 y				1 0 0 1
0A / 10 / 012 LF	1A / 26 / 032 SUB	2A / 42 / 052 *	3A / 58 / 072 :	4A / 74 / 112 J	5A / 90 / 132 Z	6A / 106 / 152 j	7A / 122 / 172 z				1 0 1 0
0B / 11 / 013 VT	1B / 27 / 033 ESC	2B / 43 / 053 +	3B / 59 / 073 ;	4B / 75 / 113 K	5B / 91 / 133 [	6B / 107 / 153 k	7B / 123 / 173 {				1 0 1 1
0C / 12 / 014 FF	1C / 28 / 034 FS	2C / 44 / 054 ,	3C / 60 / 074 <	4C / 76 / 114 L	5C / 92 / 134 \	6C / 108 / 154 l	7C / 124 / 174 |				1 1 0 0
0D / 13 / 015 CR	1D / 29 / 035 GS	2D / 45 / 055 -	3D / 61 / 075 =	4D / 77 / 115 M	5D / 93 / 135]	6D / 109 / 155 m	7D / 125 / 175 }				1 1 0 1
0E / 14 / 016 SO	1E / 30 / 036 RS	2E / 46 / 056 .	3E / 62 / 076 >	4E / 78 / 116 N	5E / 94 / 136 ^	6E / 110 / 156 n	7E / 126 / 176 ~				1 1 1 0
0F / 15 / 017 SI	1F / 31 / 037 US	2F / 47 / 057 /	3F / 63 / 077 ?	4F / 79 / 117 O	5F / 95 / 137 —	6F / 111 / 157 o	7F / 127 / 177 �				1 1 1 1

NOTE: HEXADECIMAL ———┐ ┌——— ASCII

DECIMAL ——— 41   A
              65
OCTAL ———   101

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