Burroughs

MT 983/MT 993 Display Terminals

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TABLE OF CONTENTS

TABLE OF CONTENTS (CONT)

LIST OF ILLUSTRATIONS

LIST OF TABLES

SECTION 1
GENERAL INFORMATION

GENERAL DESCRIPTION

The MT 983 and MT 993 units are microprocessor-based modular terminal systems designed for general-purpose input and display applications. The MT 983 terminal consists of a free-standing, self-contained, cathode ray tube (CRT) display monitor and a keyboard. (The MT 983 is shown in figure 1-1.) The MT 993 terminal (figure 1-2) differs from the MT 983 only in its physical screen size and physical packaging. The MT 993 monitor has 9-inch (diameter) screen; whereas, the MT 983 monitor has a 12-inch screen. The MT 993 display monitor is packaged separately from the logic control circuits which are housed in a separate cabinet. MT 983 logic circuits are housed in the display monitor cabinet. Unless otherwise stated, the information in this manual applies to both models.

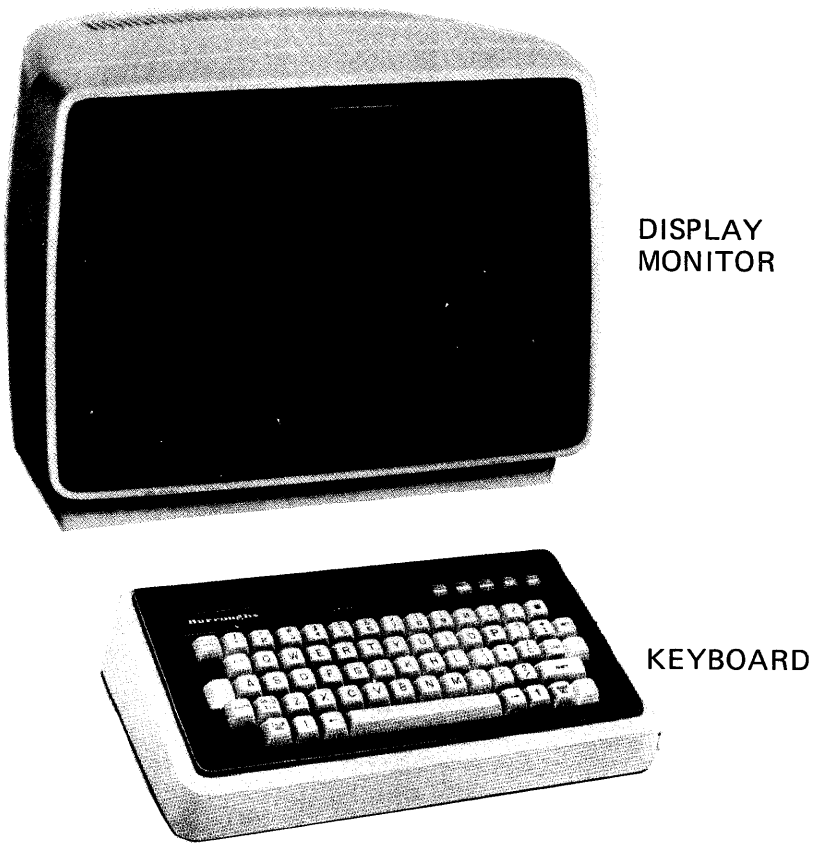


Figure 1-1. MT 983 Display Terminal

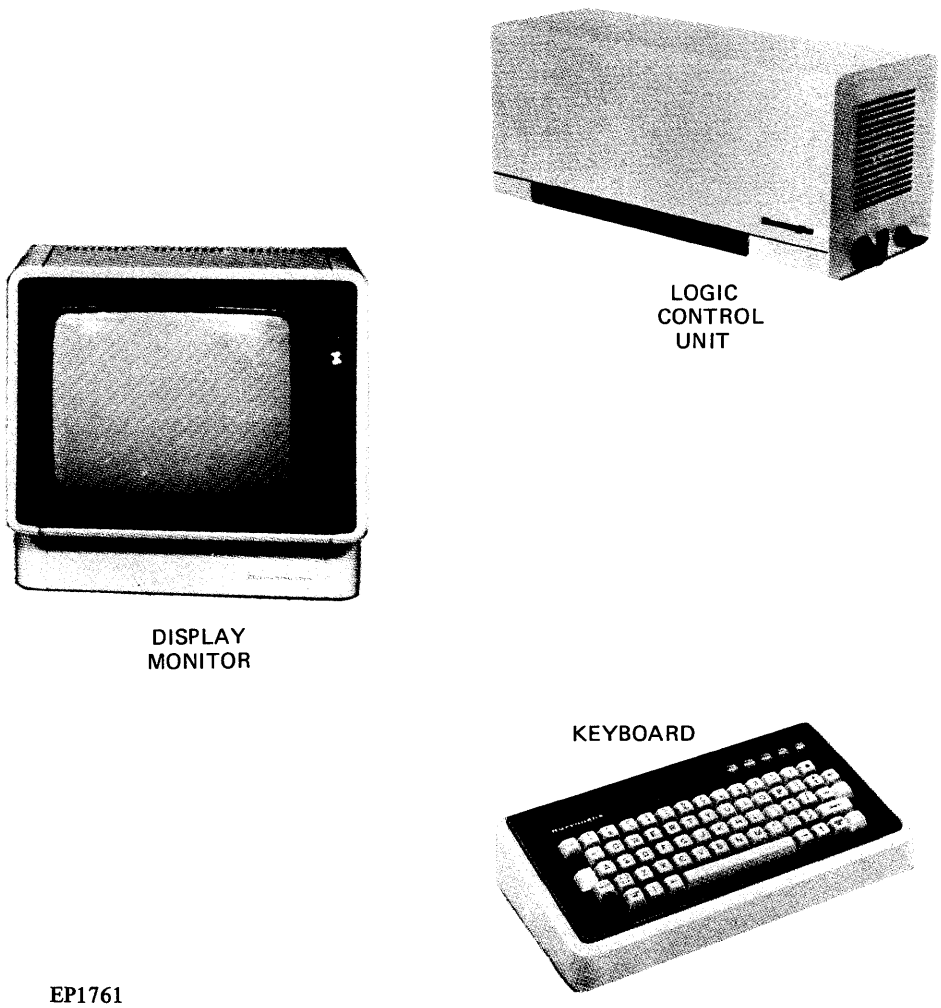


Figure 1-2. MT 993 Display Terminal

CRT Display

The CRT provides a green phosphor high-persistence display of fully formed characters. Each character is made up of small segments as opposed to solid line strokes. The MT 983/MT 993 can display up to 25 lines of information on the screen at one time: 24 lines of display data and one status line (25th line). Each line has a maximum length of 80 characters. The format of display data is alterable to 24 lines of double-width characters with each line having a maximum length of 40 characters. In this case, the 25th line (status line) is still displayed in standard character size format (80 characters in length).

Keyboard

The keyboard is used by the operator to enter information into the terminal. There are several types of keyboards which may be used. These are identified and described in Section 5 of this manual.

Peripheral Options

Optional peripheral devices may be used with either terminal system. These include auxiliary output printers, micro-disk file storage devices, and magnetic card readers. Specific information concerning the models and functions of the printers and micro-disk is contained in Sections 6 and 7.

Interface Capabilities

The terminal can exchange data with both local and remote devices. Data interchange (data communications interface) with a remote device (host system) such as a central computer system uses the ASCII transmission code.

The data communication interface can be performed using either the Burroughs asynchronous or the synchronous method of transmission. More detailed information is given in Section 3.

Data is exchanged with local devices such as keyboards and peripherals using a serial I/O interface. More detailed information concerning this is in Section 4.

SYSTEM CONFIGURATION

The basic system configuration for the MT 983/MT 993 is shown in figure 1-3.

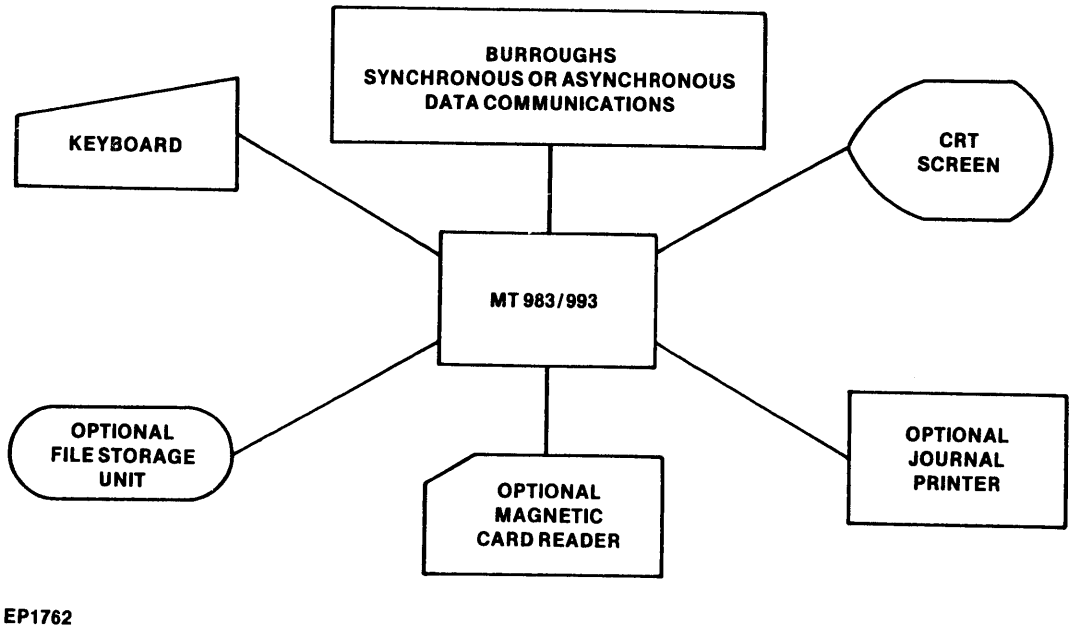


Figure 1-3. MT 983/MT 993 System Configuration

SYSTEM CHARACTERISTICS

The characteristics of the MT 983/MT 993 terminal system are given in table 1-1.

Table 1-1. MT 983/MT 993 Characteristics

Item	Characteristic
MT 983 Dimensions (without keyboard)	15.0 inches (38 cm) high; 16 inches (40.6 cm) wide; 13.0 inches (33 cm) deep
MT 993 Dimensions (without keyboard)	
Monitor	11 inches (28 cm) high; 8 inches (20 cm) wide; 11 inches (28 cm) deep
Logic Control Unit	7.5 inches (19 cm) high; 13.5 inches (34.3 cm) wide; 5.5 inches (14 cm) deep

(continued)

Table 1-1. MT 983/MT 993 Characteristics

Item	Characteristic
Weight (without keyboard)	
MT 983	35 pounds (15.9 kilograms)
MT 993	
Monitor	8 pounds (3.6 kg.)
Logic Control Unit	11 pounds (5 kg.)
Display screen	Cathode ray tube (CRT)
Display color	Green characters on dark background (normal video); dark characters on green background (negative video)
Display screen capacity	Up to 1,920 characters, plus an 80-character status line (25th line)
Display data format	24 lines with standard 80 or double-width 40 characters per line
Display character format	fully formed characters in an 8 x 16 character image area or 16 x 16 (double-width) character image area
Character generator	Up to 128 characters (upper and lower case alphanumeric characters and special symbols)
Character code	US ASCII or international
Data transfer rates	up to 1800 bps EIA RS232C asynchronous up to 9600 bsp EIA RS232C synchronous Up to 9,600 bps TDI (1000 ft. maximum distance) Up to 38,400 bps BDAA (15,000 ft. maximum distance)
Display memory	2,000 (optional 4,000) characters
Data comm buffer	up to 2000 characters with optional 4000 character display memory (configurable)
Status line	80 characters, displayed as the 25th line
Display refresh rate	60 or 50 Hz (input line frequency)
Input voltage range	100 to 240 volts ac to 50 or 60 Hz
Heat generated	500 BTU/hour
Relative humidity range	10 to 90 percent
Operating environment	40 to 122 degrees F (5 to 50 degrees C)

CAPABILITIES AND FEATURES

Various capabilities and features have been incorporated into the terminal to enable the terminal to function as a general purpose input and display system. These capabilities and features are described separately in the following subparagraphs.

Capabilities

The terminal is capable of being operated in three different functional modes and three separate operational states. The functional mode determines the behavior of the terminal in response to various operator and host system initiated actions; whereas, the operating state determines the interface operation of the terminal.

Functional Modes

The terminal may be in one of following three functional modes at any given time:

Forms mode
Non-forms mode
Configuration mode

The forms mode and non-forms mode are considered to be operational modes. The configuration mode is a non-operational mode and is only used to set up or alter the terminal configuration. The use of the configuration mode is not considered to be a normal operator function. A description of this mode is contained in Section 2.

Forms Mode

Forms mode operations can be entered from the keyboard or from the host system. In the forms mode, the terminal protects part of a page from being changed (either by the operator or by the host system). The forms page is divided into two types of fields: protected fields and unprotected fields. When a page is displayed on the screen in the forms mode, the operator can enter data in the unprotected fields but is prohibited from altering the protected fields. However, both unprotected fields and protected fields are transmittable.

Delimiters are used to define the beginning and end of the unprotected fields. Any two symbols (one for beginning and one for end) may be setup to represent keyboard entered delimiters (configuration selectable). However, the symbols used to represent the delimiters displayed on the screen when the terminal is in forms mode or when the delimiters are transmitted are fixed.

A forms-mode page must have at least one unprotected field. Therefore, before the terminal designates a page as being in forms mode, it examines the page to determine whether it contains an unprotected field. Furthermore, once a page has been designated as a forms page, the terminal ensures that it continues to meet this criteria by prohibiting any operation that would either over-write a delimiter in the page or store a delimiter into a page. (Were it not for this prohibition, the operator or host system could fill an unprotected field with delimiters, resulting in no unprotected space.)

The fixed delimiters used to signify the beginning of an unprotected field are the US delimiter (graphic symbol ▷) or the GS delimiter (graphic symbol △). The US delimiter signifies that the unprotected field is a normal left-justified field; whereas, a GS delimiter signifies a right-justified unprotected field. The fixed delimiter used to signify the beginning of a protected field (end of an unprotected field) is the RS delimiter (graphic symbol ◁) (See figure 1-4.)

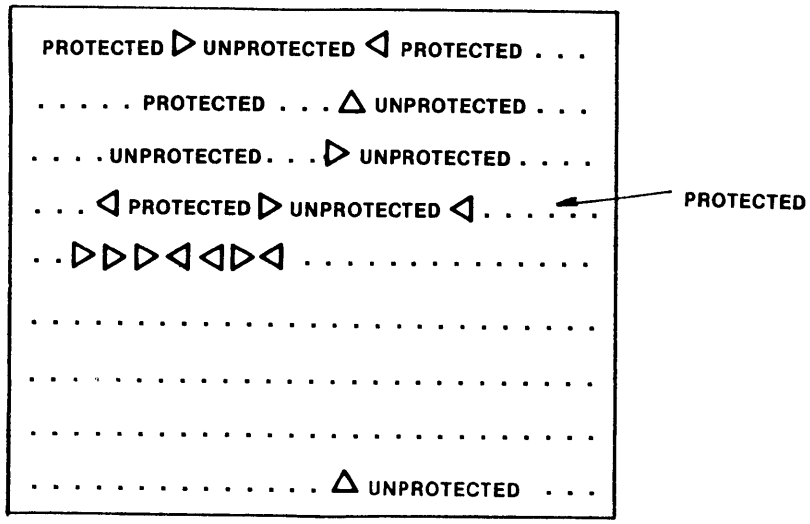


Figure 1-4. Sample of a Forms Mode Page

The forms delimiters are always protected, as are any characters between the beginning of the page and the first delimiter. The actual unprotected fields, therefore, consist of the characters between each GS/US delimiter and the next delimiter (or the end of the page, if a GS or a US is the last delimiter on the page). Neither protected nor unprotected fields are limited by the beginning or the end of a line. Fields may begin on one line and continue on subsequent lines.

Non-Forms Mode

The non-forms mode is the default mode when the terminal is not in forms mode or configuration mode. In the non-forms mode, data can be entered or altered by the keyboard operator or host system in the conventional methods as described in the remainder of this section.

Operating States

The system can be in one of the three operating states:

Local
Receive
Transmit

These operating states are selectable from the keyboard.

Local State

In the local state, the terminal accepts data entered from the keyboard or the optional peripherals or may output data to an optional peripheral. While in the local state, the host system cannot gain access to the display data. However, the host system can force the terminal into the receive state or transmit state through a Fast Select, Group Select, or Broadcast Select data comm operation for the purpose of sending or retrieving display data. The terminal will sound an alarm to signify a request from the host system for access to the terminal.

There are two substates which operate in the local state: control and character insert. The control substate is entered into from the keyboard by way of the CTRL key. This substate extends the keyboard commands available to the operator. When in the control substate, the terminal interprets the keyboard data entered as specific commands (refer to subparagraph titled Keyboard Controls in this section). The character insert substate is entered when the character insert key is activated. For a description of the operation of the terminal in this substate, refer to the subparagraph titled Character Insert by Line or Page in this section.

Receive State

The receive state is entered into locally from the keyboard by the RCV key or remotely from the host system through a Fast Select, Group Select, or Broadcast Select data comm operation. In this state, the terminal accepts data messages from the host system. No action is taken by the terminal on an incoming message until the message is received in it's entirety and message parity is checked. The host system can send control messages or display data messages.

Transmit State

The transmit state is entered into locally from the keyboard by the XMT key or remotely from the host system through a special control character sequence which may be contained in the received data. In this state, the terminal waits to be polled unless the the terminal is in the Contention mode of data communications interface; in which case, the terminal sends a transmit request to the host system. When the terminal is polled or the host system acknowledges the transmit request, the terminal proceeds to transmit the contents of the display screen from the cursor location to the first ETX (end-of-text) character. If no ETX character is present on the screen, then the contents of the display screen from the home position to the cursor location are transmitted.

Features

Following is a list of features of the terminal:

Page formatting
Configuration control
Status display line

Negative video
Highlighting
Cursor display
Editing
Data communications
Storing and retrieving data from an optional storage unit
Sending data to an optional auxiliary printer

The following subparagraphs describe the various features of the terminal. The operation of many of these features is dependent upon the configuration of the terminal. The configuration of the terminals is changeable by the user. Refer to Section 2 for detailed information concerning terminal configuration.

Page Formatting

The terminal allows for the formatting of display data (either by the operator or host system) into pages. If specific page boundaries are not specified, the entire contents of the display memory are considered one page.

In regard to page formatting, it is essential that a distinction be made between the terms "page" and "screen window." A page is a group of contiguous lines of data grouped together for storage. The term "screen window" refers to the lines (not including the status line) visible to the operator. The screen window may contain several pages, exactly one page, or a portion of a page.

Configuration Control

The terminal contains stored data which programs the terminal configuration. This data can be changed from the keyboard when the terminal is in the configuration mode. Configuration data can also be changed from the host system through the use of data communications interface control characters. Section 2 of this manual provides more detailed information on terminal configuration.

Status Display Line

The status line displays information to the operator which indicates existing or previous error conditions, special messages from the host system, and page number of the cursor page. The status line is also used to indicate when the terminal is in the control (CTRL) substate. The status line is not accessible to the operator. The status line is divided into the following parts:

Error messages (columns 1-16)
Special messages (17-73)
Page number (74-80)

Error Messages

The terminal displays error messages in the first 16 character positions of the status line. The terminal can display the following error messages:

Error Message	Error Condition
DATA COMM ERROR	Block check or data comm hardware error
KEYBD DATA LOST	Keyboard buffer overflow
PRINTER ERROR	Printer hardware error (Power off or faulty cable connection)
RECEIVE ERROR	Error condition detected during receive operation

Special Messages

The special message section of the status line is used to display data comm entered data that cannot be altered by the operator. Special messages of up to 57 characters may be displayed when the terminal is not in the

control (CTRL) substate. When the terminal is in this substate, special messages of up to 52 characters may be displayed. Character positions 69 through 73 are reserved for display of the control substate indicator (CTRL). Typical special messages may include computer or system status and operator notification of data entry on non-displayed pages.

Page Number

The word PAGE and the number of the page on which the cursor is located appear automatically in the last seven positions of the status line.

Negative Video

The terminal has the feature of negative video. The video presentation is under the control of the operator via the keyboard, and the host system via the data communications interface. The display is in normal video (green characters on a dark background) when power is turned on. The display can be changed to negative video (dark characters on a green background) or back to normal video:

1. From the keyboard through the use of a control (CTRL) code. (Refer to table 1-2.)
2. From the host system through the use of data communications control characters. (Refer to Appendix C.)

Cursor Display

The terminal generates a visual cursor which indicates where data entered from the keyboard will appear. The cursor is displayed as the reverse image of the character at the cursor location.

The cursor position is stored in a cursor counter and not in display memory. As each character is loaded into the display memory from the keyboard, the cursor is advanced one position to the right. When the end-of-line is reached, the cursor is advanced to the first position of the next line.

The cursor may be configured for blinking or non-blinking operation. The cursor can be positioned remotely from the host system. The position of the cursor can be transmitted to the host system.

Highlighting

Highlighting can be used to emphasize specific blocks of data (up toone line long) or areas of the screen. Highlighting can be enabled by the operator via the keyboard (refer to table 1-2) or by the host system. The entered highlighting information is automatically included in the display data when it is stored in memory or transmitted to the host system. During on-line operations with a host system, highlighting is enabled by receiving one or more of the highlighting control characters within the text of a data comm message (refer to Appendix C).

Highlighting functions may be grouped to produce more than one highlight on a given line or field (forms mode) of data. This requires the entry of successive highlight control characters on the cursor line. Each entered highlight control character occupies a separate location in display memory. The highlighting functions recognized by the terminal are:

Underline
Blink
Secure
Bright
Reverse Video

Highlight control characters are stored in memory but are not displayed. A highlight control character occupies one space in display memory and is displayed on the screen as a blank. The applicable highlight starts at the highlight character and extends over the following characters to the right, up to and including the next RS delimiter. If no RS delimiter is present, the highlight extends to the end of the line. The highlight may not extend beyond the end of the display line. Note that the presence of two reverse highlight control characters

in the same line or field do not cancel out each other. In this case, the second reverse highlight control character has no effect, provided that no RS delimiters are encountered between the two reverse highlight control characters. If the terminal is in negative video operation, the effects of highlighting are reversed.

In the forms mode, highlights can be displayed in both protected and unprotected areas; however, they may not extend beyond the RS delimiter. When in the forms mode, highlighting can be initiated from the keyboard only in the unprotected areas.

Underline Video

The underline highlight enables the underlining of a designated character or field. When an underline highlight control code is detected, the display begins to underline and continues this highlight until an RS delimiter is detected or until the end of the line, whichever occurs first. The underline consists of solid video which is in contrast to the background video.

Blink

The blink highlight enables blinking of a designated character or field. When a blink highlight character is detected, the characters immediately following the highlight character (displayed as a blank) and up to the RS delimiter or end-of-line (whichever occurs first) blink at a 1.3 Hz rate.

Secure

The secure highlight allows data such as security codes to be entered in memory but not displayed on the screen. The secure highlight fills in the character position immediately following the highlight character and all the remaining characters in the line or up to the next RS delimiter (whichever occurs first) with solid video; green when in normal video operation and dark (non-video) when in the negative video operation.

Bright Video

The bright video highlight causes brighter characters to appear when the display is in normal video operation. In negative video operation, this highlight causes a brighter background to appear.

Reverse Video

This highlight causes reverse video from the highlight character position until an RS delimiter is detected or the end of line is reached (whichever occurs first).

This highlight causes negative video to be displayed in the highlight boundaries if the display is in normal video operation. Activation of the reverse video highlight when the display is in negative video operation causes normal video to be displayed in the highlight boundaries.

Edit Functions

The edit functions provided by the terminal are described in the following subparagraphs. Most of these functions may be invoked remotely from a host system by means of data communications control characters, or locally from the keyboard. The data comm control codes used to invoke the various edit functions from a host system are contained in Appendix C. The keyboard controls are described in this section under the heading "Operator Controls and Functions".

Character Insert by Line or Page

The terminal has the capability of two types of character insert functions: by line or by page.

Pressing the character insert key puts the terminal in a character insert condition and initiates a character insert by line operation. The terminal automatically inserts a single space at the cursor position. Subsequent pressing of any non-control key (alphanumeric character key or punctuation key; including space) causes the applicable character to be inserted at the cursor location. The succeeding characters within the line are moved one space to the right. Surplus characters, if any, are shifted off the end of the line and lost.

Pressing the character insert key when the terminal is in the control (CTRL) substate also puts the terminal in a character insert condition; however, the function is performed on a page basis. The succeeding characters are moved one space to the right and down line by line through the page. A second pressing of the character insert key disables the character insert condition.

When in forms mode, the character insert function causes data shifting within the single unprotected data field in which the cursor is located.

The terminal can also perform the character insert function through host system control. However, the data communications character insert function differs from the keyboard control function. The character insert condition is not entered. Instead, each character to be inserted requires a new character insert data communications control code.

Character Delete by Line or Page

The character delete key causes the erasure of the displayed character at the cursor location. The succeeding characters within the line move one space to the left. Putting the terminal in the control (CTRL) substate prior to pressing the character delete key, performs the character delete operation on a page basis. The succeeding characters down on the page are moved one space to the left and up line by line.

In forms mode, the character delete function causes data shifting within the unprotected data field in which the cursor is located. If the cursor is in a protected field, character deletion is prohibited. From the keyboard, the character delete operation in a US unprotected field is different than in a GS unprotected field. In a US field, the character is deleted and the succeeding characters in the field are shifted one space to the left. In a GS field, the entire field is shifted to the right, provided the cursor is at the rightmost position in the field.

The terminal also performs the character delete functions through host system data communications control. From host system control, the character delete operation in a GS field is the same as in an US field.

Line Insert/Delete

The terminal can insert and delete lines. The line insert function moves all data in the page below the cursor line (including the line with the cursor) down one line.

Line delete erases the line in which the cursor is positioned and all data in the page below the cursor line moves up one line.

This function is inhibited in forms mode.

Line Movement Up/Down

The line movement function causes a line of display data to be interchanged with the line immediately above or below, depending on the specific function selected. The line of data to be moved is selected by placing the cursor in that line. When line movement causes data to be displaced, the displaced data reappears in the original position of the line moved. The cursor follows the moved line in all cases. An upward movement of the top line of a page causes the bottom line of the page to be exchanged with the top line of the page. The same exchange occurs if a downward movement is requested for the bottom line of a page. This function is inhibited during forms mode.

Clear Page

This function may be invoked from the keyboard or from the host system. In the non-forms mode, the clear page operation fills the entire page with blanks and returns the cursor to the home position.

If the terminal is in forms mode, either the entire page may be cleared from the keyboard or only the unprotected fields may be cleared, depending on the configuration option invoked. If the entire page is cleared, the terminal is put into the non-forms mode. When in the forms mode and the clear page operation is invoked from the host system, only the unprotected fields are cleared. In all cases of forms mode operation, the cursor (pointer) is left in the data entry position of the first unprotected field of the page.

Clear to End-of-Line/Page

This operation clears data from the cursor position to the end of a line or page. In the non-forms mode, the clear end-of-line operation clears all data from the cursor position to the end of a line. In forms mode, this operation clears all data from the cursor position to the RS delimiter.

The clear end-of-page operation clears all data from the cursor position to the end of the page.

The terminal is also capable of initiating the clear to end-of-line/page function through host system control.

Lower Case Enable/Disable

It is possible, through keyboard or host system control, to enable/disable the display of lower case letters. When the lower case is disabled, all letters are displayed in upper case. Note that keyboard control disables only keyboard-entered lower case. Host system control disables only data comm entered lower case characters.

Roll Page Up/Down

The purpose of this function is to enable the operator to roll the contents of the page through the screen window. The roll page up function shifts the entire page up one line while the cursor remains stationary. The top line of the page becomes the bottom line. In the roll page down operation, movement is reversed. This function is inhibited in forms mode. This function can be invoked from the keyboard or by the host system.

Scroll Display Data Up/Down

The purpose of this function is to enable the operator to scroll the entire contents of the display memory through the screen window. This function can only be invoked from the keyboard. In this function, the cursor remains stationary while the display memory data is moved line-for-line up or down the screen. During a scroll up operation, the top line of the screen disappears from view and the bottom line is filled from memory with the next display data line. When the last line of the display memory is shown at the bottom of the screen, all further scroll up operations are ignored. Scroll down operation is the reverse of scroll up.

If the scroll operation causes a new page to appear on the screen, the page number located on the status line is changed accordingly. If the new page is a forms protected page, the FORMS indicator lights and the terminal is put in forms mode when the first line of the forms protected page appears at the top of the screen. If the operator tries to alter the data on that page, the limitations of a forms protected page apply (only unprotected fields may be altered).

Page Advance/Back

The page advance function, when invoked from the keyboard, displays the next page with the cursor in the home position of that page. If the new page is a forms protected page, the FORMS indicator lights and the terminal enters forms mode; the home position of the cursor is the home position of the first unprotected field (left-most position of a US field and right-most position of a GS field).

When this function is invoked from the host system, the specified page is displayed on the screen. If the specified page is in the forms mode, the cursor (pointer) is placed at the beginning of the first unprotected field.

In either case, if the last line of the new page appears above the last line of the screen, the display is adjusted so that the last line of the page appears at the last line of the screen. As a result, the first line of the page may not be at the top of the screen.

Move Cursor (Pointer) Up/Down

This function moves the cursor (pointer) vertically to the line directly above or below its initial position. If the cursor is initially at the top line of the page and a move cursor up function is invoked, the cursor moves

to the same column in the bottom line of the page. if the bottom line of the page was not previously in the screen window, the screen window is automatically rolled through the page until the last line of the page is displayed. This function can be invoked from either the keyboard or the host system.

Move Cursor (Pointer) Left/Right

This function moves the cursor (pointer) horizontally one character position to the left or right. If the cursor is initially at the last character on the last line of the page and a move cursor right function is invoked, the cursor moves diagonally to the first character position on the first line of the page. The reverse is true for the move cursor left operation when the cursor is at the first position of the top line. When changing lines would put the cursor out of the screen window (page is larger than the screen), the page is advanced through the screen window to keep the cursor in view.

Position Cursor (Pointer)

This function moves the cursor (pointer) directly to the row and column position of the page as specified in the parameters of the command. This function can be invoked from either the keyboard or host system. If either the row or column value specified by the parameters is out of range for the current line and page size, the operation is inhibited.

Align Cursor to Pointer

When this function is invoked, the cursor moves directly to the current position of the data comm pointer if the cursor and data comm pointer are located on the same page. If, during the operation, the cursor leaves the screen window, the page automatically rolls through the window to the extent necessary to bring the cursor back onto the screen.

Set Mobile Home Pointer

This function is used to specify a start-of-transmission point. This function can be invoked from either the keyboard or the host system. The location of the cursor during keyboard operations or the data comm pointer during host system operations establishes the row and column position of this point.

Cursor Tabulation

This function provides a means of rapid cursor movement both horizontally (across the cursor line) and vertically (upward or downward in the cursor column). In this function, the cursor will proceed to the next tab stop. Horizontal tab stops can be fixed or variable.

Setting and Clearing Horizontal Tab Stop

If the terminal is configured for the variable tab stop option, individual tab stops can be set from either the keyboard or the host system. The current column location of the cursor is set as a tab stop upon receipt of the valid command from the keyboard or host system. All variable tab stops can be cleared by use of a single keyboard or host system command.

If the terminal is configured for the fixed tab stop option, tab stops are invoked every eight columns starting at column 1 (1, 9, 17, and so on).

Horizontal Tab Forward Function

This function can be invoked from either the keyboard or the host system. When this function is invoked, the cursor moves to the next tab stop (non-forms mode) or to the first character position of the next unprotected field (forms mode). An HT character is written into the new cursor location in memory. The tab symbol is displayed if the tab function is invoked by use of the TAB key on the keyboard or from the host system and the terminal is configured for this feature. If the terminal is not so configured, or if the tab function is invoked by use of the SKIP key on the keyboard, nothing is stored in memory and no tab page symbol is displayed. If no tab stops have been set, the cursor is left at the home position of the page.

If the terminal is in the forms mode and the next unprotected field is a GS field, the cursor continues to the rightmost position of the field. However, if the terminal is configured for the HT character as described above, the HT character is written into the leftmost position of the field even though the cursor is positioned at the rightmost position of the GS field.

Horizontal Tab Reverse Function

This function can only be invoked from the keyboard. In non-forms mode, the cursor is moved left to the previous tab stop, or to the home position if no tab stops are set. If the terminal is in the forms mode, the cursor moves left to the previous field and stops at the leftmost position of a US field and the rightmost position of a GS field.

Vertical Tabulation

The terminal can be configured for vertical tab stops at lines 1, 9, and 17. The vertical tab down function can be invoked from the keyboard or from the host system. The vertical tab down function moves the cursor down to the next vertical tab stop. If the initial cursor position is the last tab stop (line 17), it moves to the first line of the page. The reverse is true if the cursor is initially at the first line of the page and a vertical tab up function is invoked. The vertical tab up function can only be invoked from the keyboard. In all cases, the cursor is left at the first character position of the new line.

Carriage Return Function

When the terminal is in the non-forms mode, the carriage return function may or may not write the carriage return character in memory and display such at the initial cursor (pointer) position (depending on the terminal configuration). Also depending on terminal configuration, the carriage return function either returns the cursor (pointer) to the first character position in the current or next line. (If the cursor is initially at the last line of the page, the first line of the page is the next line.) The page automatically rolls through the screen window to keep the cursor in view.

When the terminal is in forms mode, the operation of the carriage return function is the same as in the non-forms mode except that the cursor is moved to the next unprotected field of the page (keyboard operations only). A data comm invoked carriage return function in the forms mode does not automatically skip the data comm pointer to the next unprotected field.

End-of-Text (ETX) Function

The ETX or end-of-text function can be invoked either from the keyboard or from the host system. The operation of the ETX function differs depending upon whether the function is invoked from the keyboard or the host system.

In a keyboard ETX operation, an ETX character is stored at the cursor location unless the cursor is in a protected area of a forms page. (The ETX function has no effect if the cursor is in a protected area of a forms page.) Depending on the terminal configuration, the cursor either returns to the first character position of the current line or to the "mobile home pointer"location. (If necessary, the page is automatically rolled through the screen window to keep the cursor in view.)

In a host system (data comm) invoked ETX operation (an ETX character occurs exactly once in each incoming data message), the ETX character is stored at the current location of the data comm pointer (non-forms mode) provided the terminal is so configured. If the terminal is configured to store the ETX character, the data comm pointer moves one space to the right. if the data comm pointer is located on the same page as the cursor, the two are aligned with one another.

Search Function

The search function makes it possible to designate a 'search character" and to tab the cursor through display memory stopping at each occurance of the 'search character". The SKIP key on the keyboard is used for this function.

OPERATOR CONTROLS AND FUNCTIONS

Operator controls and functions are of two types: display monitor controls and keyboard controls.

Display Monitor Controls

Display monitor controls (figure 1-5) consist of an ON-OFF switch and the BRIGHTNESS control. On the MT 983 the ON-OFF switch and BRIGHTNESS control are located on the front of the monitor below the CRT.

On the MT 993, the BRIGHTNESS control is on the upper right front corner of the monitor cabinet and the ON-OFF switch is on the logic control unit. The functions of these controls are:

ON-OFF Switch. The ON-OFF switch provides the control for activating the terminal with ac line voltage.

BRIGHTNESS Control. The BRIGHTNESS control is used to adjust the display intensity for optimum viewing level.

Keyboard Controls

Keyboard controls are used by the operator to invoke the various functions and features of the terminal. (Many functions and features of the terminal are dependent on terminal configuration; refer to Section 2.) Table 1-2 lists the various functions and the associated keyboard controls. The specific key mnuemonic used for each keyboard control is dependent on the model keyboard used with the terminal. Refer to Section 5 for detailed information on these keyboards.

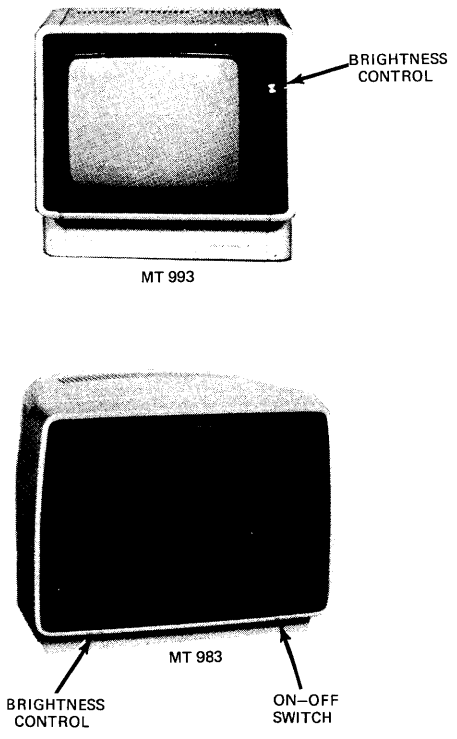


Figure 1-5. Display Monitor Controls

Table 1-2. Keyboard Controls

1. This table is intended as a quick reference to the commonly used keyboard controls needed to operate the terminal. A brief description of the action caused by the keyboard controls in the non-forms mode is given. For a description of the actions caused by the keyboard controls when in the forms mode, refer to the subparagraphs in this section describing the specific control functions.

2. Parentheses are used to indicate actual key names.

Function	Keyboard Controls	Action
SELECT FUNCTIONS:		
Control Function	(CTRL)	Press key once to activate control function. Pressing the key a second time, or pressing one or more keyboard keys, deactivates this function. To lock terminal in control function for an extended period, use shifted (CTRL) key. In this case, control function can be deactivated by pressing (CTRL). When terminal is in control function, the message CTRL appears on the right side of the status line, preceeding the page number.
Forms Mode	(CTRL) W	When forms mode is activated, the FORMS indicator located on the keyboard is lit. The forms mode can only be activated when valid delimiters are present in the display data. Refer to subparagraph titled Forms Mode for more detailed information concerning the operation of forms mode. To deactivate forms mode, press (CTRL) Q.
Local State	(LOCAL)	If no other state is activated, the terminal defaults to the local state. When local state is activated, LOCAL indicator on keyboard is lit.
Search Function	(CTRL) A	When search function is activated, it is possible to designate the "search" character. To designate the search character, press (CTRL) E x (where x equals the search character). To deactivate search function, press (CTRL) S. Refer to subparagraph titled search function for more detailed information. The default "search" character is (¦).
Receive State	(RCV)	When receive state is activated, RCV indicator located on keyboard is lit. Activation of any other state deactivates receive mode.
Transmit State	(XMT)	When transmit state is activated, the XMT indicator on keyboard is lit. Successful transmission of data or activation of the local state deactivates transmit state.
HIGHLIGHT FUNCTIONS:		
Negative Video	(CTRL) U	Screen shows dark characters on a green background.
Normal (Positive) Video	(CTRL) I	Screen shows green characters on a dark background.

Table 1-2. Keyboard Controls (Cont.)

Function	Keyboard Controls	Action
Reverse Video	(CTRL) H (.)	Beginning at the cursor, the line is displayed in reverse video (opposite of the rest of the screen).
Bright Video	(CTRL) H (:)	Beginning at the cursor, the remainder of the line is displayed in brighter video than the rest of screen.
Blink	(CTRL) H 8	Beginning at the cursor, the remainder of the line blinks.
Underline	(CTRL) H (/)	Beginning at the cursor, the remainder of the line is underlined.
Secure	(CTRL) H 9	Beginning at the cursor, the remainder of the line is filled in with solid video.
EDIT FUNCTIONS:		
Move Cursor Right	(→)	Cursor is moved one character position to the right.
Move Cursor Left	(←)	Cursor is moved one character position to the left.
Move Cursor Down	(↓)	Cursor is moved down one line.
Move Cursor Up	(↑)	Cursor is moved up one line.
Move Cursor Home	(HOME)	Cursor is moved to the home position.
Carriage Return	(RETURN)	Cursor is returned to beginning of next (or same) line, depending on configuration.
Character Insert (Line)	(CHAR INS)	Entered character(s) is inserted at cursor location and succeeding characters on the line are moved one position to the right.
Character Insert (Page)	(CTRL) (CHAR INS)	Entered character(s) is inserted at cursor location and succeeding characters on the page are moved one position to the right and down line by line through the page.
Character Delete (Line)	(CHAR DEL)	Character at cursor location is deleted and succeeding characters on the line are moved one position to the left.
Character Delete (Page)	(CTRL) (CHAR DEL)	Character at cursor location is deleted and succeeding characters on the page are moved one position to the left and up, line by line.
Line Insert	(LINE INS)	Cursor line and succeeding page lines are moved down to allow for new line.
Line Delete	(LINE DEL)	Cursor line is deleted and succeeding lines are moved up.
Line Movement Up	(CTRL) V	Cursor line is interchanged with line above.
Line Movement Down	(CTRL) B	Cursor line is interchanged with line below.

Table 1-2. Keyboard Controls (Cont.)

Function	Keyboard Controls	Action
Roll Page Up	(CTRL) N	Page is rolled up one line while cursor remains stationary.
Roll Page Down	(CTRL) M	Page is rolled down one line while cursor remains stationary.
Scroll Data Up	(CTRL) (↑)	Display memory contents are scrolled up one line through the screen window while cursor remains stationary.
Scroll Data Down	(CTRL) (↓)	Display memory contents are scrolled down one line through the screen window while cursor remains stationary.
Page Advance	(CTRL) (→)	Next page is displayed.
Page Back	(CTRL) (←)	Previous page is displayed.
Clear Page	(CLEAR)	Cursor page is cleared (non-forms mode).
Clear to End of Line	(CLR EOL)	All data from cursor position to end of line is cleared (non-forms mode).
Clear to End of Page	(CLR EOP)	All data from cursor position to end-of-page is cleared (non-forms mode).
Enable Lower Case	(CTRL) T	Enables display of upper and lower case characters.
Disable Lower Case	(CTRL) Y	All characters are displayed in upper case.
Set Variable Tab	(CTRL) P	If terminal is configured for variable tab stops, establishes a tab stop at current cursor position. If tab stop is already established, tab stop is disabled.
Clear Variable Tab Stops	(CTRL) O	Clears all variable tab stops, if set.
Tab Forward	(TAB)	Cursor moves forward to next tab stop.
Reverse Tab	(RTAB)	Cursor moves back to the previous tab stop.
Search Character	(SKIP)	Cursor moves forward to next occurrance of "search" character on the page.
COMMUNICATIONS FUNCTIONS:		
Set Mobile Home	(CTRL) (HOME)	Establishes a start-of-transmission-point (other than screen home) at the current location of the cursor.
Move Cursor to Data Comm Pointer	(CTRL) (>)	Cursor moves directly to current location of data comm pointer.
Set Data Comm Bit Rate;		
600 baud	(CTRL) space H (CTRL)	Data comm bit rate is set to 600 baud.
1200 baud	(CTRL) space J (CTRL)	Data comm bit rate is set to 1200 baud.
1800 baud	(CTRL) space K (CTRL)	Data comm bit rate is set to 1800 baud.

Table 1-2. Keyboard Controls (Cont.)

Function	Keyboard Controls	Action
Send Special Data Comm Message	(CTRL) H (applicable key)	Data comm character associated with applicable key (refer to figure D-3 in Appendix D) is entered into display memory for the purpose of transmitting a special message to the host system. The related symbol is displayed on the screen. Note, this feature should be used causiously because of effect these data comm control characters may have on host system.
PRINTER OUTPUT FUNCTIONS:		
Print Screen Data from Home to Cursor (Form Feed)	(CTRL) (;)	Screen data from home position to current cursor location is printed on optional printer with form feed taking place.
Print Screen Data from Home to Cursor (No Form Feed)	(CTRL) (])	Screen data from home position to current cursor location is printed on optional printer without form feed taking place.
Print Unprotected Data from Home to Cursor	(CTRL) (:)	All unprotected screen data from home to current cursor location is printed on optional printer.

SECTION 2
SYSTEM CONCEPTS

GENERAL

This section describes the memory allocation and the operational concepts of the MT 983/MT 993 terminal system. These concepts include the major processes of the terminal, functional modes, and maintenance functions.

MEMORY ALLOCATION

Memory allocation is shown in a simplified form in table 2-1. Memory is laid out in terms of accessibility by firmware, the host system, and the user.

Firmware Memory

Firmware memory is an area of memory which contains a set of operating microinstructions. These instructions control edit functions, confidence tests, interrupt procedures, and peripheral control. Firmware memory is internal to the terminal and is protected from being altered either by Burroughs field engineers or by the user.

Host System Accessible Memory

This area of memory is of primary concern to the host system programmer. It is subdivided into the data comm buffer, display memory, status line buffer, and scratchpad memory.

The data comm buffer transfers data to and from the host system. Buffer size is configurable and can be up to 2,000 characters with the expanded memory options.

The display memory contents may be viewed on the screen by accessing a selected portion of display memory. The selected viewable area of display memory is called the screen window. Data goes from the display memory to the host system and is received in display memory from the host system via the data comm buffer. Data can be entered into display memory from the keyboard. The display memory size is 1,920 characters in the basic system and 3,840 characters with expanded memory.

The status line buffer is an area of memory which is used to assemble the 80-character status line (displayed as the 25th line on the screen). Data is entered into this area of memory from the host system (special messages) and from the firmware memory (error messages).

The scratchpad memory is an area of memory reserved for configuration data. Most of this message area is accessible to the user. Address location 0080 (Hex) through 00A0 (Hex) are the user-accessible areas of scratchpad memory. The remaining locations of this memory area are only accessible by a Burroughs field engineer. These locations contain such data as the terminal password and error message formats.

Table 2-1. MT 983/MT 993 Memory Allocation

Memory Area	Accessible By
Data Comm Buffer	Host System
Display Memory	User and Host System
Status Line Buffer	Host System and Firmware
Scratchpad Memory	User and Host System
System Firmware	Firmware

MAJOR PROCESSES

Figure 2-1 shows the major processes of the terminal and the main data paths they use to communicate with one another. The major processes are:

Main process
Display store process
Video process
Keyboard interface process
Data comm interface process

Main Process

The main process includes four subprocesses: the keystroke interpreter, message synthesizer, message interpreter, and a driver to control the other three.

Input to the main process is keystroke signals, data comm control data, or host system messages.

A keystroke signal is simply an integer; its presence signifies either an actual keystroke or one generated by the repeat function during continuous pressing of a key. The value of the integer identifies not only the key responsible for the signal, but also whether the SHIFT key (which produces no keystroke signal itself) is simultaneously pressed.

Data comm control data advises the main process of an event that has occurred in the data comm interface operation. There are 12 different events: some originate in the data comm network (false select, SOH received); some in the data comm transceiver (transmit complete, receive complete).

The main process is characterized by the three operating states (local, receive, and transmit) as shown in figure 2-2. This diagram reflects how the main process functions with respect to the overall terminal operation.

Local State Operation

In the local state, the terminal neither transmits nor receives. Instead, the terminal is in an idle condition waiting for keyboard input. A keyboard input starts the keystroke interpreting subprocess and the terminal remains in the local state. During local state operation, the terminal is sensitive to data comm input request indications. If such an indication occurs, the terminal sounds the audible alarm to alert the operator to put the terminal into the receive state.

Receive State Operation

When an operator activates the receive key (RCV) or upon successful transmission of data, the terminal enters the receive state. At this time the data comm input is received through the data comm interface process. If the incoming data is control data, it is routed to the driver subprocess where it is acted upon. If the incoming data is a message, the message is loaded into the data comm buffer; after which, message interpreting takes place. If no other state is selected, the terminal remains in the receive state.

Transmit State Operation

When the transmit key (XMT) is activated, the terminal enters the transmit state. The driver initiates any control data to be transmitted. The message data to be transmitted is retrieved from memory through the display store process and the message is composed by the message synthesizer subprocess. The message is then loaded into the data comm buffer. When the message is fully loaded into the buffer, the terminal waits for an invitation to transmit from the host system. Upon receipt of this signal, the message is transferred from the data comm buffer to the data comm interface lines by the data comm interface process.

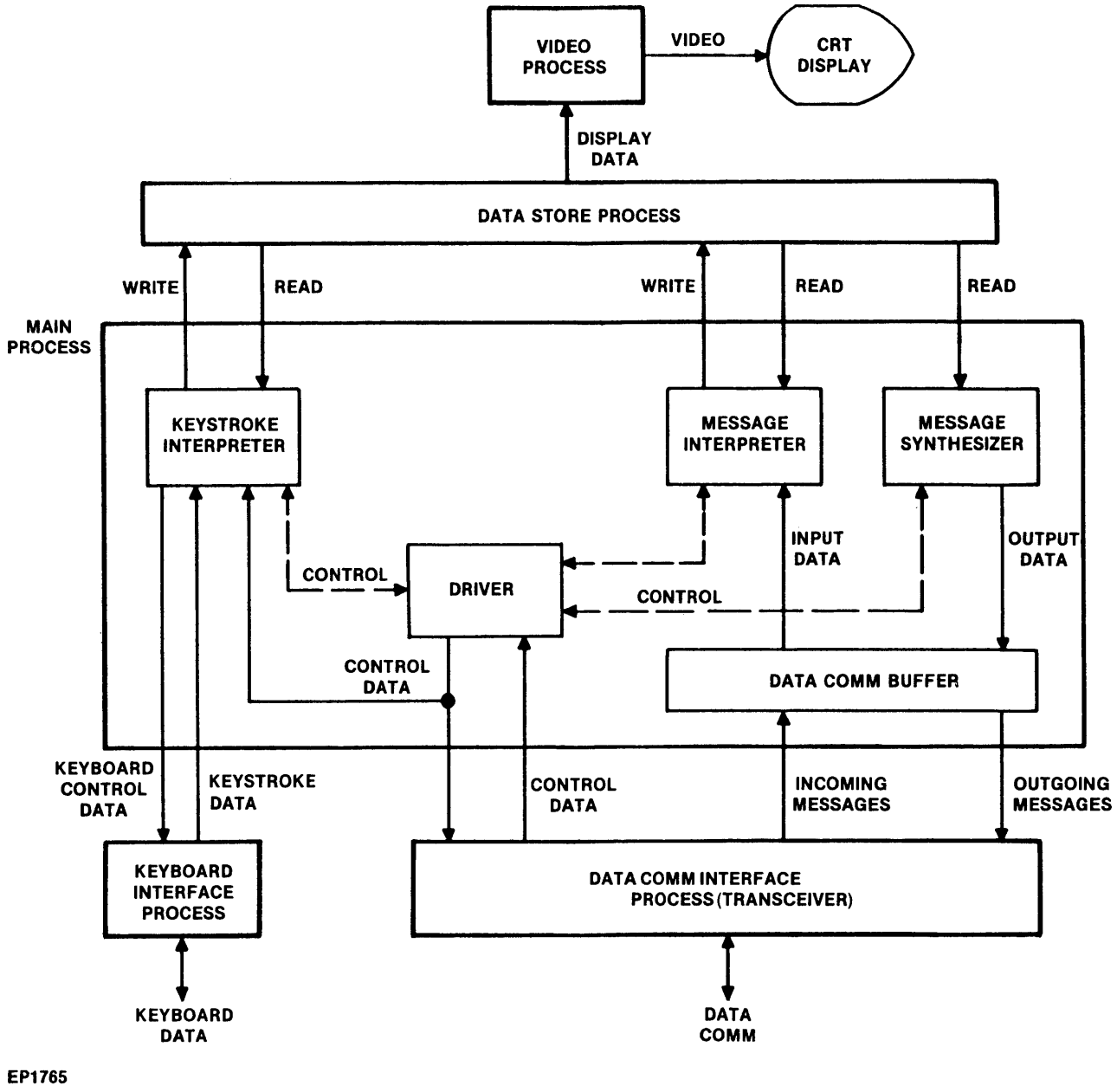


Figure 2-1. Major Processes of Terminal

Keystroke Interpreter

The keystroke interpreter decodes and initiates operations invoked by a stream of keystrokes from the keyboard. The operations fall into two categories: control and non-control. Non-control operations are straightforward interpretations of the keyboard keys. Control operations extend the number of functions which can be invoked from the keyboard. Control operations are initiated by the CTRL key and modify the interpretation of the keyboard keys. A control operation is activated by pressing the CTRL key (shifted or unshifted), fol-

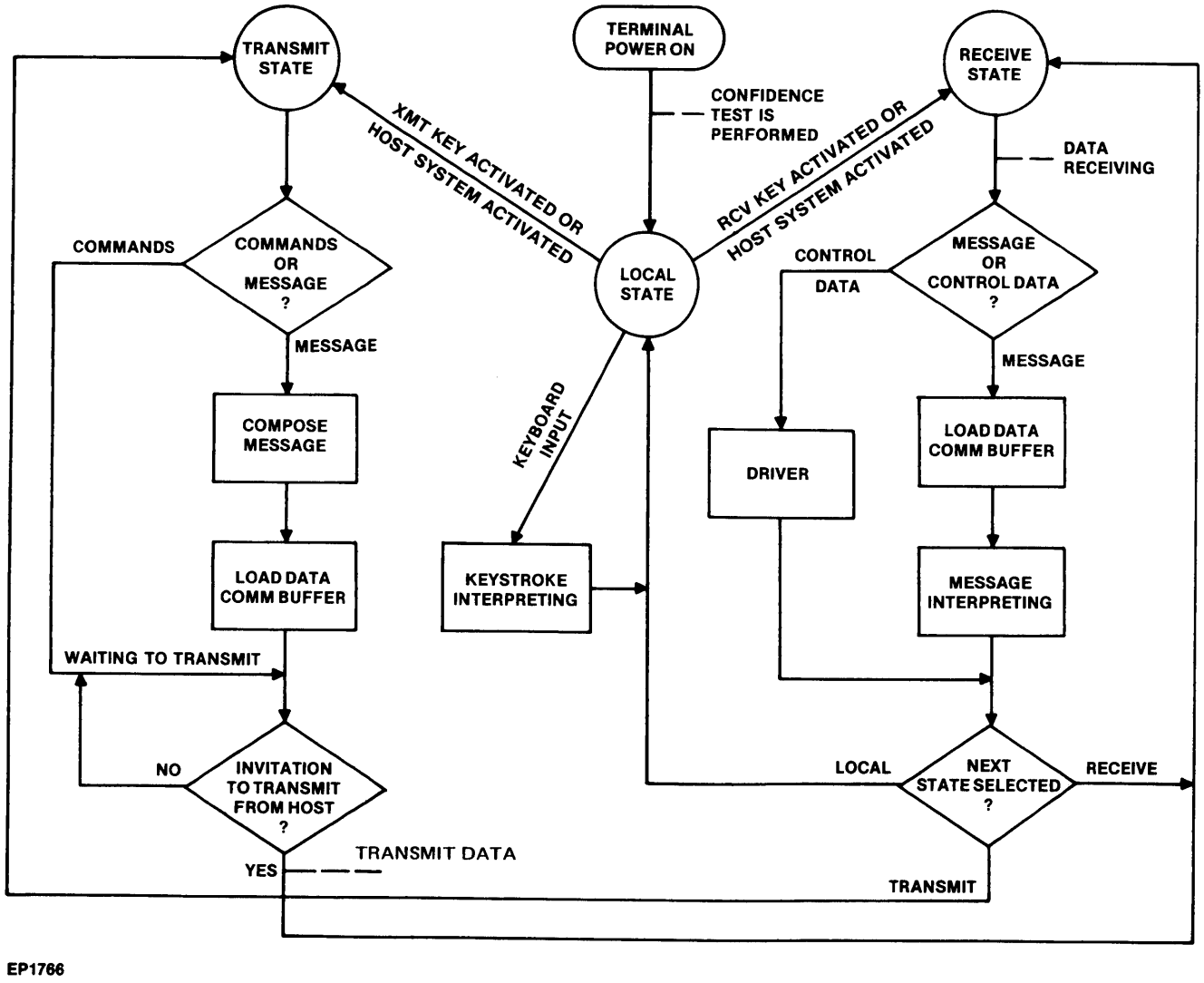


Figure 2-2. Main Processor Operation, Flow Diagram

lowed by one or more keyboard keys. The control operation remains in effect until one or more of the following events occurs:

1. The CTRL key is pressed a second time.
2. A key is pressed that ends a valid control sequence. (If the sequence began with shifted CTRL, the CTRL operation allows for multiple key entries.)
3. A key is pressed that cannot be interpreted as part of a valid CTRL sequence (this has no effect other than to erase the CTRL indicator).

The various CTRL-initiated control sequences are tabulated in Appendix B.

Message Interpreter

The message interpreter performs a function for data comm operations similar to that performed by the keyboard interpreter for keyboard operations. The message interpreter decodes and initiates the operations invoked by the host system. The message interpreter extends the number of control functions available in the standard 128-character ASCII set. The specific data comm character that allows for the extended control functions is the "escape" (ESC) character. The various ESC-initiated functions are tabulated in Appendix C.

Data Comm Buffer

The data comm buffer (DCB) is an area of memory which is used to temporarily store input messages so that the individual parts of the input message can be interpreted without interfering with the data comm process. For outgoing messages, the data comm buffer stores the fully composed message before it is transmitted.

Buffer Overflow

If an incoming or outgoing message is larger than the data comm buffer capacity, an audible alarm (buzzer) sounds and a DATA COMM ERROR message is displayed on the status line. The length of the data comm buffer can be specified during configuration of the terminal. The actual message is transferred; however, the portion exceeding the boundaries of the data comm buffer will be missing.

Data Comm-Buffer Synchronization

The multipoint data comm network environment poses a buffer synchronization problem for the terminal. The particular circumstance in which the problem arises is the arrival of a False Select, Group Select, or Broadcast Select message at a time when the main process is either interpreting a previous message or loading the buffer with an outgoing message. If the transceiver were to store the incoming message in the buffer, the operation of one or the other process would be disrupted.

To prevent this, access to the buffer is regulated so that only one of the controlling modules can access it at a time. For example, before starting to load the buffer with an outgoing message, the main process issues a SEIZE DCB command and waits for a DCB SEIZED response from the transceiver before proceeding. It retains control of the buffer until it issues a transmit (releasing not only the message for transmission but also the buffer) or a RELEASE DCB (which occurs when the operator presses the local key to cancel a transmission).

The other instance in which the main process gains control of the buffer occurs when the transceiver acknowledges an incoming message and sends a RCV DONE report to the main process. The buffer then belongs to the main process until it issues a RELEASE DCB command at the completion of message interpretation.

If a Fast Select, Group Select, or Broadcast Select message arrives while the main process has control of the buffer, the message text is discarded and the transceiver responds with a NAK, signifying to the host machine that the message has not been properly received. When the transceiver has control of the buffer, a Fast Select, Group Select, or Broadcast Select message is accepted and loaded into the buffer, although the main process can still pre-empt the buffer with a SEIZE DCB command at any time before the incoming message has been acknowledged.

Message Synthesizer

The message synthesizer has exclusive responsibility for assembling outgoing messages in the data comm buffer. Outgoing messages are derived from various sources within the terminal. It is the function of the message synthesizer to develop the outgoing message from one of the following sources:

1. Display data solely derived from display memory (keyboard or host system initiated).
2. A numeric message derived from entered keystrokes.
3. A specify message initiated by the SPCFY key. This message informs the host system of the present position of the cursor.
4. System register data (host system initiated).

5. A message indicating the terminal firmware level (host system initiated).
6. Reconfiguration response and successful restart response messages (host system initiated).
7. A message indicating the contents of the error log.

Keyboard Initiated Display Memory Messages

The XMT key initiates one of several buff-loading processes, depending on whether the cursor page is in forms mode or non-forms mode and whether the page has an ETX (end-of-text) character.

Non-Forms

If the cursor page contains an ETX character, the message scan begins at the cursor and proceeds to the ETX; if the scan encounters no ETX (every ETX on the page precedes the cursor), the scan stops at the end of the page. When the cursor is positioned directly on an ETX, that character constitutes the entire message. The transmit-home position is ignored.

If the cursor page contains no ETX, the scan begins at the transmit-home location. If the cursor is at, or ahead of this location, the scan proceeds to the end of the page. If the cursor is beyond the transmit-home location, the message scan ends at (but excludes) the cursor.

Loading the buffer from a non-forms page is interrupted if the scan encounters either a carriage return (graphic ▽) or an HT character (graphic →). When a carriage return is encountered, it is loaded. However, further loading is suspended until the scan reaches column 1 of the next line. When an HT character is encountered, it is loaded; however, further loading is suspended until the scan reaches the next tab stop column. In both cases, scanning continues unaffected by the suspension of message loading, and all stopping conditions apply without alteration. Hence, a carriage return preceding an ETX or on the last line of a page effectively terminates a message. An HT terminates a message when no tab stops are set.

Forms

The buffer-loading operation of a forms page depends primarily on whether the search function is activated. The combination of search and forms is a special case. Scanning starts at the transmit-home location and stops at an ETX or the end of the page. The carriage return and HT characters have the same effect as in a non-forms page, and the forms delimiters have no special significance.

The non-search loading operation is an entirely different process. It recognizes forms mode by skipping over protected fields as it loads. This operation interprets the FS graphic (▯) as an opening delimiter, in addition to the GS and US characters. Loading stops when the scan encounters any delimiter and resumes one character past an opening delimiter. The delimiters themselves are not loaded. For buffer loading purposes, a forms mode page consists not of protected and unprotected fields, but of transmittable and non-transmittable fields. When the scan encounters a transmittable HT character, the character is loaded and loading is suspended until the next opening delimiter. A transmittable carriage return character is loaded; however, loading does not resume until an opening delimiter is encountered on a subsequent line.

The points in forms mode at which the message scan begins and ends depend primarily on the configuration of the terminal. One option enables the message scan to start at the transmit-home location and continue until it encounters either an ETX or end-of-page. At the starting point, loading is either active or suspended, depending on whether the transmit-home location is in a transmittable field. Cursor position is immaterial, except that it may affect the transmit-home position.

In the other option, the end points of the message scan depend on the presence or absence of an ETX in the page being scanned. If the page has an ETX, the scan begins at the cursor and continues to an ETX or end-of-page. If the cursor is in a GS field, the starting point of the scan is adjusted left to the beginning of the field. A user wishing to send a message beginning with a GS field need not move the cursor manually to the left end of the field. If the page contains no ETX, the scan begins at the transmit-home location and stops at the cursor. The cursor character itself is not loaded unless the cursor is

in a GS field. If the scan never encounters the cursor, or if no characters have been loaded when the scan encounters it, the scan continues to the end of the page.

System-Initiated Display Memory Message

The host system can initiate a terminal output message consisting of display memory data. This output message is initiated by receipt of an escape (ESC) control character followed by a open parenthesis (() character from the host system. The effect of this operation is delayed until the incoming control message is interpreted.

The message scan of a page always begins at column 1 of line 1. If the data comm pointer is at the scan's starting position, the scan proceeds to the end of the page. Otherwise, it stops when it reaches the data comm pointer position. In either case, the scan stops at once if it encounters an ETX. During this message scan, the criteria for loading are the same as in the keyboard-initiated display memory message.

Keyboard-Initiated Numeric message

This message is invoked by keyboard control sequence CTRL nn XMT where n can be any number from 0 to 9. This operation loads the characters ESC, m, n, ETX into the buffer for transmission to the host system. (The designations m and n stand for any two numeric digits entered from the keyboard.)

Specify Message

The SPCFY key loads the ESC character followed by the row (line) and column numbers of the cursor location, augmented by a value of 31, and followed by ETX.

Scratchpad Memory Data Message

This message type enables the host machine to read the configuration data contained in the terminal scratchpad memory. Unlike the host system-initiated display memory message, where the effect is delayed until after interpretation of the incoming control message is complete, this control message is acted upon as soon as the message interpreter recognizes it. The remainder of the control message is never interpreted. (Refer to the subparagraph headed Configuration Mode in this section and to Appendix A for detailed information concerning terminal configuration.)

Firmware Level Message

An incoming control character sequence of ESC space V terminates interpretation of the message being received and loads the buffer with the terminal firmware version and patch numbers.

Reconfiguration Response and Successful Restart Response Messages

These messages are a result of a reconfiguration of the terminal or a successful terminal restart operation. The terminal goes off-line prior to reconfiguration or restarting. Provided that no errors are found, the terminal returns on-line and loads the data comm buffer with the same message (six asterisks) appearing on the screen. Reconfiguration operations activated from the keyboard do not invoke any such transmission.

Error Log Message

This operation loads the data comm buffer with a string of 10 hexadecimal characters representing the current state of the error log. The second character indicates the number of data comm errors. The sixth character indicates the number of printer errors. All other characters are 0. (Refer to the paragraph titled Maintenance Functions in this section for more information concerning the error log.)

Data Comm Interface Process (Transceiver)

The terminal is equipped with a multipoint data comm transceiver which is used for communication on a shared data comm line (a line connecting a host system with several terminals).

The data comm transceiver operates in accordance with the Burroughs multipoint procedures as described in Section 3.

The multipoint transceiver operation consists of various states. The process is driven from state to state by two types of events: commands from the main process and the transmission of certain character sequences by the host system.

Transceiver/Main Process Interface

The interface between the data comm transceiver and the main process consists of:

1. The data comm buffer, through which the two modules communicate incoming and outgoing messages.
2. A set of commands issued by the main process.
3. A set of reports issued by the transceiver.

The commands and reports serve not only to inform each process of events that have occurred in the other, but also to coordinate the use of the data comm buffer.

Transceiver Commands

The commands issued by the main process to control transceiver operation are:

Command	Definition
TRANSMIT	Signals transceiver that buffer has a message ready for transmission; this command also releases the buffer to the transceiver.
RECEIVE	Puts transceiver in a state in which normal select requests from the host system are acknowledged.
OFF-LINE	Puts terminal off-line (for reconfiguration).
ON-LINE	Puts terminal on-line.
DISCONNECT	Commands transceiver to issue DLE-EOT sequence.
SEIZE DCB	If buffer is not already in use by transceiver, this reserves it for the main process.
RELEASE DCB	Main process relinquishes control over buffer to transceiver.
CLEAR	Returns transceiver to its IDLE state from all other conditions except DCB SEIZED; transceiver replies with IDLE report.
ABORT	Similar to CLEAR, except that transceiver gives no reply if its condition is DCB SEIZED. Allows reception of an incoming message to be aborted unless the message has already been acknowledged.

Reports

The reports are signals by which the transceiver acknowledges commands received from the main process and advises it of significant data comm network events. The reports and their definitions are:

Report	Definition
IDLE	Response to CLEAR command.
DCB SEIZED	Response to SEIZE DCB command.
RCV READY	Response to receive command.
XMIT DONE	Reports successful transmission of outgoing message.
GBSEL	Reports incoming GROUP SELECT or BROADCAST SELECT message.
RECEIVING	Reports reception of incoming message header.
RCV ERR	Reports end of incoming message containing a parity error, or message termination by EOT.
RCV DONE	Reports end of valid incoming message; control of buffer passes to main process.
DCB OVERFLOW	Reports incoming message too long for buffer.
XMIT READY	Response to transmit command.
FSEL	Reports incoming FAST SELECT message.

Keyboard Interface Process

The keyboard interface process controls all keyboard operations. The majority of keyboard keys are ordinary text keys (letters, digits, punctuation marks); however, it is convenient to view every keystroke as a command which is forwarded to the keystroke interpreter. In addition, control data to light various keyboard indicators and to enable various keyboard functions is transferred to the keyboard by the interface. This process is accomplished through serial input/output (SIO) procedures. Refer to Section 4 for a description of SIO interface procedures.

Display Store Process

The display store process stores in display memory characters received from the keyboard or data comm and is the source of characters displayed on the screen and transmitted to data comm.

Display memory is organized into lines which are all the same length (either 40 or 80 characters depending on configuration). The lines are grouped into pages, all of equal size (also dependent upon configuration). A common configuration of the terminal divides its display store into two pages, both consisting of 24 lines of 80 characters, for a total of 3,840 characters.

That portion of display memory data which is displayed is referred to as the screen window. Figure 2-3 illustrates a typical relationship of pages and screen window to the total display memory.

As stated, the display store process has two sources of data: the keyboard and the data comm port. Each of these sources has a separate pointer which denotes (at any time) the location where incoming data is stored in display memory. One of these pointers (the keyboard cursor) is usually displayed; that is, the displayed portion of the display memory always includes the cursor location. The actual position of the cursor is indicated by a reverse-video field, which may be made to blink or to be turned off (configuration dependent). The other pointer is an invisible data comm pointer. Its position can only be inferred from the effects of data comm inputs, or by means of specific operations that align the two pointers (move one of the pointers to the current location of the other). With the exception of these few specific operations, the positions of the two pointers are entirely independent. They may be in different lines or even different pages, controlling completely independent input processes.

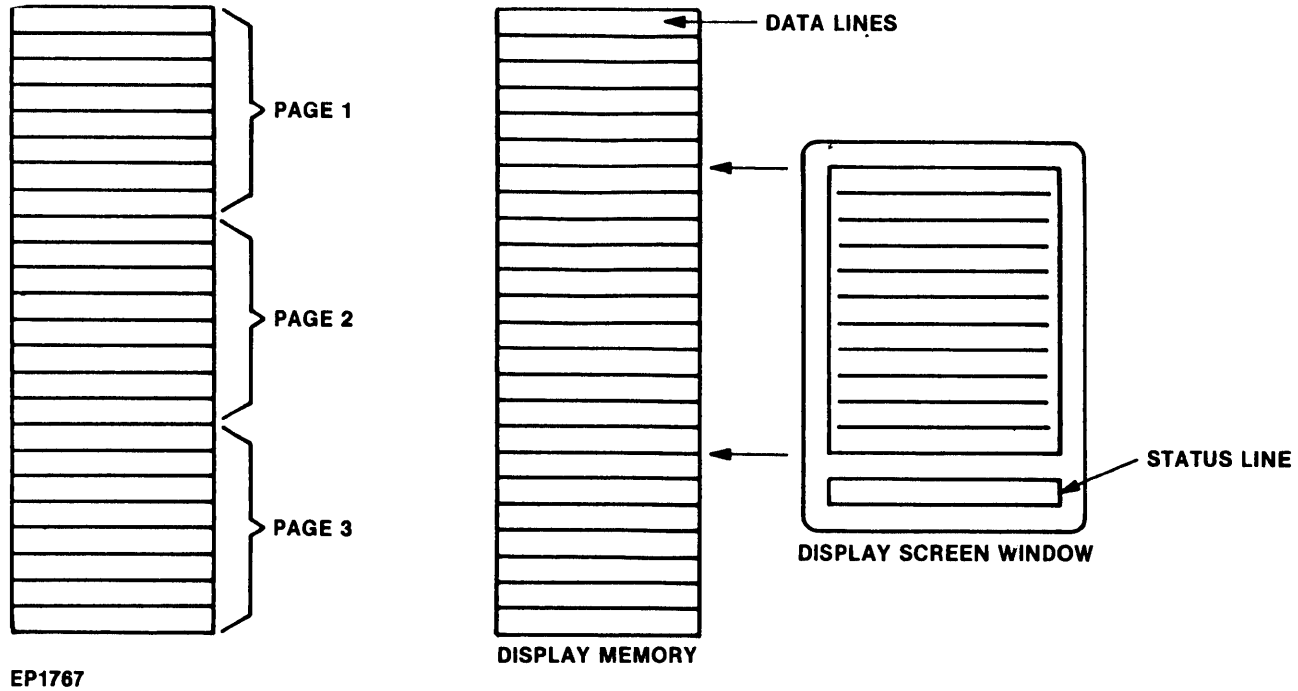


Figure 2-3. Typical Display Memory Organization

Video Process

The video process converts data retrieved from display memory into video presentations on the screen. The individual data characters retrieved from memory are decoded by a character generator which is used to generate the various alphanumeric characters and symbols of the display. The characters and symbols displayed are dependent on the character set being used with the terminal. Refer to Appendix D for a presentation of the character sets.

FUNCTIONAL MODES

The terminal can be operated in one of three modes: forms, non-forms, and configuration mode.

Forms Mode

Forms mode protects part of a page from being modified, particularly by the keyboard operator. When a forms page is displayed on the screen, the keyboard operator is permitted to alter the unprotected areas (fields) but is prevented from altering the protected areas (fields).

The designation of forms mode entails determining whether a page is a valid forms page.

A valid forms page contains at least one US or one GS delimiter. However, it is possible for a page to contain other delimiter symbols, particularly when entered from keyboard. This is because the keyboard does not include US or RS keys, although it does have a GS key; as a result, the terminal allows other characters to represent the US and RS delimiters. The actual identities of alternate delimiters are configuration options. Common alternate delimiters are the parenthesis, brace, or bracket. The terminal scans the entire page and converts every alternate delimiter into the US graphics symbol or the RS graphic symbol (depending on the alternate delimiter encountered).

Keyboard/Data Comm Differences

In some aspects, the operation of the terminal in forms mode depends on the source of input (keyboard or data comm interface). For example, the forms indicator light indicates whether the page in which the cursor is located is in forms mode. It flashes on and off when the cursor page switches between forms mode and non-forms mode, and also as the cursor is moved from a forms page to a non-forms page. No such indication is provided for the data comm pointer (nor is the host system able to determine if the data comm pointer is in a forms page).

During editing operations, the protected fields of a forms page are protected only from keyboard inputs; data comm messages can freely over-write protected fields, although the delimiters are fully protected.

Another difference is in the number of different types of fields that can be recognized. Keyboard operations recognize three types of fields: protected (RS), left-justified unprotected (US), and right-justified unprotected (GS); whereas data comm operations recognize only protected and unprotected (there is no distinction made between left and right-justified unprotected fields).

In operations invoked from the keyboard, US fields are normally filled from left to right (just like ordinary text entry), the cursor can be freely moved back and forth, and text can be entered at any position. A GS field is quite different. It has but a single data-entry point, the right-most position of the field. Positioning the cursor anywhere else in a GS field disables editing operations just as if it were in a protected field. Text entry in a GS field is also different. Instead of writing a character and then moving the cursor to the right, it first shifts the characters in the field left (discarding its left-most character) and then writes the character; the cursor, therefore, never moves at all.

Data comm operations treat GS and US fields identically. These fields are handled in some ways like RS fields. Straight text entry is allowed in all three fields, storing each text character and advancing the data comm pointer. The distinction occurs at the end of a field. When the data comm pointer advances to a position occupied by a delimiter, it immediately jumps to the beginning of the next unprotected field (making no distinction between GS and US fields). Most operations other than text entry (character insertion and deletion, for example) are allowed only in GS/US fields.

Entry Into Forms Mode

Pages can be switched to forms mode from the keyboard by the sequence CTRL W or by a data comm message with the sequence ESC W. In addition, the terminal can be configured so that a DC2 character in a data comm message has the same effect as ESC W, provided that the data comm pointer page is not already in the forms mode. If the pointer page is already in forms mode, CTRL W and ESC W have no effect, but DC2 (depending on terminal configuration) switches the page to non-forms mode.

The first step in a switch-to-forms-mode operation is a scan of the page containing the pointer. During this scan, it is also noted whether the page satisfies the requirement for forms mode (that it contains at least one opening delimiter followed by a non-delimiter). If the page fails this test, the operation terminates, leaving the pointer in the home position of the page.

The second step (undertaken only if the page meets the forms criterion) is to record that the pointer page is now in forms mode and, if it is a keyboard operation, to turn on the FORMS indicator light.

The third and last step, which is to position the pointer in the page, depends on whether the search feature is activated. If the search feature is off, the pointer jumps to the first unprotected location of the page. If the operation is invoked from the keyboard, then an HT character may be stored in the leftmost position of the field, depending on terminal configuration. If the search feature is activated, the page is scanned for an instance of the search character. If one is found preceding the first delimiter, the pointer is left at that location and a skip flag is turned on; otherwise, the skip flag is turned off and the pointer is placed as if the search feature were off.

Exit from Forms Mode

From the keyboard, entering CTRL Q sets the page to non-forms mode and leaves the cursor at the home position of the page. If the terminal is so configured, the entire page is cleared as well.

In a data comm message, the sequence ESC X sets the data comm pointer page to non-forms mode and puts the pointer at the page's home position. If the data comm pointer is on the cursor page, the FORMS light is cleared as well. The terminal can be configured so that a DC2 character has the same effect as ESC X.

In addition, the reception of a data comm message (regardless of its content) can affect the forms mode state of a page in two distinct situations. In one case, the terminal can be configured so that the reception of the SOH character in the heading of a message addressed to the terminal clears the entire page, leaving it in non-forms mode and the data comm pointer in the home position. The other situation occurs as interpretation of a data comm message begins. Regardless of the message content, the data comm pointer page is put into non-forms mode, turning the FORMS light off if the cursor is located in the same page. This is the only forms-exit operation that does not affect the location of the pointer involved.

Configuration Mode

Although the functions and features of the terminal are basically fixed, many parameters of its operation are changeable. These are variables with values that can be altered (either from the keyboard or data comm interface) for the duration of terminal operation (until power-off) or can be preserved through power-off periods. These variable parameters (such as page size, data comm transmission rate, cursor blink) are collectively referred to as terminal configuration options. The following subparagraphs describe the aspects of terminal configuration. Refer to Appendix A for detailed information concerning identification and alteration of the terminal configuration.

Scratchpad Memory

The terminal memory contains an area of scratchpad memory which is used to temporarily store the terminal configuration data. Terminal behavior is directly controlled by the data stored in this area of memory. At turn-on or restart, the scratchpad memory is automatically loaded with a fixed set of terminal configuration parameters derived from a separate device: the EAROM (electrically alterable read-only memory). This fixed

configuration data is preserved in the EAROM through power-off periods. However, it is changeable by the user (through the keyboard) or the host system (through data comm controls). When the terminal is turned off, the contents of the scratchpad memory are destroyed, thereby requiring a reload from EAROM when the terminal is powered-on.

The scratchpad memory consists of a string of eight-bit bytes. Each byte is identified by a four-digit hexadecimal address. The contents of the scratchpad memory can be displayed for the user on the display screen and can be modified from the keyboard. The host system can also read the scratchpad memory and write into it. Changes to the displayed scratchpad data on the screen do not in themselves alter the configuration data. It takes a configuration operation by the user or the host system to transfer the displayed scratchpad data into the scratchpad area of memory.

A transfer of displayed scratchpad data to the scratchpad memory may not always be allowed. When a transfer operation is attempted, a comparison is made between the displayed configuration data values and the specific limitations of the terminal. If the displayed values violate or exceed the specific limitations of the terminal, the configuration does not take place and a message to this effect is displayed on the top line of the screen. (For example, the storage allocation for display data can not exceed the total available memory space in the terminal.)

Default Terminal Configuration

The terminal contains default configuration parameters which are installed by the factory in a non-accessible area of memory. If during terminal configuration operations by the user a problem occurs where the EAROM contents are destroyed, recovery can be made through the use of the default configuration data. The user can transfer this default configuration data to the scratchpad memory by pressing a key on the keyboard (preferably the space bar) during the operation of the terminal confidence test at power-on or restart. At this point the user can recover to the desired terminal configuration as follows:

1. Display scratchpad memory contents.
2. Make desired configuration changes to the displayed data.
3. Perform a terminal configuration operation to write the changed data into the scratchpad memory from the screen.
4. Perform an EAROM rewrite operation to transfer the scratchpad memory contents to the EAROM to re-establish the fixed configuration parameters. Refer to Appendix A for detailed information on how to enter terminal configuration data into the scratchpad memory and EAROM.

Terminal Password

An operator is required to enter a four-character password to gain access to the scratchpad area of memory. This requirement protects against an unauthorized user making changes to the terminal configuration. The password can consist of any four characters. The default password set by the factory is MODE. The password can be changed by a Burroughs field engineer to customize the password for a particular user.

MAINTENANCE FUNCTIONS

The terminal has certain built-in maintenance functions to aid the user in determining the operational state of the terminal system. These include:

A built-in confidence test
Status line error messages
A displayable error log

Confidence Test

The terminal contains a built-in confidence test which is automatically run every time the terminal is powered-on or restarted. This confidence test can also be initiated by the user from the keyboard by the entry of the following keystroke sequence: CTRL space D CTRL. The confidence test can also be remotely initiated from the host system by sending the data comm instruction ESC space D.

A successful performance of the confidence test is indicated by six asterisks (* * * * * *) on the first display line of the screen with the terminal in the local state (local indicator is lit; all other indicators are off). If the confidence test is not completed successfully, the terminal can be left in various operational conditions.

The following are the normal observable indications which occur during the operation of the confidence test:

1. Buzzer sounds once approximately 1 second after power-on or restart and then goes off.

2. After buzzer sounds, all keyboard indicators light and stay lit for approximately 10 seconds; after which, they go out.

3. Flashes of video appear on the screen for several seconds.

4. local indicator relights; other keyboard indicators stay off.

5. Six asterisks are displayed in first line of display screen. Terminal is ready for operation.

Any indications other than those just described may indicate a malfunction in the terminal.

Status Line Error Messages

The following error messages are displayed on the status line to signify operational errors:

DATA COMM ERROR
PRINTER ERROR
RECEIVE ERROR
KEYSTROKE LOST

Error Log

The terminal maintains a record of the number of occurrences of certain errors. This record, known as the error log, can be displayed on the screen by the following keystroke sequence in upper case (shifted) form: CTRL RWxxxx CTRL RLxxxx, where xxxx is the four-character password required to gain access to the restricted areas in terminal memory. Error log contents can also be transmitted to the host system in response to an ESC R L instruction in a data comm message. Although the error log provides for five distinct types of error reporting, only two types (data comm errors and printer errors) are used at this time. The other three are reserved for future use.

The reported error counts are limited to 15, and are set to 0 only by the system confidence test. The data comm error log counts only parity errors and block check errors in incoming messages. Buffer overflows, which cause a data comm error message to appear on the status line, are not counted. The error log format in shown in figure 2-4.

For example, the terminal might respond to a display error log request with the following hexadecimal digits:

0B0040000

indicating that 11 data com errors and 4 printer errors have occurred.

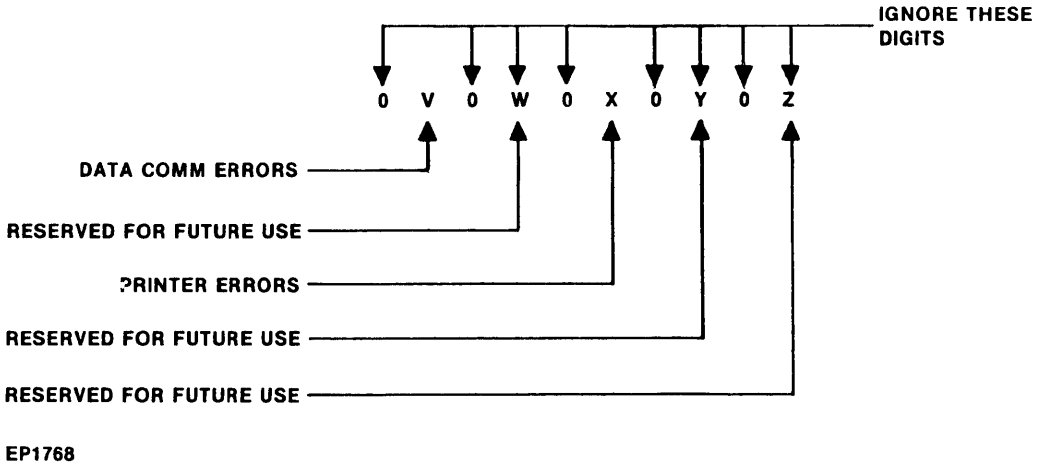


Figure 2-4. Error Log Format

SECTION 3
DATA COMMUNICATIONS INTERFACE

GENERAL

Data communications between the terminal and host system consist of control character sequences and data messages which are transferred between the host system and the terminal. These character sequences and messages are transferred over data communication interface circuits. This transfer of data can be carried out through the use of various communications procedures (line disciplines). This section provides an overview of data communications interface. Specific references are made to other documents for more detailed information.

CONTROL CHARACTER SEQUENCES

The data comm control characters which are used by the terminal are defined in Appendix C.

ILLEGAL CHARACTERS

An illegal character is defined as a character having incorrect parity, or a control character appearing incorrectly in a predefined sequence. The terminal tests each character received for correct parity and accepts control characters only in the sequence defined for the communications procedure being employed.

DATA ERROR CHECKING

Upon receiving a message, the terminal employs two types of error checking. The first is a character parity check utilizing the eighth bit of each received character as the parity bit.

The second error check is a longitudinal binary sum (without carry) of the seven data bits of the received characters following SOH or STX, up to and including the ETX. The longitudinal sum is contained in the block check character (BCC), which also contains the character parity bit. All received characters are included in the BCC check. If the tests for character parity within the text of the message and longitudinal redundance are correct, the terminal responds with an ACK character. If either error check fails, the terminal responds with a NAK character.

TERMINAL ADDRESS

Each terminal has a unique address through which the host system or another terminal can access it. The terminal address (AD1, AD2) is set through configuration change. The AD1 and AD2 address digits are set in scratchpad memory locations 0089 and 008A. (Refer to Appendix A.)

The terminal group poll and group select addresses are separate from the terminal address and are also set through configuration change. The group poll address (GPL1, GPL2) is set in scratchpad memory locations 008E and 008F. The group select address (GSL) is set in location 008B. (Refer to Appendix A.)

TRANSMISSION NUMBER

A transmission number feature is provided by the terminal to assign numbers to outgoing messages. The transmission number is used to identify send messages and to determine the loss or duplication of these messages.

The transmission number is configurable and can be set in scratchpad memory location 0088. (Refer to Appendix A.)

COMMUNICATION PROCEDURES

The terminal can utilize any of the following multipoint communications procedures for transmitting and receiving data:

Poll
Group Poll
Select
Fast Select
Broadcast Select
Group Select
Contention

The following subparagraphs provide a brief description of the communication procedures. The communications procedures (line disciplines) utilized in the terminal are described in greater detail in the Burroughs Basic Data Communications Line Control Procedures, form 1086956, and Burroughs Basic Data Communications Line Control Procedures for TD Series Terminals, form 1097805.

Poll (POL)

The POL procedure is used to transmit data and status information to the host system. In this procedure, the terminal is polled as an individual entity.

Group Poll (GPL)

The GPL procedure is an option of the standard poll procedure. In the GPL procedure, a group of terminals are polled as a group through their group address.

Select (SEL)

The SEL procedure is used for receiving data from the host system. A selection will be acknowledged by the selected terminal.

Fast Select (FSL)

The FSL procedure is used when it is desired to transmit a message to a terminal whose status is known to be 'receive ready'' or when the host system does not choose to test the receive status of the terminal.

Broadcast Select (BSL)

The BSL procedure is used when the host system desires to transmit a message to all terminals on a line. The BSL overrides the terminal's transmit and receive states causing the terminal to automatically switch to the receive state and sound it's alarm.

Contention (CON)

The CON procedure enables the host system to terminate polling of the multipoint network after placing the system in contention. Any terminal desiring to transmit a message to the host system may do so by initiating a host system polling action through the transmission of a special character sequence to the host system.

COMMUNICATIONS INTERFACE

The terminal is capable of operation in a two to four-wire circuit with half-duplex asynchronous data communications interface, (conforming to EIA Standard RS232C, CCITT Recommendation V24 for the international market) the two-wire direct interface, and the Burroughs direct asynchronous access (BDAA) interface to the extend described in this manual. Table 3-1 lists the characteristics of the various interfaces.

Table 3-1. Communications Interface Characteristics

Type of Interface	Characteristic
Asynchronous Data Set (EIA RS232C or CCITT)	150 to 1800 bps*
Synchronous Data Set (EIA RS232C or CCITT)	1200 to 9600 bps
Two-Wire Direct Interface (TDI) (Asynchronous)	150 to 9600 bps at 1000 feet
Burroughs Direct Asynchronous Access (BDAA)	150 to 38,400 bps and up to 15,000 feet (But not concurrently).
Concatenation from a Single Asynchronous Data Set	Maximum of 1000 feet of concatenated cable between terminals.
Concatenation from a Single Synchronous Data Set	The maximum total concatenation cable length from first to last terminal is based on data rate, as follows: 9600 bps - 400 feet, 4800 bps - 800 feet, 2400 bps - 1600 feet, 2000 bps - 2000 feet, 1200 bps - 3200 feet, 600 bps - 6400 feet.

* Bits per second.

Two-Wire Direct Interface (TDI) Communications

The terminal is capable of two-wire direct interface (TDI) with the conditions:

1. Character format is 10 bits (asynchronous).
2. Data transmission rates for asynchronous data may be selected from the following rates:

150 bps
1200 bps
1800 bps
2400 bps
4800 bps
9600 bps

The characters of a message sequence should be in accordance with the terminal multipoint communications procedures (listed under Communications Procedures) to the extend applicable to the terminal.

The cable used for the TDI connection should be twisted two-wire cable and have a maximum length of 1,000 feet. This cable is a single cable with multiple drops along its length. The TDI cable characteristics, including gauge and shielding, conform to Burroughs part number 1110 0062 The number of terminals in a TDI installation is limited to a maximum of nine on a 1,000-foot cable. Refer to Burroughs Terminal Systems Cabling Reference Manual, form 1105012.

Burroughs Direct Asynchronous Access (BDAA) Interface

The terminal is capable of meeting the requirements of the BDAA interface.

Data rates, up to a maximum of 64K bps, at a maximum cable distance of 15,000 feet are provided. The actual data is dependent on the type of transmission line cable used and the length of the cable separating the most distant locations. The combination of parameters of data rate, maximum installed cable length, and cable wire size provide the limits which govern each BDAA installation containing a single multipoint The number of terminals in a BDAA installation containing a single multipoint line is limited to a maximum of 20.

With BDAA, the connection from each customer-installed BDAA cable and junction box to each terminal in the multipoint network is made with the BDAA Device Connection Kit. Refer to Burroughs Terminal Systems Cabling Reference Manual, form 1105012.

Concatenation Cables

A means is provided for connecting multiple terminals to a single data set. For concatenating the terminal, two specific cable types are required for compliance with the various possible combinations:

1. Terminal to Data Set: A family of cable lengths (15, 25, 50 or 100 feet) which contain a plug on the data set end of connectors 1, 2, or 3 (table 3-2) depending on the domestic or international market being served, and a jack on the terminal end conforming to connector 1. For domestic applications this cable type (using connector 1 on both ends) is identical to the cable of (2).

2. Terminal to Terminals: A family of cable lengths (15, 25, 50, or 100 feet) which contain a plug and jack on the respective ends, conforming to the mating pair of connectors (table 3-2).

Asynchronous Data Communication

Asynchronous (RS232, TDI, or BDAA) data communication uses even parity. Each character is serially transmitted using 10 bits per character. The meaning of each bit of the character is, in order: a space bit, seven ASCII code bits with the least significant bit first, a parity bit, and a mark bit. When data is received or transmitted, the baud rate and baud timing sequence are produced by a baud rate counter in the terminal.

Synchronous Data Communication

Synchronous data communication uses odd parity. Each character is serially transmitted using eight bits per character. The meaning of each it of the character is, in order: seven ASCII code bits with the least significant bit first and a parity bit. When data is received or transmitted, the baud rate timing is received over separate timing lines from the communications interface. The SYN character is used to provide a signal on the line to establish and maintain synchronism between the terminal and the central processor. When a synchronous transmission is started, at least four SYN characters must be transmitted before any other character is transmitted in order to enable synchronization.

Table 3-2. Communications Interface Connector Assignments

Circuit	RS232C EIA	CCITT	Connector No. 1	Connector No. 2	Connector No. 3
Protective Ground	AA	101	1	1	1
Signal Ground	AB	102	7	7	7
Transmitted Data	BA	103	2	2	2
Received Data	BB	104	3	3	3
Request to Send	CA	105	4	4	4
Clear to Send	CB	106	5	5	5
Data Set Ready	CC	107	6	6	6
Data Terminal Ready	CD	108.2	20(4)	20(4)	20(4)
Connect Data Set to Line		108.1		20(4)	20(4)
Ring Indicator (9)	CE	125	22	22	22
RCV Line Signal Detector	CF	109	8	8	8
Data Signal Rate Selector	CH	111	23(5)	23(5)	11(5)
Select Transmit Frequency		126		11(6)	11(6)
Transmit Signal Timing Element	DB	114(7)	15	15	15
Receive Signal Timing Element	DD	115(7)	17	17	17
Select Standby		116	1	24	24

NOTES

1. Connector No. 1 consists of Burroughs parts 1694 7244, 1699 4345 (2), and 2471 2036, and shall be similar to the Bell connector or equivalent.
2. Connector No. 2 consists of Burroughs parts 1694 7244, 1900 2484, or 1900 2534, and shall be similar to the SEL connector or equivalent.
3. Connector No. 3 consists of Burroughs parts 1472 0635, 1473 9213, or 1257 0420 (2), and shall be similar to the BPO connector.
4. "Data Terminal Ready" and "Connect Data Set to Line" shall be used as follows:
   (a) Switched Lines - provide positive voltage to maintain connection for duration of call.
   (b) Leased Lines - provide permanent positive voltage for leased-line operation.
5. The data signal rate selector lead shall provide a positive or negative voltage for data rate selection. A positive voltage on this lead shall condition the data set for the higher data rate as required for leased line operation. A negative voltage on this lead shall condition the data set for the lower data rate as required for switched line operation. Positive or negative voltage selection shall be made through field engineering adjustment. Data signal rate selection shall be used with CCITT V23 and V26 data sets
6. The select transmit frequency lead shall provide a positive or negative voltage for frequency selection. A positive voltage on this lead shall condition the data set for the operating frequency. The select transmit frequency shall be used with the V21 data sets.
7. Circuits DB and DD are used only with synchronous communications systems and are not applicable to the terminal.
8. Circuit CE (Ring Indicator) is not used by the terminal.

SECTION 4
SERIAL I/O INTERFACE

GENERAL

Communication with peripheral (channels) is accomplished via a serial I/O (SIO) interface which consists of a two-signal synchronous serial bus. A device number, which is easily modified, is used to identify the peripheral in the serial bus interface.

INTERFACE CONTROLS

Interface communication is controlled by a three-bit instruction code. The I-code is sent by the terminal to the peripheral (the peripheral is always a slave station to the terminal) over the three least-significant data lines (DB0-DB2), immediately followed by data bits.

The instructions signified by the I-code are:

Interface Data Bits	2	1	0	Instruction
I-Code	0	0	0	INVITATION TO INTERRUPT
	0	0	1	SELECT DEVICE
	0	1	0	GET DATA
	0	1	1	SEND DATA
	1	0	0	GET DEVICE STATUS (DSTATUS)
	1	0	1	SEND DEVICE COMMAND
	1	1	0	GET INTERFACE STATUS (ISTATUS)
	1	1	1	SEND INTERFACE COMMAND

Invitation to Interrupt

The Invitation to Interrupt instruction is a request by the terminal that a peripheral device with a pending interrupt send its device number. A device which needs servicing responds to the Invitation to Interrupt I-code by transmitting its device number. The device monitors the data line as it transmits each bit in order to detect a conflict with a higher priority unit. If a 1 is detected on the serial interface line when the device attempting to transmit a 0, the device does not transmit the rest of its device number. If all eight bits of the device number are successfully transmitted, the device is considered to be selected.

The terminal may immediately deselect the device by sending another Invitation to Interrupt or Device Select I-code. If the terminal deselects the device prior to first performing a Get IStatus, then the device responds to subsequent Invitation to Interrupt I-codes.

The device continues to attempt to interrupt the terminal until it is successful or until it is selected by a Device Select I-code.

Device Select

During this interface control sequence, the terminal transmits both the I-code and a data character. If the data character matches the peripheral device number, the printer is selected. The device remains selected until the next Device Select or Invitation to Interrupt I-code. Only when the device is selected will it respond to a Get or Send I-code.

GET Instructions

The GET instructions cause a selected peripheral device to transmit data to the terminal. The peripheral transmits one byte o data (most significant bit first) to the terminal. Note that only one eight-bit byte of information

is transferred with each command. There are three Get instructions which are recognized when the device is selected: Get Interface Status (ISTATUS), Get Device STatus (DSTATUS), and Get Data.

Get IStatus

The device transmits an eight-bit word indicating the state of the device serial interface.

The device interrupts the terminal whenever the device is in a Receive-Ready state or when its device status changes significantly. A significant device status change may be the device entering the Idle state, or operator attention being required or a device failure.

Get DStatus (Device Status)

This instruction is used to access the device status bytes. Following a Get IStatus instruction which indicated that device status had changed, the terminal is expected to issue a Get DStatus command. (Bits 3 and 2 of the interface status word are equal to 01).

Get Data

The Get Data instruction causes a selected peripheral to transmit data to the host terminal. When this instruction is decoded by the device, it puts the data into the data field, high-order bit first.

Send Instructions

The Send instructions cause a selected peripheral to receive data from the terminal. The peripheral takes the input data from the data field, the most significant bit first. There are three Send Instructions which are recognized by the terminal: Send Data, Send Device Command, and Send Interface Command.

Send Data

The Send Data I-code is only recognized when the device is selected. This I-code will be followed by a byte of data from the terminal. Prior to each Send Data I-code, the terminal must ensure that the device is Receive Ready by checking its interface status. Following each Send Data I-code, the printer interrupts the terminal when it is again Receive Ready. In the interim, the device interface status is invalid.

The device interrupts the terminal only once should the device go Receive Ready while it is trying to interrupt the terminal due to a change in its device status, or should the device status change while it is attempting to interrupt the terminal because of having gone Receive Ready. The interface status indicates a change in device status. After the terminal has read the device status, it should check the interface status to determine if the device is Receive Ready.

Send Device Command

This I-code is sent to the terminal by the device as a request for a device command. The terminal responds with a device command, if applicable.

SECTION 5
KEYBOARD

GENERAL DESCRIPTION

The keyboards presently used with the MT 983/MT 993 terminal systems are the Burroughs model TP 110 alphanumeric keyboard and the TP 119 data preparation keyboard.

FUNCTIONAL CHARACTERISTICS

Keyboard Code Output

Each keyboard is capable of operating in two modes: an unshifted mode and a shifted mode. Up to three keys on each keyboard are used to select the mode of operation. When a keyswitch is pressed while in the unshifted mode, the keyboard generates and stores in the keyboard buffer a unique eight-bit code for subsequent transfer to the terminal. Each keyswitch pressed while in the shifted mode causes the keyboard to generate another code for transfer to the terminal. This second code may be identical to the code generated in the unshifted mode.

Code Buffer

Each keyboard is capable of buffering a minimum of eight sequentially-entered eight-bit codes for subsequent transfer to the terminal. Overflow of the code buffer causes the last eight-bit code entered to be overwritten with the following error code: MSB 10110100 LSB. This error code indicates to the terminal that data was lost.

N-Key Rollover

Each keyboard provides the capability of N-key rollover. N-key rollover is the ability to sense keyswitch input in the order the keys are pressed, independent of the order of key release.

Security Keylock

Each keyboard provides a keylock switch. When activated, this keylock prevents the keyboard from generating eight-bit codes. As a result, the keyboard appears to have no data to transfer when interrogated by the terminal. The keylock switch causes a single eight-bit code to be placed into the keyboard buffer upon completion of the keyboard power-up sequence. This eight-bit code indicates to the terminal the on (locked) or off (unlocked) position of the keylock switch. Each change in the on/off position of the keyboard switch during keyboard operation also places an eight-bit code in the buffer indicating to the terminal the new position of the keylock switch.

The code for the keylock switch when locked is: MSB 10110101 LSB. The code for the keylock when unlocked (not used) is: MSB 11010110 LSB.

In the event that a change in keylock switch position causes a code buffer overflow condition or a change in keylock switch position occurs when the code buffer is already in an overflow condition, the next to last byte in the code buffer is overwritten with the appropriate keylock switch code and the last byte in the code buffer is overwritten with an error code.

The LED indicators are accessible to the terminal regardless of the keylock position.

Automatic Key Repeat Function

Each key, when pressed, causes the keyboard to output the assigned code for that key. For most of the keys, if the key remains pressed for a period exceeding one second, the keyboard initiates an automatic 12-character per second repeat action. This repeat function is operable only for the last key pressed (excluding shift keys).

TP 110 KEYBOARD

The Burroughs TP 110 alphanumeric keyboard is a general-purpose typewriter-style keyboard to be used with the MT 983/MT 993. The keyboard consists of a 65-key typewriter keyboard, five function keys, and six indicator lights with a security keylock (see figure 5-1).

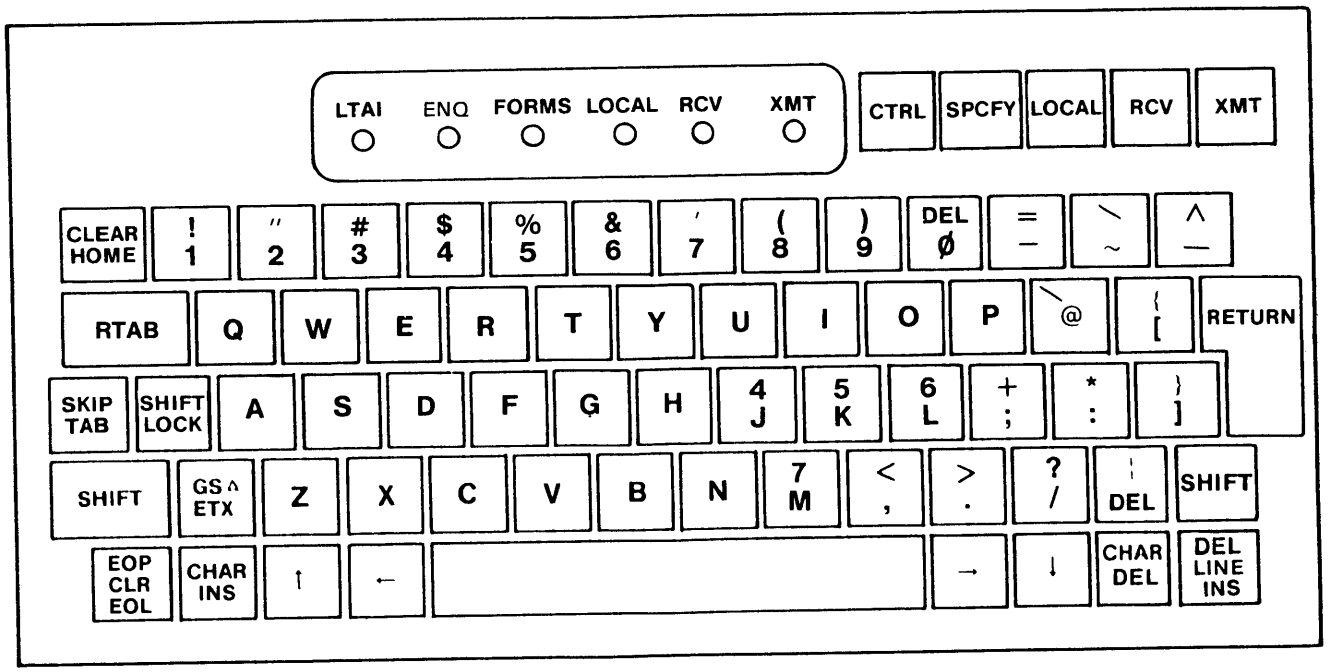


Figure 5-1. TP 110 Alphanumeric Keyboard

The keyboard is buffered for rapid manual input of alphanumeric data. An N-key rollover capability allows entry of data in the order keys are pressed, independent of the order of key release. The automatic repeat-key function repeats the action of the pressed key until it is released.

The typewriter keyboard is standard U.S. layout with shifted and unshifted modes. The keyboard consists of the following:

26-character alpha keyboard (upper and lower case)
22 numeric and special character keys
16 editing keys (refer to table 5-1)
5 control keys (refer to table 5-1)
1 space bar

Table 5-1. Summary of TP 110 and TP 119 Keyboard Edit and Function Keys and Indicators

Keys	Functions
CTRL	Control key; activates control function of terminal and displays CTRL indicator; a valid CTRL sequence removes it. (Refer to Appendix B.)
SHIFT-CTRL	Same as CTRL except control function is locked in (displays CTRL indicator). A valid CTRL sequence leaves it on.
SPCFY	Aligns data comm pointer to cursor, and transmits message indicating cursor position.
LOCAL	Terminates transmission or reception; clears status line, CTRL indicator; sets terminal state to local.
RCV	If terminal state is local, changes it to receive-ready, and aligns data comm pointer to cursor.
XMT	Aligns data comm pointer to cursor and transmits a message derived from display store.
CLEAR	Clear Page: Non-forms page: fills page with blanks; leaves cursor at screen home. Forms page: If bit 3 of 0096 = 1, it fills page with blanks; leaves cursor at screen home and page in non-forms mode. If bit 3 is 0096 = 0, it fills unprotected fields with blanks; leaves cursor in first such field.
HOME	Home functions: Non-forms page: moves cursor to screen home. Forms page: moves cursor to first unprotected field.
RTAB	Reverse Tab: Non-forms page: moves cursor to preceding tab stop (if none, to screen home). Forms page: moves cursor to preceding field.
RETURN	Carriage Return: Non-forms page: if bit 0 of 00A0 = 1, stores and displays symbol, moves cursor to column 1; if bit 5 of 00A0 = 0, moves cursor down. Forms Page: if bit 6 of 00A0 = 1 and cursor location is unprotected, stores ▽ ; moves cursor to column 1. If bit 5 of 00A0 = 1, moves cursor down and right to next unprotected field.
SKIP	Search on: Non-forms page: moves cursor right to next instance of search character (if none, leaves cursor at screen home). Forms page: moves cursor right to next instance of search character or next field. Search off: Same as TAB, except that → is suppressed.
TAB	Tab function: Non-forms page: if bit 6 of 0096 = 1, stores → (HT); moves cursor right to next tab stop (if none, leaves cursor at screen home). Forms page: if bit 6 of 0096 = 1 and cursor location is unprotected, stores → (HT); moves cursor right to next unprotected field.
SHIFT LOCK	SHIFT key with mechanical latch.
SHIFT	Modifies keystroke codes: letter keys yield uppercase codes; other keys are modified as indicated on keytops.
ETX	End-of-Text: if cursor is in protected location of forms page no effect, otherwise, stores ?? (ETX) and moves cursor as follows: If bit 7 of 00A0 = 1, moves cursor to column 1 (same line). If bit 7 of 00A7 = 0, moves cursor to mobile home position.
CLR EOP	Clear to end-of-page (if forms page, protected locations are not cleared).
CLR EOL	Clear to end-of-line (in forms page, clears to end-of-field).
CHAR INS	Character insertion.
↑	Moves cursor up one line.
←	Moves cursor left one column.
→	Moves cursor right one column.
↓	Moves cursor down one line.
CHR DEL	Character deletion.
LINE DEL	Deletes cursor line, shifting succeeding line up (no effect in forms pages).
LINE INS	Inserts blank line at cursor position, shifting the former cursor line and succeeding lines down and discarding bottom line of page (no effect in forms pages).
All other keys	Text entry.

(continued)

Table 5-1. Summary of TP 110 and TP 119 Keyboard Edit and Function Keys and Indicators

Indicator	Function
LTAI	Line Terminal Activity Indicator is lit whenever data is transmitted from the host system to any terminal on the line. Whenever the addressed terminal responds to the host system, that terminal extinguishes its LTAI indicator. In normal operation, the LTAI indicator blinks due to the data line activity. An LTAI indicator which remains lit indicates that the terminal is not responding. The LTAI indicator may be extinguished by pressing the LOCAL key.
ENQ	The ENQ indicator is lit when a message from the host system is detected by the terminal and the terminal is not in receive state. The ENQ indicator goes out when the terminal is placed in the receive (RCV) state or when the operator presses the LOCAL key.
FORMS	The FORMS indicator is lit when the unshifted FORMS key is pressed or when the terminal enters forms mode from data comm. FORMS indicator is extinguished upon pressing of the shifted FORMS key or whenever the terminal leaves forms mode.
LOCAL	The LOCAL indicator is lit by the activation of the LOCAL key or by use of the keyboard when the terminal is in the receive state with no data being transmitted to the terminal. It is also lit following the successful completion of data transmission to the terminal unless the programmatic mode control character (DC1) was present in the received text. The indicator is extinguished when the terminal is switched to the receive or transmit states.
RCV	The RCV (receive) indicator is lit by the activation of the RCV key or by the successful completion of data transmission from the terminal. The indicator signifies that the terminal is prepared to receive data. The indicator is extinguished when the terminal is switched to the local or transmit states.
XMT	The XMT (transmit) indicator is lit by the activation of the XMT key and indicates that the terminal is transmit-ready. The indicator is extinguished when a transmission from the terminal has been positively acknowledged by the receiving station or when the terminal is switched to local state.

For the effect of keystrokes when CTRL indicator is on, refer to Appendix B.

TP 119 KEYBOARD

The data preparation keyboard resembles a keypunch keyboard in the placement of numerals. Figure 5-2 shows the layout. It is designed for ease in entering both alphanumeric and numeric data. Numeric data may be entered in both shifted and unshifted condition. The edit keys, function keys, and indicators contained on this keyboard are described in table 5-1. The data preparation keyboard is recommended for a data entry installation.

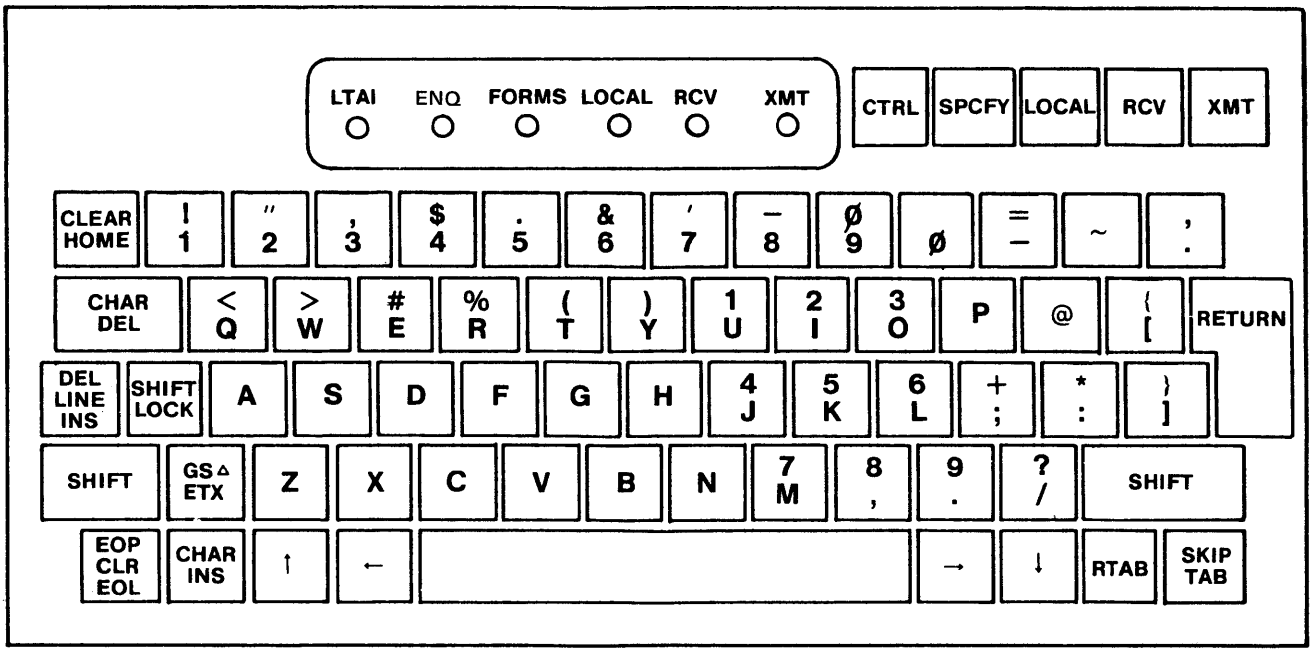
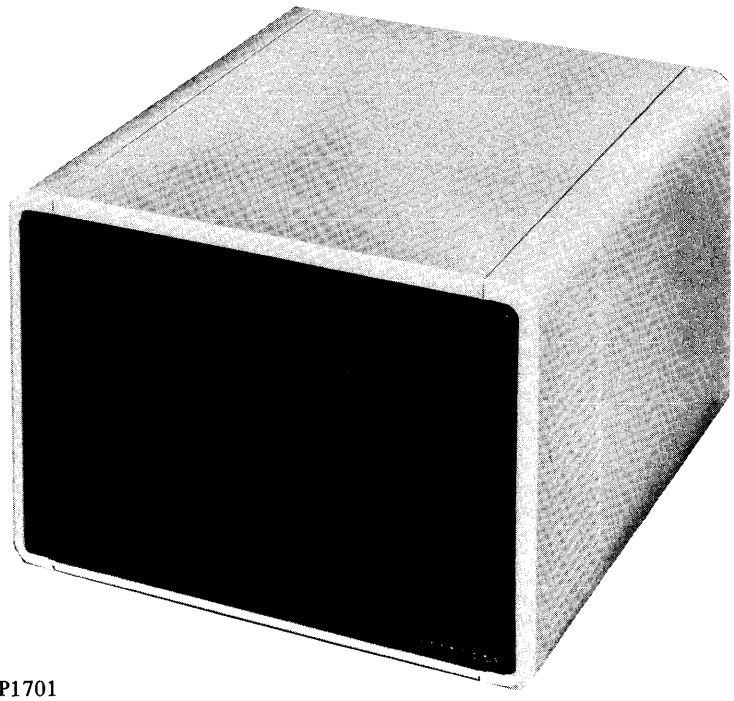


Figure 5-2. TP 119 Data Preparation Keyboard

SECTION 6
MICRO-DISK FILE STORAGE DEVICES

GENERAL DESCRIPTION

The micro-disk storage devices which may be used with the TP 983/TP 993 terminal system are the Burroughs model TP 410 and TP 420 file storage modules (FSM). (See figure 6-1.) The storage media is a 5 1/4 inch single-sided, soft-sectored, flexible (floppy) diskette (see figure 6-2).



EP1701

Figure 6-1. TP 420 File Storage Module

The FSM includes one (TP 410) or two (TP 420) micro-disk drive units. Each disk drive unit accommodates one diskette. The data storage capacity of a diskette is 80 thousand bytes; therefore, the model TP 410 provides a storage capacity of 80 thousand bytes and the TP 420 160 thousand bytes.

DISKETTE ORGANIZATION

The diskette is divided into 35 concentric tracks. The FSM uses soft-sector formatting in which each track is divided into five equal segments (sectors) of 512 bytes each.

DATA FORMATTING

Groups of related data segments are organized into data blocks (catalogs and files). These files and catalogs can vary in length and are symbolically named. All storage and space management functions (including the physical location of files) are handled by the FSM.

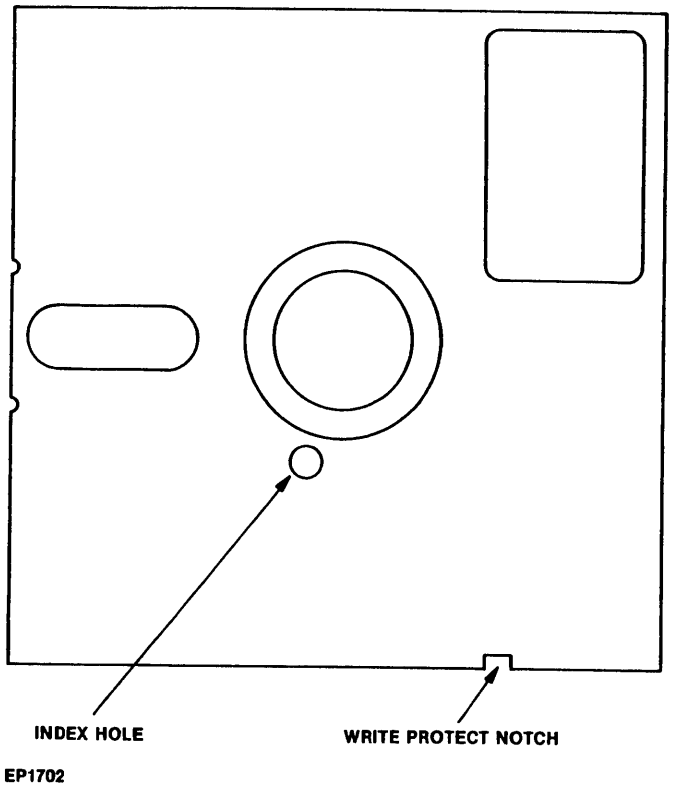


Figure 6-2. Diskette Storage Medium

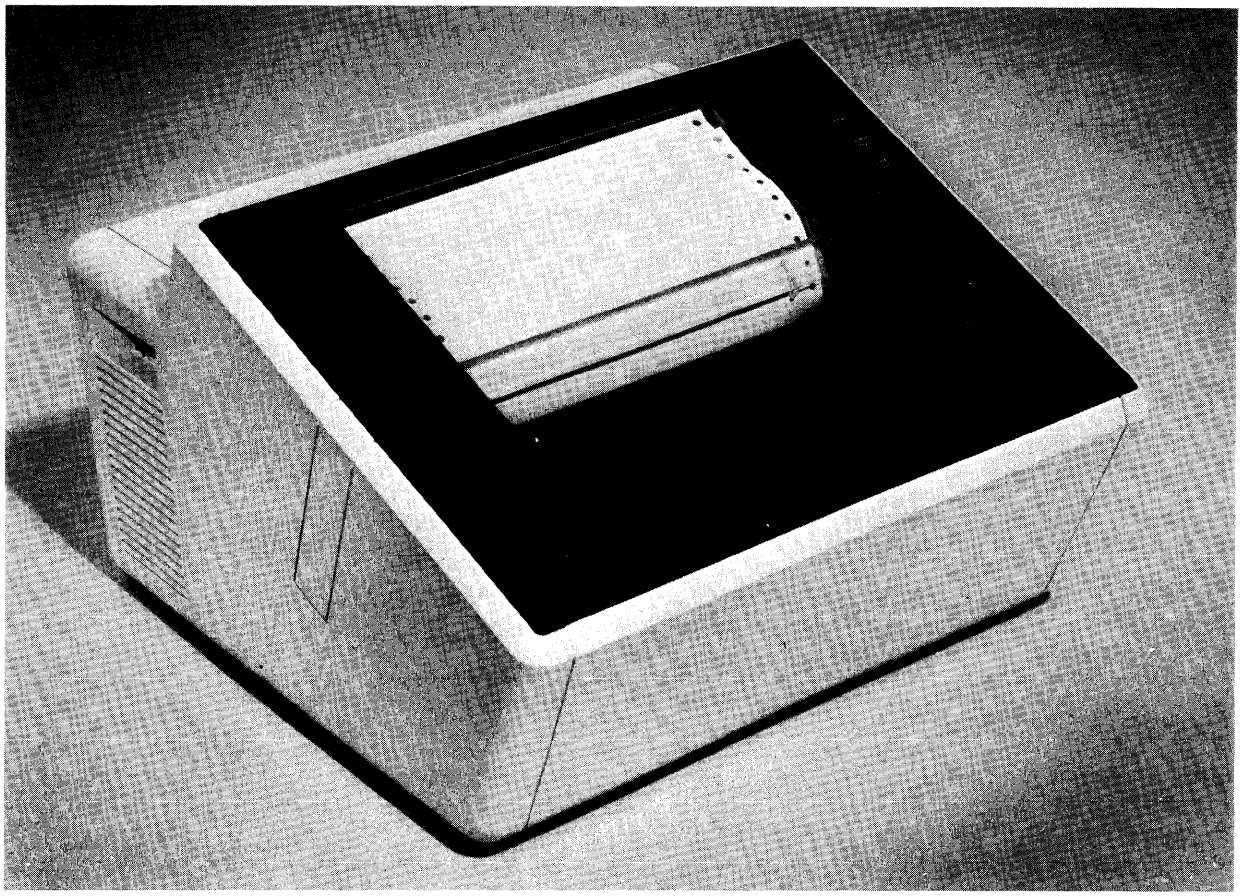
APPLICABLE DOCUMENTATION

For more detailed information concerning the features and capabilities of the FSM (as well as operating instructions), refer to the TP 410/TP 420 Reference Manual, form 1118387.

SECTION 7
PRINTERS

GENERAL DESCRIPTION

The printer device which may be used with the MT 983/MT 993 terminal systems is the Burroughs Model TP 313 journal printer. (See figure 7-1.) This section provides a brief general description of the TP 313 printer. For more detailed information refer to the TP 300 Reference Manual, form 1121936.



EP1778

Figure 7-1. TP 313 Journal Printer

The printer is a free-standing matrix printer capable of operating with host terminals. The printer simulates the operation of a line printer. Printing begins when a full line of print has been received. If the message buffer is not full, further print data may be received during printing.

A nine-pin print head is used to print on journal paper. Each line of print has a maximum length of 8.25 inches (209.6 mm.) and a nominal print speed of 90 characters per second. Head motion begins at the left margin, printing occurs on both the forward and reverse strokes of the carrier.

The TP 313 models provide for printing on a two-ply journal only.

PRINTER FEATURES

The major features of the TP 313 printer are identified in the following subparagraphs.

Print Field Density

The standard print density is 12 characters per inch (4.72 characters per cm.). The print density may be programmatically changed to 16 characters per inch (6.3 characters per cm.), 8 characters per inch (3.15 characters per cm.), and 6 characters per inch (2.36 characters per cm.). The print density may be changed between two adjacent print characters within a line.

The maximum number of characters which may be printed on a line at each print density is:

Print Density	Characters Per Line
16 CPI	132
12 CPI	99
8 CPI	66
6 CPI	49

Print Speed

The nominal print speed is 90 characters per second, bidirectionally. The line speed depends on the length of the line printed and the efficiency of turn-around allowed by the print format.

Bidirectional Printing

The print head traverses the paper until all characters on that line are printed. At that point, the printer determines the most efficient route of travel to begin the next line of print. When printing is completed, the print head moves to the home position (left margin).

Forms Handler

The forms handler mechanism requires pin feed, fan fold, and continuous paper. Single and double ply carbon or carbonless papers may be used.

Maximum paper width is 9.5 inches (241.3 mm.). Width between the detachable edges is 8.5 inches (215.9 mm.). Maximum usable print width is 8.25 inches (209.6 mm.).

Vertical Line Spacing

The default condition for vertical line spacing advances the paper in 1/6 inch steps (4.24 mm.). Control codes exist which change the pitch of the vertical spacing to multiples of 1/24 inch (1.06 mm.) steps (maximum line advance is 19/24 inch). When vertical line spacing is 1/8 inch or less, overlapping between lines may occur. The time to advance one line at the standard 1/6 inch vertical spacing is typically 80 msec. The optional 1/8 inch spacing typically requires 70 msec., 1/4 inch spacing typically requires 90 msec.

Variable Page Length

The length of page used by top-of-page control is selectable via control codes. A host may select the page length by specifying the number of lines on a document. The default condition is selectable by a field engineer-settable switch between 5.5 inches (139.7 mm.) and 11 inches (279.4 mm.).

Out-of-Paper Detection

When printing is approximately 1 inch (25.4 mm.) from the bottom of the last sheet of paper, the Out-of-Paper signal halts printing on a line boundary. The alert indicator (the audible indicator sounds, if present) is blinking and the validation chute (if implemented) is closed. Opening the door turns off the indicators.

Printing automatically continues when paper has been properly loaded.

PRINT CHARACTERS

Character fonts are generated by the combination of a basic ROM pattern and print control algorithms. The algorithms are initiated by control characters.

All fonts are selected by a two-character control string. Once selected, these fonts are always used until a new selection is made.

The basic matrix pattern is stored in a 2K x 8 ROM located in main memory. A pin-compatible PROM is available which allows any character font to be specified for specialized markets. Nationalistic character sets are selected by a specific ROM and a switch configuration which may be modified by a field engineer.

PRINTER STATUS

An eight-bit status word indicates the status of the printer. The lower digit identifies the state of the message and buffer; the upper digit contains flags that continuously monitor various printer conditions.

PRINTER CONTROLS

Printer operations can be controlled by the operator through the keyboard or by the host system through data comm controls.

Keyboard Printer Controls

The keyboard entered printer controls are:

Desired Action	Keyboard Control Sequence
Print screen data from home to cursor with form feed enabled	(CTRL) ;
Print screen data from home to cursor with form feed disabled	(CTRL)]
Print unprotected data from home to cursor	(CTRL) :

Note: (CTRL) designates control function key on keyboard

Data Comm Printer Controls

Printer controls which can be initiated by the host system through data comm are of two types:

1. Printer controls for the terminal to print screen data.
2. Printer controls to print data sent by the host system to control the operation of the printer.

Printing Screen Data

The data comm controls to print screen data are acted upon by the terminal firmware and are the following:

Desired Action	Data Comm Control Sequence
Print screen data from home to cursor with form feed enabled	ESC ;
Print screen data from home to cursor with form feed disabled	ESC]
Print unprotected data from home to cursor	ESC :

Note: ESC designates data comm "escape" character (refer to Appendix C)

Controlling Print Operation from the Host System

In the process of printing terminal screen data from the host system as described in the previous paragraph, it is sometimes necessary to control the operation of the printer. This is done by sending the applicable printer control characters (described in the TP 313 Reference Manual, form 1121936) to the printer by way of the terminal. In order to make these control characters transparent to the terminal, it is necessary to precede each sequence of control characters with the following control sequence:

ESC nnn ETX;

Where n can be any number from 0 to 9

The printer control characters which follow this control sequence are displayed on the terminal screen as special symbols (refer to Appendix D) and are sent to the printer as part of the screen data when a print operation is invoked by the host system.

APPENDIX A
TERMINAL CONFIGURATION

GENERAL

This appendix provides the information required to enter terminal configuration data into the scratchpad memory of the terminal. (For information concerning the configuration function of the terminal, refer to Section 2 under the heading Configuration Mode.)

SCRATCHPAD MEMORY DISPLAY

Scratchpad memory contents are displayed as 16 pairs of Hex digits. Each pair represents the contents of one address location in the scratchpad memory. (See figure A-1.) As shown, the entered scratchpad address is displayed, followed by the Hex digits representing that address and the next 15 consecutive scratchpad address locations.

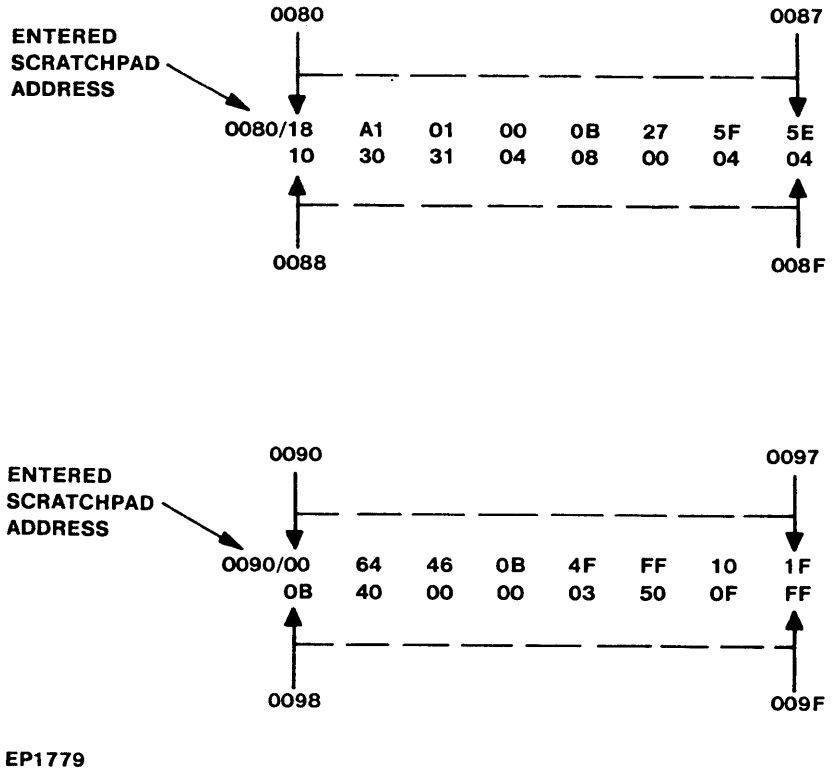


Figure A-1. Display Format of Configuration Area of Scratchpad Memory

To avoid the possibility of entering data in an area of scratchpad memory beyond the boundaries reserved for configuration data, always enter address 0080 for changes to the first 16 scratchpad addresses (0080-008F)

and 0090 for changes to the next 16 scratchpad addresses (0090-009F). To change scratchpad address 00A0, enter that address and confine changes to the first pair of Hex digits displayed.

Figure A-2 shows the contents of a typical single address location in scratchpad memory and identifies the most significant and least significant Hex digits as displayed on the screen.

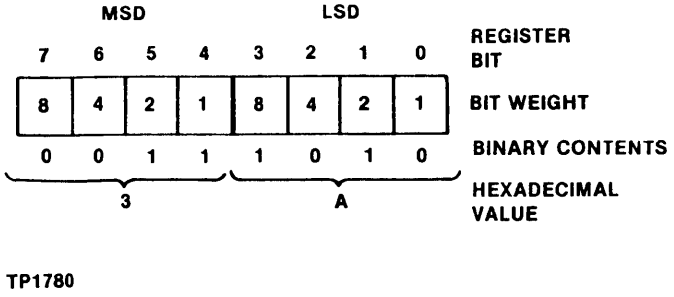


Figure A-2. Interpretation of a Typical Scratchpad Memory Byte

ENTERING CONFIGURATION DATA FROM KEYBOARD

The procedure to enter configuration data from the keyboard is given in table A-1.

Table A-1. Terminal Configuration From Keyboard

Step	Action	Indication
1. Put terminal in configuration mode.	a. Press CTRL key	CTRL is displayed on status line.
	b. Enter shifted RWxxxx (where xxxx represents four-character password required to enter configuration mode).	Symbol > is displayed in upper left corner of display.
2. Display contents of any 16 consecutive scratchpad memory locations starting at the entered scratchpad address.	a. Press CTRL key.	CTRL is displayed on status line.
	b. Enter shifted RH followed by unshifted hhhh (where hhhh is the four-digit Hex address of starting scratchpad location).	Contents of selected 16 scratchpad locations is displayed along with the starting scratchpad address. (See figure A-1).
3. Enter desired configuration data into applicable scratchpad address location as displayed on screen.	a. Position cursor over applicable Hex digit (most significant four bits or least significant four bits) of location to be altered. b. Enter Hex digit reflecting desired configuration (Refer to table A-2). c. Repeat steps 2 and 3 until all desired configuration entries have been made.	Entered Hex digit appears at the cursor location.
4. Write screen data back into scratchpad memory. (This enables entered configuration data to be in effect until terminal is turned off.)	a. Press CTRL key.	CTRL is displayed on status line.
	b. Entered shifted RCxxxx, where xxxx represents four-character password.	Symbol √ appears in first column of status line.

(continued)

Table A-1. Terminal Configuration From Keyboard

Step	Action	Indication
	c. Press LOCAL key.	Screen is momentarily cleared while a reconfiguration operation takes place. If reconfiguration is successful, six asterisks are displayed in upper left corner of screen. If reconfiguration is not successful, an error message is displayed on the screen.
5. Make configuration changes fixed through power-off periods.	a. Press CTRL.	CTRL is displayed on status line.
	b. Enter shifted RPxxxx (where xxxx represents four-digit password).	The character P is displayed in first column of status line. If operation is successful, terminal performs a start-up routine (confidence test) and six asterisks are displayed in upper left corner of screen. If operation is not successful, error message is displayed on the screen.

Table A-2. Terminal Configuration Parameters

Scratchpad Memory Address	Bits	Value	Function	Remarks
0080	0	1	Inhibit parity check	Maintenance aid
		0	Check parity	Standard operation
	1	1	Spare	
		0	Spare	
	2	1	ODT flag: On	Terminal is an operator display terminal
		0	ODT flag: Off	Terminal is not an operator display terminal
	3	1	DC1=Programmatic mode control	
		0	DC1=line erase	
	4	1	Transmit page in forms	Home to ETX/home to end-of-page
		0	Standard forms transmit	Cursor to ETX/home to cursor
	5	1	SOH=clear page	
		0	SOH=NOP	
	6	1	Point-to-point network	
		0	Multipoint network	
	7	1	Synchronous data comm	
		0	Asynchronous data comm	
0081			Baud rate	(Refer to table A-3)
0082			Clear-to-send delay	(Refer to table A-4)
0083	0-7	03 (Hex)	3 msec	Transmit-to-receive delay value
	0-7	16	22 msec	
	0-7	FF	255 msec	
0084	0-7	03 (Hex)	4	Lines per page select
	0-7	07	8	
	0-7	08	12	
	0-7	0F	16	
	0-7	13	20	
	0-7	17	24	
	0-7	1F	32	
	0-7	2F	48	

(continued)

Table A-2. Terminal Configuration Parameters

Scratchpad Memory Address	Bits	Value	Function	Remarks
0085	0-7	27 (Hex)	40	Characters per line select value; no other values allowed (must agree with bit 2 of address 0092)
	0-7	4F	80	
0086	0-7	7B (Hex)	{	Left delimiter select (other symbols acceptable; see figure D-4 in Appendix D for Hex codes of other symbols)
	0-7	5B	[	
0087	0-7	7D (Hex)	}	Right delimiter select (other symbols acceptable; see figure D-4 for Hex codes of other symbols)
	0-7	5D	]	
0088	0	1	Optional poll/select character	7B/7C
		0	Standard poll/select character	70/71
	1	1	@ and A data transmission numbers	40/41
		0	1 and 0 data transmission numbers	30/31
	2	1	Circuit 111/126 enabled	Required for certain CCITT data sets
		0	Circuit 111/126 disabled	
	3	1	Circuit 116 enabled	
		0	Circuit 116 disabled	
	4	1	Internal clear-to-send enabled	Refer to address 0082 for delay value
		0	Internal clear-to-send disabled	
	5	1	Transmit-to-receive delay enabled	Refer to address 0083 for delay value
		0	Transmit-to-receive delay disabled	
	6	1	Enable transmit number	Option in point-to-point and multipoint data comm procedures
		0	Disable transmit number	
	7	1	Point-to-point switched	For terminals with point-to-point data comm capability
		0	Point-to-point non-switched	
0089	0-7	*	AD1 (Burroughs)/Poll and Select address	* Use any address between ASCII 2,0 and 7,E; used with AD2 as one address
008A	0-7	*	AD2 (Burroughs)/Poll and Select address	* Use any address between ASCII 2,0 and 7,E; used with AD1 as one address
008B	0-7	*	Group Select (GSL) address (Burroughs)/Device address	* Use any address between ASCII 2,0 and 7,E
008C	0-7	OA	75-300 baud	Data comm baud value
		09	600-4800 baud	
		08	9600-38.4K baud	
008D			Spare	
008E	0-7	*	Group Poll GPL1 address	* Use any address between ASCII 2,0 and 7,E
008F	0-7	*	Group Poll GPL2 address	* Use any address between ASCII 2,0 and 7,E
0090			Spare	
0091	0-7	CB (Hex)	12 lines	Total lines per system select
		17	24 lines	
		1F	32 lines	
		2F	48 lines	
		5F	96 lines	

(continued)

Table A-2. Terminal Configuration Parameters

Scratchpad Memory Address	Bits	Value	Function	Remarks
0092	0	1	Interpret LF as line feed with automatic carriage return	
		0	Interpret LF as line feed without carriage return	
	1	1	Blink cursor	Address 0092 bit 5 must be enabled for cursor display
		0	Solid cursor	
	2	1	80 character/line display	
		0	40 character/line display	Characters per line select (must agree with parameters in address 0085
	3	1	24 line display	
		0	12 line display	lines displayed select (must agree with parameters in address 0093)
	4	1	Field overflow inhibit	No skip at end-of-field
		0	Field overflow allow	Skip at end-of-field
	5	1	Cursor display inhibited	
		0	Cursor display enabled	
	6	1	Keyboard upper case only	Prevents keyboard entry of characters from ASCII columns 6 and 7
		0	Lower case enabled	For keyboards with lower case
	7	1	Spare	
		0	No RTS hold	No delay
0093	0-7	0G (Hex)	12 lines	Lines displayed on screen (must
		17	24 lines	agree with bit 3 of address 0092)
0094	0-7		End address of display memory 07 (Hex) - 1920 character memory 0F (Hex) - 3840 character memory 16 (Hex) - 5760 character memory	Enter most significant byte
0095	0-7		End address of display memory 80 (Hex) - 1920 character memory 00 (Hex) - 3840 character memory 80 (Hex) - 5760 character memory	Enter least significant byte
0096	0	1	Interpret DC2 as data comm pointer advance	
		0	Interpret DC2 as forms enable/disable	
	1	1	Interpret FF as clear page and variable tab stops	Cleared page is data comm printer page
		0	Interpret FF as clear page only	
	2	1	Invoke vertical tab stops from data comm (VT) or keyboard	TD 700 emulation
	2	0	Interpret data comm VT as set horizontal variable tab stops; keyboard vertical tab controls as advance page	Horizontal tab stops are set for entire display memory
	3	1	Interpret CLEAR key to erase entire page	
		0	Interpret CLEAR key to erase only unprotected data	Forms mode
	4	1	Write ETX into memory at location of data comm pointer	
		0	Do not write ETX into memory	
	5	1	Variable tab stops feature enabled	
		0	Fixed tab stops feature enabled	
	6	1	Tab-field-identifier option enabled	HT (→) character is written into memory from keyboard
		0	Tab-field-identifier option disabled	
	7	1	Cursor wrap-around inhibit (forms and non-forms keyboard only)	Inhibits keyboard data entry beyond last position on page
		0	Cursor wrap-around enabled	
0097	0-7	48 (Hex)	End-of-page alarm column detector = column 72	
		4F	End of page alarm column detector = column 80	
0098	0-7	0B (Hex)	Set end-of-page alarm row detector = row 12	
		17	Set end-of-page alarm row detectors = row 24	

(continued)

Table A-2. Terminal Configuration Parameters

Scratchpad Memory Address	Bits	Value	Function	Remarks
0099	0-7		Starting address of display memory C0 (Hex) recommended value; other values allowed	Enter most significant byte
009A	0-7		Starting address of display memory 00 (Hex) recommended value; other values allowed	Enter least significant byte
009B	0		Spare	
	1		Spare	
	2		Spare	
	3	1	Hold in receive mode after data comm message	
		0	Enter local mode after data comm message	
	4		Spare	
	5		Spare	
	6		Spare	
	7		Spare	
009C			Starting address of data comm buffer: 00 (Hex) recommended value; other values allowed	Enter most significant byte
009D			Starting address of data comm buffer 00 (Hex) recommended value; other values allowed	Enter least significant byte
009E			End address of data comm buffer (07 (Hex) - 1920 character memory; 0F (Hex) - 3840 character memory)	Enter most significant byte
009F			End address of data comm buffer (80 (Hex) - 1920 character memory; D0 (Hex) - 3840 character memory)	Enter least significant byte
00A0	0	1	Write data comm HT into memory during tab operations	
		0	Do not write data comm HT into memory	
	1		Unused	
	2	1	Automatic cursor advance after data comm ETX	Ignored if ETX not stored (refer to scratchpad address 0096, bit 4)
		0	No cursor advance after data comm ETX	Ignored if ETX not stored (refer to scratchpad address 0096, bit 4)
	3	1	Interpret data comm CR as carriage return without line feed	
		0	Interpret data comm CR as carriage return with line feed	
	4	1	Write data comm CR into memory	
		0	Do not write data comm CR into memory	
	5	1	Interpret keyboard CR (return key) as a carriage return without line feed	
		0	Interpret keyboard CR as carriage return with line feed	
	6	1	Write keyboard CR into memory	
		0	Do not write keyboard CR into memory	
	7	1	Line-at-a-time transmission	Line home to cursor
		0	Standard transmission	Transmission point (mobile home)

NOTE:
The RTS hold delay is used with older style data sets (including Bell 202 C and D). If set, the terminal holds RTS (request-to-send) high for an additional three bit times to assure that the data from the terminal is passed through the data set. Newer style data sets (Bell 202 S and T, Bell 209) and direct-connect networks do not require any RTS hold delay.

ENTERING CONFIGURATION DATA FROM HOST SYSTEM (DATA COMM)

The terminal may be reconfigured from the host system provided that the terminal is configured so that communication through data comm is possible. The data comm controls used for terminal configuration are described in the following subparagraphs.

Table A-3. Baud Rate Conversion

Baud Rate	Hex Code for Address 0081
75	41
110	7E
150	A1
300	D1
600	A1
1200	D1
1800	E1
2400	E9
4800	F5
9600	A1
19.2K	D1
38.4K (asychronous only)	E9

Table A-4. Clear-to-Send Delay

Type of Communications	Delay in Milliseconds	Hex Code for Address 0082
V23 (four-wire), 1200 or 600 baud	16/200	10/C8
V23 (two-wire), 1200 or 600 baud	200	C8
V21 and Bell 202 series	50	32
Bell 103 series	255	FF
Burroughs TA 713	16	10
Burroughs TA 783	16	10
TDI or BDI	0	00

Notes:
1. Internal clear-to-send delays are not required for use with data sets. Data sets provide clear-to-send delays appropriate for its designs. To simulate data set clear-to-send delays when needed, use the delay as listed in this table. The delay circuit is enabled by loading a logic 1 into Address 0088 bit 4.
2. If no internal CTS signal is required, disable by loading a logic 0 into address 0088, bit 4.
3. Internal CTS value is minimum delay if using data set interface. If internal CTS is shorter than data set CTS, it waits for data set. If data set CTS is shorter than internal CTS, it waits for internal value.

ESC RT Sequence

This sequence in an incoming data comm message enables the host system to read the terminal scratchpad memory. The ESC RT sequence is acted upon immediately, that is, as soon as the message interpreter recognizes it. The rest of the message is never interpreted.

The full sequence is ESC RT aaaacc, where aaaa represents four Hex-digit characters denoting the starting scratchpad address and cc represents two Hex-digit characters which denote the number of scratchpad bytes to be transmitted. The scratchpad bytes are scanned in ascending order; for each byte, the two characters representing it in accordance with the customary Hex unpacking, are loaded into the data comm buffer. If any part of the address span specified by this sequence falls outside the scratchpad area of memory (specifically 0000-007F or beyond 018C), the appropriate number of 00 Hex digit pairs is automatically entered.

ESC RH Sequence

This sequence enables the host system to enter configuration data into the scratchpad memory.

The full sequence is ESC RH abc which is interpreted as follows:

1. "a" represents the four-digit Hex address used to identify the starting scratchpad memory address at which the host system begins to write configuration data.
2. "b" represents the two-character Hex byte count used to identify the number of memory bytes to be reconfigured.

3. "c" represents the configuration data to be written into the area of scratchpad memory selected in item 1. This data can be up to 254 bytes long.

ESC RC Sequence

This sequence is used to initiate a restart operation following an ESC RH sequence. The ESC RC sequence enables the terminal to be operated with the changed configuration data, thus allowing the changed data to be checked for accuracy before it is transferred to EAROM. Provided that no errors are found in the values loaded into the scratchpad memory, the terminal responds to the host system with a message containing six asterisks.

ESC RP Sequence

This sequence is used to write the updated scratchpad memory data into the EAROM to change the fixed terminal configuration data. This operation allows the terminal configuration changes to survive power-off periods of the terminal.

If this operation is successful, the terminal is returned to the local state.

APPENDIX B
LOCAL KEYBOARD CONTROL (CTRL) SEQUENCES

GENERAL

This appendix describes control functions which may be invoked from the keyboard by use of the CTRL key. Table B-1 is a composite list of these control functions for quick reference. The following is a description of the control functions.

Control	Function
CTRL A	Turns search function on.
CTRL B	Interchanges the cursor line with the line immediately below it. Cursor moves down with line.
CTRL E x	Designates the search character; where x can be any text key.
CTRL H x	Used to designate a highlight operation; where x can be any valid highlight code. Also used to send special data comm control characters to host system where x is the key which represents the desired data comm character. (See figure D-3 in Appendix D.)
CTRL I	Sets the video presentation to positive (green characters on a dark background) video which is the terminal's normal presentation.
CTRL M	Initiates a roll page down operation. Displayed page rolls down one line each time this control sequence is entered (cursor remains stationary).
CTRL N	Initiates a roll page up operation. Displayed page rolls up one line each time this control sequence is entered (cursor remains stationary).
CTRL O	Clears variable tab stops, if applicable.
CTRL P	Complements variable tab stop for present cursor location provided that the variable tab stops configuration option is invoked. (Sets tab if not already set; resets tab if already set.)
CTRL Q	Puts the cursor page to the non-forms mode; cursor is moved to the home position of the cursor page. If bit 3 of system register 0096 is set to a 1, page is cleared.
CTRL RA (shifted) hhhh (unshifted)	If configuration mode is set, displays contents of 16 consecutive scratchpad memory locations (in ASCII) beginning at the address signified by the numeric value entered in the hhhh segment of the control sequence (for example, RA0090). This control sequence is intended for use by a Burroughs field engineer to alter fixed message data and terminal password.
CTRL RCxxxx (shifted)	Stores back into the scratchpad memory updated configuration data displayed on the screen. (Used for temporary configuration changes.) The terminal password is entered in the xxxx segment of the control sequence. The details of the process depend on which of the display-scratchpad operations (ASCII or Hex) has been most recently invoked (if neither has been invoked since the most recent password sequence, the scratchpad memory restore operation does nothing). In the display Hex case, 16 consecutive pairs of Hex digits are packed into characters and stored; if any character other than a Hex digit is encountered, the process terminates prematurely. In both cases, the starting scratchpad address is the one used in the most recent display scratchpad operation, regardless of how the address displayed on the screen may have been edited.

(continued)

Control	Function
	Moreover, the data to be stored is taken from the positions on the screen where the display scratchpad operation wrote it. This must be remembered when editing the display data. Finally, when the last piece of data has been stored, an ACK (symbol) is displayed on the status line in the leftmost blank position. If the operation is terminated by an invalid Hex digit, a NAK (symbol) appears instead. If the LOCAL key is pressed after a scratchpad memory restore operation, the screen is cleared and a reconfiguration operation is attempted. If it is successful, the configuration mode flag is cleared and a display of * * * * * * is written in the home position of page 1. The data comm transceiver goes on-line. If it is unsuccessful, an error message is written in page 1 (see section 2 for a list of error messages), the configuration mode remains set, and the data comm transceiver remains off-line.
CTRL RH (shifted) hhhh (unshifted)	If configuration mode is set, displays contents of 16 consecutive scratchpad memory locations (in hexadecimal), beginning at the scratchpad address signified by the numeric value entered in the hhhh segment of the control sequence (for example, RH0090). The screen is cleared and the scratchpad memory data is displayed in upper left corner of screen. Refer to Appendix A for more detailed information.
CTRL RLxxxx (shifted)	If configuration mode is set, displays contents of the error log. Enter terminal password in the xxxx segment of the control sequence.
CTRL RPxxxx (shifted)	If configuration mode is set, writes scratchpad memory contents into EAROM to change the fixed configuration data to reflect new data entered into the scratchpad memory. Enter terminal password for the xxxx segment of the control sequence. At the end of this process, a P is displayed in the leftmost position of the status line and the terminal enters its startup routine.
CTRL RWxxxx	Puts the terminal in configuration mode. RW must be shifted. Enter the terminal password (must match exactly) in the xxxx segment of the control sequence. The data comm transceiver goes off-line and the search function (if active) is disabled. The cursor is displayed in the upper left corner of page 1 and the symbol > is displayed at the cursor location. As long as the configuration mode is set, the XMT, RCV, and SPCFY keys are disabled.
CTRL S	Turns the search function off.
CTRL T	Enables the entry of lowercase characters from the keyboard. (Sets bit 2 of system register 0092 to 0.)
CTRL U	Sets video presentation to negative (dark characters on a green background) video.
CTRL V	Interchanges the cursor line with the line immediately above it. Cursor moves up with the line.
CTRL W	Puts the cursor page in the forms mode (provided that all requirements to enter forms mode are met). Cursor is moved to the first unprotected field.
CTRL Y	Disables keyboard entry of lowercase characters. (Keyboard becomes all upper case.) Sets bit 2 of system register 0092 to a 1.
CTRL ;	Enables a printer operation where screen data is printed out on the printer and form feed is enabled in the printer.
CTRL]	Enables a printer operation where screen data is printed out on the printer and form feed is not enabled in the printer.
CTRL :	Enables a printer operation where the unprotected data of a page (forms mode) is printed out on the printer and form feed is enabled in the printer.

(continued)

Control	Function
CTRL ?	Complements the horn enable flag. (If horn enabled; disables horn; if horn disabled, enables and sounds horn.)
CTRL ↑	Initiates a scroll display-memory up operation. Display memory data moves up one line through the screen window for each time this control sequence is entered. (Cursor remains stationary.)
CTRL ↓	Initiates a scroll display-memory down operation. Display memory data is moved down one line through the screen window each time this control sequence is entered. (Cursor remains stationary.)
CTRL →	Moves cursor to the home position of the next page or moves cursor down to the next vertical tab stop, depending on terminal configuration.
CTRL ←	Moves cursor to the home position of the previous page or moves the cursor up to the previous vertical tab stop, depending on terminal configuration.
CTRL >	Moves the cursor to the current location of the data comm pointer.
CTRL CHAR/INS	Initiates a character insert operation on a page basis. (When a character is inserted, all the following characters on the page are moved one place to the right and down as required. The last character of the page is lost.)
CTRL CHAR/DEL	Initiates a character delete operation on a page basis. (When a character is deleted, all following characters on the page are moved up and to the left as required.
CTRL carriage return	Initiates a carriage return operation without storing (displaying) the carriage return symbol (∇).
CTRL HOME	Sets the mobile home parameter to the line and column of the current cursor location.
CTRL space C CTRL	Clears the cursor page and displays the resident character set in the first 128 character positions of the screen.
CTRL space D CTRL	Perform terminal restart. (Confidence test is performed and scratchpad memory is loaded from EAROM.)
CTRL space E CTRL	Performs repetitive memory test. Terminal enters restart mode when any key is pressed. (Used for maintenance only.)
CTRL space H CTRL	Sets data comm bit rate to 600 baud and restarts data comm. This control sequence also makes the following configuration changes to the system registers: Sets: register 0081 to equal A1 (Hex) bit 3 of register 0088 to a 1 bit 2 of register 0088 to a 0
CTRL space J CTRL	Sets data comm bit rate to 1200 baud and restarts data comm. This control sequence also makes the following configuration changes to the system registers: Sets: register 0081 to equal D1 (Hex) bit 3 of register 0088 to a 1 bit 2 of register 0088 to a 1
CTRL space K CTRL	Sets data comm bit rate to 1800 baud (asynchronous) or 2400 baud (synchronous) and restarts data comm. This sequence also makes the following configuration changes to the system registers: If terminal is configured for asynchronous, sets register 0081 to equal E1 (Hex). If terminal is configured for synchronous, sets register 0081 to equal E9 (Hex). Sets bit 3 of register 0088 to a 0. Sets bit 2 of register 0088 to a 0.

(continued)

Control	Function
CTRL space M CTRL	Fills entire screen with the letter E.
CTRL space V CTRL	Clears the cursor page and displays firmware version number in the upper left corner of the display.
CTRL < cr	Moves cursor to the column (c) and row (r) specified. Cursor position is not limited to screen data but can be positioned anywhere in display memory (row 1 through row 96). See figure D-4 in Appendix D for information concerning the keyboard graphic character to be entered for the desired column/row values.
CTRL nn XMT	Loads data comm character sequence ESC nn ETX into buffer for transmission to host system. (The letters nn represent the special data digits to be sent to the host system; n can be any number from 0 to 9.)

Table B-1. Keyboard Control Sequences

Control Sequence	Function
CTRL]	Print screen data (no form feed)
CTRL :	Print unprotected data
CTRL ;	Print screen data (form feed enabled)
CTRL >	Align display cursor to data comm pointer
CTRL < cr	Move cursor to column (c) and row (r) specified. (Column and row values are given in table D-4.)
CTRL ?	Sound audible alarm
CTRL A	Enable search mode
CTRL B	Line movement down
CTRL E x	Set search character equal to value of x
CTRL H x	Enable special symbol or highlight function signified by value of x, where x stands for key associated with desired special symbol or highlight. (See figure D-3 in Appendix D for list of special symbol keys.)
CTRL I	Negative video off
CTRL M	Roll down
CTRL N	Roll up
CTRL O	Clear all variable tab stops
CTRL P	Set or reset a tab stop
CTRL Q	Forms disable
CTRL R ( )	CTRL R sequences are used for terminal configuration (refer to Appendix A)
CTRL S	Disable search mode
CTRL T	Enable lower case from keyboard
CTRL U	Negative video on
CTRL V	Line movement up
CTRL W	Forms enable
CTRL Y	Disable lower case from keyboard
CTRL ↑	Scroll up
CTRL ↓	Scroll down
CTRL →	Page advance
CTRL ←	Page back
CTRL (CHAR/DEL)	Character delete by page
CTRL (CHAR/INS)	Character insert by page
CTRL (carriage return)	Carriage return without related symbol displayed
CTRL (HOME)	Mobile home parameter equal to cursor location
CTRL space C CTRL	Display resident character set
CTRL space D CTRL	Initiate system confidence test
CTRL space E CTRL	Repetitive memory test
CTRL space H CTRL	Data rate: 600 bps
CTRL space J CTRL	Data rate: 1,200 bps
CTRL space K CTRL	Data rate: 2,400 bps if synchronous, 1,800 bps if asynchronous
CTRL space M CTRL	Fill screen with E characters
CTRL space V CTRL	Display firmware version number
CTRL nn XMT	Transmit ESC nn ETX sequence to host system; where n can be any number from 0 to 9.

APPENDIX C
DATA COMM CONTROL CHARACTERS AND SEQUENCES

GENERAL

This appendix describes the control characters and sequences which may be invoked from the host system through the data comm interface. Table C-1 defines the data comm control characters and table C-2 describes the control sequences invoked by use of the ESC (escape) control character.

Table C-1. Data Comm Control Characters

Sequence or Character	ASCII Coding Column Row	Definition of Terminal Response
NUL	00	Time Fill
SOH	01	Start-of-Heading
STX	02	Start-of-Text
ETX	03	End-of-Text
EOT	04	End-of-Transmission
ENQ	05	Enquiry
ACK	06	Acknowledge
BEL	07	Sound Audible Alarm (unless disabled by ESC ?)
BS	08	Move data comm pointer one position to the left
HT	09	Move data comm pointer to next tab stop
LF	0A	Move data comm pointer down to same column, next row
VT	0B	Complement variable tab stop for present location of data comm pointer (provided variable tab stop configuration option is invoked)
FF	0C	Home Cursor, Clear Display
CR	0D	Initiate carriage return (Display ∇)
SO	0E	Initiate Reverse Video Highlight (Display Space)
SI	0F	Initiate Underline Highlight (Display Space)
DLE	10	Display DLE symbol
DC1	11	Set Hold-In-Receive flag or clear to end of line
DC2	12	Move data comm pointer one position to the right or complement forms mode
DC3	13	Move data comm pointer up to same column, next row
DC4	14	Move data comm pointer to the home position
NAK	15	Not-Acknowledge
SYN	16	Display SYN symbol
ETB	17	Display ETB symbol
CAN	18	Initiate Blink Highlight (Display Space)
EM	19	Initiate Secure Video Highlight (Display Space)
SUB	1A	Initiate Bright Video Highlight (Display Space)
ESC	1B	Designates control sequence (refer to table C-2)
FS	1C	Display ▯ (Signified beginning of a protected field where data is transmitted unchanged)
GS	1D	Display △ (Signifies beginning of a GS unprotected field)
RS	1E	Display ◁ (Signifies end of unprotected field; beginning of protected field
US	1F	Display ▷ (Signifies beginning of a US unprotected field)

Table C-2. Description of Data Comm Escape Control Sequence

Notes: Unlike CTRL sequences; ESC sequences that include letters require them to be in upper case. Lower case letters in this table have the following significance:
h, k = hexadecimal digit (O,...,9,A,...,F)
p,c,r = character in the ASCII subset (space,...,DEL)
x = character

Escape Character	Function
ESC C	Move data comm pointer one position to the right.
ESC D	Set mobile home line and column to the line and column of the data comm pointer.
ESC E	Turn search function on.
ESC F	If data comm pointer and keyboard cursor are in the same page, turn search function off and set search character equal to 1.
ESC J	Clear from data comm pointer to end-of-page.
ESC K	Clear from data comm pointer to end-of-line.
ESC L	Insert a blank line at data comm pointer.
ESC M	Delete the data comm pointer line.
ESC N	Set video presentation of data comm pointer page to negative video.
ESC O	Set video presentation of data comm pointer page to normal (positive) video.
ESC P	Delete (by page) the data comm pointer character.
ESC RThhhhkk	Transmit to host machine kk bytes of data from scratchpad memory beginning with address hhhh.
ESC RAhhhhkk	Store next kk bytes of message (ASCII data) into scratchpad memory, beginning at address hhhh.
ESC RHhhhhkk	Interpret next kk characters of message as Hex digits; pack pairs of digits into bytes and store them into scratchpad memory beginning at address hhhh.
ESC R C	Perform configuration operation.
ESC R P	Copy scratchpad memory contents into EAROM and start terminal.
ESC R S kk	Clear status line and copy next kk bytes of message into it.
ESC R L	Transmit contents of error log to host system.
ESC S	Roll data comm pointer page up.
ESC T	Roll data comm pointer page down.
ESC W	Transform data comm pointer page to forms mode (provided transformation is valid), and move data comm pointer to first unprotected field.
ESC X	Set forms mode of data comm pointer page off.
ESC Y	Disable keyboard entry of lowercase characters (sets bit 6 of system register 0092 to 1).
ESC Z	Enable keyboard entry of lowercase characters (sets bit 6 of system register 0092 to 0).
ESC !	Insert (by line) a blank at the data comm pointer location.
ESC @	Insert (by page) a blank at the data comm pointer location.
ESC %	Delete (by line) the character at the data comm pointer location.
ESC " c r	Move data comm pointer to (column c, row r) of the page it is on. (Refer to table D-4 in Appendix D for information concerning the ASCII code to be entered for the desired column/row values.)
ESC $ n	Move data comm pointer to the home position of page n. Refer to table D-4 for the ASCII code to be entered for desired page (n).
ESC #	If variable tab stop option is in effect, clear tab stops.
ESC &	Move keyboard cursor to the current location of the data comm pointer.
ESC (	Set transmit page flag to initiate transmit operation.
ESC - x	Set search character equal to x.
ESC .	If variable tab stop option is in effect, complement the tab stop corresponding to the current data comm pointer column number.

(continued)

Table C-2. Description of Data Comm Escape Control Sequence

Notes: Unlike CTRL sequences; ESC sequences that include letters require them to be in upper case. Lower case letters in this table have the following significance:
h, k = hexadecimal digit (O,...,9,A,...,F)
p,c,r = character in the ASCII subset (space,...,DEL)
x = character

Escape Character	Function
ESC <	Move the data comm pointer line down.
ESC >	Move the data comm pointer line up.
ESC ?	Beep horn (audible alarm) if enabled.
ESC ;	Print screen data from home to cursor with form feed enabled.
ESC :	Print unprotected data from home to cursor with form feed enabled.
ESC]	Print screen data from home to cursor, no form feed.
ESC ' x	Used to designate highlight operation where x can be any valid highlight code. Also used to send data comm control characters to terminal without their control functions being invoked.
ESC space D	Terminal restart (confidence test, reconfiguration from EAROM)
ESC space V	Transmit firmware version number to host system.
ESC space C	Write resident character set in first 128 locations of page. (Data comm pointer is left in the lower position of page).

APPENDIX D
REFERENCE DATA

b_7 → b_6 → b_5 →					0 0 0	0 0 1	0 1 0	0 1 1	1 0 0	1 0 1	1 1 0	1 1 1
b_4 ↓	b_3 ↓	b_2 ↓	b_1 ↓	COL → / ROW ↓	0	1	2	3	4	5	6	7
0	0	0	0	0	NUL	DLE	SP	Ø	@	P	`	p
0	0	0	1	1	SOH	DC 1	!	1	A	Q	a	q
0	0	1	0	2	STX	DC 2	"	2	B	R	b	r
0	0	1	1	3	ETX	DC 3	#	3	C	S	c	s
0	1	0	0	4	EOT	DC 4	$	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	A	LF	SUB	*	:	J	Z	j	z
1	0	1	1	B	VT	ESC	+	;	K	[	k	{
1	1	0	0	C	FF	FS	,	<	L	\	l	|
1	1	0	1	D	CR	GS	-	=	M	]	m	}
1	1	1	0	E	SO	RS	.	>	N	^	n	~
1	1	1	1	F	SI	US	/	?	O	_	o	DEL

EPI408

Figure D-1. Standard U.S. ASCII Chart

DEC	HEX	DEC	HEX	DEC	HEX	DEC	HEX
1	00	25	18	49	30	73	48
2	01	26	19	50	31	74	49
3	02	27	1A	51	32	75	4A
4	03	28	1B	52	33	76	4B
5	04	29	1C	53	34	77	4C
6	05	30	1D	54	35	78	4D
7	06	31	1E	55	36	79	4E
8	07	32	1F	56	37	80	4F
9	08	33	20	57	38	81	50
10	09	34	21	58	39	82	51
11	0A	35	22	59	3A	83	52
12	0B	36	23	60	3B	84	53
13	0C	37	24	61	3C	85	54
14	0D	38	25	62	3D	86	55
15	0E	39	26	63	3E	87	56
16	0F	40	27	64	3F	88	57
17	10	41	28	65	40	89	58
18	11	42	29	66	41	90	59
19	12	43	2A	67	42	91	5A
20	13	44	2B	68	43	92	5B
21	14	45	2C	69	44	93	5C
22	15	46	2D	70	45	94	5D
23	16	47	2E	71	46	95	5E
24	17	48	2F	72	47	96	5F

Figure D-2. Decimal to Hexadecimal Conversion Chart

USACII	Keyboard	Video	USACII	Keyboard	Video
NUL	SPACE		DLE	0	
SOH	!		DC1	1	
STX	"		DC2	2	
ETX	#		DC3	3	
EOT	$		DC4	4	
ENQ	%		NAK	5	
ACK	&		SYN	6	
BEL	'		ETB	7	
BS	(		CAN	8(blink)	
HT	)		EM	9(secure)	
LF	*		SUB	:(bright	
VT	+		ESC	:	
FF	,		FS	<	
CR	-		GS	=	
SO	.(neg.vid.)		RS	>	
SI	/(underline)		US	?	

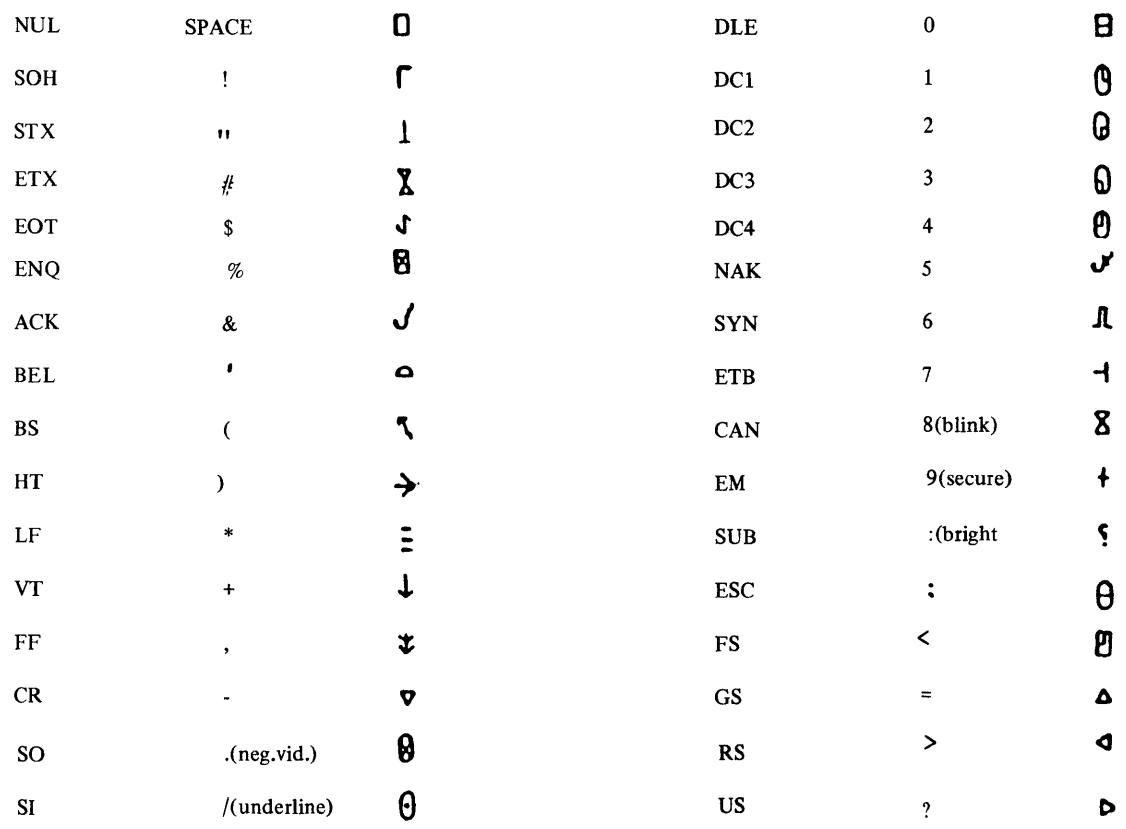


Figure D-3. Special Symbols Chart

Cursor Position COLM/ ROW	Graphic Character	USASCII Code	Cursor Position COLM/ ROW	Graphic Character	USASCII Code	Cursor Position COLM/ ROW	Graphic Character	USASCII Code
1	space	20	33	@	40	65		60
2	!	21	34	A	41	66	a	61
3	"	22	35	B	42	67	b	62
4	=	23	36	C	43	68	c	63
5	$	24	37	D	44	69	d	64
6	%	25	38	E	45	70	e	65
7	&	26	39	F	46	71	f	66
8	'	27	40	G	47	72	g	67
9	(	28	41	H	48	73	h	68
10	)	29	42	I	49	74	i	69
11	*	2A	43	J	4A	75	J	6A
12	+	2B	44	K	4B	76	k	6B
13	,	2C	45	L	4C	77	l	6C
14	–	2D	46	M	4D	78	m	6D
15	.	2E	47	N	4E	79	n	6E
16	/	2F	48	O	4F	80	o	6F
17	0	30	49	P	50	81	p	70
18	1	31	50	Q	51	82	q	71
19	2	32	51	R	52	83	r	72
20	3	33	52	S	53	84	s	73
21	4	34	53	T	54	85	t	74
22	5	35	54	U	55	86	u	75
23	6	36	55	V	56	87	v	76
24	7	37	56	W	57	88	w	77
25	8	38	57	X	58	89	x	78
26	9	39	58	Y	59	90	y	79
27	:	3A	59	z	5A	91	z	7A
28	;	3B	60	[	5B	92	{	7B
29	<	3C	61	\	5C	93	¦	7C
30	=	3D	62	]	5D	94	}	7D
31	>	3E	63	^	5E	95	~	7E
32	?	3F	64	–	5F	96	DEL	7F

Figure D-4. Programmable Cursor Select Values

INDEX

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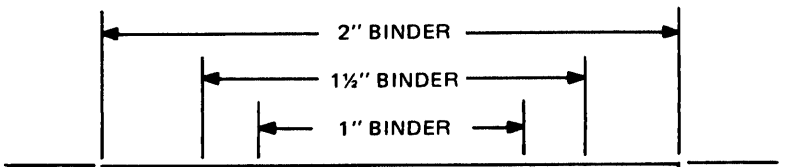

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