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TECHNICAL USER MANUAL
Video Display Terminal



BEEHIVE INTERNATIONAL

DM78

Technical User's Manual

VIDEO DISPLAY TERMINAL

MARCH 1982



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SECTION I INTRODUCTION

1.1 DOCUMENTS RELATED TO THE TERMINAL

The complete documentation of the DM78 terminal consists of three manuals which are available from the department of Customer Service Administration at Beehive's home office. See title page for address or use the order form shipped with this manual.

1.1.1 Technical User Manual

A copy of this Technical User Manual is shipped with each terminal and contains introductory information to help install and use the terminal properly. This manual provides configuration information for the technician and a description of local and interactive operation for the data processing operator. Because the terminal is usually installed in conjunction with a host operating system, not all operational features can be presented.

1.1.2 Maintenance Guide

Beehive International's extensive network for customer service covers most continents. For use in the few areas where logistics make on-site service inefficient or where it is not desired, the Maintenance Guide provides repair information. It contains procedures to assist with site diagnosis (subassembly and cable replacement) and technical information to aid in lab repair (component level replacement). It assists with terminal identification, assembly and disassembly, and troubleshooting. (Beehive's Maintenance Guide part number is TM81-DM5-2 REVISED 02/82 VERSION 2.1 or more recent).

1.1.3 Illustrated Parts Manual

This manual is an aid to disassembly/assembly, and component level repair. It contains a comprehensive list of parts, a list of terminal options, and parts ordering information.

1.2 "HELPS" IN UNDERSTANDING THE MANUAL

To prevent descriptions of keyboard operations from being confused with normal sentence punctuation, some special conventions are used throughout Beehive International user manuals. For example, whenever the individual keys on the keyboard are described, their keycap legends are presented in capital letters.

1.2.1 Multiple Key Sequences

When multiple key sequences are described (that is, instructions requiring the operator to depress two or more keys in order), a box or rectangle encloses the components of the key sequence . Spaces occurring within the boxes are provided for clarity and do not mean that the space bar is to be depressed. If a sequence involves the space bar, the word "SPACE" is used.

1.2.2 Simultaneous Key Strokes

Some key sequences require the operator to depress and *bold* one or more keys while other keys are depressed. When simultaneous key strokes are described, the key which must be held down is presented in italics. For example, three keys must be depressed at the same time to cause the terminal to reset: the ALT key, the SHIFT key, and the capital V. This key sequence is presented as follows:

ALT *SHIFT* V

1.2.3 Escape Sequences

Escape codes are generated from the DM5A keyboard by multiple key sequences involving the escape (ESC) key. Escape codes are not generally displayed on the CRT screen, but are transmitted to the host processor causing specific operations to occur.

Escape codes are generated by pressing and then releasing the ESC key, then pressing the required alphanumeric key. For example, **[ESC E]** clears the screen.

1.2.4 Alternate Functions

An Alternate (ALT) key is present on both the DM78 and DM5A-style keyboard. Multiple key sequences involving this key are similar to escape sequences – they cause specific operations to occur and are not normally displayed on the screen. These operations are initiated by depressing the ALT key while typing the required alphanumeric key from the keyboard. For example, **[ALT G]** rings the bell. Remember, the italicized key (ALT) is held down while the next key is pressed.

1.3 PRODUCT OVERVIEW

In recent years, the availability of low-cost conversational display terminals has provided an attractive alternative to more costly IBM equipment. It is now practical for users to buy protocol converters and low-cost terminals for use with IBM hosts. The historical disadvantage to this approach has been the physical differences among terminals. For example, operators trained in the operation of IBM equipment find it difficult to use the replacement terminals because of differences in keyboard layout, keycap legends, and displayed characters. Beehive's DM78 dual mode terminal addresses these problems by providing the familiar IBM features – and many more – that make it an excellent substitute for the original IBM model.

The DM78 is a low-cost, asynchronous ASCII terminal with an IBM 3278-style keyboard with video display – the ideal choice for operation in conjunction with protocol converters attached to 3270-type networks. A second I/O port is standard on the DM78 to allow the attachment of a printer without committing a separate communication line or for connection to a second host with no need for additional terminals.

1.4 DM78's DUAL PERSONALITY

The DM78 is a dual personality terminal having two complete terminal algorithms with distinct characteristics. Unlike other terminals, which simply allow some commands to be selected and others ignored, mode selection with the DM78 changes the basic operating features of the terminal. In the DM5A mode, the terminal is a conversational asynchronous ASCII terminal, with few differences from Beehive's DM5A. The DM78 personality is specifically designed for operation with a protocol converter. Features present in one mode of operation are not necessarily included in the other. For example, the DM78 mode does not have scrolling capability. Both modes of operation have transparent print.

1.4.1 DM78's Two Keyboards

To accommodate both operating modes the DM78 uses more than 128 different displayable characters (some EBCDIC characters are used in the DM78 mode, in addition to the standard DM5 ASCII set). The DM78 mode uses both Program Attention (PA) and Program Function (PF) keys, while the DM5A mode uses only PF keys. Because of these variables, the user has the option of two keyboards: a DM5A and/or a DM78. Although both keyboards have the same number of key stations, in the same configuration, there are differences in the keycaps. Identical codes are generated for each key station, but the main logic board interprets these codes according to the operational mode which is active. For example, when the DM78 mode is active, codes are interpreted to conform with the DM78-style keyboard – even if a DM5A-style keyboard is connected. The operator must be aware that it is the **current active mode** of operation, and not the keyboard which is connected, that determines the set of codes interpreted for keystrokes.

1.4.2 Changing the Keyboard

With the terminal powered down, the keyboard can easily be changed by the user with no alteration of switches, ROMs, or zero-ohm resistor packs. It is the keyboard that is connected which determines the mode the terminal will select when power is turned on.

WARNING: The keyboard MUST NOT be disconnected, reconnected, or changed while the terminal is on. DAMAGE MAY RESULT!!!

1.4.3 Personality Selection After Power Up

While on, the terminal is capable of switching modes of operation in response to a command either from the host processor or from the keyboard. The result of switching modes is just as if the user had turned off one terminal and turned on another.

NOTE: One of the purchase options of the DM78 terminal is an additional 4K bytes of RAM memory. In terminals configured with 8K of RAM, the display contents of the inactive mode can be saved in memory when the operating mode is changed and restored to the display as necessary.

1.4.4 Operation With DM78 Keyboard

Although two keyboards are offered for the convenience of the operator, the DM78 operates in either mode with either keyboard. The keyboard options simply provide closer correspondence between keycap legends and the functions of the terminal. If a terminal is used mostly with a protocol converter, the DM78 keyboard should be connected when the terminal is off. In this way, the unit powers up as a DM78, the characters on the screen match the keycaps, and the keyboard layout corresponds to the comparable IBM layout. If the terminal needs to be used occasionally as a conversational terminal, a simple escape sequence enables the DM5A mode, and the terminal becomes an ASCII conversational terminal with an alternate keyboard.

1.4.5 Operation with DM5A Keyboard

For a terminal used primarily as a normal conversational ASCII work station for the collection and manipulation of data, and only occasionally to communicate with a mainframe as an IBM terminal, the DM5A keyboard should be connected so that the terminal powers up as a DM5A. To transmit data to the host or to connect to a host CPU through a protocol converter, the operating mode can easily be switched to DM78, and the user sees an IBM-style display and operational features. Once again, the keyboard will not match, but the necessary commands can be generated with a little help from keycap charts inside the front covers of this manual.

1.4.6 Common Personality Features

Some of the features common to both modes of operation are:

1. 12-inch P42 green phosphor monitor.
2. Integral monitor/power supply.
3. Asynchronous, switch-selectable baud rates up to 19.2 kBd on main and auxiliary ports.
4. Switch selectable parity on main and auxiliary ports.
5. Switch selectable printer protocol on auxiliary port.
6. 5 x 7 dot character matrix in 7 x 10 dot cell.
7. 87 key IBM-style sculptured keyboard.
8. 4K character generator containing both DM5A and DM78 character sets.

1.4.7 DM78 Mode Features

In DM78 mode the terminal functions as a semi-smart glass teletype. All keystrokes generate codes that are sent from the main port to the host processor and are not acted upon locally. The video display is under the control of the local processor via the main I/O port. Some DM5A-type commands (e.g. Clear Screen and Cursor Positioning) remain in DM78 mode but function only if their control codes are received through the main I/O port. Auxiliary port control is limited to the transparent print commands which exist in both modes.

The DM78 display functions as a 24 x 80 character block of memory. Unlike the DM5A, with its invisible attributes, attributes codes are visible as spaces in the DM78 mode. There is no scrolling when the cursor reaches the bottom of the screen, and all attributes (as well as the cursor) wrap from the bottom of the screen to the top. In this mode, screen function is much more like that of an IBM terminal than of a conversational ASCII terminal.

Another difference in DM78 mode is the absence of the DM5A-type status line. This is replaced by a blank status line that is reserved for messages deposited by the host CPU. If the message deposit line is disabled by the host processor, row 25 is lost as usable display.

The CPU message deposit feature of the DM78 mode is explained in Section 3.4.

1.4.8 DM5A Mode Features

In the DM5A mode the terminal operates like a model DM5A with the following differences:

1. The terminal powers up on-line.
2. The terminal has three additional commands for the printer port which allow transparent printing (the operating system in the terminal shares a single communications line with the printer):
 - boot loaded transparent printer protocol
 - character-dependent transparent print
 - count-dependent transparent print
3. The modified boot load, a program which is used to alter certain internal variables of the terminal, varies slightly from the modified boot load program of the standard DM5A terminal. The features of the modified boot load program are summarized in Table 5-5.

1.5 TECHNICAL SPECIFICATION

DISPLAY FORMAT

24 lines x 80 characters.

OPTIONAL STATUS LINE

25th line of display.

CRT SIZE

12" measured diagonally (15" optional).

CHARACTER SIZE

12" CRT - approximately 0.2" high x 0.1" wide.
15" CRT - approximately 0.25" high x 0.125" wide.

CHARACTER GENERATOR

256 displayable ASCII characters, each formed within a 7 x 10 dot matrix, including displayable EBCDIC characters and graphic symbols for simulation of 3278-style status line. Line monitor mode displays control codes as two-letter symbols (both within one cell). Decenders appear on lower-case characters.

REFRESH RATE

50 or 60 Hz (AC line voltage dependent).

CHARACTER DISPLAY

Light characters on a dark background or vice versa (switch selectable).

VISUAL ATTRIBUTES

Normal, reverse, blink, underline, half intensity, and security fields.

TABULATION/BACKTAB

Positions the cursor at the next character following a visual attribute, (DM78 mode) or at pre-defined tab settings (DM5A mode).

CURSOR

Block or underline, blinking or non-blinking (key selectable), on or off (escape sequence selectable).

CURSOR CONTROL

Up, down, left, right, home, carriage return, and line feed.

CURSOR SENSE

Cursor position is transmitted to host upon request.

CURSOR ADDRESSING

Direct X-Y cursor positioning by line and column.

MEMORY ADDRESS POINTER

An invisible cursor that is used to read from and write to display memory; independent of visible screen functions.

MEMORY POINTER DATA SENSE

ASCII value of the character located at the memory address pointer.

READ TERMINAL STATUS

Upon request from the host processor, the terminal sends a 27-character status message.

EDITING OPERATIONS

Insert/Delete character within a field (DM78 mode), or page (DM5A mode) backspace and character overwrite.

ERASE FUNCTIONS

Erase to end of field (EOF), Clear, (DM78 mode) plus erase EOL/EOP (DM5A mode).

COMMUNICATIONS INTERFACE

Serial RS232/20 mA current loop or RS232/RS422.

TRANSMISSION RATE

Switch selectable to 9600 baud, (19200 baud under Xon/Xoff protocol).

PARITY

Switch selectable - odd or even, mark or space.

COMMUNICATION MODE

Asynchronous only. Full duplex on main port, full/half duplex on auxiliary port.

COMMUNICATION CODE

ASCII 7 bits plus parity.

OPERATIONAL MODES

Conversational: Character by character transmission.
Line Monitor: Displays all escape and control code sequences.

BELL

Audible alarm upon receipt of **CONTROL G**, and continuous alarm on/off.

KEYBOARD

A sculptured, detachable 87-station keyboard featuring IBM 3278 layout, auto repeat, two-key rollover, shift lock, alpha lock, and 12-key numeric pad. Keyboard has an optional clicker to provide audible feedback, of key closures. Keys with two functions bear alternate symbols on the fronts of the keycaps.

SELF DIAGNOSIS

Performed automatically upon power up and manually by the host CPU or operator.

POWER REQUIREMENTS

Either 115 or 230 V AC +/- 15% at 47/63 Hz with 50 watts consumption typical, 60 watts maximum, at 115 V AC.

ENVIRONMENTAL SPECIFICATIONS

Altitude: Sea level to 10,000 feet.
Operating Temperature: 0 to 40° C, (32 to 104° F).
Humidity: 5 to 95% (non-condensing).

TERMINAL SIZE

18.2" (46.2 cm) side, 13.1" (33.3 cm) high, 24" (61 cm) deep.

TERMINAL WEIGHT

Monitor weight: 34 lbs. (approximate).
Keyboard weight: 4 lbs. (approximate).
Shipping weight: 50 lbs. (approximate).

AUXILIARY INTERFACE

A serial RS232, asynchronous, bidirectional interface with a character buffer on both send and receive lines. Selectable data flow control and baud rates from 110 to 19,200.

MEMORY LOCK (DM5A mode only)

The display area above the line of the current cursor location is frozen.

LINE LOCK (DM5A mode only)

The host CPU may selectively designate reserved display lines.

SECTION II INSTALLATION

2.1 UNPACKING AND IDENTIFICATION

In order to ensure the trouble-free installation of the DM78 terminal, it is essential that the steps described in this section be undertaken in the order in which they are presented.

1. Unpacking and Site Selection
2. Interface Options and System Configuration
3. Operating Configuration (Switch Settings)
4. Terminal Turn On Procedure

DO NOT, under any circumstances, **plug in** or **turn on** the terminal until the necessary preliminary steps are understood and accomplished.

2.1.1 General

Upon receipt of the terminal, carefully check for any signs of shipping damage. The shipping container has been especially designed to protect its contents and prevent damage under normal shipping conditions. If the container has been mishandled, this should be evident by visual inspection. If damage is found, document it with photographs, save any physical evidence, and contact the transport carrier as soon as possible.

While unpacking, confirm that the display enclosure, the keyboard, and the intervening cable are present and intact. Find the Technical User Manual in the box. Verify that no tie-downs or packing materials remain inside the display enclosure.

An identification plate located on the rear of the terminal provides the model number, part number, serial number, weight, voltage and current requirements, and frequency/power classifications for the terminal.

2.1.2 Site Selection & Air Flow Warning

The terminal is fully self-contained and easily accommodates to alternate operating positions without the removal or alteration of any wiring. Select a convenient, level surface and place the terminal so that the power cable and data cables do not interfere with the operator. Route the cables so that they are not accidentally pulled or disturbed by changes in terminal position or operator movement. The keyboard is detachable and is connected to an output jack centered below the rear panel. A contrast control knob is located on the rear panel.

Do not place the terminal on any surface that blocks cooling air from the back of the cabinet. The terminal is equipped with an internal fan for cooling; air exhausts through a grill-protected hole in the rear panel. To ensure efficient air circulation, maintain a clearance of at least 3-1/2 inches at the rear of the terminal.

Figure 2-1
Terminal Dimensions

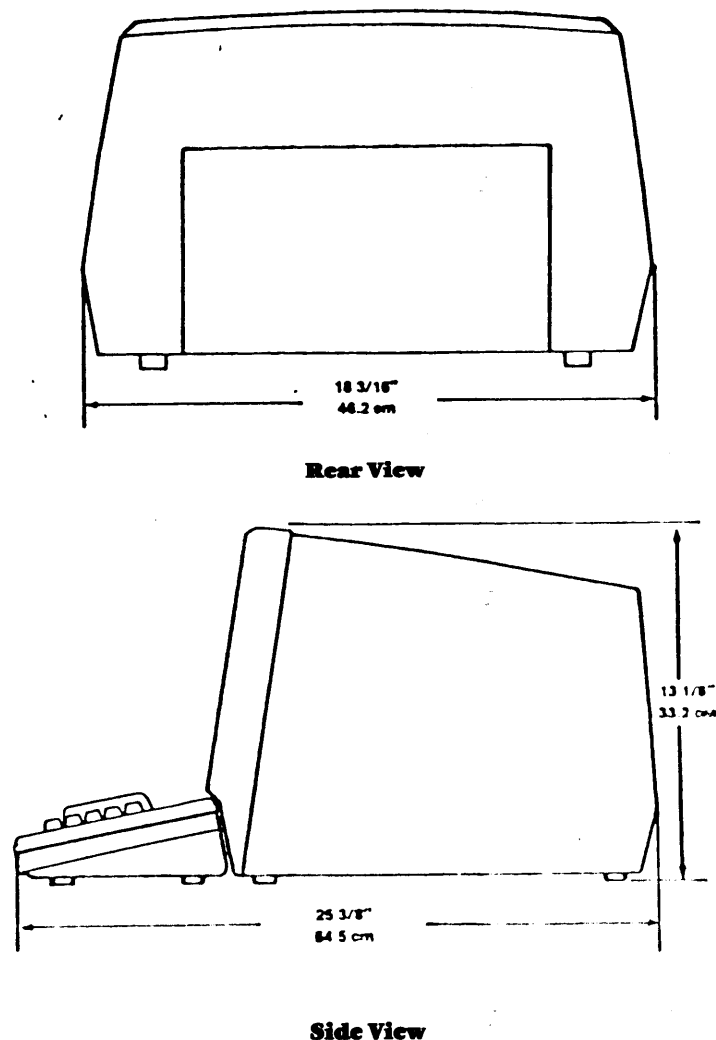
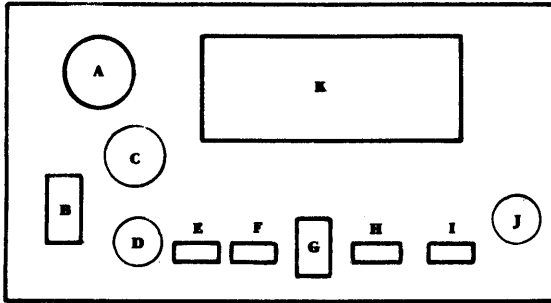


Figure 2-2
Typical Rear Panel



- | | |
|---------------------------------------|------------------------------------|
| A FAN | G KEYBOARD CABLE RECEPTACLE |
| B POWER SWITCH | H SWITCH S1 |
| C FUSE | I SWITCH S2 |
| D POWER CORD | J CONTRAST CONTROL |
| E AUXILIARY PORT I/O CONNECTOR | K EXTERNAL SWITCH USAGE |
| F MAIN PORT I/O CONNECTOR | |

2.2 INTERFACING OPTIONS

Two different logic board assemblies are available for the terminal. Both allow the use of an RS232 interface. Logic board (112-2538-*) accommodates an RS422 communication interface. Logic board 112-2544-* accommodates a 20 mA current loop interface.

2.2.1 RS232C Interface

Using this interface, output voltage swings from -12 V to $+12\text{ V}$ while the receivers present a minimum of 3 k ohms impedance to the line. The input resistance is approximately 4 k ohms. The driver circuits limit current to a maximum of 10 mA on both source and sink. All connections are made through the 25-pin miniature D-type connector(s) on the rear of the terminal. The pin designations of the RS232 interface specification are presented in Table 5-1.

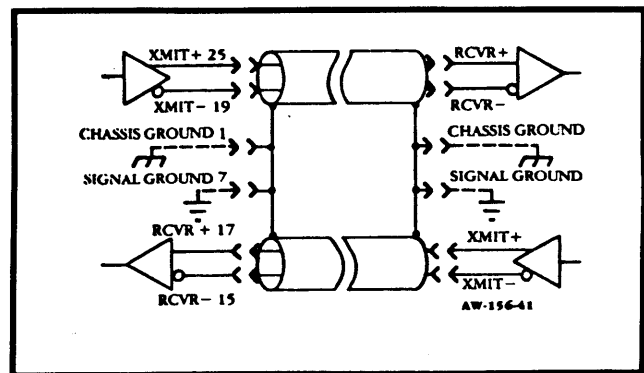
2.2.2 RS422 Interface

The RS422 interface is a balanced differential voltage interface that allows cable lengths of up to 4000 feet (1.2 km) and baud rates of up to 19,200 bps. 24 AWG copper, twisted-pair shielded cables are suggested for the transmit and receive lines. The four RS422 data lines (RCVR+, RCVR-, XMIT+, and XMIT-) are located on the same 25-pin connector as the RS232C signals. They occupy four of the unused pins: 15, 17, 19, and 25. All control lines are available, but at RS232C voltage levels. A more detailed explanation is found in the Maintenance Guide.

Proper operation of the interface circuits requires a path between the circuit grounds of the equipments at each end of the interconnection. There are several possibilities:

- Through Earth Ground, both ends have their frame ground connected to Earth Ground (third wire of the power cord). This method is the preferred one when the two earth grounds are at a potential difference of less than four volts.
- When potential difference is greater than four volts between the two earth grounds, and the DTE earth ground is the quieter, a connection of the Send Common line to the DCE circuit ground is recommended. To avoid circulating ground currents, circuit ground must be separated from frame ground when this connection is made. The circuit ground for the DCE is obtained from the DTE circuit ground through the interchange circuit SC. The DCE must be capable of withstanding the potential differences that result between circuit ground and frame ground.
- When potential difference is greater than four volts between the two earth grounds, and the DCE earth ground is the quieter, a connection of the Receive Common line to the DTE circuit ground is recommended. To avoid circulating ground currents, circuit ground must be separated from frame ground when this connection is made. The circuit ground for the DTE is obtained from the DCE circuit ground through the interchange circuit RC. The DTE must withstand the potential differences resulting between circuit and frame ground.

Figure 2-3
RS422 Cabling

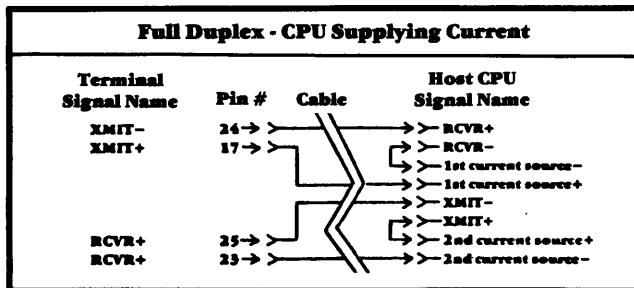
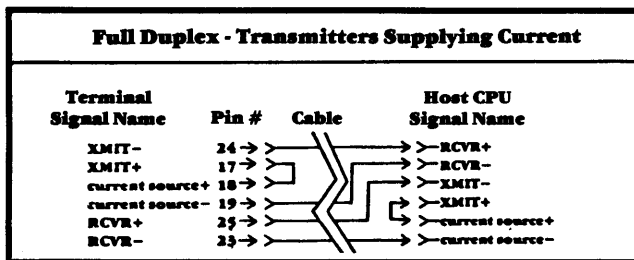
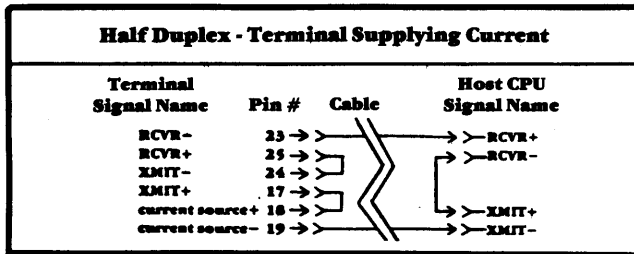
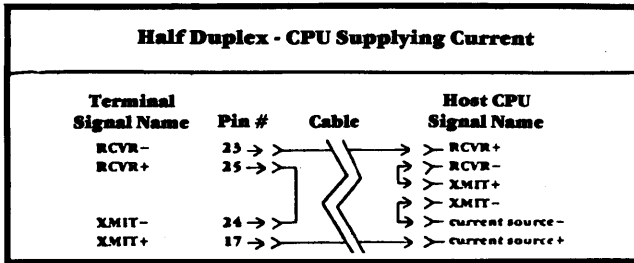


2.2.3 Current Loop

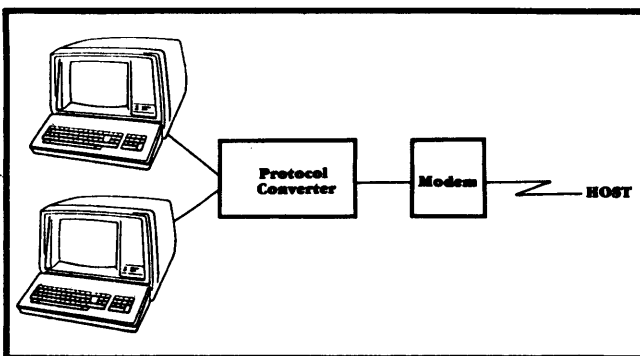
The current loop interface is a 20mA constant current device which allows the terminal to be used up to 2000 feet (60 m) from the computer. Baud rates of 9600 or less must be used. If a baud rate of less than 9600 is used with shielded and twisted pairs, the terminal may be located up to 6000 feet (1.8 km) from the CPU.

Current loop converts TTL signals into current signals at one end of the loop, transmits the pattern, and reconverts the pattern to TTL signals at the other end for delivery to the computer or terminal. The current loop connections are contained within the RS232C connector and do not interfere with the RS232C signals required for asynchronous operation.

Figure 2-4
Current Loop Cabling



2.2.4 Typical System Connection #1

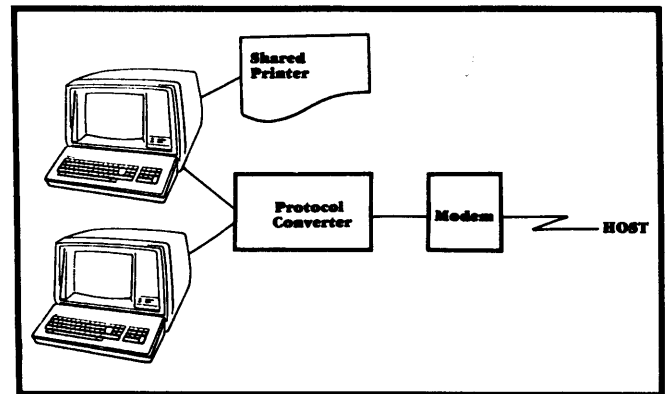


Protocol Converter - Dedicated

In this application the DM78 operates as a dedicated terminal, through the protocol converter, to the host IBM product. The protocol converter receives and transmits synchronous data, converts it to asynchronous data for transmission to and from the DM78. A complete copy of the data on the screen of the

DM78 is kept in the memory of the protocol converter. In this configuration, the DM78 operates with the IBM 3278-style keyboard, powers up as a DM78, and operates in that mode exclusively.

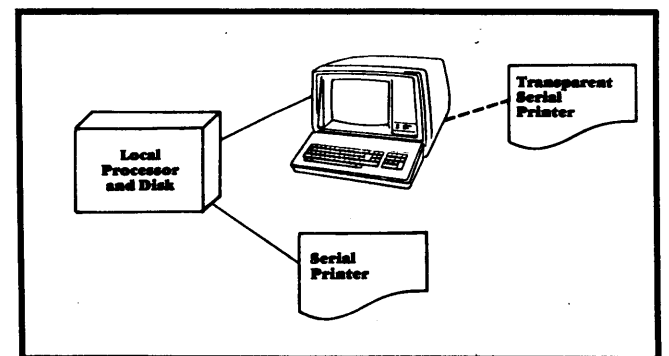
2.2.5 Typical System Connection #2



Protocol Converter - Shared Printer

This configuration allows the protocol converter to access a serial printer over a communication line shared with the DM78 terminal. In configurations with a high number of terminals and/or printers, the dedication of a communications line to each printer will rapidly exhaust the available lines. By using the DM78's transparent print feature, a correctly programmed protocol converter can accommodate from one to eight terminals operating with from one to eight printers in any combination of up to sixteen devices and still use only eight ports.

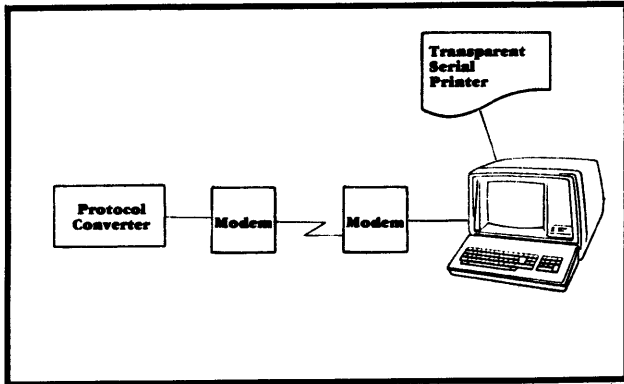
2.2.6 Typical System Connection #3



Workstation

In this configuration the DM78 can operate as the console for a local workstation. In this example it is operating in DM5 mode and would be configured with a DM5A-style keyboard. One technical advantage of the DM78 in such a configuration is its ability to handle the optional transparent serial printer.

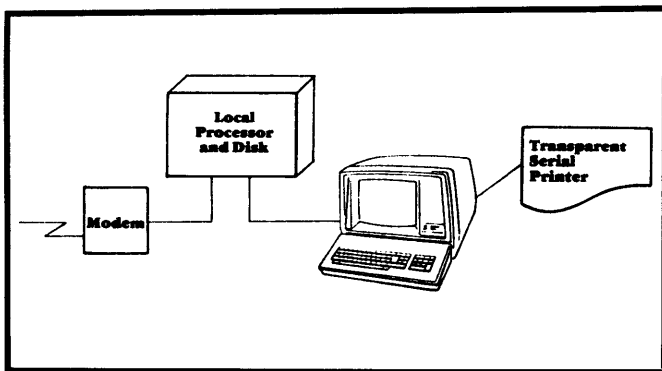
2.2.7 Typical System Connection #4



PC on Host Side of ASYNC Data Link

This illustration shows how the DM78 operates asynchronously through a data link with the protocol converter located on the host end of the data link. While using the transparent print feature, the protocol converter can support up to 16 devices through the use of only eight ports.

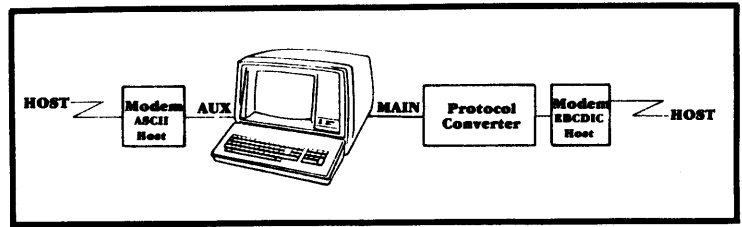
2.2.8 Typical System Connection #5



Communicating Workstation

In the operating environment illustrated above the programmability of the local processor, combined with the flexible modes of operation of the DM78, provide significant opportunities for the tailoring of DM78 applications to specific user requirements.

2.2.9 Typical System Connection #6



Dual Mode Terminal

The configuration illustrated above allows the user to communicate with two host computers at one location. The DM78 works ideally when one host is an IBM host communicating synchronously in EBCDIC, and one is a non-IBM asynchronous ASCII device. This configuration requires non-overlapped and non-dedicated usage.

2.3 CONFIGURATION

The operating configuration of the terminal is defined by the switches on the rear panel and logic board. S1 and S2 are located on the rear panel; up is closed, and down is open. S3 and S4 are accessible with the terminal cover removed; they are marked on the switch or the PC board. Whenever any control switch is changed, it is necessary to reset the terminal (cycle the power switch or depress RESET or **ESC V**) to allow the new switch position to be scanned by the software.

2.3.1 External Switch S1

S1-1
DM78 Mode - Unused
DM5A Mode - Roll Mode

When roll mode is enabled (S1-1 up), data scrolls upward if the cursor is in the bottom line and a line feed code (0AHex) is processed. As a result of the upward scroll, all data on the screen moves up one line, the data previously on the top line is lost, and a new blank line appears at the bottom of the page. This simulates the line feed action of a teletypewriter.

If roll mode is disabled, the display page does not scroll. Instead, a command which attempts to move the cursor down from the bottom line causes the cursor to appear in the top line.

S1-2
DM78 Mode - Autoline Feed Mode
DM5A Mode - Autoline Feed Mode

In auto line feed mode (S1-2 up) a carriage return (CONTROL M or 0DHex) received by the terminal from any source (main port, auxiliary port, or keyboard) causes the terminal to execute a return followed by a line feed. If the keyboard is the source of the instruction and the terminal is on-line, a carriage return is transmitted. If auto line feed is disabled (S1-2 down), only a carriage return is executed and/or transmitted.

S1-3**DM78 Mode - Unused
DM5A Mode - Main Port Full/Half Duplex**

The full and half duplex transmit modes are meaningful only when the terminal is on-line.

When full duplex is enabled (S1-3 up), all keyboard entries are transmitted out the main port and are not displayed or executed locally unless switch S3-8 (auto echo) is enabled. Request to send (RTS, pin 4) remains high while the terminal is on-line in full duplex.

When half duplex is enabled (S1-3 down), all keyboard entries are transmitted out the main port as well as being executed and/or displayed locally. RTS is raised only when a character is transmitted.

S1-4, 5**DM78 and DM5A Modes - Parity**

This switch defines the parity mode as odd, even, mark, or space. If odd or even parity is selected and the terminal receives data with incorrect parity, its bell rings and the ASCII character SUB (CONTROL Z or 1AHex) is displayed in place of the incorrectly-received character.

**Table 2-1
Parity Selection**

Switch	Mark	Space	Odd	Even
S1-4	UP	DOWN	UP	DOWN
S1-5	UP	UP	DOWN	DOWN

S1-6, 7, 8**DM78 & DM5A Modes - Main Baud Rate**

The main port baud rates are selected by these switches. If 110 baud is selected, two stop bits are used; otherwise, one stop bit is used. 19,200 baud is valid only when main port XON/XOFF protocol is selected by switch S3-4. Subhead 5.1.2, explains how the host CPU can select the main port baud rate.

**Table 2-2
Baud Rate Selection**

Baud Rate	SW1-6	SW1-7	SW1-8
110	UP	UP	UP
300	DOWN	UP	UP
1200	UP	DOWN	UP
1800	DOWN	DOWN	UP
2400	UP	UP	DOWN
4800	DOWN	UP	DOWN
9600	UP	DOWN	DOWN
19,200	DOWN	DOWN	DOWN

2.3.2 External Switch S2**S2-1, 2****DM78 & DM5A Modes - Termination Characters**

The user may select the termination character(s) to be transmitted whenever the return key is depressed or after a line send, page send, or function key code is processed.

**Table 2-3
Termination Characters**

Switch	CR	EOT	ETX	CR-LF
S2-1	UP	UP	DOWN	DOWN
S2-2	UP	DOWN	UP	DOWN

S2-3, 4, 5**DM78 & DM5A Modes - Auxiliary Control**

The user may select from eight protocols for controlling data flow through the auxiliary port. Pins 4 (RTS) and 20 (DTR) are always monitored. Dropping RTS or raising DTR causes transmission to cease. If pins 4 or 20 are not used by the auxiliary port device they will not affect data transmission.

**Table 2-4
Auxiliary Port Protocol**

Protocol	S2-3	S2-4	S2-5
DTR (Pin 20)	UP	UP	UP
Pins 11 & 19 READY	DOWN	UP	UP
Pins 11 & 19 BUSY	UP	DOWN	UP
ETX/ACK	DOWN	DOWN	UP
XON/XOFF	UP	UP	DOWN
ACK/NAK	DOWN	UP	DOWN
TTY	UP	DOWN	DOWN
Single Buffer	DOWN	DOWN	DOWN

S2-6, 7, 8**DM78 and DM5A Modes - Auxiliary Baud Rate**

The auxiliary baud rates are specified through these three switches. The switch settings are the same as for the main port baud selection described in Table 2-2. (For host CPU selection of the auxiliary port baud rate refer to Subhead 5.2.1).

2.3.3 Internal Switch S3

This switch is located at A57 on the printed circuit board inside the terminal.

S3-1**DM78 & DM5A Modes - Current Loop Enable**

In terminals configured with logic board 112-2544, the opening of switch S3-1 enables the 20 mA current loop interface.

S3-2

DM78 Mode - Normal/Reverse Video
DM5A Mode - Normal/Reverse Video

This switch defines the visual attributes for normal and reverse video fields. With the switch closed, normal video consists of light characters on a dark background, and reverse video consists of dark characters on a light background. Contrast may have to be adjusted for proper screen display.

S3-3

DM78 Mode - Unused
DM5A Mode - Normal/Half Intensity Video

This switch controls the definition of normal and half intensity display. With the switch open, normal is defined as full intensity.

S3-4

**DM78 & DM5A Modes -
Main Port XON/XOFF**

When S3-4 is closed, XON/XOFF protocol for the main port is enabled. The terminal transmits and responds to DC1 and DC3 (11Hex and 13 Hex). When S3-4 is open, XON/XOFF is disabled.

S3-5

DM78 Mode - Unused
DM5A Mode - Inhibit Escape Code Sequences

When S3-5 is enabled (closed), all keys which generate multi-code escape sequences (such as Page Send) act only locally and are not transmitted (even if the terminal is on line and in full duplex mode).

S3-6

DM78 & DM5A Modes - 50/60 Hz

The terminal video controller and clock are programmed according to this power line frequency setting (open=60 Hz).

S3-7

DM78 Mode - Unused
DM5A Mode - Go On Line

If switch s3-7 is enabled (closed), the terminal will go on-line upon completion of a main port block send when operating in the full duplex mode. After a transmission from the auxiliary port, the terminal will enable that port.

S3-8

DM78 Mode - Unused
DM5A Mode - Auto Echo

When switch S3-8 is enabled (closed), and the terminal is on-line in the full duplex mode, any transmission out the main port is also acted upon locally. This allows full duplex communication without requiring an echo from the host CPU.

2.3.4 Internal Switch S4

This switch is found on the printed circuit board at location A-7.

S4-1

DM78 & DM5A Modes - Keyboard lower-case

If S4-1 is closed, the keyboard will generate both upper and lower case characters. If it is open, lower case characters from the keyboard are converted to upper case before they are displayed or transmitted.

S4-2

DM78 & DM5A Modes - Unused

S4-3

**DM78 Mode -
Auxiliary Port Half/Full Duplex**
**DM5A Mode -
Auxiliary Port Half/Full Duplex**

If S4-3 is closed, and if the main port is in local mode and the auxiliary port is enabled, any data entered from the keyboard is both transmitted and processed locally. If S4-3 is open, when the main port is enabled data is transmitted out of the auxiliary port but is not processed locally.

In the DM5A mode, this switch is only effective when the auxiliary port is enabled. When S4-3 is closed, half duplex is selected; when open, full duplex is selected.

S4-4

DM78 & DM5A Modes-Unused

S4-5

DM78 & DM5A Modes-Main Port RS422

In terminals configured with logic board 112-2538 the opening of switch S4-5 enables RS422 communication. When S4-5 is closed, RS232C is enabled.

S4-6, 7, 8

DM78 & DM5A Modes-Auxiliary Port RS422

In terminals configured with logic board 112-2538, if S4-6 is closed, S4-7 is open, and S4-8 is closed, auxiliary port RS232C is selected. If S4-6 is open, S4-7 is closed, and S4-8 is open, auxiliary port RS422 is selected.

SECTION III

TERMINAL INITIALIZATION

This section instructs the operator in the initial power-up of the DM78 terminal. For troubleshooting during power-up, a table of common error conditions and probable remedies is presented. Using this guide, the operator can identify corrective action in case the DM78 fails to function normally after initialization.

3.1 TURNING ON THE TERMINAL

3.1.1 Power Connection

DO NOT turn on the terminal until all preliminary steps presented in Section II of this manual have been accomplished.

Before the terminal is plugged in and powered up, it must be carefully installed and configured by qualified personnel. The terminal is shipped with a three-conductor power cord which grounds the instrument through the offset pin. The safety feature of this ground must be preserved by grounding the terminal to the outlet box or other earth ground. If it is necessary to use an adapter, ground the pigtail.

CAUTION

Turn POWER SWITCH on rear of terminal OFF before plugging in power cord.

Although the ground pins on the monitor connector as well as the power plug are fashioned to eliminate the hazard of electric shock, **ALWAYS** verify that the **POWER SWITCH** is turned **OFF** before applying power to the terminal.

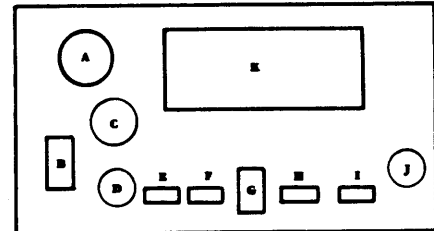
3.1.2 AC Power Requirements

Note the electrical power requirements shown on the identification plate at the rear of the terminal. When turning on the terminal for the first time or after changing the terminal's operating location, make sure that the selected power outlet is properly grounded and that it supplies acceptable voltage and frequency.

3.1.3 Power Up Procedure

Set the POWER ON/OFF switch on the rear panel to ON. Allow a warm-up period of about one minute, confirm that the fan is running, and verify that the cursor and status line are visible on the screen. The cursor is an indicator that shows the location where information will next be written on the display. The status line occupies the 25th display line (the bottom line of the CRT screen) and is displayed in half-intensity reverse video.

Figure 3-1
Terminal Back Panel (typical)



- | | |
|---------------------------------------|------------------------------------|
| A FAN | G KEYBOARD CABLE RECEPTACLE |
| B POWER SWITCH | H SWITCH S1 |
| C FUSE | I SWITCH S2 |
| D POWER CORD | J CONTRAST CONTROL |
| E AUXILIARY PORT I/O CONNECTOR | K EXTERNAL SWITCH USAGE |
| F MAIN PORT I/O CONNECTOR | |

If either the cursor or the status line does not appear, adjust the contrast control knob on the terminal rear panel. Write several characters on the screen by typing from the keyboard. Turn the contrast control knob completely down and then up again until a close inspection of the dot pattern shows blurring; then turn the contrast control back down slightly. This will be a good starting place to insure a recognizable difference between regular and half-intensity visual attributes.

Any time power is initially applied, the terminal performs a self-test of display memory and general terminal operation (the self-test routine is described in more detail in Section 3.2). Because of CRT warm-up time, there is no visible effect on the screen. If the unit is turned off and back on, a display flicker occurs while the test is run.

If any of the normal conditions described above are absent, seek help before proceeding to operate the terminal. Continuing with routine operation when a hardware or software problem is encountered may cause damage to either the data base or the terminal hardware.

3.2 SELF TEST

Key Sequence: DM5A Mode - [ESC f]
DM78 Mode - None

I/O Sequence: [ESC f]

Whenever the terminal power is turned on, a RAM and ROM self-test is executed, the switches are read, and the screen is cleared. The self-testing firmware may also be invoked with an [ESC f] command from the DM5A keyboard or from the host CPU. Any time the test is performed, the terminal is re-initialized to the power-up state. When the logic board completes its test, it requests the keyboard to self test. The keyboard's results are transmitted to the main CPU and integrated with the final result.

3.2.1 Self Test Results

DM5A Mode—When the terminal is powered-up in the DM5A mode, self-test clears all but the first line on the screen to stop-video codes (the first line is cleared to spaces) and places

the terminal in the "on-line" mode (on-line and local modes are explained in Section 4.4. If self test is successful, the message "SYSTEM RDY" appears in Field E of the status line; if the test is not successful, "ERR CHECK" is displayed. The actual messages conveyed in the event of the self-test failure are presented in Table 3-3.

DM78 Mode—When the terminal is initialized in the DM78 mode, self-test clears the screen to spaces. The CPU message deposit (status) line at the bottom of the display is initialized. This line consists of a normal video attribute followed by 79 overlined spaces. If a self-test error occurs, one of the following error messages appears at the far right side of the CPU message line:

- ROM Error
- RAM Error
- KBD Error

**Table 3-1
Troubleshooting**

SYMPTOM	PROBABLE CAUSE	SOLUTION	
		DM78	DM5A
Screen is blank	Terminal unplugged Power not on Contrast control not adjusted	Plug in terminal Turn power ON Adjust contrast control	Plug in terminal Turn power ON Adjust contrast control
Cursor is present No data can be entered from the keyboard	Keyboard locked Terminal in full duplex and CPU not echoing characters	Cycle main power N/A	Cycle main power Set terminal to half duplex or set auto echo to ON (if full duplex)
Cursor is present No data is entered on screen Cursor moves	Security field enabled	Delete security field attribute	Delete security field attribute
All data displayed as graphic symbols	Graphics mode on	N/A	Depress ALT GRAHIC or ESC S
Control characters or escape sequences being displayed instead of being acted upon.	Line monitor mode enabled	N/A	Depress ESC*
ASCII control codes written instead of normal symbols in CPU message deposit line.	Line monitor mode enabled	Depress ALT ESC*	N/A
Characters enlarged horizontally Characters in reverse fields obliterated	Contrast control out of adjustment	Adjust contrast control	Adjust contrast control
Random or SB characters displayed on screen	Incorrect baud rate Incorrect parity setting	Set baud rate on rear panel Make parity selection using	Set baud rate on rear panel Make parity selection on rear panel
Continuous alarm bell	Alarm has been set by code	Enter ALT ESC 9	Depress any key on keyboard
Clock displays invalid time and/or date	Incorrect entry	N/A	Depress ESC SPACE BAR and set hours : minutes
Two characters displayed when one key activated	Half duplex switch selected on full duplex system Full duplex and auto echo	N/A N/A	Enable full duplex switch on rear Turn off auto echo
No response from host CPU	Terminal in LOCAL mode Incorrect parity setting Incorrect baud rate I/O cable faulty or disconnected	No related keyboard function Verify switch settings & connections	Depress ALT LOCAL or ESC n Enable full duplex switch rear panel Verify switch settings & connections
Double line feed	Incorrect auto line feed switch setting	Set auto line feed switch (S1-2) on rear panel DOWN to disable	Set Auto line feed switch (S1-2) on rear panel DOWN to disable
Upper case characters only	Shift lock depressed Lower case enable switch OFF	Release shift lock Set switch S4-1 ON to enable lower case	Release shift lock Set switch S4-1 ON to enable lower case
CPU fails to recognize end of transmission message	Incorrect termination character selected	Select desired termination character using switches on back panel	Select desired termination character using switches on back panel
Partial screen inaccessible to operator (DM5A mode only)	Memory lock asserted Line lock asserted	N/A N/A	Depress ALT MLOCK or ESC h No associated keyboard function ESC V line* from I/O releases line lock
CPU message deposit (status line) missing from display	Status line turned off by keyboard or I/O Empty CPU message displayed	No related keyboard function I/O command is ESC I	Depress STATUS LINE or ESC T

3.3 TROUBLESHOOTING

Most functional problems that occur soon after installation result from an operator's lack of familiarity with the equipment. Some problems appear to be terminal malfunctions when, in fact, an improper mode or function has been selected. Such errors can usually be remedied with a simple keyboard sequence or by changing a switch setting. Table 3-1 on the preceding page describes the corrective action appropriate for some common error conditions.

3.3.1 Alarms and Indicators

Audible Alarms – The terminal emits three distinct audio tones which act as alerts for the operator. These are a bell (a 1200-Hz tone), a low bell (a 600-Hz tone) and a continuous alarm (or warble). A high/low volume control is provided inside the keyboard. Contact Beehive Field Service for instructions if a change to this control is necessary.

Bell – The CONTROL G or 07Hex instruction from the host computer causes the terminal's bell to sound for approximately 83 ms. In the DM5A mode, the bell may also be activated by an `ALT G` command from the keyboard. The bell sounds to alert the operator whenever 1) data entered by the operator moves the cursor through column 72 of the display, 2) the line monitor mode is turned off, 3) odd or even parity is selected and a parity error is detected.

Low Bell – The low tone (600 Hz) is emitted if keyboard data is entered while the terminal is on-line but the transmitter buffer is unable to accept data. (For additional information about data transmission requirements refer to Section V). Sixteen characters may be placed in the transmitter buffer before the tone will sound. It will then sound for every keystroke. To recover from this mode the data link must be restored or a hard reset `ALT SHIFT V` employed.

Continuous Alarm On – The `ESC 8` command from the I/O initiates the terminal's internal alarm (alternating 1200- and 600-Hz tones). In the DM5A mode, the continuous alarm may also be activated from the keyboard with the `ESC 8` sequence. The alarm sounds briefly to indicate an illegal operation, e.g., an attempt to initiate an I/O escape sequence from the keyboard.

Continuous Alarm Off – To turn off the terminal's internal alarm from the DM5A keyboard, strike any key. The I/O operation that turns off the continuous alarm is `ESC 9`.

Clicker – The key inscribed with the horn symbol acts locally to enable audible feedback of key closures. This key has a toggle function and alternately enables and disables the audible click.

3.4 CPU MESSAGE DEPOSIT (DM78 Mode)

In the DM78 mode, the 25th line of display memory is reserved for messages deposited by the host CPU. To write on this line, the host uses the sequence `ESC ; (DATA) GS` where GS is a termination character (CONTROL] or 1DHex).

The message deposit line may also be accessed using the memory address pointer (refer to Section 4.5).

The message deposit line is not accessible by normal typing from the keyboard, cursor movement, or cursor addressing. Once `ESC ;` is entered, all characters are written to the message line without translation or execution, with one exception: the set visual attribute escape sequence `ESC d (ATTRIBUTE)`. All CPU messages should start with this sequence to set an attribute at the beginning of the 25th line; otherwise, the last attribute on the user's writable screen will extend into the CPU message field.

When DM78 mode is initialized, the CPU message deposit line consists of a normal video attribute in the first column followed by 79 overlined spaces. All of the available message symbols contain this overline, and a space with overline is also available. Normal text written into the CPU message line will not be overlined. When the `ESC ;` instruction is received, the CPU message line is cleared to prepare for the updated message. Refer to Table 3-2 for a list of the DM78 status line indicators.

Status Line ON/OFF - The `ESC 1` sequence from the I/O turns on the CPU message deposit line. `ESC 2` from the I/O turns the message deposit line off by replacing it with a video-suppress code.

3.5 TERMINAL STATUS LINE (DM5A Mode)

In the DM5A mode, line 25 is a true status line consisting of eight fields displayed in half-intensity reverse video. The user may establish an alternate status line by using the CPU message deposit feature of DM5A operation (see Subhead 3.5.2). An additional line for host CPU messages may be achieved using the CPU line lock feature. Following is an explanation of the eight fields of the status line and the messages which may appear during terminal operation.

**Table 3-2
Status Line Indicators
(DM78 Mode)**

CHARACTER POSITION	CHARACTER DISPLAYED	FEATURE CONVEYED	MESSAGE CONVEYED
0	0-7	Main Baud Rate	0=110 1=300 2=1200 3=1800 4=2400 5=4800 6=9600 7=19200
1	0-7	Aux Baud Rate	0=110 1=300 2=1200 3=1800 4=2400 5=4800 6=9600 7=19200
2	0-3	Term Character	0=CR-LF 1=ETX 2=EOT 3=CR
3	0-3	Parity Select	0=Even 1=Space 2=Odd 3=Mark
4	0-3	Self-diagnosis	0=NoFault 1=ROM fault 2=RAM fault 3=Keyboard fault
5	0	Unused	
6	0	Roll Mode	0=OFF
7	0-1	Auto Line Feed	0=OFF 1=ON
8	0-7	Printer Mode	0=DTR 1=11/19 RDY 2=11/19 BSY 3=ETX/ACK 4=XON/XOFF 5=ACK/NAK 6=TTY 7=DTR (Single Buffer)
9	1	Duplex Mode	1=FDX
10	0	Auto-Echo	0=OFF
11	0-1	Aux On	0=OFF 1=ON
12	0-1	Main Port	0=On Line 1=Local
13	0	Aux Enable	0=OFF
14	0	Graphic Mode	0=OFF
15	0	Line Lock	0=OFF
16	0	Memory Lock	0=OFF
17	0-1	Keyboard Lock	0=OFF 1=ON
18	0-1	Main XON/XOFF	0=OFF 1=ON
19	0	Unused	
20	0-1	ESC Code Supp.	0=OFF 1=ON
21	0-1	Main Baud Rate	0=Switch Command 1=Software Command
22	0-1	Aux Baud Rate	0=Switch Command 1=Software Command
23	Various	Software Version	ROM Revision Level
24	Various	Software Version	ROM Revision Level
25	Various	Software Version	ROM Revision Level
26	Various	Software Version	ROM Revision Level
27			
28	Various	Keyboard Version	ROM Control Number
29	Various	Keyboard Version	ROM Control Number
30	Various	Keyboard Version	ROM Control Number
31	Various	Keyboard Version	ROM Control Number

Field A - shows the status of the main port, either ON LINE or LOCAL.

Field B - shows Monitor Mode.

Field C - indicates the status of the data set ready line of the main I/O port: DSR indicates true, blank indicates false.

Field D - indicates the status of the auxiliary port: blank is disabled and off, AUX ON is auxiliary connected to main on line, AUX RDY signifies that the auxiliary port is enabled with the keyboard entries going out the auxiliary port, AUX BSY indicates a Pin-20 Not Ready condition when AUX ON/ENABLED.

Field E - indicates main message which is displayed on the following priority basis: 1) Main Send, 2) AUX Send, 3) Error Check for RAM/ROM, 4) Keyboard Lock, 5) Message Wait, 6) Line Lock, 7) Memory Lock, 8) System Ready.

Field F - indicates status of terminal operation. May also indicate 1) Character Insert, 2) Keyboard Error (an error exists in the terminal-keyboard interface - contact Beehive Field Service).

Field G - indicates that the terminal is in graphics mode or that keyboard shift is enabled.

Field H - contains the 24 hour clock in the format

hours:minutes:seconds

Fields F & G are where a 27-character terminal status message appears in character positions 40 through 66 in response to an **[ESC O]**. This action is initiated by the host CPU or by the operator through the keyboard and contains information pertaining to the current terminal operating configuration. This message supersedes the existing display and remains until any keyswitch is pressed. At that time, the 27-character message disappears and the status line returns to its former condition. Table 3-3 assists the operator in interpreting the numeric message presented.

3.5.1 Status Line ON/OFF (DM5A Mode)

<p>Key Sequence: ON - STATUS LINE or [ESC T] OFF - STATUS LINE or [ESC U]</p> <p>I/O Sequence: ON - [ESC T] OFF - [ESC U]</p>

To enable the DM5A status line from the keyboard, depress the STATUS LINE key or depress **[ESC T]**. (The STATUS LINE key toggles, alternately enabling and disabling the line.) The status line is also enabled by the I/O command **[ESC T]**.

To inhibit the status line, press the STATUS LINE key again, or depress **[ESC U]**. An **[ESC U]** command from the host CPU also turns off the status line.

**Table 3-3
Status Line Indicators
(DM5A Mode)**

A		B		C		D		E		F		G		H	
1		2		3		4		5		6		7		8	
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Local On Line	Monitor	DSR	Aux Busy Aux On Aux Ready	Main Send Aux Send Error Check Keyboard Lock Message Waiting Line Lock Memory Lock System Ready	Character Insert Keyboard Error	Graphic Shift	HH:MM:SS								

CHARACTER POSITION	CHARACTER DISPLAYED	FEATURE CONVEYED	MESSAGE CONVEYED
-40	0-7	Main Baud Rate	0=110 1=300 2=1200 3=1800 4=2400 5=4800 6=9600 7=19200
-41	0-7	Aux Baud Rate	0=110 1=300 2=1200 3=1800 4=2400 5=4800 6=9600 7=19200
-42	0-3	Term Character	0=CR-LF 1=ETX 2=EOT 3=CR
-43	0-3	Parity Select	0=Even 1=Space 2=Odd 3=Mark
-44	0-3	Self-diagnosis	0=Nofault 1=ROM fault 2=RAM fault 3=Keyboard fault
-45	0-1	Go On Line	Unused
-46	0-1	Roll Mode	0=OFF
-47	0-1	Auto Line Feed	0=OFF 1=ON
-48	0-7	Printer Mode	0=DTR 1=11/19 RDY 2=11/19 BSY 3=ETX/ACK 4=XON/XOFF 5=ACK/NAK 6=TTY 7=DTR (Single Buffer)
-49	0-1	Duplex Mode	0=HDX 1=FDX
50	0-1	Auto-Echo	0=OFF 1=ON
51	0-1	Aux On	0=OFF 1=ON
52	0-1	Main Port	0=On Line 1=Local
53	0-1	Aux Enable	0=OFF
54	0-1	Graphic Mode	0=OFF
55	0-1	Line Lock	0=OFF
56	0-1	Memory Lock	0=OFF 1=ON
57	0-1	Keyboard Lock	0=OFF 1=ON
58	0-1	Main XON/XOFF	0=OFF 1=ON
59	0-1	CPU Message Waiting	0=NO Message Waiting 1=Message Waiting
60	0-1	ESC Code Supp.	0=OFF 1=ON
61	0-1	Main Baud Rate	0=Switch Command 1=Software Command
62	0-1	Aux Baud Rate	0=Switch Command 1=Software Command
63	Various	Software Version	ROM Revision Level
64	Various	Software Version	ROM Revision Level
65	Various	Software Version	ROM Revision Level
66	Various	Software Version	ROM Revision Level

3.5.2 CPU Message Deposit (DM5A Mode)

I/O Sequence: **ESC; (DATA) GS**

The message following the sequence **ESC;** from the I/O is deposited into an 80-character message buffer, and "MESSAGE WAITING" is displayed in Field E of the status line. The message is terminated by receipt of the GS command (CONTROL | or 1DHex). Messages longer than 80 characters cause overwriting of the 80th character in the message buffer. Any control characters in the message text are displayed and are not acted upon (except GS—the message terminator). If no data is entered with the escape sequence, a blank line is entered in the buffer.

The CPU message deposit instruction may not be initiated by any keyboard entry.

3.5.3 CPU Message ON/OFF (DM5A Mode)

Key Sequence: **ALT MESSAGE DISPLAY**

I/O Sequence: **ON - ESC 1**
OFF - ESC 2

To display the message deposited by the CPU, depress **ALT MESSAGE DISPLAY**. This key toggles causing the deposited message to alternate with the normal DM5A status line. The I/O instruction **ESC 1** also causes the CPU message to be

displayed. To restore the status line in place of the deposited message, depress **ALT MESSAGE DISPLAY** once again. **ESC 2** from the I/O causes the CPU message to be replaced by the status line (if the status line is enabled).

3.5.4 Read Terminal Status (DM5A Mode)

A terminal status message will be transmitted to the I/O if requested by the sequence **ESC O**. The transmitted message consists of the following:

- STX
- 27 status characters
- 8 clock characters (or 8 spaces if clock not set)
- Termination character

The termination character is the switch-defined terminator explained in Section 2.3.2. An explanation of the status bytes is provided in Table 3-3.

If a terminal status message is requested by **ESC O** from the keyboard, the 27-character status message is displayed in the status line (columns 40 to 66). The next keyboard entry (except ALT or SHIFT) removes the message from the status line, and that keystroke is ignored.



SECTION IV LOCAL OPERATION

4.1 SELECTING & CHANGING THE OPERATING MODE

It is the keyboard connected to the terminal at the time of power up that initially determines the terminal's operating mode. Although a two-keyboard configuration is offered as an option, the terminal is fully operational in both modes with either keyboard. The two keyboards may be alternated by the operator as necessary.

Before changing the keyboards, be sure that the terminal is turned OFF.

The operating mode of the terminal can be changed by an instruction from the host CPU or from the keyboard in either mode. There are four methods of mode selection.

4.1.1 Change DM5A Mode to DM78 Mode

An `ESC.C` from the host computer enables the DM78 mode of operation. If the terminal is on line in full duplex, `ALT ESC.C` from the keyboard enables DM78 mode. If on line in half duplex, the keyboard sequence is `ESC.C`.

- Main port DTR and auxiliary port DSR are turned off
- The screen is initialized to the DM78 format
- The cursor is sent home
- Any DM5A modes that were enabled are reset
- The DM78 character generator is selected
- The CPU message deposit line is cleared to a normal video attribute followed by 79 overlined spaces
- The switches are read for mode initialization
- Main port DTR and auxiliary port DSR are turned on

4.1.2 Change DM78 Mode to DM5A Mode

In response to an `ESC.D` from the host computer, the DM5A mode of operation is enabled. `ALT ESC.D` from the terminal keyboard also enables the DM5A mode. The escape sequence from the keyboard is effective whether the terminal is on-line or off-line.

- Main port DTR and auxiliary port DSR are turned off
- The screen is initialized to the DM5A format
- The cursor is sent home

- Any DM78 modes that were enabled are reset
- The DM5A character generator is selected
- The switches are read for mode initialization
- Main port DTR and auxiliary port DSR are turned on

4.1.3 Restore Previous DM78 Screen (Save DM5A Screen)

As discussed in Section 1.3.6, an optional 4K bytes of RAM is required for this operation. In response to an `ESC.F` instruction from the host CPU, the currently-displayed DM5A screen is saved in RAM, and the previous DM78 screen (if it was saved) is restored to the display. The terminal is reset, and the DM78 mode enabled. From the keyboard, the sequence `ALT ESC.F` is effective when the terminal is on line in full duplex. If the terminal is on line in half duplex, use the sequence `ESC.F` from the keyboard.

4.1.4 Restore Previous DM5A Screen (Save DM78 Screen)

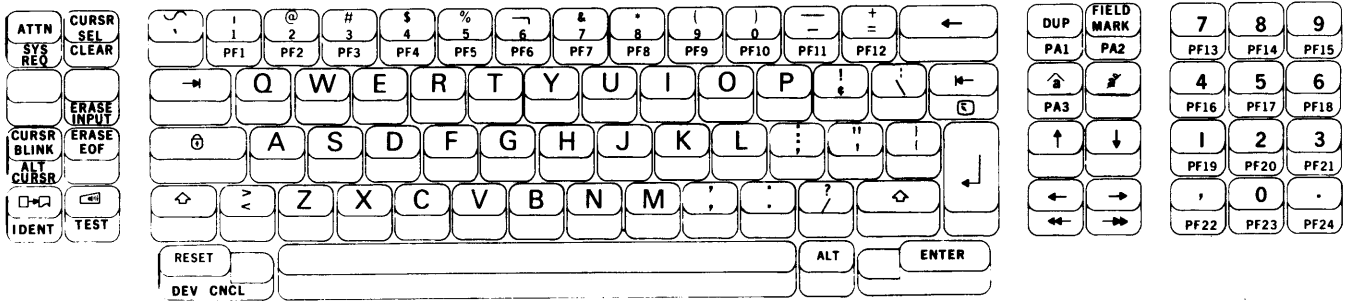
In terminals configured with 8K bytes of RAM, the sequence `ESC.G` from the host computer causes the DM78 screen currently being displayed to be saved in RAM, and the previous DM5A display (if it was saved) is restored to the screen. The terminal is reset, and the DM5A mode is enabled. The sequence `ALT ESC.G` is effective from the keyboard.

4.2 KEYBOARD OPTIONS

4.2.1 DM78 Keyboard

The DM78 keyboard codes are not processed locally during normal operation. Each keystroke produces a code (or codes) for transmission to the host CPU. To cause escape codes to be displayed and/or executed locally in the DM78 mode, the ALT key must be depressed and held down while any normal escape sequence is typed. In cases of the `ALT ESC` combination, no codes are transmitted out the main port. Table 4-1, which follows, illustrates the codes normally transmitted from the DM78 keyboard.

**Figure 4-1
DM78 Keyboard Layout**



**Table 4-1
DM78 Keys and Transmit Codes**

KEY	TRANSMIT CODE	KEY	TRANSMIT CODE
ALT	NONE	↓	ESC B
ATTN	BREAK CONDITION	←	ESC D
SYS REQ	ESC +	→	ESC C
CURSOR SEL	ESC \$	↔	ESC i
CLEAR	ESC E	↔↔	ESC h
(BLANK)	ESC	PF1	ESC p
ERASE INPUT	ESC (	PF2	ESC q
CURSOR		PF3	ESC r
BLINK	(LOCAL FUNCTION)		
ALT CURSOR	(LOCAL FUNCTION)	PF4	ESC s
ERASE EOF	ESC J	PF5	ESC t
IDENT	ESC /	PF6	ESC u
	(LOCAL FUNCTION)	PF7	ESC v
TEST	ESC f	PF8	ESC w
RESET	ESC V		
DEV CNCL	ESC)	PF9	ESC x
		PF10	ESC y
ENTER	ETB (CONTROL W or 17Hex)	PF11	ESC z
↔	HT (CONTROL I or 09Hex)	PF12	ESC { (7BHex)
↔↔	ESC >	PF13	ESC | (7CHex)
↔↔↔	(CONTROL M or 0DHex)		
DUP	ESC %	PF14	ESC } (7DHex)
		PF15	ESC ~ (7EHex)
FIELD MARK	ESC ' (APOSTROPHE or 27Hex)	PF16	ESC DEL (7FHex)
PA1	ESC (SPACE) (SPACE = 20Hex)	PF17	ESC g
PA2	ESC !	PF18	ESC =
PA3	ESC "		
SHIFT *	SO	PF19	ESC 4
SHIFT LOCK*	SI	PF20	ESC 5
^	EM (CONTROL Y or 19Hex)	PF21	ESC 6
↖		PF22	ESC 7
↑	ESC P	PF23	ESC &
	ESC A	PF24	ESC 0

Depressing the SHIFT key causes the control code SO (0EHex) to be transmitted if this option has been selected by the user during a modified boot load. Otherwise, the SHIFT key acts only locally, and no code is transmitted. (Refer to Table 5-5 for a list of the variables affected by the modified boot load feature.) In the same way, SHIFT LOCK transmits the control code SI if the user has selected this option during a modified boot load.

4.2.2 DM5A Keyboard

Figure 4-2
DM5A Keyboard Layout

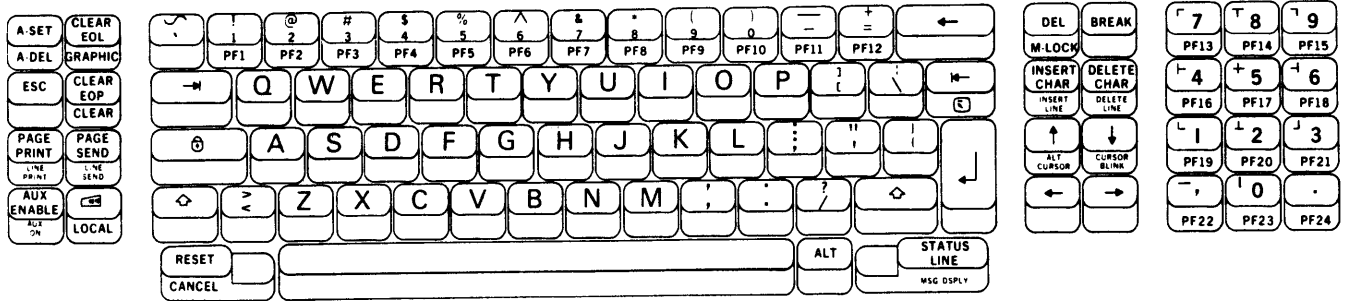


Table 4-2
DM5A Keys and Transmit Codes

KEY	TRANSMIT CODE	KEY	TRANSMIT CODE
ALT	NONE	LOCAL	
ALT + DISPLAYABLE KEY	00 - 1FHex	When going on line	ESC n
ESC	ESC (CONTROL] or 1DHex)	When going off line	ESC N
HOME	ESC H	AUX PAGE SEND	ESC 3
CURSOR UP	ESC A	AUX LINE SEND	ESC 4
CURSOR DOWN	ESC B	AUX ENABLE	
CURSOR RIGHT	ESC C	When enabling	ESC j
CURSOR LEFT	ESC D	When disabling	ESC k
BACKSPACE	BS (CONTROL H or 08Hex)	AUX ON	
RETURN-LINE FEED	CR (CONTROL M or 0DHex)	When going ON	ESC (
TAB	LF (CONTROL J or 0AHex)	When going OFF	ESC)
BACKTAB	HT (CONTROL I or 09Hex)	DELETE	DEL (7FHex)
NUMERIC PAD NUMBER 0-9	ASCII 0-9	STATUS LINE DISPLAY	
COMMA	ASCII ,	When turning ON	ESC T
PERIOD	ASCII .	When turning OFF	ESC U
GRAPHIC CHARACTER	ASCII Equivalent Graphic Character	RESET	ESC V
ATTRIBUTE SET	ESC d	MESSAGE DISPLAY	
ATTRIBUTE DELETE	ESC e	When turning ON	ESC 1
CLEAR EOL	ESC K	When turning OFF	ESC 2
CLEAR EOP	ESC J	FUNCTION KEYS	STX ESC (CODE) TERM. Code
CLEAR	ESC E	Key	p
MEMORY LOCK		PF1	q
If turning memory lock ON	ESC g	PF2	r
If turning memory lock OFF	ESC h	PF3	s
GRAPHIC		PF4	t
If turning graphics ON	ESC R	PF5	u
If turning graphics OFF	ESC S	PF6	v
INSERT LINE	ESC L	PF7	w
DELETE LINE	ESC M	PF8	x
INSERT CHARACTER		PF9	y
If turning mode ON	ESC Q	PF10	z
If turning mode OFF	ESC @	PF11	left bracket {
DELETE CHARACTER	ESC P	PF12	|
PAGE SEND	ESC I	PF13	|
LINE SEND	ESC i	PF14	right bracket }
		PF15	~
		PF16	DEL
		PF17-24	User-Defined*

* - Program function keys 17 through 24 may be programmable by the user, depending upon the option selected using the modified boot load sequence. (refer to Table 5-5). If the option to enable programmable function keys is selected, the instructions for each key are then installed using the standard boot load sequence (refer to Subhead 5.3.1).

4.3 INTRODUCTION TO THE CRT SCREEN

4.3.1 Set Visual Attributes

Key Sequence: **DM78 Mode - None**

DM5A Mode - [A-SET ATTRIBUTE]

I/O Sequence: **[ESC d ATTRIBUTE]**

DM78 Mode - In the DM78 mode, the CRT screen contains 24 usable lines plus the CPU message deposit line (25). All lines have 80 columns. Screen visual attributes such as half-intensity, blink, and reverse video are available. The codes for these attributes occupy a space in display memory and are evident as blanks on the screen. Table 4-3 presents the available visual attributes and their ASCII equivalent characters. The definitions of certain visual attributes rely upon switch settings, as explained in Subhead 2.3.3. For example, under one switch setting normal video consists of light characters on a dark background; under another, normal video is defined as dark characters on a light background.

The sequence **[ESC d ATTRIBUTE]** from the host computer causes one of the twenty-one visual attributes to be established on the screen at the position of the cursor. The visual nature of the display is altered from that point until another visual attribute code is encountered. The last attribute on the screen (excluding the CPU message deposit line) wraps to the start of the screen.

The attribute set escape sequence can be used in a Memory Address Pointer (explained in Section 4.5) or a CPU Message Deposit data stream.

Table 4-3
Visual Attributes
and ASCII Equivalents

Key ASCII Code	Visual Attribute
@	Normal (Stop Visual Attribute)
A	Half-Intensity
B	Blinking
C	Half-Blink
P	Reverse Video
Q	Reverse-Half
R	Reverse-Blink
S	Reverse-Half-Blink
'	Underline-Normal
a	Underline-Half
b	Underline-Blink
c	Underline-Half-Blink
p	Underline-Reverse
q	Underline-Reverse-Half
r	Underline-Reverse-Blink
s	Underline-Reverse-Half-Blink
\$	Security (Invisible)
4	Reverse-Security
5	Half-Reverse-Security
6	Blinking-Reverse-Security
7	Blinking-Half-Reverse-Security

DM5A Mode - The DM5A-style display consists of 24 lines of 80 characters plus a terminal status line (line 25). In the DM5A mode, visual attributes may be placed in display memory using the A-SET key or the **[ESC d]** sequence from the DM5A keyboard, or in response to an **[ESC d]** from the host CPU.

The code for the desired attribute is invisibly placed in display memory at the position of the cursor. A maximum of 16 attributes may be entered in any one line, and no attribute may be entered in column 80.

CAUTIONS - VIDEO ATTRIBUTE DEFINITION

- **DM5A MODE** - An attribute placed in display memory perpetuates through the screen until another attribute code is read, until a null line is encountered, or until the end of the screen is reached. When entire lines are cleared (during power-up, or using one of the clear screen functions) they are assigned null status with stop video codes in column 1. If a null line has not been accessed by the operator or the CPU, it causes any preceding visual attribute to terminate. Accessing the line (e.g. by cursor movement) cancels its null status and allows a previously-entered attribute to continue.
- **DM5A MODE** - Setting a visual attribute in a screen of null lines and then addressing the cursor to null lines produces that attribute only in the lines addressed; lines not addressed remain blank.
- **DM5A MODE** - Care must be taken when setting attributes in the roll mode. If the screen is scrolled a line is lost at the top of the screen, and any visual attribute contained in that line is also lost. Unless an attribute is set in the new top line, the display reverts to normal video.
- **DM5A MODE** - If the roll mode switch is off (page mode enabled) and a carriage return is executed, video attributes to the right of the cursor are erased from memory.
- **DM5A MODE** - A visual attribute placed immediately before a graphic symbol causes that symbol to be displayed as its ASCII equivalent character. (Refer to Table 4-4 for a presentation of graphic symbols and their ASCII equivalents).
- An input code for any attribute will replace the existing attribute at a given display location.
- The security (invisible) attribute causes keyboard entries in that field to be invisible to the operator; however, entered data is secure in display memory and may be read by the host CPU using either the Read Cursor Character or Memory Address Pointer function (explained in Section 4.5). This feature is useful for passwords.

4.3.2 Normal Video (DM5A Only)

Key Sequence: **[ESC m]**

I/O Sequence: **[ESC m]**

A normal video (stop visual attribute) code may be placed in display memory at the cursor location by the sequence `ESC m`, either from the keyboard or the host CPU. This code terminates the prevailing visual attribute. This instruction is equivalent to the `ESC d @` instruction presented in Table 4-3.

4.3.3 Start Blink

Key Sequence: `ESC I`
I/O Sequence: `ESC I`

The blinking video attribute may be initiated from the keyboard or the host CPU by the sequence `ESC I`. This instruction is equivalent to the `ESC d B` code presented in Table 4-3.

4.3.4 Attribute Delete (DM5A Only)

Key Sequence: `ALT A-DEL` or `ESC e`
I/O Sequence: `ESC e`

To delete a visual attribute from display memory, position the cursor at the location of the attribute to be deleted and depress `ALT A-DEL` or `ESC e`. An `ESC e` command from the I/O also deletes the visual attribute at location of the cursor.

4.3.5 Clear Function

Key Sequence: **DM78 Mode** - `ALT CLEAR`
DM5A Mode - `ALT CLEAR` or `ESC E`
I/O Sequence: `ESC E`

DM78 Mode - To clear all information from the DM78 screen, depress `ALT CLEAR`. An `ESC E` sequence from the I/O clears the screen. When either instruction is received, every line on the screen (with the exception of the CPU message deposit line) is cleared to spaces.

DM5A Mode - To clear the DM5A screen, depress either `ALT CLEAR` or `ESC E`. An `ESC E` sequence from the host CPU also clears the screen. All unlocked lines are cleared (data in locked lines is preserved) and the cursor is moved to the home position (column 1 of the first unlocked line).

4.3.6 Clear To End Of Form (DM78 Only)

Key Sequence: `ERASE EOF`
I/O Sequence: `ESC J`

A form is defined on the DM78 screen as the area between two visual attributes. To clear the area from the position of the cursor to the next visual attribute, depress `ERASE EOF`. If an `ESC J` is echoed from the host CPU, the data from (and including) the cursor position to the next visual attribute is deleted. The attribute is not affected.

4.3.7 Clear to End of Line

Key Sequence: **DM78 Mode** - `ALT ESC K`
DM5A Mode - `ESC K` or `CLEAR EOL`
I/O Sequence: `ESC K`

DM78 Mode - To clear all data from the position of the cursor to the end of the line, use `ALT ESC K`. An `ESC K` from the host computer also clears data to the end of the line. When this clear instruction is used, the area from (and including) the position of the cursor to the end of the line is cleared to spaces (the cursor does not move). If a visual attribute immediately precedes the cursor, that attribute is deleted.

DM5A Mode - To clear to the end of a line in the DM5A mode, use the `CLEAR EOL` key or the sequence `ESC K`.

4.3.8 Clear to End of Page (DM5A Only)

Key Sequence: `CLEAR EOP` or `ESC J`
I/O Sequence: `ESC J`

To clear all data from the position of the cursor to the end of the screen, depress `CLEAR EOP` or `ESC J`. An `ESC J` instruction from the I/O also clears the screen. When `CLEAR EOP` is activated, the area to the end of the line is cleared to spaces. The remaining lines, to the end of the screen, are cleared to stop video codes, and the cursor does not move. If a visual attribute immediately precedes the cursor, that attribute is deleted. Locked lines are unaffected by the `CLEAR EOP` instruction.

4.3.9 Clear By Space Insertion

Subhead 4.7.5 describes the escape sequence that allows the user to fill a field on the screen with a selected character. With the cursor position as the beginning of the field and a user-selected address specifying the end of the field, the appropriate escape sequence will cause the field to be cleared to spaces.

4.4 MODES OF OPERATION

4.4.1 Graphic Mode (DM5A Only)

Key Sequence: **Graphic Mode ON** - `ESC R` or `ALT GRAPHIC` (key toggles)
Graphic Mode OFF - `ESC S` or `ALT GRAPHIC`
I/O Sequence: **Graphic Mode ON** - `ESC R`
Graphic Mode OFF - `ESC S`

`ALT GRAPHIC` or `ESC R` from the keyboard or `ESC R` from the host computer enables screen line drawing, providing access to the eleven graphic symbols depicted on the keys in the ten-key numeric pad. Once the graphic mode is enabled, the keys 0 through 9 on the pad (as well as the keys bearing the ASCII equivalent characters shown in Table 4-4) produce graphic symbols in display memory and transmit their ASCII equivalents to the host processor. In the graphic mode, other ASCII characters or control codes are displayed and/or executed normally. When this mode is enabled, the message "GRAPHIC" appears in Field G of the status line.

Displayed graphic symbols assume one of the following qualities, depending on the attribute last set from the keyboard.

- Normal intensity
- Half intensity
- Normal intensity, blinking
- Half intensity, blinking

Any time the SHIFT key is held down and the numeric pad keys with graphic symbols on their faces are struck, graphic symbols are entered in display memory. If the terminal is on line, the ASCII equivalent characters are transmitted to the host.

To disable the graphic mode, depress **ALT GRAPHIC** once again or depress **ESC S**. The **ESC S** sequence from the host CPU also disables the graphic mode.

CAUTION:

- If a graphic symbol immediately follows a visual attribute code, the graphic symbol is displayed as its ASCII equivalent.
- If a Read Cursor Character or a Read Memory Address Pointer instruction is executed over a graphic symbol, the ASCII equivalent of the graphic symbol is read.

Table 4-4
Graphic Symbols & ASCII Equivalents

Symbol	ASCII Equivalent			
	Normal	Half	Blink	Half/Blink
ⓐ	@	A	B	C
ⓓ	D	E	F	G
ⓗ	H	I	J	K
Ⓛ	L	M	N	O
Ⓟ	P	Q	R	S
Ⓣ	T	U	V	W
Ⓝ	X	Y	Z	[
Ⓝ	\]	^	-
Ⓝ	'	a	b	c
Ⓝ	d	e	f	g
Ⓝ	h	i	j	k

4.4.2 Keyboard Lock

Keyboard Sequence: DM78 - None DM5A - ESC c
I/O Sequence: Lock- ESC c Unlock- ESC b

In both operating modes, an **ESC c** from the host computer disables the keyboard. In the DM5A mode, **ESC c** may also be initiated by the operator from the keyboard. When the keyboard is disabled, all typed entries are ignored, both for processing and transmission, with the exception of the hard reset. The I/O command which enables the keyboard is **ESC b**. In the DM5A mode, the disabled keyboard is indicated by the message "KEYBD LOCK" displayed in reverse video in Field E of the status line.

Hard Reset - The command **ALT SHIFT V**, or hard reset, restores the terminal to its original powered-up state, including the performance of the terminal self-test (see power-up description in Section 3.1.3). This function may be performed under all conditions.

Soft Reset - The soft reset (RESET key in DM78 mode, RESET or **ESC V** in DM5A mode) will not function in the event of a keyboard lock. Under circumstances other than keyboard lock, soft reset re-initializes the terminal to its power-on state, reading the switch settings but not performing a self-test. With a soft reset, the information on the screen is saved, the cursor is moved to the home location, and the bell rings. The terminal does not change mode.

4.4.3 Line Monitor

Key Sequence: Line Monitor ON - ALT ESC : Line Monitor OFF - ALT ESC *
I/O Sequence: Line Monitor ON - ESC : Line Monitor OFF - ESC *

The Line Monitor mode is a method of checking the communication link between the host computer and the terminal. To enter the Line Monitor mode while on-line in either the DM78 or the DM5A mode, type **ALT ESC :**. (If the terminal is in the DM5A mode, and if the Local mode is enabled, simply type **ESC :**.)

In Line Monitor mode all entered data, including all control characters and escape sequences, is entered directly into display memory without execution. The Line Monitor mode displays all 128 ASCII codes, including control codes such as NULL and ESCAPE (refer to Table 4-5, Control Code Symbols). The **only** code that is executable while in this mode is the **ALT ESC *** sequence which causes the terminal to exit the Line Monitor mode. This is true for characters both received and transmitted in half duplex (half duplex transmission is not a feature of the DM78 mode) or received in full duplex.

If the terminal is operating in the DM5A mode, the message "MONITOR" is displayed in Field B of the status line. If operation is in the DM78 mode, a DM5A normal video attribute is written at the cursor position (this allows display of ASCII characters instead of the symbols normally used in the DM78 CPU message line), and "MONITOR" is displayed in the right-most portion of the message line.

To exit the Line Monitor mode while the terminal is on-line type **ALT ESC ***. If the terminal is off-line in the DM5A mode type **ESC ***. When the Line Monitor mode is disabled, the terminal's bell sounds briefly, and routine operation is restored.

Table 4-5

CONTROL CODE SYMBOLS CHART			
@ - N _L	H - B _S	P - D _L	X - C _N
A - S _H	I - H _T	Q - D ₁	Y - E _M
B - S _X	J - L _F	R - D ₂	Z - S _B
C - E _X	K - V _T	S - D ₃	[- E _C
D - E _T	L - F _F	T - D ₄	\ - F _S
E - E _D	M - C _R	U - N _K	] - G _S
F - A _K	N - S _D	V - S _V	^ - B _S
G - D	O - S _I	W - E _B	_ - U _S

4.4.4 On Line/Off Line

Key Sequence:	
DM78 Mode - On Line	None
Off Line	ALT ESC N
DM5A Mode - On Line	ESC n or ALT LOCAL (key toggles)
If HDX	Off Line ESC N or ALT LOCAL
If FDx	Off Line ALT ESC N or ALT LOCAL
I/O Sequence:	
On Line	ESC n
Off Line	ESC N

DM78 Mode - When the terminal is in the off line mode, bi-directional communication between the main port device and the keyboard is disabled. However, the main port receiver is not totally disabled, and continues to monitor for and execute the escape sequences listed below. To restore on line operation in the DM78 mode requires an **ESC n** command from the host CPU.

ESC (	AUX ON
ESC)	AUX OFF
ESC ;	CPU MESSAGE DEPOSIT
ESC V	RESET
ESC n	GO ON-LINE
ESC A	SET MEMORY ADDRESS POINTER

While the terminal is off line, any operator entries will be processed by the terminal and/or entered into display memory.

DM5A Mode - When the DM5A mode of operation is changed to off line, bi-directional communication between the CPU and the terminal is disabled. However, the main port receiver continues to monitor for and execute the escape sequences listed above.

4.4.5 Write Control Mode

Key Sequence (DM5A only):	ESC 6 (Character)
I/O Sequence:	ESC 6 (Character)

When an **ESC 6 (CHARACTER)** sequence is received from the host CPU (or, in the DM5A mode, is executed from the keyboard) the character which follows the escape sequence is written directly into display memory—even if it is normally an executable character. The character entered can be any control or displayable character, such as line feed, carriage return, or null.

4.4.6 Memory Lock/Line Lock (DM5A Only)

Key Sequence:	
Memory Lock	ESC g or ALT MLOCK (key toggles)
Memory Unlock	ESC h or ALT MLOCK
I/O Sequence:	
Memory Lock	ESC g
Memory Unlock	ESC h

In the DM5A mode, memory lock is initiated by the I/O instruction **ESC g**. From the keyboard, memory lock is activated either by an **ESC g** sequence or by depressing **ALT MLOCK**. When display memory is locked, all lines above the position of the cursor are locked and inaccessible to the operator. The CPU can access the locked lines through the use of the memory pointer (refer to Subhead 4.6). Memory-locked lines are transmitted during page sends in the DM5A mode of operation.

To unlock display memory, depress **ALT MLOCK** or **ESC h** from the keyboard. The I/O sequence **ESC h** also unlocks display memory.

Line Lock

Key Sequence: Illegal (Sounds Alarm)	
I/O Sequence: Line Lock	ESC < (LINE NUMBER)
Line Unlock	ESC = (LINE NUMBER)

In the DM5A mode, line lock is initiated by the I/O operation **ESC < (LINE NUMBER)**. There is no related keyboard operation to enable a line lock, and if the instruction is attempted from the keyboard the terminal alarm sounds. When line lock is activated, the line number following the **ESC <** sequence is locked and inaccessible to the operator. Locked lines are transmitted during page send in the DM5A mode. The line number associated with this instruction must be one of the ASCII line numbers presented in Table 4-6.

Display lines are unlocked by the I/O instruction **ESC = LINE NUMBER**. This escape sequence is an illegal operation from the keyboard, and if attempted, causes the alarm to sound.

All locked lines on the display (not memory-locked lines) can be released by the I/O instruction **ESC ?**.

4.5 CURSOR CONTROL FUNCTIONS

The cursor is a visual indicator that shows the location where information will next be written on the display. The display is divided into line and column locations: lines are numbered as they descend vertically, from 1 to 24; columns are numbered left to right, from 1 to 80. Cursor controls are provided on the keyboard to rapidly move the cursor to areas where information needs to be entered or manipulated.

4.5.1 Define Cursor Characteristics

The appearance of the cursor can be defined by the user to be either a blinking or non-blinking block or a blinking or non-blinking underline.

BLINKING CURSOR

Key Sequence: DM78 Mode - **CURSOR BLINK**
(Key toggles)
DM5A Mode - **ALT UP ARROW**
(Key toggles)

If the present cursor is blinking, it may be replaced with a non-blinking cursor by depressing the **CURSOR BLINK** key (DM78 Mode) or by depressing **ALT UP ARROW** (DM5A mode). These keys toggle, and alternately enable and disable the blinking cursor.

BLOCK OR UNDERLINE

Key Sequence: DM78 Mode - **ALT CURSOR BLINK**
(Key toggles)
DM5A Mode - **ALT DOWN ARROW**
(Key toggles)

If the cursor on the screen is a block, it may be changed to an underline by depressing **ALT CURSOR BLINK** (DM78 mode) or **ALT DOWN ARROW** (DM5A mode).

4.5.2 Cursor On/Off

Key Sequence: DM78 Mode - None
DM5A Mode - **ESC Z**
I/O Sequence: ESC Z

The **ESC Z** sequence from the host CPU (or from the DM5A keyboard) toggles the displayable cursor, with the first **ESC Z** causing the cursor to become invisible, and the next **ESC Z** causing the cursor to reappear. Nonvisual cursor functions remain available while the cursor is invisible.

4.5.3 Cursor Up

Key Sequence: DM78 Mode - UP ARROW
DM5A Mode - UP ARROW or **ESC A**
I/O Sequence: ESC A

The CURSOR UP key bears the symbol of the up arrow. When this key is activated, the cursor moves up to the next line (in the DM5A mode, the next unlocked line), maintaining the same column position. If the cursor is on line 1, or if there are no unlocked lines above the cursor, it wraps to line 24. If line 24 is locked, the cursor proceeds to the lowest unlocked line. If only one line on the screen is unlocked, the cursor will not move in response to the CURSOR UP key.

The sequence **ESC A** from the host computer or from the DM5A keyboard also initiates the cursor up action.

4.5.4 Vertical Tab (DM5A Only)

Key Sequence: ALT K
I/O Sequence: VT (CONTROL K or 0BHex)

The vertical tab function is identical to that of the CURSOR UP

key and is initiated by the **ALT K** sequence from the DM5A keyboard. From the host CPU, vertical tab is prompted by the code VT (CONTROL K or 0BHex).

4.5.5 Cursor Down

Key Sequence: DM78 Mode - DOWN ARROW
DM5A Mode - DOWN ARROW or **ESC B**
I/O Sequence: ESC B

The CURSOR DOWN key bears the symbol of a down arrow. When this key is activated, the cursor moves down one line, maintaining the same column position. (In the DM5A mode, the cursor moves to the next unlocked line). If the cursor is on line 24 (or if line 1 is locked) the cursor moves to the top-most unlocked line. If there is only one unlocked line on the display, the cursor does not move in response to the CURSOR DOWN key.

The sequence **ESC B** from the host computer or from the DM5A keyboard also initiates the cursor down action.

4.5.6 Cursor Left

Key Sequence: DM78 Mode - LEFT ARROW
DM5A Mode - LEFT ARROW or **ESC D**
I/O Sequence: ESC D

The CURSOR LEFT and BACKSPACE keys bear the symbol of the left arrow (the backspace key is double the width of the cursor left key), and their cursor control functions are identical. When either of these keys is activated, the cursor moves one character position to the left, remaining on the same line. If this function is activated when the cursor is in column 1 of a line, the cursor wraps to column 80 of the next previous line (in the DM5A mode, the next previous unlocked line). If CURSOR LEFT is activated when the cursor is at HOME, (or in column 1 with no unlocked line above the cursor) it wraps to column 80 of the lowest unlocked line.

The sequence **ESC D** from the host computer or from the DM5A keyboard also initiates the cursor left action.

Rapid Left (DM78 Only)

Key Sequence: ALT LEFT ARROW
I/O Sequence: ESC I

The alternate function of the cursor left key is a rapid cursor movement to the left.

4.5.7 Backspace

Key Sequence: DM78 Mode - None
DM5A Mode - **ALT H**
I/O Sequence: BS (CONTROL H or 08Hex)

The BS instruction (CONTROL H or 08Hex) from the host CPU initiates the backspace action. From the DM5A keyboard, the sequence **ALT H** may be used.

4.5.8 Cursor Right

Key Sequence: DM78 Mode - RIGHT ARROW DM5A Mode - RIGHT ARROW or ESC C
I/O Sequence: ESC C

The CURSOR RIGHT key bears the symbol of the right arrow. When this key is activated, the cursor moves one character position to the right, remaining on the same line. If cursor right is activated when the cursor is in column 80 of a line, the cursor wraps to column 1 of the next line (in the DM5A mode, to the next unlocked line). If cursor right is activated when the cursor is in column 80 of the bottom line, the cursor wraps to the HOME position (in the DM5A mode, to the column 1 of the first unlocked line).

The sequence **ESC C** from the host CPU or from the DM5A keyboard also initiates the cursor right action.

Rapid Right (DM78 Only)

Key Sequence: ALT RIGHT ARROW
I/O Sequence: ESC h

The alternate function of the cursor right key is a rapid cursor movement to the right.

4.5.9 Space Bar

The use of the SPACE BAR writes a space into display memory and moves the cursor one character position to the right. The SPACE BAR is a *destructive* key, and if it is used to move the cursor over displayed data the data is deleted from the display and lost from memory.

When a space is written in the last character position of a line, the cursor wraps to column 1 of the next (unlocked) line. If the space bar is depressed when the cursor is in column 80 of the bottom line, the cursor moves to the HOME location.

DM5A Roll Mode - If the terminal is in the DM5A mode, and if roll mode is enabled, the depression of the SPACE BAR with the cursor in column 80 of the bottom line causes the screen to scroll up one line. When the display scrolls the data from the top line is lost, and the cursor moves to column 1 of the new blank line at the bottom of the display.

4.5.10 Tab

Key Sequence: DM78 Mode - TAB DM5A Mode-TAB or ALT I
I/O Sequence: HT (CONTROL I or 09Hex)

The TAB key bears the symbol of a right arrow pointing to a short vertical line.

DM78 Mode - In the DM78 mode, tab stops are defined by the placement of visual attribute codes within the display. A received TAB instruction advances the cursor to the position following the next attribute code on the screen. If the cursor is beyond the last attribute on the screen (or if the final attribute code is in the last character position on the screen) the cursor advances to the HOME position and then moves to the position

following the first attribute code. If no visual attributes are defined, a TAB instruction moves the cursor to the HOME position.

DM5A Mode - When the terminal is initialized in the DM5A mode, tab stops are set at columns 1, 9, 17, 25, 33, 41, 49, 57, 65, and 73. In this mode, the TAB key moves the cursor to the next pre-defined tab stop on a line. If the cursor is located beyond the last tab stop on a line, it advances to the first tab stop on the next unlocked line. If the cursor is located on the bottom line (or if no unlocked lines are below the cursor) it advances to the first tab stop in the first unlocked line on the screen.

Roll Mode (DM5A) - If roll mode is enabled and the cursor is located after the last tab stop in the bottom line, the screen scrolls upward, the top unlocked line is lost, and the cursor moves to the first tab stop on the new blank bottom line.

The HT instruction (CONTROL I or 09Hex) from the host CPU or the instruction **ALT I** from the DM5A keyboard initiates the same action as the activation of the TAB key.

4.5.11 Change Pre-Defined Tab Settings (DM5A only)

In the DM5A mode, the pre-defined tab settings may be changed by short escape sequences from either the host CPU or the DM5A keyboard.

ESC - Clear all Tabs
ESC + Clear Single Tab at Current Cursor Column
ESC , Set Tab at Current Cursor Column

If all tab stops are cleared, the activation of the TAB key moves the cursor to column 1 of the next unlocked line. If TAB is activated when the cursor is on the bottom line, or if there are no unlocked lines below the cursor, the cursor moves to column 1 of the first unlocked line.

To restore all tab stops to their original power-up locations, use the SOFT RESET function (RESET or **ESC V**).

CAUTION: SOFT RESET allows the terminal to be reset while preserving the information on the screen. This instruction, rather than the HARD RESET, should be used to restore tab settings.

4.5.12 Backtab

Key Sequence: DM78 Mode - BACKTAB DM5A Mode - BACKTAB or ESC >
I/O Sequence: ESC >

The BACKTAB key bears the symbol of the left arrow pointing to a short vertical line. In the DM78 mode, the BACKTAB instruction moves the cursor to the position following the first previous visual attribute code. If a visual attribute code occupies the position immediately preceding the cursor, the cursor advances to the position following the next previous attribute code. If no attributes precede the cursor, or if no visual attributes have been defined, the cursor moves to the HOME position. If a BACKTAB is executed with the cursor in the HOME position, the cursor does not move.

In the DM5A mode, BACKTAB moves the cursor to the first previous pre-defined tab stop. If the cursor is located at the first tab stop on a line, the BACKTAB key moves the cursor to the last tab stop on the previous unlocked line. If the cursor is in the first line, the BACKTAB action stops at the HOME position. (If BACKTAB is activated with the cursor at the HOME position, the cursor does not move.)

The instruction **[ESC>]** from the host CPU or from the DM5A keyboard also initiates the backtab function.

4.5.13 Home

Key Sequence: DM78 Mode - **[ALT BACKTAB]**
 DM5A Mode - **[ALT BACKTAB]** or **[ESC H]**
I/O Sequence: **[ESC H]**

The HOME position is the intersection of column 1 and row 1 at the top left corner of the display. The HOME key is the alternate of the BACKTAB key, and is denoted by the diagonal arrow pointing to a short horizontal line. The keyboard operation for the home function is **[ALT BACKTAB]**.

When HOME is activated, the cursor moves to column 1 of row 1 (in the DM5A mode, to column 1 of the first unlocked line on the display.)

An **[ESC H]** sequence from the host CPU or the DM5A keyboard also moves the cursor to the HOME position.

4.5.14 New Line (Carriage Return and Line Feed)

Key Sequence: DM78 Mode - DOWN/LEFT ARROW
 DM5A Mode - DOWN/LEFT ARROW
 or **[ALTM]**
I/O Sequence: CR (CONTROL M or 0DHex)

The NEW LINE key bears the symbol of the down and left arrow. A CR instruction (CONTROL M or 0DHex) from the host CPU, or the sequence **[ALTM]** from the DM5A keyboard, also initiates the NEW LINE instruction.

DM78 Mode - In the DM78 mode, NEW LINE moves the cursor to column 1 of the current cursor line. In addition, a line feed is executed if switch S1-2 (auto line feed) on the rear of the terminal is UP. No scrolling of the display occurs, and no data is erased.

DM5A Mode - When the NEW LINE key is activated, the cursor moves to column 1 of the current line. If auto line feed is enabled (switch S1-2 UP), a line feed is executed. If a visual

attribute immediately precedes the cursor, it is deleted. If the cursor is on the bottom line, and roll mode is disabled, the cursor wraps to column 1 of the top unlocked line. If roll mode is enabled, the screen scrolls up one line, the top unlocked line is lost, and the cursor moves to column 1 of the new blank bottom line.

4.5.15 Line Feed

Key Sequence: DM78 Mode - None
 DM5A Mode - **[ALT J]**
I/O Sequence: LF (CONTROL J or 0AHex)

The LF instruction (CONTROL J or 0AHex) from the host CPU initiates the line feed function in both modes. In addition, the sequence **[ALT J]** from the DM5A keyboard initiates the line feed function.

DM78 Mode - In response to a line feed instruction, the cursor moves down to the next line, remaining in the same column. If the cursor is on the bottom line, it moves to the same column position in the top line.

DM5A Mode - The line feed instruction moves the cursor to the same column position in the next line. If the cursor is located at the bottom line, and if roll mode is disabled, the cursor wraps to line 1 of the first unlocked line. If roll mode is enabled, the screen scrolls up one line, the top unlocked line is lost, and the cursor moves to the same column position in the next new blank bottom line.

4.6 COMMUNICATED CURSOR FUNCTIONS

4.6.1 Cursor Address

Key Sequence: DM78 Mode - None
 DM5A Mode -
[(ESC F) (LINE ADDRESS) (CHARACTER ADDRESS)]
I/O Sequence: **[(ESC F) (LINE ADDRESS)**
(CHARACTER ADDRESS)]

The escape sequence shown above - either from the host CPU or the DM5A keyboard - moves the cursor to any specified legal address within display memory. In the DM5A mode, locations in locked or memory-locked lines are not legal entries for cursor addressing.

Table 4-6 depicts the ASCII characters that correspond to the possible line and column addresses. Example:

Line 10, Column 47 = **[(ESC F) N]**

Table 4-6
Cursor Addresses and ASCII Equivalents

Line or Column	ASCII Character	Line or Column	ASCII Character	Line or Column	ASCII Character
1	Space	28	;	55	V
2	!	29	<	56	W
3	"	30	=	57	X
4	"	31	>	58	Y
5	\$	32	?	59	Z
6	%	33	@	60	[
7	&	34	A	61	\
8	'	35	B	62]
9	(	36	C	63	^
10	)	37	D	64	_
11	*	38	E	65	`
12	+	39	F	66	a
13	,	40	G	67	b
14	-	41	H	68	c
15	.	42	I	69	d
16	/	43	J	70	e
17	0	44	K	71	f
18	1	45	L	72	g
19	2	46	M	73	h
20	3	47	N	74	i
21	4	48	O	75	j
22	5	49	P	76	k
23	6	50	Q	77	l
24	7	51	R	78	m
25	8	52	S	79	n
26	9	53	T	80	o
27	:	54	U		

4.6.2 Cursor Sense

Key Sequence: DM78 Mode - None
DM5A Mode - Illegal (sounds alarm)
I/O Sequence: ESC /

When the sequence **ESC /** is received from the host CPU, the current cursor position is transmitted to the host as a cursor address escape sequence **(ESC F) (LINE ADDRESS) (CHARACTER ADDRESS)**. Line and column are the ASCII equivalents listed in Table 4-6 above.

4.6.3 Read Cursor Character

Key Sequence: DM78 Mode - None
DM5A Mode - Illegal (sounds alarm)
I/O Sequence: ESC G

When an **ESC G** sequence is received from the host CPU, the character at the current cursor position is transmitted. If the cursor is positioned over a visual attribute, the ASCII SB character (1AHex) is transmitted. The cursor does not move after the character is read. If the terminal is in the DM5A mode and the cursor is positioned over a graphic symbol, the ASCII equivalent character (refer to Table 4-4) is transmitted to the host.

4.6.4 Set Memory Pointer

Key Sequence: DM78 Mode - None
DM5A Mode - Illegal (sounds alarm)
I/O Sequence:
(ESC V)(LINE ADDRESS)(CHARACTER ADDRESS)(DATA)
(GS)

This host-generated escape sequence establishes a CPU-controlled, invisible cursor at the line and character address specified. The line and column addresses are the ASCII codes listed in Table 4-6. If no data is to be displayed at the position of the memory pointer, a GS (CONTROL J) or 1DHex) is entered after the character address in the escape sequence. If data is intended for display at the pointer address, it is entered after the character address and before the GS. The entered data is then written to display memory, starting at the pointer location. As characters are written, the pointer moves one character position to the right, wrapping from line to line and from the bottom to the top of the display.

DM78 Mode - Any control codes included in the data are displayed without translation, with one exception: the sequence which sets visual attributes **ESC d (ATTRIBUTE)** is recognized and executed, creating the indicated attribute at the location of the pointer.

The memory address pointer may be used to write in the CPU message deposit line by addressing line 25. When writing in the CPU message deposit line, the pointer increments from character to character, but stops at the end of the line. Any additional data over-writes the last entry (column 80).

DM5A Mode - Locked lines, memory-locked lines, and protected fields are accessible to the memory address pointer.

4.6.5 Read Data at Memory Pointer

Key Sequence: DM78 Mode - None
DM5A Mode - Illegal (sounds alarm)
I/O Sequence: ESC -

The sequence **ESC -** from the host CPU causes the character at the location of the memory address pointer to be transmitted. If the character at the pointer location is a visual attribute, the ASCII SB character (1AHex) is transmitted. After a character is read, the pointer moves one character location to the right, wrapping from line to line, and from the bottom to the top of the screen. No scrolling occurs. In the DM78 mode, if the CPU message deposit line is being read, the memory address pointer stops at the end of the line (column 80).

If the terminal is in the DM5A mode, and if the character being read is a graphic symbol, the ASCII equivalent of that symbol (see Table 4-4) is transmitted to the host.

4.7 EDITING FUNCTIONS

4.7.1 Insert Character

Key Sequence (DM5A only): Insert ON: ESC Q or INSERT CHAR (key toggles) Insert OFF: ESC @ or INSERT CHAR I/O Sequence (both modes): Insert ON: ESC Q Insert OFF: ESC @

DM78 Mode - The insert character mode is enabled by the host CPU and remains on until turned off by the **ESC @** instruction. When a character is inserted, all characters from the cursor position to the beginning of the next visual attribute move one position to the right, and the character that immediately precedes the visual attribute code is lost.

The inserted character is displayed at the cursor position, and the cursor advances one position to the right. If the cursor is located beyond the last attribute on the screen, all characters to the end of the screen move one position to the right, and the last character on the display (column 80) is lost.

DM5A Mode - When a character is inserted, all characters from the cursor position to the end of the line move one position to the right, and the last character on the line is lost. The inserted character is displayed at the cursor position, and the cursor advances one position to the right. The insert mode remains on until disabled by the **INSERT CHAR** key or the **ESC @** sequence.

4.7.2 Delete Character

Key Sequence (DM5A only): ESCP or DELETE CHAR I/O Sequence (both modes): ESCP

DM78 Mode - The sequence **ESC P** from the host CPU deletes the character at the cursor position, and all characters from the cursor to the next visual attribute (or the end of the line, whichever is first) move one position to the left. A space is inserted before the visual attribute or line ending. The deletion of one character disables the delete character mode.

DM5A Mode - The activation of **DELETE CHAR** or the sequence **ESC P** deletes the character at the cursor position, and all characters from the cursor to the end of the line move one position to the left. A space is inserted at the end of the line. Visual attributes are not affected by the delete action and remain fixed. The deletion of one character disables the delete mode.

4.7.3 Insert Line (DM5A only)

Key Sequence: ESCL or ALT INSERT LINE I/O Sequence: ESCL
--

The line on which the cursor is positioned, and all unlocked lines below it, scroll down. A line of spaces is inserted at the cursor line, and the bottom line is lost. The cursor moves to column 1 of the new blank line.

4.7.4 Delete Line (DM5A only)

Key Sequence: ESCM or ALT DELETE LINE I/O Sequence: ESCM
--

The line on which the cursor is positioned is deleted, and all unlocked lines below the cursor scroll up one line. A blank line is inserted at the bottom of the screen. The cursor remains on the same line, but moves to column 1.

4.7.5 Repeat Character to Address

Key Sequence: None I/O Sequence: (ESC.H)(ROW)(COLUMN)(CHARACTER)

This sequence from the host processor causes the area from (and including) the position of the cursor to (and including) the specified row and column address to be filled with the character specified in the escape sequence. If a space is selected as the repeat character, the field defined in the escape sequence is cleared.

If the address specified is above the position of the cursor, the area from the cursor and to the end of the screen (except the message deposit line) is filled, as well as the area from the HOME position to the specified address.

If the address specified is the same as the cursor position, the entire screen (except the message deposit line) is filled with the specified character.

The row and column address codes are presented in Table 4-6 on the preceding page.

SECTION V COMMUNICATION

5.1 MAIN PORT COMMUNICATION

**Table 5-1
Main Port Pin Definition**

5.1.1 Transmit On/Transmit Off (XON/XOFF) Protocol

In both the DM78 and DM5A modes, the main port supports a switch-selectable, full duplex line protocol that allows the terminal to control data transmission and reception. This protocol, called XON/XOFF, enables maximum transmission rates to be used. Because XON/XOFF protocol requires simultaneous transmission and reception of data, its use is limited to systems operating in full duplex. (Terminals operating 19.2k baud **must** operate with the XON/XOFF protocol enabled.)

The terms XON and XOFF, as they are used here, mean:

XON	Transmit On	DC1 (CONTROL Q or 11 Hex)
XOFF	Transmit Off	DC3 (CONTROL S or 13 Hex)

These codes interrupt transmission as necessary to prevent data loss.

Related Switch Usage – Internal switch S3-4 enables or disables the XON/XOFF protocol for the main port. When XON/XOFF protocol is disabled (switch S3-4 OFF), XON/XOFF codes received by the terminal are ignored, and the terminal's main receiver buffer is not monitored so these codes are not transmitted by the terminal.

When XON/XOFF is disabled, the data transmitted by the terminal is controlled only by hardware interface pins 5 (CTS) and/or 6 (DSR). (Refer to Table 5-1 for a description of the interface pins used in the RS232C interface configuration.)

When XON/XOFF protocol is disabled, the quantity of unprocessed data in the receive buffer is not monitored. The user must compensate for timing anomalies between devices within the data stream. For example, instructions such as CLEAR SCREEN or ATTRIBUTE SET require more time for their execution than functions such as RETURN, BACK SPACE, or TAB. Depending on the effective baud rate and the frequency of such codes in the data stream, the insertion of null characters or delete codes may be required to avoid buffer overflow and data loss.

Pin #	RS232C Name	Description
1	AA	A direct connection to the DM5 frame, called CHASSIS GROUND.
2	BA	TRANSMITTED DATA from DM5 to host.
3	BB	RECEIVED DATA which comes from host to DM5.
4	CA	REQUEST TO SEND, a control signal, originates in the DM5 and is sent to the host. When the DM5 is off line, it is held lo. When on line and in full duplex, it is kept hi. When on line and in half duplex it is lo until data transmission, goes hi during and returns to lo afterwards.
5	CB	CLEAR TO SEND, a control signal which comes from the host. When hi, it enables data transmission by the DM5.
6	CC	DATA SET READY, a control signal which comes from the host and indicates that the host data set is ready for transmission to or from the DM5.
7	AB	SIGNAL GROUND, has the same potential as pin 1.
20	CD	DATA TERMINAL READY, a control signal that comes from the DM5 and indicates that the DM5 is ready.

Terminal Output Control – When an XOFF code is received, data transmission out the main port stops within the transmit time of two characters. As many as 16 characters may be entered in the terminal's transmit buffer before there is any indication that the terminal has received the XOFF and is no longer transmitting keyboard entries. After the 16th character every additional keystroke causes the low bell to sound, indicating that the transmit buffer is full and losing data. When an XON (DC 1) is received, the remaining buffered data is transmitted and normal data flow is restored.

Terminal Input Control — The capacity of the main port receive buffer is 256 characters. If data is received faster than it can be processed, it accumulates in the receive buffer until the buffer is 80 percent full (205 unprocessed characters). At this point, the terminal transmits an XOFF (DC3) code through the main port to stop data transmission until the number of unprocessed characters can be reduced. An additional XOFF code is transmitted for every received character until the content of the buffer is reduced to 20 percent of capacity (51 characters). When this condition is satisfied, the terminal transmits an XON, permitting routine transmission to resume.

5.1.2 Main Port Baud Rate

Key Sequence:	DM78 — None
	DM5A — ESC 7 (BAUD RATE CODE)
I/O Sequence:	ESC 7 (BAUD RATE CODE)

As explained in Subhead 2.3.1, the main port baud rate is determined by the setting of switches S1-6, S1-7, and S1-8. This rate may be changed by the sequence ESC 7 (BAUD RATE CODE) from the I/O or, in the DM5A mode, from the terminal keyboard. Table 5-2 presents the ASCII equivalent codes for baud rate selection.

If data is present in the main port transmit buffer, the effective baud rate does not change until all buffered data has been transmitted. The software-selected baud rate does not change when the terminal is reset.

**Table 5-2
Baud Rate Selection**

Main Baud Rate ESC y ()	0	1	2	3	4	5	6	7
Aux Baud Rate ESC 5 ()	0	1	2	3	4	5	6	7

NOTE: The main and auxiliary ports are capable of operating at baud rates from 110 baud to 19,200 baud. Because of internal timing and processing requirements, 19,200 baud requires the use of the XON/XOFF protocol. At this baud rate, the terminal must control the flow of data sent to it.

5.1.3 On-Line Operation

Key Sequence:	DM78 Mode - None
	DM5A Mode - ESC n or ALT LOCAL (key toggles)
I/O Sequence:	ESC n

The ESC n sequence from the I/O — or ESC n or ALT LOCAL from the DM5A keyboard — enables bidirectional communication between the keyboard and the main port device. In the DM78 mode, no local processing of entries occurs.

5.1.4 Conversational Mode

When the DM78 terminal is on-line, transmission occurs in a character-by-character fashion as keys are depressed. This method of transmission is referred to as the "conversational" operating mode and is the standard method of communication with the host CPU in both DM78 and DM5A modes. Alternate terminal modes (such as LOCAL and LINE MONITOR) are discussed in Subhead 4.4.

DM78 Communication — In the DM78 mode, all intelligence is under the control of the host processor by way of the main I/O port, with the terminal functioning as a semi-smart glass teletype. All keystrokes generate codes that are transmitted through the main port to the local processor and are not acted upon locally (see Subhead 4.2 for detail of the DM78 transmit codes).

5.1.5 Block Send Mode (DM5A Only)

When the terminal is off-line in the DM5A mode, the contents of the screen may be transmitted to the host CPU in a block send — a line or page at a time. The PAGE SEND/LINE SEND key initiates such transmissions through the main port. In the same way, PAGE PRINT/LINE PRINT sends discrete blocks of information out the auxiliary port.

5.1.6 Page Send (DM5A Only)

Key Sequence:	ESC I or PAGE SEND
I/O Sequence:	ESC I

The PAGE SEND operation is initiated by the sequence ESC I from the host processor or by ESC I or the PAGE SEND key from the DM5A keyboard.

When PAGE SEND is initiated, an STX (start of text) code is transmitted, followed by each unlocked line on the screen. Trailing spaces (spaces between the end of text on a line and column 80) are not transmitted. Visual attributes and graphic characters are treated as spaces. During transmission, the message "MAIN SEND" is displayed in Field E of the status line, the keyboard is locked, and the cursor does not move.

Page send transmission is accomplished in the following format:

STX	Start of text
DATA	Lines of data, with trailing spaces suppressed. When a full 80-character line is transmitted, a CR is sent; when trailing spaces are suppressed, CR and LF are sent. This is repeated for each line transmitted.

TERMINATION CHARACTER The termination character defined by the settings of switches S2-1 and S1-2 is sent.

When transmission is complete, the terminal follows the setting of the Go On-Line switch, S3-7. (Switch-selectable attributes are described in Subhead 2.3.3)

5.1.7 Line Send (DM5A Only)

Key Sequence: `ESC i` or `ALT PAGE SEND`
I/O Sequence: `ESC i`

The LINE SEND operation is initiated by the sequence `ESC i` from the host processor or by `ESC i` or `ALT PAGE SEND` (LINE SEND) from the DM5A keyboard.

When LINE SEND is initiated, the entire line on which the cursor is positioned is transmitted. Where trailing spaces are detected, CR and LF are sent to avoid sending null characters. During transmission, the message "MAIN SEND" is displayed in Field E of the status line and the keyboard is locked. At the end of data, the termination character (defined by the setting of switches S2-1, -2) is transmitted, and the terminal follows the setting of the Go On-Line switch (S3-7).

When transmission is complete, the cursor moves to column 1 of the next unlocked line. If roll mode is enabled and the cursor is on the bottom unlocked line, the screen scrolls up one line, the top line is lost, and the cursor moves to column 1 of the new blank bottom line. If roll mode is disabled and the cursor is positioned on the bottom unlocked line, the cursor moves to the HOME position.

5.1.8 Page Dump (DM5A Only)

Key Sequence: `ESC o`
I/O Sequence: `ESC o`

The PAGE DUMP operation sends all of the data necessary to rebuild an entire screen, including graphic symbols, visual attributes, and locked and memory-locked lines. Data is transmitted in the following order and format:

STX	Start of text
ESC ?	Unlock all lines
ESC S	Graphic mode off
ESC h	Memory lock off
ESC E	Clear screen

DATA

All data on the screen is transmitted, including graphic symbols and visual attributes. When graphic symbols are encountered, an `ESC R` sequence (graphic mode on) is sent, followed by ASCII equivalent characters (see Table 4-4 for ASCII equivalents of graphic symbols). When the next non-graphic symbol is encountered, an `ESC S` sequence (graphic mode off) is transmitted. When a visual attribute is encountered, an `ESC d` sequence (attribute set) is inserted into the data stream and the ASCII equivalent character is transmitted (refer to Table 4-3 for ASCII equivalent codes for visual attributes). The last character on the screen is not transmitted.

ESC | (LINE NUMBER)

For each locked line on the screen, this escape sequence, which includes the ASCII line address, is transmitted. (Refer to Table 4-6 for ASCII codes for line and column addresses.)

(ESC F) (ADDRESS OF 1ST NON-MEMORY-LOCKED LINE) (SPACE)

The line number/column-one address of the first non-memory-locked line is transmitted.

ESC g

Memory lock on

(ESC F) (CURSOR COLUMN ADDRESS) (CURSOR LINE ADDRESS)

The current cursor address is transmitted.

TERMINATION CHARACTER

The termination character defined by the settings of switches S2-1 and S2-2 is transmitted.

During transmission, the message "MAIN SEND" is displayed in Field E of the status line, and the keyboard is locked. When transmission is complete, the terminal follows the setting of the Go On-Line switch (S3-7).

5.1.9 Break (DM5A Only)

Key Sequence: `BREAK`
I/O Sequence: None

The BREAK key on the DM5A keyboard disables graphic mode so that ASCII data can be displayed and causes a 250 ms null (spacing condition) to be generated on the main port data transmission line. The break instruction cannot be initiated through the I/O.

5.1.10 Cancel Transmission (DM5A Only)

Key Sequence: `ALT RESET`
I/O Sequence: None

When CANCEL is activated, any line or page transmission currently in progress is immediately terminated. Termination characters are sent and the setting of the Go On-Line switch is followed.

5.1.11 Null

Key Sequence: None

I/O Sequence: NUL (CONTROL @ or 00 Hex)

A null is ignored by the terminal except in the monitor or write control mode, or the CPU message deposit, or set memory address pointer function. This code can be used in an I/O data stream to create delays where necessary.

5.1.12 Receiver Control Code Handling

In normal operating modes, the only received codes written into display are, with three exceptions, the displayable characters shown in Tables 5-6 and 5-7. The three exceptions are DEL (7FHex); SUB (CONTROL Z or 1AHex), which displays SB and normally indicates a parity error; and a code received as part of an escape sequence which specifically enters data into display memory (for example, write control mode). Escape sequences and control characters that are listed in Tables 5-6 and 5-7 are valid and executable. Those not listed are invalid and are ignored. If necessary, NULs (00Hex) may be used to create delays in a data stream. NULs are normally ignored. All received codes, whether control characters or escape sequences (except `ESC *` which is monitor mode off) are displayed in the line monitor mode. Write control mode will display any individual code. Monitor mode and write control mode are described in Subhead 4.4 of this manual.

5.1.13 Send Termination Characters

Key Sequence: None

I/O Sequence: `ESC ' (Apostrophe or 27Hex)`

Upon receipt of this escape sequence from the host processor, the terminal transmits the termination character selected by the switches on the rear of the terminal.

5.1.14 Answer Back

Key Sequence: None

I/O Sequence: ENQ (CONTROLE or 05Hex)

Upon receipt of an ENQ control code, a user-definable message or a terminal identification code or number is transmitted to the host processor. This feature requires the installation of the 32 X 8 fusible-link ROM which is an optional feature of the DM78 terminal (see Subhead 5.3.2).

5.2 AUXILIARY PORT COMMUNICATION

5.2.1 Auxiliary Port Baud Rate

Key Sequence: DM78 Mode - None

DM5A Mode - `ESC 5 (BAUD RATE CODE)`

I/O Sequence: `ESC 5 (BAUD RATE CODE)`

Switches S2-6, S2-7, and S2-8 are used to set the baud rate for the auxiliary port. To set the baud rate through the I/O (or from the DM5A keyboard), use the `ESC 5` sequence plus the desired ASCII baud rate code from Table 5-2. This software-specified value does not change when the terminal is reset. If data is present in the auxiliary port transmit buffer, the effective rate does not change until all data has been transmitted.

5.2.2 Auxiliary Port Transparent Print

Boot Loaded Transparent Print Protocol - A protocol similar to XON/XOFF enables transparent data transmission between the host processor and the printer in either the DM78 or the DM5A mode.

The escape sequence `ESC " * L 0 1`, introduced as a component of the modified boot load program (Subhead 5.3.1), initializes the transparent print protocol. During transparent print, the terminal monitors the level of the auxiliary transmit buffer and uses the characters DC2 and DC4 (12 and 14Hex) to moderate transmission and accommodate the the rate of character processing. This escape sequence only needs to be sent to the terminal once, at the time of power-up.

The capacity of the auxiliary port transmit buffer is 128 bytes (80Hex). When the transparent print routine is enabled, a DC2 received from the CPU indicates that the data which follows is for the printer; a received DC4 indicates that following data is intended for the screen and/or terminal.

In the typical case of a high baud rate through the main port and a low rate through the auxiliary port, many characters will accumulate in the buffer while a single character is being processed.

When the auxiliary transmit buffer contains 88 unprocessed characters, a DC4 is transmitted (40 characters can still be buffered before data backs up into the main receive buffer). When the content of the buffer is reduced to 40 characters, a DC2 is transmitted by the terminal, and routine transmission is resumed.

Using this method of control, the printer can be kept supplied with data and can become busy without affecting full-duplex communications between the terminal and the main port device.

Alternate Transparent Print Modes

Count-Dependent Transparent Print

Key Sequence: None

I/O Sequence: `ESC . B (HIGH DIGIT) (LOW DIGIT)`

Transparent communication from the main port device to the auxiliary port device is enabled for the number of characters specified by the received digits (the hexadecimal byte count encoded in ASCII). For example, to transparently print 83 characters, send the following sequence: `ESC . B 5 3` (83 decimal = 53 hexadecimal). Keyboard entries and any data

received from the auxiliary port device are still transmitted out the main port (the count is not affected).

Character-Dependent Transparent Print

<p>Key Sequence: None</p> <p>I/O Sequence: ESC . C (STOP CHARACTER)</p>

Transparent communication from the main port device to the auxiliary port device is enabled until the stop character defined in the escape sequence occurs in the data stream. When the stop character is sent to the terminal, it is transmitted to the auxiliary port and the auxiliary port is turned off. The stop character can be any character from 00 to 7FHex. Keyboard entries and any data received from the auxiliary port device are still transmitted out the main port.

If either of the alternate transparent print routines (AUX ON plus character-dependent or count-dependent printing) is enabled, the level of the auxiliary transmit buffer is monitored as an XON/XOFF condition for transmission by the main port device (in this case DC1 and DC3 are used).

If a printer control method which relies on other control codes (refer to Subhead 5.2.3) is selected by the setting of the terminal switches, those codes are received from the auxiliary port but are not transmitted to the main port device.

5.2.3 Switch-Selectable Handshaking Protocols

There are seven switch-defined methods for interaction between the terminal and the auxiliary port device. Table 2-4 presents the available switch options. Regardless of the method selected, pins 4 (RTS) and 20 (DTR) are always monitored, and either can be used to control transmission. (Table 5-3 presents the RS232 C pin definitions for the auxiliary port.) If unused by the particular interface, these signals default "ON" and will permit transmission. When the auxiliary port is ON or ENABLED, the hi condition of pin 20 (DTR) causes the display of AUX RDY or AUX ON in Field D of the status line. If DTR is lo, AUX BSY (not ready) is displayed.

PROTOCOL	DESCRIPTION
1. XON/XOFF	If the terminal receives an XOFF (13Hex) from the auxiliary port device, it ceases transmission until an XON (11Hex) is received. Also, if the terminal receiver buffer becomes 80 percent full (101 characters), the terminal transmits an XOFF. When the content of the buffer is reduced to 20 percent of capacity (25 characters), the terminal sends an XON, and the transmission of data intended for the auxiliary port is resumed.
2. PIN 11/19 BUSY	If pin 11 or pin 19 goes "busy" the terminal inhibits transmission out the auxiliary port.

- 3. PIN 11/19 READY If pin 11 or 19 goes "ready" the terminal inhibits transmission out the auxiliary port.
- 4. PIN 20 Unless pin 20 is "ready" the terminal inhibits transmission out the auxiliary port.
- 5. ACK/NAK This mode is similar to the XON/XOFF protocol, but ACK (06Hex) is used instead of XON, and NAK (15Hex) is used instead of XOFF.
- 6. ETX/ACK After 78 characters are transmitted the terminal sends an ETX (03 Hex). The ETX is transmitted after every 78 characters. The terminal expects to receive an ACK (06 Hex) for every ETX transmitted. If there are two outstanding ETXs which have not been ACK'd, the terminal will stop transmission. Each ACK received by the terminal acknowledges one ETX.
- 7. TTY Every CR (0DHex) that is transmitted is followed by three delete codes (7FHex).
- 8. SINGLE BUFFER The auxiliary port 8251A UART must be both ready and empty before another character is placed in it.

**Table 5-3
Auxiliary Port Pin Definitions**

Pin #	RS232C Name	Description
1	AA	A direct connection to the DM78 frame, called CHASSIS GROUND.
2	BA	RECEIVED DATA to the DM78 from the printer.
3	BB	TRANSMITTED DATA from the DM78 to printer.
4	CA	REQUEST TO SEND, a control signal, is sent from the printer to the DM78 and enables DM78 transmission when hi.
5	CTS	CLEAR TO SEND is true if: AUX ON (or any transparent print enabled), or AUX ENABLED IN HALF DUPLEX, or AUX ENABLED IN FULL DUPLEX (CTS is true only if data is in the AUX TRANSMITTER BUFFER or in the 8251A UART), or XON/XOFF or ACK/NAK protocol selected, and 1) XOFF or NAK has not been received or the buffer is less than 80 percent full.
6	CC	DATA SET READY, a control signal which goes to the printer and is hi at all times.
7	AB	SIGNAL GROUND, has the same potential as pin 1.

(continued on page 5-6)

Table 5-3 continued

8	CF	CARRIER DETECT, a control signal which is the same as pin 6.
11		READY-BUSY, a control signal which is switch selectable so that either hi or lo level can control transmission from the DM78.
19		Same as pin 11 and present only on AUX.
20	CD	DATA TERMINAL READY, a control signal that comes from the printer and when lo is interpreted as a busy from the printer (printer is unable to received data from the DM78).

5.2.4 Auxiliary Port Control

Auxiliary Port ON

<p>Key Sequence: DM78 Mode - None DM5A Mode - ESC (or ALT AUX ON (key toggles)</p> <p>I/O Sequence: ESC (</p>

Bi-directional communication between the auxiliary port and the main port is enabled. Data is not processed by the terminal, but only passed between ports. If the main port is on, data from the main port continues to go to the screen, and keyboard entries are transmitted out the main port. The AUX ON command from the I/O is recognized even when the terminal is operating in the local mode.

Auxiliary Port OFF

<p>Key Sequence: DM78 Mode - None DM5A Mode - ESC) or ALT AUX ON (key toggles)</p> <p>I/O Sequence: ESC)</p>

Bi-directional communication between the main port and auxiliary port is disabled. The sequence **ESC)** is not transmitted out the auxiliary port.

Auxiliary Port Status

<p>Key Sequence: None</p> <p>I/O Sequence: ESC . 8</p>

The host processor can audit the status of the auxiliary port by sending the escape sequence **ESC . 8**. If the auxiliary port is active, that is, if there is data in the transmit buffer or data in the 8251A UART, a NAK is transmitted out the main port. If the auxiliary port is inactive, an ACK is transmitted.

Auxiliary Port Enable/Disable (DM5A Only)

<p>Key Sequence: Enable- ESC j or AUX ENABLE (key toggles)</p> <p>Disable- ESC k or AUX ENABLE</p> <p>I/O Sequence: Enable- ESC j</p> <p>Disable- ESC k</p>

The sequence **ESC j** from the host processor – or **ESC j** or **AUX ENABLE** from the keyboard – enables bi-directional communication between the terminal and the auxiliary port device. When the auxiliary port is enabled, all keyboard entries are transmitted out the auxiliary port, and all codes received from the auxiliary port are processed. If single key escape codes are inhibited by the setting of switch S3-5, they act locally only. The **ESC k** sequence (disable) is not transmitted out the auxiliary port.

Page Print (Auxiliary Port) (DM5A only)

<p>Key Sequence: PAGE PRINT or ESC 3</p> <p>I/O Sequence: ESC 3</p>
--

PAGE PRINT is identical to the PAGE SEND function of the main port, with the following exceptions: transmission is out the auxiliary port, and a Carriage Return/Line Feed is transmitted at the end of each line, regardless of line length or space suppression. The user-defined termination character is sent following the last line. If the Go On-Line switch (S2-3) is enabled, the terminal enables the auxiliary port after transmission. While transmission is in progress, the message "AUX SEND" is displayed in Field E of the status line.

Line Print (Auxiliary Port) (DM5A Only)

<p>Key Sequence: ALT PAGE PRINT or ESC 4</p> <p>I/O Sequence: ESC 4</p>
--

The LINE PRINT function is identical to LINE SEND except that transmission is through the auxiliary port.

Page Dump (Auxiliary Port) (DM5A Only)

<p>Key Sequence: ESC /</p> <p>I/O Sequence: ESC /</p>

When PAGE DUMP is activated, all of the necessary information to completely rebuild the current screen is transmitted out the auxiliary port. This function is otherwise identical to the main PAGE DUMP described in Subhead 5.1.8.

5.3 SPECIAL APPLICATIONS

5.3.1 Boot Load and Modified Boot Load

Key Sequence: ESC " (LOAD ADDRESS) (CODE) (@ or #)
I/O Sequence: ESC " (LOAD ADDRESS) (CODE) (@ or #)

The escape sequence illustrated above loads an 8085 program in hexadecimal code into the terminal, starting at the specified load address. If "@" follows the code, it is immediately executed; if "*" follows the code, it is loaded and saved for later execution. The valid "code" entries are ASCII hexadecimal digit strings (0-9, A-F) paired as high digit, low digit. An asterisk (*) entered instead of a load address provides access to the MODIFIED BOOT LOAD program, which enables short character sequences to be used to alter variables in the terminal logic. Once altered, these new values remain in effect even when the terminal is reset. The only way to restore the original values is to load another sequence or to power-down and re-initialize the terminal.

The modified boot load format is

ESC " * (BYTE DESIGNATOR) (CODE BYTE)
--

where (BYTE DESIGNATOR) is an ASCII letter A-S, and (CODE BYTE) is an ASCII hexadecimal high-digit low-digit pair (or pairs if a multi-byte entry is allowed). Table 5-5 on the following page shows the byte designators, the values affected, the default values, and the code byte choices.

5.3.2 Fusible-Link Hook ROM Option

A 32 x 8 ROM is optional on the DM78 logic board. In terminals configured with this option, areas of the ROM are read at power-up or self-test to alter values that the terminal would otherwise derived from internal tables. Many of these values are also accessible through modified boot load; however, the availability of the hook ROM prevents the values from being lost when the terminal is powered down.

5.3.3 User-defined Program Function Keys (DM5A only)

Program function keys 17 through 24 are user programmable if this option is selected using the "Z" designator of modified boot load (refer to Table 5-5).

Once programmability is enabled, the data may be loaded into the function keys using the standard boot load sequence. The data for each key is loaded at the address specified in Table 5-4 and must be of the length specified in the table (for a 16-byte length, 32 ASCII Hex digits must be loaded). The last byte (ASCII Hex pair) for each key must have the hi bit "on."

Table 5-4
Program Function Keys
(DM5A Mode Only)

KEY	LOCATION (HEX)	MAXIMUM LENGTH IN BYTES
PF17	8E35	32
PF18	8E55	32
PF19	8E75	32
PF20	8E95	32
PF21	8EB5	32
PF22	8ED5	32
PF23	8EF5	32
PF24	8F15	32
PF25*	8F35	16
PF26*	8F45	16
PF27*	8F55	16
PF28*	8F65	16
PF29*	8F75	16
PF30*	8F85	16
PF31*	8F95	16
PF32*	8FA5	16
PF33*	8FB5	16
PF34*	8FC5	16
PF35*	8FD5	16
PF36*	8FE5	16

Table 5-5
Modified Boot Load Variables

Byte Designators	Value Affected	Default Value	Code Byte Choices
A	MAIN XON BYTE	XON (11H)	00-7F
B	MAIN XOFF BYTE	XOFF (13H)	00-7F
C	AUX XON (or ACK)	XON (11H) or ACK (06H)	00-7F
D	AUX XOFF (or NAK)	XOFF (13H) or NAK (15H)	00-7F
E	CURSOR ADDRESS/CURSOR SENSE/ SET MEM ADD PTR	CUR ROW-CUR COL	00=ROW/COL ADDRESS 01=COL/ROW ADDRESS
F	CURSOR ROW/COL ADDRESS OFFSET	ROW & COL 1=20H	00-30=COL/ROW 1 ADR
G	FILL SCREEN	NONE	00-7F
H	TERM CHAR(S)	SWITCH SELECTED	00-7F (note 1)
I	STX AT START OF BLOCK SENDS	STX (02H)	00-7F (note 1)
K	CURSOR TYPE	REV BLINK BLOCK	00=REV BLINK BLOCK 01=BLINK UNDERLINE 02=REV NON-BLK BLOCK 03=NON-BLK UNDERLINE
L	DC2/DC4 PRINT CONTROL	DISABLED	00=DISABLED 01=ENABLED
M	RECEIVER ERR CHK	RCVR ERR CHK ENABLED	00=ENABLED 01=DISABLED
N	MAIN STOP BITS	1 (2 at 110 BAUD)	00=DEFAULT VALUE 01=1 STOP BIT 02=1-1/2 STOP BITS 03=2 STOP BITS
O	AUX STOP BITS	1 (2 at 110 BAUD)	(SAME AS DESIGNATOR "N")
R	AUX TTY FILL CHAR	DELETE (7FH)	00-7F
T	CURSOR ON/OFF	CURSOR ON	00=CURSOR ON 01=CURSOR OFF
U	KBD AUTO-REPEAT	24 KEYS/SEC	00=8 KPS (KEYS/SEC) 01=12 KPS 05=28 KPS 02=16 KPS 06=32 KPS 03=20 KPS 07=50 KPS 04=24 KPS
V	KBD HOLD-DOWN	.50 SEC	00=.25 SEC 04=1.00 SEC 01=.50 SEC 05=1.20 SEC 02=.60 SEC 06=1.40 SEC 03=.80 SEC 07=1.60 SEC
W	KBD CLICKER	NONE	00=OFF 01=ON
X	RESET KBD	NONE	RESET KBD
Y	KBD TEMP AUDIO	NONE	00=1200 Hz 01= 600 Hz 02=WARBLE
Z	USER PROGRAMMABLE FUNCTION KEYS	NONE	00=NO PROG. FUNCTION KEYS 01=PF17-24 ARE PROGRAMMABLE
\	CR IN MONITOR MODE	CR IS DISPLAYED ONLY	00=ONLY DISPLAYED 01=DISPLAYED and EXECUTED AS CR-LF
[	PAGE DUMP (DM5A ONLY)	ENTIRE SCREEN TRANSMITTED	00=ALL DATA 01=TRAILING SPACES SUPPRESSED
]	SCREEN SAVER	SCREEN SAVER OFF	00=DISABLED 01=ENABLED
^	CLEAR SCREEN	ENABLED	00=ENABLED 01=DISABLED
a	BLOCK XMIT RATE	NORMAL	00=NORMAL 01=SLOWER
b	DISPLAY KBD VERSION NUMBER		01=DISPLAY IN STATUS LINE
c	DISPLAY CORRECT CRC BYTES		01=DISPLAY IN STATUS LINE
d	SHIFT-LOCK STATUS	NOT TRANSMITTED	00=DISABLED 01=ENABLED (S1=ON, S0=SHIFT OFF)
e	ATTN KEY	250 MS BREAK	00=BREAK (250 ms) 01=TRANSMITS 1 NUL

NOTE 1 (Items H and I only): These entries can be up to 16 pairs of digits in length. The last pair should have the high-bit on as an end flag. For example, to enter the code "48 49 20 21 03" (HI! (ETX)) enter "48 49 20 21 83".

BINARY VALUE 7 6 5 4 3 2 1	CONTROL CHARACTERS					DISPLAYABLE CHARACTERS						ESCAPE SEQUENCES						3 CODE EXTENSIONS							
	HEX VALUE	00		01		010	011	100	101	110	111	010	011	100	101	110	111								
		0	DISPLAY CHARACTER	01	DISPLAY CHARACTER	2	3	4	5	6	7	2	3	4	5	6	7								
0000	0	NUL	☐	DLE	P	SP	0	@	P	'	p	SP	0	INSERT CHARACTER OFF	DELETE CHARACTER	/	P	AUX PORT STATUS	8						
0001	1	SOH	A	DC1 X-ON	Q	|	1	A	Q	a	q	|	1	CPU MESSAGE ON	CURSOR UP	↑	A	INSERT ON	Q	a	q	9			
0010	2	STX	B	DC2	R	"	2	B	R	b	r	"	2	CPU MESSAGE OFF	CURSOR DOWN	↓	B	KEYBOARD ENABLE	R	b	r	:			
0011	3	ETX	C	DC3 X-OFF	S	#	3	C	S	c	s	#	3		CURSOR RIGHT	→	C	KEYBOARD DISABLE	S	c	s	;			
0100	4	EOT	D	DC4	T	\$	4	D	T	d	t	\$	4		CURSOR LEFT	←	D	ATTRIBUTE SET	T	d	t	<			
0101	5	ENQ	E	NAK	U	%	5	E	U	e	u	%	5	AUX BAUD RATE SET	CLEAR	E	U						-		
0110	6	ACK	F	SYN	V	&	6	F	V	f	v	&	6	WRITE CONTROL MODE	CURSOR ADDRESS	F	RESET	V	SELF TEST	f	v	SINGLE TAB CLEAR	>		
0111	7	BEL	G	ETB XMIT	W	'	7	G	W	g	w	'	7	SEND TERM CHAR	MAIN BAUD RATE SET	G	READ CURSOR CHARACTER	W					?		
1000	8	BS	H	CAN	X	(	8	H	X	h	x	(	8	AUX ON	CONTINUOUS ALARM ON	H	HOME	X					•
1001	9	HT	I	EM	Y	)	9	I	Y	i	y	)	9	AUX OFF	CONTINUOUS ALARM OFF	I	CURSOR ADDRESS	Y					A
1010	A	LF	J	SUB	Z	*	:	J	Z	j	z	*	:	LINE MONITOR OFF	LINE MONITOR ON	J	CURSOR DISPLAY ON/OFF	Z					TRANSPARENT PRINT (CNT)	B	
1011	B	VT	K	ESC	[+	;	K	[k	|	+	;	CPU MESSAGE DEPOSIT	CLEAR EOF	K							DM78 ON DM5A OFF	C	
1100	C	FF	L	FS	\	.	<	L	\	l	|	.	<		CURSOR SENSE	\							DM78 OFF DM5A ON	D	
1101	D	CR	M	GS]	-	=	M]	m	|	-	=										TRANSPARENT PRINT (CHR)	E	
1110	E	SO	N	RS	^	.	>	N	^	n	~	.	>	3 CODE EXTENSION	BACKTAB	>	OFF LINE (LOCAL)	N	SET MEMORY POINTER	^	ON LINE	n	~	DM78 ON and SAVE DM5A	F
1111	F	SI	O	US	_	/	?	O	_	o	RUB OUT	/	?		READ TERMINAL STATUS	O	READ DATA AT MEMORY POINTER	_						DM5A ON and SAVE DM78	G

 = I/O FUNCTION ONLY

REPEAT CHARACTER TO ADDRESS H

Table 5-6
ASCII Code Chart
(DM78)

BINARY VALUE 7 6 5 4 3 2 1	CONTROL CHARACTERS					DISPLAYABLE CHARACTERS							ESCAPE SEQUENCES					3 CODE EXTENSIONS
	HEX VALUE	0	1	2	3	4	5	6	7	2	3	4	5	6	7			
	000	001	010	011	100	101	110	111	010	011	100	101	110	111				
0000	0	NUL	NL	DLE	SP	0	@	P		P	SET CLOCK	AUX SEND	INSERT CHARACTER OFF	DELETE CHARACTER	PF1	AUX PORT STATUS		
0001	1	SOH	SH	DC1 X-ON	D1	!	1	A	Q	a	q	DISPLAY MESSAGE ON	CURSOR UP	LINE INSERT ON	PF2			
0010	2	STX	SX	DC2	D2	"	2	B	R	b	r	DISPLAY MESSAGE OFF	CURSOR DOWN	GRAPHIC MODE ON	KEYBOARD ENABLE	PF3		
0011	3	ETX	EX	DC3 X-OFF	D3	#	3	C	S	c	s	AUX PAGE SEND	CURSOR RIGHT	GRAPHIC MODE OFF	KEYBOARD DISABLE	PF4		
0100	4	EOT	ET	DC4	D4	\$	4	D	T	d	t	AUX LINE SEND	CURSOR LEFT	STATUS LINE ON	ATTRIBUTE SET	PF5		
0101	5	ENQ	EQ	NAK	NK	%	5	E	U	e	u	AUX BAUD RATE SET	CLEAR	STATUS LINE OFF	ATTRIBUTE DELETE	PF6		
0110	6	ACK	AK	SYN	SY	&	6	F	V	f	v	WRITE CONTROL MODE	CURSOR ADDRESS	RESET	SELF TEST	PF7		
0111	7	BEL	B	ETB XMT	EB	'	7	G	W	g	w	MAIN BAUD RATE SET	READ CURSOR CHARACTER	MEMORY LOCK ON		PF8		
1000	8	BS	BS	CAN	CN	(	8	H	X	h	x	AUX ON	CONTINUOUS ALARM ON	HOME	MEMORY LOCK OFF	PF9	
1001	9	HT	HT	EM	EM)	9	I	Y	i	y	AUX OFF	CONTINUOUS ALARM OFF	PAGE SEND	CURSOR ADDRESS	LINE SEND	PF10	
1010	A	LF	LF	SUB	SB	.	:	J	Z	j	z	LINE MONITOR OFF	LINE MONITOR ON	CLEAR EOP	CURSOR DISPLAY ON/OFF	ENABLE AUX PORT	PF11	
1011	B	VT	VT	ESC	EC	+	:	K	[k	[SINGLE TAB CLEAR	CPU MESSAGE DEPOSIT	CLEAR EOL	DISABLE AUX PORT		PF12	
1100	C	FF	FF	FS	FS	,	<	L	\	l	|	TAB STOP SET	LINE LOCK	INSERT LINE	CURSOR SENSE	START BLINK	PF13	
1101	D	CR	CR	GS	GS	-	=	M]	m	|	CLEAR ALL TABS	LINE UNLOCK	DELETE LINE	NORMAL VIDEO		PF14	
1110	E	SO	SO	RS	RS	.	>	N	^	n	~	3 CODE EXTENSION	BACKTAB	OFF LINE (LOCAL)	SET MEMORY POINTER	ON LINE	PF15	
1111	F	SI	SI	US	US	/	?	O	_	o	~	AUX PAGE DUMP	UNLOCK ALL LINES	READ TERMINAL STATUS	READ DATA AT MEMORY POINTER	PAGE DUMP	PF16	

 = I/O FUNCTION ONLY

REPEAT CHARACTER TO ADDRESS

Table 5-7
ASCII Code Chart
(DM5A)

BEEHIVE INTERNATIONAL



LIMITED WARRANTY INFORMATION

Beehive's Equipment is warranted against defects in material and workmanship for a period of ninety (90) days from date of shipment to Beehive's direct customer. ¹ Beehive will repair or, at its option, replace Equipment which proves to be defective during the Warranty Period, provided such Equipment is returned to Beehive's factory as hereinafter provided.

No defective Equipment may be returned to Beehive without an Advance Return Authorization from the Beehive Field Service Department (801/355-6000). The Return Authorization number must be referenced on both the shipping container and the packing list.

Subject to all of the above conditions, Equipment found to be defective may be returned to Beehive's factory freight prepaid. Following repair or replacement, said Equipment shall be returned to the shipping party, freight collect.

The following items are not covered by warranty:

- a. Routine maintenance and adjustment that is required to maintain products for operations as specified in the Maintenance Guide or Operators Manual.
- b. Failure or malfunctions which occur as a result of improper maintenance, operation (including hostile operating environment), or lack of care.
- c. Components (if any) which are specified in the Maintenance Guide or Operating Manual as being excluded from warranty.
- d. Malfunctions which occur as a result of customer supplied interfacing.

LIMITATIONS OF WARRANTY

The foregoing warranties are in lieu of all other warranties express or implied, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. In no event will Seller be liable for consequential damages.

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¹Beehive's standard terms and conditions provide for a pass-through warranty to its contract customers as follows:

Buyer may pass on to its customer, Seller's standard Equipment warranty in effect at the time such Equipment is purchased by Buyer, provided that Buyer advises Seller in writing as to the date Buyer ships to its customer, including customer address, within ten (10) days from date of shipment to Buyer's customer. Failure to so notify Seller voids all warranty obligations on the part of Seller. In no event shall Seller have any obligation under this warranty clause to Buyer or Buyer's customer after one hundred and eighty (180) days from the date of shipment to Buyer.

In some cases Beehive's direct customer has, by written contract, waived all warranties, express and implied, in exchange for an additional discount.