CTI 5360-TERM VIDEO TERMINAL

INSTALLATION AND OPERATION GUIDE

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FEDERAL COMMUNICATIONS COMMISSION (FCC) STATEMENT

Warning: This product generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instruction manual, may cause interference to radio communications. Although designed to comply, it has not been tested and compliance verified for the limits of a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference, in which case the user at the user's own expense will be required to take whatever measures may be required to correct the interference.

USAGE CONVENTIONS

NOTE:
Notes alert the user to special features or procedures.

CAUTION:
Cautions alert the user to procedures which could damage equipment.

WARNING:
Warnings alert the user to procedures which could damage equipment and endanger the user.

Some conventions used throughout this manual are:

Number Notation | Decimal numbers are shown without notation, i.e., 1, 256.

Hexadecimal numbers are followed by the letter H, i.e., 4BH is the hex equivalent of decimal 75.

Memory size is specified with the letter K (kilo) where 1K is equal to 1024.

Keyboard | When two or more keys must be pressed simultaneously the key notations are separated by a dash, i.e., a Ctrl-Alt notation means the Control Key should be pressed and held while the Alternate key is pressed.

Keyboard/Keypad | When two or more keys must be pressed in succession the key notations are separated by a comma, i.e., a Ctrl, Alt notation means the Control key should be pressed and released then the Alternate key should be pressed.

Escape Sequences | The escape (ESC)(CTRL-[) key is used to denote the start of an escape sequence.

(Pn) or *(Pn1); (Pn2)* | An escape sequence parameter. A (Pn) parameter indicates that only one parameter is expected. A (Pn1); (Pn2) parameter indicates that two parameters are expected. Multiple parameters are separated by semicolons.

(Pn) | An escape sequence parameter. A *(Ps)* parameter indicates that any number of parameters may be expected. Multiple parameters are separated by semicolons.

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CHAPTER 1. INTRODUCTION

Fig. 1 The 5360-TERM Video Terminal

The 5360-TERM Video Terminal is a CRT-based operator interface designed for use in industrial environments. It includes a 7-inch diagonal white phosphor VGA monitor that provides high visibility regardless of lighting conditions. Character size is software selected as single (24 lines and 80 columns), double (12 lines and 40 columns), or quad (6 lines and 20 columns). An internal Setup mode can be accessed via the keypad or optional keyboard for setting the menu-driven configuration parameters.

The 5360-TERM uses battery-backed RAM for storage of configuration information and up to 32 user defined operator screens. This feature permits multiple display screens to reside in Video Terminal memory and allows any screen to be displayed by sending a single command from the Host or by operator input. The 5360 Screen Generation Utility provided on the enclosed diskette greatly simplifies the process of designing, building, and saving operator display screens. This software allows the screens to be constructed on an IBM compatible PC, saved to disk, and downloaded to the Video Terminal without requiring knowledge of special ANSI control codes or escape sequences.

The use of multiple display pages (or screens) also allows use of independent "Active" and "Display" pages. The "Active" page is defined as the one where the cursor is located. The "Display" page is the screen currently displayed on the Video Terminal. Therefore, it is possible to build or update an operator screen while displaying any other page.

The Model 5360-TERM will interface with intelligent Hosts that use RS-232C, RS-422A, and/or RS-485 communications. All versions of the communication standards are optically isolated from the Host. Data rates of 110 to 38.4K bits per second (BPS) are supported. Data is exchanged between the Host and Video Terminal using ANSI escape sequences and ASCII control characters plus several Control Technology Inc. (CTI) private escape sequences. The Video Terminal also has a parallel communications port that supports a printer for program listing, report generation, event logging, etc.

The Model 5360-TERM features an integral membrane sealed keypad. In addition, an IBM PC/XT keyboard receptacle is provided on the front panel. The IBM PC/XT compatible keyboard may be user supplied or is optionally available from CTI.

NOTE:

The enhanced IBM/XT keyboard with 12 function keys is not compatible with the Video Terminal. Some "clone" keyboards may not perform satisfactorily with the Video Terminal because they are not designed strictly to IBM specifications. User supplied keyboards must truly be IBM compatible.

The Video Terminal is powered by 110VAC, 60Hz. The power switch is located on the rear panel. The Video Terminal has a NEMA 12 rated front panel.

CHAPTER 2. INSTALLATION

2.1 Mounting

The Model 5360-TERM may be rack or panel mounted at the user's discretion. An optional rack mount adapter is available for standard 19 inch rack mounting. When the cutout has been made and mounting holes provided, the Video Terminal is placed into the opening and held in place by ten #10-32x5/8 inch mounting bolts that are an integral part of the front panel. Nuts are provided for the mounting bolts. A front panel to mounting surface gasket is provided to maintain NEMA 12 front panel integrity (see the following figure).
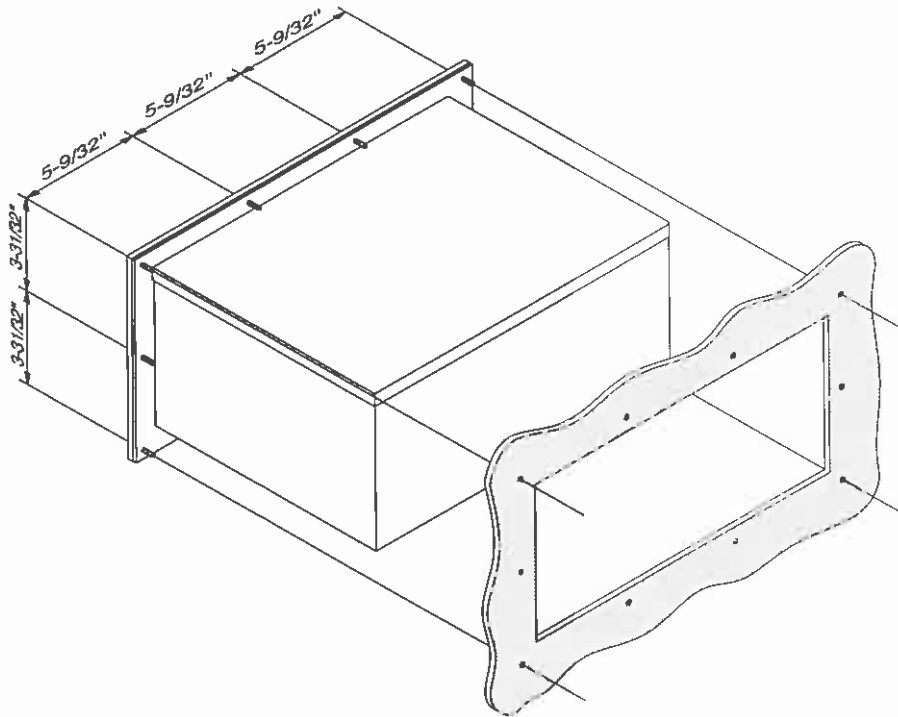
Fig. 2 Video Terminal Mounting

2.2 Power Connections

Field wiring for 120VAC power is connected to a three position screw terminal block on the Video Terminal's rear panel.

The AC input is fused for surge protection. The fuse is a 3/4 Amp, 250 Volt SDL type and is accessible from the rear panel. See the following figure for power connections, functions, and connector location.
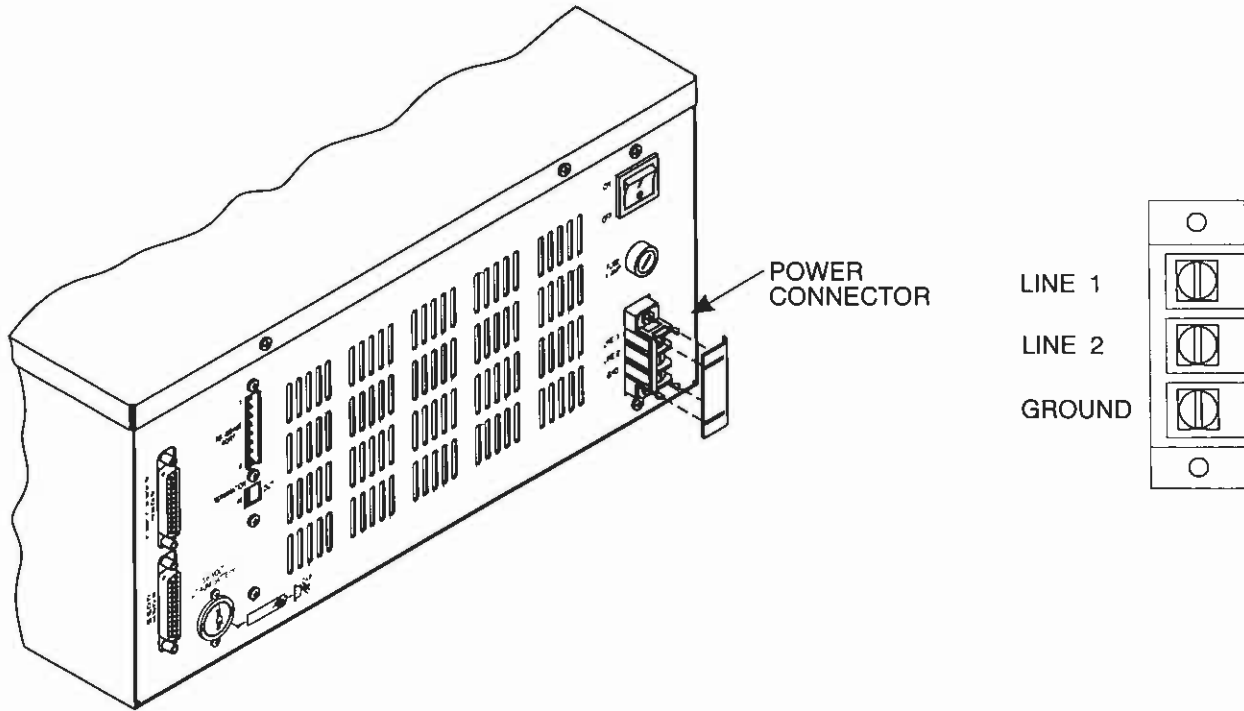
Fig. 3 Power Connector

2.3 Communication Connections

The Model 5360-TERM supports serial communications with the Host via RS-232C, RS-422A, or RS-485 electrical connections. The use of multipoint protocol may be selected with RS-422 or RS-485 connections.

The selection of interface is made by making the appropriate connections to the communications connector, choosing the appropriate Setup menu configuration, and by correctly formatting the data sent by the Host.

A multipoint system is defined as one or more Video Terminals acting as slave stations, linked by a common RS-422 or RS-485 electrical interface to a single Host or control station.

NOTE:
Appendix H contains wiring and connections for both the Allen-Bradley and the Texas Instruments BASIC Modules.

2.3.1 RS-232C Connections

The Model 5360-TERM operates as a DTE RS-232C device. RS-232C connections are made to the Video Terminal using 25 position D type female receptacle marked Comm Port, located on the rear panel of the Video Terminal. Pin numbers, functions and connector location are shown in the following figure.

PIN	FUNCTION
1	GROUND (Common/Shield)
2	TXD (Transmit Data - Output)
3	RXD (Receive Data - Input)
4	RTS (Request To Send - Output)
5	CTS (Clear To Send - Input)
6	Not Connected
7	Common
8-19	Not Connected
20	DTR (Data Terminal Ready - Output)
21-25	Not Connected

RTS (Pin 4), CTS (Pin 5), and DTR (Pin 20) connections are used as Hardware Handshake signals. These signals are described in Section 3.4.2.

Fig. 4 RS-232C Comm Port Connector

2.3.2 RS-422 Connections

Using the RS-422 electrical interface, the user may configure the system for single or multipoint communications.
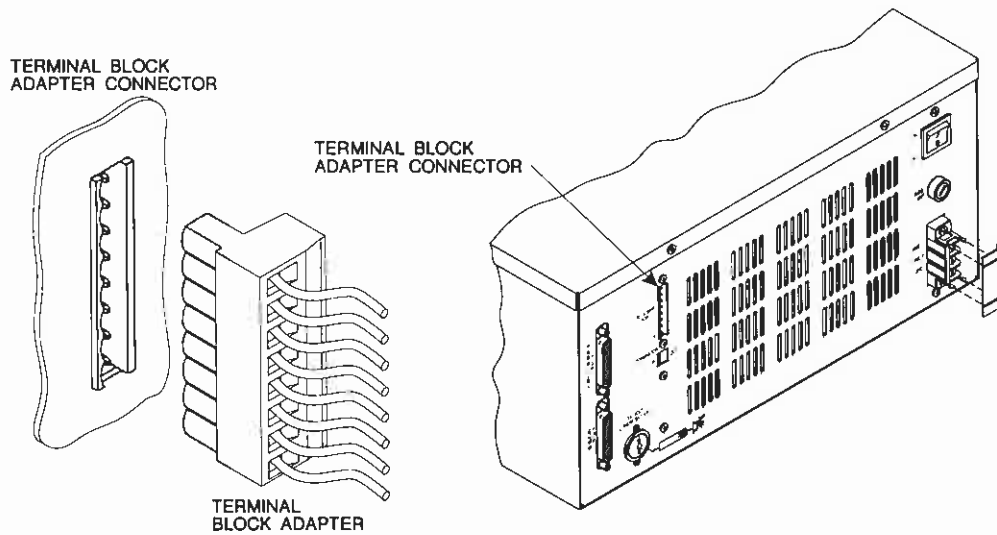
Fig. 5 DB-25/8 Pin Terminal Block Adapter

Connections are made as shown in the chart below:

PIN FUNCTION	DB-25 PIN	SCREW CONNECTION
RS-422 TxD(+)	14	4
RS-422 TxD(-)	25	5
RS-422 RxD(+)	16	1
RS-422RxD(-)	18	2
Signal GND	7	7
Protective GND	1	8
Cable Sheath		3

NOTE:
Connections for RS-422 may be made at either the DB-25 Connector or the 8-pin Terminal Block Adapter.

2.3.2.1 RS-422 Point-to-Point Communications

The diagram below illustrates proper Video Terminal pin-outs and interconnections for RS-422 Point-to-Point operation. To select RS-422 Point-to-Point communications, access Setup Menu #3 on the Video Terminal (see Chapter 3), select **Communications** and change it to **422S** (for single) by pressing the **ENTER** key.

The selection of RS-422 Point-to-Point Communications (422S) in the Setup menu causes the Video Terminal to communicate in the standard character by character format. If message packet communications are desired, RS-422 Multipoint (422M) must be selected in the Setup menu and a node address or Terminal ID# assigned (see Chapter 3).

R_T = Characteristic impedance of the cable
(i.e. 82 ohms for Belden 9463 Twinax)
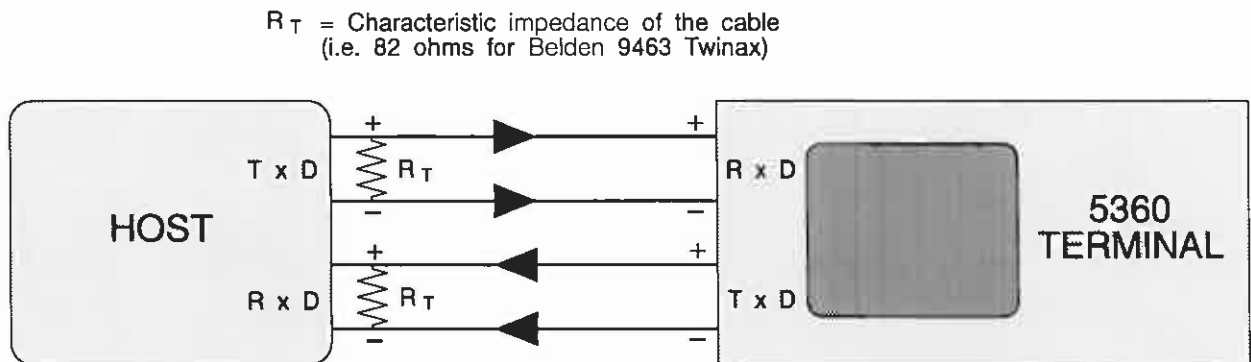
Fig. 6 RS-422 Point-to-Point Interconnections

2.3.2.2 RS-422 Multipoint Communications

The following diagram illustrates proper Video Terminal pin-outs and interconnections for RS-422 Multipoint operation. To select RS-422 Multipoint communications, access Setup Menu #3 on the Video Terminal, select **Communications** and **422M**, Select **Terminal ID#** and press **ENTER** to change the Video Terminal's node address. A valid address may be any value from 0 to 31.

NOTE:
Each Video Terminal on the link should be set to a unique address.
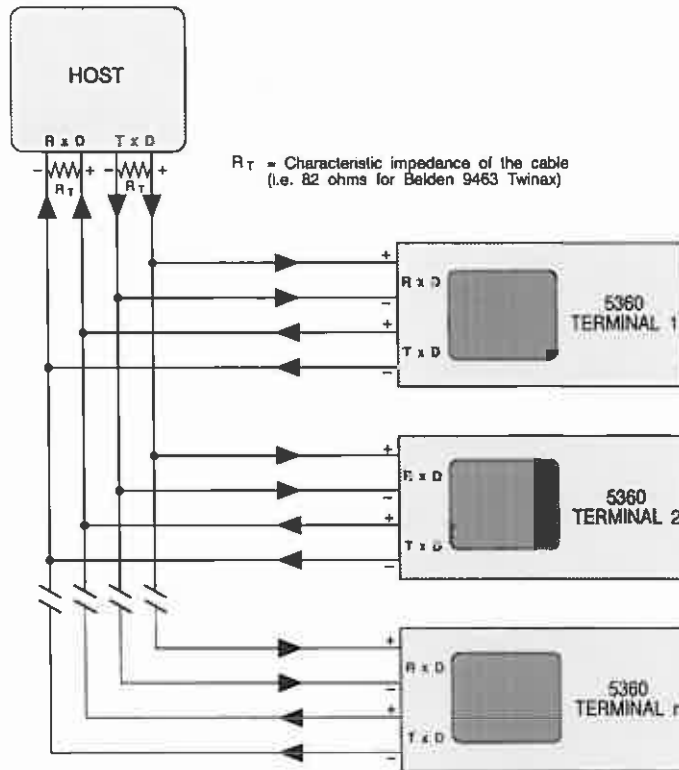
Fig. 7 RS-422 Multipoint Interconnections

2.3.2.3 RS-422 Termination

The Video Terminal on a RS-422 Point-to-Point link, or the last Video Terminal on a RS-422 Multipoint link, must be properly terminated. For that Video Terminal only, the Termination Switch located below the RS-422/485 screw terminal block should be placed in the "IN" position. See the following figure for the location of this switch.
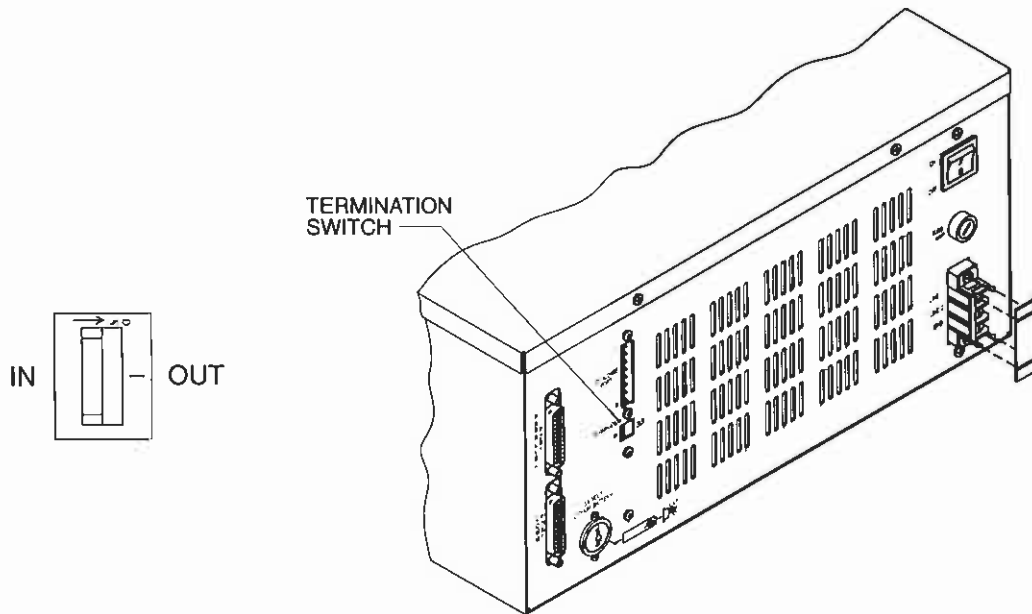
Fig. 8 Termination Switch

When the Termination Switch is placed in the "IN" position, bias resistors are placed in the RS-422/485 circuits to force the lines to a known state when they are not actively driven (such as between information packets). This often improves noise immunity on the lines. However, to avoid excessive loading of the transmitters, only the two units at the end of the transmission lines should have termination resistors enabled.

2.3.3 RS-485 Connections

With the RS-485 electrical interface configuration, the Video Terminal supports multipoint communications over a twisted pair.
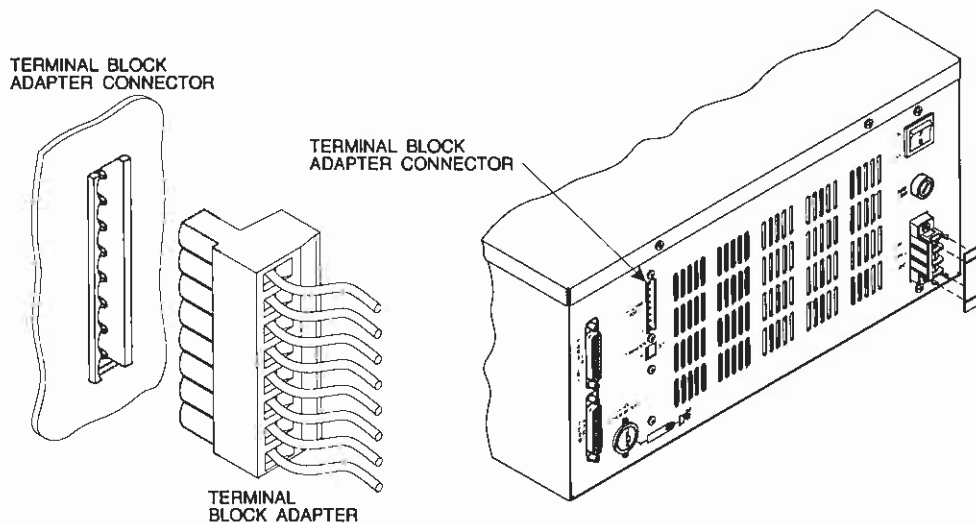
Fig. 9 DB-25/8 Pin Terminal Block Adapter

Connections are made as shown in the chart below:

PIN FUNCTION	DB-25 PIN	SCREW CONNECTION
RS-485 TR(+)	14	4
RS-485 TR(-)	25	5
Signal GND	7	7
Protective GND	1	8
Cable Sheath		3

NOTE:
***Connections for RS-422 may be made at either the DB-25 Connector
or the 8-pin Terminal Block Adapter.***

2.3.3.1 RS-485 Termination

The last Video Terminal on an RS-485 Multipoint link must be properly terminated. For that Video Terminal only, the termination switch located below the RS-422/485 screw terminal block should be placed in the "IN" position. See the following figure for the location of this switch.
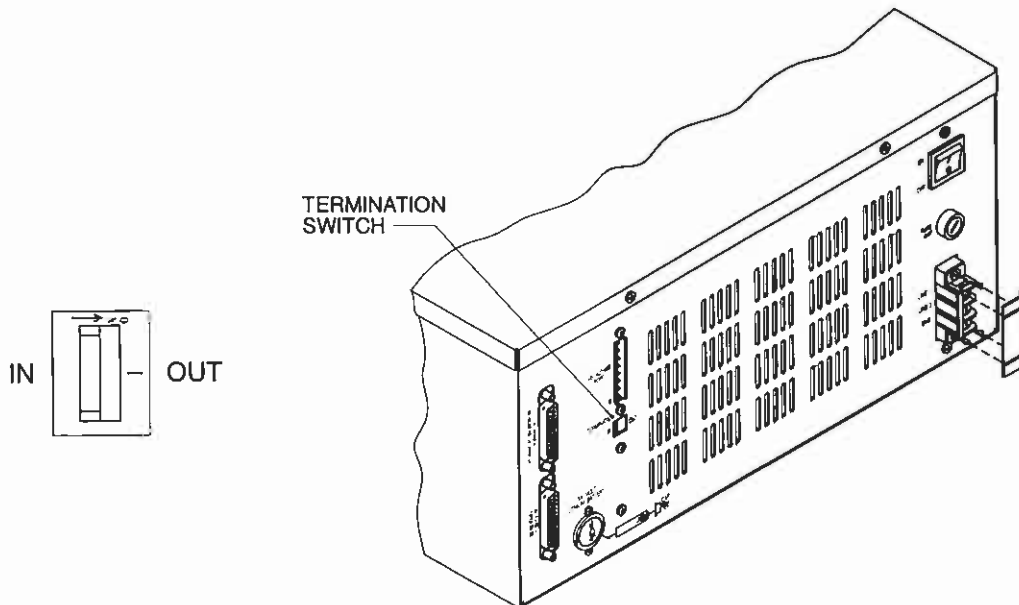
Fig. 10 Termination Switch

When the Termination Switch is placed in the "IN" position, bias resistors are placed in the RS-422/485 circuits to force the lines to a known state when they are not actively driven (such as between information packets). This often improves noise immunity on the lines. However, to avoid excessive loading of the transmitters, only the two units at the end of the transmission lines should have termination resistors enabled.

NOTE:
Each Video Terminal on the link should be set to a unique address.

2.3.3.2 RS-485 Multipoint Communications

The diagram below illustrates proper Video Terminal pin-outs and interconnections for RS-485 Multipoint operation. To select RS-485 Multipoint communications, access Setup Menu #3 on the Video Terminal (see Chapter 3), select **Communications** and change it to **485**. Select **Terminal ID#** and press **ENTER** to change the Terminal's node address. The address may be any value from 0 to 31.
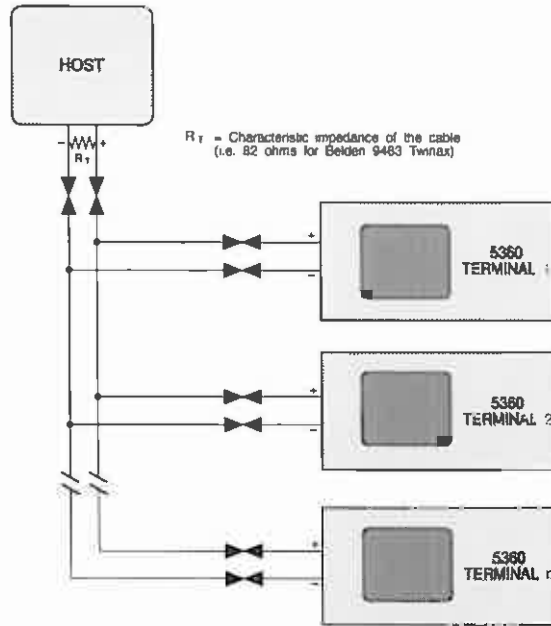
Fig. 11 RS-485 Multipoint Interconnections

2.3.4 Keyboard Connections

The optional keyboard connections are made to the Video Terminal using the 5-pin DIN receptacle located on the front panel. This receptacle has a screw cap dust cover with a retaining chain. The receptacle is IBM PC/XT compatible. Pin numbers, functions and receptacle location are shown in the following figure.

PIN	FUNCTION
1	Keyboard Clock
2	Keyboard Data
3	Keyboard Reset
4	Ground
5	+5 VDC
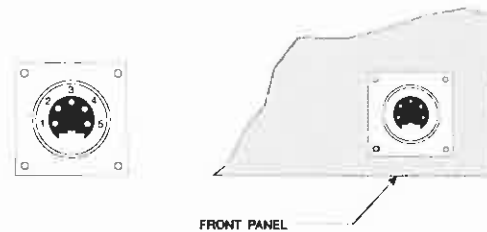
Fig. 12 Keyboard Receptacle

2.3.5 Printer Connections

The Video Terminal has a Centronics printer interface that supports parallel communications which may be used for report generation or to output a page of displayed data to a printer. The parallel port operates on TTL level voltages. Consult the printer user's guide to insure compatibility, proper installation and use. Printer connections are made to the Video Terminal using a 25-pin D type female receptacle marked Parallel Port, located on the rear panel. Pin numbers, functions and connector location are shown in the following figure.

PIN	FUNCTION
1	Strobe (-)
2	Data Bit 0 (+)
3	Data Bit 1 (+)
4	Data Bit 2 (+)
5	Data Bit 3 (+)
6	Data Bit 4 (+)
7	Data Bit 5 (+)
8	Data Bit 6 (+)
9	Data Bit 7 (+)
10	Not Connected
11	Busy (+)
12-17	Not Connected
18-25	Ground

PARALLEL
(PRINTER CONNECTOR)
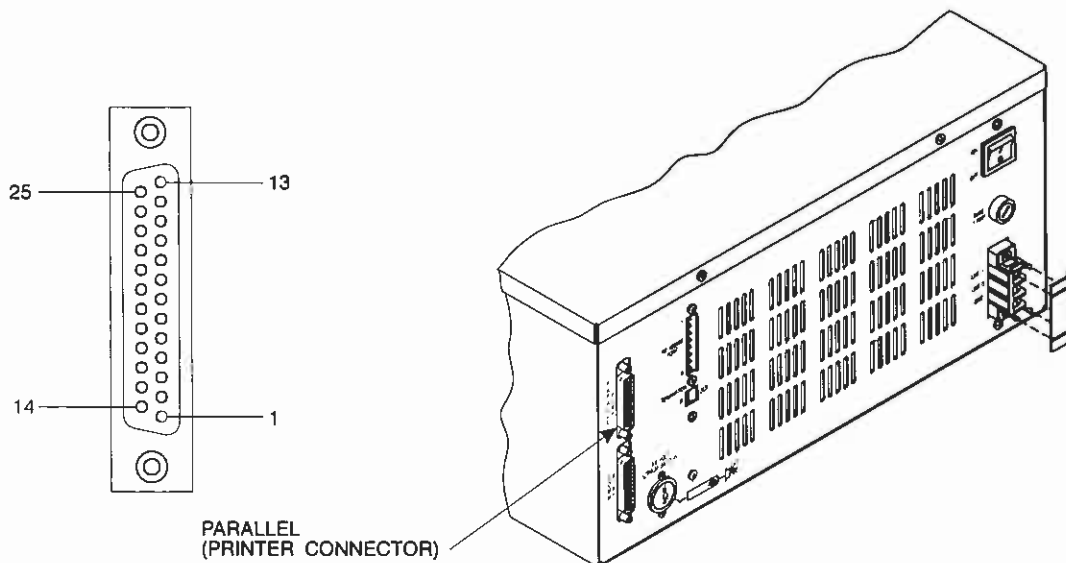
Fig. 13 Parallel Printer Port Connector

CHAPTER 3. CONFIGURATION

All configuration parameters of the Model 5360-TERM are established with software. Initial configuration and changes may only be accomplished when the Video Terminal is in the Setup mode. The Setup mode is entered by pressing and releasing the shift key and then pressing the home key (Shift, Home) on the Video Terminal keypad or by simultaneously pressing the Control, Alt, and Ins keys (Ctrl-Alt-Ins) on an attached keyboard. Note that Setup parameters determine the initial operating parameters of the Video Terminal on power up and cannot be altered by the Host.

Setup Menu 1, 2, or 3 are displayed on lines 20 through 25 of the screen when the Setup mode is initiated. A prompt is displayed in reverse video at the active field. As each configuration selection is made the selected data is placed in a buffer and held until the Setup mode is exited.

The function keys F2 through F4 on the keyboard and keypad are used to alter configuration features when the Video Terminal is in the Setup mode. F1 is used to exit the Setup mode. F2 advances pages. F3 and F4 adjust screen brightness. When in Setup mode the Video Terminal will not act on any characters received from the Host. When not in the Setup mode all function keys may be used as directed by the Host. The Video Terminal does not transmit any characters to the Host while in Setup mode. If the Host transmits data to the Video Terminal while it is in Setup mode, it buffers the data until Setup mode is exited. Software and/or hardware handshaking is used to notify the Host if the input buffer nears full (see Section 3.4.2).

Setup changes take place when the Setup mode is exited. The new configuration data, with exception of character size, is saved in battery backed RAM if the save feature is selected from the menu. The Setup mode is exited by pressing the keyboard or keypad F1 and at that time the features selected are implemented by the Video Terminal operating system. Setup features that are not changed will retain previous values or remain in default settings if never altered.

3.1 Setup Menus

The three Setup menus are incremented from the keyboard or keypad by pressing the F2 key. If the menu is advanced from menu 3, the first menu is displayed. Values displayed in the menu are altered by pressing the keypad ENTER key or the keyboard RETURN key.

Line 25 contains instructions to aid in the selection of options (arrows), change values (Enter), advance menu pages (F2), and exit Setup mode (F1). The cursor position keys (arrows) select configuration features. The ENTER/RETURN key increments selected values within the field.

The configuration parameters defined on the following pages may be selected only when in the Setup mode. They are defined in the order they appear on the screen. Setup menu numbers refer to the screen on which they appear. List of Setup fields with a brief statement of parameters for each field follows:

Setup Menu #1

Baud Rate (110-38.4K BPS)	Default: 1200 BPS
Line (Online-Local)	Default: Online
Local Echo (Yes-No)	Default: Yes
Brightness (10 Levels)	Default: Mid-Range
Character Size (Single-Double-Quad)	Default: Double
Cursor Type (Line-Block-None)	Default: Blinking Line
Reverse Video (Yes-No)	Default: No

Setup Menu #2

Auto Linefeed (Yes-No)	Default: Yes
Wraparound (Yes-No)	Default: Yes
Keyboard (Enabled-Disabled)	Default: Enabled
Parity Select (Odd-Even-Mark(1)-Space(0))	Default: Odd
Parity Enable (Yes-No)	Default: No
Stop Bits (One-Two)	Default: One
UART Wordlength (7 Bits-8 Bits)	Default: 7 Bits

Setup Menu #3

Communications (RS232-RS422-RS485)	Default: RS232
Handshaking (Software-Hardware)	Default: Software
Terminal ID# (0-31)	Default: 0
Display Pages (32 Standard)	Default: 32
Save Setup (Press -)	
Recall Setup (Press -)	

3.2 Setup Menu #1

3.2.1 Baud Rate

<div align="center">

BAUD RATE - SEND/RECEIVE
BAUD RATE - DEFAULT: 1200 BPS

</div>

BAUD RATE is in the range of 110 BPS to 38.4K BPS as follows:

110 BPS	1200 BPS	19.2K BPS
150 BPS	2400 BPS	38.4K BPS
300 BPS	4800 BPS	
600 BPS	9600 BPS	

BAUD RATE selects the data transmission rate between the Video Terminal and the Host. The rates are displayed one at a time and selections may be viewed by pressing the ENTER/RETURN key. When the desired rate is displayed it is selected by going to the next line using the cursor controls.

3.2.2 Line

<div align="center">

LINE DEFAULT: ONLINE

</div>

LINE selections are:

ONLINE - Communications link is established and data may be transferred between the Video Terminal and Host.

LOCAL - No data is received from or transmitted to the Host. Any keyboard/keypad entries at the Video Terminal will be displayed but not transmitted.

Line mode (ONLINE/LOCAL) is displayed on the status line.

3.2.3 Local Echo

LOCAL ECHO DEFAULT: YES

LOCAL ECHO MODE selections are:

YES - Keyboard/keypad entries will be transmitted to the Host immediately but will not be displayed or executed until each entry is returned from the Host. Keyboard entries CTRL-S, CTRL-Q, and Setup mode entry are exceptions and are executed immediately.

Local Echo Mode (Echo On/Off) is displayed on the status line.

3.2.4 Brightness

BRIGHTNESS DEFAULT: MID-RANGE

BRIGHTNESS may be increased or decreased through 10 levels. It is increased, when in the Setup mode, by pressing F3 and decreased by pressing F4 until the desired screen brilliancy is achieved. The prompt does not have to be located on the BRIGHTNESS field to adjust the setting. The functions of F3/F4 keys are determined by the Host when the Video Terminal is not in the Setup mode.

3.2.5 Character Size

CHARACTER SIZE DEFAULT: DOUBLE SIZE CHARACTERS

The CHARACTER SIZE selections are:

SINGLE SIZE - Characters displayed in 24 lines by 80 characters format.

DOUBLE SIZE - Characters displayed in 12 lines by 40 characters format.

QUAD SIZE - Characters displayed in 6 lines by 20 characters format.

3.2.6 Cursor Type

CURSOR TYPE DEFAULT: BLINKING LINE

The CURSOR TYPE selections are:

BLINKING LINE, BLINKING BLOCK, STATIC LINE, STATIC BLOCK, NONE

3.2.7 Reverse Video

REVERSE VIDEO DEFAULT: NO

The REVERSE VIDEO selection is YES or NO.

REVERSE VIDEO displays the entire page with black characters on a white background.

3.3 Setup Menu #2

3.3.1 Auto Line Feed

AUTO LINE FEED DEFAULT: YES

The AUTO LINE FEED selection is YES or NO.

This feature causes the Video Terminal to add a Line Feed every time a Carriage Return (ASCII 0DH) is received from the attached keyboard, keypad, or Host.

When the Video Terminal is in print mode and a Carriage Return is sent to the Video Terminal , a Carriage Return and Line Feed are sent to the Video Terminal parallel port if this field is enabled.

3.3.2 Wraparound

WRAPAROUND DEFAULT: YES

The WRAPAROUND selection is YES or NO.

With WRAPAROUND enabled, the cursor moves to the first column of the next line before it reaches column 81. With WRAPAROUND not enabled, the cursor will not advance past column 80 on the current line.

3.3.3 Keyboard

KEYBOARD DEFAULT: ENABLED

The KEYBOARD selection is ENABLED or DISABLED.

When enabled, normal functions may be performed from the attached keyboard. Most keyboard entries cannot be made if this feature is disabled. Functions involving escape sequences are not affected. This feature does not affect keypad operation on the Video Terminal.

If disabled, KEYBOARD OFF is displayed on the status line.

3.3.4 Parity Select

PARITY SELECT DEFAULT: ODD

The PARITY SELECT choices are:

ODD   EVEN   MARK   SPACE

The selection made in this field has no effect unless parity is enabled in the following field. MARK parity always sets one (1) for a parity data bit. SPACE parity sets zero (0) for a parity data bit.

3.3.5 Parity Enable

PARITY ENABLE DEFAULT: NO

The PARITY ENABLE selection is YES or NO.

PARITY ENABLE must be selected YES for the previous selection (PARITY SELECT) to be valid. If NO is selected, the Video Terminal ignores the Parity bit on data sent from the Host and sets the Parity bit to zero (0) for data sent to the Host.

3.3.6 Stop Bits

STOP BITS DEFAULT: ONE

The STOP BITS selection is ONE or TWO.

This feature selects the number of stop bits per ASCII character.

3.3.7 UART Word Length

UART WORD LENGTH DEFAULT: 7 BITS

The UART WORD LENGTH selection is 7 or 8 BITS.

This feature selects the number of data bits per ASCII character. UART is an acronym for Universal Asynchronous Receiver - Transmitter.

NOTE:
Baud Rate, Parity Enable, Stop Bits, and UART Word Length selections at the Video Terminal must be configured in a like manner at the Host in order to display and execute commands.

In order to use graphic characters,
the UART WORD LENGTH selection must be 8 bits.

3.4 Setup Menu #3

3.4.1 Communication

The COMMUNICATION mode determines the electrical interface between the Video Terminal and the Host.

The following selections are supported:

        RS-232C
        RS-422S   Single point RS-422, forces software handshaking
        RS-422M   Multipoint RS-422, forces software handshaking
        RS-485

3.4.2 Handshaking

HANDSHAKING DEFAULT: SOFTWARE

The HANDSHAKING selection is SOFTWARE or HARDWARE.

If software handshaking is enabled, the Video Terminal will initiate and respond to XON (CTRL-Q) and XOFF (CTRL-S) messages from the Host.

The Video Terminal will initiate an XOFF when the input buffer is approximately 50% full and will send XON when the input buffers are empty. This handshaking prevents the Host from transmitting data that may overfill the Video Terminal input buffer. This will normally not occur when data sent by the Host consists of simple ASCII characters, however, this can occur at high baud rates if data received contains multiple escape sequences and/or control characters.

When XOFF is received from the Host the status line will display Host OFF. The Video Terminal will not transmit data from the serial port while Host OFF is displayed. When XON is received by the Video Terminal the status message is cleared and normal communication is resumed.

XON and XOFF may be used as operator functions from the attached keyboard in software and hardware handshaking modes. XON and XOFF messages from the Host are ignored if hardware handshaking is selected but continue to function from the attached keyboard.

NOTE:
If operating in Echo Off mode, the Host must not be allowed to echo XOFF (CTRL-S) received from the Video Terminal. The Video Terminal will respond to the echo as if it were a XOFF initiated by the Host resulting in a Host OFF message and locked out condition that can be cleared by cycling power to the Video Terminal or receipt of XON (Ctrl-Q) from the Host.

Hardware handshaking may be used only when RS-232C communication is selected. The hardware handshaking feature uses CTS and DTR pins on the 25-pin D type connector at the Video Terminal's serial port.

PIN	FUNCTION
4	RTS (Request To Send)
5	CTS (Clear To Send)
20	DTR (Data Terminal Ready)

RTS (pin 4) is high when the Video Terminal has power applied. If hardware handshaking is selected, Video Terminal CTS (pin 5) must be held high by the Host for the Video Terminal to transmit. DTR (pin 20) goes high when the Video Terminal is ready to receive

data from the Host. If the Video Terminal input buffer nears full capacity, DTR (pin 20) will drop low forcing the Host to pause until the buffer is emptied and DTR returns high.

Hardware and/or software handshaking remains active when the Video Terminal is in Setup mode.

NOTE:
XON and XOFF is not sent when entering or exiting if the Video Terminal is in multipoint configuration.

3.4.3 Terminal ID#

TERMINAL ID# DEFAULT: 0

The Terminal ID# sets the node address for the Video Terminal when multipoint communications are used. The valid range is 0 through 31.

3.4.4 Display Pages

DISPLAY PAGES DEFAULT: 32

This field displays the number of displayable pages (or screens) available to the user in the Video Terminal's memory. This value is determined by the unit on power up and cannot be modified by the user.

3.4.5 Save Setup

This field will save all Setup selections as they currently appear in the Setup menu. To initiate this feature press the minus sign on the keyboard/keypad when the cursor is positioned at the SAVE SETUP field. The Video Terminal will display "DONE" in the SAVE SETUP field after the save function has been performed.

If no selections have been made in a particular field that field will be saved in the default value or condition.

3.4.6 Recall Setup

This field will cause the Video Terminal to return to the most recently saved Setup configuration when the minus sign (-) is pressed. If no alterations have been made the Video Terminal will list all Setup fields in the default mode. When RECALL SETUP is invoked Setup menu #1 is displayed.

NOTE:
No configuration changes take place while the Video Terminal is in the
Setup mode. All alterations occur as the Setup mode is exited.

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CHAPTER 4. OPERATION

The operating controls on the Video Terminal are the rear panel on/off switch and the front panel keypad. In addition the Video Terminal has a front panel IBM PC/XT compatible receptacle that accepts a keyboard that may be user supplied or optionally available from CTI. All operating functions are made from a keyboard, keypad, or from the Host.

At power up, the Video Terminal will set previously selected Setup configurations or default modes in Setup fields where no previous configurations have been selected.

4.1 Status Line

When in normal operation the 25th display line of the Video Terminal will display a status line that contains the following information:

ONLINE - LOCAL: ONLINE indicates comm port is active.

ECHO ON - ECHO OFF: When on, keyboard/keypad entries will be displayed and transmitted to the Host immediately. When ECHO OFF is selected, the Video Terminal only displays characters received from Host port.

KYBD OFF: Indicates that the Video Terminal has received a "Disable Keyboard" command from Host. Display clears when "Enable Keyboard" command is received, or unit is powered off/on.

Host OFF: Indicates that the Video Terminal detects the Host off-line. No display if the Host is on-line.

I-PRT: Indicates the "Interactive Print Mode" is enabled. There is no display if interactive print is off.

CAPS: Indicates the Caps Lock key on the attached keyboard has been activated to cause upper case characters to be displayed. There is no display if CAPS is off.

BATTERY LOW: Indicates low battery voltage or no battery installed. The display is cleared if battery voltage is adequate.

PAGE: Indicates the current display page number.

SHIFT: Indicates "Shift" key on keypad has been pressed. Pressing the "Shift" key a second time effectively returns shift status to normal (OFF) state. There is no display when shift status is OFF.

4.2 Battery Installation

The battery used to back-up the Video Terminal RAM is a 3.6V AA size lithium battery such as a Tadiran TL-2100 or equivalent and should be replaced when a BATTERY LOW warning is seen on the Video Terminal status line.

The Battery Low status may also be obtained by the Host by using CTI Private Command - Request for Terminal Status (see Chapter 5). The battery is replaced from the Video Terminal rear panel. Press in and turn the battery cap a quarter turn counterclockwise using a screwdriver or a coin. The cap may then be removed. Replace the battery observing proper polarity. The positive battery terminal should face the battery cap. Replace the cap. With the cap in place press and turn a quarter turn clockwise to lock the cap in place.

NOTE:
To maintain the integrity of the data in memory, the battery must be replaced with AC power on.

WARNING:
Lithium batteries should never be subjected to extreme pressure changes as might occur during air shipment. Lithium batteries should never be shipped by air or transported in an aircraft. It must not be recharged, forced open, or disposed of in fire.

4.3 Keypad Operation

The Video Terminal keypad function definitions are given in the following pages with key strokes, resulting escape sequences were applicable and appropriate hexadecimal (H) values. The keypad functions such as Page Down/Up, Display Pg Select and cursor position arrows are valid only when the Video Terminal is in Echo On mode. When the Video Terminal is in Echo Off mode the keypad functions are not performed until echoed back from the Host.

The keys are not user definable in the Video Terminal in that, when a particular key is pressed, its ASCII equivalent will be transmitted to the Host. Once the ASCII equivalent is received by the Host, it may be user defined. When in Setup mode Function key F1 is dedicated to exiting Setup mode. The Function keys F2 through F4 are dedicated to the tasks as defined in this document when the Video Terminal is in Setup menu. All keypad functions may be user defined when the Video Terminal is in Echo Off mode.

The recommended Setup mode when utilizing the keypad is ECHO OFF mode. This mode selection is very important in appliactions where continuous serial communications for page updates are necessary. In this mode, the user has control of where any character appears and at what time any actions such as page changes occur (i.e. the display page would not be changed in the middle of an update when such a change could have caused new data to appear on the wrong page).

For a quick reference, a summary of these keypad functions is also located in Appendix B.

4.3.1 Function Keys F1 - F8

F1 - Function Key 1

ASCII	:	ESC O P
HEX	:	1BH, 4FH, 50H
KEY SEQUENCE	:	CTRL-[, O, P

used to exit Setup mode. Configuration changes take place when the Setup mode is exited with the exception of brightness control. F1 function key may be defined by the user when the Video Terminal is not in Setup mode.

F2 - Function Key 2

ASCII	:	ESC O Q
HEX	:	1BH, 4FH, 51H
KEY SEQUENCE	:	CTRL-[, O, Q

used to scroll menu pages when in the Setup mode. When the Setup mode is entered and menu page 1 is displayed, pressing F2 will display page 2, pressing F2 a second time will display page 3. Pressing F2 a third time will display page 1 again. F2 function key may be defined by the user when the Video Terminal is not in Setup mode.

F3 - Function Key 3

ASCII	:	ESC O R
HEX	:	1BH, 4FH, 52H
KEY SEQUENCE	:	CTRL-[, O, R

used to set the screen brightness level in the Setup mode. When screen brightness is in default mode a mid-level of brightness is configured and is set at initial power-up and at total reset. Pressing F3 will increase brightness. F3 function key may be defined by the user when the Video Terminal is not in Setup mode.

F4 - Function Key 4

ASCII	:	ESC O S
HEX	:	1BH, 4FH, 53H
KEY SEQUENCE	:	CTRL-[, O, S

used to set the screen brightness in the Setup mode. Pressing F4 will decrease the brightness level. F4 function key may be defined by the user when the Video Terminal is not in the Setup mode.

F5 - Shift, F1

ASCII	:	ESC O T
HEX	:	1BH, 4FH, 54H
KEY SEQUENCE	:	CTRL-[, O, T

function may be defined by the user when the Video Terminal is not in the Setup mode. This key performs no function when the Video Terminal is in Setup mode.

F6 - Shift, F2

ASCII	:	ESC O U
HEX	:	1BH, 4FH, 55H
KEY SEQUENCE	:	CTRL-[, O, U

function may be defined by the user when the Video Terminal is in Setup mode. This key performs no function when the Video Terminal is in Setup mode.

F7 - Shift, F3

ASCII	:	ESC O V
HEX	:	1BH, 4FH, 56H
KEY SEQUENCE	:	CTRL-[, O, V

function may be defined by the user when the Video Terminal is in Setup mode. This key performs no function when the Video Terminal is in Setup mode.

F8 - Shift, F4

ASCII	:	ESC O W
HEX	:	1BH, 4FH, 57H
KEY SEQUENCE	:	CTRL-[, O, W

function may be defined by the user when the Video Terminal is in Setup mode. This key performs no function when the Video Terminal is in Setup mode.

4.3.2 Shift - Shift Key

used to shift the keypad. The notation used in this manual is Shift, F1 as opposed to the notation Shift-F1 for two keys pressed simultaneously.

4.3.3 Left Arrow - Left Arrow Key

ASCII	:	ESC[D
HEX	:	1BH, 5BH, 44H
KEY SEQUENCE	:	CTRL-[, [, D

used to move the cursor one character position to the left each time the key is pressed. Characters in the cursor path are not deleted. The cursor stops at column 1 of the current line. In Setup mode the Left Arrow key is used to select configuration fields.

4.3.4 Delete - Shift, Left Arrow Key

ASCII	:	DEL
HEX	:	7FH

used to move the cursor one character position to the left each time the keys are pressed. This is a destructive backspace since characters in the path of the cursor are deleted. The cursor stops at column 1 of the current line. A keypad delete functions the same as a keyboard backspace.

4.3.5 Right Arrow - Right Arrow Key

ASCII	:	ESC[C
HEX	:	1BH, 5BH, 43H
KEY SEQUENCE	:	CTRL-[, [, C

used to move the cursor one character position to the right each time the key is pressed. The cursor stops at column 80 of the current line. Right Arrow does not delete characters in the cursor path. In Setup mode the Right Arrow key is used to select configuration fields.

4.3.6 Display Page - Shift, Right Arrow\DISP PG Key, Page Number, Enter

ASCII	:	ESC[>*(Pn)*w
HEX	:	1BH, 5BH, 3EH, *(Pn)*, 77H
KEY SEQUENCE	:	CTRL-[, [, >, *(Pn)*, w

used with a page number parameter *(Pn)* and the ENTER key to select a page to be displayed. The range of the *(Pn)* parameter will vary between 1 and 32 pages. Missing or zero *(Pn)* values are taken as one.

4.3.7 Up Arrow - Up Arrow Key

ASCII	:	ESC[A
HEX	:	1BH, 5BH, 41H
KEY SEQUENCE	:	CTRL-[, [, A

used to move the cursor one line up each time the key is pressed. The cursor stops at row 1 of the current display page. Up Arrow does not delete characters in the cursor path. In Setup mode, the Up Arrow key is used to select configuration fields.

4.3.8 Page Up - Shift, Up Arrow Key

ASCII	:	ESC[V
HEX	:	1BH, 5BH, 56H
KEY SEQUENCE	:	CTRL-[, [, V

used to shift to the preceding display page. When page 1 is the display page, no action takes place. The cursor location does not change. In Setup mode, the Up Arrow Key is used to select configuration fields.

4.3.9 Down Arrow - Down Arrow Key

ASCII	:	ESC[B
HEX	:	1BH, 5BH, 42H
KEY SEQUENCE	:	CTRL-[, [, B

used to move the cursor one line down each time the key is pressed. The column position of the cursor does not change. The cursor stops at line 24 of the current display page. Down Arrow does not delete characters in the cursor path. In Setup mode the Left Arrow key is used to select configuration fields.

4.3.10 Page Down - Shift, Down Arrow Key

ASCII	:	ESC[U
HEX	:	1BH, 5BH, 55H
KEY SEQUENCE	:	CTRL-[, [, U

used to shift to the next display page. When page 32 is the display page, no action takes place. The cursor location does not change. In the Setup mode, the Down Arrow Key is used to select configuration fields.

4.3.11 Home - Home Key

ASCII	:	ESC[H
HEX	:	1BH, 5BH, 48H
KEY SEQUENCE	:	CTRL-[, [, H

used to position the cursor to line 1, column 1 of the current page.

4.3.12 Setup - Shift, Home Key

used to enter the Setup mode. Configuration changes may be made when the Video Terminal is in the Setup mode. Function key F1 is used to exit the Setup mode.

4.3.13 Enter - Enter Key

ASCII	:	CR
HEX	:	0DH
KEY SEQUENCE	:	CTRL-M

used to produce a Carriage Return (ASCII 0DH). When AUTO LINE FEED has been selected in the Setup mode, the cursor will increment one line and CR/LF transmitted each time a Carriage Return is entered. In the Setup mode, pressing Enter will change the available selections of displayed values at the prompt when choices are available. If the prompt is at the Brightness, Communications, Display Pages, Save or Recall Setup fields, the ENTER key will have no effect. Enter is also used to complete the Select Page escape sequence. If the cursor is on line 24 and the Enter key is pressed, data on line 1 will scroll off the screen and will be lost.

4.3.14 Signs/Punctuation

- Minus Sign (2DH) used to save and recall configurations in the Setup mode.

+ Plus Sign (2BH)

. Decimal Point (2EH)

, Comma (2CH)

4.3.15 Numeral Keys

0	30H
1	31H
2	32H
3	33H
4	34H
5	35H
6	36H
7	37H
8	38H
9	39H
A	Shift, 1\A. 41H
B	Shift, 2\B. 42H
C	Shift, 3\C. 43H
D	Shift, 4\D. 44H
E	Shift, 5\E. 45H
F	Shift, 6\F. 46H

CHAPTER 5. COMMAND AND CONTROL

Battery-backed RAM holds ASCII data for 32 operator display screens (or pages). Each page contains 24 lines of data and must be displayed in its entirety. Therefore, it is not possible to display only the top half of a stored screen. The active page of video RAM is the page on which the cursor is located. This is the page affected by data received from the Host port or keyboard/keypad input. The active cursor position is the row and column where the cursor is currently located and is the position where the next displayable character is placed.

The display page is the page of video RAM currently shown on the video terminal screen. The active page and the display page can be the same or different pages. When the active and display pages are the same, the cursor is displayed and input characters appear on the screen. When they are set to different pages, the display screen is static.

The active page, display page, and cursor information may be obtained by the Host using CTI Private - Request for Terminal Status (see section 5.8.1).

The Video Terminal displays 24 lines by 80 columns of single size characters. If double size character mode is selected, each character occupies 2 lines and 2 columns (4 positions) of display. Each quad size character occupies 4 lines and 4 columns (16 positions) of display. The display window consists of 12 lines by 40 columns of double size characters, and 6 lines by 20 columns of quad size characters. Any combination of character sizes can exist on the same screen.

Character size may be selected from the Setup menu or via commands from the Host. The cursor control keys automatically move one character position for each keystroke depending on the character size selected (i.e., two lines/columns for double size character mode and four lines/columns for quad size character mode).

Cursor positioning always uses 24 line by 80 column format regardless of character size. Because each double size character occupies 2 lines and 2 columns of display, these characters are placed so that the top left quadrant is always an odd line/column position (i.e., line 1, 3, 5, ..., 23/column 1, 3, 5, ..., 79). Each quad size character occupies 4 lines and 4 columns, resulting in the top left character position being every fourth line/column starting with Line 1/Column 1 (i.e., line 1, 5, 9, ..., 21/column 1, 5, 9, ..., 77). Designating the cursor position to any of the display locations occupied by a double or quad size character results in the cursor being displayed at the corresponding top left character position.

Figure 14 helps demonstrate cursor and character positioning. In this example, the single size character "A" is displayed at this position by placing the cursor on Line 1/Column 1. The double size character "B" appears at this location by placing the cursor at one of the occupied character positions Line 3-4/Column 7-8. The quad size character "C" is displayed as shown by placing the cursor on any of the character positions Line 1-4/Column 13-16.
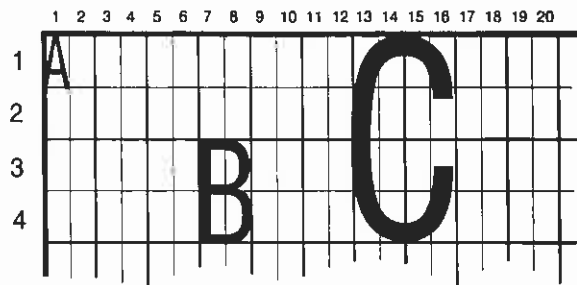
Fig. 14 Cursor Positioning for All Character Sizes

When entering valid commands (escape sequences and control characters) from the attached keyboard or transmitting them from the Host, the Video Terminal will not display the keystrokes or Host transmissions.

If an illegal character or value is discovered during an escape or control sequence, the sequence is aborted at the illegal character or value. If the illegal character is an ESC, a new ESC sequence will begin.

The following listings describe both standard (ANSI) and private (CTI) escape sequences and control characters supported by the Video Terminal.

The escape key is represented as ESC (CTRL-[) in this User's Guide. Some escape sequences contain parameters which are represented as *(Pn)* or *(Pn1)*; *(Pn2)*. A *(Pn)* parameter indicates that exactly one parameter is expected. A *(Pn1)*; *(Pn2)* parameter indicates that two parameters are expected. Other escape sequences contain parameters which are represented as *(Ps)* and indicates that any number of parameters may be expected. *(Ps)* parameters are processed in the order received. Multiple parameters are separated by semicolons in all cases.

All parameters are entered as decimal values and are sent in ASCII representation from the Host to the Video Terminal. For example, a parameter value of 6 should be sent as a 1 byte value of 36H. All parameters may be preceded by any number of leading zeroes, but they are not required. The maximum value entered for any parameter should be less than or equal to 255. The Video Terminal will accept any number of parameters entered but only the first 32 are processed. If more parameters are entered than are needed, the extra parameters are ignored.

Any *(Pn)* parameter value that is invalid for a particular escape sequence will be replaced with the maximum valid value for that parameter. Any *(Pn)* parameter set to zero or any omitted parameter will be taken as 1.

If a *(Ps)* parameter value is omitted, a default value of zero is assumed. Any invalid *(Ps)* parameter value is ignored.

Parameters are shown in parentheses, i.e., *(Ps)* and *(Pn)*, for clarity only. The parentheses should not be used in the escape sequences.

The Escape and Control Commands are described in the following pages. For quick reference, a summary of these Commands is also in the Appendix C.

5.1 Setup

5.1.1 Disable Selection of Setup Mode Entry from Keypad

ESC [< i   (From Host, Keyboard)

disables the entry into the Setup mode from the keypad. Setup may still be invoked from the attached keyboard.

5.1.2 Enable Selection of Setup Mode Entry from Keypad

ESC [< k   (From Host, Keyboard)

enables the entry into the Setup mode from the keypad. Setup may now be invoked from an attached keyboard or from the Video Terminal keypad using the ENTER SETUP MODE command.

5.1.3 Enter Setup Mode

Ctrl-Alt-Ins   (From Keyboard)
Shift, Home   (From Keypad)

used to enter Setup mode. The keyboard keys must be pressed simultaneously. The keypad keys must be pressed sequentially. Setup may only be invoked from an attached keyboard or from the Video Terminal keypad. Setup may not be invoked from the Host.

5.1.4 Exit Setup Mode

Function Key F1   (From Keyboard, Keypad)

used to exit Setup mode from a keyboard or keypad. Setup may not be exited from the Host.

5.1.5 Setup - Menu Advance

Function Key F2   (From Keyboard, Keypad)

used to advance Setup menu pages from a keyboard or keypad. Menu pages are circular so pressing F2 at the last menu page will cause the first page to be displayed. Menu pages may not be advanced from the Host.

5.1.6 Setup - Increase Brightness

Function Key F3   (From Keyboard, Keypad)

used to increase screen brightness when in the Setup mode. The cursor does not have to be located on the brightness field to increase intensity. Screen intensity has 10 levels with a mid level default setting. Brightness may not be increased from the Host.

5.1.7 Setup - Decrease Brightness

Function Key F4   (From Keyboard, Keypad)

used to decrease screen brightness when in the Setup mode. The cursor does not have to be located on the brightness field to decrease intensity. Brightness may not be decreased from the Host.

5.2 Function Keys

5.2.1 Function Key Escape Sequences

The escape sequences generated from the Video Terminal by pressing the function keys are:

F1	ESC O P
F2	ESC O Q
F3	ESC O R
F4	ESC O S
F5	ESC O T
F6	ESC O U
F7	ESC O V
F8	ESC O W
F9	ESC O X
F10	ESC O Y

5.2.2 Function Keys F1 through F8 (Keyboard, Keypad)

transmits an escape sequence to the Host when the Video Terminal is not in the Setup mode. These escape sequences may be incorporated at the user's discretion at the Host. At the Video Terminal, keypad function keys F5 through F8 are invoked by sequentially pressing the shift key then function keys, i.e. :

F5	Shift, F1\F5	F7	Shift, F3\F7
F6	Shift, F2\F6	F8	Shift, F4\F8

5.2.3 Function Keys F9 and F10 (Keyboard Only)

transmits an escape sequence to the Host when the Video Terminal is not in the Setup mode. These escape sequences may be incorporated at the user's discretion at the Host.

5.3 Format

5.3.1 Select Graphic Rendition (SGR)

ASCII	:	ESC[(Ps)m
HEX	:	1BH, 5BH, *(Ps)*, 6DH
KEY SEQUENCE	:	CTRL-[, [, *(Ps)*, m

invokes new graphic renditions for each character following the escape sequence on a character by character basis as selected by parameter *(Ps)*. Multiple parameters may be used if separated by semicolons. *(Ps)* values are processed in the order received and *(Ps)* values not listed below are ignored. New graphic renditions do not affect previously displayed characters. Normal video (Ps=0) resets all attributes to a default condition of no bold, no underline, no blink, and no reverse video. Missing *(Ps)* values are taken as zero.

(Ps)	Action
0	Normal Video
1	Bold
4	Underline
5	Blink
7	Reverse Video

Example: ESC[1;4m

causes each character entered after the escape sequence to be bold (Ps=1) and underlined (Ps=4).

NOTE:
Character attributes set by the SGR escape sequence stay in effect until revoked by future SGR or CTISGR escape sequences or until the Video Terminal is reset.

5.3.2 CTI Private - Select Graphic Rendition (CTISGR)

ASCII	:	ESC[<(Ps)m
HEX	:	1BH, 5BH, 3CH, (Ps), 6DH
KEY SEQUENCE	:	CTRL-[, [, <, (Ps), m

chooses the attribute for each character following the escape sequence on a character by character basis as indicated by the parameter *(Ps)*. Multiple parameters may be used in one escape sequence if separated by a semicolon. A maximum of 16 *(Ps)* values are allowed. The *(Ps)* values are processed in the order received and values not listed below are ignored. Missing *(Ps)* values result in no operation. The parameters to select the desired video attributes are:

(Ps)	**Action**
0	Normal Video
1	Bold
4	Underline
5	Blink
7	Reverse Video
40	Quad Height/Width Character Mode
50	Double Height/Width Character Mode

Examples: ESC[<1;50m

causes each character entered after the escape sequence to be bold, double size characters.

      ESC[<1;5;0

results in Normal Video mode for each character entered after the escape sequence. The Bold and Blink attributes are not in effect because the Normal Video attribute was received later in the sequence, and parameters are processed in order of receipt.

NOTE:

Character attributes set by the CTISGR escape sequence stay in effect until revoked by future escape sequences or until the Video Terminal is reset.

Bold, Underline, Blink, and Reverse Video attributes may be revoked by CTISGR or SGR escape sequences. Double Height/Width character mode and Quad Height/Width character mode can be revoked only by CTISGR escape sequence.

5.4 Cursor

5.4.1 Back Space

ASCII	:	BS
HEX	:	08H
KEY SEQUENCE	:	CTRL-H

moves the cursor one character position to the left on the same line and removes any character previously occupying that position. A CTRL-H from the keyboard or Host is the same as the Back Space key. If the cursor is positioned at the first column of a line Back Space will have no effect.

5.4.2 Carriage Return

ASCII	:	CR
HEX	:	0DH
KEY SEQUENCE	:	CTRL-M

moves the cursor to the first column of the same line if the Auto Linefeed feature is not selected in the Setup mode. If Auto Linefeed is selected, Carriage Return moves the cursor to the first column of the next line. This code is generated by the keyboard and keypad Enter key.

5.4.3 Horizontal Tabulation

ASCII	:	HT
HEX	:	09H
KEY SEQUENCE	:	CTRL-I

moves the cursor to the next tab stop. The tab positions are fixed at 8 character intervals (8 columns for single size characters; 16 columns for double size characters; 32 columns for quad size characters). Tab has no effect if the cursor is located in a column beyond the last tab stop for the line. This code is generated by the keyboard Tab key.

5.4.4 Horizontal and Vertical Positioning (HVP)

ASCII	:	ESC[(Pn1);(Pn2)f
HEX	:	1BH, 5BH, *(Pn1)*, 3BH, *(Pn2)* 66H
KEY SEQUENCE	:	CTRL-[, [, *(Pn1)*, ;, *(Pn2)*, f

positions the cursor to line number *(Pn1)* and column number *(Pn2)*. Missing or zero *(Pn)* values are taken as 1.

(Pn)	Action
1	Line Number (1 - 24)
2	Column Number (1 - 80)

Example: ESC[12;40f   positions the cursor to line 12, column 40.

Example: ESC[f   positions the cursor to line 1, column 1.

5.4.5 Line Feed

ASCII	:	LF
HEX	:	0AH
KEY SEQUENCE	:	CTRL-J

moves the cursor down one character line with the cursor remaining in the same column. If the cursor is on the bottom line, displayed data will be scrolled up one row of characters (one line for single size characters, two lines for double size characters, and four lines for quad size characters. Any data on line(s) scrolled off of the display is lost. This control character gives the same results as the Down Arrow key. The resulting action of the receipt of CTRL-K (Vertical Tab) and CTRL-L (Form Feed) codes are identical to LF character.

5.4.6 Cursor Backward (CUB)

ASCII	:	ESC[(Pn)D
HEX	:	1BH, 5BH, (Pn), 44H
KEY SEQUENCE	:	CTRL-[, [, (Pn), D

moves the cursor to the left *(Pn)* character positions (one column for single size characters, two columns for double size characters, or four columns for quad size characters). Missing or zero *(Pn)* values are taken as 1. Once the cursor is in column 1 a Cursor Backward has no effect. Cursor Backward does not delete characters in its path. A Cursor Backward escape sequence with a *(Pn)* value of 1 gives the same results as the Left Arrow key.

Example: ESC[10D

positions the cursor 10 character positions to the left of its current position. The cursor stops at column 1 regardless of the cursor position and the value of *(Pn)*.

5.4.7 Cursor Down

ASCII	:	ESC[(Pn)B
HEX	:	1BH, 5BH, (Pn), 42H
KEY SEQUENCE	:	CTRL-[, [, (Pn), B

moves the cursor down *(Pn)* character lines (one line for single size characters, two lines for double size characters, or four lines for quad size characters). Missing or zero *(Pn)* values are taken as 1. Once the cursor is on the last line of the page a Cursor down has no effect. This sequence with a *(Pn)* value of 1 gives the same results as the Down Arrow key.

Example: ESC[B

positions the cursor 1 character line down from the current cursor position but not past the last line of the page.

5.4.8 Cursor Forward (CUF)

ASCII	:	ESC[(Pn)C
HEX	:	1BH, 5BH, (Pn), 43H
KEY SEQUENCE	:	CTRL-[, [, (Pn), C

moves the cursor forward *(Pn)* character positions (one column for single size characters, two columns for double size characters, or four columns for quad size characters). Missing or zero *(Pn)* values are taken as 1. Once the cursor is in the last column of a line a Cursor Forward has no effect. A *(Pn)* value greater than the number of columns remaining on a line will move the cursor to the last column. This sequence with a *(Pn)* value of 1 gives the same results as a Right Arrow key.

Example: ESC[C

moves the cursor one character to the right of its current position. The cursor stops at the last character position on the line regardless of the *(Pn)* value.

5.4.9 Cursor Up (CUU)

ASCII	:	ESC[(Pn)A
HEX	:	1BH, 5 BH, (Pn), 41H
KEY SEQUENCE	:	CTRL-[, [, (Pn), A

moves the cursor up *(Pn)* character lines (one line for single size characters, two lines for double size characters, or four lines for quad size characters). Missing or zero *(Pn)* values are taken as 1. Once the cursor is on the top line a Cursor Up has no effect. The sequence with a *(Pn)* value of 1 gives the same results as an Up Arrow key.

Example: ESC[5A

moves the cursor 5 character lines up from the current cursor position. The cursor will stop at line 1 regardless of the value of *(Pn)*.

5.4.10 Cursor Position (CUP)

ASCII	:	ESC[*(Pn1)*;*(Pn2)*H
HEX	:	1BH, 5BH, *(Pn1)*, 3BH, *(Pn2)* 48H
KEY SEQUENCE	:	CTRL-[, [, *(Pn1)*, ;, *(Pn2)*, H

positions the cursor to line *(Pn1)* and column *(Pn2)*. If either *(Pn)* is missing or zero it is taken as 1. If both are missing, Cursor Position homes the cursor. Cursor movement stops at column 80 and line 24 if either or both (Pn/s) are to large.

(Pn)	Action
1	Line Number (1 - 24)
2	Column Number (1 - 80)

Example: ESC[10H

positions the cursor to line 10, column 1.

5.4.11 Home

ASCII	:	ESC[H
HEX	:	1BH, 5BH, 48H
KEY SEQUENCE	:	CTRL-[, [, H

moves the cursor to line 1, column 1 of the active page. This escape sequence is transmitted when the keyboard and keypad Home key is pressed.

5.4.12 End

ASCII	:	ESC[25B
HEX	:	1BH, 5BH, 32H, 35H, 42H
KEY SEQUENCE	:	CTRL-[, [, 2, 5, B

moves cursor to the bottom of the active page. The cursor remains in the same column. This escape sequence is the same as the keyboard End key.

5.4.13 CTI Private - Save Cursor on Page (CTISCP)

ASCII	:	ESC7
HEX	:	1BH, 37H
KEY SEQUENCE	:	CTRL-[, 7

saves the current cursor position on the active page. The current graphic rendition: bold, underline, blink, reverse video, and character size are also saved. This escape sequence functions on a page by page basis and may be invoked on each page separately. See CTIRCP to restore the cursor position. This function is automatically executed when the active page is changed.

Example: ESC7

saves the current cursor position and graphic rendition on the active page.

5.4.14 CTI Private - Restore Cursor on Page (CTIRCP)

ASCII	:	ESC8
HEX	:	1BH, 38H
KEY SEQUENCE	:	CTRL-[, 8

restores the cursor position and graphic rendition on the current active page that was previously saved by the CTISCP escape sequence. This sequence, like CTISCP, functions on a page by page basis and may be invoked on each page separately. If the CTISCP sequence has not been used since power up or reset the CTIRCP has no effect. Once CTISCP has been used, CTIRCP may be used repeatedly to restore the last saved cursor position and graphic rendition. This function automatically restores cursor position and attributes when a new active page is selected. If the new page has not been previously called, the cursor is positioned at line 1, column 1 with no attributes.

Example: ESC8

restores the previously saved cursor position and graphic rendition.

5.5 Page

5.5.1 CTI Private - Display Page (CTIDP)

ASCII	:	ESC[>*(Pn)*w
HEX	:	1BH, 5BH, 3EH, *(Pn)*, 77H
KEY SEQUENCE	:	CTRL-[, [, >, *(Pn)*, w

causes page *(Pn)* to become the display page. If *(Pn)* is missing or zero, the current active page becomes the display page. The cursor remains on the active page. See CTISP. This sequence may be invoked from the keypad with Shift, Right Arrow, *(Pn)*, Enter.

Example: ESC[>w

causes the active page to become the display page.

Example: ESC[>2w

causes page 2 to become the display page.

5.5.2 CTI Private - Select Page (CTISP)

ASCII	:	ESC[<*(Pn1)*;*(Pn2)*w
HEX	:	1BH, 5BH, 3CH, *(Pn1)*, 3BH, *(Pn2)*, 77H
KEY SEQUENCE	:	CTRL-[, [, <, *(Pn1)*, ;, *(Pn2)*, w

causes page *(Pn1)* to become the new active page and page *(Pn2)* to become the new display page. A missing or zero *(Pn1)* value causes the current active page to remain the same. A missing or zero *(Pn2)* value causes the current display page to remain the same. The contents of the old active page are saved and the contents of the new active page are restored. When a new active page is selected the cursor is restored to the cursor position when that page was last active. If that page has not been active the cursor is positioned at line 1, column 1.

(Pn)	Action
1	Active Page (1 - 32)
2	Display Page (1 - 32)

Example: ESC[<1;3w

causes page 1 to be the active page and page 3 to be the display page. The cursor remains on page 1.

5.5.3 Page Down

ASCII	:	ESC[*(Pn)*U
HEX	:	1BH, 5BH, *(Pn)*, 55H
KEY SEQUENCE	:	CTRL-[, [, *(Pn)*, U

saves the contents of the current page and advances *(Pn)* pages through display memory. The contents of the new page are restored and that page is displayed. A missing or zero *(Pn)* value is taken as 1. A Page Down escape sequence while on page 32 has no effect. If the value of *(Pn)* exceeds the number of available pages, page 32 is set as the display page. This escape sequence with *(Pn=0)* is the same as the Page Down key on the keyboard and a Shift, Down Arrow from the keypad. It does not effect the current active page or active cursor position.

Example: ESC[2U

causes page 3 to be the displayed page if page 1 is the currently displayed page.

Example: ESC[33U

causes page 32 (the last page) to become the display page.

5.5.4 Page Up

ASCII	:	ESC[*(Pn)*V
HEX	:	1BH, 5BH, *(Pn)*, 56H
KEY SEQUENCE	:	CTRL-[, [, *(Pn)*, V

saves the contents of the current page and goes backward *(Pn)* pages through display memory. The contents of the new page are restored and that page is displayed. A missing or zero *(Pn)* value is taken as 1. A Page Up escape sequence while on the page 1 has no effect. If the value of *(Pn)* exceeds the number of available pages, page 1 is set as the display page. This escape sequence with *(Pn=0)* is the same as the keyboard Page Up key and a Shift, Up Arrow from the keypad. It does not effect the current active page or active cursor position.

Example: ESC[1V

causes page 3 to become the display page if page 4 is currently displayed; page 2 if page 3 is currently displayed; page 1 if page 2 is currently displayed; page 1 if page 1 is currently displayed.

5.6 Status Line

5.6.1 Disable Status Line Display

ASCII	:	ESC<55m
HEX	:	1BH, 5BH, 35H, 35H, 6DH
KEY SEQUENCE	:	CTRL-[, <, 5, 5, m

used to disable the display of the status line on the 25th line. The status line is automatically enabled when the Setup mode is exited.

5.6.2 Enable Status Line Display

ASCII	:	ESC[<56m
HEX	:	1BH, 5BH, 35H, 36H, 6DH
KEY SEQUENCE	:	CTRL-[, <, 5, 6, m

used to enable the display of the status line on the 25th line.

5.7 Enable/Disable Inputs

5.7.1 Keypad Inputs

5.7.1.1 Disable Manual Input (DMI)

ASCII	:	ESC'
HEX	:	1BH, 60H
KEY SEQUENCE	:	CTRL-[, '

disables the Video Terminal keypad.

This escape sequence uses a grave accent ('). If the keypad is already disabled the DMI escape sequence will have no effect.

5.7.1.2 Enable Manual Input (EMI)

ASCII	:	ESCb
HEX	:	1BH, 62H
KEY SEQUENCE	:	CTRL-[, b

enables the Video Terminal keypad. If the keypad is already enabled the EMI escape sequence will have no effect.

5.7.1.3 Disable Keypad Setup Entry

ASCII	:	ESC[<k
HEX	:	1BH, 5BH, 3CH, 6BH
KEY SEQUENCE	:	CTRL-[, [, <, k

disables the entry into the Setup mode from the keypad.

5.7.1.4 Enable Keypad Setup Entry

ASCII	:	ESC[<j
HEX	:	1BH, 5BH, 3CH, 6AH
KEY SEQUENCE	:	CTRL-[, [, <, j

enables the entry into the Setup mode from the keypad.

5.7.2 Keyboard Inputs and Local Echo

5.7.2.1 Reset Mode (RM)

ASCII	:	ESC[*(Ps)*l
HEX	:	1BH, 5BH, *(Ps)*, 6CH
KEY SEQUENCE	:	CTRL-[, [, *(Ps)*, l

resets (enables) the attached keyboard and/or the local echo feature. This escape sequence is used in conjunction with the SM escape sequence. Multiple *(Ps)* values are allowed, each separated by a semicolon. This escape sequence uses a lower case (small letter) l.

(Ps)	Action
2	Enable keyboard.
12	Enable local echo. Keyboard entries are echoed and displayed by the Video Terminal with the exception of escape sequences and control characters which are executed but not displayed. Keyboard entries are also transmitted to the Host if the Video Terminal is online.

Example: ESC[2;12l

enables the keyboard and local echo.

5.7.2.2 Set Mode (SM)

ASCII	:	ESC[(Ps)h
HEX	:	1BH, 5BH, (Ps), 68H
KEY SEQUENCE	:	CTRL-[, [, (Ps), h

sets (disables) the attached keyboard and/or the local echo feature. Multiple (Ps) values are allowed, each separated by a semicolon. Out of range (Ps) values have no effect.

(Ps)	Action
2	Disables keyboard except for valid escape sequences.
12	Disables local echo. Keyboard entries are not echoed to the Video Terminal or displayed. Escape sequences and control characters are not executed. If the Video Terminal is online keyboard entries are transmitted to the Host. If the Video Terminal is in local mode (offline), disabling local echo has no effect but if the Video Terminal is placed online later the local echo will still be disabled.

Example: ESC[2h

disables the keyboard.

5.8 Request for Video Terminal and Screen Information

5.8.1 Request for Video Terminal Status (Host only)

ASCII	:	ESC[<59m
HEX	:	1BH, 5BH, 3CH, 35, 39, 6DH
KEY SEQUENCE	:	CTRL-[, [, <, 5, 9, m

The Host may obtain the current status of the Video Terminal using this escape sequence. The status is sent to the Host as an ASCII string. The following is a description of each byte in this string.

Byte 1:   Battery Indicator (0 for OK, 1 for LOW)
Byte 2:   Cursor Row - Tens value
Byte 3:   Cursor Row - Ones value
Byte 4:   Cursor Column - Tens value
Byte 5:   Cursor Column - One value
Byte 6:   Display Page - Tens value
Byte 7:   Display Page - Ones value
Byte 8:   Active Page - Tens value
Byte 9:   Active Page - Ones value
Byte 10:   Printer Status - Printer Busy Line
            (0 for NOT BUSY, 1 for BUSY)

BUSY: the Video Terminal only recognizes the fact that the printer is BUSY.

NOT BUSY: If the printer is ON, ONLINE, and not out of paper, this is the NOT BUSY state. If the printer is OFF or not physically connected to the parallel port, this would appear to the Video Terminal as the NOT BUSY state.

Byte 11:   Interactive Print Mode Status
            (0 for INACTIVE, 1 for ACTIVE)
Byte 12:   <cr> - End of status string (ASCII 0DH)

NOTE:
This command is not allowed when using multipoint communications.

Example: 12075120410<CR>

Byte 1	=	1	, battery low
Bytes 2 & 3	=	20	, cursor row position is 20
Bytes 4 & 5	=	75	, cursor column position is 75
Bytes 6 & 7	=	12	, page 12 is displayed
Bytes 8 & 9	=	04	, cursor is active on page 4
Byte 10	=	1	, printer status is BUSY
Byte 11	=	0	, interactive Print Mode status is inactive
Byte 12	=	<cr>	, end of status string

5.8.2 Request for Page Checksum

This allows the user to request a checksum for active page. The page checksum is computed as the sum of Character/Attribute values for each row (1-24) and column (1-80) positions on the page. This sum is then logically ANDed with FFH to get the final checksum.

To use this feature select the active page desired and then send the following escape sequence:

ESC[<60m

The return format from the Video Terminal is as follows:

Byte 1 - ASCII most significant digit of checksum
Byte 2 - ASCII least significant digit of checksum
Byte 3 - Carriage Return (CR)

The following example will return the checksum of the current Active Page:

10 CLOSE 1:OPEN "com1:9600,n,8,1" AS 1
20 PRINT #1, CHR$(27);"[<60m";
30 INPUT #1,A$
40 PRINT A$ 'print checksum for current Active Page

NOTE:
This command is not allowed when using multipoint communications.

5.8.3 Request Character and Attributes

This returns the character and attribute at the current cursor position. To use this feature place the cursor at the desired location and send the following escape sequence:

ESC[<67m

The return format from the Video Terminal is the following:

Byte 1 - ASCII character
Byte 2 - BINARY attribute
Byte 3 - Carriage Return (CR)

This example returns the character and attribute at the current cursor position:

```
10 OPEN "com1:9600,n,8,1" AS 1
20 PRINT #1, CHR$(27);"[<67m";              ' get char & attribute
30 INPUT #1,A$                              ' reads till CR
40 PRINT "character: ";LEFT$(A$,1)"         ' Byte 1
50 PRINT "attribute; ";HEX$(ASC(RIGHT$(A$,1)))   ' Byte 2 in HEX/ASCII
```

Attributes are defined according to the following bit assignment:

```
7   6   5   4   3   2   1   0
|   |   |   |   |   |   |   |_____ Reverse Video
|   |   |   |   |   |   |_____ Normal Intensity (NOT BOLD)
|   |   |   |   |   |_____ Blink
|   |   |   |   |_____ DOUBLE
|   |   |   |_____ QUAD
|   |   |_____ Underline
|   |_____ Not Used (Always "1")
|_____ Graphics Char
```
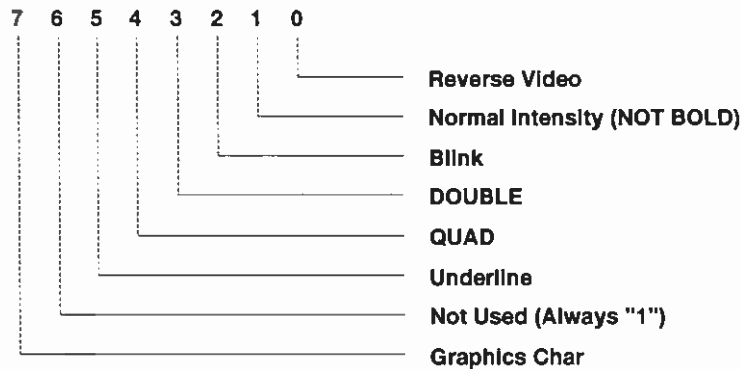
Fig. 15 Character Attribute Bit Assignments

The character attribute is selected if the corresponding bit is low (0). To determine the attribute combination according to the value read by the Request Character and Attribute escape sequence, simply read the attribute description with its corresponding bit.

Ex.	Single Size, No Attributes -	1 1 1 1 1 1 0 1 or hex FD.
Ex.	Double Size Bold -	1 1 1 1 0 1 1 1 or hex F7.
Ex.	Single Size Graphics Char -	0 1 1 1 1 1 0 1 or hex 7D.

NOTE:
This command is not allowed when using multipoint communications.

5.9 Software Handshaking

5.9.1 Device Control 1 - XON

ASCII	:	DC1
HEX	:	11H
KEY SEQUENCE	:	CTRL-Q

Used in conjunction with DC3 (XOFF), XON signals the Host to resume transmission to the Video Terminal. When Software Handshaking is selected (via Setup), the Video Terminal sends XON to the Host when its input buffer is empty and it is ready to receive data.

5.9.2 Device Control 3 - XOFF

ASCII	:	DC3
HEX	:	13H
KEY SEQUENCE	:	CTRL-S

Used in conjunction with DC1 (XON), XOFF signals the Host to stop transmitting to the Video Terminal. When Software Handshaking is selected (via Setup), the Video Terminal sends XOFF to the Host when its input buffer reaches approximately 75% full.

5.10 Video Terminal Reset

5.10.1 Reset to Initial State (RIS)

ASCII	:	ESCc
HEX	:	1BH, 63H
KEY SEQUENCE	:	CTRL-[, c

resets the Video Terminal to the last saved Setup configuration, erases the active page, and positions the cursor to line 1, column 1 of the active page (See CTIRIS section below).

Example: ESCc

resets the Video Terminal and erases the active page.

5.10.2 CTI Private - Reset to Initial State (CTIRIS)

ASCII	:	ESC[*(Ps)*z
HEX	:	1BH, 5BH, *(Ps)*, 7AH
KEY SEQUENCE	:	CTRL-[, [, *(Ps)*, z

resets the Video Terminal based on *(Ps)* as follows:

(Ps)	Action
0	Resets the Video Terminal to the most recently saved setup configuration. This sequence erases the active page and repositions the cursor to line 1, column 1 on the active page. See Reset to Initial State (ESCc).
9	Resets the Video Terminal to the factory defaults. This sequence erases all pages, resets the active page to page 1 and repositions the cursor to line 1, column 1 on that page. All pages are reset to the initial state.

Example: ESC[9z

resets the Video Terminal to the factory setup configuration.

5.11 Printing

The Video Terminal connects directly to a standard parallel printer to provide a hard copy record of display screens or information sent to the Terminal. Printer output is routed to a 8K byte area of RAM dedicated as a print buffer. Data is then transmitted from this buffer to the parallel port as the printer is ready for data. If the print buffer is filled, future printer output data will be lost until buffer space is made available (either by sending data to the printer or resetting the unit).

5.11.1 Print Command Timeout

If the Video Terminal is unable to complete any of the print commands listed in Section 5.11, a timeout will occur in approximately one minute.

When the timeout occurs in Interactive Print Mode, the Video Terminal removes itself from Interactive Print Mode. This status may be monitored using bytes 10 and 11 of the Video Terminal Status.

5.11.2 Enter/Exit Interactive Print Mode

ASCII	:	ESC[*(Ps)*i
HEX	:	1BH, 5BH, *(Ps)*, 69H
KEY SEQUENCE	:	CTRL-[, [, *(Ps)*, i

causes the Video Terminal to enter or exit interactive print mode depending on the value of *(Ps)*.

When Interactive Print Mode is enabled, each character received for display from the Host, keyboard, and/or keypad is routed to the parallel (printer) port. When enabled, the status line displays "I PRINT ON". Interactive print mode may be entered and exited from the keyboard by simultaneously pressing the control and print screen keys (Ctrl-PrtSc). Valid escape sequences are not printed. Control characters that directly effect the printer, i.e., LF, CR, and FF are printed.

(Ps)	Action
4	Exit Interactive Print Mode
5	Enter Interactive Print Mode

Example: ESC[5i

enters Interactive Print mode.

5.11.3 CTI Private - Transmit Data (CTITD)

ASCII	:	ESC[*(Ps)*p
HEX	:	1BH, 5BH, *(Ps)*, 70H
KEY SEQUENCE	:	CTRL-[, [, *(Ps)*, p

directs data transfers to the parallel (printer) port based on the parameter *(Ps)*. This escape sequence may be invoked from the keyboard by simultaneously pressing the Shift and Print Screen keys (Shift-PrtSc).

(Ps)	Action
4	Display page is output to the parallel port.

Example: ESC[4p

outputs the display page to the parallel port.

5.12 Editing

5.12.1 Erase in Display (ED)

ASCII	:	ESC[*(Ps)*J
HEX	:	1BH, 5BH, *(Ps)*, 4AH
KEY SEQUENCE	:	CTRL-[, [, *(Ps)*, J

erases the characters on the active page based on the value of *(Ps)*. The character at the cursor position is erased and the cursor position remains the same. A missing *(Ps)* value is taken as zero.

(Ps)	Action
0	Erases from cursor position to end of page.
1	Erases from start of the page to the cursor position.
2	Erases the entire page.

Example: ESC[2J

erases the entire page and leaves the cursor position unchanged.

5.12.2 Erase in Line (EL)

ASCII	:	ESC[*(Ps)*K
HEX	:	1BH, 5BH, *(Ps)*, 4BH
KEY SEQUENCE	:	CTRL-[, [, *(Ps)*, K

erases characters on the active line based on the value of *(Ps)*. The character at the cursor position is erased and the cursor position remains the same. A missing *(Ps)* value is taken as 0.

(Ps)	Action
0	Erases from the cusor position to the end of the line.
1	Erases from the start of the line to cursor position.
2	Erases the entire line.

Example: ESC[K

erases the characters from the cursor position to the end of the line and leaves the cursor position unchanged.

5.12.3 Delete

ASCII	:	DEL
HEX	:	7FH
KEY SEQUENCE	:	Delete Key (Keyboard)
		Shift, Left Arrow (Keypad)

deletes the character to the left of the cursor position. A Delete key pressed from the keyboard is the same as the Back Space key. From the keypad press Shift, Left Arrow.

5.13 Graphic Characters

The Video Terminal uses the standard PC ASCII graphics character set. All graphics characters may be displayed in single, double, or quad size character mode.

The Video Terminal uses ASCII character positions 00-15 (0-0FH) for internal storage and does not display graphics characters associated with those values. All other ASCII character positions 16-255 (10H-FFH) are fully supported.

Dec	Hex	Char	Code	Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char
0	00		NUL	32	20		64	40	@	96	60	`	128	80	Ç	160	A0	á	192	C0	└	224	E0	α
1	01		SOH	33	21	!	65	41	A	97	61	a	129	81	ü	161	A1	í	193	C1	┴	225	E1	ß
2	02		STX	34	22	"	66	42	B	98	62	b	130	82	é	162	A2	ó	194	C2	┬	226	E2	Γ
3	03		ETX	35	23	#	67	43	C	99	63	c	131	83	â	163	A3	ú	195	C3	├	227	E3	π
4	04		EOT	36	24	$	68	44	D	100	64	d	132	84	ä	164	A4	ñ	196	C4	─	228	E4	Σ
5	05		ENQ	37	25	%	69	45	E	101	65	e	133	85	à	165	A5	Ñ	197	C5	┼	229	E5	σ
6	06		ACK	38	26	&	70	46	F	102	66	f	134	86	å	166	A6	ª	198	C6	╞	230	E6	µ
7	07		BEL	39	27	'	71	47	G	103	67	g	135	87	ç	167	A7	º	199	C7	╟	231	E7	τ
8	08		BS	40	28	(	72	48	H	104	68	h	136	88	ê	168	A8	¿	200	C8	╚	232	E8	Φ
9	09		HT	41	29	)	73	49	I	105	69	i	137	89	ë	169	A9	⌐	201	C9	╔	233	E9	Θ
10	0A		LF	42	2A	*	74	4A	J	106	6A	j	138	8A	è	170	AA	¬	202	CA	╩	234	EA	Ω
11	0B		VT	43	2B	+	75	4B	K	107	6B	k	139	8B	ï	171	AB	½	203	CB	╦	235	EB	δ
12	0C		FF	44	2C	,	76	4C	L	108	6C	l	140	8C	î	172	AC	¼	204	CC	╠	236	EC	∞
13	0D		CR	45	2D	-	77	4D	M	109	6D	m	141	8D	ì	173	AD	¡	205	CD	═	237	ED	φ
14	0E		SO	46	2E	.	78	4E	N	110	6E	n	142	8E	Ä	174	AE	«	206	CE	╬	238	EE	ε
15	0F		SI	47	2F	/	79	4F	O	111	6F	o	143	8F	Å	175	AF	»	207	CF	╧	239	EF	∩
16	10	►	DLE	48	30	0	80	50	P	112	70	p	144	90	É	176	B0	░	208	D0	╨	240	F0	≡
17	11	◄	DC1	49	31	1	81	51	Q	113	71	q	145	91	æ	177	B1	▒	209	D1	╤	241	F1	±
18	12	↕	DC2	50	32	2	82	52	R	114	72	r	146	92	Æ	178	B2	▓	210	D2	╥	242	F2	≥
19	13	‼	DC3	51	33	3	83	53	S	115	73	s	147	93	ô	179	B3	│	211	D3	╙	243	F3	≤
20	14	¶	DC4	52	34	4	84	54	T	116	74	t	148	94	ö	180	B4	┤	212	D4	╘	244	F4	⌠
21	15	§	NAK	53	35	5	85	55	U	117	75	u	149	95	ò	181	B5	╡	213	D5	╒	245	F5	⌡
22	16	▬	SYN	54	36	6	86	56	V	118	76	v	150	96	û	182	B6	╢	214	D6	╓	246	F6	÷
23	17	↨	ETB	55	37	7	87	57	W	119	77	w	151	97	ù	183	B7	╖	215	D7	╫	247	F7	≈
24	18	↑	CAN	56	38	8	88	58	X	120	78	x	152	98	ÿ	184	B8	╕	216	D8	╪	248	F8	°
25	19	↓	EM	57	39	9	89	59	Y	121	79	y	153	99	Ö	185	B9	╣	217	D9	┘	249	F9	·
26	1A	→	SUB	58	3A	:	90	5A	Z	122	7A	z	154	9A	Ü	186	BA	║	218	DA	┌	250	FA	·
27	1B	←	ESC	59	3B	;	91	5B	[	123	7B	{	155	9B	¢	187	BB	╗	219	DB	█	251	FB	√
28	1C	∟	FS	60	3C	<	92	5C	\	124	7C	|	156	9C	£	188	BC	╝	220	DC	▄	252	FC	ⁿ
29	1D	↔	GS	61	3D	=	93	5D	]	125	7D	}	157	9D	¥	189	BD	╜	221	DD	▌	253	FD	²
30	1E	▲	RS	62	3E	>	94	5E	^	126	7E	~	158	9E	₧	190	BE	╛	222	DE	▐	254	FE	■
31	1F	▼	US	63	3F	?	95	5F	_	127	7F	⌂	159	9F	ƒ	191	BF	┐	223	DF	▀	255	FF	

Graphics characters for ASCII 00-15 (00-0FH) are not supported.
ASCII 32 (20H) is a "space".
ASCII 255 (FFH) is a "blank".

Fig. 16 ASCII Character Set Chart

CHAPTER 6. MULTIPOINT COMMUNICATIONS

A multipoint system is defined as one or more Video Terminals acting as slave stations, linked by a single RS-422 or RS-485 electrical interface to a common Host or control station. This must be a master-slave type communications link. Only one station, whether Host or slave, may transmit at a time. Every transaction is initiated by the Host; unsolicited transmission by a Video Terminal is not allowed.

To use the Video Terminal as a slave station in a multipoint link configuration:

1. Connect the Host and slave stations on the link. Use the appropriate communications connector pin-outs when making electrical connections to the link.

2. If the Video Terminal is the last station on an RS-422/485 link, configure the termination switch on the back of the Video Terminal.

3. Choose the appropriate Communications and Terminal I.D. selection (see Section 3 - Setup Menu).

4. Adhere to the multipoint communication protocol as described in this section.

Several examples are provided in APPENDIX G - RS-422M Examples Using Allen-Bradley 1771-DB to Video Terminal.

6.1 Multipoint Communications Protocol

The Video Terminal adheres to a well defined and very flexible communications protocol in which data is transmitted in groups of characters as opposed to a character-by-character transmission. Messages in this system are referred to as packets and the manipulation of these packets of data is accomplished via a packet protocol.

6.1.1 Important Features of the Protocol

The packet protocol implemented by the Video Terminal is designed with a number of important features:

Compatibility. The multipoint message protocol utilizes the ANSI control characters and byte protocol standards specified in ANSI standards X3.4 and X3.28.

Rejection of other protocols. In addition, the protocol allows rejection of messages with different protocols destined to other devices on the link, and minimizes the false acceptance of messages intended for the Video Terminal by other devices that share

the link. Interference with the protocols of other devices that share the link is minimized by this packet format and by the ability to insert "dummy" characters.

Ease of use. Implementation of the protocol is as simple as possible for each level of communications integrity. The protocol provides near minimum Host actions to communicate with a given level of reliability. As the user selects additional error detection and delivery verification, the protocol gradually gets more complex, but is always within the scope of embedded controllers and typical PLC BASIC modules.

6.2 The Message Packet

6.2.1 Terminology and Usage Conventions

The following terms used in this section are defined below:

Hexadecimal (Hex) Number base 16 containing the digits 0 through 9 and letters A, B, C, D, E, and F.

Decimal (Dec): Number base 10 containing the digits 0 through 9.

Byte: Eight (8) continuous bits numbered from the right, 0 through 7. This is equivalent to decimal values 0-255 and hexadecimal values 00H-FFH.

Nibble: The Low-order and High-order four (4) bits of a byte numbered from the right as 0 through 3 (Low-order) and 4 through 7 (High-order).

ASCII: An international standard consisting of a set of 128 (0-127) characters (control characters and graphic characters such as letters, digits, and symbols) as their coded byte representation.

Character: A symbol represented by an ASCII code.

HEX/ASCII: A two (2) character ASCII representation of a single Hex byte.

For illustration purposes only, note that:

1. All hex values are followed by an "H".

2. Each transmitted ASCII character is placed in angle brackets <>, i.e., <SOH> represents the single ASCII character Start Of Header (SOH, 01, 01H).

3. Referenced bit values are labeled 0 - 7, right to left.

4. Referenced multiple byte words are labeled 1 - n, left to right.

```
┌─────────────────────────────────────────────────────────────┐
│                           NOTE:                             │
│  Neither the brackets (< >) or the "H" are used in the       │
│  actual application.                                         │
└─────────────────────────────────────────────────────────────┘
```

6.2.2 Data Transmission

All data is transmitted between the Host and the Video Terminal in a byte format. The actual information contained in this byte is interpreted as either an ASCII character, a Hex byte or a HEX/ASCII byte. These are defined as:

1. An ASCII character is simply the representation of a letter, number or special character by a 7 bit hex byte. Each hex byte from 00H to 7FH represents one ASCII character (see the ASCII table in the Appendix).

2. A hex byte is a 7 or 8 bit hexadecimal value. It represents a value of 00H to 7FH in 7 data bits or 00H to FFH in 8 data bits.

3. A HEX/ASCII byte is the 2 character ASCII representation of a single hex value. The advantage of HEX/ASCII format is to allow binary data to be transmitted between standard ASCII devices. This is performed by sending 2 ASCII bytes to represent one binary byte. The example below illustrates the Hex to HEX/ASCII conversion.

HEX TO HEX/ASCII CONVERSION

To convert a single byte of Hex data to HEX-ASCII, each nibble of the byte is converted from its Hex value to its ASCII representation. For example if the Hex byte is 3FH, the HEX/ASCII characters to represent this value are an ASCII <3> (33H) and an ASCII F (46H). The conversion is shown graphically in the following figure:

HEX BYTE 3FH CONVERSION TO HEX/ASCII

HIGH NIBBLE OF HEX BYTE	LOW NIBBLE OF HEX BYTE
3	F
03H	0FH
+30H (offset to ASCII numbers)	+37H (offset to ASCII letters)
33H (Byte 1)	46H (Byte 2)
ASCII <3>	ASCII <F> (2 ASCII characters)

Fig. 17 HEX to HEX/ASCII Conversion

The ASCII 3 would precede the ASCII F in the actual bytes sent. If the value of the nibble to be converted is 0H - 9H, the HEX/ASCII representation may be obtained by adding 30H to that nibble. If the value of the nibble is 0AH - 0FH, adding 37H to the nibble results in its HEX/ASCII representation. The HEX/ASCII representation of one Hex byte (high nibble followed by low nibble) results in two ASCII characters:

Byte 1 = ASCII equivalent of Hex value of high nibble

Byte 2 = ASCII equivalent of Hex value of low nibble

NOTE:
It is important to understand the HEX/ASCII representation to properly design the header.

6.2.3 Message Packet Format

A message packet consists of up to three fundamental components shown in the diagram below:
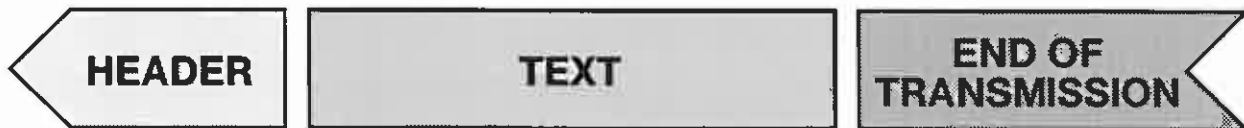
Fig. 18 Message Packet Format

The message packet formats for specific transactions and the individual elements of each packet component are explained and illustrated in the following pages.

6.2.4 Host to Terminal Transactions

Using the three message components - header, text, and end of transmission - there are four basic forms of transactions with the Video Terminal: RESET, SEND TEXT, POLL, and ENQUIRY. These Host/slave transactions are illustrated and described below:
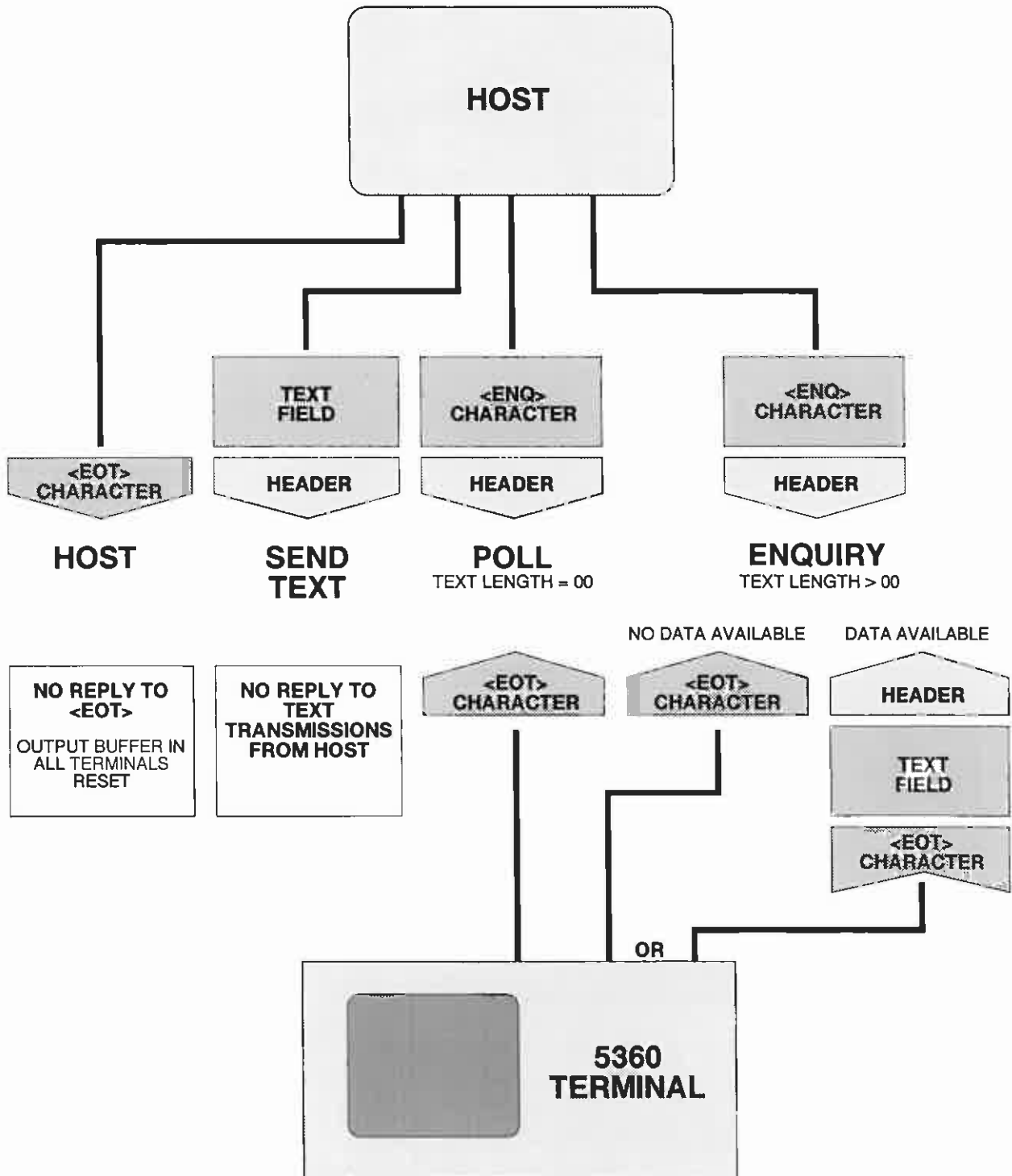
Fig. 19 Host to Terminal Transactions

1. The RESET transaction is used to terminate and reset all slave station transmissions. The slave does not respond.

2. The SEND TEXT transaction is a download of information to a slave station. The slave does not respond.

3. The POLL transaction is used to determine the active stations on the link. Each address is "polled" and each on-line Video Terminal (slave) with that address responds with an <EOT> character. No text is transferred.

4. An ENQUIRY transaction is used by the Host to check for and receive text from a slave station. Two responses are possible.

    a. If no text is present, the slave simply responds with an End-of-Transmission <EOT> character.

    b. If text is present, the slave responds with a message packet, followed by an End-of-Transmission <EOT> character.

In general the link, controlled by the Host, starts in an idle state, moves through a transaction, and then returns to idle before beginning the next transaction.

6.3 Message Packet Construction

The individual message packet components are constructed using standard ASCII Communications Characters.

6.3.1 ASCII Communications Control Characters

The ASCII communication control characters used in message packet protocol are defined and prescribed in ANSI X3.28-1976. The ASCII, Hex, and decimal equivalents and a brief description of these characters follows:

ASCII	Hex	Decimal	Description
<SOH>	01H	1	ASCII "Start of Header" is used to start all packets and is the attention character.
<STX>	02H	2	ASCII "Start of Text" is used to start the text field.
<ETX>	03H	3	ASCII "End of Text" is used to end the text field.
<EOT>	04H	4	ASCII "End of Transmission" character is used to reset (clear) the link to the idle state. It is normally used at power up and at the end of each transaction. Whenever the Host detects a failure, the <EOT> is used to recover control. All stations on the link immediately return to idle upon reception of an <EOT>, effectively aborting any pending transaction.
<ENQ>	05H	5	ASCII "Enquiry" followed by the optional Transmission Check Field (TCF) completes a polling packet.
<SYN>	16H	22	ASCII "Synchronous Idle" may be used by the Host anywhere in a message packet except between the end of text delimiter <ETX> and the Transmission Check Field (TCF) if the TCF is used. It may be used by the Host to break up character sequences that may have meaning to other devices on the common link. It is discarded by the Video Terminal when found in the input stream. Any number of <SYN> characters may be used in the message packet, however they are not counted in the text length or in the computation of the TCF.

The following communication control characters are not currently used in this protocol; <ETB>, <ACK>, <NAK>, <DLE>.

6.3.2 The Header

All packets begin with a header. The header begins with the fixed attention character <SOH>. The header is followed by the active slave address (a1)(a2). The address is followed by a Host supplied sequence identification (SID), which is followed by a protocol option specifier (OPT), and a length of text field (L1)(L2). The Video Terminal returns a header with the (OPT) byte bit 3 cleared and the text length equal to the number of characters of text between <STX> and <ETX>. The components of the header are shown in the diagram below and described in the following sections.
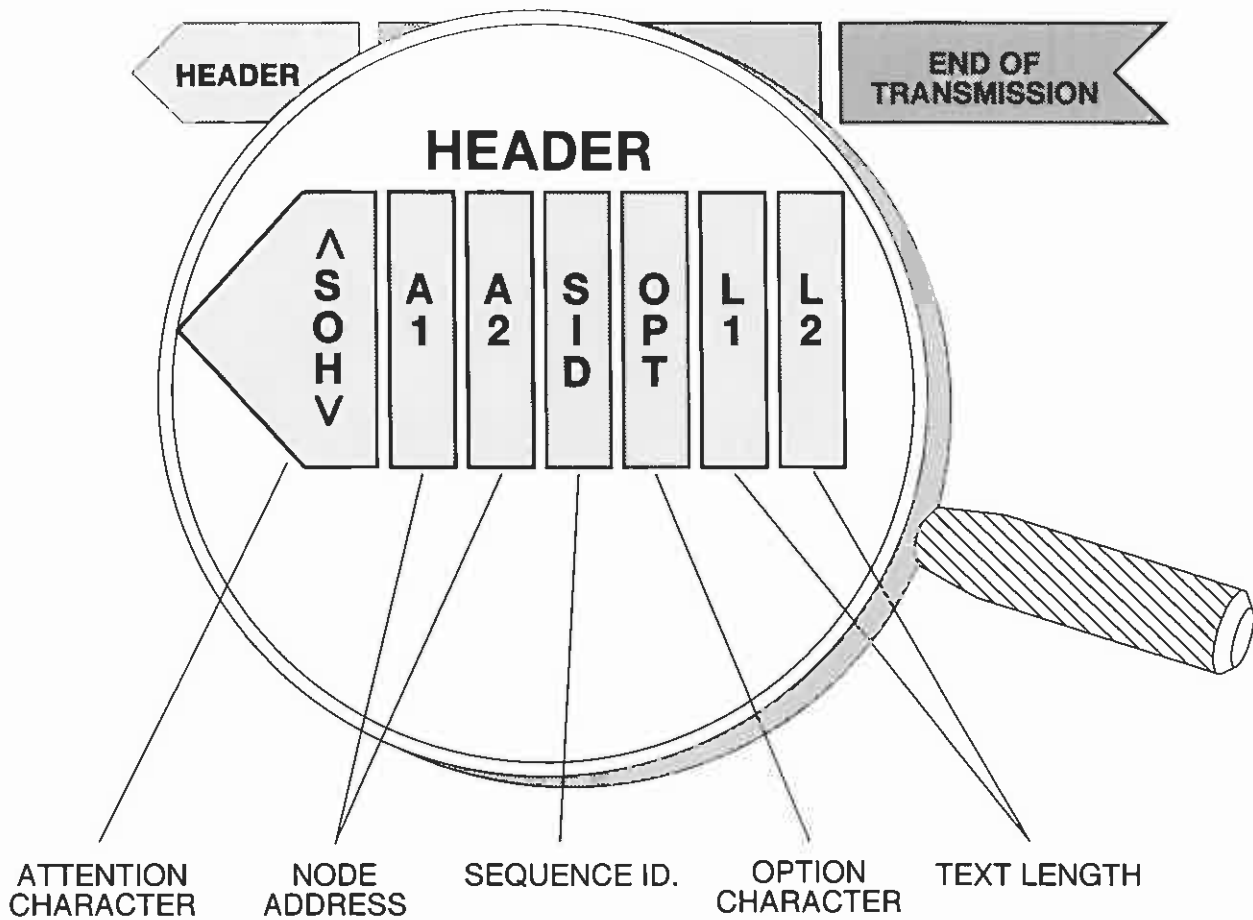
Fig. 20 The Header

Header Byte 1: Start of Header <SOH>

Byte Type: ASCII
Value: ASCII SOH

      HEX   01H
      DECIMAL 1
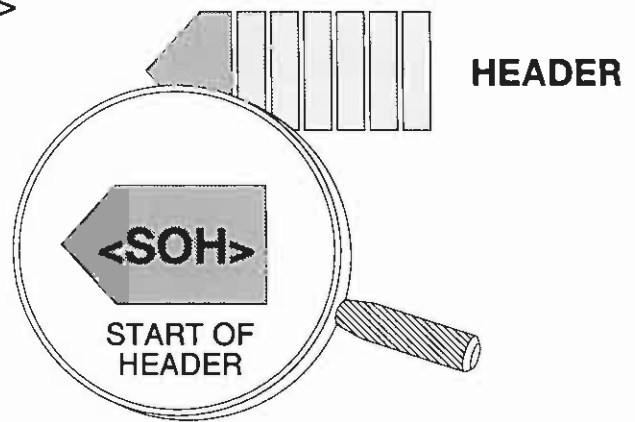
Fig. 21 Start of Header

A single ASCII character is used to specify the start of the header. The ASCII character <SOH> is always the first character of each packet and can only appear as the first character of a header.

Header Bytes 2 and 3: Terminal I.D. (Address) Characters <A1><A2>
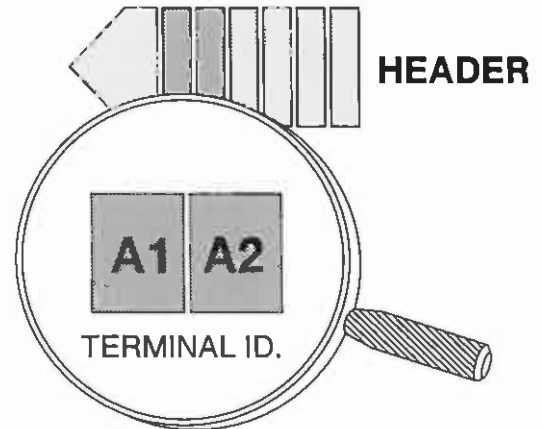
Byte Type: HEX/ASCII
Range: 0-1FH

	A1	A2
ASCII	0 - 1	0 - 9, A - F
HEX/ASCII	30 - 31H	30 - 39H, 41 - 46H
DECIMAL	48 - 49	48 - 57, 65 - 70

Fig. 22 Terminal I.D. (Address)

The Video Terminal must be assigned a link address (set to a value between 0-31 (0-1FH) via Setup Menu). Two ASCII characters are used to specify the station to which a transmission is addressed (see preceding diagram). The link address characters in the header of a message from the Host to a Video Terminal is a destination address. The header of a Video Terminal reply to a previous message or poll is considered a source address. A broadcast address (from the Host to all Terminals) of F0H (240 decimal) is supported.

NOTE:
The Host should not use the broadcast address (F0H) in an Enquiry or poll.
Doing so will result in transmit contention.

Header Byte 4: Sequence Identification (SID)

Byte Type: ASCII

Range:	ASCII	0 - 9, ?
	HEX/ASCII	30H - 39H, 3FH
	DECIMAL	48 - 57, 63

HEADER

SID
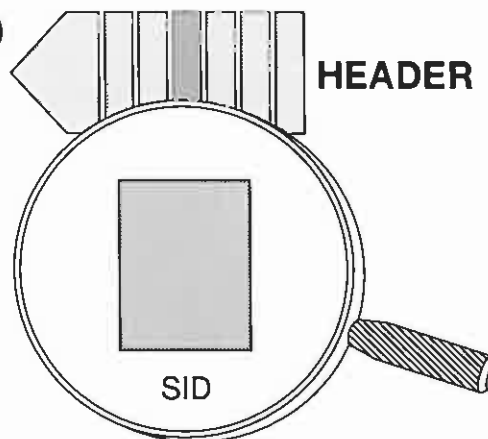
Fig. 23 Sequence I.D.

The Sequence ID is a single ASCII character used to uniquely identify a transaction (see above diagram). The Video Terminal will always return it unaltered when a header is included in the Video Terminal response. If a duplicate or lost packet detection is enabled, consecutive messages must have different sequence numbers. When consecutive messages are received by the Video Terminal with the same (SID), the second message will be taken as a retransmission and ignored. Since only one message may be outstanding at one time, the (SID) may alternate between 0 (30H) and 1 (31H). If ASCII <?> (3FH) is used, it disables duplicate or lost packet detection for that transaction. It is echoed unchanged and is not checked against the previous (SID) value. The next (SID) is accepted as being in sequence.

Duplicate messages may be sent in cases where data lines are extremely noisy. If the duplicate message has the same SID and the first message was received correctly, the duplicate message will be ignored. If the first message was not received correctly, the duplicate message may be received correctly.

B7 - B4 RESERVED	B3 - PACKET DIRECTION	B2 - RESERVED	B1, B0 - ERROR CHECKING
0 0 0 0	0 TO HOST 1 FROM HOST	0	0 0 DISABLED 0 1 LONG. PARITY 1 0 CHECKSUM
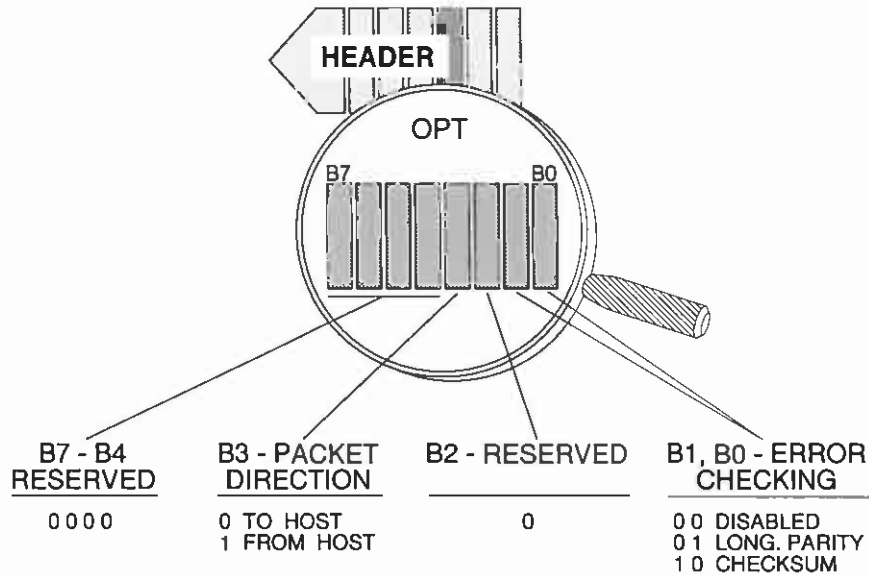
Byte Type: HEX/ASCII

Value:	From Host	From Terminal
ASCII	8, 9, A	0, 1, 2
HEX/ASCII	38H, 39H, 41H	30H, 31H, 32H
DECIMAL	56, 57, 65	48, 49, 50

Fig. 24 The Option Character

A single ASCII character is used to encode the options available with packet protocol. The options available are: type of error checking, delivery verification, and transmission direction. The ASCII character values chosen for (OPT) are allocated to the options as shown in the diagram above.

The two Least Significant Bits (b1 and b0) determine which error checking option is selected. The options provided by these two bits are error checking disabled, longitudinal parity, and checksum:

Bits b1, b0 = 00: Error Checking Disabled

Bits b1, b0 = 01: Longitudinal Parity. This is the preferred error checking method. It is referred to as block checking and the transmitted value is the block check character (BCC). The BCC is transmitted immediately following <ETX> or <ENQ>. It is calculated by XORing all characters (excluding <SOH>) through and including the <ETX> character. The BCC may be any ASCII character including control characters.

Bits b1, b0 = 10: Checksum. Every character excluding the attention character, <SOH>, through and including the text ending delimiter, <ETX>, is summed. The

check field, (CF), immediately following <ETX> will contain two ASCII characters that represent the summation logically ANDed with FFH. This is not a standard error checking technique and should be used only if the Host cannot use the preferred and more reliable longitudinal parity checking.

Bit b2: Reserved. This is reserved for future use and must always be set to 0.

Bit 3: Message Direction. Bit 3 denotes the direction of the message. The bit is always one (1) if the message is from the Host. It is always 0 if toward the Host. In some transactions, this is the only difference in the header between a message sent by the Host and a message received by the Host in reply.

Bits b4-b7: Reserved.

NOTE:
Bits b4 - b7 are reserved and should always be cleared to 0.

The (OPT) values may be combined as follows:

ASCII	HEX	Packet Direction	Error Checking
0	30H	To Host	Disabled
1	31H	To Host	Long. Parity
2	32H	To Host	Checksum
3	33H	To Host	Reserved
4	34H	Reserved for future use	
5	35H	Reserved for future use	
6	36H	Reserved for future use	
7	37H	Reserved for future use	
8	38H	From Host	Disabled
9	39H	From Host	Long. Parity
A	41H	From Host	Checksum
B	42H	From Host	Reserved
C	43H	Reserved for future use	
D	44H	Reserved for future use	
E	45H	Reserved for future use	
F	46H	Reserved for future use	

Header Bytes 6 and 7: Text Length Field <L1><L2>
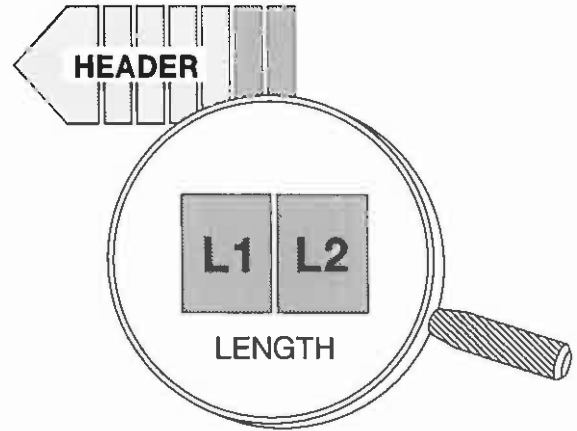
Byte Type: HEX/ASCII

Range:

	L1	L2
ASCII	0 - 9, A - E	0 - 9, A - F
HEX/ASCII	30H - 39H, 41H - 45H	30H - 39H, 41H - 46H
DECIMAL	48 - 57, 65 - 69	48 - 57, 65 - 70

Fig. 25 Text Length

Two ASCII characters are used to represent the number of characters in the text field of the packet (see diagram above). A value of zero indicates a packet with no text field and is only used to reset Sequence I.D. (SID) or to verify a station's active presence on the link without transmitting data. The text length field may consist of no more than 224 (EOH) characters. A value of 255 (FFH) indicates a variable text length. When the variable length enquiry (FFH) is sent by the Host, the Video Terminal responds with the number of characters in the text field.

6.3.3 The Text Field
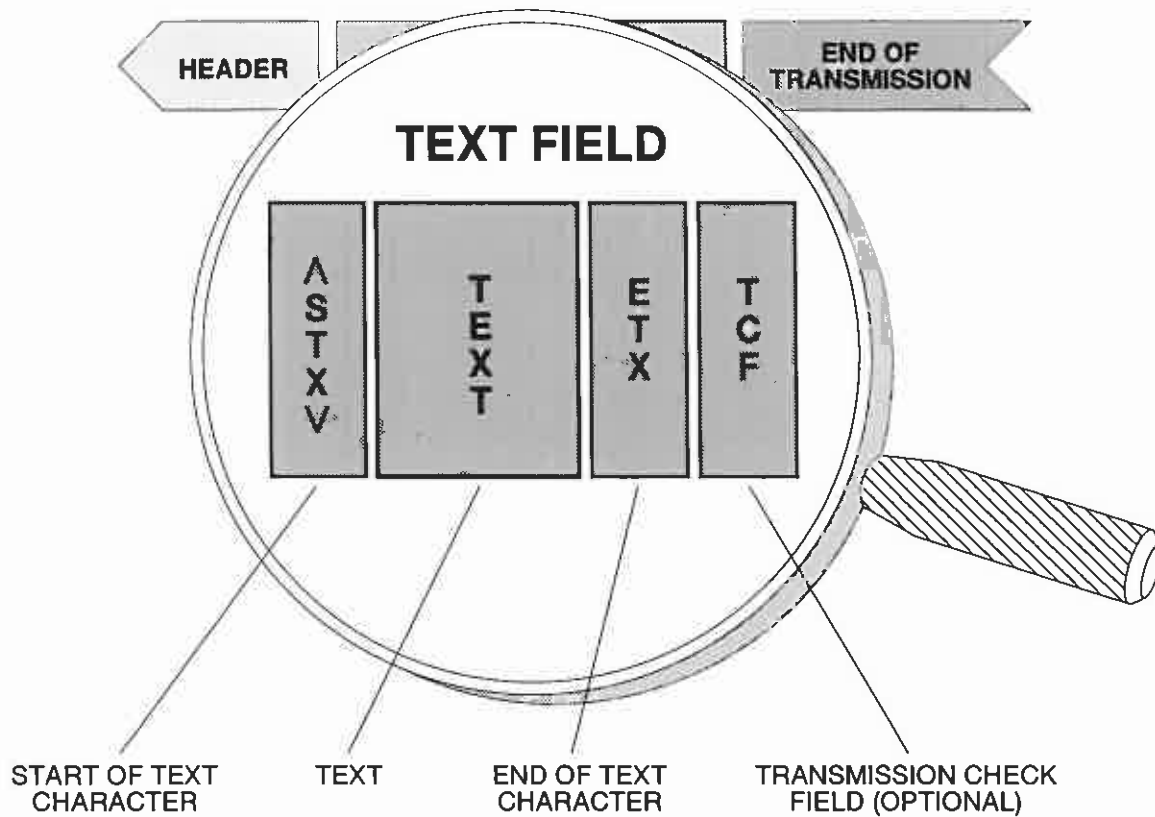
Fig. 26 Text Field

The body of the text field packet begins with the <STX> character and ends with the <ETX> or optional Transmission Check Field (TCF) character. It consists of the Start of Text delimiter, <STX>, which immediately follows the header text length field. <STX> is followed by the Text (0 - 224 characters) and then the End of Text delimiter, <ETX>. The <ETX> delimiter is followed by the Transmission Check Field (TCF) if selected. The text field contains characters that will be interpreted according to the ANSI 3.64 controls implemented by the Video Terminal.

The Text Field Byte 1: Start of Text <STX>

Byte Type: ASCII
Value: ASCII <STX>

      HEX   02H
      DECIMAL   2
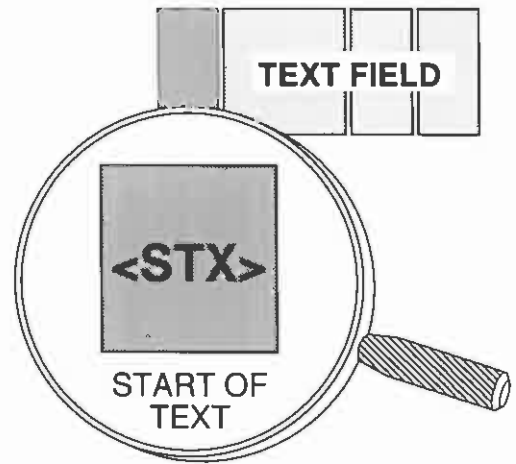
Fig. 27 Start of Text

This ASCII character is the start of the text field. The <STX> character immediately follows the header and is always the first character of the text.

The Text
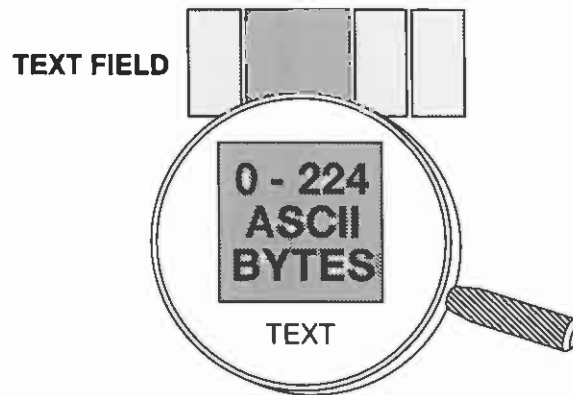
Fig. 28 The Text

This field, up to 224 characters long, contains the actual screen control data and may contain any valid ASCII character except these 9 communications control characters:

ASCII	HEX	DECIMAL
<SOH>	01H	1
<STX>	02H	2
<ETX>	03H	3
<EOT>	04H	4
<ENQ>	05H	5
<ACK>	06H	6
<DLE>	10H	16
<NAK>	15H	21
<ETB>	17H	23

Text Field: End of Text <ETX>

Byte Type: ASCII
Value: ASCII <ETX>

    HEX   03H
    DECIMAL 3
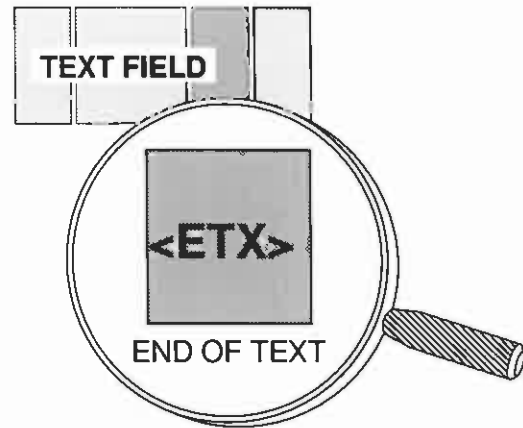
Fig. 29 End of Text

This ASCII character is used to specify the end of the text field. If no error checking is enabled, the <ETX> character is the last character of the text body. If error checking is enabled, the Transmission Check Field (TCF) immediately follows the End of Text delimiter <ETX>.

6.3.4 Transmission Check Field
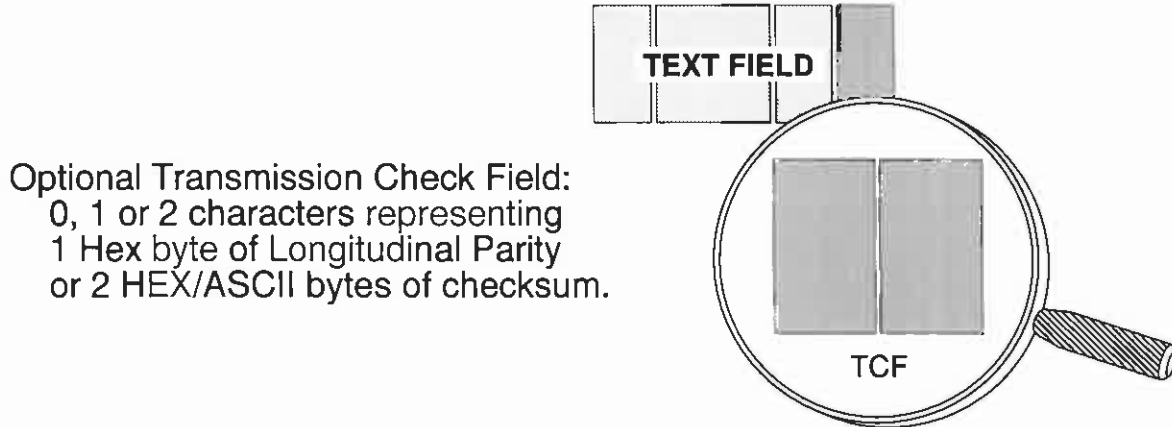
Optional Transmission Check Field:
0, 1 or 2 characters representing
1 Hex byte of Longitudinal Parity
or 2 HEX/ASCII bytes of checksum.

Longitudinal Parity Byte Type: One Hex byte

Range:		TCF1	TCF2
	HEX	00H - FFH	N/A

Checksum Byte Type: Two HEX/ASCII bytes

Range:		TCF1	TCF2
	HEX	30H - 39H, 41H - 46H	30H - 39H, 41H - 46H
	DECIMAL	48 - 57, 65 - 70	48 - 57, 65 - 70

Fig. 30 Transmission Check Field

The check field contains error detection information as selected by the (OPT) field in the header (see diagram above). If error checking is disabled, this field is not present. If checksum is selected, this field contains two HEX/ASCII characters.

The checksum value is derived by summing every character following the attention character <SOH> through and including <ETX>, the text ending delimiter. The transmission check field (TCF) then contains two ASCII characters that represent this sum logically ANDed with FFH. The checksum is derived as shown in the example on the following page:

CHECKSUM EXAMPLE

Message: <SOH>01?AFF<STX>HELLO WORLD<ETX>8E<EOT>

Message Packet	DEC	HEX	Comment
<SOH>			Attention chararcter
0	48	30H	A1
1	49	31H	A2
?	63	3FH	SID (universal)
A	65	41H	OPT (from Host, checksum)
F	70	46H	L1
F	70	46H	L2 (station enquiry)
<STX>	2	2H	Start of Text character
H	72	48H	Text
E	69	45H	Text
L	76	4CH	Text
L	76	4CH	Text
O	79	4FH	Text
<SP>	32	20H	Text (space)
W	87	57H	Text
O	79	4FH	Text
R	82	52H	Text
L	76	4CH	Text
D	68	44H	Text
<ETX>	3	03H	End of Text character
	1166	48EH	Sum of A1 through <ETX>
	142	8EH	Sum of logically ANDed with FFH
8			TCF1
E			TCF2
<EOT>			

If longitudinal parity has been selected the field contains a hexqadecimal character called a Block Check Character (BCC). It may correspond to any ASCII character, including the control characters. It is calculated by XORing all characters (excluding <SOH>) through and including the <ETX> character. The BCC is derived as shown in the example below:

LONGITUDINAL PARITY EXAMPLE

Message: <SOH>01?9FF<STX>HELLO WORLD<ETX>&<EOT>

Message Packet	DEC	HEX	Comment
<SOH>	1	01H	Attention character
0	48	30H	A1
1	49	31H	A2
?	63	3FH	SID (universal)
9	9	39H	OPT (from Host, checksum)
F	70	46H	L1
F	70	46H	L2 (variable length)
<STX>	2	02H	Start of Text character
H	72	48H	Text
E	69	45H	Text
L	76	4CH	Text
L	76	4CH	Text
O	79	4FH	Text
<SP>	32	20H	Text
W	87	57H	Text
O	79	4FH	Text
R	82	52H	Text
L	76	4CH	Text
D	68	44H	Text
<ETX>	3	03H	End of Text character
&	38	26H	Longitudinal parity
<EOT>	4	04H	Termination character

6.4 Example Transactions

In the following example the Host will place the prompt "Press Return to Continue" at the bottom of the screen of Video Terminal addressed 23 (17H). The Host will poll until the Return (Enter) key at the Video Terminal is pressed. The example uses no error checking, and no text field length verification. Duplicate messages are allowed. The solution is in several transactions. The Cursor Position (CUP) escape sequence is used to position the cursor. The text field is then assembled by determining the byte protocol characters needed in a point to point system to accomplish the Video Terminal actions. The header and text are then compiled and transmitted to the Video Terminal.

6.4.1 Transaction 1, Send Text

Host: <EOT><SOH>17?8FF<STX><ESC>[24;25HPress<SP>Return<SP>to<SP>Continue <ETX> <EOT>

Terminal: no reply to SEND TEXT

The Host transmits to the Video Terminal a (CUP) sequence to position the cursor at line 24, column 25, where it prints the message "Press Return to Continue". Shown below is the transaction broken down into individual characters. The characters to be sent are listed down the left side of the page with ASCII values and hexadecimal equivalents.

ASCII	HEX	Comments
<EOT>	04H	This is the End of Text character, <EOT>. It resets the link and returns it to the idle state. It is optional.
<SOH>	01H	This is the Start of Header attention character, <SOH>. It begins all packets.
1	31H	The first character of the station address, <a1>.
7	37H	The second character of the station address, <a2>. (Terminal 17H is 23 decimal.)
?	3FH	The Sequence ID field is set to the disabled value and is ignored, (SID).
8	38H	The protocol option field is set to indicate a message from the Host and no error checking, (OPT).
F	46H	The first character of the text length field, the disable checking value, <L1>.
F	46H	The second character of the text length field, the disable checking value, <L2>.
<STX>	02H	The end of header and Start of Text delimiter, <STX>.
<ESC>	1BH	The first character of the escape sequence introducer for the cursor position command (CUP), ESC[*(Pn1)*;*(Pn2)*H.
[	5BH	The second character of the escape sequence introducer.
2	32H	The first character of the line number, (Pn1).

Transaction 1, continued.

ASCII	HEX	Comments
4	34H	The second character of the line number, *(Pn1)*. The line number is 24.
;	3BH	The parameter delimiter.
2	32H	The first character of the column number, *(Pn2)*.
5	35H	The second character of the column number, *(Pn2)*. The column number is 25.
H	48H	The CUP escape sequence final character.
P	50H	The message to be displayed on line number 24, column number 25, of Terminal number 23 (17H).
r	72H	Text
e	65H	Text
s	73H	Text
s	73H	Text
<SP>	20H	Text (space)
R	52H	Text
e	65H	Text
t	74H	Text
u	75H	Text
r	72H	Text
n	6EH	Text
<SP>	20H	Text (space)
t	74H	Text

Transaction 1, continued.

ASCII	HEX	Comments
o	6FH	Text
<SP>	20H	Text (space)
C	43H	Text
o	6FH	Text
n	6EH	Text
t	74H	Text
i	6AH	Text
n	6EH	Text
u	75H	Text
e	65H	Text
<ETX>	03H	The End of Text character ends the text field. Since error checking was disabled by (OPT), the <CF> field is empty.
<EOT>	04H	The End of Transmission character, <EOT> resets the link and returns it to the idle state. This is recommended.

There will be no response from the Video Terminal because the Host retains control of the link. This transaction (#1) is not an invitation to transmit from the Host.

6.4.2 Transaction 2: Enquiry

The Host transmits a poll for data with an enquiry request packet. This is an invitation for the Video Terminal to transmit data. Since all error checking is disabled, the header from Transaction 1 will be repeated. The Video Terminal will return whatever data it currently has in its buffer. It is up to the Host to continue polling until all the needed characters are returned.

Host: <EOT><SOH>17?8FF<ENQ>

Terminal: <EOT> no data reply (no keys pressed)   - or -

Terminal: <SOH>17?005<STX>01234<ETX><EOT> (when 5 number keys are pressed)

The Host sends:

ASCII	HEX	Comments
<EOT>	04H	The End of Text character, <EOT>. It resets the link and returns it to the idle state. This is optional.
<SOH>	01H	The Start of Header attention character, <SOH>. It begins all packets.
1	31H	The first character of the station address, <a1>.
7	37H	The second character of the station address, <a2>. (Terminal 17H is 23 decimal).
?	3FH	The Sequence ID field is set to the disabled value and is ignored, (SID).
8	38H	The protocol option field is set to indicate a message from the Host and no error checking, (OPT).
F	46H	The first character of the text length field, the disable checking value, <L1>.
F	46H	The second character of the text length field, the disable checking value, <L2>.
<ENQ>	05H	The enquiry, <ENQ> or poll packet delimiter.

Until characters have been entered at the Video Terminal, the Terminal responds with:

Transaction 2, continued.

ASCII	HEX	Comments
<EOT>	04H	This is the End of Text character, <EOT>. It resets the link and returns it to the idle state. In this case the <EOT> signifies that the Terminal has no data to send.

After characters have been entered, the Video Terminal responds with:

ASCII	HEX	Comments
<SOH>	01H	The Start of Header attention character, <SOH>. It begins all packets.
1	31H	The first character of the station address, <a1>.
7	37H	The second character of the station address, <a2>. (Terminal 17H is 23 decimal.)
?	3FH	The Sequence ID field is set to the disabled value and is ignored, (SID).
0	30H	The protocol option field, (OPT), is set to indicate a message to the Host and no error checking.
0	30H	The first character of the text length field, the disable checking value, <L1>.
5	35H	The second character of the text length field, the disable checking value, <L2>.
<STX>	02H	The end of header and Start of Text delimiter.
0	30H	The data entered at the Terminal is transmitted in the text field.
1	31H	Text
2	32H	Text
3	33H	Text
4	34H	Text
<ETX>	03H	The End of Text and start of error check field delimiter. Since error checking was disabled by (OPT), the <CF> field is empty.

Transaction 2, continued

ASCII	HEX	Comments
<EOT>	04H	The End of Transmission character that resets the link and returns it to the idle state. This is required.

6.4.3 Transaction 3: The Host Polls Again (Same Header)

Host: <EOT><SOH>17?8FF<ENQ>

Terminal: <EOT> no data reply   - or -

Terminal: <SOH>17?005<STX>01234<ETX><EOT>

The Host sends:

ASCII	HEX	Comment
<EOT>	04H	The End of Text character, <EOT>. It resets the link and returns it to the idle state. This is optional.
<SOH>	01H	The Start of Header attention character, <SOH>. It begins all packets.
1	31H	The first character of the station address, <a1>.
7	37H	The second character of the station address, <a2>. (Terminal 17H is 23 decimal.)
?	3FH	The Sequence ID field is set to the disabled value and is ignored, (SID).
8	38H	The protocol option field is set to indicate a message from the Host and no error checking, (OPT).
F	46H	The first character of the text length field, disable checking value, <L1>
F	46H	The second character of the text length field, disable checking value, <L2>
<ENQ>	05H	The enquiry, <ENQ> or poll packet delimiter.

The ENTER key was pressed before the Host poll, so the Video Terminal responds with:

Transaction 3, continued.

Terminal: <SOH>17?002<STX><CR><LF><ETX><EOT>

ASCII	HEX	Comments
<SOH>	01H	The Start of Header attention character, <SOH>. It begins all packets.
1	31H	The first character of the station address, <a1>.
7	37H	The second character of the station address, <a2>. (Terminal 17H is 23 decimal.)
?	3FH	The sequence ID field is set to the disabled value and will be ignored, (SID).
0	30H	The protocol option field, (OPT), is set to indicate a message to the Host and no error checking.
0	30H	The first character of the text length field.
2	01H	The second character of the text length field.
<STX>	02H	The end of header and Start of Text delimiter.
<CR>	0DH	The character for the Return key; the ASCII Carriage Return.
<LF>	0AH	Line Feed
<ETX>	03H	The End of Text <ETX> character. Since error checking was disabled in (OPT), the <CF> field is empty.
<EOT>	04H	The End of Transmission <EOT> character that resets the link and returns it to the idle state.

This completes the transaction.

VIDEO TERMINAL OPTIONS

The Video Terminal has the following options:

A full travel, membrane keyboard that is IBM PC compatible. It may be plugged into the front 5-pin DIN connector on the Video Terminal front panel. Part number 5300-KB1.

Rack Mount Adapter for easy installation in a standard 19 inch rack. Part number 5300-RA.

SPECIFICATIONS

POWER REQUIREMENTS

Voltage:	110 VAC (90 to 135 V)
Frequency:	48 to 65 Hz
Current:	Nominal 0.25 Amp at 110 VAC Maximum 0.5 Amp at 110 VAC

HOST COMMUNICATION

Electrical Interface:	RS-232-C, RS-422, RS-485
Data Rate:	110 to 38.4K BPS
Data Bits:	7 or 8
Stop Bits:	1 or 2
Parity:	Odd, Even, Mark, Space
Cable Length (Max.):	RS-232-C 50 Feet (15 Meters) RS-422/485 4000 Feet (1200 Meters)
Connector:	25 Pin D Type Female (RS-232-C, RS-422, RS-485) 8 Position Screw Terminal Block (RS-422, RS-485)

PRINTER COMMUNICATION

Electrical Interface:	Centronics-type Printer Interface
Connector:	25 Pin D Type Female

BATTERY

Type:	Tadiran TL-2100 Lithium
Size:	AA

SPECIFICATIONS, continued

Voltage: 3.6 Volts

Current Drain (Installed):   < 5 microAmps with no power applied to Terminal,
                                     negligible with power applied.

ENVIRONMENTAL

Operating Temperature: 32° to 140°F (0° to 60°C)

Storage Temperature: -40° to 185°F (-40° to 85°C)

Humidity: 5% to 95% (non-condensing)

Weight: 25 lbs. (55 Kgrams)

Dimensions (Front Panel):   Height: 8.7 inches (22.10 cm)
                                     Width: 16.6 inches (42.16 cm)
                                     Depth: 0.6 inches (1.52 cm)

Dimensions (Cabinet):   Height: 6.72 inches (17.07 cm)
                                     Width: 14.5 inches (36.83 cm)
                                     Depth: 10.75 inches (27.31 cm)

Specifications subject to change without notice.

DIMENSION DRAWING

16-5/8"
5-9/32"
5-9/32"
5-9/32"
5-9/32"
11-9/16"
10-3/4"
8-7/8"
3-31/32"
3-31/32"
6-7/8"
14-5/8"
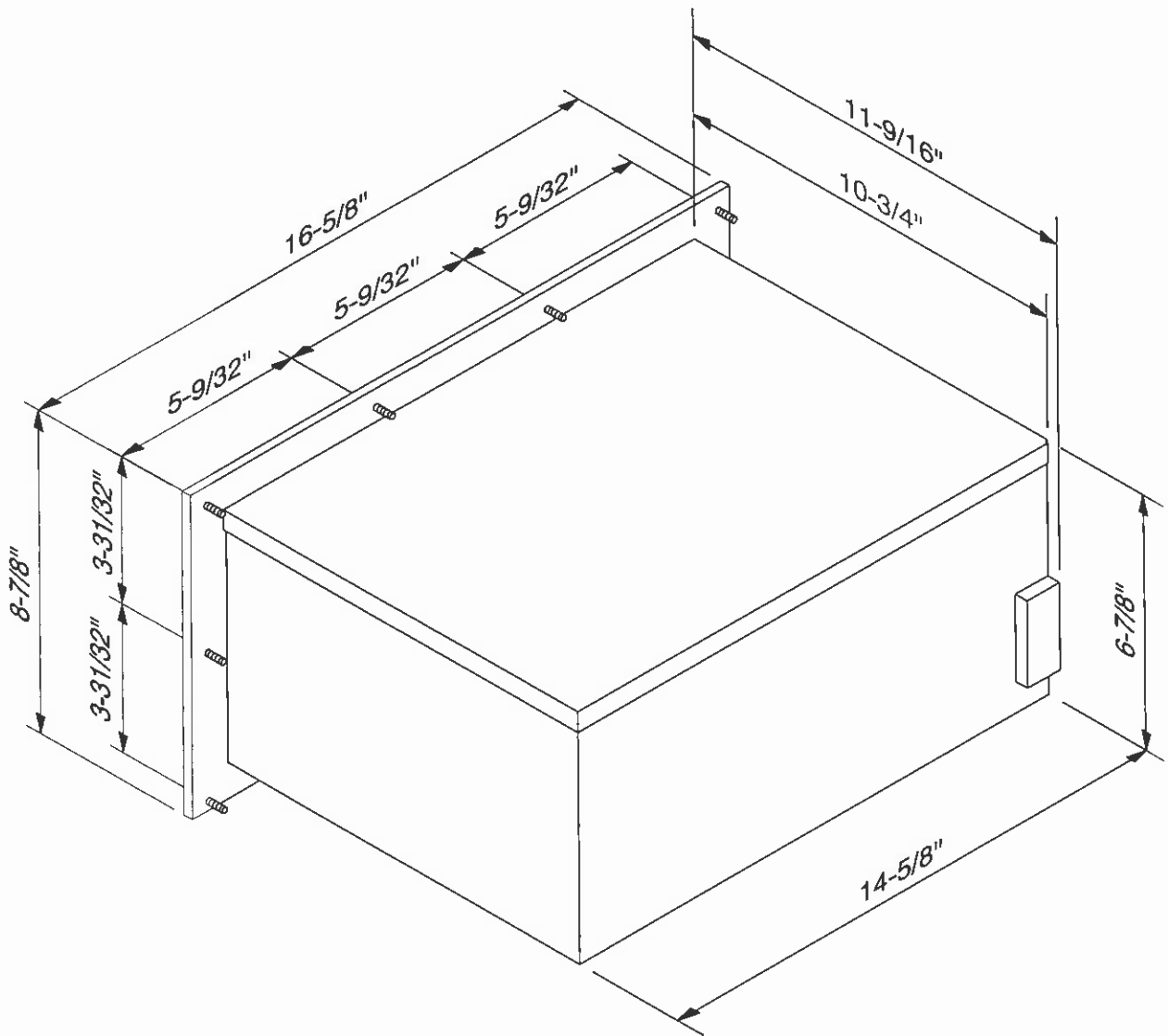
LIMITED PRODUCT WARRANTY (EXCLUDING SOFTWARE)

CTI warrants that this CTI Industrial Product shall be free from defects in material and workmanship for a period of one (1) year after purchase from CTI or from an authorized CTI Industrial Distributor. This CTI Industrial Product will be newly manufactured from new and/or serviceable used parts which are equal to new in the Product.

Should this CTI Industrial Product fail to be free from defects in material and workmanship at any time during this one (1) year warranty period, CTI will repair or replace (at its option) parts or Products found to be defective and shipped prepaid by the customer to a designated CTI service location along with proof of purchase date and associated serial number. Repair parts and replacement Product furnished under this warranty will be on an exchange basis and will be either reconditioned or new. All exchanged parts or Products become the property of CTI. Should any Product or part returned to CTI hereunder be found by CTI to be without defect, CTI will return such Product or part to the customer.

This warranty does not include repair of damage to a part or the Product resulting from: failure to provide a suitable environment as specified in applicable Product specifications, or damage caused by accident, disaster, acts of God, neglect, abuse, misuse, transportation, alterations, attachments, accessories, supplies, non-CTI parts, non-CTI repairs or activities, or to any damage whose proximate cause was utilities or utility like services, or faulty installation or maintenance done by someone other than CTI.

Control Technology Inc. reserves the right to make changes to the Product in order to improve reliability, function, or design in the pursuit of providing the best possible Product. CTI assumes no responsibility for indirect or consequential damages resulting from the use or application of this equipment.

THE WARRANTY SET FORTH ABOVE IN THIS ARTICLE IS THE ONLY WARRANTY CTI GRANTS AND IT IS IN LIEU OF ANY OTHER IMPLIED OR EXPRESSED GUARANTY OR WARRANTY ON CTI PRODUCTS, INCLUDING WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE AND IS IN LIEU OF ALL OBLIGATIONS OR LIABILITY OF CTI FOR DAMAGES IN CONNECTION WITH LOSS, DELIVERY, USE OR PERFORMANCE OF CTI PRODUCTS OR INTERRUPTION OF BUSINESS, LOSS OF USE, REVENUE OR PROFIT. IN NO EVENT WILL CTI BE LIABLE FOR SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES FOR CONSUMER PRODUCTS, SO THE ABOVE LIMITATIONS OR EXCLUSIONS MAY NOT APPLY TO YOU.

THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH MAY VARY FROM STATE TO STATE.

REPAIR POLICY

In the event that the Product should fail during or after the warranty period, a Return Material Authoriztion number (RMA) can be requested verbally or in writing from CTI main offices. Whether this equipment is in or out of warranty, a Purchase Order number provided to CTI when requesting the RMA number will aid in expediting the repair process. The RMA number that is issued and your Purchase Order number should be referenced on the returning equipment's shipping documentation. Additionally, if under warranty, proof of purchase date and serial number must accompany the returned equipment. The current repair and/or exchange rates can be obtained by contacting CTI's main office at 1-800-537-8398 or FAX 1-615-584-5720.

APPENDIX A. SETUP MENUS

SETUP MENU ONE

	DEFAULT
Baud Rate - (110 - 19.2K BPS)	1200
Local Echo (On - Off)	On
Duplex Mode (Full - Half)	Half-Duplex
Brightness	Mid-Range
Character Size (Single - Double - Quad)	Double
Cursor Type (Line - Block - None)	Blinking Line
Reverse Video (Yes - No)	No

SETUP MENU TWO

	DEFAULT
Auto Line Feed (Yes - No)	Yes
Wraparound (Yes - No)	Yes
Keyboard Enable (Yes - No)	Enabled
Parity Select (Odd - Even - Mark - Space)	Odd
Parity Enable (Yes - No)	No
Stop Bits (1 - 2)	1
UART Word Length (7 - 8)	7

SETUP MENU THREE

	DEFAULT
Communication (RS-232, RS-422, RS-485)	RS-232
Handshaking (Software - Hardware)	Software
Terminal ID (0 - 31)	0
Memory (32 pages)	32
Save Setup	
Recall Setup	

APPENDIX B. VIDEO TERMINAL KEYPAD FUNCTIONS

KEY	DEFINITION
F1	Exit Setup mode. As directed by Host if not in Setup mode.
F2	Advance menu in Setup mode. As directed by Host if not in Setup mode.
F3	Increase brightness in Setup mode. As directed by Host if not in Setup mode.
F4	Decrease brightness in Setup mode. As directed by Host if not in Setup mode.
Shift, F1 / F5	F5. Performs no function in Setup mode. As directed by Host if not in Setup mode.
Shift, F2 / F6	F6. Performs no function in Setup mode. As directed by Host if not in Setup mode.
Shift, F3 / F7	F7. Performs no function in Setup mode. As directed by Host if not in Setup mode.
Shift, F4 / F8	F8. Performs no function in Setup mode. As directed by Host if not in Setup mode.
SHIFT	Allows access to secondary (shifted) key functions.
Left Arrow	Moves the cursor one character position to the left.
Shift, Left Arrow / DEL	Delete, destructive back space.
Right Arrow	Moves the cursor one character position to the right.
Shift, Right Arrow / DISP PG	Display page, generates partial escape sequence to specify a display page.
Up Arrow	Moves the cursor up one character line in the same column.
Shift, Up Arrow/UP PG	Page up, displays previous sequential display page.

KEY	DEFINITION
Down Arrow	Moves the cursor down one character line in the same column.
Shift, Down Arrow / DN PG	Page down, displays the next sequential display page.
HOME	Positions cursor on line 1, column 1 of current active page.
Shift, Home	Enter Setup mode.
ENTER	Carriage Return.
-	Minus sign, save or recall configurations in Setup mode.
Shift, - / +	+ (Plus sign).
.	Decimal point
Shift, . / ,	, (Comma).
0 through 9	Numeral keys
Shift, 1 / A	A. Used to enter hexadecimal values.
Shift, 2 / B	B. Used to enter hexadecimal values.
Shift, 3 / C	C. Used to enter hexadecimal values.
Shift, 4 / D	D. Used to enter hexadecimal values.
Shift, 5 / E	E. Used to enter hexadecimal values.
Shift, 6 / F	F. Used to enter hexadecimal values.

APPENDIX C. ESCAPE AND CONTROL

1. Setup

Enter Setup Mode
    Keyboard   Ctrl-Alt-Ins
    Keypad   Shift, Home

Enter Setup Mode	
Keyboard	Ctrl-Alt-Ins
Keypad	Shift, Home
Exit Setup Mode (Keyboard/Keypad)	F1
Setup - menu Advance (Keyboard/Keypad)	F2
Setup - increase Brightness (Keyboard/Keypad)	F3
Setup - decrease Brightness (Keyboard/Keypad)	F4

2. Function Keys

F1 (Terminal to Host)	ESC O P
F2 (Terminal to Host)	ESC O Q
F3 (Terminal to Host)	ESC O R
F4 (Terminal to Host)	ESC O S
F5 (Terminal to Host)	ESC O T
F6 (Terminal to Host)	ESC O U
F7 (Terminal to Host)	ESC O V
F8 (Terminal to Host)	ESC O W
F9 (Keyboard Only)	ESC O X
F10 (Keyboard Only)	ESC O Y

3. Format

Select Graphic Rendition (SGR)   ESC [*(Ps)* m

Select Graphic Rendition (CTISGR)   ESC [< *(Ps)* m

4. Cursor

Back Space
    Keyboard   [Back Space] Key
    Keyboard/Host   CTRL-H

Carriage Return
    Keyboard/Keypad   [Enter] Key
    Keyboard/Host   CTRL-M

Horizontal Tab   CTRL-I

Horizontal and Vertical Positioning (HVP)   ESC [*(Pn1)* ; *(Pn2)* f

Line Feed (From Keyboard/Host)   CTRL-J

Cursor Backward
    Keyboard/Keypad   [Left Arrow] Key
    Host   ESC [B

Cursor Down
    Keyboard/Keypad   [Down Arrow] Key
    Host   ESC [B

Cursor Forward
    Keyboard/Keypad   [Right Arrow] Key
    Host   ESC [C

Cursor Up
    Keyboard/Keypad   [Up Arrow] Key
    Host   ESC [A

Cursor Position - same function as HVP   ESC [*(Pn1)* ; *(Pn2)* H

Home
    Keyboard/Keypad   [Home] Key
    Host   ESC [H

End
   Keyboard/Keypad   [End] Key
   Host   ESC [25 B

Save Cursor on Page   ESC 7

Restore Cursor on Page   ESC 8

5. Page

Display Page
   Host/Keyboard   ESC [> *(Pn)* w
   Keypad   Shift, [Right Arrow], *(Pn)*, Enter

Select Page   ESC [< *(PN1)* ; *(Pn2)* w

Page Down
   Host/Keyboard   ESC [*(Pn)* U
   Keyboard   [Pg Dn]
   Keypad   Shift, [Down Arrow]

Page Up
   Host/Keyboard   ESC [*(Pn)* V
   Keyboard   [Pg Up]
   Keypad   Shift, [Up Arrow]

6. Enable/Disable Inputs

Keypad
   Disable Manual Input (Keypad)   ESC'

   Enable Manual Input (Keypad)   ESC b

   Disable Keypad Setup Entry   ESC [< k

   Enable Keypad Setup Entry   ESC [< j

Keyboard	
Reset Mode	ESC [*(Ps)* l
Set Mode	ESC [*(Ps)* h

7. Printing

Enter/Exit Interactive Print Mode	ESC [*(Ps)* i
Enter/Exit Interactive Print Mode (Keyboard)	Ctrl-PrtSc
Transmit Data	ESC [*(Ps)* p
Transmit Data (Keyboard)	Shift-PrtSc

8. Terminal Status

Request for Terminal Status (From Host Only)	ESC [< 59 m
Request for Page Checksum (from Host only)	ESC [< 60 m
Request for Character and Attributes	ESC [< 67 m

9. Set/Reset

Reset to Initial State (RIS)	ESC c
Reset to Initial State (CTI RIS)	ESC [*(Ps)* z

10. Status Line

Disable Status Line	ESC [< 55 m
Enable Status Line	ESC [< 56 m

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11. Editing

Erase in Display	ESC [*(Ps)* J
Erase in Line	ESC [*(Ps)* K
Delete (destructive back space)	
Keyboard	[Delete] and [Backspace] Keys
Keypad	Shift-[Left Arrow] Key
Host	7FH

12. Miscellaneous

XON (DC1)	CTRL-Q
XOFF (DC3)	CTRL-S

APPENDIX D. CLEANING INSTRUCTIONS

The Cathode Ray Tube (CRT) of the Video Terminal is covered with a translucent material manufactured by General Electric call LEXAN which requires proper cleaning procedures to preserve appearance.

Wash with mild soap or detergent and luke warm water using a clean sponge or soft cloth. Rinse well with clean water. Dry thoroughly with a chamois or moist cellulose sponge.

Tough stains such as paint, grease etc., may be removed by rubbing lightly with naphtha or isopropyl alcohol. Wash, rinse, and dry as described in paragraph 2.

Some don'ts:

> DO NOT use abrasive or alkaline cleaners.

> DO NOT scrape with squeegees, razor blades, or other sharp instruments.

> DO NOT clean with benzene, gasoline, acetone, or carbon tetrachloride.

> DO NOT clean in hot sun or at elevated temperatures.

APPENDIX E. WIRING AND CONNECTIONS

Video Terminal/A-B BASIC Module

The following connections are required to use a Video Terminal with an Allen-Bradley BASIC Module 1771-DB. These connections are shown below.

Hardware Handshaking

VIDEO TERMINAL COMM PORT				1771-DB PERIPHERAL PORT	
1	GROUND	————	1		CHASSIS/SHIELD
2	TXD OUTPUT	————	3		RXD INPUT
3	RXD INPUT	————	2		TXD OUTPUT
			4		RTS OUTPUT
			5		CTS INPUT
5	CTS INPUT		20		DTR OUTPUT
7	COMMON	————	7		SIGNAL COMMON
20	DTR OUTPUT	————	6		DSR INPUT

Fig. 31 Video Terminal/1771-DB Connections

Pin 4 (RTS Output) and Pin 5 (CTS Input) of the 1771-DB must be jumpered together. The Video Terminal has a 16 ASCII character input buffer. The 1771-DB has a 256 ASCII character input buffer and a 256 ASCII character output buffer. The connection between the 1771-DB Pin 20 (DTR Output) and the Video Terminal is an optional connection.

Software Handshaking

VIDEO TERMINAL COMM PORT				1771-DB PERIPHERAL PORT	
1	GROUND	————	1		CHASSIS/SHIELD
2	TXD OUTPUT	————	3		RXD INPUT
3	RXD INPUT	————	2		TXD OUTPUT
			4		RTS OUTPUT
			5		CTS INPUT
7	COMMON	————	7		SIGNAL COMMON

Fig. 32 Video Terminal/1771-DB Pin-Out

APPENDIX F. RS-422M EXAMPLES: ALLEN-BRADLEY 1771-DB TO VIDEO TERMINAL

These three example BASIC programs were written using the Video Terminal with the Allen-Bradley 1771-DB BASIC Module as Host. The BASIC Module and the Video Terminal should be connected as shown in the diagram below:
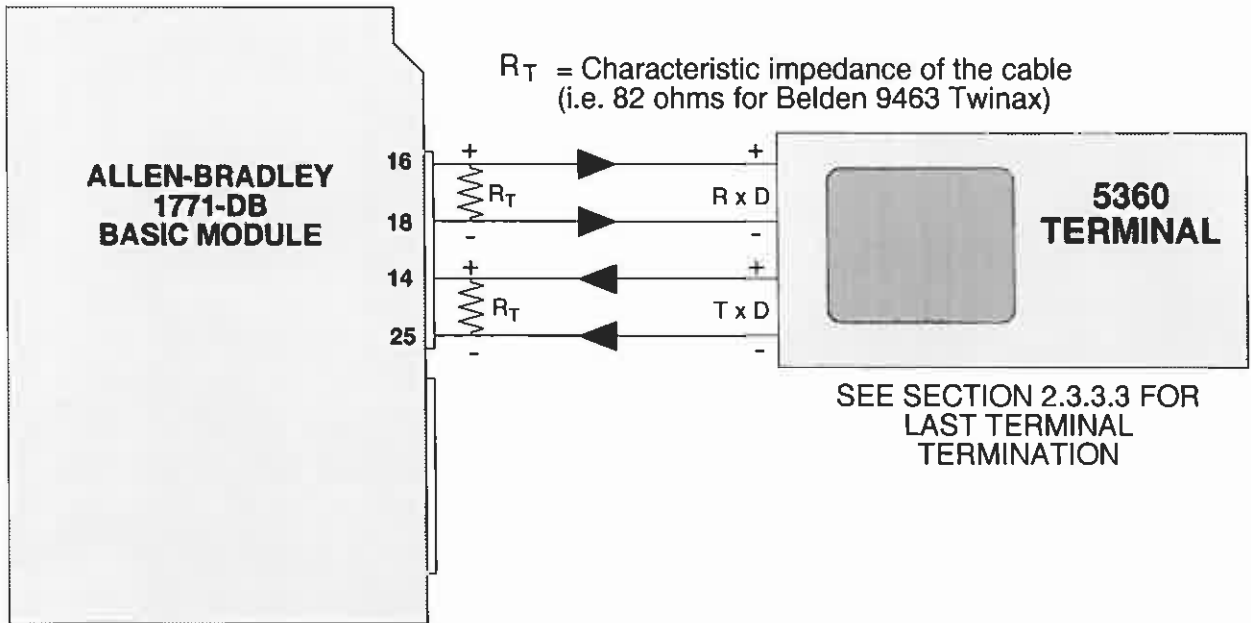

Fig. 33 *Allen-Bradley 1771-DB to Video Terminal Commections*

Example Program 1

The first program clears the screen, positions the cursor at the center of the Video Terminal screen, and then prints the text.

```
1       REM EXAMPLE PROGRAM A-B 1771-DB AS HOST SENDING 422M MESSAGE
2       REM TO 5360-TERM ADDRESSED AS #1
4       REM MESSAGE TO CLEAR THE SCREEN, POSITION THE CURSOR
5       REM AT THE CENTER OF THE SCREEN, AND PRINT THE TEXT
10      STRING 1000,50
20      REM SETUP THE PERIPHERAL PORT
30      PUSH 7,0,1,0,0 : CALL 30
100     REM BUILD THE HEADER AND <STX>
120     $(1)="-01?8FF-"
130     ASC($(1),1)=1 : ASC($(1),8)=2
200     REM BUILD THE CLEAR SCREEN COMMAND
220     $(2)="-[2J"
230     ASC($(2),1)=27
300     REM POSITION THE CURSOR IN THE CENTER OF THE SCREEN COMMAND
320     $(3)="-[12;40f"
330     ASC($(3),1)=27
400     REM BUILD THE TEXT
420     $(4)="HELLO WORLD"
1000    REM SEND THE MESSAGE PACKET
1010    PRINT #$(1),$(2),$(3),$(4),CHR(3),CHR(4),
2000    END
```

Example Program 2

The second example enquiries the Video Terminal for data every second, and then displays any data received on the Host's terminal.

```
1       REM EXAMPLE PROGRAM A-B 177-DB AS HOST SENDING 422M MESSAGE
2       REM TO VIDEO TERMINAL ADDRESSED AS #1
4       REM ENQUIRY THE TERMINAL EVERY SECOND FOR DATA AND DISPLAY
5       REM ANY RECEIVED DATA ON THE HOST TERMINAL
10      STRING 1000,50
20      REM SET UP THE PERIPHERAL PORT
30      PUSH 7,0,1,0,0 : CALL 30
100     REM BUILD THE HEADER AND <ENQ>
120     $(1)="-01?8FF-"
130     ASC($(1),1)=1 : ASC($(1),8)=5
500     REM SEND THE ENQUIRY MESSAGE TO TERMINAL #1
520     PRINT #$(1),
700     REM WAIT FOR REPLY AND DISPLAY ONLY THE DATA TO THE SCREEN
710     F1=0 : REM START DISPLAY FLAG INITIALIZED TO 0
720     CALL 35 : POP A : IF A<>0 THEN 730
725     K=K+1 : IF K=150 THEN 520 ELSE 720 : REM TIMEOUT FOR ANOTHER ENQ
730     IF A=3 THEN 2000 : REM WHEN <ETX> RECEIVED END THIS MESSAGE
735     IF A=4 THEN PRINT "<EOT>"
740     IF F1=0.AND.A<>2 THEN 720 : REM DON'T DISPLAY UNTIL <STX> RECEIVED
750     IF A=2 THEN F1=1 : GOTO 720
760     PRINT CHR(A), : GOTO 720
2000    PRINT: PRINT
2030    GOTO 500: REM FOUND THE END OF THIS PACKET
2050    END
```

Example Program 3

The third example enquiries the Video Terminal for data every second checking for longitudinal parity, then displays any data received on the Host's terminal.

```
1      REM EXAMPLE PROGRAM A-B 177-DB AS HOST SENDING 422M MESSAGE
2      REM TO 5360-TERM ADDRESSED AS #23 USING LONGITUDINAL PARITY
4      REM ENQUIRY THE TERMINAL EVERY SECOND FOR DATA AND DISPLAY
5      REM ANY RECEIVED DATA ON THE HOST TERMINAL
10     STRING 1000,50
20     REM SET UP THE PERIPHERAL PORT
30     PUSH 7,0,1,0,0 : CALL 30
100    REM BUILD THE HEADER AND <ENQ>
120    $(1)="-17?9FF--"
130    ASC($(1),1)=1 : ASC($(1),8)=5
140    REM DETERMINE THE LONG. PARITY
145    PUSH 1: CALL 68: POP R: REM GET THE LENGTH OF THE STRING
150    FOR 1=2 TO (R-1)
160    C=ASC($(1),1)
170    L=L.XOR.C
180    NEXT I
190    ASC($(1),9)=L
500    REM SEND THE ENQUIRY MESSAGE TO TERMINAL #23
520    PRINT #$(1),
700    REM WAIT FOR REPLY AND DISPLAY ONLY THE DATA TO THE SCREEN
710    F1=0 : REM START DISPLAY FLAG INITIALIZED TO 0
715    K=0
720    CALL 35 : POP A : IF A<>0 THEN 730
725    K=K+1 : IF K=150 THEN 520 ELSE 720 : REM TIMEOUT FOR ANOTHER ENQ
730    IF A=3 THEN 2000 : REM WHEN <ETX> RECEIVED END THIS MESSAGE
735    IF A=4 THEN PRINT "<EOT>"
740    IF F1=0.AND.A<>2 THEN 720 : REM DON'T DISPLAY UNTIL <STX> RECEIVED
750    IF A=2 THEN F1=1 : GOTO 720
760    PRINT CHR(A), : GOTO 720
2000   PRINT: PRINT
2030   GOTO 500: REM FOUND THE END OF THIS PACKET
2050   END
```

APPENDIX G. ASCII CHARACTER SET CHART

Dec	Hex	Char	Code	Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char
0	00		NUL	32	20		64	40	@	96	60	'	128	80	Ç	160	A0	á	192	C0	└	224	E0	α
1	01		SOH	33	21	!	65	41	A	97	61	a	129	81	ü	161	A1	í	193	C1	┴	225	E1	ß
2	02		STX	34	22	"	66	42	B	98	62	b	130	82	é	162	A2	ó	194	C2	┬	226	E2	Γ
3	03		ETX	35	23	#	67	43	C	99	63	c	131	83	â	163	A3	ú	195	C3	├	227	E3	π
4	04		EOT	36	24	$	68	44	D	100	64	d	132	84	ä	164	A4	ñ	196	C4	─	228	E4	Σ
5	05		ENQ	37	25	%	69	45	E	101	65	e	133	85	à	165	A5	Ñ	197	C5	┼	229	E5	σ
6	06		ACK	38	26	&	70	46	F	102	66	f	134	86	å	166	A6	ª	198	C6	╞	230	E6	µ
7	07		BEL	39	27	'	71	47	G	103	67	g	135	87	ç	167	A7	º	199	C7	╟	231	E7	τ
8	08		BS	40	28	(	72	48	H	104	68	h	136	88	ê	168	A8	¿	200	C8	╚	232	E8	Φ
9	09		HT	41	29	)	73	49	I	105	69	i	137	89	ë	169	A9	⌐	201	C9	╔	233	E9	Θ
10	0A		LF	42	2A	*	74	4A	J	106	6A	j	138	8A	è	170	AA	¬	202	CA	╩	234	EA	Ω
11	0B		VT	43	2B	+	75	4B	K	107	6B	k	139	8B	ï	171	AB	½	203	CB	╦	235	EB	δ
12	0C		FF	44	2C	,	76	4C	L	108	6C	l	140	8C	î	172	AC	¼	204	CC	╠	236	EC	∞
13	0D		CR	45	2D	-	77	4D	M	109	6D	m	141	8D	ì	173	AD	¡	205	CD	═	237	ED	φ
14	0E		SO	46	2E	.	78	4E	N	110	6E	n	142	8E	Ä	174	AE	«	206	CE	╬	238	EE	ε
15	0F		SI	47	2F	/	79	4F	O	111	6F	o	143	8F	Å	175	AF	»	207	CF	╧	239	EF	∩
16	10	►	DLE	48	30	0	80	50	P	112	70	p	144	90	É	176	B0	░	208	D0	╨	240	F0	≡
17	11	◄	DC1	49	31	1	81	51	Q	113	71	q	145	91	æ	177	B1	▒	209	D1	╤	241	F1	±
18	12	↕	DC2	50	32	2	82	52	R	114	72	r	146	92	Æ	178	B2	▓	210	D2	╥	242	F2	≥
19	13	‖	DC3	51	33	3	83	53	S	115	73	s	147	93	ô	179	B3	│	211	D3	╙	243	F3	≤
20	14	¶	DC4	52	34	4	84	54	T	116	74	t	148	94	ö	180	B4	┤	212	D4	╘	244	F4	⌠
21	15	§	NAK	53	35	5	85	55	U	117	75	u	149	95	ò	181	B5	╡	213	D5	╒	245	F5	⌡
22	16	▬	SYN	54	36	6	86	56	V	118	76	v	150	96	û	182	B6	╢	214	D6	╓	246	F6	÷
23	17	↕	ETB	55	37	7	87	57	W	119	77	w	151	97	ù	183	B7	╖	215	D7	╫	247	F7	≈
24	18	↑	CAN	56	38	8	88	58	X	120	78	x	152	98	ÿ	184	B8	╕	216	D8	╪	248	F8	°
25	19	↓	EM	57	39	9	89	59	Y	121	79	y	153	99	Ö	185	B9	╣	217	D9	┘	249	F9	·
26	1A	→	SUB	58	3A	:	90	5A	Z	122	7A	z	154	9A	Ü	186	BA	║	218	DA	┌	250	FA	·
27	1B	←	ESC	59	3B	;	91	5B	[	123	7B	{	155	9B	¢	187	BB	╗	219	DB	█	251	FB	√
28	1C	└	FS	60	3C	<	92	5C	\	124	7C			156	9C	£	188	BC	╝	220	DC	▄	252	FC	ⁿ
29	1D	↔	GS	61	3D	=	93	5D	]	125	7D	}	157	9D	¥	189	BD	╜	221	DD	▌	253	FD	²
30	1E	▲	RS	62	3E	>	94	5E	^	126	7E	~	158	9E	₧	190	BE	╛	222	DE	▐	254	FE	■
31	1F	▼	US	63	3F	?	95	5F	_	127	7F	⌂	159	9F	ƒ	191	BF	┐	223	DF	▀	255	FF	

Graphics characters for ASCII 00-15 (00-0FH) are not supported.
ASCII 32 (20H) is a "space".
ASCII 255 (FFH) is a "blank".