CONTROL DATA® 3290

(EDIT) MULTISTATION TERMINAL

PRELIMINARY

CONTROL DATA CORPORATION

OPERATING AND PROGRAMMING GUIDE

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3290-4 (EDIT) MULTISTATION TERMINAL

OPERATING AND PROGRAMMING GUIDE

SECTIONS IN THIS MANUAL

Section I —— General Description

Section II —— Operation

Section III —— Programming

Section IV —— Programming Aids

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FOREWORD

This manual discusses some of the major aspects of a Multistation Terminal. The primary purpose is to provide the reader with a reasonably complete understanding of operating and programming principles.

The discussion is arranged in four basic sections and an appendix. The first explains the characteristics of the terminal from both operational and functional viewpoints. Controls available to the operator along with basic operating procedures are covered in the second section. In the third section, attention focuses on programming; including flow charts and communication sequences. The reader should pay considerable attention to Section IV, Programming Aids. Here, some of the less obvious features are discussed. An appendix is used to highlight all equipments used in the configuration. Specifications are given for each equipment, as well as a listing of available documentation.

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SECTION I

GENERAL DESCRIPTION

A terminal consists of a variety of data entry and retrieval devices communicating through a processor. The 3290-4 terminal discussed is capable of communicating with the processor over data cables at a distance of 3000 feet. This terminal features data output in the form of cathode-ray tube displays and hardcopy. Data entry is achieved by entry keyboards associated with the displays. Figure 1-1 shows a typical terminal.

All processing for the terminal is handled by the Equipment Controller. This device is connected to the processor by data cables. All input/output devices are attached by cables.

The crt display unit is termed a Display Station. When a keyboard is added, it becomes a Display/Entry Station.

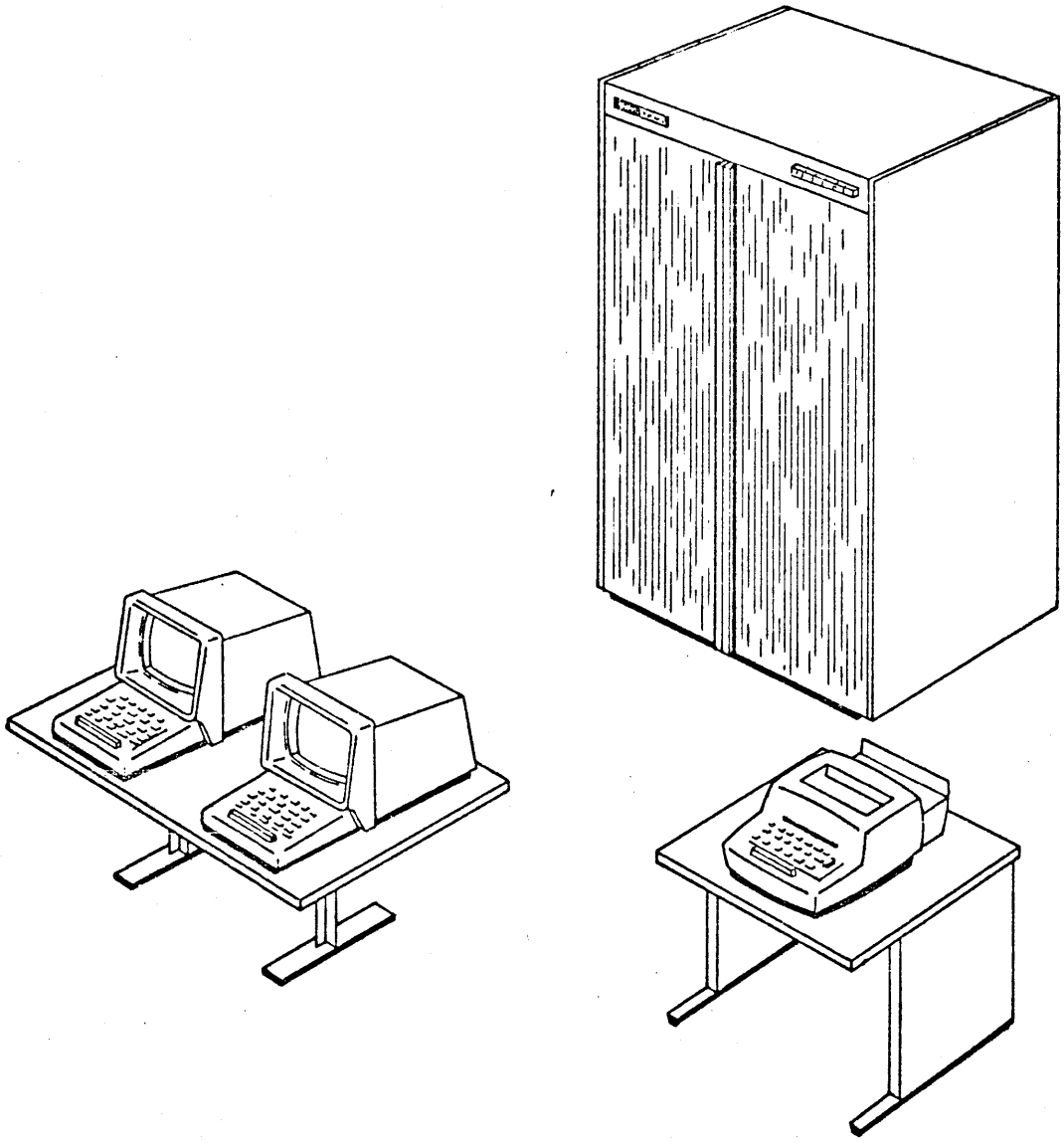
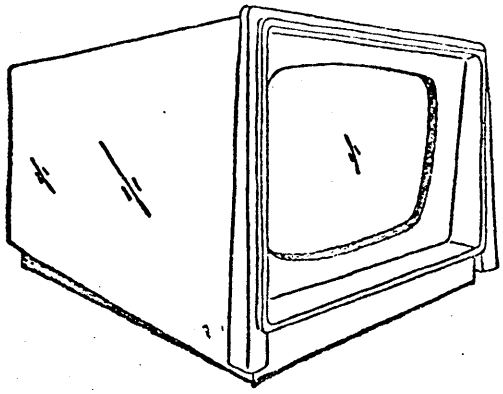


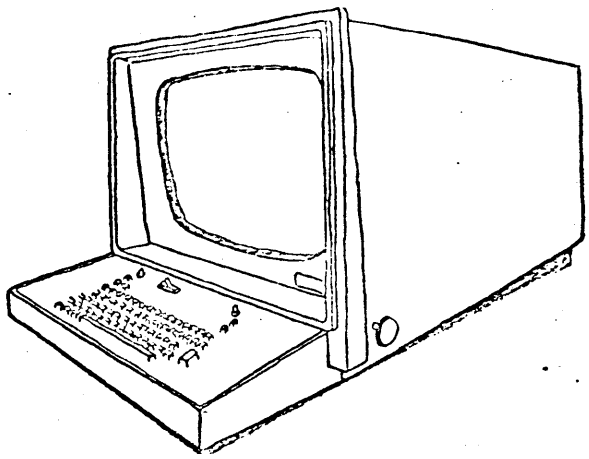
Figure 1-1. Typical Terminal

Two types of keyboards are offered. Each allows an operator to compose a message and initiate transmission. The basic keyboard consists of symbol and editing keys which allow the operator to compose a message on the crt and message transmission keys to initiate input. An "edit" keyboard features numerous editing facilities along with a "protected area" concept. These are in addition to the same symbol and transmission key repertoire of a basic keyboard.

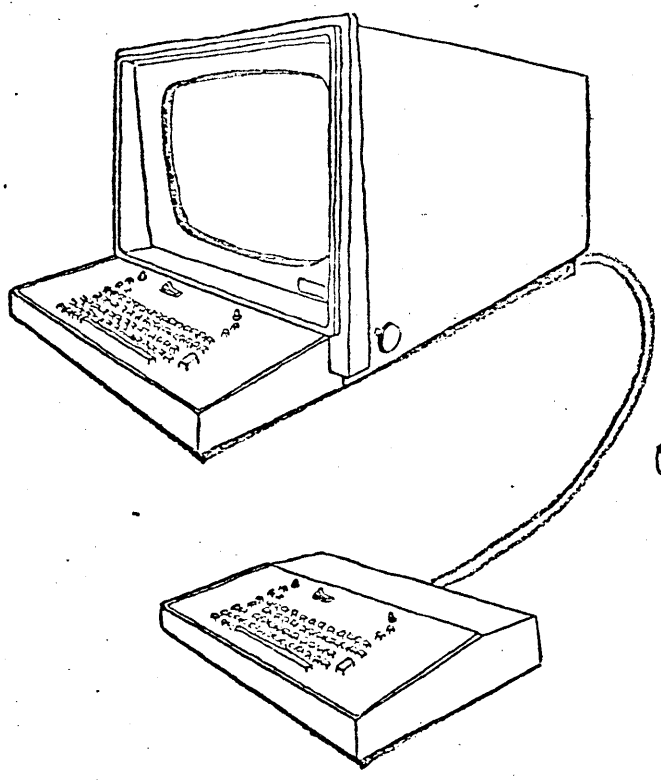
When one keyboard is used with a Display Station, it may be attached or detached. Detached keyboards can be located up to twenty cable feet from the display. When two keyboards are used with a station, one may be attached and one detached or both may be detached. Figure 1-2 illustrates the various configurations.



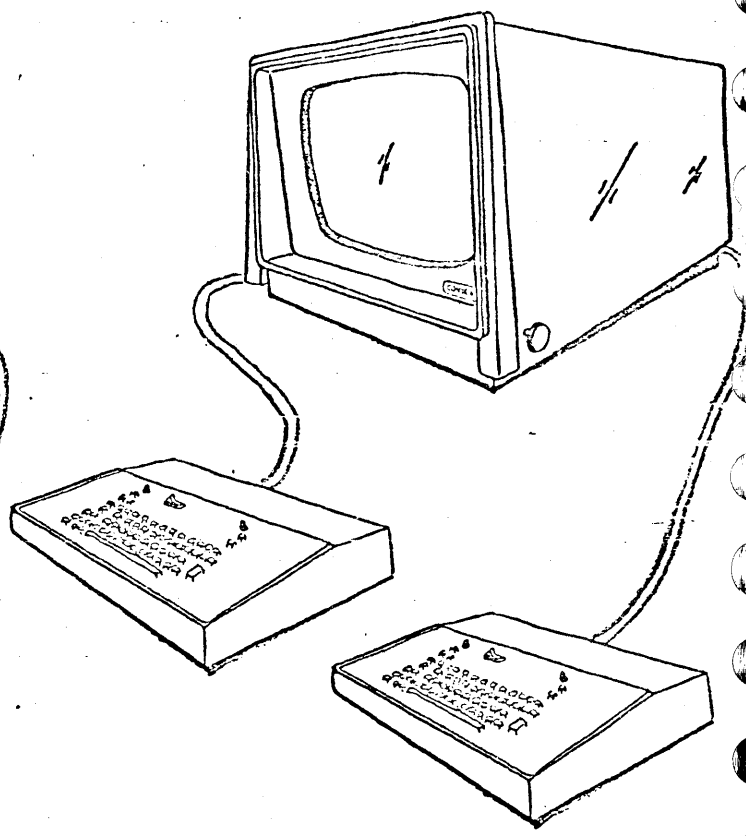
DISPLAY STATION
(NO ENTRY KEYBOARDS)



DISPLAY/ENTRY STATION
(1 ATTACHED ENTRY KEYBOARD)



DISPLAY/ENTRY STATION
(1 ATTACHED AND 1 DETACHED ENTRY KEYBOARD)



DISPLAY/ENTRY STATION
(2 DETACHED ENTRY KEYBOARDS)

Figure 1-2. Display/Entry Station Configurations

Each Typewriter Station consists of a Selectric* typewriter mounted on a desk-type pedestal. Because the station is restricted to output activity, its keyboard is not used. A paper handler behind the typewriter holds the paper supply.

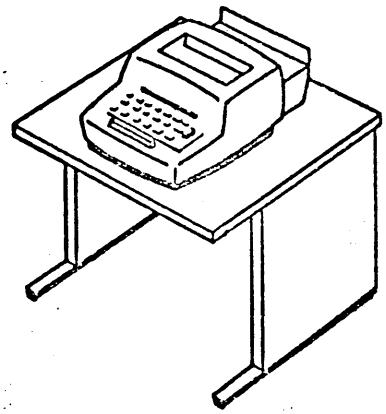


Figure 1-3. Typewriter Station

*IBM Trademark

DATA PRESENTATION.

A Display Station features a 14-inch rectangular crt. Symbols display within a nominal 6- by 8-inch area on the crt screen. Standard display format is 20 lines of 50 symbols. An optional format is 13 lines of 80 symbols. Each symbol position is nominally 1/4-inch high by 1/8-inch wide and consists of a 5- by 7-dot matrix. A symbol is formed by brightening certain dots within the matrix. Figure 1-4 shows a typical formation, using the letter A. Symbols include the alphabet in upper-case, arabic numerals, punctuation marks, and several special symbols. Figure 1-5 shows an actual crt display.

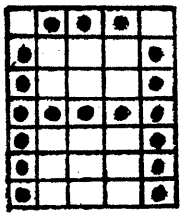


Figure 1-4. Symbol Formation

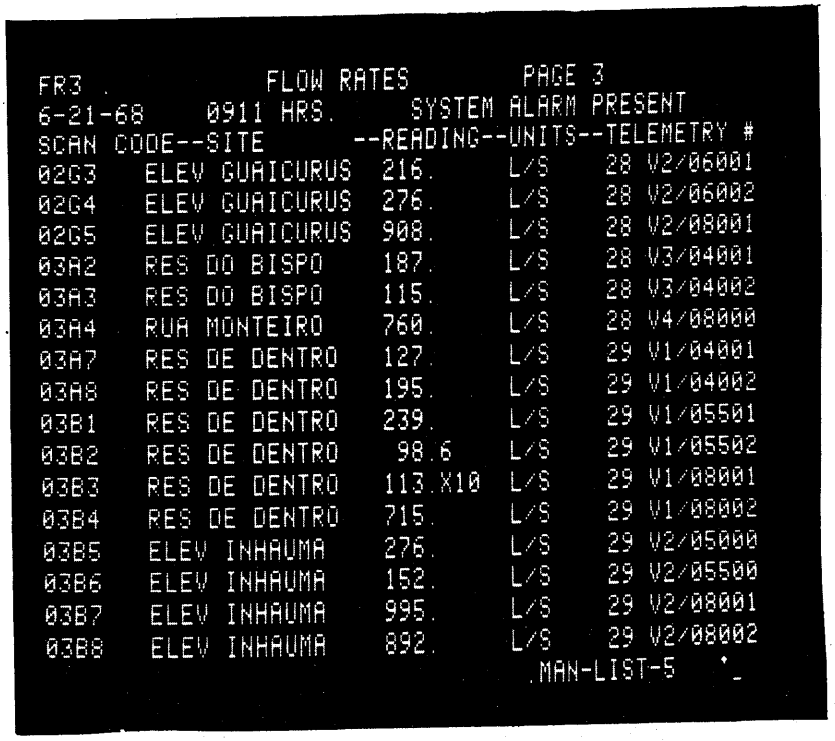


Figure 1-5. Display Presentation

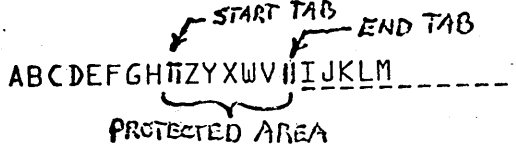
OPERATIONAL DESCRIPTION.

In typical operation, the operator composes an inquiry message using the alphanumeric entry keyboard. As the message is composed, it is displayed on the crt. A chain of markers (underlines of symbol positions) indicate to the operator where the next symbol will be displayed. Initially, the markers extend from the left to the right edge in the top line of the raster. In this case, the marker in the upper left corner is called the entry marker.

Depressing a symbol key enters a symbol at this position and erases the marker. The next marker to the right now becomes the entry marker. After reaching the end of the line, the marker chain is automatically displayed in the next lower line. When the end of the last line is reached, the chain is re-displayed in the first line, with the marker in the upper left corner becoming the entry marker again.

The data source may send start tab (⊤) and end tab (⊥) symbols to stations with edit keyboards. These symbols form protected areas on the crt. A protected area may only be entered by the data source. The end tab symbol can also be entered via the keyboard.

Any attempt by the operator to enter this protected area results in an automatic tab function. This moves the entry marker to the first symbol position beyond the end tab symbol.



Either complete or partial message transmission is possible at the discretion of the user. A "start of text" indicator (■) may be inserted anywhere on the display page to indicate the starting point of transmission. Another indicator (Δ) is used to define the end of the message. In this case, only data between the two symbols is transferred. If the start of text symbol is not used, the upper left corner of the raster becomes the starting position. The end of message symbol (Δ), additionally, identifies the enclosed data as a "read" message for transmission to the data source.

THIS PORTION OF THE MESSAGE WILL NOT BE TRANSMITTED. ■DATA INCLUDED BETWEEN THE START OF TEXT AND END OF TEXT SYMBOLS FORMS THE READ MESSAGE.Δ

Partial Message

ALL INFORMATION UP THROUGH THE END OF TEXT SYMBOL WILL BE SENT TO THE DATA SOURCE IN A READ MESSAGE.Δ

Complete Message

SECTION II

OPERATION

Operator action governs most of the communications network. This section describes the operations necessary to begin communications. The descriptions provided are of a general nature. For more detail, reference the applicable Reference/Customer Engineering Manuals.

Main power is applied via the control panel in the upper right corner of the Equipment Controller cabinet. Figure 2-1 shows the panel, while table 2-1 explains the function of each indicator and switch.

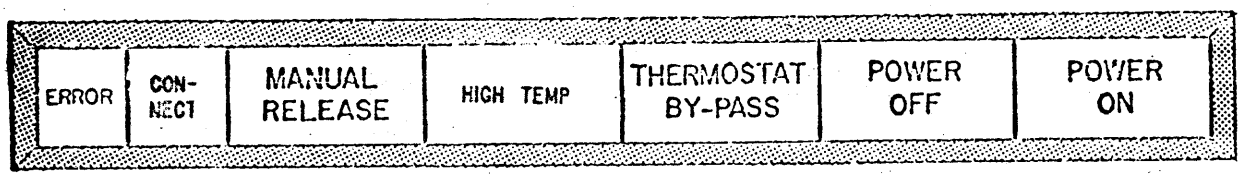


Figure 2-1. Control Panel

TABLE 2-1. CONTROL PANEL FUNCTIONS

CONTROL	TYPE	FUNCTION
POWER ON	Push-button indicator-switch	When depressed, applies power to and clears all controller circuitry. Releasing the switch allows equipment operation to begin. Depressing the switch during operation master clears all controller circuitry. The switch lights whenever power is applied to the controller.
POWER OFF	Push-button switch	When depressed, removes power from the controller.
THERMOSTAT BY-PASS	Alternate-action push-button indicator-switch	If the indicator is not lit, depressing the switch lights the indicator and places the controller in the by-pass state. This state prevents an overtemperature condition from removing controller power. Depressing the switch again disables the by-pass state and turns off the indicator. In the by-pass state, the indicator remains lit if controller power is turned off.
HIGH TEMP	Indicator	Lights when controller temperature exceeds 110 degrees Fahrenheit. The indicator remains lit while an over temperature condition exists, even if controller power is off.
MANUAL RELEASE	Push-button switch	When depressed, resets the entry marker at each Display/Entry Station and clears all controller circuitry except data storage delay lines. Releasing the switch allows equipment operation to continue.
CONNECT	Indicator	Lights when a message is being received or transmitted by the controller.
ERROR	Indicator	Lights when an error is detected in an incoming message and turns off when the controller completes the error response message.

COMPOSING A MESSAGE FROM THE KEYBOARD.

The entry keyboard allows the operator to input data for communications with the data source or local printout. Assuming an initial power-off condition, use the following steps to make the terminal operational.

(a) Depress POWER ON (figure 2-1).

(b) Rotate Display Station OFF/ON switch to ON position (figure 2-2).

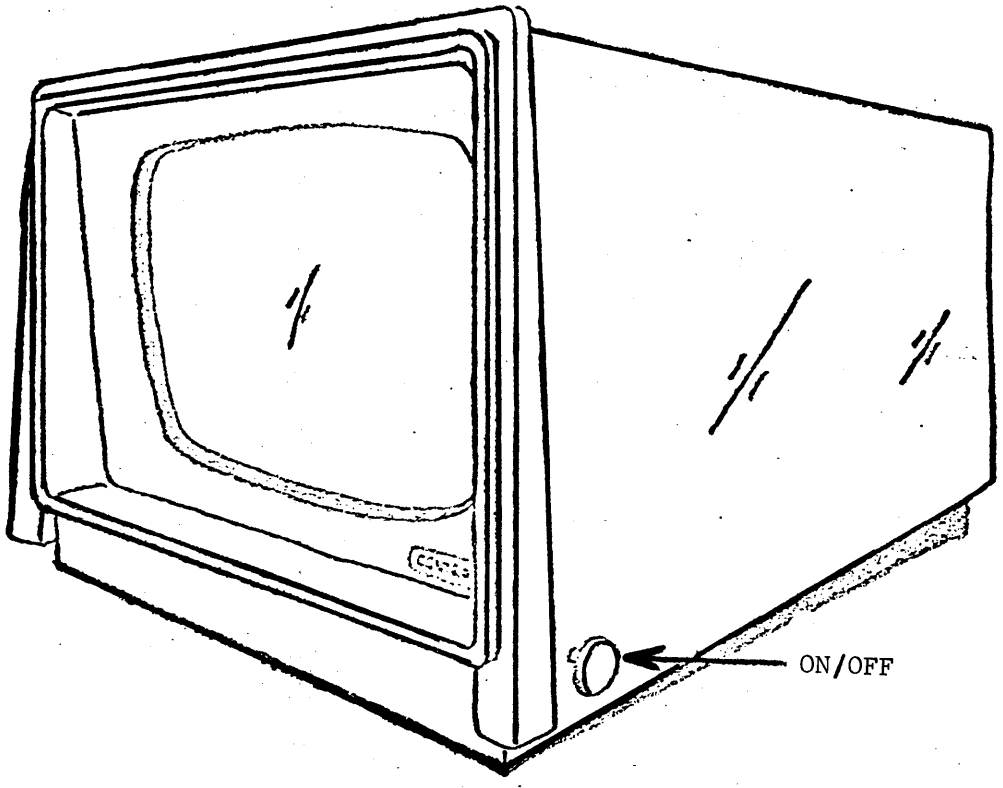


Figure 2-2. Display Station

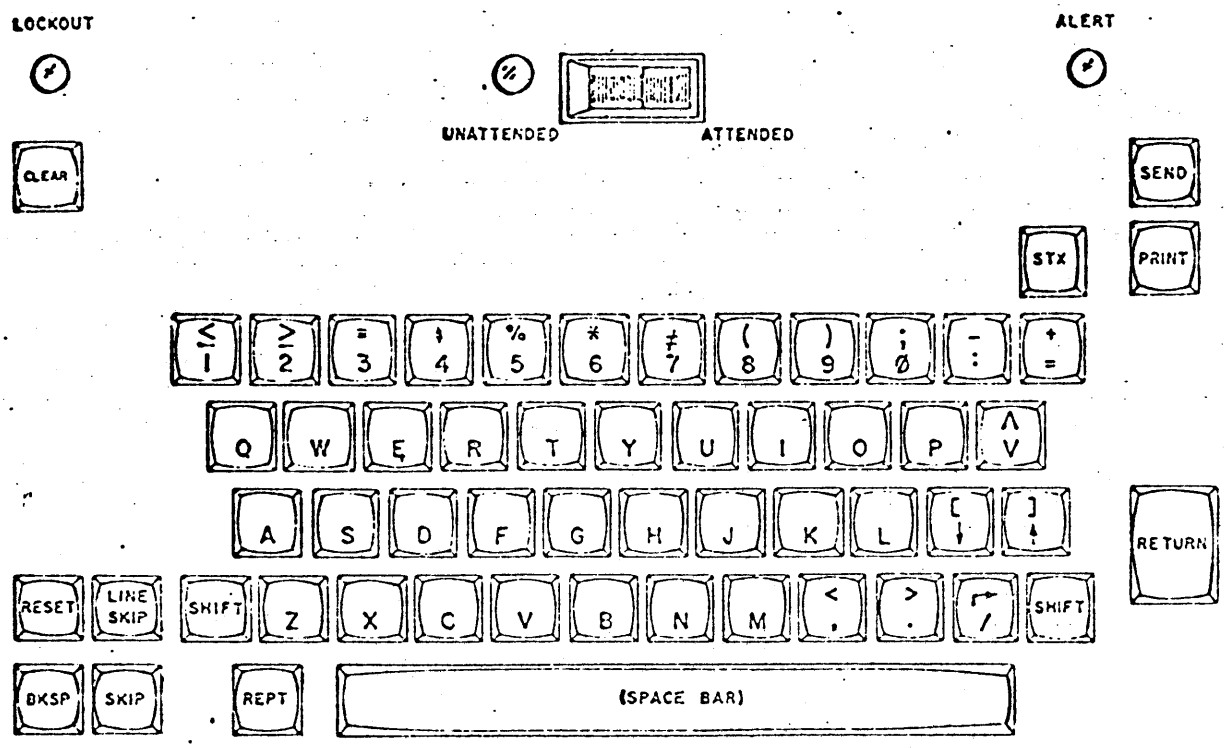


Figure 2-3. Basic Keyboard

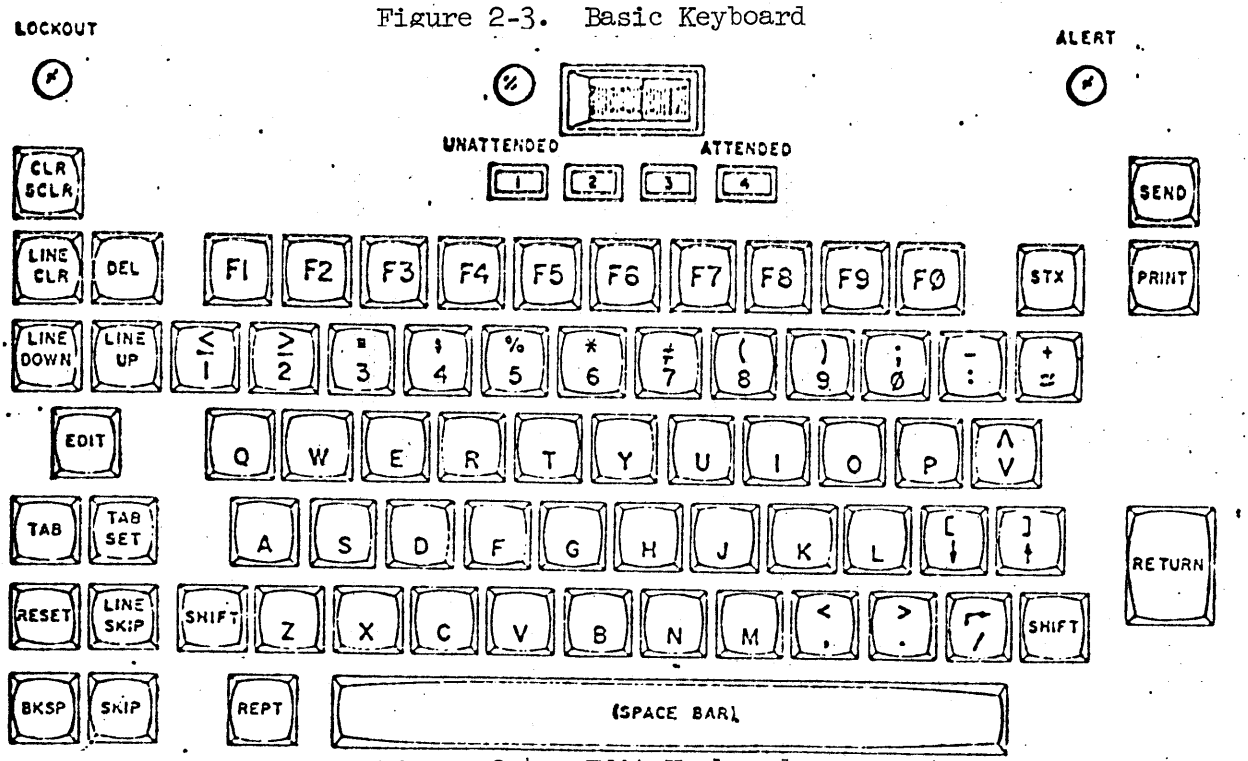
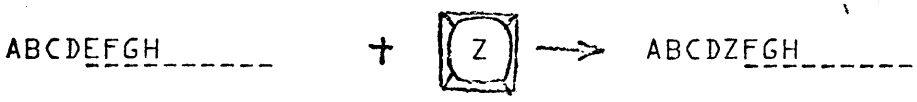


Figure 2-4. Edit Keyboard

There are 44 alphanumeric keys on the keyboard. Depression of anyone of the keys enables the corresponding symbol to be displayed at the current entry marker position; advancing the marker one symbol position. The keyboard is electrically interlocked so the depression of two or more keys, simultaneously, results in display of only one of the selected symbols. The non-interlocking SHIFT keys are used to enable selection of the upper symbol on the two-symbol keys. They have no affect on single-symbol keys (the alphabet is in uppercase).

Should a symbol key be depressed when the entry marker references another symbol, the old symbol is replaced by the new selection and the marker advances.



EDITING KEYS.

The following group of illustrations show the affect of the various editing keys on the display.

Skip.

The SKIP key advances the entry marker one symbol position without affecting data already displayed.

Backspace.

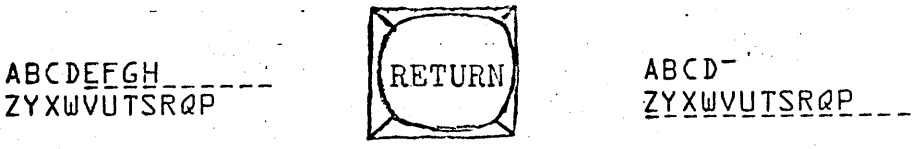
Depression of the BKSP key moves the marker one symbol position to the left without affecting displayed data.

Line Skip.

The marker chain is moved to the next lower line when the LINE SKIP key is used. Displayed data is unaffected.

Return.

The RETURN key inserts a carriage return symbol (⁻) at the current entry marker position. All data to the right of this symbol is erased and the marker chain is moved to the next lower line.



Repeat.

Depression of the REPT key in conjunction with a second key performs a repeated action as designated by the second key. For example, depression of REPT and the "A" key causes repeated entry of the symbol "A" onto the display screen. The REPT key functions with all keys except the following:

(a) PRINT - a repeated printout is performed if the keys are held down long enough.

(b) SEND

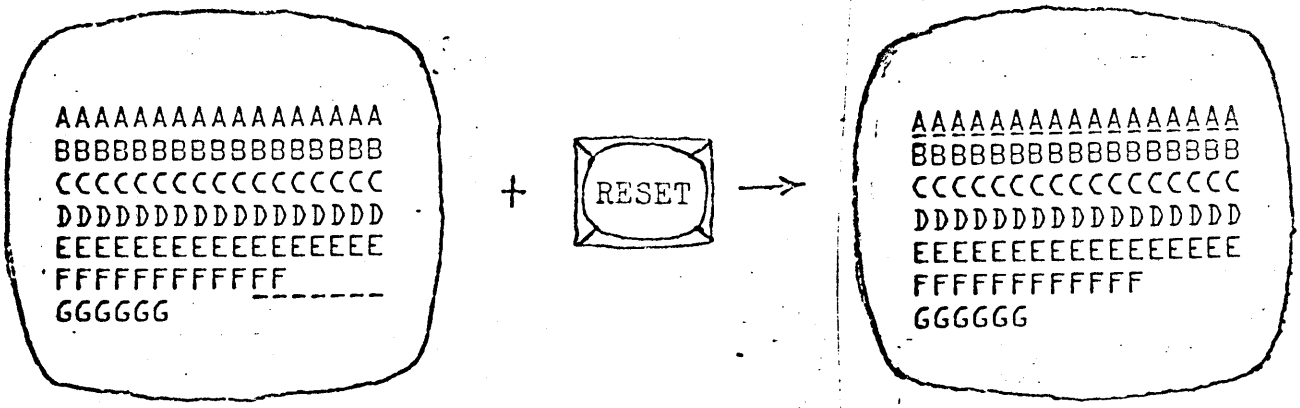
(c) CLEAR

(d) EDIT

(e) CLR/S CLR

Reset.

Depression of the RESET key moves the entire marker chain to the top line without affecting displayed data.



Clear (Basic Keyboard Only).

The CLEAR key erases all data from the raster and resets the marker chain to the top line.

Tab and Tab Set (Edit Keyboard Only).

Two tab codes may be entered into memory: end tab and start tab. End tab codes can be entered from the keyboard and the data source. Start tab codes can be entered only by the data source and the operator may neither enter nor ignore start tab codes.

The TAB and TAB SET keys function similarly to the tab and tab set keys on a typewriter. Depressing the TAB SET key enters an end tab symbol ( ) at the current entry marker position and advances the entry marker one symbol position.

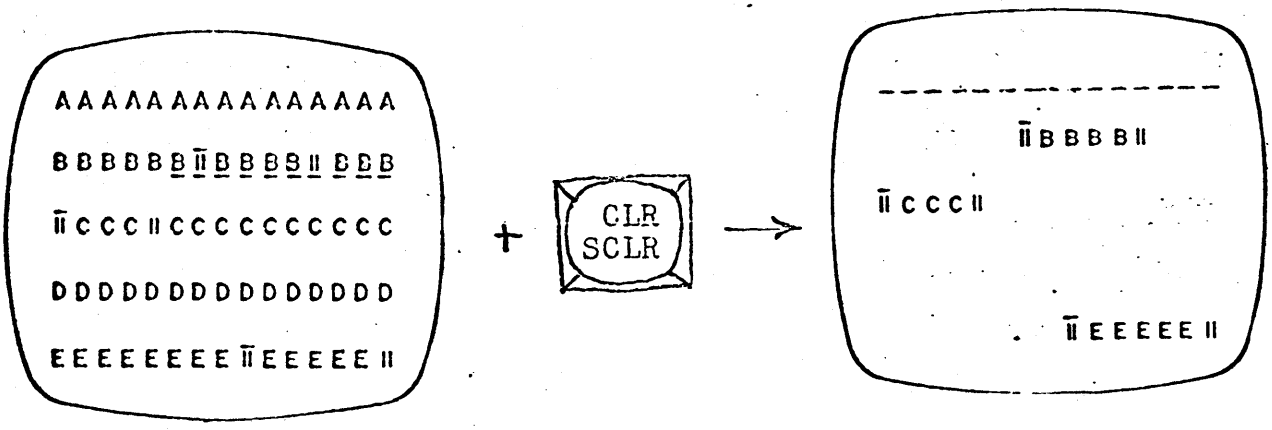
When the TAB key is depressed, the entry marker searches forward to the first end tab symbol and moves to the first symbol position beyond. If no end tab symbols are present between the entry marker position and end of page, the search terminates when the marker reaches the end of page. The entry marker then moves to the upper left corner of the screen.

Start tab is used in conjunction with end tab to form a memory protect area and can be inserted only by the data source. All areas on the display screen preceded by a start tab symbol (⊤⊤) and terminated by an end tab symbol (⊥⊥) cannot be entered by the operator (see Section I). The data source can alter protected areas only when the information is preceded by an access code. A practical application of this feature is filling out blank forms.

An automatic tab function occurs whenever the operator attempts to move the entry marker under a start tab symbol (or end tab symbol by backspacing); it is therefore impossible for the operator to move the entry marker to any position within a protected area. The data source may read only information displayed outside the protected areas.

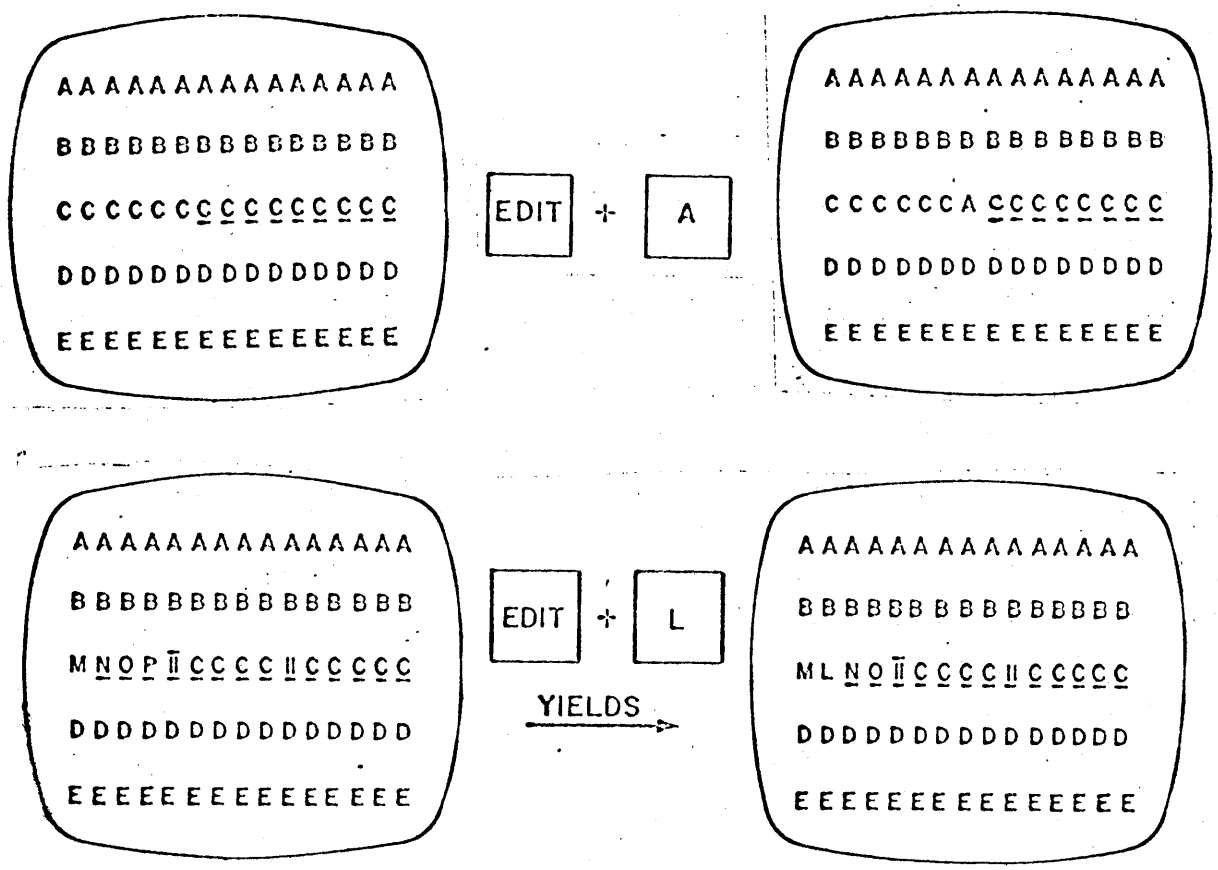
Clear/Select Clear (Edit Keyboard Only).

The CLR/S CLR key removes all data from the crt excluding protected areas and resets the marker chain to the top line. Depression in conjunction with SHIFT clears all data from the crt, including protected areas, and resets the marker chain.



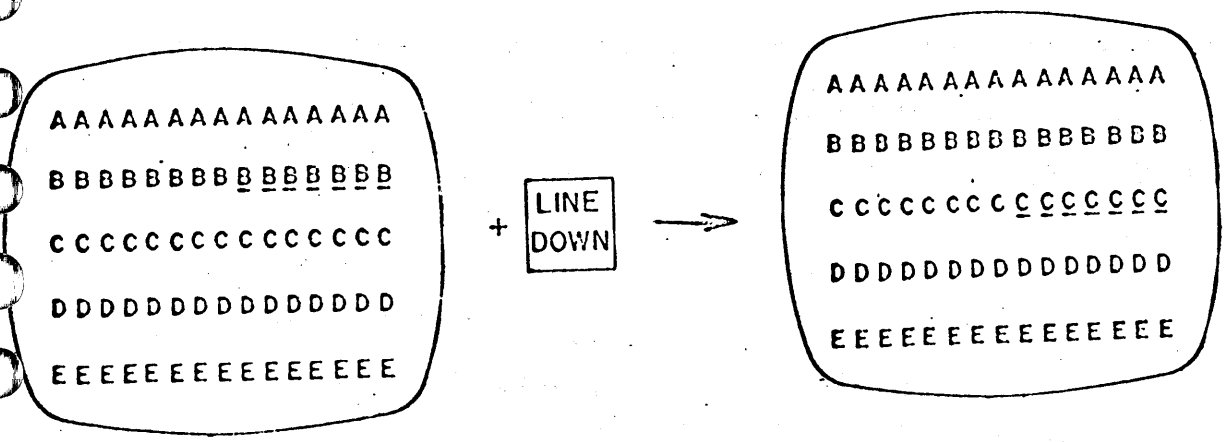
Edit (Edit Keyboard Only).

Depressing EDIT alone has no affect on displayed data. Depression in conjunction with a symbol key displays that symbol at the existing entry marker position and causes the symbol previously at that position and all symbols to the right of that position on the same line to shift one position to the right. The symbol in the last position of the line is lost. EDIT also enables moving data with the LINE DOWN, LINE UP, and DEL keys.

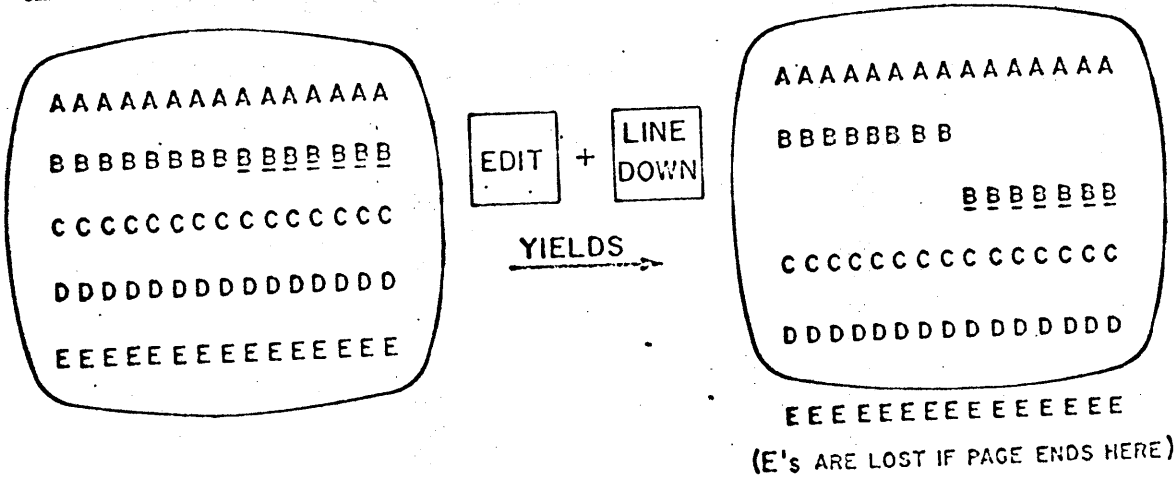


Line Down (Edit Keyboard Only).

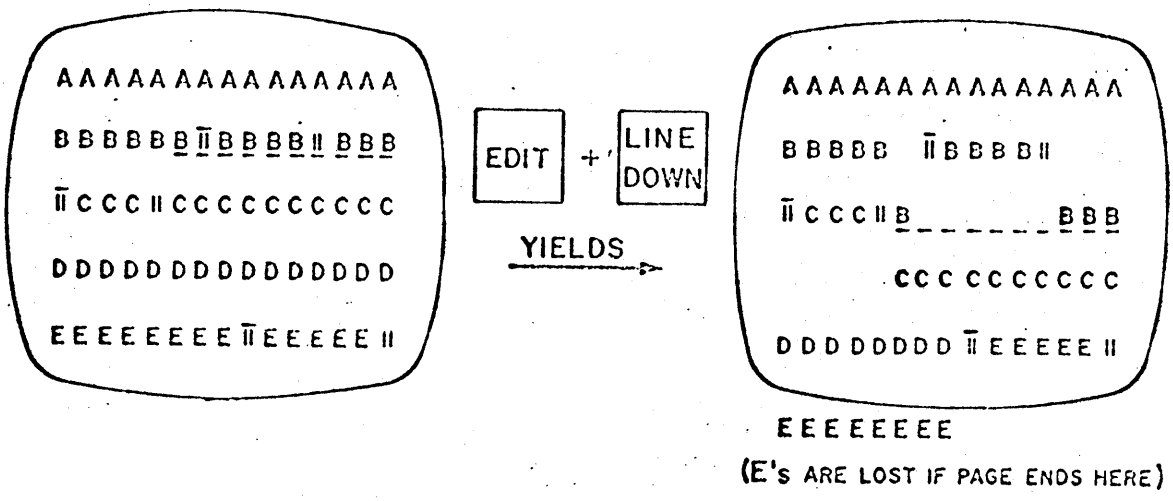
Depressing the LINE DOWN key by itself moves the entry marker to the corresponding symbol position on the line directly below its current position. If this action places it in a protected area, an automatic tab function is performed.



Depressing the LINE DOWN key while the EDIT key is held depressed causes symbols on the line containing the entry marker and all lines below it to be shifted down one line. All unprotected symbols on the bottom line of the display are lost. On the line containing the marker, symbols to the left of the marker position are not shifted down, but blanks are shifted in their place. All symbols shifted down from the line containing the marker are replaced by blanks.

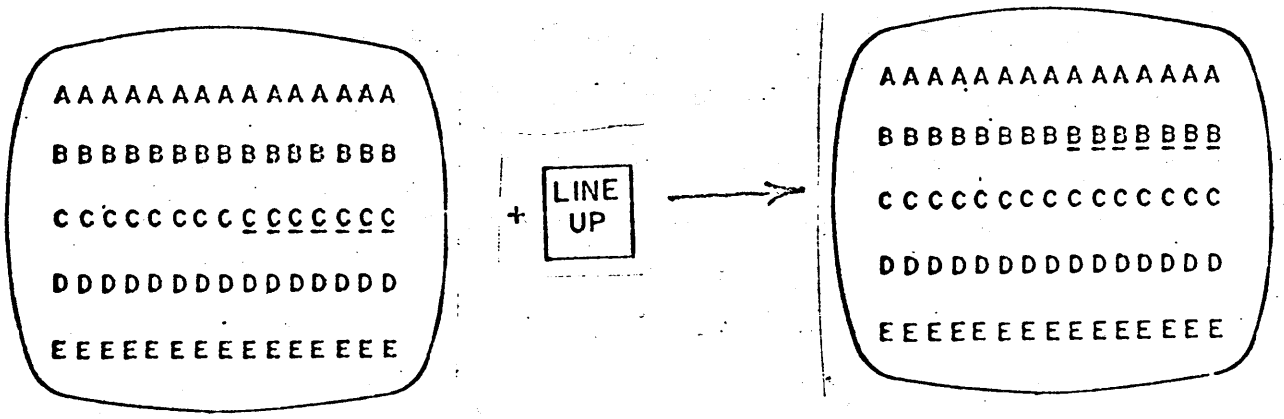


Symbols displayed in protected areas are not shifted down, but are replaced by blanks in the next lower line. Symbols shifted into protected areas are lost. The entry marker moves down one line and if this places it in a protected area, an automatic tab is performed. The LINE DOWN key has no effect when the marker is on the bottom line of the display.

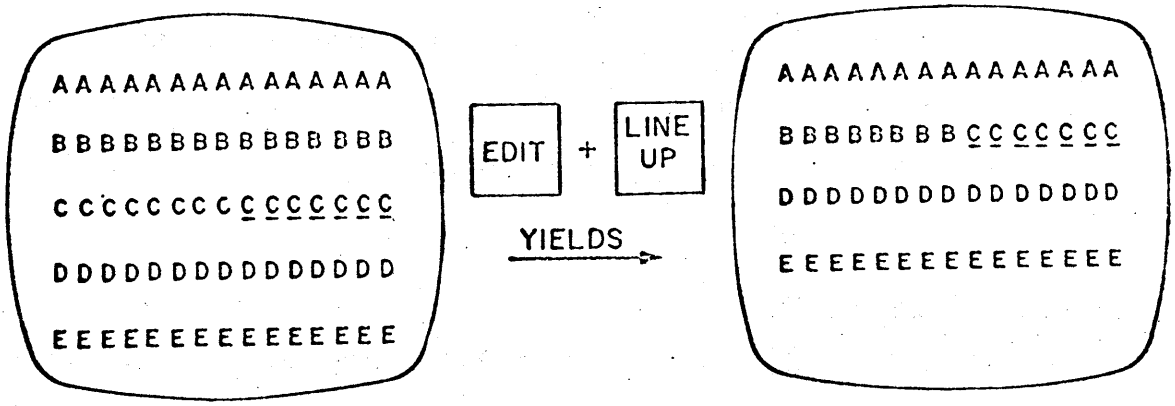


Line Up (Edit Keyboard Only).

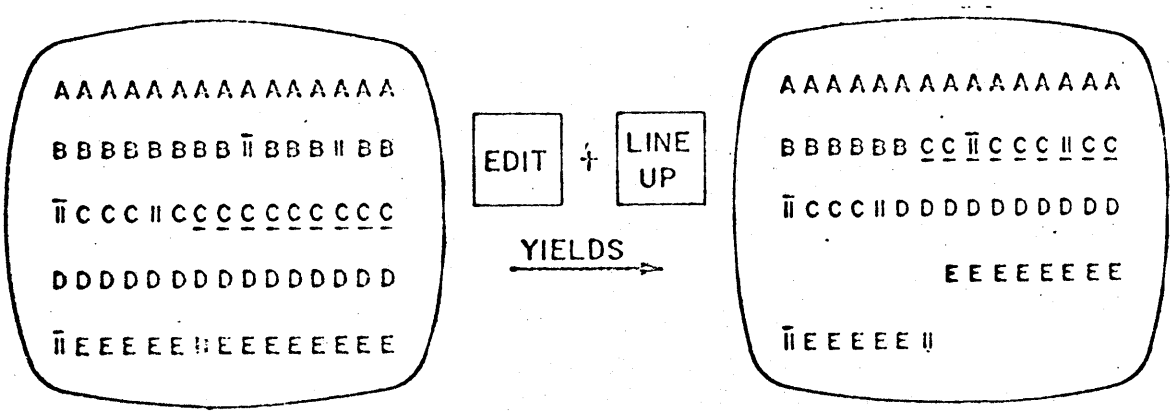
Depressing the LINE UP key by itself moves the entry marker to the corresponding position in the line above its current position. If this action places it in a protected area, an automatic tab moves the entry marker outside the protected area.



Operating the LINE UP key with the EDIT key depressed causes symbols on the line containing the entry marker and all lines below it to be shifted up one line. All unprotected symbols to the right of the marker position on the line shifted into are erased. On the line originally containing the marker, symbols to the left of the marker are not shifted up and are lost.



Symbols displayed in protected areas are not shifted up, but are replaced by blanks in the next upper line. Symbols shifted into protected areas are lost. The marker moves up one line and if this places it in a protected area, an automatic tab is performed. The LINE UP key has no effect if the marker is on the top line of the display.



Line Clear (Edit Keyboard Only).

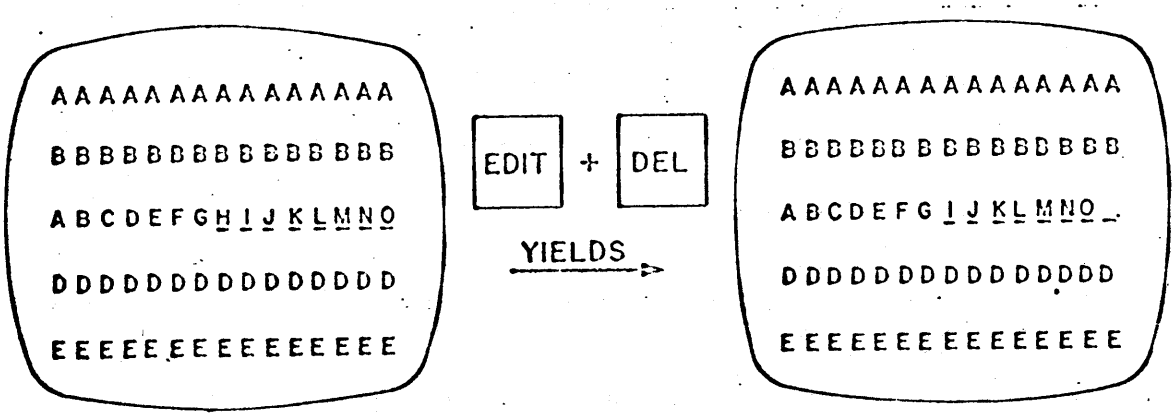
Depressing the LINE CLR key erases all unprotected data displayed between the entry marker and the end of the line. Areas protected by start and end tab symbols remain unaffected.

Delete (Edit Keyboard Only).

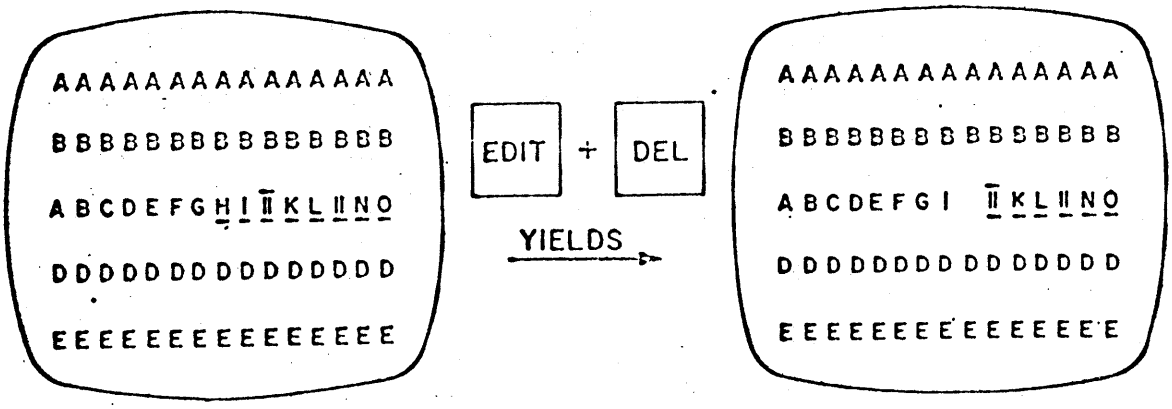
The DEL key by itself has no effect on the display. Operation of the DEL key while the EDIT key is depressed erases the symbol at the current entry marker position. All symbols to the right on the same

line shift left one symbol position and a space is entered in the last symbol position on the line. If a start tab symbol is displayed on the line between the entry marker and the right margin, it terminates the left shift. The start tab symbol and all symbols to the right are unaffected and a space is inserted in the symbol position immediately to the left of the start tab symbol. The entry marker does not advance.

Example 1: Without Start Tab



Example 2: With Start Tab



SPECIAL KEYS.

The two rows of keys on the upper portion of the edit keyboard can be used to meet unique software requirements. The lower row consists of "function" keys while the upper keys are called "status" switches.

Function Keys.

Any one of the 10 function keys places a unique symbol on the display screen at the current entry marker position, and the marker advances to the next unprotected symbol position. Depressing function key FØ displays a plus sign with an overline ($\bar{+}$), and F1 through F9 display the letters A through I, respectively. Each of these is also displayed with an overline.

Status Switches.

The four status switches are alternate-action, noninterlocking pushbuttons. The data source may read the setting of these switches at any time and interpret them in any manner desired. Each switch should be assigned a meaning independent of the others. This prevents the data source from receiving misleading information if the switches are read while the operator is changing their positions.

TRANSMISSION CONTROL KEYS.

The remaining group of keys are classified as transmission control keys. They aid in determining output activity.

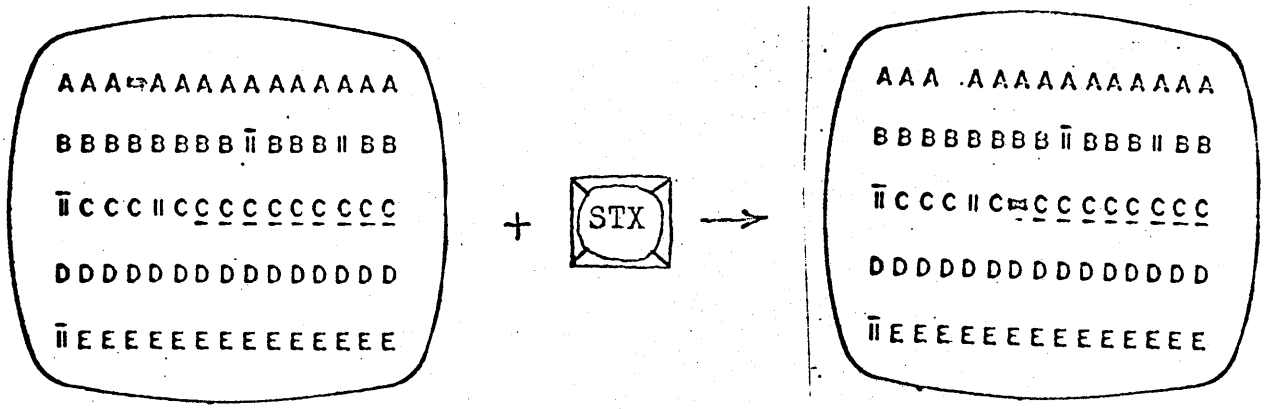
Transmission to Data Source.

At some point during the formation of a message, the operator should determine how much of the displayed message is to be transmitted. A "start of text" (STX) key permits the operator to maneuver the starting point. Use the following steps if a partial message is to be formed.

(a) Move the entry marker one symbol position to the left of the desired starting point.

(b) Depress the STX key. This inserts the associated symbol (▬) above the entry marker, and the marker is advanced. Any other STX symbol on the page will be erased.

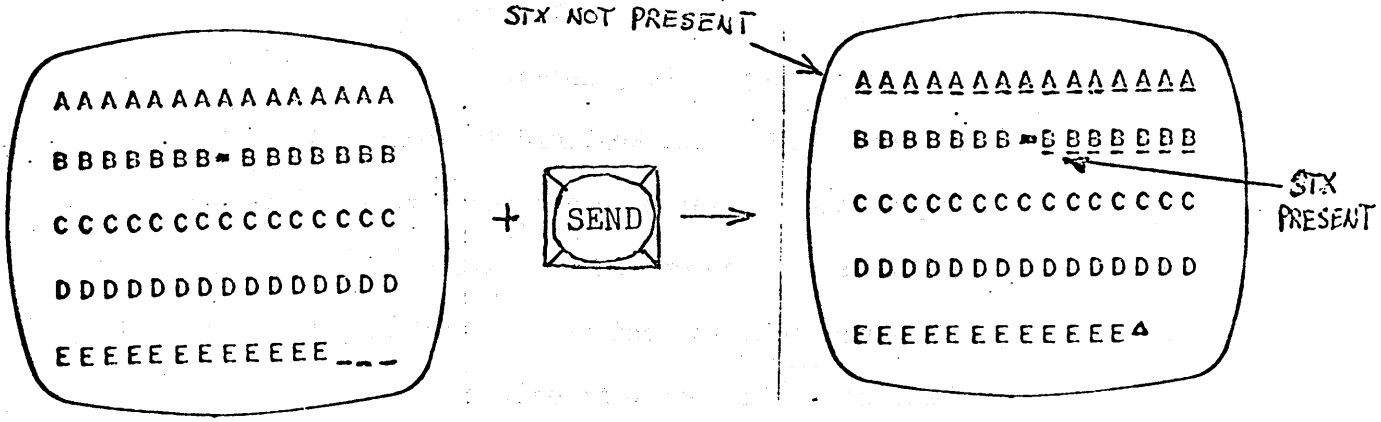
(c) The STX symbol will be the first symbol read.



The SEND key is used to terminate the message and request the data source to read the displayed information. In addition, it locks out the keyboard (the LOCKOUT indicator will light); preventing any further key depressions until the message is read and a correct reply received. The MANUAL RELEASE button on the controller will release the keyboard without affecting the display.

(a) Move entry marker one symbol position to the right of the last symbol in the message.

(b) Depress SEND key. An "end of message" symbol (Δ) will be displayed above the entry marker, and the marker chain will be reset. When reset, the entry marker will reference the STX symbol (if one exists) or the symbol in the upper left corner of the raster (if no STX symbol is present).



When the data source begins to read the displayed information, the CONNECT indicator on the controller lights. This indicator is illuminated whenever the terminal is transmitting or receiving information. As the read operation progresses, the entry marker continually advances. Upon completion of the read, it is displayed one symbol position to the right of the end of text symbol. The keyboard, however, remains locked out while the terminal awaits a reply from the data source.

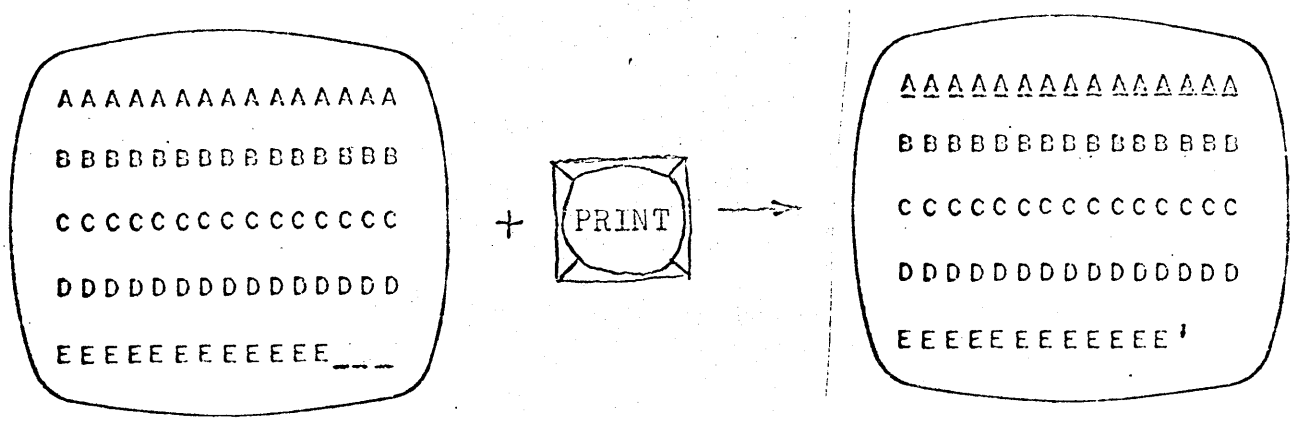
Local Printout.

The operator has the option of locally printing displayed information rather than transmitting to the data source if a typewriter is associated with the Display/Entry Station. In this instance, the STX key is of no value since printout begins with the symbol in the upper left corner of the raster. The end of print symbol (') in this case is inserted by the PRINT key.

(a) Move the marker one symbol position to the right of the last character to be printed.

(b) Depress PRINT. The keyboard is locked out (LOCKOUT will light) and the marker chain reset to the top line in the raster after the end of print symbol (') is displayed.

(c) All data up to the end of print symbol will be printed (end of print is not printed).



All symbols are typed exactly as they are displayed, with the exception of end of print and start of text symbols.

AAA^A	is printed as	AAA2A
AAA'A	is printed as	AAA
AAA:A	is printed as	AAAJA
AAA-A	is printed as	AAAKA

After transfer to typewriter module has been completed, the keyboard is released to the operator. The display remains, however, and must be cleared if another message is to be generated.

Unattended/Attended and Alert Operation.

As long as the operator is present at the terminal, the UNATTENDED/ATTENDED switch should be in the ATTENDED position. Under normal circumstances, this means that the ALERT indicator and alarm will be activated when the data source wishes to transmit data (the ALERT alarm can be turned off with the ALERT switch on the keyboard). This feature allows the operator to complete any message in progress and depress either PRINT or SEND. An activated SEND key will prevent an incoming message from destroying the one composed locally, and turns off the light and alarm. PRINT does not turn off the light and alarm, but the stored message is protected from destruction by incoming data.

Whenever the site is to be vacated, but left operable, the UNATTENDED/ATTENDED switch should be placed in the UNATTENDED position. This allows the data source to gain access to the terminal for output purposes. Receipt of an STX or E1 (end of text) code from the data source lights the UNATTENDED indicator.

In the UNATTENDED mode, the ALERT light and alarm are disabled. Correct receipt of an alert message from the data source clears the display screen, displays an El symbol ( ) in the upper left corner of the crt, and resets the entry marker. This one-character message is transmitted to the data source when the station is polled. The entire operation simulates SEND key depression. The ATTENDED mode can be re-established by placing the switch in the ATTENDED position.

Lockout Indicator.

The LOCKOUT indicator is activated whenever the keyboard is disabled. Under normal operating conditions, this situation occurs in the following instances:

(a) Depressing the SEND key lights the LOCKOUT indicator and disables the keyboard with the exception of the CLEAR or CLR/S CLR key which is also disabled when the data source polls the station for a SEND key depression. This enables an operator to disable the send request and clear the display screen if he decides, before the station is polled, not to transmit the message. When the data source polls the station, the CLEAR or CLR/S CLR key is disabled. The keyboard is enabled and the LOCKOUT indicator extinguished following correct receipt of a write message containing an El or STX code from the data source.

(b) The keyboard is disabled and the LOCKOUT indicator lit when the Display/Entry Station receives a message from the data source modifying the display presentation. The keyboard is released and the LOCKOUT indicator extinguished following correct receipt of a write message containing an El or STX code from the data source.

(c) When a typewriter is associated with a Display Station, depressing the PRINT key activates the LOCKOUT indicator and disables the keyboard. Following message transfer, the keyboard is enabled and the LOCKOUT indicator extinguished.

(d) The keyboard is disabled and the LOCKOUT indicator lit when the station is in the UNATTENDED mode.

OPERATION OF THE TYPEWRITER STATION.

This station consists of a Selectric* typewriter mounted on a stand containing the power supply. Basic operations are performed by a moving typeball, containing the repertoire, while the carriage remains motionless. Various other features common to most electric typewriters are included. However, this device is used for output only, so the keyboard (with the exception of the ON/OFF switch) is not functional. Figure 2-5 shows the typewriter controls while table 2-2 explains the functions.

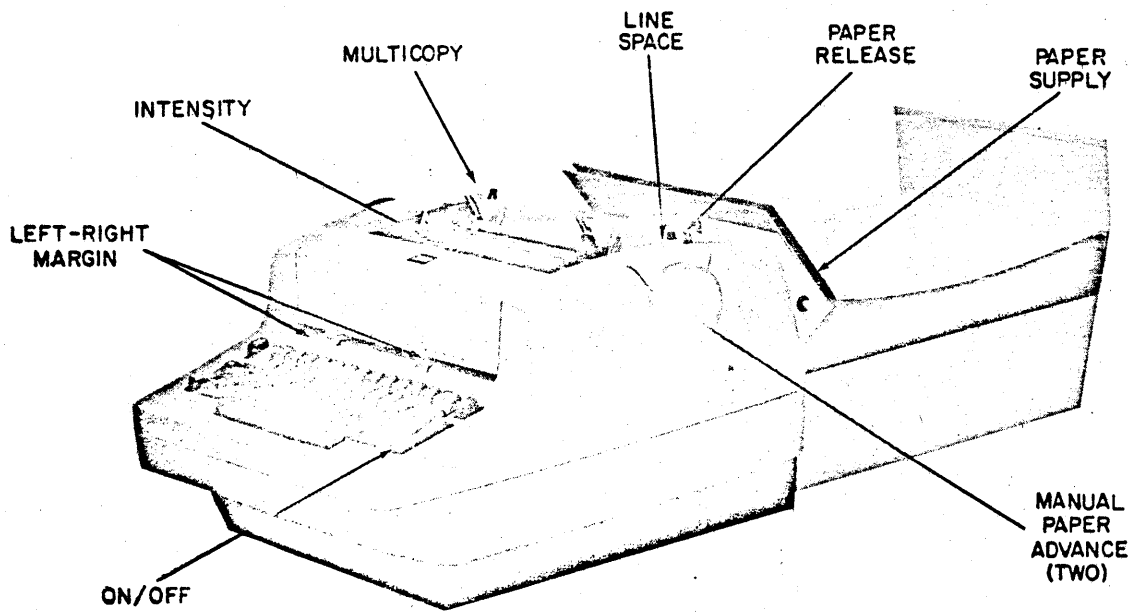


Figure 2-5. Typewriter Controls

*Trademark of IBM

TABLE 2-2. TYPEWRITER STATION CONTROLS

CONTROL NAME	TYPE	FUNCTION
ON/OFF	Rocker Switch	Turns Typewriter Station power on and off.
Keyboard	Keys	Not used.
Manual Paper Advance	Knobs	Advances paper through the carriage assembly.
Line Space	Lever	Selects single or double spacing.
Left-Right Margin	Sliding Tabs	Determine the left and right typing margins.
Intensity	Lever	Adjust the striking force of the typing element.
Multicopy	Lever	Provides even printing for carbon copy typing.
Low Paper Switch		Automatically removes power to the typewriter when the paper handler is out of paper.
Low Paper Indicator-Switch	Push-Button	Illuminates when the paper handler is out of paper. When the paper handler is refilled, depressing the switch turns off the indicator and enables typewriter power.

A paper handler is provided to perform the stacking and storing chores required with the use of continuous-strip paper. The paper is stored in the bottom tray and is threaded through the slot to feed the tractor assembly in the typewriter. The typewriter processes the paper and stacks it in the upper tray. The paper passes over a pressure-type switch, located on the handler, which halts printout when the paper has run out. Figure 2-6 shows the handler.

All that is really required to make the station operational is (1) ensure there is paper threaded, and (2) depress the ON/OFF rocker switch on the typewriter keyboard to the ON position.

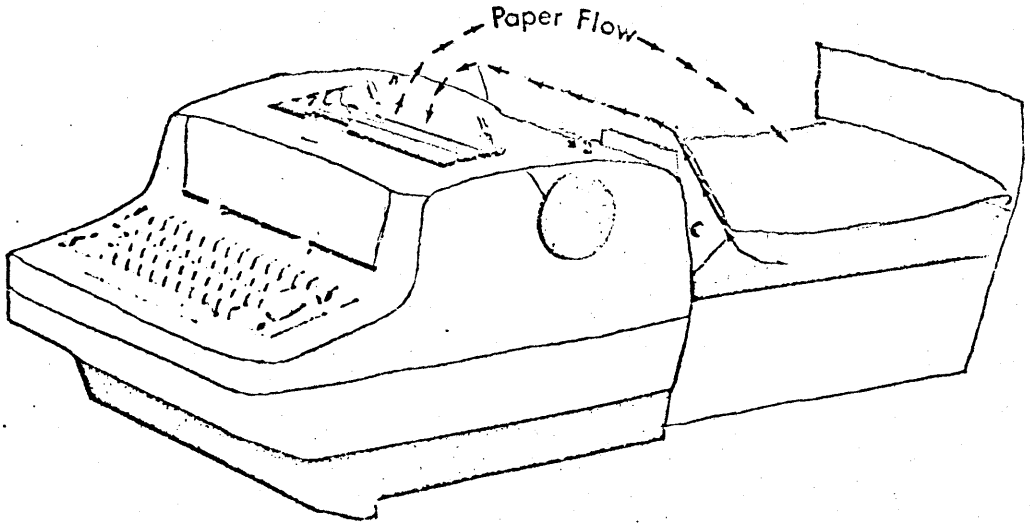


Figure 2-6. Paper Handler

SECTION III

PROGRAMMING

The 3290-4 (Edit) Multistation Terminal is designed for operation with the 3000 series of computers and associated data channels. Communications between the terminal Equipment Controller and data channel is via data cable and data is passed in parallel.

SIGNAL LINES.

Communications between controller and data channel consists of three types of signals: Command signals which are issued to the controller by the data source directing that certain operations be performed, Control signals which are issued by either data source or controller to each other that indicate that certain conditions exist or that certain operations have been performed, and Information signals which pass the actual data and the status of the terminal (figure 3-1).

COMMAND SIGNALS.

Command signals issued by the data channel to the terminal are: the Connect signal, Function signal, Data signal, Read signal, Write signal, Suppress Assembly/Disassembly signal, Negate BCD Conversion signal, and the Master Clear signal.

Connect Signal.

The Equipment Controller receives a Connect signal when the data source wishes the terminal to interpret the code on the Data Lines as a Connect Word. The controller connects only if power is on, parity

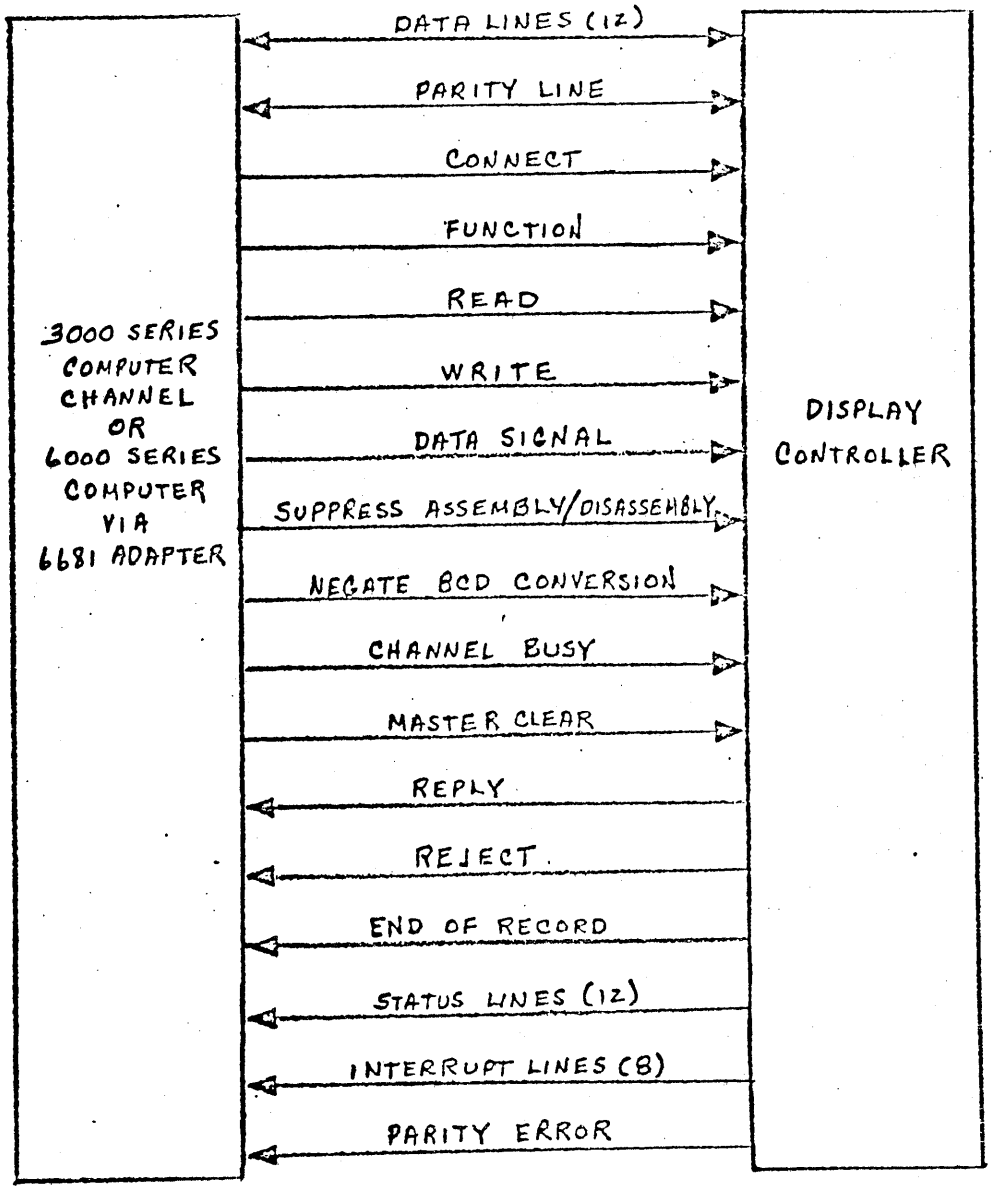


Figure 3-1. Communications Lines Between Data Channel and Terminal Equipment Controller.

is correct, and the most significant 3 bits (2^{11}, 2^{10}, and 2^{9}) of the connect code match the number setting of the EQUIP SELECT switch on the interface module. If a parity error exists on the connect code, the controller does not respond but the ERROR indicator on the controller external switch indicator panel lights on all Equipment Controllers

associated with that communications channel. After a delay of 100 microseconds, the data channel generates its own internal Reject signal.

Once a controller connects to the computer, it remains connected until the data source initiates a disconnect. A connect code with the upper 3 bits not matching the controller Equipment Select switch setting, a Master Clear signal, or a release function code performs a disconnect.

Function Signal.

The Function signal is a command by the data source for the controller to interpret the word on the Data Lines as a function code. If the controller is connected to the data channel and can execute the function at the time it receives the Function signal, it initiates the function and returns the Reply signal. If the controller cannot perform the function, it returns a Reject signal. The Function signal and 12 bit function word drop when a Reply or Reject signal returns. If a Reply or Reject signal does not return within a 100 microseconds, the computer generates it own internal reject. If parity error exists on the function code, the controller does not perform the function but returns a Parity Error signal and the ERROR indicator on the controller panel lights.

Once the controller accepts a function code, all other function codes are locked out until it acts on the first one. The controller does not stack up the function ocdes; it returns a Reply or Reject within 5 microseconds.

Read Signal.

The Equipment Controller interprets a Read signal as a command to begin reading data from a station memory.

Write Signal.

The Equipment Controller interprets a Write signal as a command to begin writing data in a specified station memory.

Data Signal.

The computer sends a Data signal to the controller for each 12-bit data word during read or write operations. When the controller transmits a Reply (or End Of Record) signal, the Data signal drops.

During a read operation, the Data signal indicates the computer is ready to accept a 12-bit data word from the controller. During a write operation, the Data signal indicates the computer has placed a 12-bit data word on the data lines.

Suppress Assembly/Disassembly Signal.

During a read operation, the Suppress Assembly/Disassembly signal forces the controller to assemble 0's in bits 6 through 11 of 12 bit byte. In a write operation, bits 6 through 11 are not used when the Suppress Assembly/Dissassembly signal is enabled. The signal has no effect on the address word during a read operation initiated by an interrupt.

Negate BCD Conversion Signal.

Information from the computer is in either internal or external binary coded decimal (BCD) form. When the data channel sends a Negate BCD Conversion signal to the controller, communication takes place using external BCD codes. When the Negate BCD Conversion signal drops, communication takes place using internal codes.

Master Clear Signal.

A Master Clear Signal sent from the computer returns the Equipment Controller to its initial condition and starts the polling operation if a poller is included.

CONTROL SIGNALS.

Control signals used between data channel and controller are: Channel Busy, Reply, Reject, End of Record, Interrupt, and Parity Error.

Channel Busy Signal.

The Equipment Controller receives a Channel Busy signal when the computer communications channel is active during a read or write operation.

Reply Signal.

The controller transmits a Reply signal in response to the following:

a) A connect code with no parity error when the equipment select code matches the number selected by the EQUIP SELECT switch, status is ready, and the controller is not busy. The station select code must reference an existing station except in response to an interrupt when the code may be 0000.

b) A function word with no parity error provided the controller can perform the specified function at the time it receives the Function signal.

c) A write operation after the controller samples the data lines in response to a Data signal.

d) A read operation when the controller has a word on the Data lines in response to a Data signal. The End of Record signal is an exception to this condition.

The Reply signal drops when the Connect, Function, and Data signals drop.

Reject Signal.

The controller transmits a Reject signal in response to the following:

a) A connect code (with no parity error) specifying a non-existent or busy station.

b) A function code (with no parity error) specifying an illegal function.

c) A function code (with no parity error) which coannot be performed within 5 microseconds after receipt of the Function signal.

d) An alert function to a poller that had its alert request status cleared.

End Of Record Signal.

The Equipment Controller transmits an End of Record signal (instead of a Reply signal) in response to the next Data signal following transmission of an end of message code or a local station status word. The End of Record signal drops when the Data signal drops. If the Read signal drops before the read operation completes, the controller does not transmit the End of Record signal.

Interrupt Signal.

Each Equipment Controller attached to a given data channel is assigned to one of eight separate interrupt lines selected by the equipment select switch. The Interrupt signal indicates to the computer that a predetermined condition has been reached. The interrupting condition can be determined by a program sampling the status lines following

transmission of an Interrupt signal if the controller is connected. The interrupt drops upon receipt of a master clear, select function code, release function code, or clear function code for that particular interrupt.

Parity Error Signal.

The controller transmits a Parity Error signal when a parity error exists on a function code or a write operation. A Parity Error signal is not generated for a parity error occurring on a connect code or a read operation. During a write operation, a parity error on one word of a 12-bit byte results in display of both words as parity error symbols when the Suppres Assembly/Disassembly signal is disabled.

INFORMATION SIGNALS.

Information signals exchanged between computer and terminal are; data signals passed in parallel over twelve lines, the parity bit signal accompanying each data word, and the status signals, passed in parallel over 12 lines.

Data Lines.

During a read operation (input to the computer), the 12 data lines carry data, 12 bits at a time, from the controller to the computer. During a write operation (output from the computer), the lines carry data from the computer to the controller. The data lines also transmit 12-bit connect and function codes associated with Connect and Function signals.

Parity Bit Signal.

A parity bit accompanies each 12 bits of data, connect code, and function code transmitted between the computer and the controller. Odd parity is used, i.e., the total number of 1's transmitted is always an odd number.

Status Signal Lines.

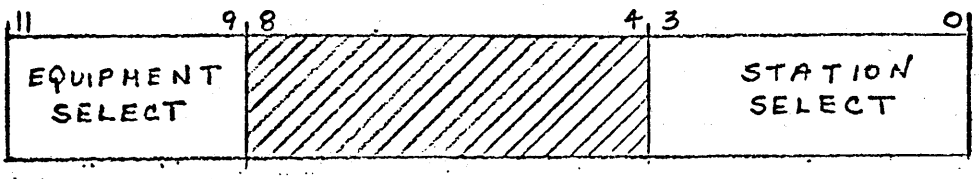
Following a connect operation, the controller places information on the status lines to indicate its operating conditions to the computer. Display subsystem status remains enabled to the ocmputer until the controller is disconnected. The computer may sample the status lines at any time.

COMMAND AND CONTROL CODES.

Controller command and control codes include connect, function, and status codes. The connect code is used in addressing the display subsystem. Function codes, with the exception of reset, reset clear, alert, read station status, and release, set up and remove interrupt conditions in the controller. Status codes indicate the conditions existing at the Equipment Controller. Following is a description of the connect code, function code, and status line assignments.

CONNECT CODE.

The computer transmits the connect code to the controller over the 12 data lines along with a connect signal. The controller interprets the connect code as follows:



Bits 9 through 11 designate the number setting of the controller equipment selector switch. The station select portion of the connect code allows selection of a station connection to a station that caused an interrupt. Bits 4 through 8 are not interpreted.

FUNCTION CODES.

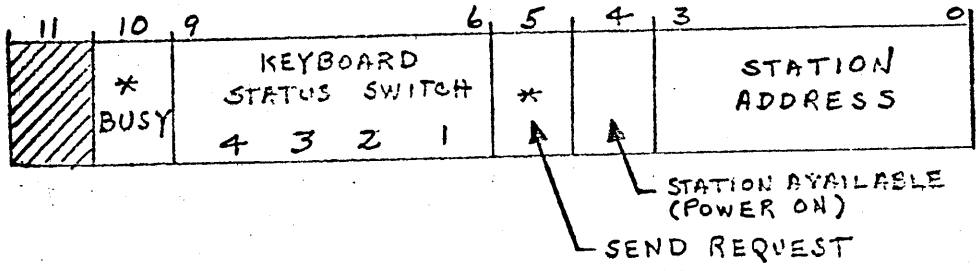
The data source transmits the 12 bit function code over the 12 data lines along with a Function signal on the function line. Table 3-1 lists and describes the controller function codes.

Table 3-1. Controller Function Codes.

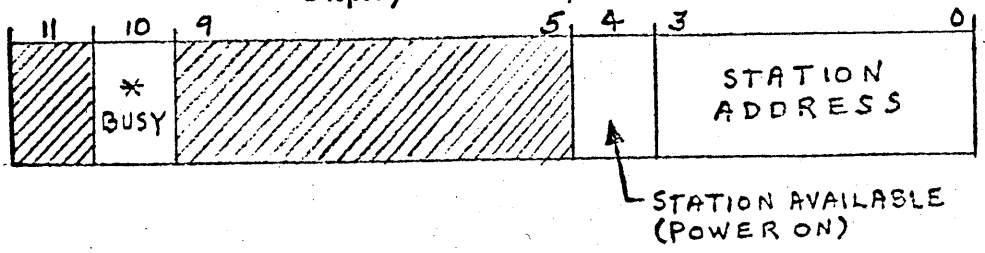
CODE	TITLE	OPERATION
0000	Release	Disconnects the subsystem from the channel, clears all interrupt selections, and clears the Parity Error signal.
0010	Reset	Positions the entry marker on the selected Display Station to the first symbol position of the page. The Display Station indicates busy status for 20 to 40 milliseconds after receipt of the function.
0011	Reset-Clear	Positions the entry marker on the selected Display Station to the first symbol position of the page and clears the memory of the selected Display or

Table 3-1. Controller Function Codes (Cont).

CODE	TITLE	OPERATION
		Typewriter Station. The station indicates busy status for 20 to 40 milliseconds.
0012	Clear Send Request	Clears the send request causing the present station interrupt, but allows the station keyboard to remain locked out and the send request status to remain active until that station has been read by the computer.
0013		Reserved.
0014		Reserved.
0015	Read Station Status	Allows a one-word read (without resetting the selected station's entry marker) to check station status and the keyboard status switches. Response words to 0015 are in the following format. A release function or End of Record signal after the one-word read clears the 0015 function.



Display Station Response



Typewriter Station Response

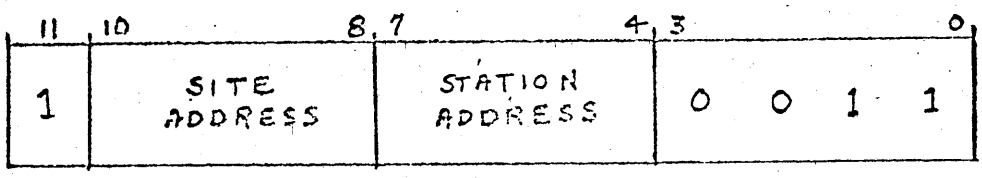
* Indicated in controller status bits.

Table 3-1. Controller Function Codes (Cont).

CODE	TITLE	OPERATION
0020	Enable Interrupt for Ready and Not Busy	Allows generation of an interrupt when a typewriter operation is complete. Reselection removes a previous interrupt.
0021	Clear Interrupt for Ready and Not Busy	Removes the 0020 interrupt and enable.
0022	Enable Interrupt on End of Operation	Allows generation of an interrupt when a read, write, or a reset or reset-clear operation is complete by the selected station. Reselection removes the previous interrupt and enable.
0023	Clear Interrupt on End of Operation	Removes the 0022 interrupt and enable.
0024	Enable Alert Interrupt	Enables generation of an interrupt upon completion of an alert message by a poller. Reselection removes the previous interrupt and enable.
0025	Clear Alert Interrupt	Removes the 0024 interrupt and enable.
0026	Enable Station Interrupt	Enables generation of an interrupt if a SEND key at a local Display Station is depressed or a Typewriter Station has completed a computer-initiated printout. Reselection removes an interrupt resulting from a previous selection if a read or write operation was performed on the interrupting station prior to reselection. Function 0012 removes the interrupt condition on the selected station. Stacking of station interrupts is possible. If more than one station has a SEND key depressed, another interrupt occurs immediately after reselection.

Table 3-1. Controller Function Codes (Cont).

CODE	TITLE	OPERATION
0027	Clear Station Interrupt	Removes 0026 interrupt and enable.
1XXXXXXX0011 (Binary)	Alert	Sends an Alert signal to the connected station. If the connected station is a poller, bits 4 through 7 indicate the remote station and bits 8 through 10 indicate the remote site to be alerted. If not a poller, bits 4 through 10 are ignored.



Alert Code Format

STATUS CODES.

Twelve status lines indicate subsystem operating conditions to the computer. The computer may sample these lines at any time. Table 3-2 identifies status conditions, lines, and octal code characteristics of the Equipment Controller. The computer may sample any single staus line or group of lines.

All conditions listed in table 3-2 except send request and print request are general status conditions, i.e., the computer connects only to the controller and any existing station before sampling status. Lines 0, 2, 3, 4, 5, and 10 are on a per station basis, i.e., a specific station must be addressed before sampling status.

Table 3-2. Controller Status Conditions.

STATUS LINE	OCTAL CODE	CONDITION	OPERATION
0	XXX1	Ready	Power on in the controller indicates ready status. Ready status also is indicated when the selected station exists and is not performing a print operation.
1	XXX2	Busy	The controller indicates busy status for the following conditions: 1) Channel Busy and Write signals are enabled. 2) Channel Busy and Read signals are enabled. 3) During a reset function. 4) During a reset-clear function. 5) When the connected station is busy.
2	XXX4	Send Request	Indicates the SEND key has been depressed at a Display Station. Also indicates a Typewriter Station has completed a computer-initiated printout or cannot initiate a printout because that station has gone not ready after write message receipt but before printout initiation.
3	XX1X	Print Request	Indicates the PRINT key was actuated at the connected Display Station and data transfer is not complete.
4	XX2X	Poll Message Error	Indicates the connected poller has been unable to receive an expected response to a poll message in three tries.
5	XX4X	Alert Request	Indicates the connected poller is ready to process an alert function from the channel and that the previous alert has been processed.

Table 3-2. Controller Status Conditions (Cont).

STATUS LINE	OCTAL CODE	CONDITION	OPERATION
6	X1XX	Station Interrupt	Indicates a station interrupt is present due to actuation of one or more SEND keys at Display Stations. Also indicates that a Typewriter Station has completed a computer-initiated printout or cannot initiate a printout because that station has gone not ready after write message receipt, but before printout initiation.
7	X2XX	Ready and not Busy Interrupt	Indicates completion of printout from any Typewriter Station (not necessarily connected).
8	X4XX	End of Operation	Indicates generation of an interrupt by the end of a read or write operation or 1 millisecond before the end of the reset or reset-clear operation at any Display Station or a reset-clear operation at a Typewriter Station.
9	1XXX	Alert Interrupt	Indicates generation of an interrupt by a poller on completion of an alert message.
10	2XXX	Poller Error	Indicates an error condition exists after three attempts to write to or alert a remote site are unsuccessful.
11			Not used (for multichannel equipment).

COMMUNICATIONS SEQUENCES.

Previous enables and existing conditions determine display subsystem and computer reaction to requested operations. To perform a desired operation, interrupts, connects and functions must be transmitted in a designated sequence.

INTERRUPTS.

Interrupts permit the display subsystem to indicate to the computer certain preprogrammed conditions. The computer can selectively activate or deactivate these interrupt conditions. Four conditions generate an interrupt and four function codes enable these interrupts to the computer. Table 3-3 lists the interrupt conditions and the enabling and disabling functions. Refer to the specific enabling function code (table 3-1) for a complete description of the interrupt conditions.

Table 3-3. Controller Interrupts.

NAME	FUNCTION CODE ENABLE	DISABLE
Ready and Not Busy Interrupt	0020	0021
End of Operation Interrupt	0022	0023
Alert Interrupt	0024	0023
Station Interrupt	0026	0027

The computer must connect to a specific station before issuing any interrupt enable function codes. Normally, it checks controller status immediately following the connect. To perform a reset operation (function code 010) or a read or write operation and be informed when the operation is complete, the computer transmits function code 022 (interrupt on end of operation) prior to the operation.

The display subsystem sends the end of operation interrupt a maximum of 33 microseconds after the read or write line disables if the interrupt is selected previous to a read or write opera tion. Until the read or write operation is complete, the display subsystem is

busy and status line 1 is enabled. Following a reset or reset-clear function, the subsystem is busy until the reset or reset-clear function is complete. When the function is complete, the subsytem becomes not busy. The Display or Typewriter Station sends the end of operation interrupt 1 millisecond before the reset or reset-clear is complete. If a read or write operation follows a reset operation , an additional 1 to 20 millisecond delay (after sending the end of operation interrupt) occurs before memory accepts the first word of data.

An end of print operation can interrupt the computer if the ready and not busy interrupt is enabled. After connecting to a specific station and finding the station busy executing a printout, the computer has the option of discontinuing the printout or selecting the interrupt on ready and not busy condition (function code 020). Although the function code is directed to a specific station, it enables a station interrupt from any station satisfying the ready and not busy condition.

The computer transmits function code 0026 (station interrupt enable) to receive data from a Display Station. Actuating the SEND key on this station, or any other Display Station, transmits an interrupt.

Upon receiving an interrupt from the display subsystem, the computer normally connects to the Equipment Controller and samples status to determine what caused the interrupt. It can immediately perform a read operation following a connect word having a station address of 0000 if the interrupt is a station interrupt. A write

operation or other interrupt requires connecting to a specific station before beginning the operation. After servicing an interrupt, reselecting or deselecting the same interrupt (except station interrupt) clears the interrupt line.

CONNECT SEQUENCE.

The connect word contains information which directs the controller to connect the data channel to the designated Display or Typewriter Station. Bits 9 through 11, the equipment select code, designate the equipment number which may be chosen on the EQUIP SELECT switch. Bits 0 through 3 (the station address code) select the specific Display or Typewriter Station with which the computer is to communicate. A station address of 0001 through 1100 binary designates one of the twelve correspondingly numbered Display or Typewriter Stations. A station address of 0000 binary indicates that the computer requests a check of status conditions or requests to communicate with the station causing an interrupt. Absence of an interrupt prevents station connection.

Figure 3-2 shows the sequence of events upon receipt of a Connect signal. If the Equipment Controller is in a ready state, it checks parity on the Connect signal. A parity error at this time illuminates the ERROR indicator and the controller disconnects. Assuming parity is correct, the equipment select switch setting is compared to the equipment select code. If they are not equal, a disconnect is performed in about 1 micrsecond, An exact comparison enables the status

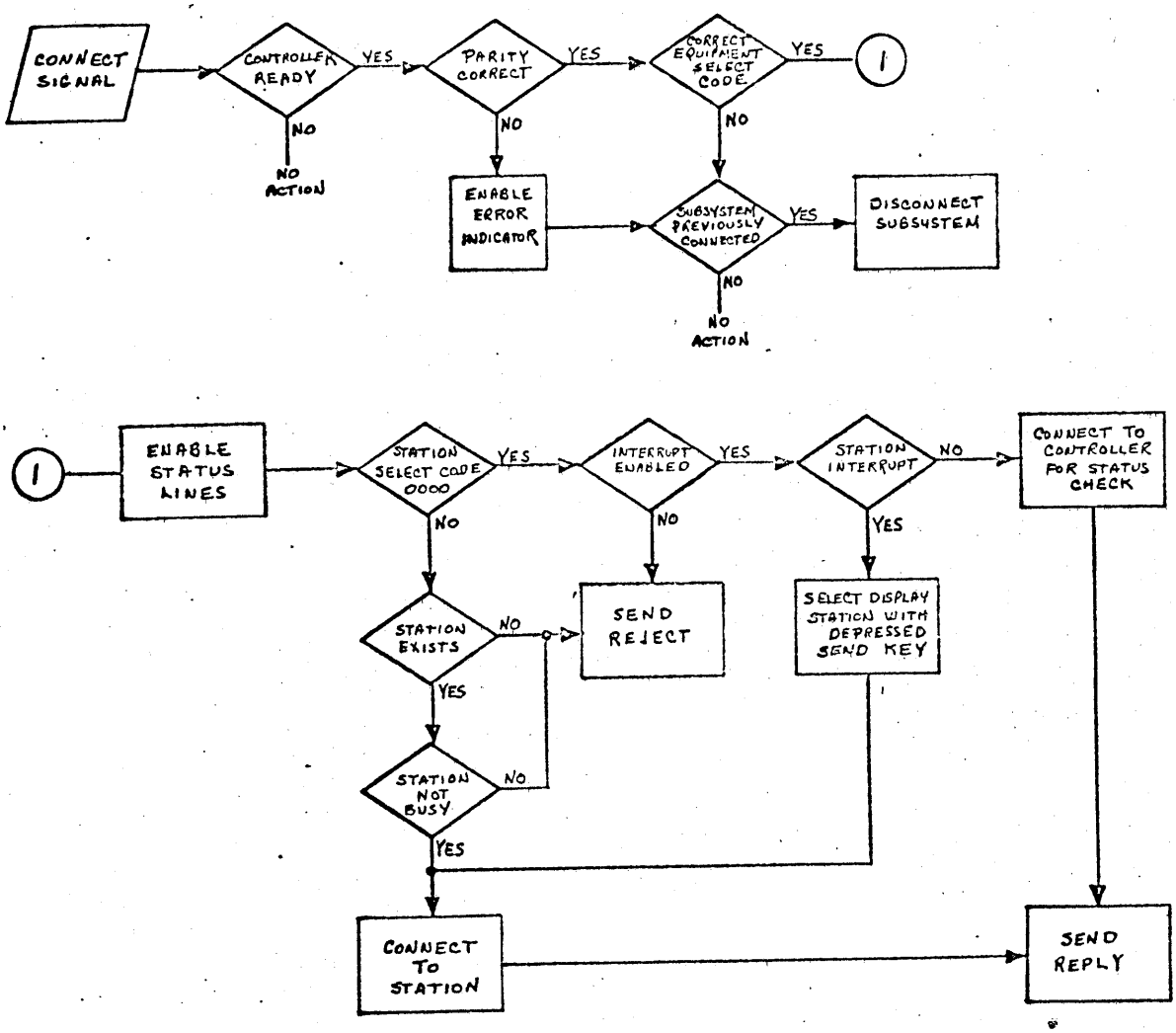


Figure 3-2. Connect Sequence.

lines. After comparing the equipment select code, the controller examines the station address code for the address of an existing Display or Typewriter Station. If the station is non-existent or busy, after 2 microseconds the controller sends a Reject signal to the computer. If the Display or Typewriter Station exists and is not busy, the controller

responds with a Reply signal in approximately 2 microseconds.

When the station address portion of the connect word contains all 0's and a station interrupt is not pending, the controller returns a Reject signal to the data source. If, however, a station interrupt does exist, the controller responds with a Reply signal and the interrupting station connects. The computer then reads at least the station word and normally continues reading all of the station's data. If a ready and not busy, alert, or end of operation interrupt exists, the computer connects to the Equipment Controller for reading controller status only---no read or write operation is performed.

FUNCTION SEQUENCE.

Once connected, the Equipment Controller is ready to perform any function requested by the computer in addition to a read or write operation. Figure 3-3 shows the sequence of events upon receipt of a Function signal.

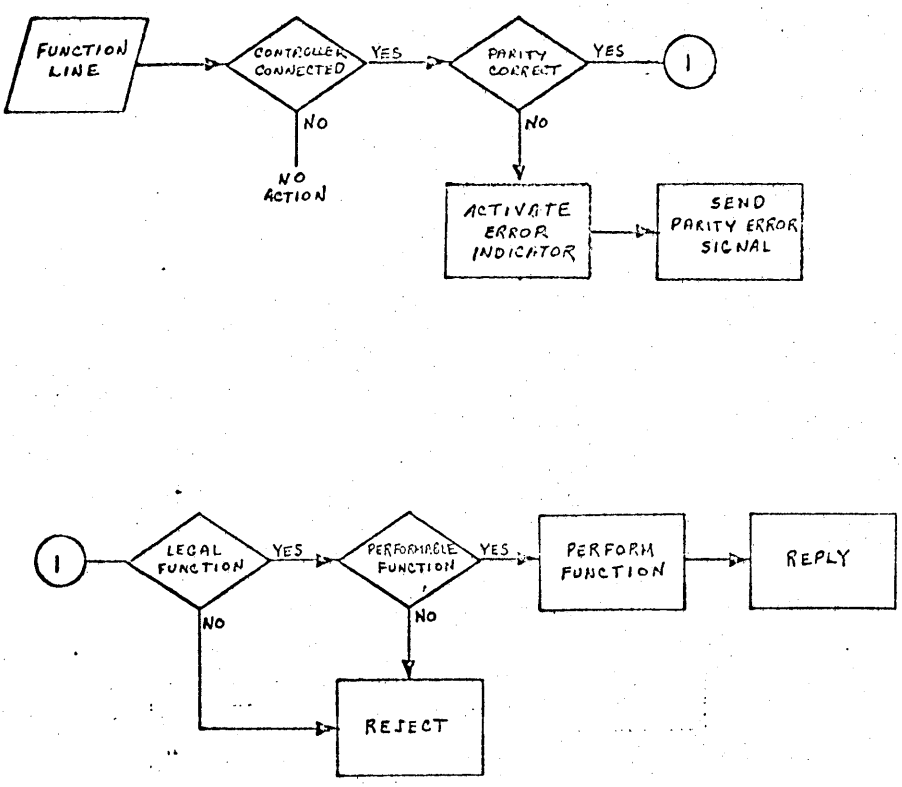


Figure 3-3. Function Sequence

READ/WRITE OPERATIONS.

Read or write operations to or from a local Display Station may be performed any time at computer discretion after checking status. The computer-initiated action takes priority over the operation. Initiation of a read or write operation during operator keyboard message composition locks out the keyboard and computer operation takes over. A read or write operation to a Display Station performing a printout results in printout termination and performance of the read or write operation at the specified Display Station.

The Equipment Controller allows the computer to enable an interrupt on an end or print condition. Following connection to a specific station and status sampling, the controller enables print request status (line 3) if the station requests a print operation. Not ready status indicates that the station has a print request active. Using function code 020 octal, the computer may enable the select interrupt on ready and not busy condition. Upon completion of printout, the controller sends an interrupt to the computer and activates status line 7 (ready and not busy interrupt). The 020 function code enables interrupt generation when any Typewriter Station completes printout.

SEND key actuation or programmed instructions from the computer initiate read operations. Only the computer initiates write operations. A description of read and write operations follows.

Read Initiated by a Requesting Station.

The definition of a requesting station is a Display Station at which a SEND key has been depressed or a Typewriter Station which has completed a data source initiated printout. The requesting Display Station inserts the end of message symbol (Δ) at the entry marker position and moves the entry marker to the upper left corner or to the STX symbol (▬). The requesting Typewriter Station generates an E3 code. If the computer has enabled function code 026, it receives a station interrupt. The computer responds to the interrupt with a connect code containing a station address of 0000 binary. The controller then connects to the requesting station in scanning sequence, and

activates the status lines (this could take up to 30 usec.). The computer must initiate a read operation to clear the send request status. If the computer does not perform a read operation, it receives the station interrupt again upon the next station interrupt enable.

The Equipment Controller sends the station word containing the number of the scanner selected requesting station in response to the first Data signal during a station interrupt-initiated read operation. Successive words after the station word contain data stored in the delay line starting at the entry marker position.

The computer receives the end of message code in a data word. If the end of message code is in the upper half of the 12-bit data word, the lower half of the word contains all zeros. In response to the next Data signal following an end of message code, the controller sends an End-of-Record signal accompanied by an all zero data word instead of the Reply signal. The read operation terminates when the Read signal disables for more than 2 microseconds. Data may be read, therefore, beyond the end of message code if the Read signal remains enabled.

Figure 3-4. Simplified Read Timing.

Read Initiated by a Computer.

The computer may initiate a read operation at any time the connected local Dispaly Station is not busy. Discretion is required in the use of this operation since it prevents entry of data by a Display Station operator. After connecting, the entry marker may be moved to the upper left corner by the reset function or may be left at its current position. In response to the Read and Data signals, the controller sends data words along with the Reply signal. The controller does not send the station word in response to a read operation after a connect to a specific station.

Write to a Display Station.

Data may be sent to a connected Display Station at any time the station is not busy. After connecting and checking status, the computer sends data words to be written on the crt starting at the entry marker. A reset or reset-clear function may move the entry marker to the upper left corner before data writing begins. Sequential symbols in data words appear from left to right and from top to bottom on the crt. After the last symbol is written in the lower right corner, the entry marker moves to the upper left corner and data writing may continue with the later data replacing data written earlier. Figure 3-5 shows simplified write operation timing.

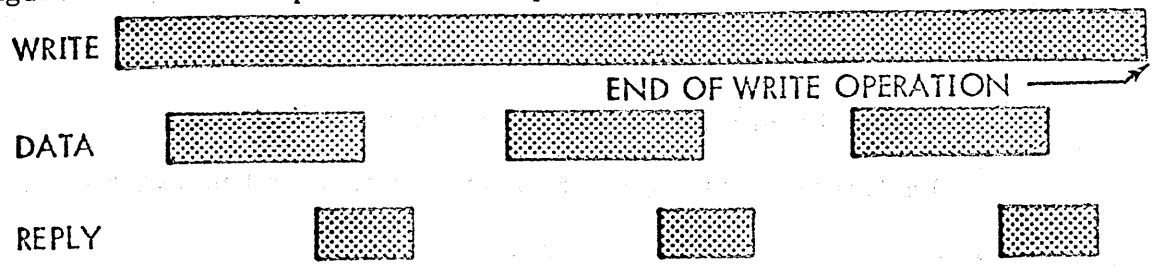


Figure 3-5. Simplified Write Timing.

Write Operation to a Typewriter.

A write message to a Typewriter Station must end with an end of print code (E2). The write should be preceded by a reset clear function to clear any data that may be in the typewriter memory. The write message should not be more than one display page of data or data is written over and the original data is lost. Upon receipt of the E2 code and dropping of the write line, printout begins and the station becomes busy. At printout completion, the station sends a ready and not busy interrupt or a station interrupt if the computer has enabled the respective interrupt. The station interrupt read message contains the station word plus an E3 code. If the read line does not drop after the E3 code, spaces are received in the data words. A parity error during the write prevents printout and sending of a station interrupt.

DATA TRANSFER.

The controller sends and receives data on the data lines in 12-bit bytes 6-bit codes in the format shown in figure 3-6.

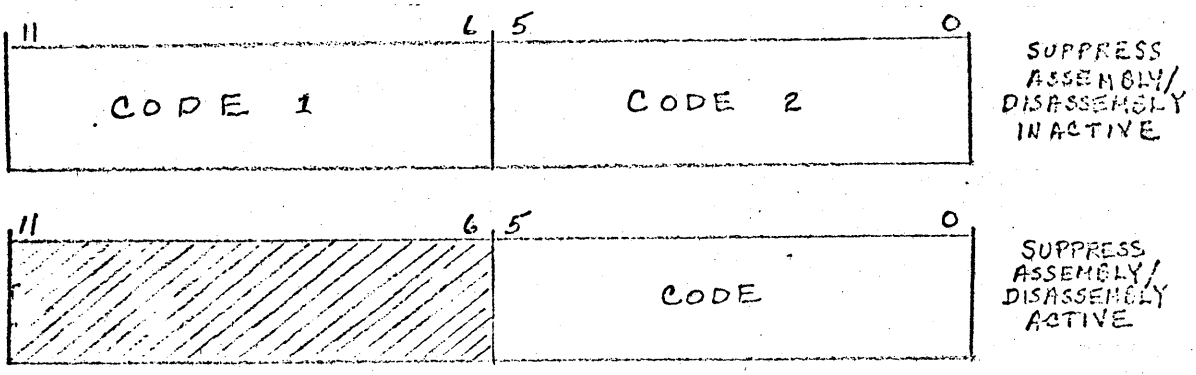


Figure 3-6. Data Word Format.

The input/output register in the controller handles packing

and unpacking chores for read and write operations. The most significant 6 bits of the data are always filled or emptied first. This means that the upper register is always first to fill or empty. If the computer enables the Suppress Assembly/Disassembly line, the upper register is disabled or locked out of the operation for the duration of the signal. The lower register, which handles the least significant 6 bits, is unaffected; therefore, data transmission takes place in the form of one 6-bit word at a time.

Each 6 bits may contain one symbol code. Symbols display from left to right as they are received. Delay-line memory characteristics limit the data transfer rate to 25,000 12 bit words per second if the Suppress Assembly/Disassembly signal is inactive or to 50,000 6-bit words per second if the Suppress Assembly/Disassembly signal is active.

The time required for symbol transfer by the memory is 16.8 microseconds. Memory cycle time is 20 milliseconds. During a read or write operation, successive data bytes must follow within 33.6 microseconds if the Suppress Assembly/Disassembly signal is inactive or 16.8 microseconds if the Suppress Assembly/Disassembly signal is active. If successive data bytes do not follow within the specified time, a 20 millisecond delay occurs between bytes due to delay-line latency characteristics.

SYMBOL CODES.

Codes 040 through 137 enable the 62 symbols, space and escape. Table 3-4 lists the external and internal BCD codes for the symbol

repertoire. Although controller internal circuitry uses 7 bits, the 2^6 bit drops at the interface. Incoming and outgoing data, therefore, is in the form of 6-bit codes.

Table 3-4. Symbol Repertoire.

CODE		SYMBOL DISPLAYED OR PRINTED	CODE		SYMBOL DISPLAYED OR PRINTED
EXTERNAL	INTERNAL		EXTERNAL	INTERNAL	
40	40	- (minus)	00	12	: (colon)
41	41	J	01	01	1
42	42	K	02	02	2
43	43	L	03	03	3
44	44	M	04	04	4
45	45	N	05	05	5
46	46	O	06	06	6
47	47	P	07	07	7
50	50	Q	10	10	8
51	51	R	11	11	9
52	52	V (logical OR)	12	00	ø
53	53	$ (dollar sign)	13	13	= (equal)
54	54	* (asterisk)	14	14	≠ (not equal to)
55	55	↑	15	15	≤ (less than or equal to)
56	56	↓	16	16	% (per cent)
57	57	> (greater than)	17	17	[(left bracket)
60	20	+ (plus sign)	20	60	SPACE
61	21	A	21	61	/ (diagonal)
62	22	B	22	62	S
63	23	C	23	63	T
64	24	D	24	64	U
65	25	E	25	65	V
66	26	F	26	66	W
67	27	G	27	67	X
70	30	H	30	70	Y
71	31	I	31	71	Z
72	32	< (less than)	32	72	] (right bracket)
73	33	. (period)	33	73	, (comma)
74	34	) (right parenthesis)	34	74	((left parenthesis)
75	35	≥ (greater than or equal to)	35	75	↦
76	36	ESCAPE to control	36	76	≡ (identical to)
77	37	; (semicolon)	37	77	∧ (logical AND)

STATION CONTROL CODES.

Station control codes are in the same octal group (040 through 137) as the symbol repertoire.

As in symbol codes, the 2^6 bit drops at the interface when code origination is by the display subsystem. To designate a station control function, the code must be preceded by an escape code. The single code following the escape code initiates the function defined in table 3-5. Escape codes are hardware generated when a station initiates the function. When a standard Display Station receives a station control code representing an edit Display station function, the code is converted to an overlined symbol or space. A Typewriter Station can detect only E codes and carriage return from the station control subset.

Table 3-5. Station Control Codes.

OCTAL CODE EXT	OCTAL CODE INT	CODE NAME	DISPLAYED	FUNCTION
40	40	E2	'	Can be inserted by Display Station PRINT key. Code denotes a message to a Typewriter Station or, when in response to a write message for printing, indicates the Typewriter Station became not ready after message receipt but before printout initiation.
41	41	E3	%	Code generated by a Typewriter Station upon completion of a printout.
42	42	STX	▭'	Denotes start of text. A displayed message containing an STX symbol transmits starting at the STX and ending at the E code. (see further explanation at end of table.)
60	20	F0	0	
61	21	F1	1	
62	22	F2	2	
63	23	F3	3	
64	24	F4	4	Determined by software application
65	25	F5	5	
66	26	F6	6	
67	27	F7	7	
70	30	F8	8	
71	31	F9	9	
00	12	Backspace		Moves the entry marker back one space.
01	01	Carriage return	-	Enters a carriage return symbol at the entry marker position, erases unprotected data on the line to the right of the symbol, and moves

Table 3-5. Station Control Codes (cont).

OCTAL CODE EXT	OCTAL CODE INT	CODE NAME	DISPLAYED	FUNCTION
				the entry marker to the first symbol position of the next line.
02	02	E1	Δ	Can be inserted by Display Station SEND key or computer. Signifies the end of a display message on message segment.
21	61	Tab		Advances the entry marker one symbol position beyond the next end tab symbol or to the beginning of page if no end tab symbol is present.
22	62	Line Skip		Moves the entry marker to the first symbol position of the next line or from the last line to the first position of the first line.
23	63	Selective Clear		Clears all unprotected display areas and resets the entry marker.
24	64	Line Clear		Clears all unprotected data from the entry marker position to the end of the same line.
25	65	Tab Protect		Inhibits the computer from entering or reading data from a protected area.
30	70	Start Blink		Can be inserted only by the computer. Enables all symbols from the start blink code to the end of line or next space code to blink at a rate of approximately 2 hertz.
31	71	Skip		Advances the entry marker one symbol position.
32	72	Reset		Moves the entry marker to the first symbol position of the first line.

Table 3-5. Station Control Codes (cont).

OCTAL CODE EXT	OCTAL CODE INT	CODE NAME	DISPLAYED	FUNCTION
35	75	Tab Access		Enables the computer to read from or write into protected areas.
36	76	End Tab	⊓	Can be inserted by Display Station operator or computer. Sets an end tab position for the TAB key function. It also denotes the right margin of a protected area.
37	77	Start Tab	$\overline{\sqcap}$	Can be inserted only by the computer. Denotes the left margin of a protected area.

The STX code defines the point at which a read message from a Display Station begins and may be entered from the keyboard or by write messages from the computer for a conversational mode of operation. Since only one STX symbol may be present on the display at a time, the Display Station memory must be searched for an existing STX code each time a new one is received. Due to the latency characteristics of the delay line, this takes up to 40 milliseconds. An STX code received in a write message stores as a reserved code (134_8) until the write message is complete. Dropping the Write line initiates the search. Any previous STX code is erased and upon detection, the reserve code is changed to an STX code. On operator-initiated messages, if an STX code is present, depression of the SEND key resets the entry marker to the STX code. The computer reads data from and including the STX code until the Read line drops for more than 200 nanoseconds. The computer may output multiple choice selections, one of which the operator is to select. Each selection contains an E1 code. The operator may then make this selection, enter an STX code, and the depress the SEND key. Depressing the SEND key immediately following an STX code enables the send request but inhibits storing an E1 code. The E1 code stores when detected in any other position.

POLLER.

Thus far in this manual and in this section, the discussion has centered on the use of a multistation terminal working through a 3000 interface with a local data source or channel. However, this system may also be adapted for expanded use that allows other multistation terminals, remotely located with respect to the data source, to make use of the local equipments for communication and data processing. This added feature is possible with the installation and use of the Buffer Data Set Adapter Kit (poller) listed in the appendix as a system option. In addition, through the use of this particular poller, data source communications through the local 3000 interface may be broadened to included remote sites that use the United States of America Standard Code for Information Interchange (USASCII) coding as well as those using external binary coded decimal (External BCD) coding. Present poller design requires that all remote sites connected to the same poller use the same coding format.

The poller is installed in place of any station driver module. Once installed, the computer interface treats the poller as a local station driver module of low priority. For each poller added to the terminal, eight remote sites can be added to the system to increase its use. Although each poller can accommodate 16 remote sites, the 3000 data channel can address only eight sites (0-7) as determined by the three data bits assigned for the purpose of site addressing.

Poller communication with a remote site operates through most modems conforming to EIA Standard RS232-B using synchronous data rates not to exceed 2400 baud. Operation is 2-wire or 4-wire half duplex. Half duplex permits non-simultaneous transmission and reception, with the 4-wire mode providing a reduction in turn around time. For particulars on the installation, operation and maintenance of the poller, consult the Buffer Data Set Adapter Kit Hardware Reference/Customer Engineering Manual listed in the appendix.

INTERFACE SIGNALS.

Figure 3-7 shows interface signals between the modem and the poller. The arrows indicate signal origin.

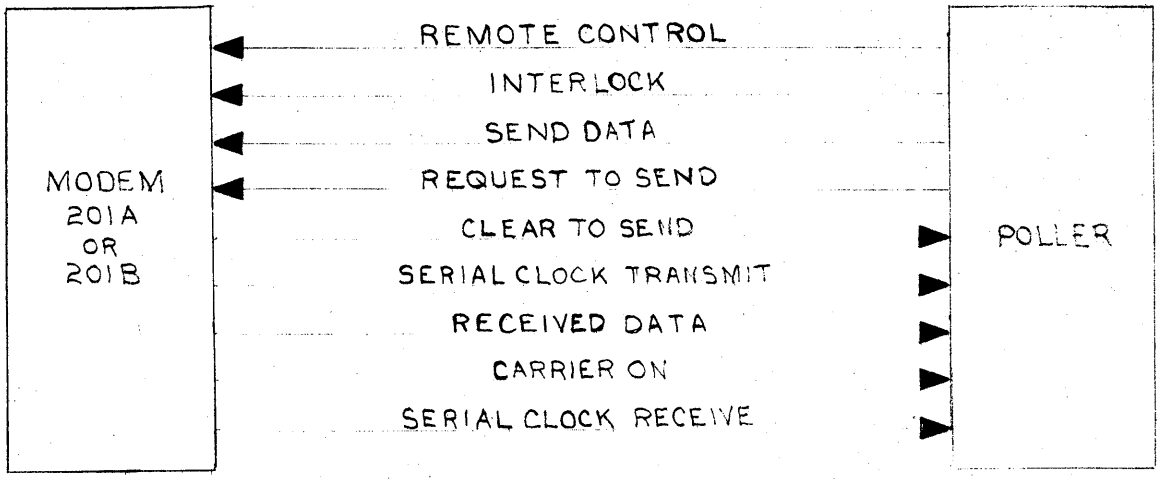


Figure 3-7. Poller Interface Signals

Poller/modem interface signals shown in Figure 3-7 are described in the following paragraphs.

Interlock.

Interlock is positive when power is applied to the poller.

Send Data.

Serial data to be sent from the poller to a remote site is placed on the Send Data line. Data bits are sent to the modem at or about the time of the positive transition of the Serial Clock Transmit signal.

Request to Send.

Request to send becomes positive when the poller desires to transmit to the modem. Dropping the Request to Send signal returns the modem to the receive condition.

Clear to Send.

Signal Clear to Send is made positive by the modem in response to a Request to Send signal from the poller. The time required to produce a Clear to Send after the Request to Send signal is sent depends on the type of modem and the number of phone lines used. Clear to Send is made negative when the modem's Request to Send signal drops.

Serial Clock Transmit.

Serial Clock Transmit is a symmetrical square wave sent by the poller to synchronize the modem for data reception. Data is placed on the Send Data line at or about the time of the positive transition of the Serial Clock Transmit signal and is sampled at the time of negative transition.

Received Data.

Received Data contains serial binary data which is synchronized with the Serial Clock Receive signal.

Carrier On.

A positive potential at the Carrier On terminal indicates that the carrier is being received by the modem. A negative potential indicates that no carrier is being received. Carrier On changes from negative to positive within 9 milliseconds after the carrier appears at the receiver terminal.

Serial Clock Receive.

Serial Clock Receive is a symmetrical square wave synchronized with the receiver timing circuits. Data bits on the Received Data line are sent to the poller on the positive transition of the Serial Clock Receive signal and are sampled by the poller at or near the negative transition.

Remote Control.

A positive potential on the Remote Control line indicates that the poller is ready to communicate with the modem.

DATA SOURCE COMMUNICATIONS.

Data Source communications with any poller are carried out similar to communications with any station within the controller cabinet. Any differences will be discussed in the pages that follow.

CONNECT.

The poller has a STATION ADDRESS switch as do all the stations located in the local controller. When connecting directly to the poller from the computer, the lower four bits of the connect word must contain the address code of the poller. See Figure 3-8.

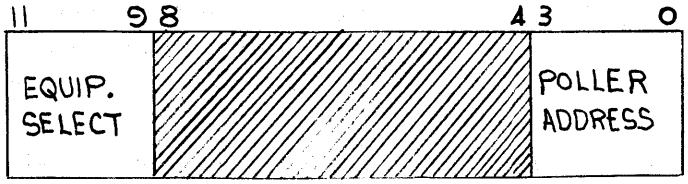


Figure 3-8. Connect Word

During computer response to a station interrupt, the computer may connect to station = 00. If the poller caused the interrupt, it is connected when the computer reads more than one word (12-bits) after connecting to station =00.

FUNCTION CODES.

Codes listed in table 3-6 cause specific action by the poller.

TABLE 3-6. FUNCTION CODES

OCTAL CODE	TITLE	OPERATION
0000	Release	Removes the condition which caused the Alert Interrupt and clears the Poll Message Error status and Poller Error status. It also allows the poller to give an indication of a new error.
0010	Reset Entry Marker	Issued before the computer writes data to a poller in response to a station interrupt indicating a read message from a remote site or in response to a multiple write station and end of operation interrupt to direct the poller to transmit a Reset Write Message.
0011	Reset Clear	Issued under the same circumstance as the Reset Entry Marker function to direct the poller to transmit a Clear Write message.
0012	Clear Send Request	Used in the same manner as with a local station.

TABLE 3-6. FUNCTION CODES (CONT)

OCTAL CODE	TITLE	OPERATION
0015	Read Station Status	Used in the same manner as with a local station WITH THE EXCEPTION THAT when the poller receives a Read Message and gives a station interrupt, or gives an alert interrupt to indicate some error condition, bits 06-09 of the station status word contain the site address of the remote site communicating with the poller at the time of the interrupt. See Figure 3-9.
1XXXXXXX0011 (Binary)	Alert	Allows the computer to initiate special messages to a specific remote site and station. This function can be issued any time Alert Request status is present. To achieve this operation, the computer must issue two consecutive alert functions. Figure 3-10 shows the format of the first function code which contains the alert function. Figure 3-11 shows the format of the second function code which contains the site and station address. Receipt of the second alert function causes the Alert Request status to become inactive until the remote site responds to the special message or until the poller encounters three errors in processing the special messages.
0024	Enable Alert Interrupt	Enables error processing (in this equipment configuration, the Alert Interrupt is used to indicate an error condition in the POLLER). When an Alert Interrupt is received by the computer, one of the Poller Error status lines is active. A release function (000) should be used to clear the condition that caused the alert interrupt.
0025	Clear Alert Interrupt	Removes the interrupt and enable at the interface.

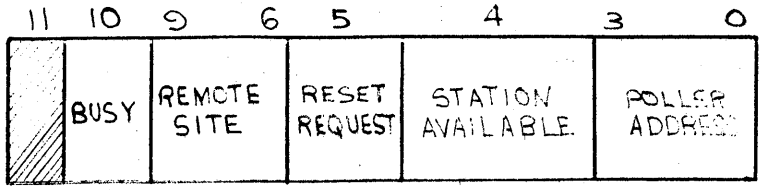
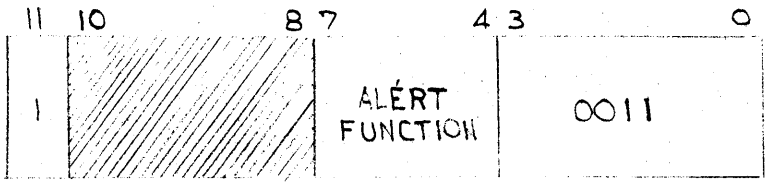


Figure 3-9. Station Status Word



ALERT FUNCTION

00 = Status Request

01 = Diagnostic Write

02 = Alert

03 = Station Poll

04 = Multiple Output

05 = Clear Multiple Output

Figure 3-10. Alert Function No. 1

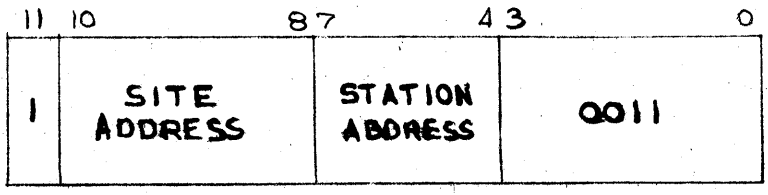


Figure 3-11. Alert Function No. 2

ALERT FUNCTIONS.

All Read and Write data transfers to and from the poller by either the data source or the remote sites are started by the poller. Data Source communication requests to the poller take two forms. First, is the non-Read/Write communication (Alert Function) and, second, is the normal Read/Write communication. Remote site communication requests to the poller use only the normal Read/Write sequence. A remote site may respond to an alert message from the poller, but it cannot send an alert request to the poller.

Data source alert functions instruct the poller to send certain types of messages to the site and station specified in the alert function. These alert functions and their codes are in Table 3-7.

TABLE 3-7. ALERT FUNCTIONS

OCTAL CODE	ALERT FUNCTION
00	Status Request
01	Diagnostic Write
02	Alert
03	Station Poll
04	Multiple Output
05	Clear Multiple Output

To send an alert function the word format shown in the previous figures 3-10 and 3-11 should be used. Both 12 bit words must be sent to acheive

an alert function. As shown in the figures, the first word must contain the alert function to be performed, with the second word specifying the site and station to which the message is to be sent. The following paragraphs describe the use of each alert function.

Status Request.

A Status Request checks the status of the remote site or station specified in the alert function.

Diagnostic Write.

Communications paths between the remote sites and the poller are checked with a Diagnostic Write.

Alert.

An Alert message indicates to the remote site and station that the computer has a message for that station. Action takes place at the remote site which allows a Read message to be sent to the poller when the poller next issues a Poll message to that site.

Station Poll.

Execution of a Station Poll polls a specific station within the remote site as called out by the computer in the alert function.

Multiple Output.

After a data source Read from poller memory, the data source may choose to have the poller transmit multiple Write messages to specified remote stations without returning to the polling sequence after completion of each message. Multiple Output allows the choice. For each additional site or station to be included in the Multiple Output, it is necessary for the data source to specify again the Multiple Output function followed by the site and station address.

Clear Multiple Output.

Clear Multiple Output is sent by the data source as an Alert function to the poller to clear the Multiple Output and return the poller to the polling sequence.

Normal Read/Write operations as carried out with the data source depend on the remote site beginning two-way communications by sending the poller a Read message during a poll sequence. Read messages sent to the poller by the remote site are sent because either the remote site wishes to communicate with the data source, or because it is responding to a computer issued Alert message as described in the preceding paragraphs.

STATUS LINES.

When communicating with the poller, the status lines of the interface have the same meaning as when communicating with a station except for the status lines listed below.

End of Operation.

Line eight becomes active if the poller is in the Multiple Write mode and is ready to receive a new site and station address code and a Write message, or when the poller is ready to receive data from the computer for a Diagnostic Write.

Alert Interrupt.

Line nine becomes active to indicate that the poller tried to communicate with a remote site three times and encountered an error during each of the tries. At the same time line nine is active, Poll Message Error or Poll Error is active.

DATA TRANSFER.

Normal poller operation is such that the poller begins data transfers with the computer by issuing a station interrupt. Computer response is first a Read and then a Write to the poller. Only the Diagnostic Write and the Multiple Write modes change this type of operation.

Read Data.

When the poller issues a station interrupt after receiving a Read message from a remote site, the computer must read at least one word from the poller's memory. If the computer connects to station = 00 and reads one 12-bit word, it has not yet read from the poller delay line. On a station = 00 read, the first word contains the interrupting station's address which is generated in the interface. It is the second 12-bit word which contains the remote site and station address that IS TAKEN from the poller memory. However, should the computer connect directly to the poller station following a station interrupt, the first 12-bit word read by the computer contains the first two words in the poller memory. The first two words are the remote site and station address (figure 3-12).

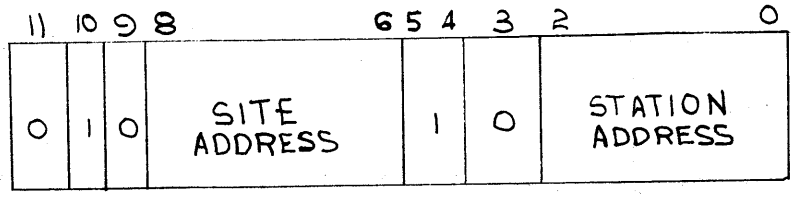


Figure 3-12. Twelve Bit Site and Station Word.

Read Buffer Length.

The maximum number of 7-bit characters contained in the poller memory is 1042, 1040 being the numb er of characters in an 80 x 13 remote station page and the other two words being the remote site and station. When reading

the data from the poller memory, the computer may receive more than 1042 characters because of the possibility of characters being preceded by an Escape code to give that character special meaning. It is possible to have all 1040 characters preceded by an Escape code, thus, doubling the number of characters read by the computer.

Write Data.

After the computer reads data from the poller memory, it must write at least one word to the poller to allow the poller to transmit some type of Write message to the remote site and station in response to the Read message which caused the station interrupt. It is not necessary for the computer to have the site and station address in the write message being sent to the poller. This is because the poller retains the remote site and station address when the station interrupt is generated and inserts them into the Write message response from the computer.

Any Write message may contain any number of STX or "E" Codes (E1, E2 or E3). However, these codes can not be in adjacent symbol positions. Any message sent to the poller must have as its last code one of the E codes or STX. If the write message is to consist of only one word it must be an E code or STX code.

Clear and Reset Write.

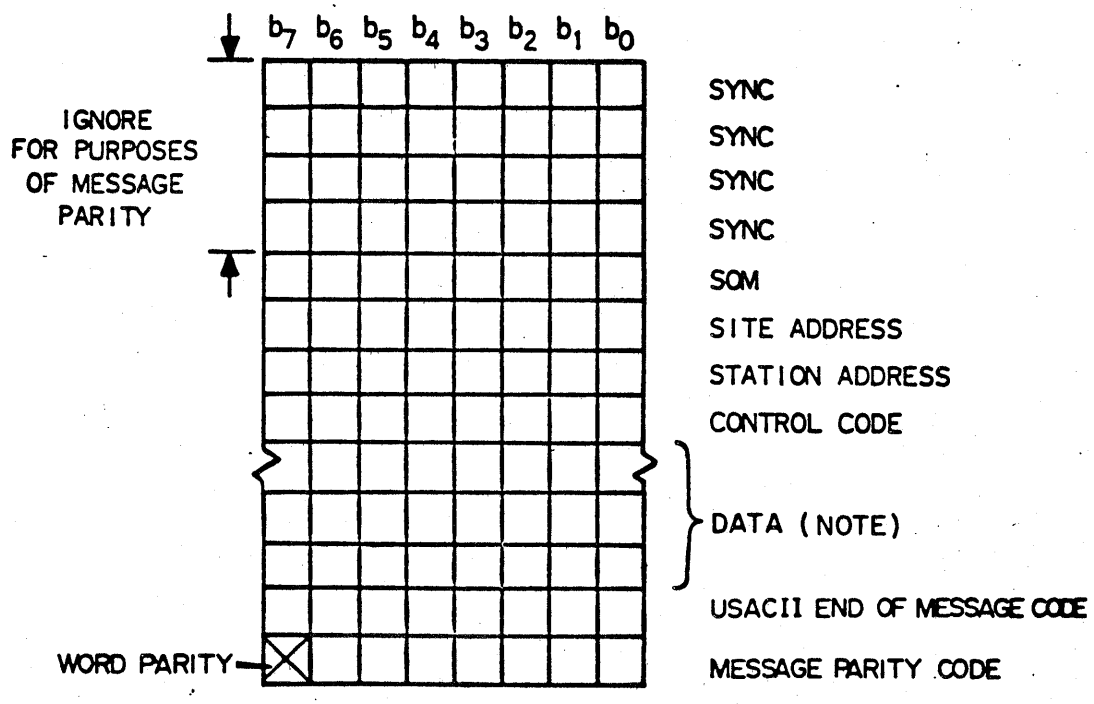
To instruct a remote site to perform a Clear Write or Reset Write, the computer sends a function code of 010 or 011 between the time it reads the poller memory and the time it sends poller a Write message. Sending either of these functions (010 or 011) to the poller results only in the poller sending a Clear or Reset Write message and does not cause an end of operation interrupt.

Sync Idles.

Should a symbol or time idle be required within a Write message, the poller automatically inserts the sync idle codes (026). Thus, the Write message sent by the computer need not contain these codes. A code of 026 (if sent to the poller by the computer) will not be interrupted as a sync idle code.

MESSAGE FORMAT.

Messages received and sent by the poller during communications with a remote site use the general format shown in figure 3-13. Message construction should follow the format shown to avoid an abort by the receiving equipment because of a failure to locate specific codes in their designated positions. Proper positioning of certain codes within any message is required since the receiving equipment is constructed to use the message format to guide internal operations for message processing. In each code position of figure 3-12, bit 0 through bit 6 represent the code with bit 7 providing code parity. CODE PARITY IS ODD.



NOTE: 1-1000 WORDS (50X20) DISPLAY FORMAT).
1-1040 WORDS (80X13) DISPLAY FORMAT).

Figure 3-13. General Message Format

A brief explanation of the purpose of each of the codes identified in figure 3-13 follows.

SYNC.

Sync codes, as their name implies, are used preceding every message between the poller and the remote sites to establish syncronization of the receiving circuits.

Start of Message (SOM).

A Start of Message code indicates to the receiving circuitry that the next code to follow is the first word of the message.

Site Address.

Site Address coding is determined by the address assigned to the remote site involved in any communication.

Station Address.

Station Address coding is determined by the address assigned to a certain station within the remote site AS called out in the Site Address code.

Control Code.

Control codes identify what function, if any, is to be performed or that data follows and that it is to be stored in memory and displayed in some manner.

Data.

Data codes make up the actual message transferred between the terminals.

USASCII End of Message.

End of Message is used to define the end of any message and that the next code to follow is the Message Parity Code.

Message Parity.

Message Parity is the last code in the message format. Odd parity is verified (excluding all sync codes) for the entire message length.

Table 3-8 lists the codes generated internally by the poller for use in the construction of the message format required to communicate with the remote sites.

TABLE 3-8. POLLER GENERATED CODES

OCTAL CODE	TITLE	OPERATION
001	Start of Message	See Text (Start of Message).
001	USASCII End of Message	See Text (End of Message).
005	Poll	Control code which indicates to the Remote site to respond with a Read message if any station in the site has a Read Request present or to respond with a Reject message if no Read Request is present.

TABLE 3-8. POLLER GENERATED CODES (CONT)

OCTAL CODE	TITLE	OPERATION
007	Alert	Control code which indicates to the remote station that the computer wishes to communicate and THAT the specific station addressed should present a Read Request as soon as possible.
014	Reset Write	Control code which directs the remote station to reset its entry marker in preparation for a Write message. This code is always followed by 12 sync codes (026) to act as idles while the station is resetting its marker.
020 BCD 024 USASCII	Diagnostic Write	Control code which starts a Write and Read sequence with the remote station to check out the communications path between the poller and the remote station. Twelve sync idle codes are transmitted following this code to allow the station time to reset its marker.
021	Write	Control code which informs the remote station that the data following this code is to be written into the station memory at the current marker position.
022	Clear Write	Control code which instructs the remote station to reset its marker and clear its memory in preparation to receive data. Twelve sync idle codes are transmitted following this code to allow the station to reset its marker.
024 BCD 027 USASCII	Status Request	Control Code which directs the remote site or station to send a Read message containing the status of the site controller and its stations.

TABLE 3-8. POLLER GENERATED CODES (CONT)

OCTAL CODE	TITLE	OPERATION
026	Sync Idle	Transmitted and received by the poller at the start of each message to establish synchronization with the modem. This code is also used anywhere in the message to act as a time or character idle. Sync is always generated by the poller and is not to be included in a data source Write message.
076 BCD 033 USASCII	Escape	Transmitted and received by the poller, preceding any code which is within the control subset of the remote system being used.
XXX	Message Parity	Represents a horizontal parity check on the total message. Checking begins with the Start of Message code and ends with the End of Message code. Message parity is odd and it is independent of any sync idle codes regardless of their position in the message
XXX	Addresss Codes	Two types of address codes are generated by the poller: site address and station address. During a Poll message, the site address code is determined by the site switches that are enabled; station address is 140_8. When the poller generates a Write message in response to a Read message, the site and station address codes are the same as those received in the Read message. Messages started by the data source have the site and station address as specifed by the data source in the Alert function.

MESSAGE TYPES.

In the following examples of message formats transmitted by the poller, it is assumed that the message is to be sent to a remote site requiring external BCD coding (See Code Conversion).

Poll.

Poll messages interrogate the remote sites to determine if a Read Request is present. If a Read Request is present, a remote site responds with a Read message; if not, the response is a Reject message. There are two types of Poll messages: site poll and station poll. A site poll is a general poll initiated by the poller which uses the site address generated by the poll counter within the poller. Station addressing for a site poll uses address 140_8. This message instructs the remote site to acknowledge any station's Read Request.

Station polls use a specific site and station address ($14X_8$ - 154_8) sent to the poller by the data source via the Alert function. A station poll directs the remote site to acknowledge a Read Request from the specific station indicated in the message.

A sample format for a poll message is shown in Table 3-9. A site address of 161_8 and station address of 140_8 (site poll) are used in THE TABLE.

Alert.

Generated by the poller, an Alert message informs the specific station selected in the Alert function that the data source wishes to write to that station. Normal response to an Alert message is an Acknowledge message. Table 3-10 is an example of an Alert message.

TABLE 3-9. POLL MESSAGE FORMAT

CODE DESCRIPTION	7-BIT OCTAL TRANSLATION	SAMPLE							
		P	2^6	2^5	2^4	2^3	2^2	2^1	2^0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
START OF HEADER	001	0	0	0	0	0	0	0	1
SITE ADDRESS	161	1	1	1	1	0	0	0	1
STATION ADDRESS	140	1	1	1	0	0	0	0	0
POLL	005	1	0	0	0	0	1	0	1
USASCII END OF TEXT	003	1	0	0	0	0	0	1	1
MESSAGE PARITY	151	1	1	1	0	1	0	0	1

TABLE 3-10. ALERT MESSAGE FORMAT

CODE DESCRIPTION	7-BIT OCTAL TRANSLATION	SAMPLE							
		P	2^6	2^5	2^4	2^3	2^2	2^1	2^0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
START OF HEADER	001	0	0	0	0	0	0	0	1
SITE ADDRESS	161	1	1	1	1	0	0	0	1
STATION ADDRESS	141	0	1	1	0	0	0	0	1
ALERT	007	0	0	0	0	0	1	1	1
USASCII END OF TEXT	003	1	0	0	0	0	0	1	1
MESSAGE PARITY	152	1	1	1	0	1	0	1	0

Write.

Write messages are generated by the poller in response to a Read message from a remote site or in response to a Write message during a Multiple Output operation. Poller Write messages begin upon completion of a data source Write message to the poller following a Data Source Read. Data received from the data source to be transmitted in the Write message must have as the last symbol code one of the four codes listed: 102, 140, 141 or 142. These codes (E1, E2, E3, or STX) may also be used within the data block to be transmitted. However, these codes can not occupy adjacent data positions. The requirements just stated for the use of the E and STX codes in message construction by the data source establish a programming restriction that must be followed. For any Write message, the poller automatically places the site and station address of the remote equipment in it's proper place. Therefore, the site and station address need not be present in the data received from the computer.

Station addresses used in write messages to a particular station should alternate bit 4 between a logical 0 and logical 1. For example, if the first write message to a station contained a station address of 141 octal, the next write message to that same station should use an address of 161 octal. This restriction enables the station to remember and report the accuracy of the preceding write message

Table 3-11 is an example of a Write message.

Clear Write.

Produced by the Poller, Clear Write messages direct the remote station to reset it's entry marker and clear it's memory in preparation to store the data portion of the Write message starting at the entry marker position. Data to be transferred is subject to the same requirements as described for a Write message. Table 3-12 is an example of a Clear Write message.

TABLE 3-11. WRITE MESSAGE FORMAT

CODE DESCRIPTION	7-BIT OCTAL TRANSLATION	SAMPLE							
		P	2^6	2^5	2^4	2^3	2^2	2^1	2^0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
START OF HEADER	001	0	0	0	0	0	0	0	1
SITE ADDRESS	161	1	1	1	1	0	0	0	1
STATION ADDRESS	141	0	1	1	0	0	0	0	1
WRITE	021	1	0	0	1	0	0	0	1
1	101	1	1	0	0	0	0	0	1
2	102	1	1	0	0	0	0	1	0
3	103	0	1	0	0	0	0	1	1
Escape	076	0	0	1	1	1	1	1	0
End of Text (E1)	102	1	1	0	0	0	0	1	0
USASCII END OF TEXT	003	1	0	0	0	0	0	1	1
MESSAGE PARITY	100	0	1	0	0	0	0	0	0

Reset Write.

Reset Write messages are generated by the poller to instruct the remote station to reset its entry marker in preparation to store the data portion of the Write message. Data storage begins at the entry marker position. Data to be transferred is subject to the same requirements as described for a Write message. An example of a Reset-Write message is shown in Table 3-13.

TABLE 3-12. CLEAR-WRITE MESSAGE FORMAT

CODE DESCRIPTION	7-BIT OCTAL TRANSLATION	SAMPLE							
		P	2^6	2^5	2^4	2^3	2^2	2^1	2^0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
START OF HEADER	001	0	0	0	0	0	0	0	1
SITE ADDRESS	161	1	1	1	1	0	0	0	1
STATION ADDRESS	141	0	1	1	0	0	0	0	1
CLEAR-WRITE	022	1	0	0	1	0	0	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
1	101	1	1	0	0	0	0	0	1
2	102	1	1	0	0	0	0	1	0
3	103	0	1	0	0	0	0	1	1
Escape	076	0	0	1	1	1	1	1	0
End of Text (E1)	102	1	1	0	0	0	0	1	0
USASCII END OF TEXT	003	1	0	0	0	0	0	1	1
MESSAGE PARITY	103	0	1	0	0	0	0	1	1

TABLE 3-13. RESET-WRITE MESSAGE FORMAT

CODE DESCRIPTION	7-BIT OCTAL TRANSLATION	SAMPLE							
		P	2^6	2^5	2^4	2^3	2^2	2^1	2^0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
START OF HEADER	001	0	0	0	0	0	0	0	1
SITE ADDRESS	161	1	1	1	1	0	0	0	1
STATION ADDRESS	141	0	1	1	0	0	0	0	1
RESET-WRITE	014	1	0	0	0	1	1	0	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
1	101	1	1	0	0	0	0	0	1
2	102	1	1	0	0	0	0	1	0
3	103	0	1	0	0	0	0	1	1
Escape	076	0	0	1	1	1	1	1	0
End of Text (E2)	040	0	0	1	0	0	0	0	0
USASCII END OF TEXT	003	1	0	0	0	0	0	1	1
MESSAGE PARITY	077	1	0	1	1	1	1	1	1

Diagnostic Write.

Should the poller decide that a Diagnostic Write is to be performed, it advises the interface to interrupt the data source. The data source then writes to the poller. Next, the poller transmits a Diagnostic Write message to the specified

remote station to test the transmission path. Marker reset takes place, but the message does not clear memory. Remote station response is a Read message which contains the same data that was in the Diagnostic Write message. Data from the beginning of the message up to the first "E" code is returned in the read response. If no "E" code exists, the read response continues to the end of page and terminates. Any parity errors experienced on incoming data are retransmitted as spaces (BCD Terminal) or as brackets with overbar ($\overline{\{}$ USASCII Terminal). A normal Read/ Write sequence is used to handle the remote stations Read message. Table 3-14 is an example of a Diagnostic Write message.

Status Request.

Produced by the poller, Status Request directs the remote site to respond with a Read message which contains the site or station status in the data portion of the message. Using 140_8 as the station address in the Status Request message, the remote site responds with the site status and the status of all the stations. With a station address greater than 140_8, the remote site returns only the status of the specific station. Table 3-15 shows the format for a status request using a site address of 161 octal and a station address of 140 octal (site request).

The only difference between the sample site status request shown in table 3-15 and a station request is the station address used. Table 3-16 is an example of a response to a site status request. In this case, the site address is identical to that of the request, and the station address remains at 140 octal. The data portion of the message consists of a site status word followed by a status word for each station at the site. The response to a station status request contains the status word for the addressed station only.

TABLE 3-14. DIAGNOSTIC WRITE MESSAGE FORMAT

CODE DESCRIPTION	7-BIT OCTAL TRANSLATION	SAMPLE							
		P	2^6	2^5	2^4	2^3	2^2	2^1	2^0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
START OF HEADER	001	0	0	0	0	0	0	0	1
SITE ADDRESS	161	1	1	1	1	0	0	0	1
STATION ADDRESS	141	0	1	1	0	0	0	0	1
DIAGNOSTIC WRITE	020	0	0	0	1	0	0	0	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
1	101	1	1	0	0	0	0	0	1
2	102	1	1	0	0	0	0	1	0
3	103	0	1	0	0	0	0	1	1
Escape	076	0	0	1	1	1	1	1	0
End of Text (E2)	040	0	0	1	0	0	0	0	0
USASCII END OF TEXT	003	1	0	0	0	0	0	1	1
MESSAGE PARITY	043	0	0	1	0	0	0	1	1

TABLE 3-15. STATUS REQUEST MESSAGE FORMAT

CODE DESCRIPTION	7-BIT OCTAL TRANSLATION	SAMPLE							
		P	2^6	2^5	2^4	2^3	2^2	2^1	2^0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
START OF HEADER	001	0	0	0	0	0	0	0	1
SITE ADDRESS	161	1	1	1	1	0	0	0	1
STATION ADDRESS	140	1	1	1	0	0	0	0	0
STATUS REQUEST	024	1	0	0	1	0	1	0	0
USASCII END OF TEXT	003	1	0	0	0	0	0	1	1
MESSAGE PARITY	170	1	1	1	1	1	0	0	0

TABLE 3-16. READ RESPONSE TO SITE STATUS REQUEST

CODE DESCRIPTION	7-BIT OCTAL TRANSLATION	SAMPLE							
		P	2^6	2^5	2^4	2^3	2^2	2^1	2^0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
START OF HEADER	001	0	0	0	0	0	0	0	1
SITE ADDRESS	161	1	1	1	1	0	0	0	1
STATION ADDRESS	140	1	1	1	0	0	0	0	0
READ	023	0	0	0	1	0	0	1	1
SITE STATUS	100	0	1	0	0	0	0	0	0
STATION 1 STATUS	101	1	1	0	0	0	0	0	1
STATION 2 STATUS	103	0	1	0	0	0	0	1	1
STATION 3 STATUS	125	1	1	0	1	0	1	0	1
STATION 4 STATUS	111	0	1	0	0	1	0	0	1
STATION 5 STATUS	041	1	0	1	0	0	0	0	1
STATION 6 STATUS	043	0	0	1	0	0	0	1	1
STATION 7 STATUS	101	1	1	0	0	0	0	0	1
STATION 8 STATUS	103	0	1	0	0	0	0	1	1
STATION 9 STATUS	125	1	1	0	1	0	1	0	1
STATION 10 STATUS	111	0	1	0	0	1	0	0	1
STATION 11 STATUS	041	1	0	1	0	0	0	0	1
STATION 12 STATUS	041	1	0	1	0	0	0	0	1
USASCII END OF TEXT	003	1	0	0	0	0	0	1	1
MESSAGE PARITY	075	0	0	1	1	1	1	0	1

Read.

Generated by the remote site, a Read message directs the poller to store the data portion of the message and to indicate to the computer via the Read Request and Message Pending signals that a Read message has been received. Read messages are sent by the remote site as a normal response to a poller transmitted Poll, Diagnostic Write or Status Request message. Table 3-17 is an example of a Read message.

TABLE 3-17. READ MESSAGE CONTAINING KEYBOARD DATA

CODE DESCRIPTION	7-BIT OCTAL TRANSLATION	SAMPLE							
		P	2^6	2^5	2^4	2^3	2^2	2^1	2^0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
START OF HEADER	001	0	0	0	0	0	0	0	1
SITE ADDRESS	161	1	1	1	1	0	0	0	1
STATION ADDRESS	141	0	1	1	0	0	0	0	1
READ	023	0	0	0	1	0	0	1	1
Escape	076	0	0	1	1	1	1	1	0
Start of Text	042	1	0	1	0	0	0	1	0
1	101	1	1	0	0	0	0	0	1
2	102	1	1	0	0	0	0	1	0
3	103	0	1	0	0	0	0	1	1
Escape	076	0	0	1	1	1	1	1	0
End of Text (E1)	102	1	1	0	0	0	0	1	0
USASCII END OF TEXT	003	1	0	0	0	0	0	1	1
MESSAGE PARITY	136	0	1	0	1	1	1	1	0

Reject.

Sent by the remote site, a Reject message indicates that the previous message transmitted by the poller was not accepted. A Reject message in response to any poller message (except a Poll message) is interpreted as an error condition. Table 3-18 shows an example of a Reject message.

TABLE 3-18. REJECT MESSAGE FORMAT

CODE, DESCRIPTION	7-BIT OCTAL TRANSLATION	SAMPLE							
		P	2^6	2^5	2^4	2^3	2^2	2^1	2^0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
START OF HEADER	001	0	0	0	0	0	0	0	1
SITE ADDRESS	161	1	1	1	1	0	0	0	1
STATION ADDRESS	141	0	1	1	0	0	0	0	1
REJECT	030	1	0	0	1	1	0	0	0
USASCII END OF TEXT	003	1	0	0	0	0	0	1	1
MESSAGE PARITY	165	0	1	1	1	0	1	0	1

Acknowledge.

Produced by the remote site, an Acknowledge message indicates that the previous poller generated Alert, Write, Clear Write or Reset Write message was properly received. Table 3-19 is an example of an Acknowledge message.

TABLE 3-19. ACKNOWLEDGE MESSAGE FORMAT

CODE DESCRIPTION	7-BIT OCTAL TRANSLATION	SAMPLE							
		P	2^6	2^5	2^4	2^3	2^2	2^1	2^0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
START OF HEADER	001	0	0	0	0	0	0	0	1
SITE ADDRESS	161	1	1	1	1	0	0	0	1
STATION ADDRESS	141	0	1	1	0	0	0	0	1
ACKNOWLEDGE	006	1	0	0	0	0	1	1	0
USASCII END OF TEXT	003	1	0	0	0	0	0	1	1
MESSAGE PARITY	153	0	1	1	0	1	0	1	1

Multiple Write.

Poller operation enters the Multiple Write mode only at the command of the computer. Following a data source Read operation to the poller, and prior to performing a Write operation, the computer may use the Alert function to place the poller in the Multiple Write mode. This mode of operation permits the computer to perform multiple write operations to remote equipments without allowing the poller to return to the polling sequence. Write messages that follow the establishment of a Multiple Ouput must contain the same site and station address as used in the Alert function. The addresses used in both the Alert function and the Write message must be the same as the site and station which generated the Read Request.

Upon completion of the Write message, the poller gives a Read Request, Message Pending and End of Operation indication to the interface. Instead of polling the next sequential site, the poller waits until the data source reacts with either another Multiple Output Alert function with a new site and station address followed by a Write message or a Clear Multiple Output Alert Function to allow the poller to return to the polling sequence.

Error.

Error messages originating at the remotes sites indicate that the previous poller generated message was received in error. A switch is available at the remote terminal to enable or disable the error message response. Remote terminal reaction to a word parity error depends upon the point in the message at which it is detected. Table 3-20 describes the remote terminals reaction to a word parity error as determined by its position within the general message format. Poller receipt of an error message causes an error condition to be sent to the computer.

TABLE 3-20. REMOTE TERMINAL RESPONSE TO WORD PARITY ERROR

CODE	RESPONSE
Sync	Code not recognized.
Sync Sync Sync Start of Header Site Address	Abort and begin search for proper sequence again.
Station Address Control Code	Abort and Transmit error message.
Sync Sync Sync Sync Sync Sync Sync Sync Sync Sync Sync Sync	Transmit error message at end of receive operation (except Diagnostic Write).
Data	Store parity error code in memory wherever an error occurs and transmit error message at end of receive operation (except Diagnostic Write).
USASCII End of Text Message Parity Code	Transmit error message at end of receive operation for all write messages except Diagnostic Write.

A word parity error in a Diagnostic Write message does not produce an error message response. Instead, a Parity Error code is stored in memory and a space code (BCD Terminal) or a bracket with an overbar ($\overline{\text{f}}$ USASCII Terminal) is substituted in the Read Response. When error messages are sent by the remote site, the format of Table 3-21 is used. Table 3-22 lists all message error conditions with the exception of the word parity error which was discussed earlier.

TABLE 3-21. ERROR MESSAGE FORMAT

CODE DESCRIPTION	7-BIT OCTAL TRANSLATION	SAMPLE							
		P	2^6	2^5	2^4	2^3	2^2	2^1	2^0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
SYNC	026	0	0	0	1	0	1	1	0
START OF HEADER	001	0	0	0	0	0	0	0	1
SITE ADDRESS	161	1	1	1	1	0	0	0	1
STATION ADDRESS	141	0	1	1	0	0	0	0	1
ERROR	025	0	0	0	1	0	1	0	1
USASCII END OF TEXT	003	1	0	0	0	0	0	1	1
MESSAGE PARITY	170	1	1	1	1	1	0	0	0

TABLE 3-22. MESSAGE ERRORS

ERROR CONDITION	CAUSE	ACTION
Nonexistent Station	Station address selects a station that is physically nonexistent or electrically not ready.	The Remote Terminal aborts the received message upon error detection.
Station 140 Write	Station address 140 received for Alert, Write, Reset-Write, Clear-Write or Diagnostic-Write.	The Remote Terminal aborts the received message upon error detection.
Unrecognized Message Control	Message control code other than Poll, Alert Write, Reset-Write, Clear-Write, Status-Request or Diagnostic-Write.	The Remote Terminal aborts the received message upon error detection.
No E or STX Code	No E1, E2, or STX code in Write, Reset-Write, or Clear-Write message text.	The Remote Terminal aborts the received message upon error detection. Data is stored in memory, but the keyboard remains locked out and print-out is prevented.
Message Parity Error	Incorrect message parity	The Remote Terminal aborts the received message upon error detection. Data is stored in memory, but the keyboard remains locked out and printout is prevented.
Carrier Drop	Modem Data Carrier Detector signal drops before EOM or MPC is received.	The Remote Terminal aborts the received message upon error detection.

ERRORS.

During the time lapse between the transmission of a poller message and the reception of the expected response, errors may occur either in the message content or in the message handling. The poller recognizes the following errors:

(a) Lack of response to a poller initiated message after a specific time out.

(b) Parity error on any message received by the poller from a remote site.

(c) Failure to receive either a Read or Reject message in response to a Poll message.

(d) Failure to receive a Read message in response to a Status Request message sent by the poller.

(e) Failure to receive an Acknowledge message in response to an Alert or Write message sent by the poller.

(f) Failure to receive a Read message in response to a Diagnostic Write message sent by the poller.

(g) An error message from a remote site in response to any message sent by the poller.

(h) A drop of the Carrier On signal from the modem before the completion of a message received by the poller

Encountering any one of the listed error conditions forces the poller to retransmit the message which resulted in the error condition. In an attempt to receive an error-free response, the poller retransmits the original message twice. If, after three transmissions, an error-free response cannot be acheived, the poller places the erring site address on the station status lines and gives an error interrupt and status to the interface to interrupt the data source. Should the error condition occur in response to a Poll message, the poller sends a status signal or Poll Message Error to the controller interface. If, instead, the error occurs in response to any other type of message, the poller indicates to the interface an error status of Poller Error.

Once the interrupt and status signals are established, the poller returns to the Poll mode and polls the next sequential remote site. Later, the erring site is again interrogated as its site address is again generated by the poller's poll counter during its normal polling sequence. Data source selection of the poller following an interrupt signal locks the poller to the computer. Once the poller and the computer are connected, a computer issued release function is required to clear the poller's error and station status lines and to allow the poller to resume polling.

When the computer selects the poller as a result of an interrupt signal, the error condition which caused the interrupt signal may no longer exist. However, the error and station status provided may help to pinpoint (over a period of time) the possible cause of the error. For example, the cause of the error condition MAY BE related to the handling of a specific type of message, message code or related to the communications link itself.

CODE CONVERSION.

As explained earlier in this section, the poller can communicate with remotes sites using either External BCD or USASCII coding. Normal 3000 channel communication is Internal BCD. Data received by the poller from the interface is External BCD. Conversion from Internal BCD to External BCD takes place in the interface. Thus, when the remote site and station are operating with External BCD no code conversion need be done by the software. However, should the remote site and station operate with USASCII coding, the software must be such that the conversion of Internal BCD codes to External BCD codes by the interface results in the codes being the same as the USASCII symbols to be displayed at the remote site.

Example:

COMPUTER CODE	POLLER CODE	DISPLAYED CODE	
INTERNAL BCD	EXTERNAL BCD	EXTERNAL BCD	USASCII
01 21 61	81 61 21	1 A / {slash}	A 1 Q

Although the poller is transparent (codes passed unchanged) to most of the codes used for communications between the interface and the remote sites, certain codes have to be converted. Code conversion (controlled by the ASCII-BCD switch) is required due to the specific characteristics of the remote site. Table 3-23 and 24 list the code conversions that occur for either position of the ASCII-BCD switch. The actual switch position used is determined by the coding requirements of the remote site.

TABLE 3-23. BCD CONVERSION*

CODES RECEIVED FROM INTERFACE	CODES TRANSMITTED TO REMOTE SITE	CODES RECEIVED FROM REMOTE SITE	CODES SENT TO INTERFACE
000	120	120	000
020	100	100	020
076	176		
1xx	076 - 1xx	076 - 1xx	1xx

* Prior to transmission, data bit 2^6 is formed as the complement of bit 2^5.

TABLE 3-24. USASCII CONVERSION*

CODES RECEIVED FROM INTERFACE	CODES TRANSMITTED TO REMOTE SITE	CODES RECEIVED FROM REMOTE SITE	CODES SENT TO INTERFACE
000	040	040	000
033	173	173	033
035	175	175	035
X40	100	100	040
1xx	033 - 1xx	033 - 1xx	1xx

* Prior to transmission, data bit 2^6 is formed as the complement of bit 2^5.

PROGRAMMING RESTRICTIONS.

The following programming restrictions should be observed:

- Data source messages sent to the poller should have as the last symbol code one of the STX or "E" codes. In addition to being listed in the Code Repertoire the codes in Internal BCD are 42 (STX), 02 (E1), 40 (E2), and 41 (E3). These codes may also be used within the data block to be transmitted. However, these codes cannot occupy adjacent data position.
- Station addresses used in write messages to a particular station should alterate bit 4 between a logical 0 and logical 1. For example, if the first write message to a station contained a station address of 141 octal, the next write message to that same station should use an address of 161 octal. This restriction enables the station to remember and report the accuracy of the preceding write message.
- The symbol greater than (>) cannot be used when communicating with a USASCII remote site.

CODE REPERTOIRE.

The USASCII code standard requires seven bit codes. However, since the computer sends only six bit codes to the local interface, the interface hardware inserts the seventh bit. In the tables that follow, tables 3-25, 26, 27, 28, and 29 list only the six bit internal BCD codes that should be selected when communicating with the remote sites. In listing the internal code, all conversions that take place during communication are considered. For an understanding of how the listed internal BCD codes are determined, see Code Conversion in this section., Tables 3-30 and 31 list the External BCD and USASCII standard binary code assignments. These last two tables are included as additional references.

TABLE 3-25. ALERT FUNCTIONS

NAME	CODE
Status Request	00
Diagnostic Write	01
Alert	02
Station Poll	03
Multiple Output	04
Clear Multiple Output	05

TABLE 3-26. TRANSMISSION CONTROL CODES

EXTERNAL BCD SITE	CODE	CODE	USASCII SITE
Start of Header	001 *	001*	Start of Message
End of Text	003 *	003*	End of Text
Poll	005 *	005*	Poll
Acknowledge	006 **	006**	Acknowledge
Alert	007 *	007*	Alert
Reset-Write	014 *	014*	Reset-Write
Diagnostic Write	020 *	024*	Diagnostic Write
Write	021 *	021*	Write
Clear-Write	022 *	022*	Clear-Write
Read	023 **	023**	Read
Status Request	024 *	027*	Status Request
Error	025 **	025**	Error
Sync	026 *	026*	Sync
Reject	030 **	030**	Reject

* Inserted in the message by the poller.
** Sent to the poller by the remote site.

TABLE 3-27. ADDRESS CODES

SITE		STATION		
7-BIT OCTAL CODE	SITE NUMBER	7-BIT OCTAL CODE		STATION NUMBER
160	0	140**	160**	--
161	1	141	161	1
162	2	142	162	2
163	3	143	163	3
164	4	144	164	4
165	5	145	165	5
166	6	146	166	6
167	7	147	167	7
170	8*	150	170	8
171	9*	151	171	9
172	10*	152	172	10
173	11*	153	173	11
174	12*	154	174	12
175	13*			
176	14*			
177	15*			

* THESE SITE ADDRESSES CANNOT BE GENERATED BY THE COMPUTER.

** THESE ADDRESSES MAY ONLY BE USED FOR THE FOLLOWING PURPOSES: SITE POLL, SITE STATUS REQUESTS, REMOTE TERMINAL READ RESPONSE IN REPLY TO THE SITE STATUS REQUEST, AND REJECT RESPONSE TO THE SITE POLL.

TABLE 3-28. SYMBOL CODES

SYMBOL DISPLAYED OR PRINTED	REMOTE SITE EXT.	REMOTE SITE USASCII	SYMBOL DISPLAYED OR PRINTED	REMOTE SITE EXT.	REMOTE SITE USASCII
: (colon)	12	32	- (minus)	40	55
1	01	21	J	41	00
2	02	22	K	42	13
3	03	23	L	43	14
4	04	24	M	44	15
5	05	25	N	45	16
6	06	26	O	46	17
7	07	27	P	47	12
8	10	30	Q	50	61
9	11	31	R	51	62
ø	00	20	V (logical OR)	52	—
= (equal)	13	35	$ (dollar sign)	53	44
≠ (not equal to)	14	—	* (asterisk)	54	52
≤ (less than or equal to)	15	—	↑	55	—
% (per cent)	16	45	↓	56	—
[(left bracket)	17	—	> (greater than)	57	NOT USED
SPACE	60	60	+ (plus sign)	20	53
/ (diagonal)	61	57	A	21	01
S	62	63	B	22	02
T	63	64	C	23	03
U	64	65	D	24	04
V	65	66	E	25	05
W	66	67	F	26	06
X	67	70	G	27	07
Y	70	71	H	30	10
Z	71	72	I	31	11
] (right bracket)	72	—	< (less than)	32	34
, (comma)	73	54	. (period)	33	56
((left parenthesis)	74	50	) (right parenthesis)	34	51
⌐	75	—	≥ (greater than or equal to)	35	—
≡ (identical to)	76	—	ESCAPE to control	36	
∧ (logical AND)	77	—	; (semicolon)	37	33
! (EXCLAMATION MARK)	—	41	#	—	43
" (QUOTATION MARK)	—	42	& (AMPERSAND)	—	46
' (APOSTROPHE)	—	43	/ (SLANT)	—	57
? (QUESTION MARK)	—	37	@ (COMMERCIAL AT)	—	40
{ (LEFT BRACE)	—	*	\ (RIGHT SLANT)	—	74
} (RIGHT BRACE)	—	*	^ (CIRCUMFLEX)	—	76
			— (UNDERLINE)	—	77

TABLE 3-29. FUNCTION CODES*

EXTERNAL BCD REMOTE SITE		USASCII REMOTE SITE	
NAME	OCTAL CODE*	OCTAL CODE*	NAME
Backspace	12	12	Backspace
CARRIAGE RETURN	01	01	NEW LINE (-)
Tab	61	61	Tab
Line Skip	62	62	Line Skip
Selective Clear	63	63	Selective Clear
Line Clear	64	64	Line Clear
Tab Protect	65	65	Tab Protect
Skip	71	71	Skip
Reset	72	72	Reset
Tab Access	75	75	Tab Access
End Tab (11)	76	76	End Tab (11)
Start Tab (11)	77	77	Start Tab (11)
END OF LINE	60	60	END OF LINE
E1	02	02	E1
E2	40	40	E2
E3	41	41	E3
STX (START OF TEXT)	42	42	SEND INDEX
START BLINK	70	70	START BLINK

* PRECEDED BY AN ESCAPE CODE.

TABLE 3-30. TERMINAL CONTROL CODES **

CODE NAME	EXTERNAL BCD REMOTE SITE		USASCII REMOTE SITE	
	CODE *	SYMBOL	CODE *	SYMBOL
F0	20	¬	20	0̄
F1	21	Ā	21	1̄
F2	22	B̄	22	2̄
F3	23	C̄	23	3̄
F4	24	D̄	24	4̄
F5	25	Ē	25	5̄
F6	26	F̄	26	6̄
F7	27	Ḡ	27	7̄
F8	30	H̄	30	8̄
F9	31	Ī	31	9̄

* Code meaning is determined by software application.
** Preceded by an escape code.

TABLE 3-31. EXTERNAL BCD CODE REPERTOIRE

							1		2				3	
							000	020	040	060	100	120	140	160
						b6	0	0	0	0	1	1	1	1
						b5	0	0	1	1	0	0	1	1
	b3	b2	b1		b4 / b0		0	1	0	1	0	1	0	1
00	0	0	0	0			DIAGNOSTIC WRITE	— (DEL) ! (EC)	+ RESERVED	: (ERASE) BACKSPACE	BLANK RESERVED	STATION ADDRESS ON SITE MESSAGES		0
01	0	0	0	1	SOM	WRITE	J ⁘ (ES)	A RESERVED	1 — (CARRIAGE RETURN)	/ TAB	R 1		S 1	
02	0	0	1	0		CLEAR WRITE	K STX	B RESERVED	2 Δ (ET)	S LINE SKIP	D 2		E 2	
03	0	0	1	1	EOM	READ	L RESERVED	.C RESERVED	3 RESERVED	T SELECTIVE CLEAR	D 3		S 3	
04	0	1	0	0		STATUS REQ	M RESERVED	D RESERVED	4 RESERVED	U LINE CLEAR	A 4		S 4	
05	0	1	0	1	POLL	ERR	N RESERVED	E RESERVED	5 RESERVED	V TAB PROTECT		5	E 5	
06	0	1	1	0	ACK	SYNC	O RESERVED	F RESERVED	6 RESERVED	W RESERVED	N 6		R 6	
07	0	1	1	1	ALERT		P RESERVED	G RESERVED	7 RESERVED	X RESERVED	O 7		D 7	
10	1	0	0	0		REJECT	Q RESERVED	H RESERVED	8 RESERVED	Y START BLINK	— 8		D 8	
11	1	0	0	1			R RESERVED	I RESERVED	9 RESERVED	Z SKIP	T 9		A 9	
12	1	0	1	0			LOGICAL OR ∨ RESERVED	< RESERVED	Ø (ZERO) RESERVED	] RESET	A 10		10	
13	1	0	1	1			$ RESERVED	• (PERIOD) RESERVED	= RESERVED	, (COMMA) NOT ASSIGNED	T 11		E 11	
14	1	1	0	0	RESET WRITE		* RESERVED	) RESERVED	≠ RESERVED	(RESERVED	S 12		T 12	
15	1	1	0	1			↑ RESERVED	≥ RESERVED	≤ RESERVED	→ TAB ACCESS			— 13	
16	1	1	1	0			↓ RESERVED	ESCAPE RESERVED	% RESERVED	≡ (11) END TAB			S 14	
17	1	1	1	1			> RESERVED	; RESERVED	[RESERVED	LOGICAL AND ∧ (FT) START TAB			15	

1 Transmission Control Subset
2 Terminal Control Subsets: Symbol (upper), Control (lower)
3 Address Subsets

TABLE 3-32. USASCII CODE REPERTOIRE

						1		2				3	
						000	020	040	060	100	120	140	160
				BIT 6		0	0	0	0	1	1	1	1
				BIT 5		0	0	1	1	0	0	1	1
BIT 3	BIT 2	BIT 1	Bit 4 / Bit 0	0	1	0	1	0	1	0	1	0	1
0	0	0	0			SPACE (ED)	0	@	P	STATION ADDRESS ON SITE MESSAGES			0
							RESERVED	EOL					
0	0	0	1	SOH	WRITE (DC1)	!	1	A	Q			1	1
							RESERVED	NEW LINE	TAB				
0	0	1	0		CLEAR WRITE (DC2)	"	2	B	R			2	2
						STX	RESERVED	ESC Δ	LINE SKIP				
0	0	1	1	ETX	READ (DC3)	#	3	C	S			3	3
						RESERVED	RESERVED	RESERVED	SELECTIVE CLEAR				
0	1	0	0		DIAGNOSTIC WRITE (DC4)	$	4	D	T			4	4
						RESERVED	RESERVED	RESERVED	LINE CLEAR				
0	1	0	1	POLL (ENQ)	ERROR (NAK)	%	5	E	U			5	5
						RESERVED	RESERVED	RESERVED	TAB PROTECT				
0	1	1	0	ACK	SYNC (SYN)	&	6	F	V			6	6
						RESERVED	RESERVED	RESERVED	RESERVED				
0	1	1	1	ALERT (BEL)	STATUS (ETB)	'	7	G	W			7	7
						RES	ER	VED					
1	0	0	0		REJECT (CAN)	(	8	H	X			8	8
						RES	ER	VED	START FIELD				
1	0	0	1			)	9	I	Y			9	9
						RES	ER	VED	SKIP				
1	0	1	0			*	:	J	Z			10	10
						RES	ER	VED	RESET				
1	0	1	1		ESCAPE	+	;	K	←			11	11
						RES	ER	VED					
1	1	0	0	RESET WRITE (FF)		,	<	L	\			12	12
						RES	ER	VED					
1	1	0	1			-	=	M	→				13
						RES	ER	VED	TAB ACCESS				
1	1	1	0			.	>	N	^				14
						RES	ER	VED	↓ END TAB				
1	1	1	1			/	?	O	_				15
						RES	ER	VED	↑ START TAB				

1 Transmission Control Subset
2 Terminal Control Subsets: Symbol (upper), Control (lower)
3 Address Subsets

SECTION IV

PROGRAMMING AIDS

This section summarizes the discussions presented throughout the text of this publication. It is intended to aid the user in the programming and operation of the 3290-4 (Edit) Terminal.

UNATTENDED OPERATION.

The UNATTENDED/ATTENDED switch on the keyboard allows the data source to use the terminal's output facilities without the presence of the operator. To go UNATTENDED, the operator must:

1) Place the UNATTENDED/ATTENDED switch in the UNATTENDED position.

2) Compose a message, using the keyboard, informing the data source that the station will no longer be attended.

3) Depress the SEND key.

This unattended message will be received as a response to the next poll. The data source should then send a write message. Once a correct write message is received by the terminal, the UNATTENDED indicator lights and the terminal is officially in the UNATTENDED mode.

If the data source is in the habit of transmitting write messages only as responses to read messages, the sequence can continue. In the ATTENDED mode, an alert message solicited an alarm. A read message response to a search could not be received until the SEND key was depressed. The alert sequence still takes place in UNATTENDED operation, but the ALERT light and alarm are deactivated. The alert

message produces a read request, so an automatic one word (E1) read message is available when the station again is polled.

OUTPUT TIMING CONSIDERATIONS.

The 3000 series of computers is capable of processing data much faster than the terminal is capable of handling data. The time required for symbol transfer by the delay line memory of the display station is 16.8 microseconds. Memory cycle time is 20 milliseconds. During a read or write operation, succesive data bytes must follow within 33.6 microseconds if the Suppress Assembly/Disassembly signal is inactive or 16.8 microseconds it the Suppress Assembly/ Disassembly signal is enabled. If succesive data bytes do not follow within the specified times, a 20 millisecond delay occurs between bytes due to delay-line latency characteristics.

If the amount of time required by the display station is long compared to the data source, then a similar comparison can be made between the display and the typewriter station. It takes much longer to process a message, and thus remains busy long after the initiating message has been received. Table 4-1 lists the time required by the typewriter to perform various functions. After the message has been completely processed (E2 code detected) a read request is raised. At this time a connect can be made for the purpose of checking status.

Table 4-1. Typewriter Timing.

FUNCTION	TIME REQUIRED
Print one character	64.5 Milliseconds
Space	64.5 Milliseconds
Shift	64.5 Milliseconds
Carriage Return (minimum)	129.0 Milliseconds

Shift is of particular importance since an extra 64.5 milliseconds is required if the case of a character differs from that of the preceding character. Figure 4-1 illustrates by the flow chart method the timing of the typewriter station.

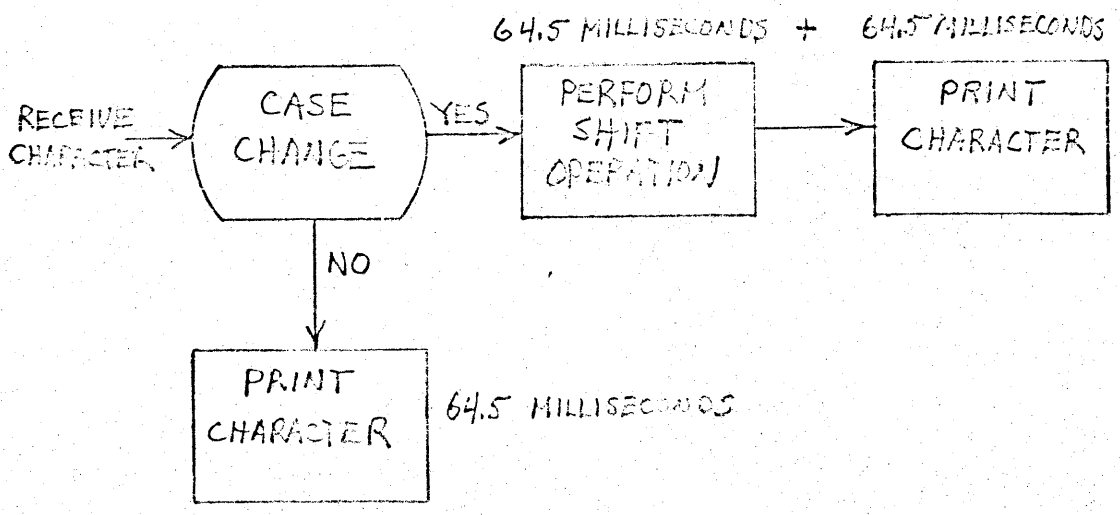


Figure 4-1. Typewriter Timing.

Talbe 4-3 lists the entire symbol repertoire, including case.

Table 4-2. Case Assignments.

SYMBOL	CASE	SYMBOL	CASE
0	Lower	W	Lower
1	Lower	X	Lower
2	Lower	Y	Lower
3	Lower	Z	Lower
4	Lower	=	Lower
5	Lower	≠	Upper
6	Lower	≤	Upper
7	Lower	%	Upper
8	Lower	⊏	Upper
9	Lower	/	Lower
A	Lower	⌴	Upper
B	Lower	,	Lower
C	Lower	(	Upper
D	Lower	⌐	Upper
E	Lower	≡	Upper
F	Lower	-	Lower
G	Lower	>	Upper
H	Lower	<	Upper
I	Lower	$	Lower
J	Lower	*	Upper
K	Lower	↑	Upper
L	Lower	↓	Upper
M	Lower	∨	Upper
N	Lower	+	Lower
O	Lower	∧	Upper
P	Lower	.	Lower
Q	Lower	)	Upper
R	Lower	≥	Upper
S	Lower	;	Upper
T	Lower	:	Lower
U	Lower	Space	Lower
V	Lower	C Ret	Lower

TYPICAL READ/WRITE OPERATION.

The following discussion centers on a read/write (display only) operation. Of main concern is the proper use of the STX key. Suppose the display station operator composes the following message at his Display/Entry Station keyboard.

SEND POLICY NUMBER 7ELB1429._____

By depressing the SEND key, the EI symbol (Δ) appears at the entry marker position and the entire chain resets. In addition, the keyboard locks out. Assumin a 50 by 20 display format and the top line of the display was used for the message, the display now reads:

SEND POLICY NUMBER 7ELB1429.Δ_____

All data from the entry marker through the EI symbol transmits to the computer when the station is selected. After the read, the entry marker references the first symbol position following the EI symbol.

SEND POLICY NUMBER 7ELB1429.Δ_____

The computer may begin dispalying its reply at the current position of the entry marker or it may clear the display and/or reset the marker chain. If the computer elects to begin displaying its reply at the present entry marker, the request and reply display together.

SEND POLICY NUMBER 7ELB1429. BE MORE SPECIFIC.
DO YOU WISH:
REVISION AΔ
REVISION BΔ
REVISION CΔ_____

Each of the choices offered in the write message terminates with an E1 symbol. The operator need only position the entry marker to precede the correct choice and depress the STX key to designate the beginning of the read message.

```
SEND POLICY NUMBER 7BLB1429. BE MORE SPECIFIC.
DO YOU WISH:
          REVISION A
        ■ REVISION B
          REVISION C
```

Depression of the SEND key at the first position to the right of the STX symbol resets the entry marker to the STX symbol, locks out the keyboard, and generates a read request. The E1 symbol does not display when SEND is depressed. Instead, the E1 symbol at the end of the choice terminates the read message. Data transmitted reads:

```
■REVISION B
```

If the write message does not supply E1 symbols after each choice before depressing SEND. In this case, the E1 symbol displays and acts as message terminator.

If the write message had not supplied E1 symbols after each choice, the operator would have to move the entry marker to the end of the choice before depressing SEND. In this case, the E1 symbol would be displayed and act as the message terminator. Only when depression occurs immediately to the right of the STX symbol will display and entry into memory be prevented.

APPENDIX

The characteristic feature of this terminal is its expandable data processing scope. Each member station adds its own unique feature to the overall performance. This appendix highlights specifications for each of the various equipments which may be used within a given configuration.

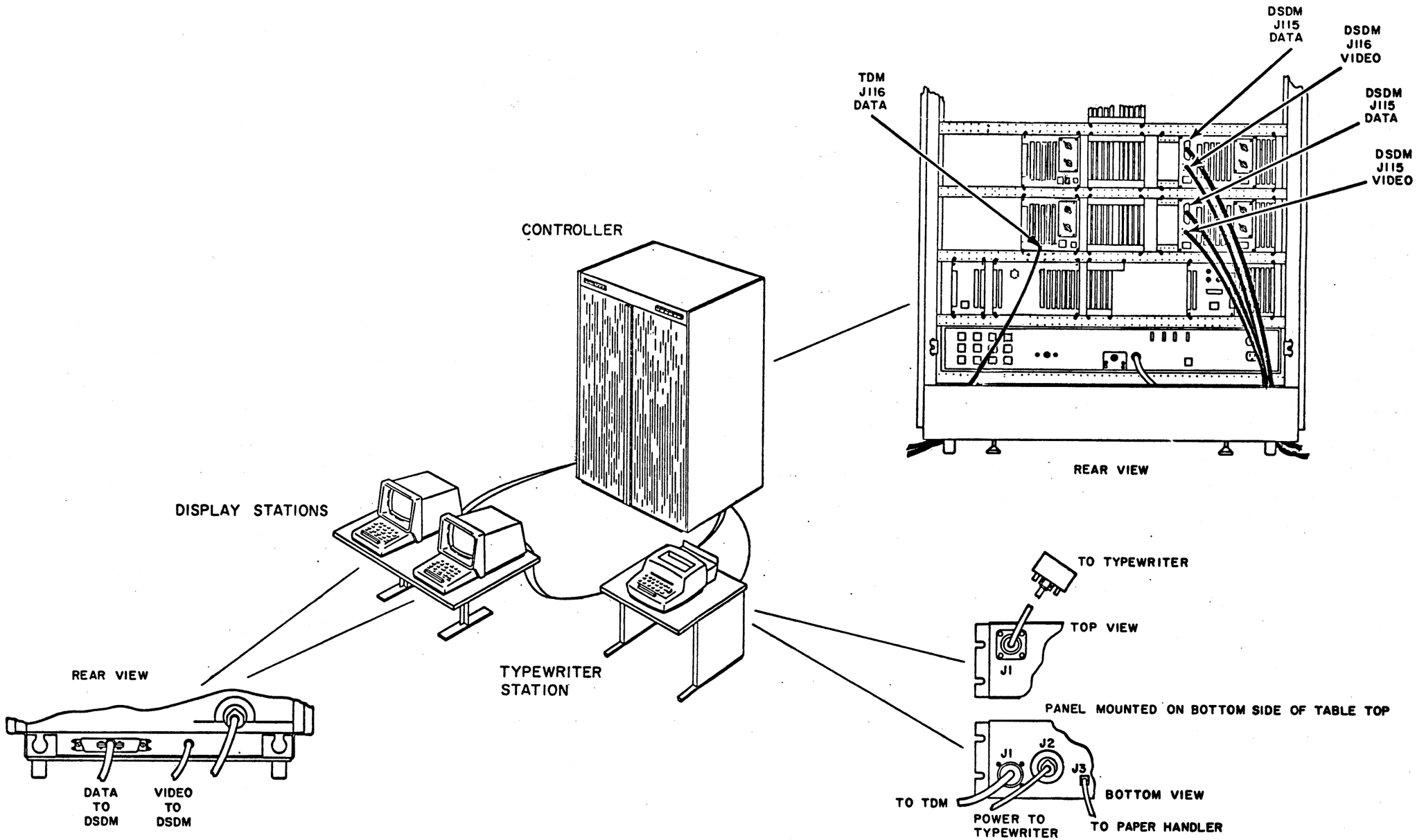
A Multistation Terminal consists of an Equipment Controller and up to twelve input/output stations. An adapter kit is required for each station added to the configuration. Furthermore, each of the 12 station locations may be occupied by a poller. Each poller can address 16 remote sites. However, the 3000 Data Source's use of only three bits for site addressing limits the number of sites connected to each poller that may be addressed to a maximum number of eight.

All adapters are housed in the controller cabinet, which provides the dc power and ventilation required. As a minimum, the cabinet should contain an interface module, main timing module, symbol generator module, and at least one station adapter kit.

Various off line operations may be performed through the local associations of adapter kits. Such associations are made possible by a special row of connectors in the cabinet. Each connector has two sets of pins to allow association between 2 data input devices and a single output device (see Basic Cabinet Manual publication number 82140600). The following list establishes the various associations

and the operations performed. Connector pin assignments (odd or even) required for each adapter are also shown.

INPUT DEVICE		OUTPUT DEVICE			INPUT DEVICE	
TYPE	PIN	PIN	TYPE	PIN	PIN	TYPE
Display	Even	Odd	Typewriter			
Display	Even	Odd	Hardcopy			


DSDM
J115
DATA
DSDM
J116
VIDEO
TDM
J116
DATA
DSDM
J115
DATA
DSDM
J115
VIDEO
CONTROLLER
REAR VIEW
DISPLAY STATIONS
TYPEWRITER
STATION
REAR VIEW
DATA
TO
DSDM
VIDEO
TO
DSDM
TO TYPEWRITER
TOP VIEW
J1
PANEL MOUNTED ON BOTTOM SIDE OF TABLE TOP
J1
J2
J3
BOTTOM VIEW
TO TDM
POWER TO
TYPEWRITER
TO PAPER HANDLER

CONTROLLER CABINET

The controller cabinet houses all adapter kits and logic required to link the data source with all input/output devices making up the terminal. It also provides all necessary dc power.

Equipment Number	Part Number
FC101-A	14036100

OPTIONS.

Equipment Number	Description	Part Number
GD601-A	50 Hz Power Conversion Kit	14038000

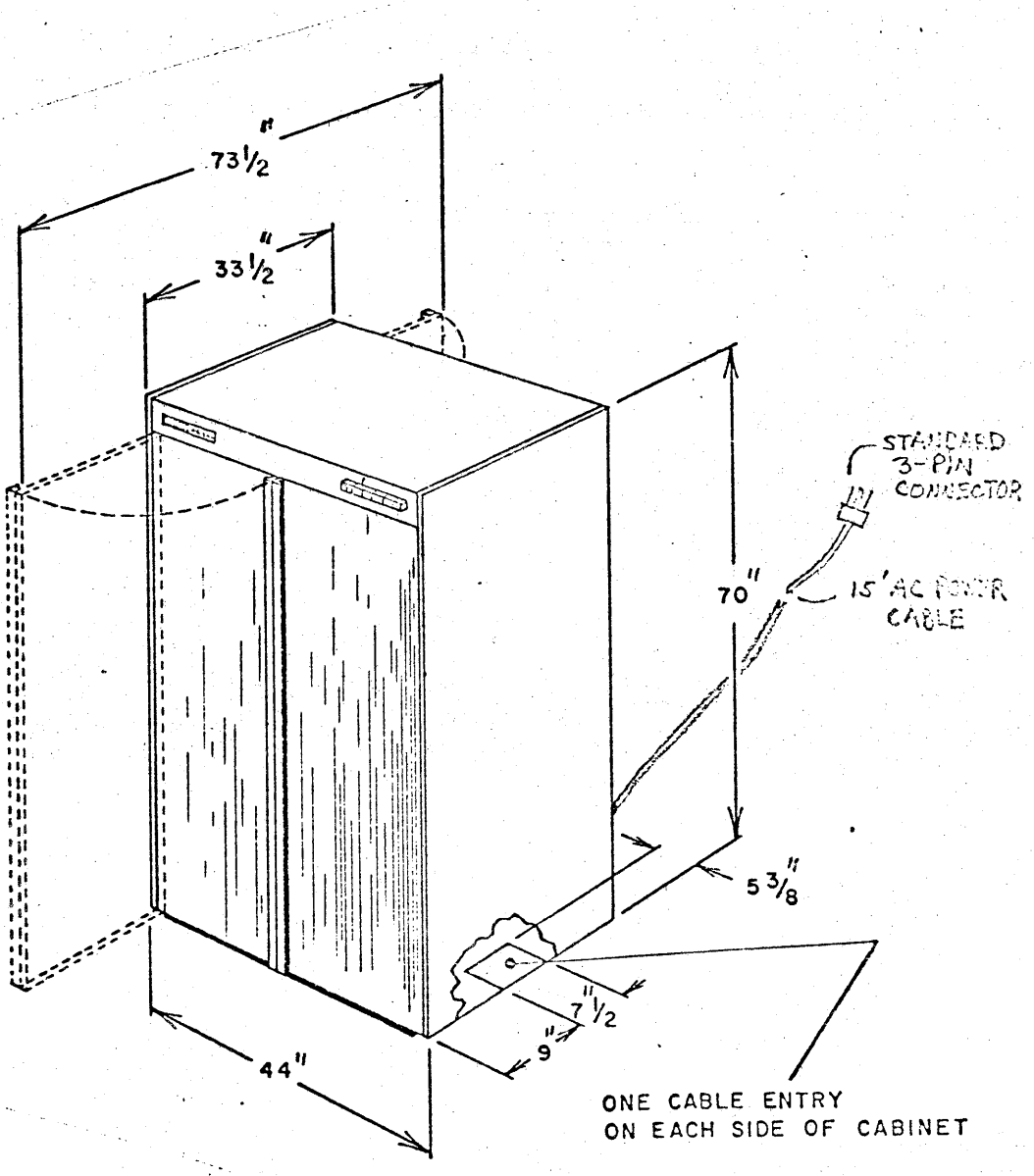
LITERATURE AVAILABLE.

Name	Publication No.
Basic Controller Cabinet Hardware Reference/Customer Engineering Manual	82140600

PHYSICAL CHARACTERISTICS.

WEIGHT: 732 Lbs
BTU'S/HOUR: 610*
INPUT POWER: 120 volts, 60 Hz, 1.52 amperes*
OUTLINE DIMENSIONS: See following illustrations

*Includes a blower and 2 basic power supplies. One add on power supply requires an additional 0.21 amperes and dissipates approximately 82 BTU's per hour. Cabinet service should be 20-ampere.


73 1/2"
33 1/2"
70"
STANDARD 3-PIN CONNECTOR
15' AC POWER CABLE
5 3/8"
7 1/2"
9"
44"
ONE CABLE ENTRY ON EACH SIDE OF CABINET

DISPLAY STATION

The Display Station provides cathode-ray-tube display capabilities for the parent sub-system. Symbol generator and display station adapter kits are required to govern output.

Equipment Number	Part Number
CC601-A	14031800
CC601-B	14031900

ADAPTER KITS REQUIRED.

Equipment Number	Description	Part Number
GK103-A	Symbol Generator Module	15503400
FV135-A*	Display Station Driver Module	15508600
FV136-A*	Display Station Driver Module	15508700
FV137-A*	Display Station Driver Module	15508800
FV138-A*	Display Station Driver Module	15508900

*Only one of these is required.

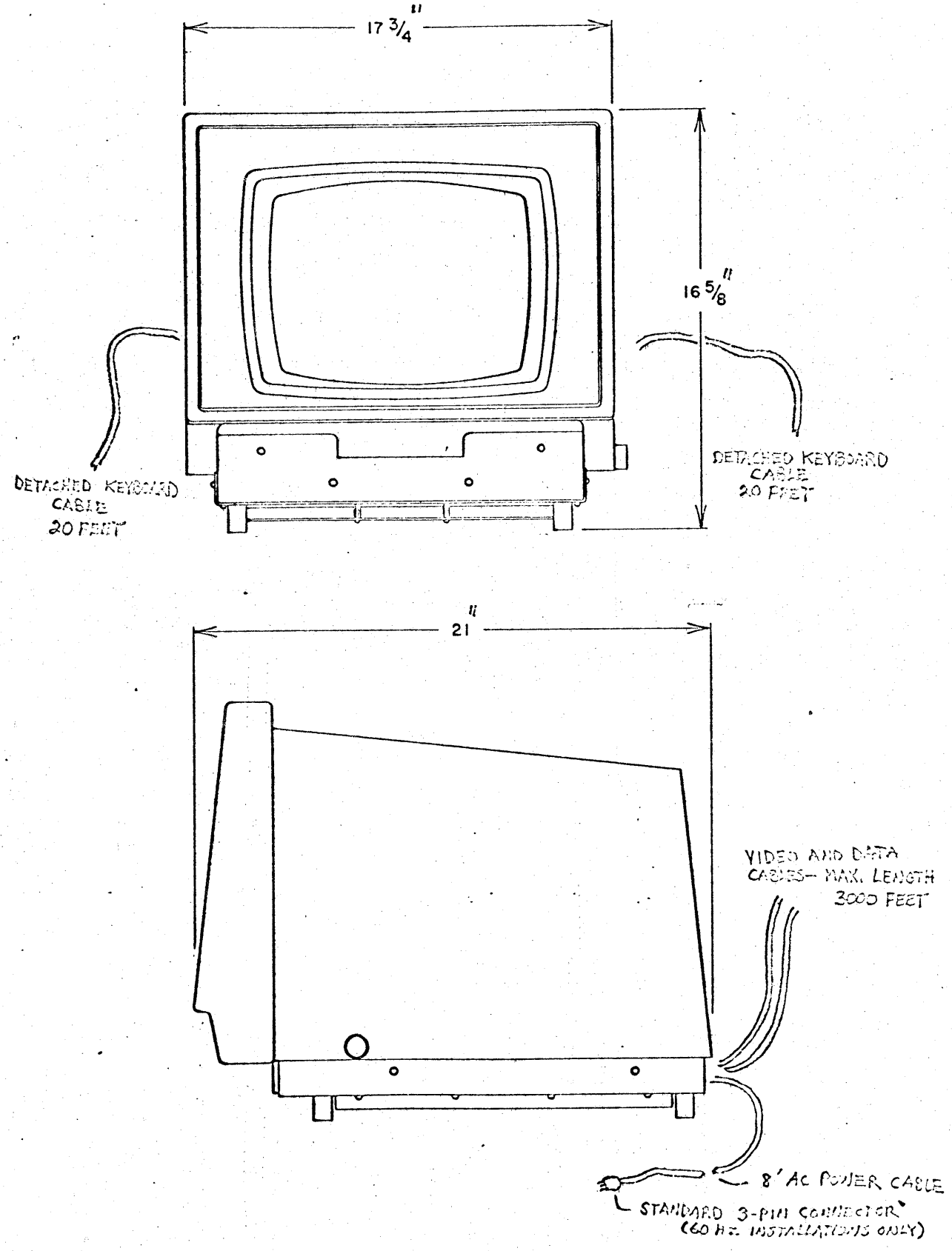
LITERATURE AVAILABLE.

Name	Publication No.
Display Station Hardware Reference/Customer Engineering Manual	82134300

PHYSICAL CHARACTERISTICS.

WEIGHT: 60 Lbs
BTU'S/HOUR: 410
INPUT POWER: (CC601-A) 120 volts, 60Hz, 1 ampere
(CC601-B) 220 volts, 50Hz, 0.5 ampere
OUTLINE DIMENSIONS: See following illustrations

DISPLAY STATION (cont)



ENTRY KEYBOARDS

The Entry Keyboard provides the operator with a method for entering coded data into a communications terminal. It is linked to the terminal processor through a Display Station. Two keyboards are offered — both 501 compatible. They are identical, with the exception that one has additional edit features. A display station driver module and main timing module are required for each or each pair of associated keyboards used.

Equipment Number	Part Number
CA101-A (non-edit)	14032000
CA101-B (edit)	14032100

ADAPTER KITS REQUIRED.

Keyboard Option	Display Station Driver Module* Equipment No.	Part No.	Main Timing Module** Equip. No.	Part No.
Non-Edit	FV135-A	15508600	GA101-A	14036400
Non-Edit	FV136-A	15508700	GA102-A	14036500
Edit	FV137-A	15508800	FV112-A	14037800
Edit	FV138-A	15508900	FV113-A	14037900

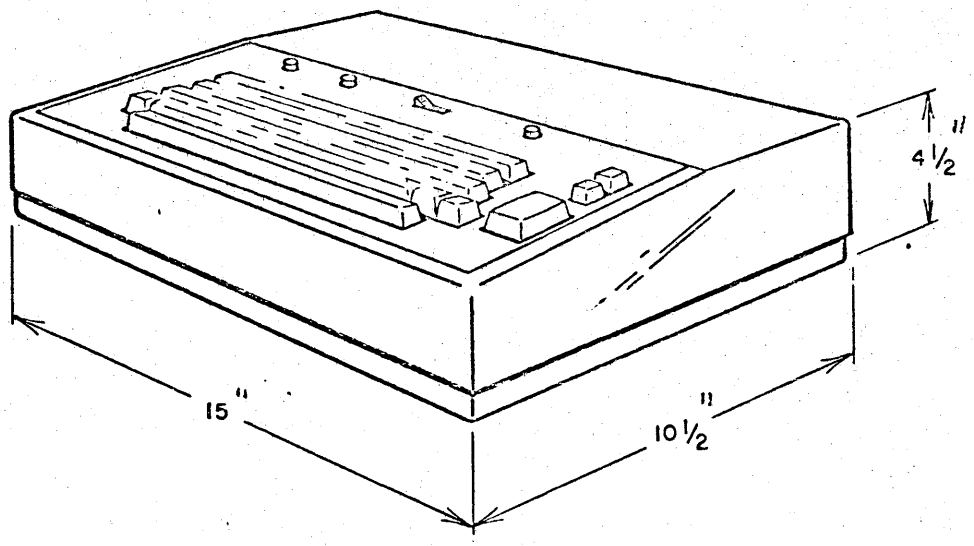
*Only one required per keyboard or pair of associated keyboards
**Only one required per machine

LITERATURE AVAILABLE.

Name	Publication No.
Entry Keyboards Hardware Reference/Customer Engineering Manual	82140400

PHYSICAL CHARACTERISTICS.

WEIGHT: 10 Lbs
INPUT POWER: Requires +12 and +16 volts from Display Station
OUTLINE DIMENSIONS: See following illustrations



TYPEWRITER STATION

The Typewriter Station produces hardcopy of coded data through the use of a Selectric typewriter. A typewriter adapter kit must be installed to provide the data link.

Equipment Number	Part Number
CK402-A	14039500
CK402-B	14039600

ADAPTER KITS REQUIRED.

Equipment Number*	Description	Part Number
DG103-A	Typewriter Driver Module	15509800
DG104-A	Typewriter Driver Module	15509900

*Only one required per typewriter

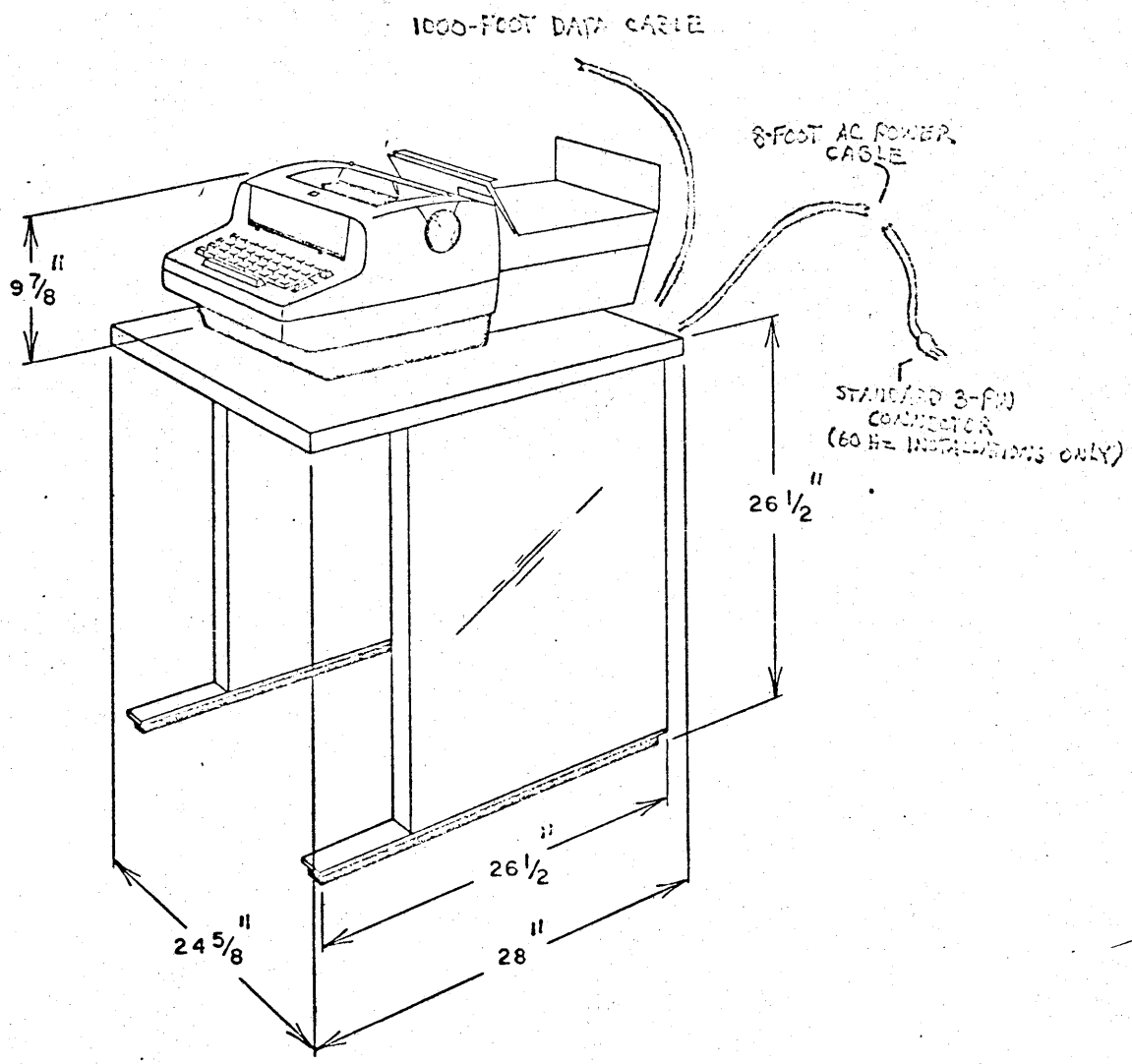
LITERATURE AVAILABLE.

Name	Publication No.
Typewriter Station Hardware Reference/Customer Engineering Manual	82134400
Scheduled Maintenance and Lubrication**	241-5308-0
Adjustments**	241-5309-0
Removal**	241-5310-0
Specifications**	241-5311-0
Diagnostic Aids**	241-5302-0
Parts Catalogue**	241-5157-7

**Must be ordered from: Office Products Division
Customer Engineering
International Business Machines Corp.
Lexington, Kentucky

PHYSICAL CHARACTERISTICS.

WEIGHT: 170 Lbs
BTU'S/HOUR: 270
INPUT POWER: (CK402-A) 120 volts, 60 Hz, 1 ampere
(CK402-B) 220 volts, 50 Hz, 0.5 ampere
OUTLINE DIMENSIONS: See following illustrations



MAIN TIMING ADAPTER KIT

The main timing module provides synchronous clock pulses for all subscribing modules. Display format and "edit" keyboard requirements necessitate four different modules, only one of which may be included in any given configuration.

Equipment Number	Keyboard	Display Format	Part No.
FV112-A	Edit	20 Lines of 50 Symbols	14037800
FV113-A	Edit	13 Lines of 80 Symbols	14037900
GA101-A	Non-Edit	20 Lines of 50 Symbols	14036400
GA102-A	Non-Edit	13 Lines of 80 Symbols	14036500

LITERATURE AVAILABLE.

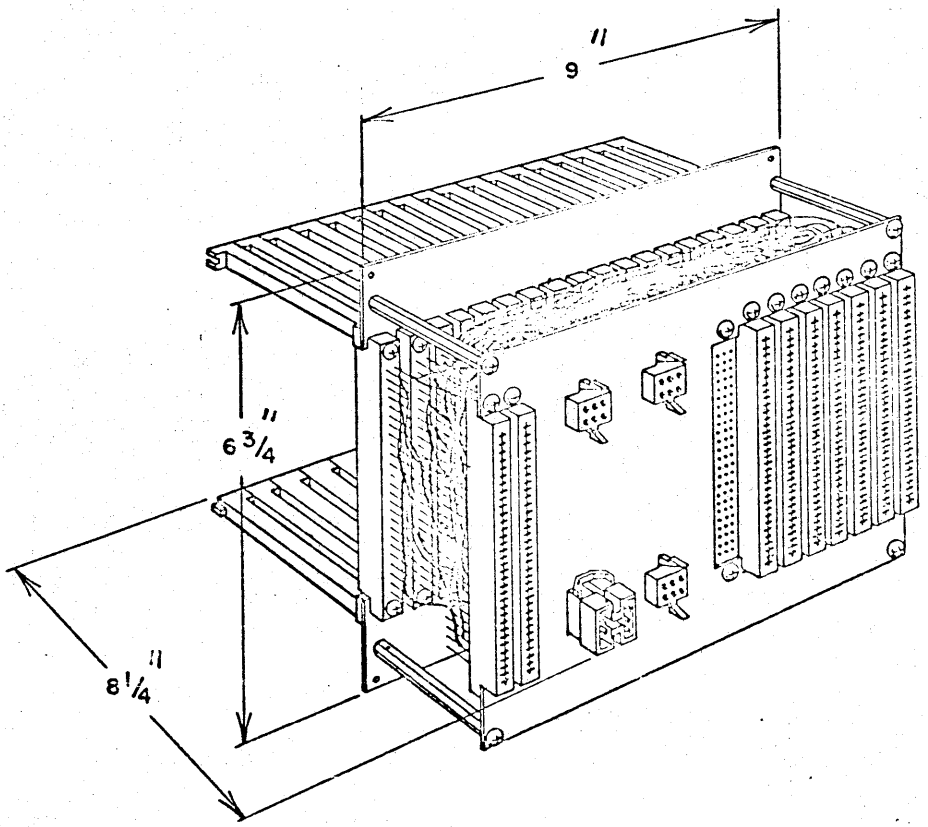
Name	Publication No.
Main Timing Adapter Kit Hardware Reference/Customer Engineering Manual	82139700

PHYSICAL CHARACTERISTICS.

WEIGHT:
BTU'S/HOUR: 264
INPUT POWER*: +5, +20, -20 volts required from cabinet
OUTLINE DIMENSIONS: See following illustrations

*Additional 0.66 ampere required on ac input to cabinet

MAIN TIMING ADAPTER KIT (cont)



SYMBOL GENERATOR ADAPTER KIT

Each Display Station within a subsystem receives pulse trains for character generation from a centralized symbol generator. Synchronous timing is provided by a main timing module, while power is obtained from the cabinet's regulated dc power supply.

Equipment Number	Part Number
GK103-A	15503400

LITERATURE AVAILABLE.

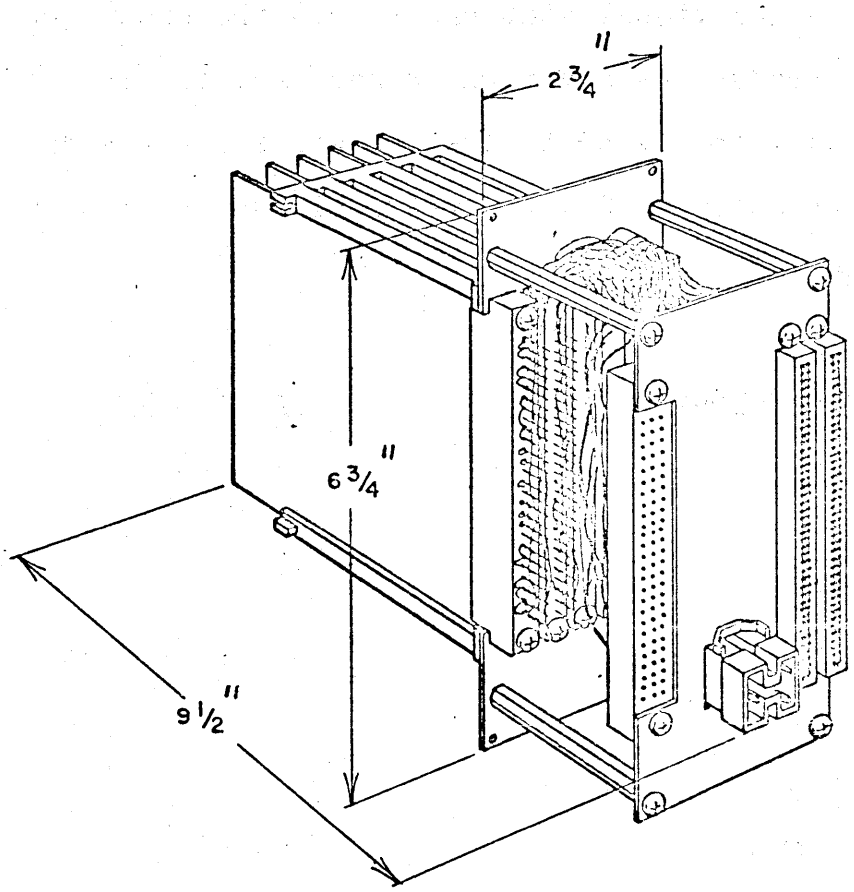
Name	Publication No.
Symbol Generator Adapter Kit Hardware Reference/Customer Engineering Manual	82139900

PHYSICAL CHARACTERISTICS.

WEIGHT:
BTU'S/HOUR: 116
INPUT POWER*: +5, +20, -20 volts required from cabinet
OUTLINE DIMENSIONS: See following illustrations

*Additional 0.3 ampere required on ac input to cabinet

SYMBOL GENERATOR ADAPTER KIT (cont)



3000 INTERFACE ADAPTER KIT

The 3000 Interface Adapter kit provides exchange of data with the 3000 Series data channel. Communication transposes twelve or six bit words from the data channel into seven bit words for the individual stations within the subsystem. In addition, it transposes seven bit words from the individual stations into six or twelve bit words for the data channel. Data transfer is 25,000 twelve bit words or 50,000 six bit words per second.

Equipment Number	Part Number
DC116-A	15508100

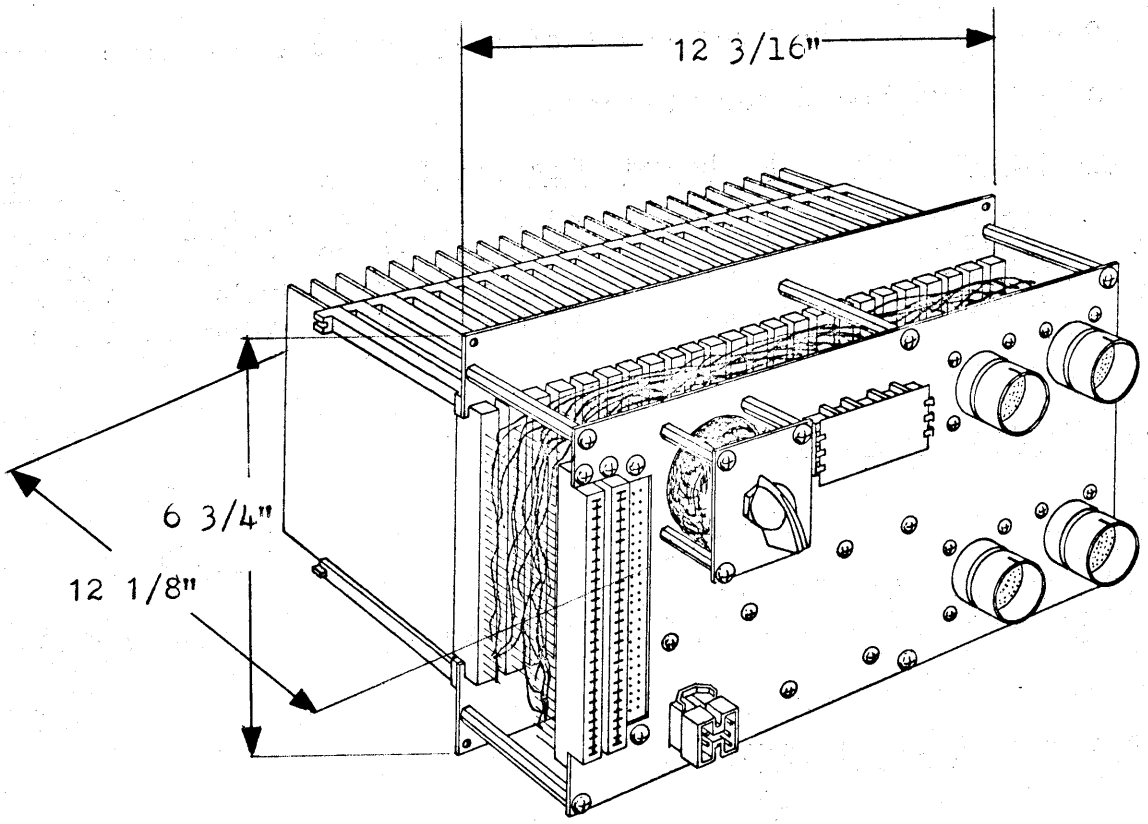
LITERATURE AVAILABLE

Name	Publication No.
3000 Interface Adapter Kit Hardware Reference/Customer Reference Manual	82141800

PHYSICAL CHARACTERISTICS.

WEIGHT:
BTU'S/HOUR: 160
INPUT POWER*: +5, +20, -20 volts required from cabinet
OUTLINE DIMENSIONS: See following illustrations

*Additional 0.4 ampere required on ac input to cabinet


12 3/16"
6 3/4"
12 1/8"

DISPLAY STATION ADAPTER KIT
(Display Station Driver Module)

The Display Station Adapter Kit provides control logic and memory for a Display Station and any associated entry keyboard(s). The four types of adapters cover display format and edit keyboard requirements.

Equipment Number	Keyboard	Display Format	Part No.
FV135-A	Non-Edit	20 Lines of 50 Symbols	15508600
FV136-A	Non-Edit	13 Lines of 80 Symbols	15508700
FV137-A	Edit	20 Lines of 50 Symbols	15508800
FV138-A	Edit	13 Lines of 80 Symbols	15508900

LITERATURE AVAILABLE.

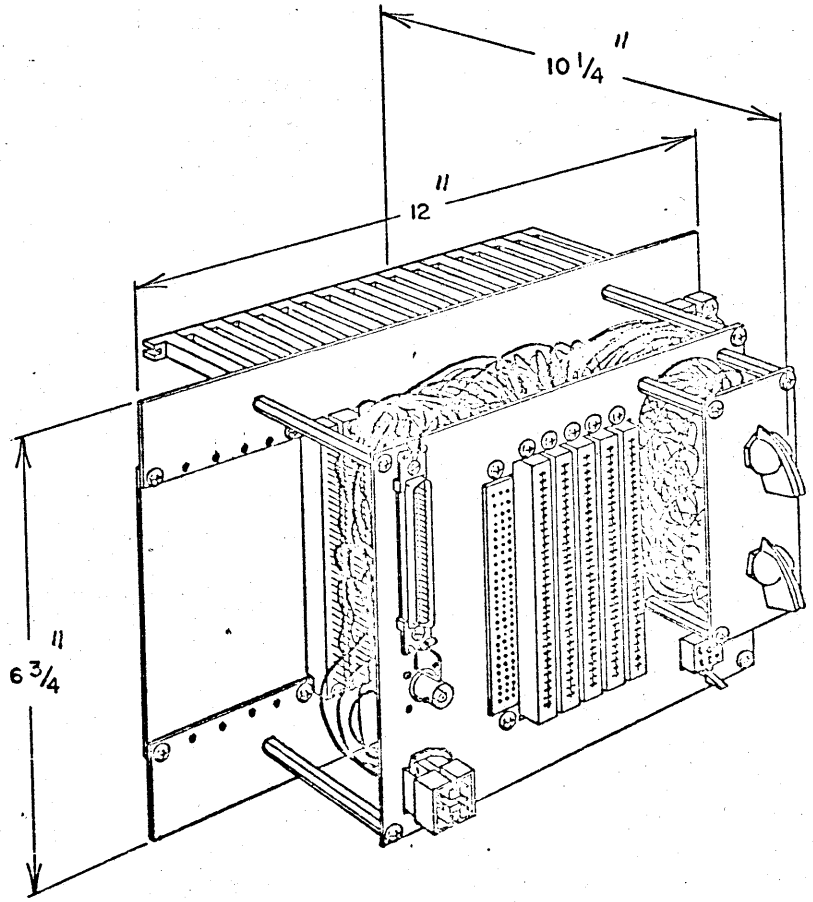
Name	Publication No.
Display Station Adapter Kit Hardware Reference/Customer Engineering Manual	82140100

PHYSICAL CHARACTERISTICS.

WEIGHT:
BTU'S/HOUR: 120
INPUT POWER*: +5, +20, -20 volts required from cabinet
OUTLINE DIMENSIONS: See following illustrations

*Additional 0.3 ampere required on ac input to cabinet

DISPLAY STATION ADAPTER KIT (cont)



TYPEWRITER ADAPTER KIT
(Typewriter Driver Module)

The Typewriter Adapter Kit links a Typewriter Station to the communications terminal. A delay line memory is provided for data storage and buffering purposes. The two adapter types provide compatibility with the two display formats.

Equipment Number	Display Format	Part Number
DG103-A	20 Lines of 50 Symbols	15509800
DG104-A	13 Lines of 80 Symbols	15509900

LITERATURE AVAILABLE.

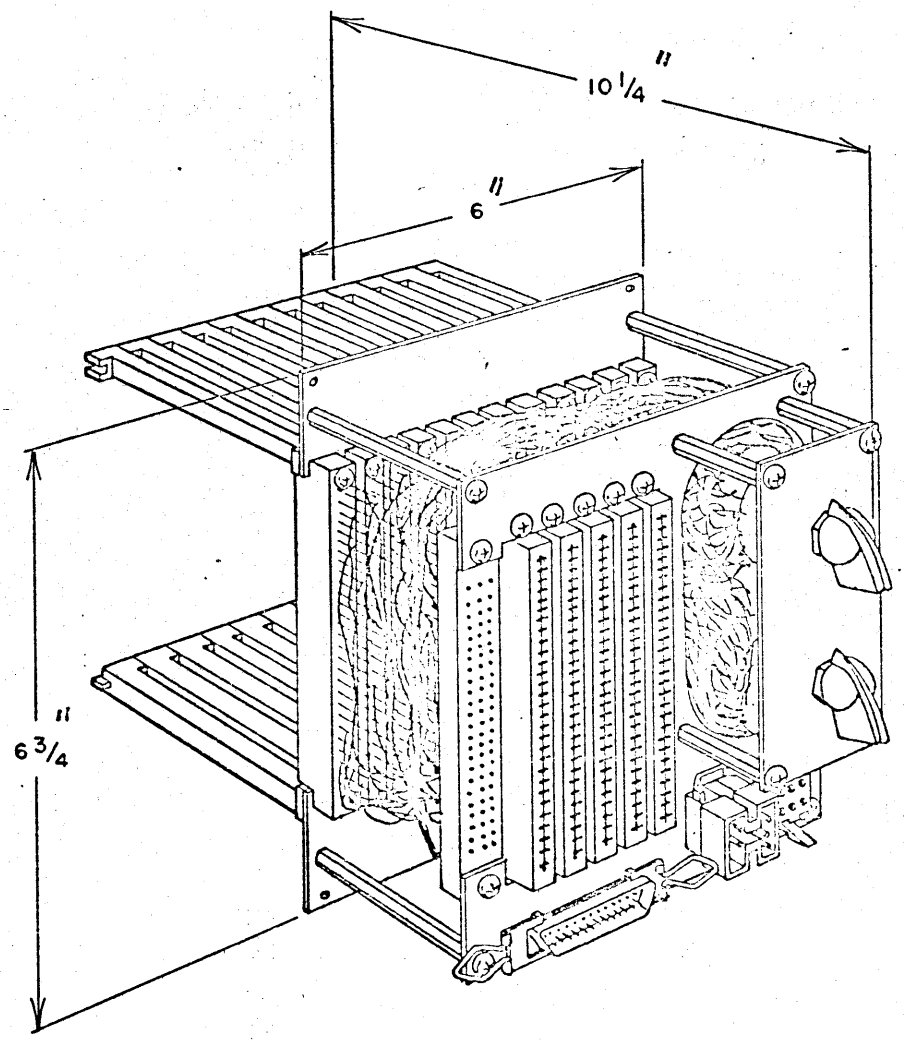
Name	Publication No.
Typewriter Adapter Kit Hardware Reference/Customer Engineering Manual	82140200

PHYSICAL CHARACTERISTICS.

WEIGHT:
BTU'S/HOUR: 60
INPUT POWER*: +5, +20, -20 volts required from cabinet
OUTLINE DIMENSIONS: See following illustrations

*Additional 0.15 ampere required on ac input to cabinet

TYPEWRITER ADAPTER KIT (cont)



POWER CONVERSION KIT

The FC101-A controller cabinet can operate from a 50 Hz power source when the power conversion kit is installed. Changes apply to the blower assembly, power distribution module, and two power supplies.

Equipment Number	Part Number
GD601-A	14038000

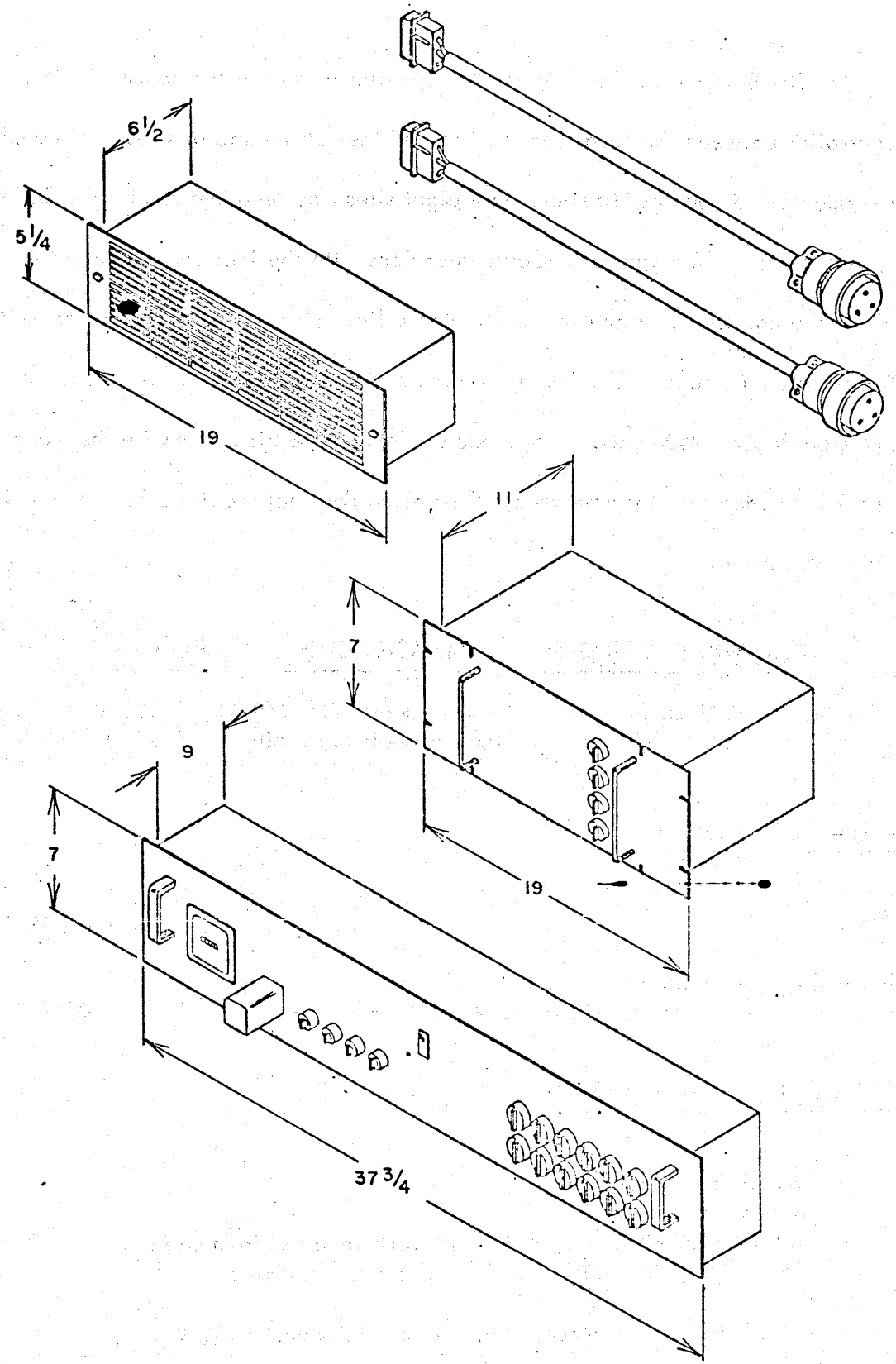
LITERATURE AVAILABLE.

Name	Publication No.
Power Conversion Kit Hardware Reference/Customer Engineering Manual	82140300

PHYSICAL CHARACTERISTICS.

WEIGHT:
BTU'S/HOUR: 610
INPUT POWER: 220 volts, 50 Hz, 1.2 amperes
OUTLINE DIMENSIONS: See following illustrations

POWER CONVERSION KIT (cont)



BUFFER DATA SET ADAPTER KIT
(Buffer Data Set Module)

The Buffer Data Set Adapter Kit operates as an interim communications controller between the local data source and the remote site or sites. Although the adapter can address 16 sites, only eight sites may be addressed by the 3000 system through each adapter. Communications with the local data source take place through the interface within the controller cabinet. Communications with the remote sites takes place through modems and telephone lines at a data rate not greater than 2400 baud. The module exchanges 8 bit codes with the modem and 7 bit codes with the interface. Operation does not require a separate power line connection.

EQUIPMENT NUMBER	MEMORY SIZE	PART NO.
FV166-A	1000 symbols (20 x 50)	15519100
FV172-A	1040 symbols (13 x 80)	15521800

LITERATURE AVAILABLE.

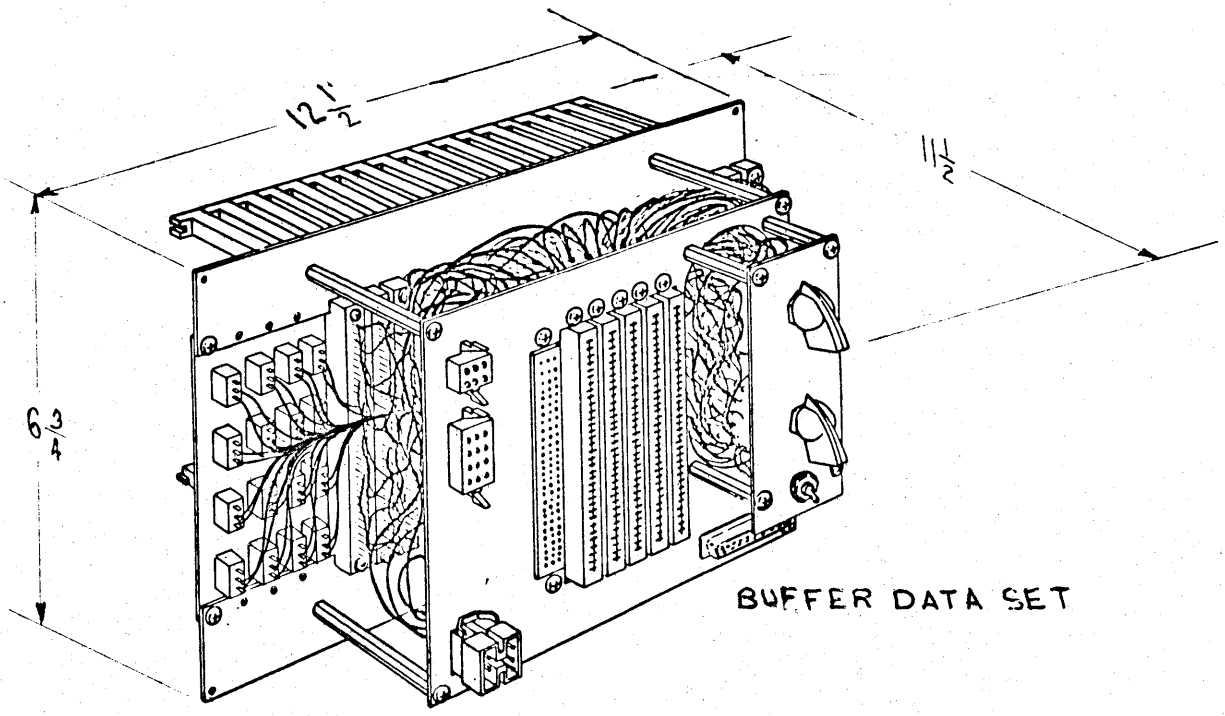
Name	Publication No.
Buffer Data Set Adapter Kit Hardware Reference/Customer Engineering Manual	82150500

PHYSICAL CHARACTERISTICS.

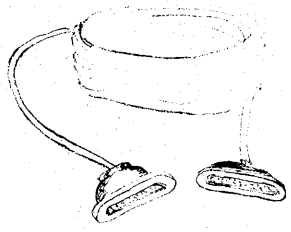
WEIGHT: 22 Lb.
BTU'S/HOUR: 40.8
INPUT POWER*: +5, +20, -20 volts required from cabinet
OUTLINE DIMENSIONS: See following illustrations

* Additional 2.26 ampere required on AC input to cabinet

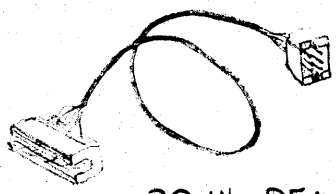
BUFFER DATA SET ADAPTER KIT (CONT)



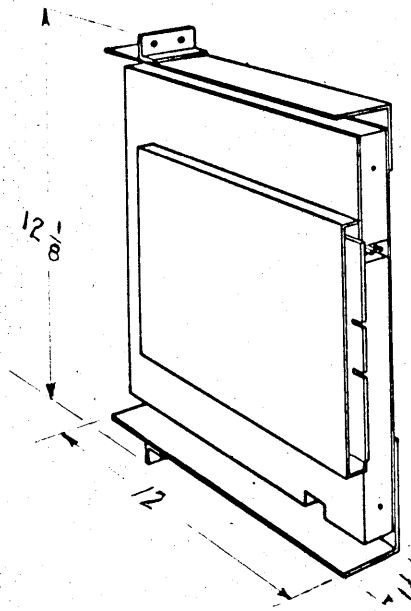
BUFFER DATA SET



30 FT. DATA CABLE



20 IN. DELAY LINE CABLE



DELAY LINE

NOTE:
DIMENSIONS IN INCHES