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IBM System/360 Component Description

| IBM 2265 Display Station Model 1

IBM 2845 Display Control

This manual describes the functional and operating characteristics of the
| IBM 2265 Display Station Model 1 and the IBM 2845 Display Control. The
two units combine to form a display system that provides visual access to
data stored in an IBM System/360. The IBM 2265 Display Station Model 2,
which can be attached only to an IBM 2772 Multi-Purpose Control Unit, is
described in *System Components: IBM 2770 Data Communications
System*, Form GA27-3013.
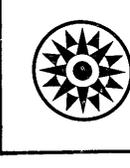
Preface

This SRL publication assumes the reader has a knowledge of System/360 principles of operation. Therefore, discussions of such System/360 considerations as instruction and command structures, Channel Status Word and Program Status Word locations and usage, varieties and priorities of interruptions, and generalized capabilities such as I/O channel status and sense byte usage, command and data chaining, length suppression, etc., have been kept to a minimum. This publication does not differentiate between the various models of System/360; i.e., main storage capacities, subchannel allocations, sharing and nonsharing of I/O channel and processor circuitry, and so forth. The reader is directed to the authoritative source for each model of System/360, *System/360 Functional Characteristics* (by model). Other IBM publications that will be of use to the reader are:

IBM System/360 Principles of Operation, Form GA22-6821
IBM 2701 Data Adapter Unit - Component Description, Form GA22-6864
IBM System/360 Bibliography, Form GA22-6822
IBM Multiplexers and Communications Terminals Installation Manual - Physical Planning, Form GA27-3006

Note: In this manual, "I/O (input/output) channel" refers to a multiplexer channel. This device provides the data path and controls between the central processor and the 2701 Data Adapter Unit. "Communications channel" refers to the communications medium (telephone lines, telegraph, microwave, etc.) used to transmit data, via appropriate data sets, between the 2701 and the 2265-1/ 2845 display system.

Illustrations

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IBM 2265 Display Station (Design Model)

IBM 2845 Display Control (Design Model)

The IBM 2845 Display Control, coupled with an IBM 2265 Display Station Model 1, forms a display system that provides rapid visual access (via communications facilities) to data stored in a remotely located System/360 Models 25 through 85 or 195. The 2265 Display Station Model 1 (hereafter called the 2265) is a high-speed display terminal that operates under control of the compact 2845 Display Control. The display system is designed to meet the requirements of customers whose facilities are widespread and who need a small number of display terminals at each facility capable of two-way communications with a centrally located computer.

For example, consider a company whose central processing unit is located at company headquarters in Chicago and whose branch offices and warehouses are scattered throughout the country. Each outlying location may be equipped with a number of 2265/2845 display systems commensurate with its business volume. By means of communications facilities (such as phone lines, data channels, etc.), each display system can store data in, and receive visual information from, the central processor.

This system satisfies the needs of customers who require relatively few displays or who desire to supplement an existing display system. It is ideally suited to applications that require immediate data acquisition capabilities at relatively low cost.

An inquiry concerning an account, a transaction, a production schedule, etc., can be entered quickly and easily in the remote computer from the 2265 keyboard. After being processed by the computer, the desired information is displayed on the 2265 screen in the form of visual data. Here, the display information can be analyzed, modified if necessary, and, when desired, returned to the computer for further processing and storage.

The 2845 may also be equipped with a special feature to permit attachment of an IBM 1053 Model 4 Printer. The Printer may be used to produce a paper copy of data sent from the central processor or of data displayed on the 2265 screen.

HIGHLIGHTS

- Character presentation uses an advanced stroke-generation technique that results in characters of unusual clarity and smoothness.

- 2265 CRT uses Type P39 phosphor to produce a green-tinted display.

- Each 2265 has a capacity of 960 characters, with an optional display format of either 15 rows of 64 characters or 12 rows of 80 characters.

- Transmission speeds of either 1200 bps or 2400 bps.

- Optional attachment of an IBM 1053 Model 4 Printer.

- Optional attachment of an alphameric keyboard which may be located up to 5 feet from the Display Station.

- Rapid cursor (character position marker) movement is provided in forward and backward directions.

- By operator control, the display screen can be erased either a line at a time, a section at a time, or completely.

- Optional Tab feature.

- A nondestructive cursor is standard; a destructive cursor is optional.

- Line addressing to permit selective writing is also available.

- For World Trade customers, a 50-Hz power option is available. Also available are keyboards for the following languages:
    United Kingdom English
    French
    German

GENERAL DESCRIPTION

The 2265/2845 display system consists of two separate units: the IBM 2265 Display Station Model 1 and the IBM 2845 Display Control. The 2845 is a free-standing unit which contains the storage and control logic necessary to interface with a 2265 and appropriate communications facilities. The unit provides for additional features such as the printer adapter and the 1200-bps or 2400-bps data set adapters described below.

The 2845 is designed for remote attachment to a System/360-type I/O channel through an IBM 2701 Data Adapter Unit equipped with IBM Terminal Adapter Type III. Program compatibility permits multidropping with the IBM 2848 Display Control. Up to sixteen 2845's may be attached to the same communications channel. The relatively small size of each unit enhances the display system's desirability in installations wherein limited space is a factor.

The 2265 Display Station contains the 14-inch cathode-ray tube (CRT) upon whose screen a maximum of 960 alphameric characters can be displayed. The 2265 is equipped with an alphameric keyboard to make it a complete input/output (I/O) device. The keyboard is connected to the display station by a cable which permits the keyboard to be positioned up to 5 feet away from the display. Display station cover design is such that when the display and keyboard are correctly positioned together they appear as a single unit.

The face of the CRT (i.e., the display screen) is coated internally with Type P39 phosphor to produce characters having a green tint. By redrawing the displayed characters approximately 50 times a second (technically, a refresh rate of approximately 50 Hz), a nonflickering image is formed.

Through use of an advanced character-generation technique, the electron beam is moved in a series of short strokes to form each character. By deflecting the beam (up to a maximum of 40 times), blanking and unblanking it as necessary, a character is drawn on the display screen.

The strokes required to compose each character are predefined and are automatically generated via digital-to-analog conversion by a character generator. Therefore, character generation need not be considered when programming the display system. The character generator responds to the characters received from the 2845 and produces the corresponding analog signals. These signals are applied to a deflection yoke surrounding the neck of the CRT to control the luminous trace of the electron beam. By blending together the strokes that compose each character, characters of unusual smoothness are formed on the display screen.

An antireflective display screen is used on the 2265 Display Station to minimize reflections from ambient light sources and reflective objects. A manually operated brightness control ensures comfortable viewing in installations with room light ambients of up to 75 footcandles.

PROGRAMMING SUPPORT

2701 Teleprocessing (TP) applications are made easier and more efficient by the use of the IBM-supplied programming-support packages. The primary support packages consist of a pair of data-management access methods designed specifically for the TP environments. These access methods satisfy the programming requirements for a large portion of commonly used TP applications, including the 2848 and 2260. They operate under either a full Operating System (OS) or the smaller Disk Operation System (DOS). The 2265/2845 can operate under these two programming packages.

One of the access methods, BTAM (Basic Telecommunication Access Method), provides the programmer with simple, efficient access to the communication environment so that he can program the terminal in a manner consistent with that used for conventional sequential-type I/O devices. BTAM controls data transmission; however, it does not provide for elaborate message-queuing capability or for actual processing of the message itself.

The second access method, QTAM (Queued Telecommunication Access Method), provides all the above-mentioned capabilities of BTAM. In addition, it incorporates facilities for queuing messages on direct-access storage devices (e.g., disk, drum, etc.). QTAM also provides capabilities for data-collection and message-switching applications and may be used intact both for these functions and for a large range of other TP uses. Like BTAM, QTAM insulates the programmer from most of the programming details of the 2701 and the attached terminal equipment. The appropriate SRL publications should be consulted for detailed information concerning the use of these access methods.

In some cases, primarily because of special system configurations or requirements, TP programming can be more appropriately implemented if the user develops the I/O channel command programs for the 2701/2845 operation. This publication provides programming information about the I/O channel commands used with the 2265/2845. These commands can be implemented through the EXCP (Execute Channel Program) macro instruction offered in each of the System/360 programming systems. This publication includes sufficient information for user preparation of the I/O channel program. Also, the user of the various programming-support packages will find this publication helpful.

FEATURES

Several features may be installed in the 2265/2845 display system. In certain cases, the feature is required to make the system function. These features must be specified by the customer and are, therefore, referred to as Specify features. An example of a Specify feature is the Display Format Feature. Other features are optional and, when installed, expand the capabilities of the system. These are referred to as special features. An example of a special feature is the Printer Adapter Feature. Although this special feature is not essential to the display system operation, it does expand the system's capability to include control of an output printer. Both types of features are described more fully below. All features are summarized in Figures 14 and 15 of Appendix A.

Specify Features

One each of the following features must be installed in the 2845 Display Control. (The number appearing in parentheses after the feature name is the feature number.)

Data Set Adapters

The 1200-bps (bits per second) and 2400-bps data set adapters provide all the controls necessary to communicate

with the System/360 channel by means of appropriate data sets and channels via an IBM 2701 Data Adapter Unit. These control functions include synchronization and recognition of special communications-channel-line-control characters, decoding and temporary storage of commands, and transfer of data and control information between the 2845 display buffer and the attached data set. To interface with the appropriate data set (see "Data Sets"), one of the following data set adapters must be specified:

Data Set Adapter (9012). This adapter permits attachment of the 2845 to a data set operating at a speed of 1200 bps; it also provides the necessary clocking.

Data Set Adapter (9013). This adapter permits attachment of the 2845 to a data set operating at a speed of 2400 bps. Clocking must be provided by the data set.

Display Format Features

The characters displayed on the Display Station screen may be presented in one of two display image formats. One format displays 15 lines of 64 characters each; the second format displays 12 lines of 80 characters each. With either format, the total number of characters that may be displayed is 960. One of the features described in the following two paragraphs must be chosen to display the desired format.

Display Format (9101). This display format uses a large character with a horizontal character step of 0.16 inch and a vertical line step of 0.32 inch to display 15 rows of 64 characters. The resulting display frame measures nominally 10.3 inches by 4.6 inches.

Display Format (9102). This display format uses a somewhat smaller character than the 9101, with a horizontal character step of 0.13 inch and a vertical character step of 0.26 inch to display 12 rows of 80 characters. The resulting display frame measures nominally 10.3 inches by 3.0 inches.

World Trade Language Features

World Trade models must have one of the World Trade Language Features installed. The language feature provides the 2265 and 2845 with equipment labels and a character generator appropriate to the language specified. See Appendix A for feature numbers and Appendix B for World Trade label, indicator and switch translations, and unique character codes.

Voltage Features

A voltage feature must be specified for U.S. (Domestic) and World Trade models of the 2265 and 2845. These features are summarized (with feature numbers) in Figures 14 and 15 of Appendix A.

Special Features

The following special features may be selected at the option of the customer. (The number in parentheses following the feature name is the feature number.)

Alphameric Keyboard Feature (4766)

This feature permits the operator to key in data at the Display Station for display and/or transmission to the central computer. When a 1053 Printer is attached to the 2845, the keyboard also permits a paper copy of the displayed data to be printed.

As World Trade options, keyboards are available in four languages. When a keyboard is selected, it is provided in the same language as specified under the World Trade Language feature. (See Figures 16, 17, and 18 in Appendix B for layout of keyboards.)

1053 (Printer) Adapter Features

A 1053 adapter feature controls the printing of information by the IBM 1053 Printer. The information to be printed may originate at the central processor and be addressed specifically to the Printer, or the information may be that which is currently being displayed on a 2265 Display Station screen. In the latter case, the 1053 Adapter Feature controls the transfer of displayed data to the Printer to obtain a permanent record of the data. The following two adapter features are mutually exclusive, and their selection depends upon which Display Format Feature is installed.

1053 Adapter Feature (7927). This feature permits attachment of an IBM 1053 Printer to a 2845 Display Control equipped with Display Format Feature 9101. It allows printing of messages of up to 240 characters from the computer. It also allows printing of messages displayed on a 2265 screen in the 15-rows-of-64-characters format.

1053 Adapter Feature (7928). This feature permits the attachment of an IBM 1053 Printer to a 2845 Display Control equipped with Display Format Feature 9102. It allows printing of messages of up to 240 characters from the computer. It also allows printing of messages displayed on a 2265 screen in the 12-rows-of-80-characters format.

Note: The 1053 Printer supplied for World Trade use with the 2845 must have the appropriate World Trade language feature. The print ball supplied contains characters unique to the language specified.

Line Addressing Feature (4801)

The line addressing feature permits the program to select the location on the 2265 screen at which a display message will start. The display starting locations coincide with the first character position of each row (line) of the 2265

screen. The line address is included as part of the message transmitted under the Write Line Address command and is described under "Principles of Operation".

Destructive Cursor Feature (3301)

When this feature is installed in the 2845, the destructive cursor symbol replaces the standard nondestructive cursor symbol as the display position marker. The destructive cursor symbol appears on the 2265 screen as a horizontal bar (▄). The cursor marks the display position that the next character will occupy. From the 2265 keyboard, the cursor may be backspaced or advanced one space at a time, moved up or down, or moved to the beginning of the next line. Any character occupying the position to which the destructive cursor is moved is deleted. (Further information concerning both the destructive and nondestructive cursors is found under "Special Symbols.")

Tab Feature (7801)

This special feature permits keyboard indexing of the cursor. Depressing the TAB key initiates a search for a colon. Upon detection of a colon, the cursor is repositioned to the character position immediately following the colon. When the nondestructive cursor is used, there is no change in the display other than the repositioning of the cursor. When the Destructive Cursor Feature is installed, any character located in the position immediately following the colon is replaced by the destructive cursor. This replacement and the repositioning of the cursor are the only changes in the display.

New Line (NL) characters have no effect on the tab operation. Character locations to the right of an NL character are also searched for the presence of a colon.

SYSTEM CONFIGURATION

Figure 1 is a block diagram of a possible 2265/2845 configuration. A basic system is the same except that the 1053 block would be absent. The 2265/2845 display system is program-compatible with the IBM 2848 Display Control, Models 1, 2, and 3, equpped with the Data Set Adapter. Therefore, the 2848 as well as the 2845 may be attached to the same communications channel in a multidrop (multistation) configuration.

DATA SETS

One of the data sets described in the following paragraphs is required to interface the 2845 Display Control with the communications channel.

U.S. (Domestic) Operation

In U.S. (Domestic) operation, the 2845 Display Control operates at 1200 or 2400 bps, point to point and multipoint.

For 1200-bps operation, four-wire Telephone Company or Western Union Type 3002 four-wire duplex facilities with C1 Conditioning* is required. Western Electric Data Set 202D1* is specified. Clocking is provided by the 2845.

For 2400-bps operation, four-wire Telephone Company or Western Union Type 3002 four-wire duplex facilities with C2 Conditioning* is required. Western Electric Data Set 201B1* is specified. Clocking is provided by the data set.

World Trade Operation

Operation with the following data sets (modems) in a point-to-point or multipoint configuration over four-wire service is at 1200 bps only:

IBM 3976 Modem Model 3

IBM 3977 Modem Model 2.

Like modems must be used in a given configuration.

TYPICAL DISPLAY SYSTEM OPERATION

The 2265/2845 display system provides a rapid and efficient means of two-way communication with the remotely located central processor. The extent and flexibility of data manipulation is a function of the Specify and special features installed in a given display system. Following is a brief description of a typical display system operation.

Assume, initially, that the Display Station screen is blank except for a Start of Message symbol (▶) in the first character position and a character position marker (—), called a cursor, in the second character position in the upper left corner of the display screen. The operator simply keys in a message on the typewriter-like keyboard. As each key is depressed, the corresponding character is stored in a buffer in the 2845 and simultaneously displayed on the 2265 screen. As each character is keyed in, the cursor advances one display position. The cursor thus serves as a marker to indicate the display position the next character will occupy on the screen. When the message is

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*or equivalent

System/360

I/O Channel

2701 Data Adapter Unit

IBM Terminal Adapter Type III

Data Set

Communications Channel

Data Set   Data Set   Data Set

2845 Display Control

2260/2848 Display Complex

2845 Display Control

2265 Display Station

1053 Printer Mod 4

1053 Printer Mod 4

2265 Display Station
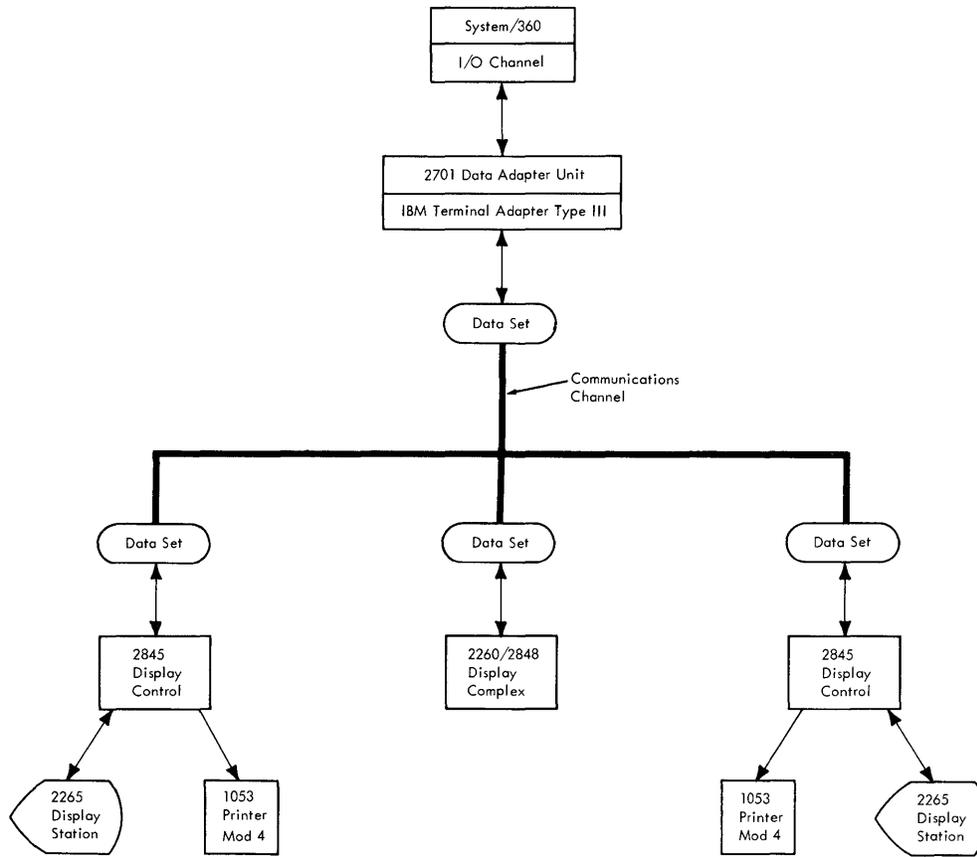
Note:
   A maximum of sixteen 2845's may be multi-dropped
   on one communications channel.

Figure 1. Typical Connection of an IBM 2845 Display Control to a Remote Central Processor Showing Application in a Multidrop Communications Network.

complete, the operator visually verifies the message and then depresses the ENTER key. At the same time, the keyboard locks and the ENTER PENDING indicator on the keyboard lights. The next time the Display Station is polled by the central processor, the completed message is automatically transmitted to the processor. The ENTER PENDING indicator remains lit until the polling operation has been successfully terminated. When the indicator turns off, the Start of Message (SOM) symbol disappears, the keyboard unlocks, and the operator is free to key in another message.

Under program control at the central processor, messages may also be sent from the central processor to the 2845 and displayed on the Display Station screen. Characters of the message text are displayed on the screen, beginning at the character position currently occupied by the cursor.

If the Display Control is equipped with the Line Addressing feature, the program may designate that the first character be displayed in the first character position of a specified line. By the use of various commands, the program may erase all data from the Display Station screen or may cause all data stored in the display buffer to be transmitted to the central processor.

The screen may also be erased by the Display Station operator. In addition to being able to erase the complete screen, the operator may selectively erase all data from the cursor to the end of that line or from the cursor to the end of the screen. The operator may erase any character or replace it with another simply by positioning the cursor to the described character location and depressing the SPACE/ERASE-ADVANCE bar (to erase the character) or

depressing a different character key (to replace the character). Rapid positioning of the cursor by the operator is also provided. By depressing the proper key, the cursor may be moved up, down, left, or right.

The functions of the commands and keyboard keys are described in detail later in this publication.

OPERATION WITH 1053 PRINTER

When a 1053 Printer is attached to the Display Control, the data displayed on a 2265 screen can be printed by depressing the PRINT key on the 2265 keyboard. All data from the first displayable character position of the screen up to the character position occupied by the cursor (except for those characters to the right of and on the same line as the NL character) are transferred to the Printer. Detection of the EOM symbol ends the print operation immediately after the EOM symbol is printed. Because the EOM symbol may be displayed to the right of an NL symbol, all character positions to the right of an NL symbol are searched for an EOM symbol even through the characters displayed in these positions are not printed. (The EOM symbol itself is printed.)

If an internal parity error occurs within the 2845 after a keyboard print operation is initiated and before the operation is terminated, a Check symbol ($\searrow$) is printed as the last character of the printed text. The Check symbol notifies the operator that an internal parity error has been detected, but does not identify the character(s) involved. The parity error may have occurred in either the display buffer or the printer buffer. In any case, all characters are printed as they exist in the display buffer.

Remotely, by means of a Write Printer command, the central processor may send a message of up to 240 characters via the 2845 to the 1053 Model 4 Printer. The entire message is received and stored in the printer buffer of the 2845 before it is transferred to the Printer. If an error is detected during message transmission, transfer to the Printer is inhibited and the entire message must be retransmitted. If, however, no errors are detected in transmission, receipt of the final message character initiates transfer of the message to the Printer and printing commences.

As in the keyboard PRINT key operation, detection of an internal parity error, either in the printer buffer or display buffer of the 2848, causes a Check symbol to be printed as the last character of the printed message. The Check character simply indicates that an error has been detected within the 2845 but does not identify the character(s) involved.

A message of up to 240 characters may be sent by the central processor to the Printer via the 2845. A Printer message of greater length may be sent to the Display Station, with the operator instructed (as part of the message) to execute a keyboard Print operation. Or, the message may be sent in individual Write Printer transmissions of 240 characters or less directly to the Printer. During transmission from the central processor to the Printer, data displayed on the display screen is not affected.

The 1053 Printer, when controlled by the 2845, is equipped with a special print element that permits printing of the SOM, EOM, and Check symbols. Therefore, all characters are printed as they exist in the printer buffer. However, the NL symbol is not printed; rather, it causes a carriage return/line feed (CR/LF) operation.

2265 DISPLAY STATION OPERATOR CONTROLS AND INDICATORS

Operator controls on the 2265 Display Station (not including those located on the keyboard) are a POWER ON switch/indicator, a POWER OFF switch, and a Brightness control. (A single POWER ON/OFF switch is the only control on the 2845 Display Control accessible to the operator.)

The POWER ON switch/indicator is located on the front right side of the 2265. Upon depression of this switch/indicator, all voltages required for operation are supplied to the 2265 and 2845 provided the 2845 POWER ON/OFF switch is set to ON. When all power is on in both units, the 2265 POWER ON switch/indicator lights. Voltages necessary for operation are turned off in both units when either the 2265 POWER OFF switch (located immediately below the POWER ON switch/indicator) is depressed or when the 2845 POWER ON/OFF switch is flipped to OFF. (A 49V source, located in the 2845, is energized and supplies 49V to the 2265 when the 2845 POWER ON/OFF switch is ON regardless of the condition of the 2265 power switches. However, other voltages, off at this time, are required to make both units operational.)

The Brightness control is located immediately above the POWER ON switch/indicator on the 2265. Rotating the Brightness control knob clockwise increases the brightness of the characters displayed on the screen, thus enabling the operator to adjust the brightness to a comfortable viewing level.

Two indicators are located on the 2265 keyboard. The DATA SET READY indicator notifies the Display Station operator that the attached data set has power on and is ready to function. The ENTER PENDING indicator informs the operator that an Enter operation is pending. While the ENTER PENDING indicator is lit, the keyboard is locked. The ENTER PENDING indicator lights when the ENTER key is depressed and is extinguished when one of the following occurs:
1. Polling of the Display Station is successfully terminated.
2. The RESET key is depressed before 2845 recognition of a specific or general poll.
3. Any other command (except Read Addressed Full DS Buffer) precedes the polling operation.

A TEST key enables the operator to quickly test the display system. By observing the display screen, a judgment may be made as to the operational status of the 2265 and 2845. The test procedure is described fully under "Display System Test Procedure".

DISPLAY STATION KEYBOARD

Images to be displayed on the 2265 Display Station screen may be initiated at the Display Station keyboard (Figure 2). Through use of the keyboard data character and control keys, the operator may compose the text to be displayed and may communicate with the 2845 regarding disposition of the text.

Character Keys

The characters that may be displayed consist of 26 uppercase alphabetic characters, 10 numeric characters, and 23 punctuation (or special) characters. Operation of any of the character keys causes the selected character to be displayed on the screen in the character position occupied by the cursor.

Control Keys

See Tables 1 and 2 for a listing of the 2265 control keys and their functions. Note that rapid cursor positioning can be performed by the SPACE/ERASE-ADVANCE and BKSP (Backspace) keys. That is, when any of these keys are depressed to their final stop, the operation of the key is continuously repeated at about nine characters per second as long as the key is held depressed (unless interrupted by an I/O operation).

Special Symbols

The special symbols described in the following paragraphs can be displayed on the screen of the 2265.

Cursor - General Description

The cursor is an automatically inserted visual display position marker; it denotes the display position on the 2265 screen that the next character entered will occupy. Two types of cursor symbols, nondestructive and destructive, are available to permit selection of the cursor best suited to individual applications. Both are described below.

Nondestructive Cursor Symbol (Standard)

The nondestructive cursor symbol appears as ─. It indicates the character position to be occupied by the next character entered on the display. The nondestructive cursor symbol appears on the 2265 screen below the character line and immediately below the character position the next character entered will occupy. Since the nondestructive cursor symbol occupies a display area below the character line, it may be moved about freely on the 2265 screen without interfering with other characters. Table 1 explains the effect that each 2265 keyboard key has on the nondestructive cursor symbol.

The movement of the nondestructive cursor symbol and its position relative to other display characters during the time the data is entered from the 2265 keyboard are described under "Control Key Functions." Also, see Programming Note under "Destructive Cursor Symbol (Feature)".
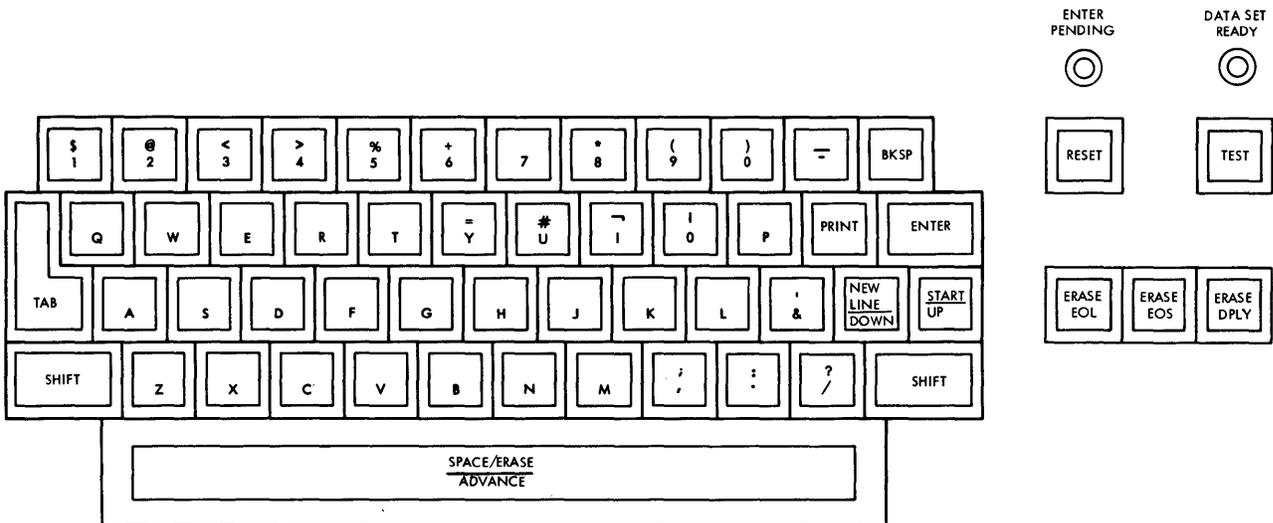
●Figure 2. Display Station Keyboard

Table 1. Functions of 2265 Display Station Keys (Nondestructive Cursor)

Key	No Shift	Shift
Single-Character Keys	Cause symbol to be displayed.	Keyboard locks. No character is entered. Keyboard may be unlocked by depressing RESET key.
Double-Character Keys	Cause symbol on lower half of key to be displayed.	Cause symbol on upper half of key to be displayed.
ENTER	Places EOM symbol in cursor position. Cursor does not move. Keyboard locks and ENTER PENDING light is lit. Upon receipt of Specific Poll or General Poll command, all data between SOM and EOM is sent to computer. If this data contains an NL symbol, data between NL symbol and end of line containing it is not sent.	Same
	If EOM is placed to right of NL symbol, all data between SOM and the NL symbol immediately preceding EOM is sent.	
	If no SOM is displayed, a zero-length message is transmitted.	
	After successful message transmission resulting from a poll, cursor and EOM symbols remain unmoved, but SOM is deleted. Keyboard unlocks and ENTER PENDING light is extinguished.	
	If Write Addressed DS or Erase/Write Addressed DS command is honored before a poll command, first character of text over-writes EOM symbol. When command is concluded, keyboard is unlocked and ENTER PENDING light is extinguished. Enter operation is ended.	
	If Write DS Line Address command is honored before a poll command, EOM symbol may or may not be over-written depending on line addressed and length of text. When command is concluded, keyboard is unlocked and ENTER PENDING light is extinguished.	
	If Read Addressed Full DS Buffer command is honored before a poll command, no change occurs on screen. When command is concluded, keyboard remains locked and ENTER PENDING light is on, indicating Enter operation still pending.	
PRINT	Places EOM symbol in cursor position. Causes all data from first character position in first line to and including the EOM symbol to be printed by the 1053 Printer. Exceptions are NL symbols and data to right of and on same line as NL symbols. However, an EOM symbol located to right of NL symbol is printed. Keyboard is locked during print operation.	Same
	If 2845 is not equipped with Printer Adapter Feature, no operation occurs.	
NEW LINE DOWN	Cursor moves down one line. If it is already in bottom line, it moves to top line. Lateral position of cursor within display remains constant.	Places NL symbol in cursor position. Cursor moves to first character position of next-lower display line. If cursor is already in bottom line, it moves to first character position of top line.
		Data between NL symbol and end of line is left undisturbed.
SHIFT	Permits function shown in "Shift" column for control keys, or enables selection of special character on upper half of keys.	Same

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Table 1. Functions of 2265 Display Station Keys (Nondestructive Cursor) (Cont)

Key	No Shift	Shift
SPACE/ERASE ADVANCE*	Advances cursor one character position, with no other modification of display. If cursor is already in last character position of bottom line, it moves to first character position of top line.	Erases character position to right of cursor and advances cursor one character position. If cursor is already in last character position of bottom line, it moves to first character position of top line.
BKSP (Backspace)*	Backs cursor by one position with no erasures. If cursor is in first character position of screen, it moves to last character position of screen.	Same
START UP	Cursor moves up one line on display. If cursor is in top line, it moves to last line. The lateral position of the cursor within the display remains constant.	1. If no SOM symbol is displayed elsewhere on screen, an SOM symbol is placed in position occupied by cursor when key is depressed. Cursor is advanced one character position. 2. If an SOM symbol is already being displayed when key is depressed, all display data between existing SOM symbol and cursor (except data on same line as and to right of an NL symbol) is erased. Cursor moves to first character position following existing SOM symbol. 3. If an SOM symbol is already being displayed and if cursor is in same character location as SOM when key is depressed, cursor is advanced one character position. No further change occurs. In the preceding cases, cursor position identifies first character that will be transmitted by 2845 upon depression of ENTER key. 4. If an SOM symbol is already being displayed and if cursor is to right of and on same line as an NL symbol when key is depressed, all display data is erased starting with position immediately following SOM symbol. Erase continues, observing NL symbols as in 2, until SOM is erased. Cursor ultimately occupies same position as when key was depressed.
RESET	Key is ineffective during time a command (except Write Printer) is in process. Following the attempted execution of an invalid keyboard operation, termination of a command operation with other than STX/ EOT, or detection by 2845 of an internal parity error (resulting in keyboard lockup), restores keyboard operation. When depressed after ENTER key depression but before Specific Poll or General Poll command is received, cancels Enter operation and unlocks keyboard. No change in displayed image occurs. When depressed after PRINT key has been depressed, causes immediate end of print operation and unlocks keyboard. Cursor moves to display position immediately following last character transferred to 1053 Printer.	Same

*Rapid cursor positioning may be performed with this key. That is, if depressed to its final stop, the key's operation is repeated at about nine characters per second as long as the key is held depressed.

Table 1. Functions of 2265 Display Station Keys (Nondestructive Cursor) (Cont)

Key	No Shift	Shift
ERASE DPLY (Erase Display)	Erases entire display, places an SOM symbol in upper left corner of display (first display-able character position), and cursor in second character position.	Same
ERASE EOL (Erase to End of Line)	Erases all characters, beginning with position in which cursor is located and continuing to end of that line. Cursor does not move.	Same
Erase EOS (Erase to End of Screen)	Erases all characters, beginning with position in which cursor is located and continuing to end of screen. Cursor does not move.	Same
TEST	Isolates 2845 data set and initiates internal "wrap" test.	Same
TAB	Initiates a search for a colon. Search begins with cursor's present position. When a colon is detected, cursor is positioned to character position immediately following colon. No characters are erased.	Same
	If no colon is detected before end of screen is reached, cursor is positioned to upper left corner of display (first displayable character position).	
	NL symbol has no effect on tab operation.	
	If no Tab feature is installed, no operation occurs.	

Destructive Cursor Symbol (Feature)

The destructive cursor symbol appears on the screen of the 2265 as a heavy horizontal bar (━); it marks the display position that the next character entered will occupy. Table 2 explains the effect of each keyboard key on the destructive cursor symbol. When the destructive cursor is advanced, backspaced, or otherwise moved to a character position containing a character, the character is erased.

The movement of the destructive cursor symbol and its position relative to other display characters during the time data is entered from the 2265 keyboard are described under "Control Key Functions".

PROGRAMMING NOTE: Whether the nondestructive cursor symbol or the destructive cursor symbol is being used as a 2265 display position marker, the EOM symbol will appear on the 2265 screen in the position occupied by the cursor when the keyboard ENTER key is depressed (as in manual input operations) or when the PRINT key is depressed.

To ensure correct manual input operations when the nondestructive cursor is used, the EOM symbol should be deleted from the 2265 screen between message transfers. This can be accomplished through programming (by issuing an Erase/Write following a Poll command) or by the operator at the keyboard (by overwriting the EOM symbol).

End of Message (EOM) Symbol

Whether or not the 2845 is equipped with the Destructive Cursor Feature, the EOM symbol (■) designates the end of a message. In appearance it is identical with the destructive cursor symbol. The EOM symbol is displayed by depressing the ENTER key or the PRINT key or by transmitting the EOM code from the I/O channel to the 2265. The latter course should be avoided since the presence of both an EOM symbol and a destructive cursor symbol can be confusing to a viewer and can cause an operation to be prematurely terminated. However, when a message is transmitted from the I/O channel to the 1053 Printer, the EOM code should be transmitted as the last character to denote the end of the message. The EOM code is printed by the 1053 Printer as an EOM symbol and it also causes a 1053 carriage return/line feed function.

The differences between an EOM symbol and the destructive cursor symbol are:

1. The cursor denotes the display position that the next character entered will occupy. The EOM symbol denotes only the end of a message.
2. The cursor advances as data is entered and can be moved about the 2265 screen. The EOM symbol, when displayed, remains stationary.
3. The cursor is automatically inserted and is displayed at all times. The EOM is displayed only when the ENTER or PRINT key is depressed or when its code is transmitted from the I/O channel to the 2265.
4. Only one cursor symbol may be validly displayed on a 2265 screen, whereas it is possible to display multiple EOM symbols.

While the viewer must rely on operation observation to distinguish the destructive cursor from an EOM symbol, the distinction within the 2845 Display Control is performed electronically.

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Table 2. Functions of 2265 Display Station Keys (Destructive Cursor)

Key	No Shift	Shift
Single-Character Keys	Cause symbol to be displayed.	Keyboard locks. No character is entered. Keyboard may be unlocked by depressing RESET key.
Double-Character Keys	Cause symbol on lower half of key to be displayed.	Cause symbol on upper half of key to be displayed.
ENTER	Keyboard locks and ENTER PENDING light is lit. Upon receipt of Specific Poll or General Poll command, all data between SOM and EOM is sent to computer. If this data contains an NL symbol, data between NL symbol and end of line containing it is not sent.	Same
	If EOM is placed to right of NL symbol, all data between SOM and the NL symbol immediately preceding EOM is sent.	
	If no SOM is displayed, a zero-length message is transmitted.	
	After successful message transmission resulting from a poll, cursor remains unmoved, but SOM is deleted. Keyboard unlocks and ENTER PENDING light is extinguished.	
	If Write Addressed DS or Erase/Write Addressed DS command is honored before a poll command, first character of text overwrites EOM symbol. When command is concluded, keyboard is unlocked and ENTER PENDING light is extinguished. Enter operation is ended.	
	If Write DS Line Address command is honored before a poll command, EOM symbol may or may not be overwritten depending on line addressed and length of text. When command is concluded, keyboard is unlocked and ENTER PENDING light is extinguished.	
	If Read Addressed Full DS Buffer command is honored before a poll command, no change occurs on screen. When command is concluded, keyboard remains locked, ENTER PENDING light is on, indicating Enter operation still pending.	
PRINT	Causes all data from first character position in first line to and including cursor to be printed by 1053 Printer. Exceptions are NL symbols and data to right of and on same line as NL symbols. However, an EOM symbol located to right of NL symbol is printed. Keyboard is locked during print operation.	Same
	If 2845 is not equipped with Printer Adapter Feature, no operation occurs.	
NEW LINE DOWN	Cursor moves down one line. If it is already in bottom line, it moves to top line. Lateral position of cursor within display remains constant. Destructive cursor replaces any character occupying character position into which it moves. Previous position occupied by cursor is displayed as a space.	Places NL symbol in cursor position. Cursor moves to first character position of next-lower display line. If cursor is already in bottom line, it moves to first character position of top line. Data between NL symbol and end of line is undisturbed.
SHIFT	Permits function shown in "Shift" column for control keys, or enables selection of special character on upper half of keys.	Same

Table 2. Functions of 2265 Display Station Keys (Destructive Cursor) (Cont)

Key	No Shift	Shift
SPACE/ERASE ADVANCE*	Advances cursor one character position. Cursor replaces character (if any) in position into which it moves. Previous position occupied by cursor is displayed as a space.	Same
BKSP* (Backspace)	Backs cursor by one position, erasing character (if any) previously displayed in new cursor position. If cursor is in first character position, it moves to last character position. A space is displayed in position previously occupied by cursor.	Same
START UP	Cursor moves up one line on display. If cursor is already in top line, it moves to last line. The lateral position of cursor in the display remains constant. Cursor replaces character in new position and a space is displayed in position previously occupied by cursor.	1. If no SOM symbol is displayed elsewhere on screen, an SOM symbol is placed in position occupied by cursor when key is depressed. Cursor is advanced one character position. 2. If an SOM symbol is already being displayed when key is depressed, all display data between existing SOM symbol and cursor (except data on same line as and to the right of an NL symbol) is erased. Cursor moves to first character position following existing SOM symbol. 3. If an SOM symbol is already being displayed and if cursor is to right of and on same line as an NL symbol when key is depressed, all display data is erased starting with position immediately following SOM symbol. Erase continues, observing NL symbols as in 2, until SOM is erased. Cursor ultimately occupies same position as when key was depressed. In all cases cursor position identifies first character that will be transmitted by 2845 upon depression of ENTER key.
RESET	Key is ineffective during time a command (except Write Printer) is in process. Following attempted execution of an invalid keyboard operation, termination of a command operation with other than STX/EOT, or detection by 2845 of an internal parity error (resulting in keyboard lockup), restores keyboard operation. When depressed after ENTER key is depressed but before Specific Poll or General Poll command is received, cancels Enter operation and unlocks keyboard. No change in displayed image occurs. When depressed after PRINT key has been depressed, causes immediate end of print operation and unlocks keyboard. Cursor moves to display position immediately following last character transferred to 1053 Printer.	Same

*Rapid cursor positioning may be performed with this key. That is, if depressed to its final stop, the key's operation is repeated at about nine characters per second as long as the key is held depressed.

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Table 2. Functions of 2265 Display Station Keys (Destructive Cursor) (Cont)

Key	No Shift	Shift
ERASE DPLY (Erase Display)	Erases entire display. Places an SOM symbol in upper left corner of display (first displayable character position), and cursor in second character position.	Same
ERASE EOL (Erase to End of Line)	Erases all characters, beginning with position immediately following that in which cursor is located and continuing to end of that line. Cursor does not move.	Same
ERASE EOS (Erase to End of Screen)	Erases all characters, beginning with position immediately following that in which cursor is located and continuing to end of screen. Cursor does not move.	Same
TEST	Isolates 2845 data set and initiates internal "wrap" test.	Same
TAB	Initiates a search for a colon. Search begins with position immediately following cursor. When a colon is detected, cursor is positioned to character position immediately following colon. If any character is already being displayed in this position, it is replaced by the cursor. No intervening characters are erased or modified.	Same
	If no colon is detected before end of screen, cursor is positioned to upper left corner of display (first displayable character position). If any character is already being displayed in this position, it is replaced by cursor.	
	NL symbol has no effect on tab operation.	
	If no Tab feature is installed, no operation occurs.	

Start of Message (SOM) Symbol

The SOM symbol (▶) is used to indicate the beginning of data that is to be transferred from a display buffer to the I/O channel during a Specific Poll or General Poll operation. If data is to be transferred during one of these operations, the SOM symbol must be displayed on the 2265 screen before the data to be transferred. Upon successful completion of either operation, the SOM symbol is automatically deleted from the 2265 screen. Deletion of this symbol signifies to the 2265 operator that the data has been successfully transferred from the display buffer and that another message may be entered.

The SOM symbol is made to appear on a 2265 screen by depressing the START key on the keyboard of the 2265 or by transmitting the code configuration of the symbol from the I/O channel to the 2265. For additional information concerning the SOM symbol, refer to the description of the above operations under "Principles of Operation" and "2265 Display Station Keyboard Operations."

New Line (NL) Symbol

The NL symbol (◢), when displayed on the 2265 screen, prohibits the transfer of all data displayed between the NL symbol and the end of the display line containing the symbol during a Specific Poll or General Poll operation. The NL symbol may be either keyboard- or program-inserted; it enables transfer of only a portion or portions of data displayed on the 2265 screen during either of the above operations. The effect of depressing the NEW LINE key is described in Tables 1 and 2.

Check Symbol

The Check symbol (╲) is used to indicate detection of a parity (VRC) error in transmission of data to the 2845 display buffer during a Write operation. When a character with incorrect parity is detected by the 2845 Display Control during a Write operation, a Check symbol is displayed in place of the character in error. The Check symbol can also be displayed by transmission of the code configuration for the Check symbol from the I/O channel to the 2265.

A single parity bit is assigned to two characters in the 2845 buffer storage. As a result, if a buffer parity error is detected within the 2845, two Check symbols are displayed on the 2265 screen since either character may be in error. See Figure 3. Due to the storage method used, these Check symbols appear exactly eight lines apart in the 15 x 64 display format (6 lines apart in the 12 x 80 display format) and in the character positions immediately following the characters in which the parity error occurred. If either of the display positions following the possible characters in error contains a character, the Check character will replace that character. If the 15 x 64 display format is used, a parity error occurring in the eighth display line will display one Check character on that line only. A second Check character is not displayed elsewhere on the screen since no 16th line is displayed.

Upon display of the Check characters, the keyboard is, in effect, locked. That is, the next attempted keyboard entry locks the keyboard, and the character is not entered into the display buffer nor displayed. Thus the operator receives a positive indication that an error has been detected. Following operator verification of the cause of the locked keyboard, the keyboard may be restored (unlocked), and keyboard entry resumed, by depressing the RESET key.

|PROGRAMMING NOTE: If a Read Addressed Full DS Buffer command is begun before the keyboard has been stored (RESET key depressed), a CAN character is automatically transmitted following the display buffer contents. No CAN character is transmitted if the RESET key is depressed before the read buffer operation is started. When an internal parity error is detected by the 2845 in any character stored in the display buffer, the error is identified by display of the check character. If an internal parity error is detected after the ENTER key is depressed and the Display Station is polled, the CAN character is transmitted following the last character of text. CAN is transmitted even though the parity error did not occur in one of the characters of the Display Station message. The operator may intervene at any time after the ENTER key is depressed but before a poll command is recognized by the 2848 if a check character is noted on the display screen. By depressing the RESET key, the operator interrupts the Enter operation. If the character in error is not included in the Display Station message (error affects other data displayed on the screen), the ENTER key is again depressed. These actions prevent the CAN character from being transmitted in the message. However, if the check character appears in the Display Station message, the operator may correct the error by inserting the proper character and again depressing the ENTER key.

CONTROL KEY FUNCTIONS

The actions that occur when certain control keys are depressed are described in Tables 1 and 2 for both the nondestructive and destructive cursor. The display symbols associated with control key functions, where applicable, are as follows:
1. SOM symbol ▶
2. NL symbol ◢

3. Nondestructive cursor __ : This symbol is displayed immediately below the next displayable position, thus ABC __ . If the D character key is depressed, the new display will appear as ABCD __ .
4. Destructive cursor ▬: The small horizontal bar is the destructive cursor symbol and denotes the next available display position, thus ABC ▬ . If the D character key is depressed, the display will appear as ABCD ▬

The control keys, described in Tables 1 and 2, all appear on 2265 Display Station keyboards even when the feature associated with the key is not installed in the associated 2845 Display Control. For example, the PRINT key is present on the 2265 keyboard even though the attached 2845 is not equipped with the Printer Adapter feature. The data in Tables 1 and 2 for each control key includes a description of the effect of depressing the key when the associated feature is not present.

2265 DISPLAY STATION KEYBOARD OPERATIONS

Manual Input

The following describes the procedures for manually entering data into the display buffer (from the keyboard) for transfer to the I/O channel during a Specific Poll or General Poll operation:
1. Position the cursor in the character position where the message is to begin. Refer to Tables 1 and 2 to select a keyboard key(s) that will facilitate positioning the cursor.
2. Depress the SHIFT key and simultaneously depress the START key. This causes the SOM symbol to be entered in the display buffer and to appear on the 2265 screen in the character position previously occupied by the cursor. The cursor is advanced to the next display position.
3. Key in the message to be transferred to the I/O channel. The message data will appear on the 2265 screen as the character keys are operated. The cursor symbol automatically advances as data is displayed on the 2265 screen.
4. After the entire message is displayed on the 2265 screen and is visually verified, depress the ENTER key. This causes all the keys on the keyboard except all ERASE keys, the RESET key, and TEST key to be locked, and initiates an Enter operation. The ENTER key causes the 2845 to respond to a poll command by sending the display message to the central processor.
5. Upon successful completion of the poll, the keyboard is restored, the ENTER PENDING indicator is extinguished, and the SOM symbol is deleted from the screen. These actions notify the operator that the Enter operation has concluded with a successful transmission of the message. Another message may now be entered at the Display Station.

▶L FOSS   ◢NAME

15 WHITNEY DR   ◢ADDRESS

EAS\ PARK

12/22/69   ◢DATE

◢PART NO.   QUANTITY

1433   1 ⊙

1576   24

164\   36_

One of these two characters   Check symbols *   Nondestructive
may be in error   Cursor

* 8 lines apart if 15 x 64 format;
  6 lines apart if 12 x 80 format.
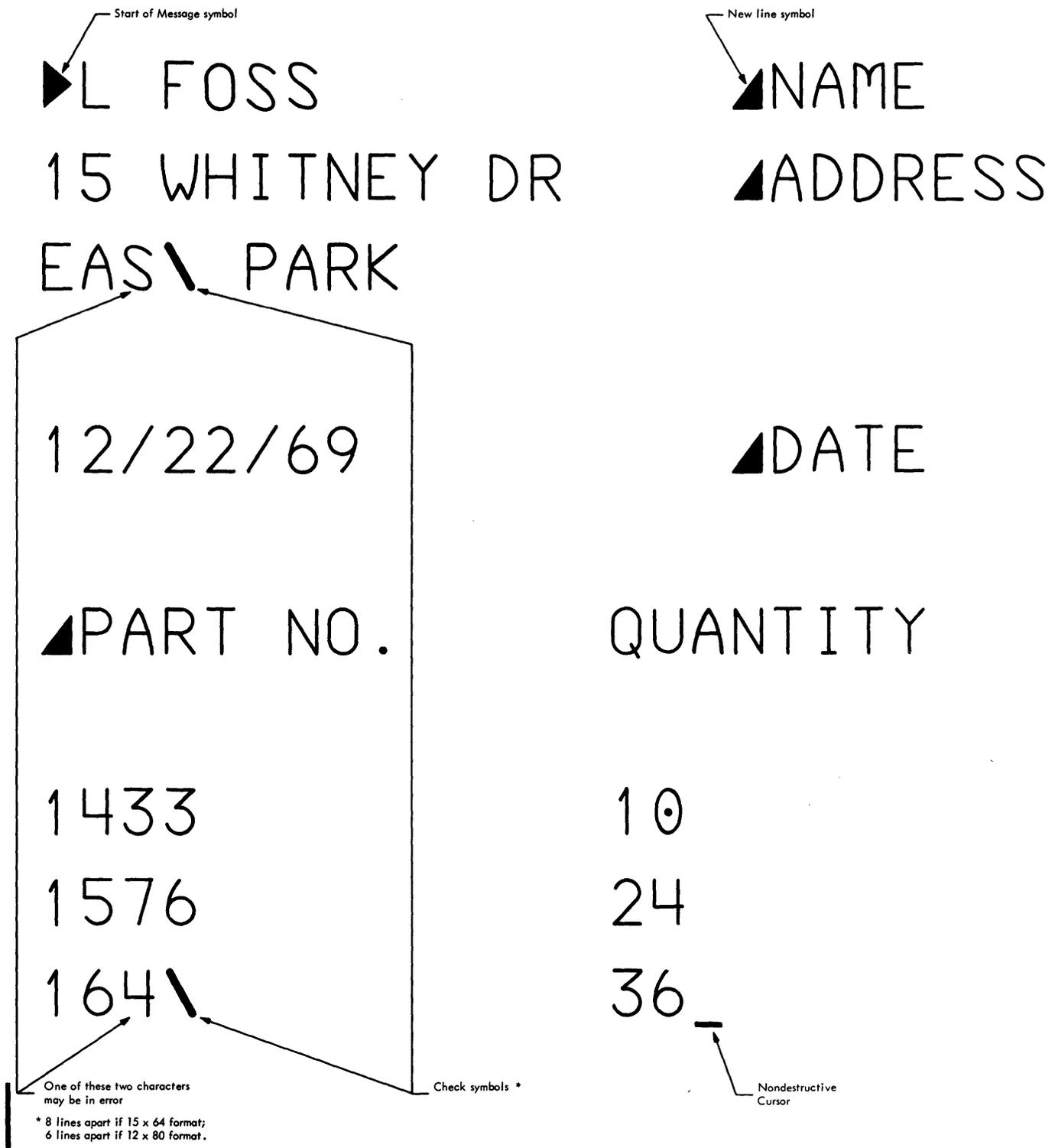
●Figure 3. Example Display Showing SOM, NL, Check Symbols, and Nondestructive Cursor (15 x 64 Display Format)

Note: Data cannot be entered from the 2265 keyboard once the 2845 recognizes a command from the central processor. (An exception is the Write Printer command, which has no effect on keyboard entry.) If a keyboard key (other than the TEST key) is depressed at any time after command processing is begun, the keyboard locks and no character is entered into the system. This ensures that command operation will proceed without interference from the 2265 keyboard.

Even if no key is depressed until after the command operation is successfully terminated, the keyboard will still lock when a keyboard key is depressed and no character will be entered if the central processor sends an EOT or SOH character to end the operation. Locking of the keyboard thus calls attention to the operator that an operation has transpired and that the display screen should be scanned for a computer message and appropriate action taken. The RESET key must be depressed before data may be entered from the keyboard.

If, however, the STX/EOT response is sent by the central processor to end the command operation, the keyboard is automatically restored and data may be keyed in immediately without depressing the RESET key. This latter method may be used when the central processor and the Display Control are operating in conversation mode.

Use of New Line (NL) Symbol

The NL symbol prohibits the transfer of data displayed between the NL symbol and the end of the display line containing the symbol during Specific Poll and General Poll operations. This capability has many applications, one of which is to display both fixed and variable data when only the variable data is to be transferred to the central processor. The ultimate benefit is a saving in transmission time. For example, fixed information such as the words "name", "address", and "date" may be entered and displayed on the right side of the 2265 Display Station screen. Variable information, actual name, etc., is then keyboard-entered on the appropriate line to the left of the fixed information. Following the entry of the last character in each display line of variable information, the NEW LINE key is depressed. This causes the NL symbol to appear between the variable and the fixed information and also positions the cursor in the first display position of the next line. Figure 3 illustrates a display at the completion of data entry from the keyboard.

After all the data has been entered in the display buffer and is displayed on the screen, the ENTER key is depressed. Receipt of a poll command causes a transfer to the I/O channel of all data between the SOM and the cursor (except the data displayed between the NL symbol and the end of the display line containing the symbol). In the display

shown in Figure 3, all the data except the fixed information (name, address, date, part no. and quantity) would be transferred to the I/O channel. The NL symbols would be included in the data transfer. However, if more than one NL symbol is displayed on a display line, only the first NL symbol is transferred.

Correction of Errors from 2265 Keyboard

Typographical errors are corrected easily by the BKSP (backspace), SPACE/ERASE-ADVANCE, and START keys. To speed correction, the first two named keys also provide a rapid cursor-positioning facility. That is, when depressed to its final stop, the key's operation is repeated at about nine characters per second as long as the key is held depressed. These keys are also described in Tables 1 and 2.

2265-to-Printer Operation

When the Printer Adapter Feature is installed, the 2265 keyboard PRINT key causes the following (see also Tables 1 and 2):
1. All the keyboard keys are locked (except the ERASE, RESET, and TEST keys).
2. An EOM symbol is displayed on the screen in the position occupied by the cursor.
3. Data displayed on the 2265 from the first displayable position to and including the EOM symbol is transferred to the printer. All characters are printed (except NL symbols and data between an NL symbol and the end of the display line containing that symbol). The EOM symbol is printed to indicate the end of a message. If NL symbols are displayed, only the first NL symbol on each display line is transferred to the printer buffer; NL causes a carriage return-line feed operation but no symbol is printed.
4. At the completion of the print operation, the 2265 keyboard is restored.

If a parity error is detected in the display buffer, characters with parity error are printed as they are read out of the buffer and a Check symbol (\ ) is printed as the last character (following the EOM symbol).

If the 1053 Printer is busy at the time the PRINT key is depressed, the keyboard PRINT key operation is queued and is executed when the 1053 Printer becomes available. If desired, the operator may cancel the PRINT key operation and restore the keyboard by depressing the RESET key. During the time the 2265-to-Printer operation is being executed, the 2265 keyboard is inoperative.

The format of the Printer copy is controlled by the NL characters in the transferred data. Since NL symbols cause a carriage return/line feed at the Printer, they should be used to achieve spacing when desired. All other characters are printed exactly as they appear on the 2265 screen.

PROGRAMMING NOTE: Any command issued to a 2265 that is performing a 2265-to-Printer operation causes the print operation to be terminated immediately. The print mechanism will not be positioned to a new line. The keyboard of the 2265 is restored upon completion of the command.

Tab Feature Operation

Tab operation on the 2265 Display Station is performed in a manner similar to the tab operation on a conventional typewriter. A colon (:), displayed on the 2265 screen, serves the same purpose as a typewriter tab stop. Colons are entered in the desired locations on the display either by depressing the colon key on the 2265 or as part of transmitted text from the CPU.

When the TAB key on the 2265 keyboard is depressed, the keyboard is locked, and a search for a colon is initiated. Each character position is checked, including those to the right of an NL symbol. When the end of a row is reached, the search continues at the beginning of the next row of characters. Upon detection of a colon, the cursor is positioned to the character location immediately following the colon. If the colon search is continued to the end of the screen and no colon is found, the cursor is positioned to the first character location in the upper left of the screen. In either event, the tab operation is ended, and the keyboard is unlocked. The next characters entered into the system, either from the keyboard or under program control from the central processor, will be displayed at the cursor's new location.

The colon search begins at the cursor's present position in display systems using the standard nondestructive cursor. Therefore, if the nondestructive cursor and a colon are both occupying the same character location when the TAB key is depressed, the cursor will move only one position. In a tab operation using the nondestructive cursor, there is no change in the display other than the repositioning of the cursor.

On the other hand, the colon search begins at the location immediately following the cursor in display systems equipped with the Destructive Cursor Feature. Also, any character being displayed in the position immediately following the detected colon will be replaced by the destructive cursor.

Note that the tab operation can be initiated from the 2265 keyboard only. No provision is made for a remote tab operation by means of any USASCII-8 or unique control character.

Display System Test Procedure (Wrap Test)

The TEST key, located on the Display Station keyboard, enables the operator to test the operation of the display system without affecting other units attached to the communications channel. This test may be performed if a communications problem is experienced with the central processor. The test (sometimes referred to as a "wrap"

test) may be helpful in localizing the problem to: (1) the 2845; (2) the host system (including the I/O channel, 2701, and associated data set); or (3) the communications facilities. Depressing the TEST key effectively disconnects the display system from the data set and communications channel. In this off-line condition, no message can be transmitted to or received from the central computer, and depressing the 2265 keyboard keys has no effect on the communications network. By observing the test operation (as described below), the operator may make a judgment as to the operating condition of the display system.

The test is performed as follows:

1. Depress the TEST key.
   This switches the 2265/2845 off-line, erases the entire screen, and places an SOM and cursor in character positions 1 and 2, respectively. A Write Addressed DS operation is internally generated by the 2845, causing the character sequence %6G▲to be written once, beginning at the cursor location (position 2 of line 1). Following this action, the character sequence %6GW is written repeatedly in consecutive character positions beginning in the first character position of line 2. This operation simulates receiving a message from the central processor.

2. Depress the RESET key.
   This action, which causes the write operation to end, must be taken in time to prevent the SOM symbol from being overwritten by the %6GW character sequence.

Note: If the RESET key is not depressed in time, and the SOM symbol is overwritten, the test must be restarted. To restart, depress the following keys in this order: RESET, ENTER, TEST, RESET. Now start at step 1.

3. Depress the ENTER key.
   This action causes the EOM symbol to be written following the last character of the four-character sequence.

4. Depress the TEST key.
   This action causes the Read operation to occur. This operation may be observed due to the nondestructive cursor advancing repeatedly from the SOM symbol to the EOM symbol. Cursor movement is not visible when the 2845 is equipped with the Destructive Cursor Feature.

5. Depress the RESET key.
   This action terminates the simulated polling operation. It also restores the 2845 to an "on-line" condition; i.e., reconnects the 2845 to the data set and thus to the communications channel.

6. Depress the ERASE DPLY key.
   This action clears the screen of the test display. If the test is performed satisfactorily, normal communications may be resumed.

Note: Once step 1 of the wrap test procedure has been performed, the remainder of the sequence (through step 5)

must be completed to return the 2845 to an on-line condition. If the wrap test indicates that the 2845 and 2265 are working satisfactorily, call the host system location to find out if the host system is operating properly and if the 2845 is being polled. If the response to both queries is "yes", make a check of the communications equipment.

The 2265/2845 display system operating in a remote environment communicates with the IBM System/360. The display system operates in half-duplex mode, through an IBM 2701 Data Adapter Unit connected for full-duplex operation and through appropriate data sets, over common-carrier facilities (see Figure 1). A choice of two data set adapters permits data transmission at the rate of 1200 or 2400 bps.

USASCII CODE SET

The United States of America Standard Code for Information Interchange (USASCII) is the basic code set used for all communication exchanges between the System/360 I/O channel and the remote display system. The 2845 is compatible with the 2848 and, therefore, uses USASCII-1963 as does the 2848. The current version of USASCII, USASCII-1967, differs slightly from USASCII-1963; the graphics shown in positions E0, FC, and FE in Figure 4 are located differently in USASCII-1967. All references to USASCII in this manual refer to USASCII-1963. Since USASCII is a seven-bit code and all data transmitted or received over the System/360 I/O channel must be of eight-bit structure, the USASCII code must be modified to an eight-bit structure. This modified version is called USASCII-8.

USASCII-8 is used within the I/O channel and for data transfer between the I/O channel and the 2701. Data transmission between the 2701 and 2845 is in seven-bit USASCII code. The 2701 converts USASCII-8 code to USASCII code for transmission to the 2845. Conversely, the 2701 converts USASCII to USASCII-8 for transfer to the I/O channel. Because conversion is automatic, the programmer need be concerned with the USASCII-8 code set only. The USASCII characters used in data interchanges between the System/360 I/O channel and the 2845 Display Control are shown in Table 11 (hexadecimal code conversion chart) and in Figure 4.

TRANSMISSION CODE BYTE STRUCTURE

Although a knowledge of the byte structure of each transmitted character is not necessary for 2845 programming and operation, Figures 4 and 5 may prove helpful in understanding byte conversion and transmission. Figure 4 shows the byte structure (bits) of USASCII-8 coded characters. USASCII bytes are identical except that bit 6 is dropped.

Figure 5 shows the format of a character (byte) as it is transmitted over the communications channel (common-carrier facility). The bits are transmitted serially, the start bit being first. The start and stop bits perform control

functions; the VRC (vertical redundancy check) bit establishes even parity and is used for error checking only. (See "Parity Checking".) These three bits are not part of the USASCII character.

BLOCK DIAGRAM ANALYSIS

As an aid to understanding the operation of the remote 2265/2845 display system, the function of the 2701 Data Adapter Unit and the data sets shown in Figure 1 are described below.

IBM 2701 Data Adapter Unit

The IBM 2701 Data Adapter Unit equipped with the IBM Terminal Adapter Type III serves as a data buffer, data converter, and synchronizer. The 2701 also provides the System/360 I/O channel with 2845 Display Control status and sense information through the 2701 status and sense bytes.

Data transferred from the I/O channel and intended for the 2845 Display Control is received by the 2701 Data Adapter Unit in data bytes of USASCII-8 code structure. The 2701 converts the USASCII-8 data bytes to USASCII code (seven bits) and places each byte in a transmit adapter (XA) register for transmission to the 2845. The 2701 transfers the seven bits of the USASCII character serially one bit at a time via appropriate data sets and communications channels to the 2845. The seven bits are preceded by a start bit and followed by a VRC bit (for parity checking) and a stop bit. The ten-bit format assumed by every character transmitted between the 2701 Data Adapter Unit and the 2845 is illustrated in Figure 5. The start, VRC, and stop bits are developed by the 2701 and accompany the seven bits of every USASCII character transmitted to the 2845 in the order shown. The data received by the 2701 from the 2845 is also in the same ten-bit format. All ten bits are the same signal length and transmitted at the speed (1200 or 2400 bps) specified by the data set adapter and data sets used.

Note: For additional information pertaining to the IBM 2701 Data Adapter Unit, refer to *IBM Component Description, IBM 2701 Data Adapter Unit,* Form GA22-6864.

Data Sets

Data sets (sometimes identified as modems, a contraction of modulator-demodulator) are devices used at each terminal of the communications channel. They provide the necessary compatibility between the 2701 Data Adapter Unit, 2845 Display Control, and the communications

First Hex Digit → Bits 4 3 2 1	Second Hex Digit →	0 0 0 0 (0)	0 0 0 1 (1)	0 1 0 0 (4)	0 1 0 1 (5)	1 0 1 0 (A)	1 0 1 1 (B)	1 1 1 0 (E)	1 1 1 1 (F) — Bits 8 7 6* 5
0 0 0 0 — 0		Note 1 / Note 2		SP	0		P	@	P
0 0 0 1 — 1		SOH		!	1	A	Q	A	Q
0 0 1 0 — 2		STX		"	2	B	R	B	R
0 0 1 1 — 3		ETX		#	3	C	S	C	S
0 1 0 0 — 4		EOT		$	4	D	T	D	T
0 1 0 1 — 5			NAK	%	5	E	U	E	U
0 1 1 0 — 6		ACK		&	6	F	V	F	V
0 1 1 1 — 7				'	7	G	W	G	W
1 0 0 0 — 8			CAN	(	8	H	X	H	X
1 0 0 1 — 9				)	9	I	Y	I	Y
1 0 1 0 — A		LF		*	:	J	Z	J	Z
1 0 1 1 — B		↑		+	;	K	Note 4	K	Note 5
1 1 0 0 — C		Note 3		,	<	L		L	¬
1 1 0 1 — D				-	=	M	¢	M	
1 1 1 0 — E				.	>	N		N	|
1 1 1 1 — F				/	?	O	—	O	

* USASCII-8 is converted by 2701 to 7-bit USASCII
(for transmission to Display Control) by deleting bit 6.

Notes:

1. Displayed on 2265's as the EOM ▉▉ symbol. Also prints on the 1053 Model 4 Printer as ▣▇ .

2. Displayed on 2265's as the Check ◥ symbol. Also prints on 1053 Model 4 as ◥

3. Displayed on 2265's as the New Line ◢ symbol. Causes a carriage return and line feed on the 1053 Model 4 Printer, but no character is printed.

4. Displayed on 2265's as the SOM ▶ symbol. Also prints on 1053 Model 4 as ▶.

5. The codes represented by the characters within the dotted outline are the USASCII-8 codes for the lower-case alphabetic characters. These codes are converted to upper case by the 2845 and displayed as upper-case characters. If retrieved by a read operation, the codes will be in the upper-case bit configuration.

Additional Notes:

A. Graphic representations are undefined for the bit patterns outside the heavily outlined portions of the chart. These bit patterns are referred to as undefined graphic bit patterns. If an undefined graphic bit pattern is sent from the I/O channel to the device, the graphic that will be displayed or printed by the device is not specified.

B. IBM reserves the right to change at any time the graphic displayed or printed by this device for an undefined graphic bit pattern sent from the I/O channel.

Figure 4. USASCII-8 Code Set

Stop Bit	VRC Bit	7	6	5	4	3	2	1	Start Bit
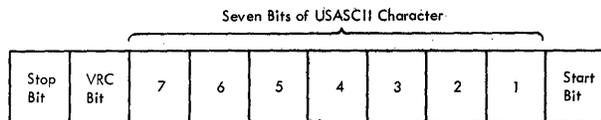
Figure 5. Ten-Bit Format of Transmitted USASCII Characters

facilities. The basic function of the data sets is modulation and demodulation of 2701 and 2845 signals for data transmission.

USASCII COMMUNICATION CONTROL CHARACTERS

To establish and maintain an orderly flow of traffic over the communications channel, particularly in multidrop applications (where more than one 2845 is attached directly to the communications channel), a method of controlling line traffic is necessary. Line traffic between the System/360 I/O channel and the remote display system is controlled by six of the USASCII communication control characters. The six codes, used singly or in sequences, perform all the necessary control functions. In addition to the six USASCII communication control characters, a USASCII format effector (line feed, LF, character) and a USASCII control character (cancel, CAN) are used in data transmissions between a remote display system and the I/O channel.

Each of these eight USASCII characters is defined below. Their code structure is shown in Figure 4. For a detailed description of each character (when it is used, its significance, and interpretation), see "Summary of Sequences and Responses".

STX (Start of Text) — A communication control character which precedes a sequence of characters (text) that is to be treated as an entity. This entity is usually terminated by ETX.

ETX (End of Text) — A communication control character used to terminate a sequence of characters (text) started with STX and transmitted as an entity.

CAN (Cancel) — A control character used to indicate that the data with which it is sent may be in error. The CAN control character is transmitted, following text and before ETX, if an internal parity error has been detected by the 2845 Display Control. CAN is transmitted only by the 2845.

ACK (Positive Acknowledge) — A communication control character transmitted by a receiver as an affirmative response to a sender.

NAK (Negative Acknowledge) — A communication control character transmitted by a receiver as a negative response to the sender.

SOH (Start of Heading) — A communication control character used at the beginning of a sequence of characters (heading) which constitute a machine-sensible address.

EOT (End of Transmission) — A communication control character used to indicate the conclusion of a transmission which may have contained one or more texts and any associated heading (addressing sequence). EOT may also be used, instead of SOH, as the first byte in the addressing sequence.

LF (Line Feed) — A format effector which should be included only as part of text. When included in text addressed to a 2265 Display Station, the LF character causes the NL symbol to be displayed and the cursor of the selected 2265 Display Station to move to the first character position in the next display line. If the cursor is in the bottom line, it will move to the first character position of the top line. The LF character received by the I/O channel from the 2845 Display Control indicates that the following data byte is the first character of the next 2265 display line.

When included in text addressed to a 1053 Printer, the LF format effector causes the Printer to perform a carriage return/line feed (CR/LF) operation.

PROGRAMMING NOTE: Use of any control character other than LF within the body of a text transmission is invalid. Receipt of a control character other than LF within the body of text has the following results:

1. SOH, EOT, or ETX causes immediate return of the 2845 to control mode (see below).
2. ACK, NAK, or STX has no effect on the 2845 mode. ACK is displayed as an F; NAK is displayed as an E; STX is displayed as a B.

2845 DISPLAY CONTROL MODES OF OPERATION

A remote 2845 Display Control operates in one of two modes: Control or Text.

Control Mode

Control mode is the mode in which the 2845 Display Control is placed preparatory to receiving an addressing sequence or control characters. The 2845 enters control mode, while in selected or non-selected status, on receipt of an SOH, EOT, or ETX control character. Receipt of an STX control character by a 2845 in selected status switches that 2845 from control mode to text mode. (The 2845 is considered selected when it has responded to an addressing sequence and is in communication with the I/O channel.)

Text Mode

Text mode is the mode in which the 2845 Display Control operates while receiving or transmitting text. The 2845 is placed in text mode, while in selected status only, upon receipt of an STX control character. Receipt of an ETX, EOT, or SOH control character switches the 2845 from text mode to control mode. In a multidrop application, only one 2845 can be in text mode at any one time.

PARITY CHECKING

A vertical redundancy check (VRC) is performed on all characters received by the 2845. Conversely, a VRC bit is added to each character by the 2845 to establish even parity before transmission to the I/O channel.

If the 2845 detects a VRC error in a control character received from the I/O channel, the 2845 will not respond. Failure to respond to the I/O channel will result in a time-out at the 2701.

The action taken by the 2845 to a VRC error detected in a text character received from the I/O channel depends upon the device to which the text is addressed. If the device is a Printer, a VRC error resets the 2845 and inhibits printing. The 2845 responds with NAK. If the device is a Display Station, the Check character is displayed on the screen in lieu of the character received in error, and the 2845 responds with NAK. Conversely, if the 2845 detects an internal parity error during transmission of a message to the I/O channel, the 2845 forces a CAN control character prior to the ETX to notify the CPU that the transmitted text contains characters with 2845 corrected parity. Simultaneously, a Check symbol, or symbols, is displayed on the 2265 screen to give visual indication to the operator. (See "Check Symbol".) At the CPU the characters with corrected parity are identified as those immediately preceding the Check characters.

Finally, during all print operations (2845 printer-buffer-to-1053 data transfers), each character is checked for an internal parity error. If an error is detected during any print operation, the Check symbol is printed at the end of the message. (See "Operation with 1053 Printer".)

An LRC (longitudinal redundancy check) character is accumulated by the transmitting device (2701 or 2845) during any transmission sequence that begins with STX and ends with ETX. As the receiving device (2701 or 2845) receives each character, it also accumulates an LRC character. Following the transmission of ETX, the transmitting device sends its accumulated LRC character. When received by the receiving device, this LRC character is compared to the LRC character accumulated by the receiving device. An equal comparison indicates successful transmission of total number of bits. An unequal comparison indicates an unsuccessful transmission; the 2845 responds with NAK. The LRC and the STX characters are not included in the LRC accumulation of either device.

PROGRAMMING NOTE: LRC generation and accumulation are performed internally in the 2701. Therefore, the program need not include an LRC character in any sequence of characters to, nor will it receive an LRC character from, the I/O channel.

ADDRESSING SEQUENCE

The 2265/2845 display system is designed to operate on communications networks wherein the central computer operates as the control station. In this centralized system, the computer initiates all contacts with the Display Control units attached to the network. The computer may poll a number of Display Controls (terminals) and their attached components (Display Station and Printer) in turn until one is found that has a message ready to send to the computer. Or, the terminal may address a particular Display Control when it has a message to send to one of the components attached to the Display Control. In either case, the computer must initiate the contact; the 2845 Display Control does not have the capability to initiate the contact. In summary, message flow from the terminal to the computer is achieved by polling the terminal; message flow from the computer to a terminal is achieved by addressing the terminal. Since the format of the four-character sequence required to initiate communication is the same in all cases, this sequence is referred to as the "addressing sequence" in this manual.

Each 2845 command issued by the I/O channel to the remote display system is transmitted to the 2845 Display Control as one of the four bytes in this addressing sequence. The purpose of the addressing sequence is to place all 2845's on the multidrop network in control mode, select the desired 2845 and attached 2265 or 1053, and specify (command) the operation to be performed. The addressing sequence of each command is shown in Figures 6 through 13.

The specific function of each of the four bytes of the addressing sequences is described below:

First Byte – The first byte of an addressing sequence must be either an SOH or EOT communication control character. The SOH or EOT communication control character places the 2845 Display Control in control mode.

Second Byte – The second byte in the addressing sequence contains the address of the 2845. Table 3 lists the permissible 2845 Display Control addresses.

Third Byte – The third byte contains the address of the remote device (2265 Display Station or 1053 Printer) to be selected. Table 4 lists the address assignments for the 2265 Display Station and 1053 Printer.

Fourth Byte – The fourth byte of an addressing sequence specifies the command to be executed by the selected 2845 Display Control. Table 5 lists the 2265/2845 commands.

Each of the four bytes of every addressing sequence is parity-checked (VRC only) by the 2845 as it is received. If a parity error is detected or if any byte of the addressing sequence is not valid or is out of sequence, the 2845 will not respond.

To maintain operational continuity, the 2845 must respond to an addressing sequence within 2 seconds after the addressing sequence is transmitted to the 2845. Failure to respond (no response) results in a 2701 line timeout.

(See causes of No Response under "Summary of Sequences and Responses" and 2701 line timeouts under "Timing Considerations".)

The 2845 response to an addressing sequence depends on the nature of the 2845 command and conditions at the 2845 and the selected device. The various 2845 responses to an addressing sequence are shown in Figures 6 through 13 and described under "Summary of Sequence and Responses".

Table 3. Display Control Address Assignments

Display Control Number	Hexadecimal Representation	USASCII-8 Address Code							
		8	7	6	5	4	3	2	1
1	40	0	1	0	0	0	0	0	0
2	41	0	1	0	0	0	0	0	1
3	42	0	1	0	0	0	0	1	0
4	43	0	1	0	0	0	0	1	1
5	44	0	1	0	0	0	1	0	0
6	45	0	1	0	0	0	1	0	1
7	46	0	1	0	0	0	1	1	0
8	47	0	1	0	0	0	1	1	1
9	48	0	1	0	0	1	0	0	0
10	49	0	1	0	0	1	0	0	1
11	4A	0	1	0	0	1	0	1	0
12	4B	0	1	0	0	1	0	1	1
13	4C	0	1	0	0	1	1	0	0
14	4D	0	1	0	0	1	1	0	1
15	4E	0	1	0	0	1	1	1	0
16	4F	0	1	0	0	1	1	1	1

Note: Any invalid or unasssigned display control address code may be transmitted as part of an addressing sequence, however it will not be acknowledged by the 2845. The 2845 will remain in control mode.

2845 COMMANDS AND COMMAND OPERATION

The remote display system equipped with the Line Addressing and Printer Adapter Features can execute eight commands. These commands, their USASCII-8 code structure and hexadecimal representation, and the feature required (if any) to enable their execution, are listed in Table 5.

The operation of each 2845 command is controlled and monitored by exchanges (between the I/O channel and the 2845 Display Control) of a single USASCII communication control character or a sequence of characters of which one (or more) is a USASCII communication control character. These exchanges are called "sequences" and "responses".

The sequences and responses that occur during an operation depend upon the command, conditions at the display system, and the program. The sequence and response diagrams (Figures 6 through 13) illustrate possible sequences and responses that may occur during each operation. Each figure is divided vertically by a broken line. Sequences and responses to the left of the line represent those that may be transmitted by the I/O channel to the 2845. Sequences and responses to the right of the line represent those that may be transmitted by the 2845 to the I/O channel. The heavy line indicates the sequences and responses that occur most frequently during an operation; the lighter lines indicate other possible sequences and responses.

Table 4. Remote Device Address Assignments

Display Control Number	Printer Address Byte								Hex Rep	Display Station Address Byte								Hex Rep
	8	7	6	5	4	3	2	1		8	7	6	5	4	3	2	1	
1	0	1	0	0	0	0	0	0	40	0	1	0	1	0	0	0	0	50
2	0	1	0	0	0	0	0	1	41	0	1	0	1	0	0	0	1	51
3	0	1	0	0	0	0	1	0	42	0	1	0	1	0	0	1	0	52
4	0	1	0	0	0	0	1	1	43	0	1	0	1	0	0	1	1	53
5	0	1	0	0	0	1	0	0	44	0	1	0	1	0	1	0	0	54
6	0	1	0	0	0	1	0	1	45	0	1	0	1	0	1	0	1	55
7	0	1	0	0	0	1	1	0	46	0	1	0	1	0	1	1	0	56
8	0	1	0	0	0	1	1	1	47	0	1	0	1	0	1	1	1	57
9	0	1	0	0	1	0	0	0	48	0	1	0	1	1	0	0	0	58
10	0	1	0	0	1	0	0	1	49	0	1	0	1	1	0	0	1	59
11	0	1	0	0	1	0	1	0	4A	0	1	0	1	1	0	1	0	5A
12	0	1	0	0	1	0	1	1	4B	0	1	0	1	1	0	1	1	5B
13	0	1	0	0	1	1	0	0	4C	0	1	0	1	1	1	0	0	5C
14	0	1	0	0	1	1	0	1	4D	0	1	0	1	1	1	0	1	5D
15	0	1	0	0	1	1	1	0	4E	0	1	0	1	1	1	1	0	5E
16	0	1	0	0	1	1	1	1	4F	0	1	0	1	1	1	1	1	5F

Table 5. 2265/2845 Commands

2845 Command	USASCII-8 Code Structure								Hexadecimal Representation	Feature Required
	8	7	6	5	4	3	2	1		
Specific Poll—2265	0	1	0	0	0	0	0	0	40	
Specific Poll—Printer	0	1	0	0	0	0	0	0	40	Printer Adapter Feature
General Poll*	0	1	0	0	0	0	0	0	40	
Read Addressed Full DS Buffer	0	1	0	1	0	0	0	0	50	
Write Addressed DS	1	0	1	0	0	0	0	0	A0	
Write Printer	1	0	1	0	0	0	0	0	A0	Printer Adapter Feature
Write DS Line Address	1	0	1	1	0	0	0	0	B0	Line Addressing Feature
Erase/Write Addressed DS	1	1	1	0	0	0	0	0	E0	

*The General Poll is identified by the third character of the addressing sequence (Device Address). An all ones code for this character (FF) and the indicated Command Code signifies the General Poll.

For example, in the execution of the Specific Poll to Display Station command (Figure 6), the addressing sequence is initiated by the I/O channel. The 2845 responds with a transmission sequence (STX, 2265 address, text, ETX, and LRC). Upon receipt of the transmission sequence, the I/O channel responds with ACK, indicating correct receipt of the transmission sequence. The 2845 responds to ACK with EOT and the poll operation is concluded. As determined by the program, the I/O channel, instead of responding to the transmitted sequence with ACK, could respond with one of the following: NAK, SOH, EOT, STX/EOT, and STX, Text, ETX, LRC.

The function and operation of each command are described in the following paragraphs. Included are descriptions of sequences and responses that may occur (as shown in Figures 6 through 13) and descriptions that are necessary to explain each operation. All sequences and responses are summarized under "Summary of Sequences and Responses". Recommended procedures for recovery from error conditions are described under "Error Recovery Procedures".

Note that a poll command is designated as Specific or General by the device address code that is used in conjunction with the Poll command. Use of a Display Station's or Printer's own address code results in a Specific Poll of only that device. Use of a device address of all 1-bits (hexadecimal representation = FF) results in a General Poll of the Display Station and, if the 2845 is equipped with the Printer Adapter Feature, also of the Printer attached to the Display Control.

Specific Poll to 2265 Display Station (Figure 6)

The Specific Poll command addressed to a 2265 Display Station enables the 2845 to determine if the ENTER key has been depressed. If the key has not been depressed, indicating the 2265 has no message ready to be transmitted, the 2845 responds to the addressing sequence with EOT. EOT terminates the transmission. If the ENTER key has been depressed, the 2845 transmits STX, the address of the 2265, and all data (text) displayed between the SOM symbol and the EOM symbol. The exception is any data between an NL symbol and the end of the display line containing the symbol. The text is followed by the ETX and LRC characters. If no SOM symbol is being displayed, the 2845 transmits STX, the address of the 2265, ETX, and LRC, but no text. Upon successful receipt of the transmission sequence, the I/O channel may respond with STX/EOT. This response causes the SOM symbol to be erased from the 2265 screen, the ENTER PENDING indicator to be turned off, and the keyboard to be restored. It also terminates the Specific Poll operation; no further response is required from the 2845.

As an alternate response, the I/O channel may respond with ACK (instead of STX/EOT) to notify the 2845 that the display message was received correctly. The ACK response causes the SOM symbol to be erased from the 2265 screen, the keyboard ENTER PENDING light to be

extinguished, and the keyboard to be restored. The 2845 responds to ACK with EOT to conclude the operation.

Another I/O channel response to receipt of the Display Station message must be considered. As indicated in Figure 6, the I/O channel may have a message to send to the polled Display Station. Therefore, after receiving the message from the 2265, the I/O channel may reply by sending a message to the 2265. Since the 2845 and 2265 are already selected, no further addressing sequence is necessary. Essentially, the Specific Poll to Display Station is converted to a Write Addressed DS. The SOM symbol is erased, the ENTER PENDING indicator is turned off, and the keyboard is restored. After the message has been received and acknowledged by the 2845, the I/O channel can send another message to the 2265 or terminate the operation with EOT.

A NAK response by the I/O channel indicates that a parity error was detected by the 2701. This response causes the 2845 to automatically retransmit the message beginning with STX. An EOT or SOH response from the I/O channel to a 2845 message ending in ETX/LRC indicates a negative response to the transmission and terminates the operation. A negative response does not result in the clearing of the SOM symbol nor the unlocking of the keyboard. The Enter operation is still pending.

The CAN character is transmitted following the last character of text and prior to ETX only if an internal parity error is detected by the 2845 after the ENTER key is depressed and before the message text is completely transmitted. Correct parity is assigned to the erroneous characters by the 2845 before they are transmitted to the I/O channel. The characters with corrected parity are identified as those immediately preceding any transmitted Check characters.

Specific Poll to 1053 Printer (Figure 7)

The Specific Poll sequence, when directed to a 1053 Printer, causes the 2845 Display Control to test the readiness and busy status of the Printer and to respond accordingly.

Three possible 2845 responses to the Specific Poll sequence provide the I/O channel with the busy and ready status of the Printer:
1. NAK—This response from the 2845 indicates that the Printer is not ready; i.e., does not have power on or is out of paper. The 2845, upon responding with NAK, also sets Printer Request in the 2845 (described under "Printer Request Condition").
2. EOT—This response from the 2845 indicates that the Printer is busy. The 2845, upon responding with EOT, also sets Printer Request in the 2845 (described under "Printer Request Condition").
3. STX, Printer Address, ETX, LRC Character—This response from the 2845 indicates to the I/O channel that the Printer is ready and free to print a message. Subsequent action is determined by the program.

If the 2701 detects a parity error in this sequence, a NAK response will cause a retransmission from the 2845.
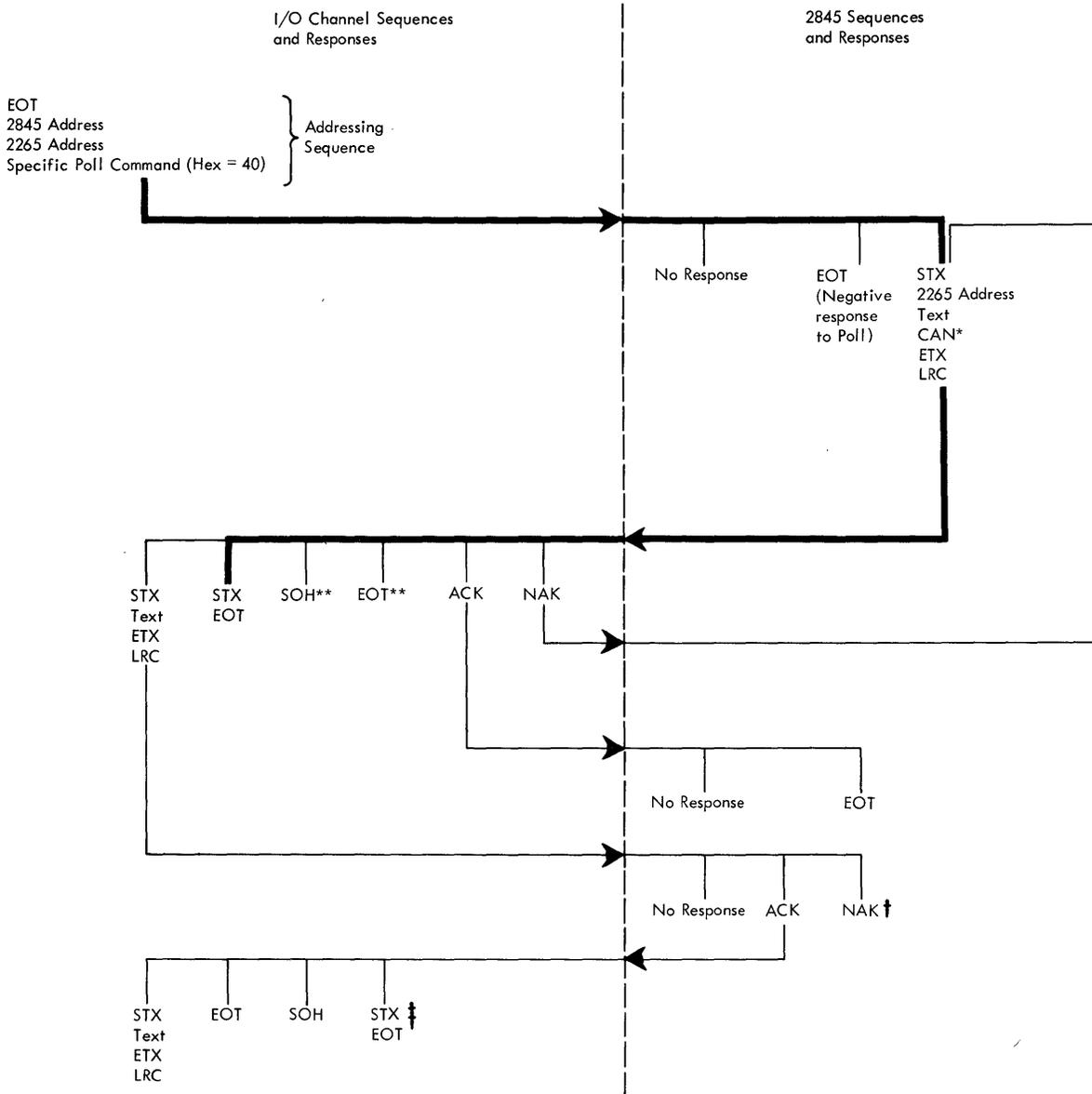
I/O Channel Sequences
and Responses

2845 Sequences
and Responses

EOT
2845 Address
2265 Address
Specific Poll Command (Hex = 40)
⎱ Addressing
⎰ Sequence

No Response

EOT
(Negative
response
to Poll)

STX
2265 Address
Text
CAN*
ETX
LRC

STX   STX   SOH**   EOT**   ACK   NAK
Text   EOT
ETX
LRC

No Response   EOT

No Response   ACK   NAK †

STX   EOT   SOH   STX ‡
Text   EOT
ETX
LRC

* CAN is transmitted only if the 2845 detects an internal parity
  error after the ENTER key is depressed but before the message
  text is completely transmitted.

** SOH or EOT response from the I/O channel to a message ending in
   ETX, LRC does not restore the 2265 keyboard, clear the SOM
   symbol, nor extinguish the ENTER indicator. The Enter operation
   is still pending.

† See "Error Recovery Procedures" for further I/O channel responses.

‡ Useful in conversation mode to restore 2265 keyboard.

Figure 6. Specific Poll to Display Station, Sequence/Response Diagram

I/O Channel Sequences
and Responses

2845 Sequences
and Responses

EOT
2845 Address   } Addressing
Printer Address   Sequence
Specific Poll Command (Hex = 40)

No Response   NAK*   EOT*   STX
              Printer   Printer   Printer Address
              Not Ready Busy   ETX
                                  LRC

STX   SOH   EOT   NAK
Text
ETX
LRC

No Response   ACK   NAK†   EOT**†

STX   EOT   SOH
Text
ETX
LRC
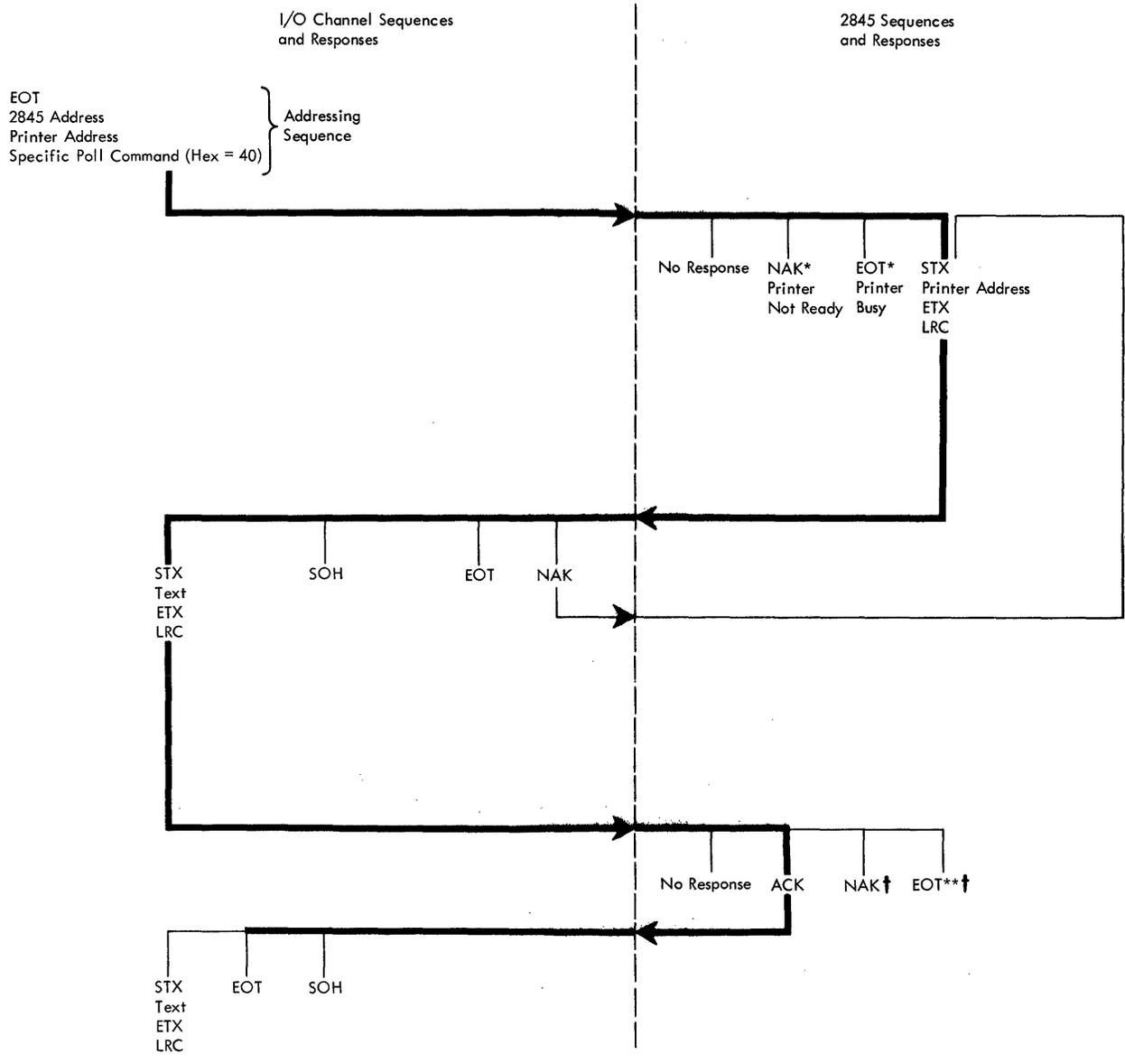
* Sets Printer Request.

** Indicates printer-buffer overrun.

† See "Error Recovery Procedures" for further I/O channel responses.

Figure 7. Specific Poll to Printer, Sequence/Response Diagram

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However, if no parity errors are detected, a normal I/O channel response will be STX, text to be printed, ETX, and the LRC character. Operation from this point is identical to that of the Write Printer command.

No response by the 2845 to the I/O channel addressing sequence indicates that the 2845 did not decode the sequence successfully or detected a VRC error in the sequence. The 2701 will time out and the program should retry.

General Poll (Figure 8)

The General Poll command is used to test the 2265 Display Station for the presence of a manually entered message pending transfer to the I/O channel, and, when the Printer Adapter Feature is installed, also causes the 2845 to test for a Printer Request condition. Printer Request will be set if a previous attempt was made (under the Specific Poll to Printer or the Write Printer command) to select the Printer while it was busy or not ready. (See "Printer Request Condition".)

If the 2845 is equipped with the Printer Adapter Feature, the 2845 first tests for Printer Request condition. If Printer Request is set and the Printer is ready and not busy, the 2845 responds with the following "printer available" sequence: STX, Printer Address, ETX, and the LRC character. Receipt of this sequence indicates to the I/O channel that the Printer is now ready to print a message. The I/O channel may respond by sending a message to the Printer (STX, text, ETX, LRC character) or it may terminate the operation with STX/EOT, SOH, or EOT.

If the I/O channel sends a message to the Printer at this time, the operation continues in the same manner as a Write Printer operation. On the other hand, if the I/O channel does not respond with a printer message, Printer Request is ended and a later General Poll to the 2845 will not elicit a printer-available response from the 2845. A message to the Printer at a later time will have to be sent using the Write Printer command. Note that if the operation is terminated at this time, the poll should be reinitiated with another complete addressing sequence to assure receipt of a message pending from the Display Station. However, if the I/O channel sends a message to the Printer, the operation continues identically to a Write Printer operation.

If Printer Request is not set, or if it is set but the Printer is still busy or not ready, the Display Station is automatically polled following the initial addressing sequence. Similarly, if the 2845 is not equipped with the Printer Adapter Feature, the General Poll command causes the 2845 to poll the Display Station. Operation from this point is identical to that of the Specific Poll to Display Station command.

The EOT response to a General Poll addressing sequence indicates that the 2265 has no message to send. When the 2845 is equipped with the Printer Adapter Feature, the

EOT also indicates that either Printer Request was not set or that the Printer is still busy or not ready.

No response to the addressing sequence indicates that the 2845 did not successfully decode the addressing sequence or detected a VRC error in the sequence. The 2701 will time out and the program should retry.

All responses that can occur to a General Poll command are shown in Figure 8. Each is summarized under "Summary of Sequences and Responses".

Read Addressed Full DS Buffer (Figure 9)

The Read Addressed Full DS Buffer command is used to transfer all characters stored in the display buffer of the selected 2845 to the I/O channel in the following sequence:

> STX
> Address of the selected 2265 Display Station
> Text (all characters displayed from character position 1
>   to character position 960, including spaces, except for
>   the nondestructive cursor)
> ETX
> LRC character

Data is transferred starting at the upper left corner of the screen and ending at the lower right corner.

Included among the characters transferred are the codes for the Check symbol, NL symbol, SOM symbol, and, when the Destructive Cursor Feature is installed, the destructive cursor (EOM symbol). A nondestructive cursor is not transferred. If a parity error is detected in the message by the 2701, the NAK response from the I/O channel causes the 2845 to retransmit the message.

The normal I/O channel response to receipt of the transmission sequence is STX/EOT, indicating to the 2845 that the message sequence was received correctly. The STX/EOT response received by the 2845 causes the nondestructive cursor to be positioned in the first character position (upper left corner) of the screen, restores the keyboard, and terminates the operation. (See programming note below for operation with the destructive cursor.)

If an internal parity error is detected by the 2845 before transmission of the 2845 text is completed, the 2845 transmits the CAN control character immediately following the text and prior to the ETX character provided the operator has not intervened by depressing the RESET key. The CAN control character indicates to the I/O channel that an internal parity error was detected by the 2845 in the preceding message. If the operator discovers the error (indicated by one or more Check characters on the 2265 screen), simply depressing the RESET will prevent the CAN character from being transmitted should a Read Addressed Full DS Buffer command be issued. Keyboard correction of the erroneous characters is optional. Characters found in error are assigned correct parity by the 2845 before being transmitted to the I/O channel. Subsequent

I/O Channel Sequences
and Responses

2845 Sequences
and Responses

EOT
2845 Address   ⎫ Addressing
General Address (Hex = FF) ⎬ Sequence
General Poll Command (Hex = 40) ⎭

No Response   EOT   STX   STX
              (Negative   Printer Address   2265 Address
              response   ETX   Text
              to Poll)   LRC   CAN***
                                                  ETX
                                                  LRC

STX*   STX*   SOH*†   EOT*†   ACK   NAK
Text   EOT
ETX
LRC

No Response   EOT

No Response   ACK   NAK‡   EOT**‡

STX   SOH   EOT
Etc.
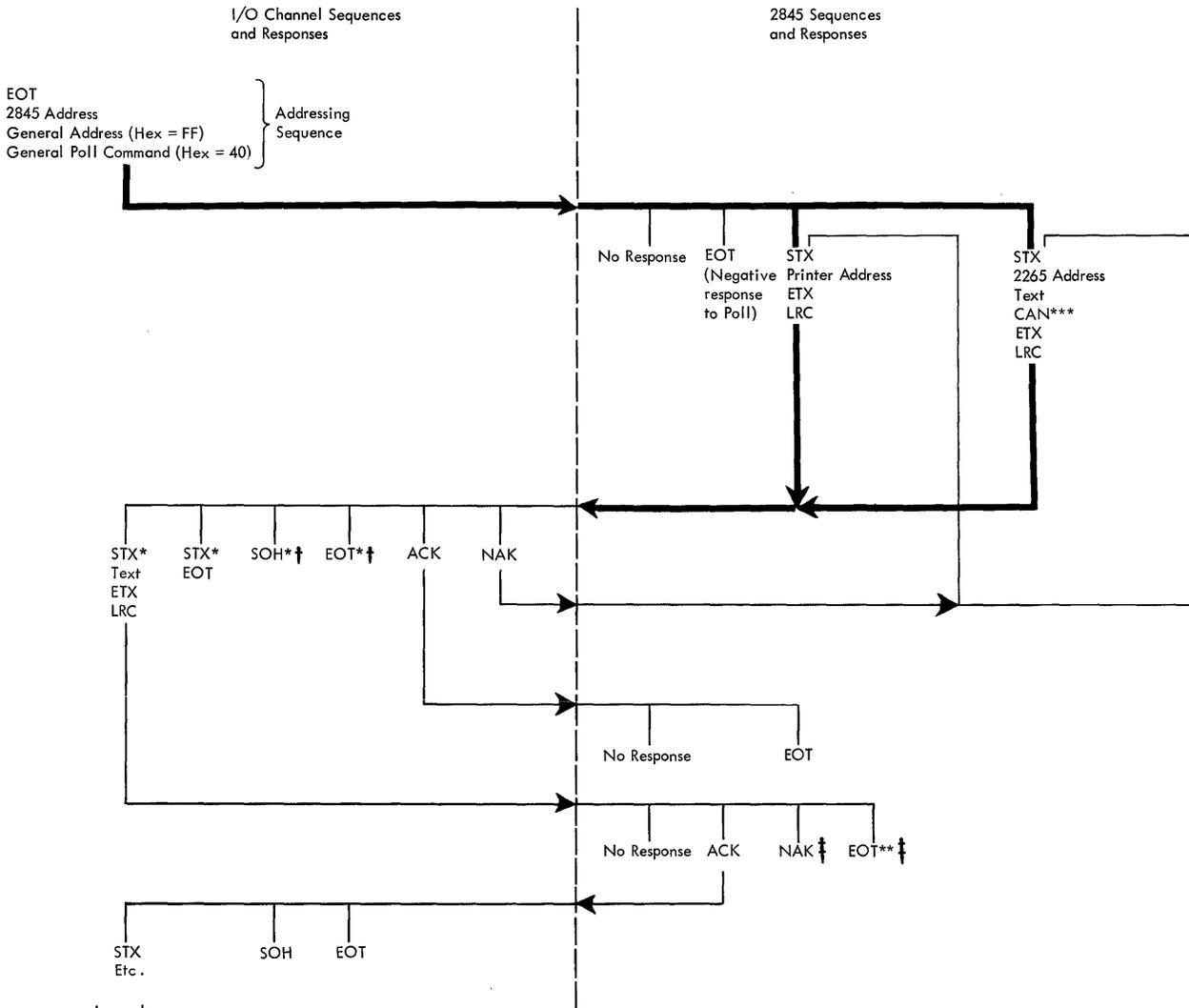
Legend:

* General Poll must be reinitiated for same 2265, if Printer is attached,
  to assure receipt of a message pending at the 2265.

** Indicates printer-buffer overrun.

*** CAN is transmitted only if the 2845 detects an internal parity
    error after the ENTER key is depressed but before the message
    text is completely transmitted.

† SOH or EOT response from I/O channel to a message ending in
  ETX/LRC does not restore the 2265 keyboard, clear the SOM symbol,
  nor extinguish the ENTER indicator. The ENTER operation is
  still pending.

‡ See "Error Recovery Procedures" for further I/O channel responses.

Figure 8. General Poll, Sequence/Response Diagram

I/O Channel Sequences
and Responses

2845 Sequences
and Responses

EOT
2845 Address
2265 Address   Addressing
Read Command (Hex = 50)   Sequence

No Response

STX
2265 Address
Text* (full buffer)
CAN**
ETX
LRC

STX   STX   SOH   EOT   NAK
Text   EOT
ETX
LRC

No Response   ACK   NAK †

STX   SOH   EOT
Text
Etc.

Legend:

* The nondestructive cursor is moved to the first character
  position of the screen (upper left corner). For machines
  equipped with the Destructive Cursor Feature, see programming
  note under "Read Full DS Buffer" in text.

** CAN is transmitted if the 2845 detects an internal parity error
   and no operator intervention has occurred (depression of RESET key)
   prior to recognition of command.

† See "Error Recovery Procedures" for further I/O channel responses.

Figure 9. Read Addressed Full DS Buffer, Sequence/Response Diagram

I/O channel response to the CAN control character is determined by the program. The characters with corrected parity are identified as those immediately preceding the Check characters.

The I/O channel may respond to the 2845 transmission with SOH or EOT. Either response terminates the Read operation but does not restore the 2265 keyboard.

Figure 9 illustrates another I/O channel response that can be made following the readout of the 2845 buffer. If the program has a computer-generated message to send to the Display Station, the message can be sent after the 2845 buffer readout is complete. Thus, the Read Addressed Full DS Buffer operation is essentially converted to a Write Addressed DS operation and, since the 2845 and 2265 are already selected, no addressing sequence is necessary. The operation may be terminated as described under "Write Addressed DS".

No response to the addressing sequence by the 2845 indicates that the sequence was not successfully decoded or that the 2845 detected a VRC error in the sequence. The 2701 will time out and the program should retry.

PROGRAMMING NOTE: When the 2845, equipped with the Destructive Cursor Feature, executes a Read Addressed Full DS Buffer command, the destructive cursor symbol will remain stationary on the screen during the command operation. After the operation is finished (buffer completely read out), depression of a character key on the 2265 keyboard will cause the entered character to be displayed in the first character position and a second destructive cursor symbol to be displayed in the second character position of the screen. Because operation with two destructive cursor symbols is not defined, an Erase/Write Addressed DS command should be issued to the selected 2265 immediately following a Read Addressed Full DS Buffer operation. In lieu of the Erase/ Write Addressed DS command, the keyboard ERASE DPLY (erase display) key can be used or the original EOM symbol can be over- written by the operator.

Write Addressed DS (Figure 10)

The Write Addressed DS command is used to transfer data from the I/O channel to a selected 2265 for presentation on the Display Station screen. Upon receipt of the Write Addressed DS addressing sequence, the 2845 Display Control responds with ACK. No response from the 2845 to the addressing sequence indicates that the sequence was not successfully decoded or that the 2845 detected a VRC error in the sequence. The 2701 will time out and the program should retry.

The ACK response indicates that the 2845 and the addressed 2265 are selected and are ready to receive a message. Note that if a keyboard key is depressed at any time after the Write Addressed DS command is received, the keyboard locks and the character is not entered. (The ERASE EOL, ERASE EOS, ERASE DPLY, TEST, and RESET keys do not lock the keyboard; neither do they perform their normal functions.)

Upon receiving the ACK response, the normal response is the following transmission sequence containing the message to be written on the screen of the selected 2265: STX, Text (message to be written), ETX, and LRC character.

The incoming USASCII characters are parity-checked and placed in the display buffer of the addressed 2845 at the location indicated by the cursor. Upon entering the display buffer, each character is displayed on the 2265 screen. The cursor automatically advances to the next character position as each character is placed in the display buffer and displayed on the screen. If a Line Feed (LF) code is received, an NL symbol is displayed, and the cursor is stepped to the first position of the next line without altering the contents of the remaining character positions on that line. The cursor proceeds to step normally with each additional character received. At the termination of text transmission, the cursor is displayed in the character position immediately following the last transmitted character.

Upon receipt of ETX and the LRC character, the 2845 responds with ACK if no parity errors were detected. The ACK response indicates to the I/O channel that the message was successfully received. The I/O channel may continue the operation by sending another message or it may terminate the operation by responding with SOH or EOT. If the operation is ended with SOH or EOT, the Display Station keyboard remains locked as a positive indication to the operator that an I/O operation has taken place. The screen should be visually checked by the operator for a computer-generated message before proceeding to enter data from the keyboard. The keyboard may be unlocked by depressing the RESET key.

PROGRAMMING NOTES:
1. Transfer of data from the I/O channel is under I/O channel byte count control. If a message length exceeds the total number of character positions on the screen, screen wraparound occurs. That is, the excess message data replaces previously written data, beginning at the first character position.
2. If a parity error is detected by the 2845 during the transmission sequence, a Check symbol is displayed in place of the character in error.
3. When operating in conversation mode, it may be desirable to unlock the keyboard following the Write Addressed DS command. If so, the program should respond with STX/EOT to the second ACK response from the 2845. See Figure 10. ("Conversation mode", in this sense, is defined as a communication between the computer and a display station in which each entry from the computer elicits a response from the display station, and vice versa.)

```
        I/O Channel Sequences                    2845 Sequences
        and Responses                            and Responses

SOH                          ⎤
2845 Address                 ⎟  Addressing
2265 Address                 ⎬  Sequence
Write Addressed DS Command (Hex = A0) ⎦

                                              No Response        ACK


STX     SOH     EOT
Text
ETX
LRC


                                              No Response   ACK      NAK †


STX     SOH     EOT     STX
Etc.                   EOT*
```

* Useful in conversation mode to restore 2265 keyboard.

† See "Error Recovery Procedures" for further I/O channel responses.
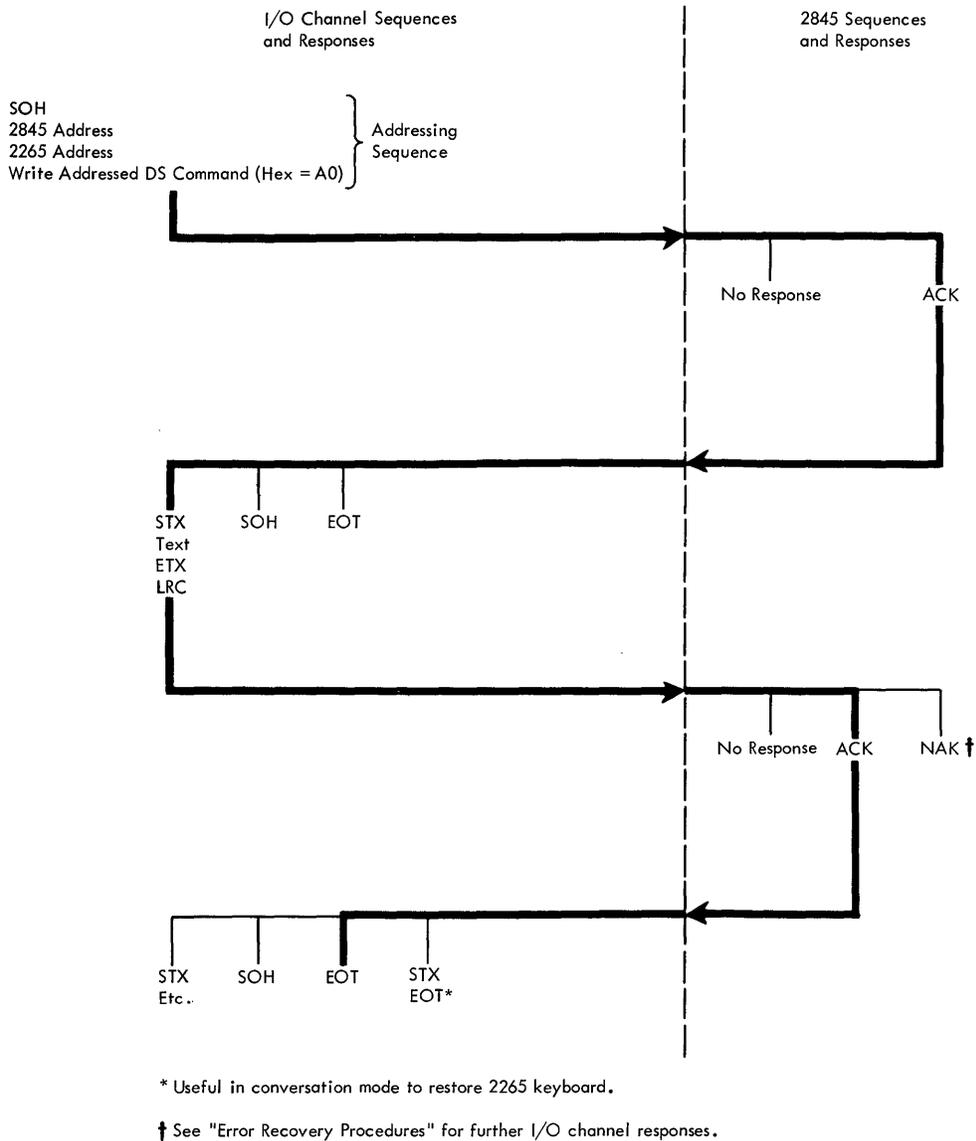
Figure 10. Write Addressed DS, Sequence/Response Diagram

As indicated in Figure 10, the 2845 may also respond to the text transmission by sending NAK. The NAK response indicates that the 2845 detected either a VRC or LRC error. When a VRC error is detected in a text character, the Check symbol is displayed on the screen in place of the character in error. The program may retry the transmission starting with STX. (See "Error Recovery Procedures".)

No response to text indicates that the 2845 did not recognize, or detected a VRC error in, a control character (STX or ETX). The 2701 will time out and the program must send SOH to re-establish the 2845 in control mode, then reissue the complete addressing sequence and message.

Erase/Write Addressed DS (Figure 11)

The Erase/Write Addressed DS command sequence may be addressed to Display Stations only. It is essentially an Erase command combined with a Write sequence. This command causes the 2845 Display Control to erase the message displayed on the screen of the selected 2265 Display Station and causes the cursor to be positioned in the first character position (upper left corner of the screen). Thus, it is assured that the message following the addressing sequence will be written on the screen of the selected 2265 beginning at the first character position.

Normal 2845 response to the Erase/Write addressing sequence is ACK. The ACK response indicates to the I/O

I/O Channel Sequences
and Responses

2845 Sequences
and Responses

SOH
2845 Address   } Addressing
2265 Address   } Sequence
Erase/Write Command (Hex = E0) }

No Response   ACK

STX*   SOH   EOT
Text
ETX
LRC

No Response   ACK   NAK †

STX*   SOH   EOT
Etc.

* No repeat erase is performed without repeating SOH sequence.

† See "Error Recovery Procedures" for further I/O channel responses.
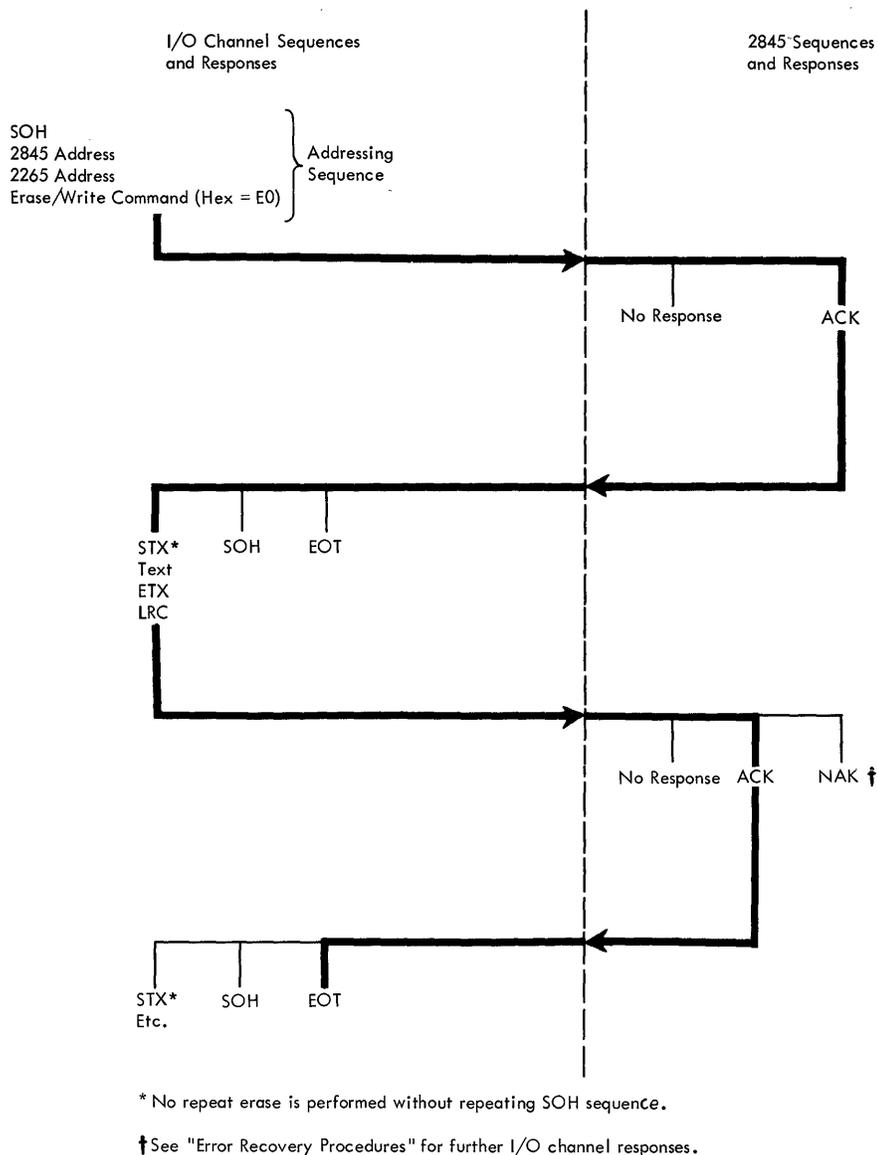
Figure 11. Erase/Write Addressed DS, Sequence/Response Diagram

channel that the screen of the selected 2265 is erased and that the cursor is in the first character position. The I/O channel response to ACK may be an EOT or SOH (either of which terminates the operation; see Programming Note, or it may be the transmission of a message beginning with STX. The sequences and responses that occur during the write portion of the operation are the same as those described in the Write Addressed DS operation.

An erase function is only performed immediately following the addressing sequence containing the Erase/Write Addressed DS command (SOH, 2845 Display Control Address, etc.). Therefore, subsequent erasures require reinitiating the addressing sequence.

PROGRAMMING NOTE: The erase/write addressing sequence not followed by a message from the I/O channel is used to erase a particular 2265 Display Station screen.

Write Printer (Figure 12)

The Write Printer command is used to select a 1053 Printer when data is to be transferred from the I/O channel and printed on hard copy. Following the addressing sequence, an ACK response from the 2845 represents a positive acknowledgment that the selected Printer is ready and not busy. "Ready" indicates that power is turned on in the Printer and that the Printer is properly loaded with paper. "Not busy" indicates that the printer buffer of the 2845

I/O Channel Sequences and Responses | 2845 Sequences and Responses

```
I/O Channel Sequences                    2845 Sequences
and Responses                            and Responses

SOH                          ⎫
2845 Address                 ⎬ Addressing
Printer Address              ⎭ Sequences
Write Printer Command (Hex = A0)

                                    ─────────────────────────────▶

                No Response   NAK*†    EOT*    ACK
                              Printer  Printer
                              Not Ready Busy

                ◀─────────────────────────────

STX      SOH      EOT
Text
ETX
LRC

                                    ─────────────────────────────▶

                No Response  ACK    NAK‡   EOT**‡

                ◀─────────────────────────────

STX      SOH      EOT
Etc.
```

* Sets Printer Request.

** Indicates printer-buffer overrun.

† If Printer is both Not Ready and Busy, Not Ready is given priority.

‡ See "Error Recovery Procedures" for further I/O channel responses.

Figure 12. Write Printer, Sequence/Response Diagram

is not in use as a result of a previous Write Printer operation and is ready to receive text. Assuming an ACK response is sent by the 2845, the I/O channel may proceed with the following sequence containing the message to be printed: STX, text,ETX, LRC character. As text characters are received from the I/O channel, they are parity-checked and stored in the 2845 printer buffer, starting in position 1. After the ETX and LRC characters are received, if no VRC or LRC error was detected, the 2845 responds with ACK to the I/O channel. The 2845 does not transfer the text to the Printer until the text is completely received

and parity-checked by the 2845. Therefore, the I/O channel must send EOT or SOH in response to ACK to initiate the actual printing of the message by the Printer. EOT or SOH also terminates the command operation.

PROGRAMMING NOTE: If another block of text is sent to the Printer in lieu of SOH or EOT, the previous text remains stored in the printer buffer, and is not printed out at this time. The text of the second message is stored in the printer-buffer area immediately following the preceding text. No printout occurs until an SOH or EOT character is received by the 2845. Be sure that the total number of text characters does not exceed 240.

When an SOH or EOT is received, the 2845 transfers the contents of the printer buffer to the Printer. If the Printer is in the process of printing out an operator-initiated print operation (PRINT key depressed on the 2265 keyboard), the 2845 holds the computer-generated Printer message until the key-initiated print operation is completed before transferring the computer-generated message to the Printer. (A print operation initiated by depressing the 2265 PRINT key transfers displayed data stored in the display buffer to the Printer for printing.) If a parity error is detected when the text is being transferred from the printer buffer to the Printer, the incorrect character is printed. A Check symbol ($\searrow$) is printed at the end of the message to indicate that an error has occurred.

Referring back to the initial addressing sequence, the 2845 will respond with NAK if the Printer is not ready, and Printer Request will be set. (See "Printer Request Condition" below.) The 2845 will respond with EOT if the 2845 finds the printer buffer busy; i.e., still transferring text to the Printer as a result of a previous Write Printer command. A busy condition also sets Printer Request. If both Not Ready and Busy conditions are detected, the 2845 responds with NAK and Printer Request is set. No response to the addressing sequence indicates that the sequence was not successfully decoded or a VRC error was detected by the 2845.

Other 2845 responses to the Printer message are shown in Figure 12. A NAK indicates that the 2845 detected a VRC or LRC error in the message transmission from the I/O channel. The program should retry the text transmission. (See "Error Recovery Procedures".)

If the Printer text exceeds 240 characters, the 2845 responds to the message transmission with EOT, indicating a printer-buffer overrun. The 2845 erases the text entered in the printer buffer and inhibits the printing operation. The message should be broken into segments of 240 characters or less and transmitted separately.

PROGRAMMING NOTES:
1. If a VRC or LRC error is detected during printer text transmission from the I/O channel, upon conclusion of the transmission the 2845 will inhibit the start of the print operation and issue a NAK response to the I/O channel. The program should retry the text transmission starting with STX.
2. Should the Printer text transmission exceed 240 characters (buffer overrun), upon conclusion of the transmission, the 2845 will inhibit the start of Printer operation and issue an EOT response to the I/O channel to indicate that a printer-buffer overrun has occurred. The program must segment the Printer text into two or more shorter messages.

3. An EOM code should be transmitted as the last character of each complete message to ensure separation of messages. The EOM code causes an EOM symbol to be printed and the print mechanism to be advanced to the first print position of the next line. The EOM symbol serves as a visual indication that the message has been completed.

4. An LF code should be used as the first character of a message when additional separation between messages is desired. The LF code causes the print mechanism to be advanced to the first print position of the next line. However, unlike the EOM code, the LF code does not cause a character to be printed.
5. A message to the Printer that contains more characters (including spaces) than can be accommodated on one print line must be segmented into two or more lines by inserting LF codes at the appropriate points within the message. Otherwise, all characters that exceed the capacity of a single print line will overprint in the last print position.
6. If two successive Write Printer commands are issued, the second command will not be accepted until the Printer has completed printing the first message. For this reason, the Write Printer command should not be chained.
7. Data chaining of successive Printer messages will result in excessive line turnaround time. If two or more messages are to be sent to the Printer, they should be combined and sent as a single message (not to exceed 240 characters.)

Printer Request Condition

The Printer Request condition will be set in the 2845 if the I/O channel attempts to select the attached Printer with a Specific Poll to Printer command or a Write Printer command while the Printer is busy or not ready. Later, upon receipt of a General Poll command, because the Printer Request condition is already set, the 2845 will test the Printer ready and busy statuses. If found still busy or not ready, General Poll is continued by automatic polling of the Display Station as described under "General Poll". The Printer Request condition remains unchanged. However, if the Printer is found to be ready and not busy, the 2845 responds to the I/O channel by sending the following sequence: STX, the Printer's address, ETX, and LRC character. This printer-available sequence indicates to the I/O channel that the Printer is ready and free to receive a message.

The I/O channel may respond to the printer-available sequence with a Printer message. If so, no addressing sequence is necessary; the operation continues as a Write Printer operation. However, if the I/O channel does not respond with a message for the Printer and instead sends another addressing sequence to the 2845, the new addressing sequence terminates Printer Request. Therefore, a new General Poll will not find Printer Request set and will not elicit the printer-available sequence from the 2845. In this case, the Write Printer command must be issued to send a message to the Printer.

Simultaneous Keyboard and Printer Operations

2265 Display Station data and 1053 Printer data are stored in separate portions of the 2845 buffer storage and are essentially independent of each other. Therefore, transfer of data from the 2845 to the 1053 Printer as the result of a Write Printer command does not interfere with keyboard entry, display of data, nor any 2845 command other than

Write Printer. Transmission of data to the 2845 as the result of a Write Printer command does not interfere with keyboard entry, a PRINT key operation, nor with the display of data. However, following depression of the PRINT key, the 2265 keyboard is locked. Any command, other than Write Printer, received at this time will stop the print operation as will depression of the 2265 RESET key.

Write DS Line Address (Figure 13)

The Write DS Line Address command may be addressed to Display Stations only. To accept and execute the Write DS Line Address command, the 2845 Display Control must be equipped with the Line Addressing Feature. The Write DS Line Address command combines the Write Addressed DS command with line selection capabilities, thus enabling selection of a particular line on the display as the beginning line of the message.

The Write DS Line Address command causes the cursor of the selected 2265 Display Station to be positioned at the first character position of the specified line. The line address is specified by the first character following the STX line control character. Subsequent message data (text) is displayed beginning at the first character position of the addressed line.

The Write DS Line Address command enables one of 12 line addresses (or 15 line addresses depending on which Display Format Feature is installed in the 2845) to be selected. With the exception that the character immediately following STX specifies the line address, the Write DS Line Address command operates the same as the Write Addressed DS command. All sequences and responses that apply to the Write Addressed DS operation apply also to the Write DS Line Address operation.

† See "Error Recovery Procedures" for further I/O channel responses.
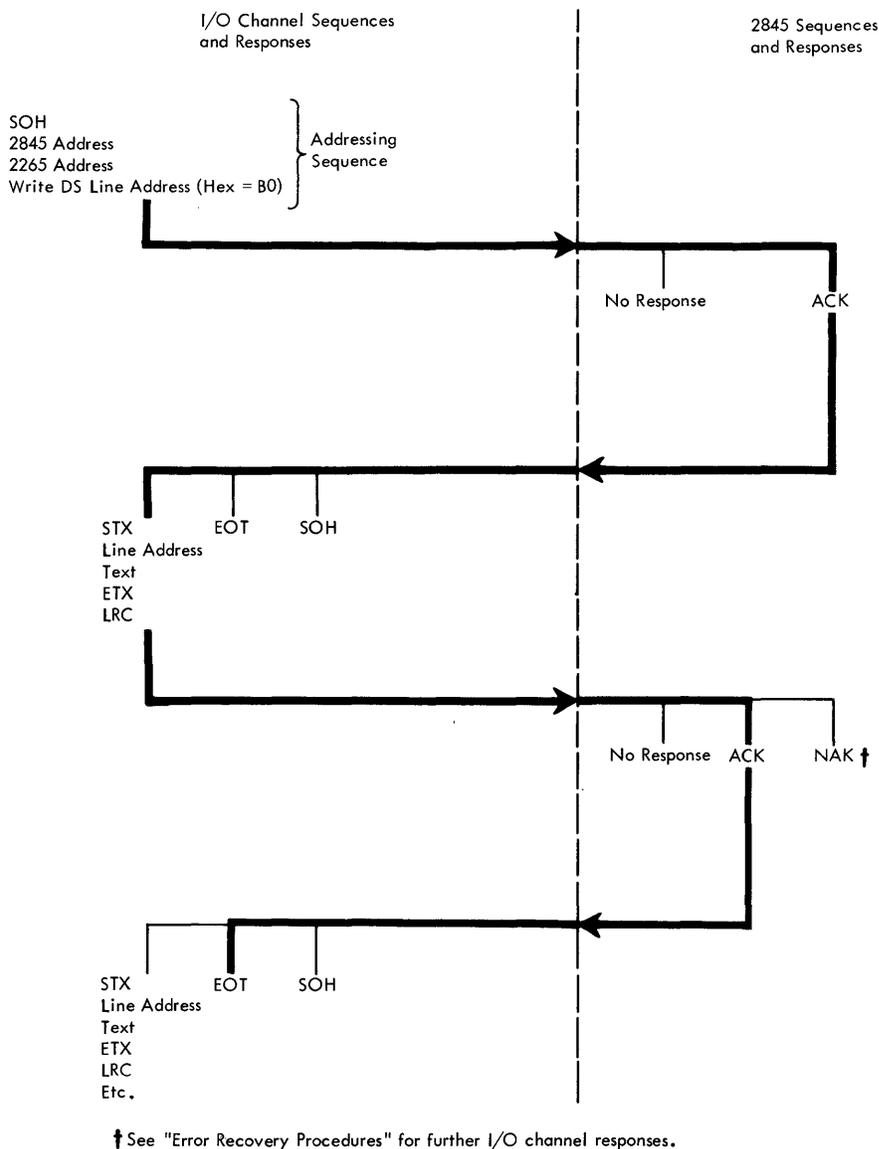
Figure 13. Write DS Line Address, Sequence/Response Diagram

Table 6 lists the 12 (or 15) possible line addresses. Note that only the byte formats listed in the table should be used to select display lines.

PROGRAMMING NOTE: All messages sent under this command must contain the line address immediately following the STX character. Since the line address character is not displayed, any other character sent in its place will be lost. Therefore, unlike other commands, this command cannot be converted to the Write Addressed DS command without sending a complete Write Addressed DS command addressing sequence.

SUMMARY OF SEQUENCES AND RESPONSES

The sequences and responses that occur between the I/O channel and the 2845 Display Control are composed of seven of the eight USASCII communication control characters. These characters, used singly or in sequences, facilitate or are directly responsible for the following:
1. Perform line control functions.
2. Maintain operational continuity.
3. Provide the I/O channel with the current status of the operation of a specific device.
4. Signal the detection of an error or unusual condition to the I/O channel or the 2845 Display Control.
5. Provide the I/O channel with specific information regarding an error or unusual condition.

The significance of a given sequence or response may differ depending on the operation and receiver; i.e., a specific response received at the 2845 may be interpreted differently than the same response directed to the I/O channel. Thus, the sequences and responses are described for both their significance to the I/O channel and to the 2845 Display Control.

2845 Display Control Sequences and Responses

All line control characters recognized during execution of a Read command issued to the I/O channel are transferred to main storage. The following communication control characters sent by the 2845 are recognized by the 2701 during execution of an I/O channel Read command:

Start of Text (STX)

The STX communication control character is the first character of a message sent by the 2845 in response to the Read Addressed Full DS Buffer and all poll commands. The STX character initiates, but is not included in, the LRC accumulation in both the 2845 and the 2701. The character following the STX is always the address of the device.

End of Text (ETX)

The ETX communication control character signifies that the last text character of the message has been transmitted and indicates the following character is the LRC character. ETX initiates line turnaround at the 2701 after receipt of the LRC character. The ETX character is included in the LRC accumulation. Upon receipt of ETX and the LRC character, the 2701 performs an LRC accumulation check. At the conclusion of the LRC check, Channel End and Device End are set in the 2701 status byte, and the status byte is transferred to the I/O channel. If an LRC or VRC error is detected in the transmission, Unit Check is also set in the status byte, and Data Check is set in the sense byte.

Cancel (CAN)

The CAN communication control character signifies that the transmitted text may contain characters with 2845-

Table 6. Display Line Addresses

USASCII-8 Data Byte Format	Hexadecimal Representation	Selected Display Line
Bits 8 7 6 5 4 3 2 1		
0 1 0 1 0 0 0 0	50	1
0 1 0 1 0 0 0 1	51	2
0 1 0 1 0 0 1 0	52	3
0 1 0 1 0 0 1 1	53	4
0 1 0 1 0 1 0 0	54	5
0 1 0 1 0 1 0 1	55	6
0 1 0 1 0 1 1 0	56	7
0 1 0 1 0 1 1 1	57	8
0 1 0 1 1 0 0 0	58	9
0 1 0 1 1 0 0 1	59	10
0 1 0 1 1 0 1 0	5A	11
0 1 0 1 1 0 1 1	5B	12
0 1 0 1 1 1 0 0	5C	13
0 1 0 1 1 1 0 1	5D	14
0 1 0 1 1 1 1 0	5E	15

corrected parity errors. The characters with corrected parity are identified to the program as those immediately preceding any transmitted Check characters.

CAN is transmitted as the last text character of a Display Station message in response to a General Poll or Specific Poll to Display Station command if an internal parity error is detected by the 2845 after the ENTER key is depressed but before the message is completely transmitted. CAN is included in the response to a Read Addressed Full DS Buffer command if an internal parity error is detected by the 2845 provided the operator has not depressed the RESET key following the error detection and prior to recognition of the command.

The 2845 inserts the CAN character between the message and the ETX communication control character as follows: STX, 2265 address, Text, CAN, ETX, and LRC character. The receipt of the CAN character at the 2701 Data Adapter Unit causes Unit Check to be set in the 2701 status byte and Remote Equipment Check to be set in the 2701 sense byte. The CAN character is included in the LRC accumulation.

PROGRAMMING NOTE: When a CAN character is received by the I/O channel during a Read Addressed Full DS Buffer, Specific Poll to Display Station, or General Poll operation, the data displayed on the 2265 containing the error should be erased and re-entered. Otherwise, a subsequent attempt to read the message will result in a recurrence of the original error indication.

Positive Acknowledgment (ACK)

An ACK response from the 2845 is a valid response to an addressing sequence containing the Write Addressed DS, Erase/Write Addressed DS, Write Printer, or Write DS Line Address command. It indicates that the addressing sequence has been accepted and that the device is ready to receive a message. An ACK response terminates the I/O channel command with Channel End and Device End.

An ACK response from the 2845 to a message sequence beginning with STX is an affirmative response and indicates that the message was received correctly. The I/O channel command ends with Channel End and Device End. ACK causes an immediate line turnaround.

Negative Acknowledgment (NAK)

The 2845 responds with NAK following the addressing sequence of a Specific Poll to Printer or a Write Printer command if the Printer is not ready. Because the 2701 is in control mode, the I/O channel command ends with Channel End, Device End, and Unit Exception.

The 2845 also responds with NAK upon receipt of a message during a Write Addressed DS, Erase/Write Addressed DS, Write Printer, or Write DS Line Address operation if, during message transmission, the 2845 detects a VRC or LRC error. Because the 2701 is in text mode at this time, the command ends with Channel End, Device

End, and Unit Check status. Data check is set in the sense byte. NAK causes an immediate line turnaround.

End of Transmission (EOT)

The EOT character, as a 2845 Display Control response, has more than one interpretation. The following describes the situations under which the 2845 responds with EOT and the significance of each:
1. EOT is a negative response to the Specific Poll to Display Station addressing sequence and indicates that there is no message pending from the Display Station.
2. EOT is a negative response to the Specific Poll to Printer and Write Printer addressing sequences and indicates the Printer is busy.
3. EOT is a negative response to the General Poll addressing sequence and indicates that the Printer is busy or that Printer Request was not set and, upon automatic polling of the Display Station, no display message was found pending.
4. EOT as a 2845 response to the transmission of a message to the 1053 Printer indicates a printer-buffer overrun condition. That is, the Printer message exceeded printer-buffer capacity.
5. When the I/O channel receives a message from the 2845 following a Specific Poll command, an ACK response indicates the message was successfully received. An EOT response from the 2845 to this ACK indicates no further messages are pending at the 2845 and ends the operation.

When EOT is received by the 2701 under any of the preceding conditions, the operation is ended with Channel End, Device End, and Unit Exception status. EOT causes an immediate line turnaround.

No Response

If a response from the 2845 is anticipated, but is not forthcoming within the time allotted (2 seconds), the 2701 Data Adapter Unit times out (see "2701 Line Timeout"). When this occurs, Channel End, Device End, and Unit Check are set in the 2701 status byte. Timeout is set in the 2701 sense byte.

The causes of a No Response condition are:
1. An invalid 2845 address (second byte of an addressing sequence).
2. An invalid 2265, 1053 Printer, or general address (third byte of an addressing sequence).
3. An invalid command (fourth byte of an addressing sequence).
4. A malfunction in the 2845 Display Control.
5. An incorrect sequence of characters (either addressing or text) transmitted to the 2845.
6. Transmission error in a control or addressing character (for example, garbled by line noise).
7. A malfunction in the communication facilities.

8. The 2845 in Test status.

9. The 2845 in a power-off condition.

I/O Channel Sequences and Responses

The following line control characters are recognized by the 2845 during execution of an I/O channel Write command:

Start of Text (STX)

STX must be transmitted by the I/O channel as the first character of a text transmission sequence. Receipt of STX by the 2845 places the 2845 in text mode and initiates LRC accumulation. (STX is not included in the accumulated LRC character.) Failure to transmit STX resets the 2845 and no response from the 2845 will be forthcoming.

End of Text (ETX)

ETX indicates the last character of the message has been transmitted. The LRC character is transmitted immediately after the ETX character. Upon receiving the LRC character, the 2845 performs an LRC accumulation check. Line turnaround also occurs at this time. The ETX character is included in the LRC accumulation. Channel End and Device End are set in the 2701 status byte following transmission of the LRC character.

Positive Acknowledgment (ACK)

An ACK response from the I/O channel to a message received from the 2845, as a result of a Specific Poll or General Poll command, is an affirmative response indicating that the message was received correctly. Upon receipt of the ACK response at the 2845, the SOM symbol is deleted, the ENTER indicator is extinguished, and the keyboard is restored. ACK causes an immediate line turnaround.

Negative Acknowledgment (NAK)

A NAK response from the I/O channel indicates that an error was detected in a message sequence transmitted by the 2845 Display Control. The NAK response from the I/O channel causes the 2845 to retransmit the message. NAK causes an immediate line turnaround.

Start of Heading (SOH)

The SOH communication control character is transmitted only by the I/O channel and is normally used as the first character of all addressing sequences containing a Write Addressed DS, Erase/Write Addressed DS, Write Printer, or Write DS Line Address command. The SOH character places the 2845 in control mode, and prepares the 2845 to receive an addressing sequence. (In this respect, it is identical in function to EOT.) LRC accumulation is inhibited.

The SOH control character may also be used as a negative response to a message sequence from the 2845. When so used, it terminates the operation but does not restore the keyboard of the selected 2265.

End of Transmission (EOT)

EOT is normally used as the first character of the Specific Poll, General Poll, and the Read Addressed Full DS Buffer addressing sequences. The EOT communication control character places the 2845 in control mode, and prepares the 2845 to receive an addressing sequence. (In this respect, it is identical in function to the SOH communication control character.) LRC accumulation is inhibited. EOT is also used to conclude an operation.

An EOT response from the I/O channel to a transmission sequence from the 2845 ending in ETX/LRC indicates a negative response to the transmission sequence and terminates the operation. It does not restore the keyboard of the selected 2265.

Start of Text/End of Transmission (STX/EOT)

The STX/EOT sequence may be used as a positive response in substitution for ACK, following a Specific Poll to Display Station, General Poll, Write Addressed DS, or Read Addressed Full DS Buffer operation. This sequence concludes the operation and does not require a reply from the 2845. When used following a Specific Poll to Display Station or General Poll, it also causes the SOM symbol to be erased from the screen, the ENTER light to be extinguished, and the keyboard to be restored.

Line Feed (LF)

The LF character is a formatting character which is recognized by the 2845 only when it is transmitted as part of the message text. When the text is addressed to a Display Station, the LF character causes the cursor to be placed in the first character position of the next line. When included in text addressed to a Printer, the LF character causes the Printer to perform a carriage return-line feed operation.

PROGRAMMING NOTE: Transmission of an SOH or EOT communication control character within the body of a message aborts the operation and places the 2845 in control mode. Therefore, they should not be transmitted as part of text. When the ACK, NAK, or STX communication control characters are transmitted within the body of a message, the character location occupied by any one of these three control characters within the body of text is displayed as a space. Transmission of an ETX communication control character within the body of text will cause a line turnaround. The LRC accumulation will not compare equally and the 2845 will respond with NAK.

ERROR RECOVERY PROCEDURES

Certain error recovery procedures are recommended when a particular response is received from the 2845 Display Control. The responses to the addressing sequence and/or text of a message are described below together with the recommended error recovery procedure.

NAK Response to Addressing Sequence

The NAK response is a valid response to the Write Printer and Specific Poll to Printer addressing sequences. In either case, NAK indicates that the Printer is not ready. The program should notify the operator via a Write Addressed DS command to make the Printer ready. The Write Printer or Specific Poll to Printer can then be sent periodically until the printer available sequence is received in response. At this time the text of the Printer message may be sent.

The NAK response to other than the above addressing sequences is invalid. If NAK is received in response to other addressing sequences, the program should respond with EOT and retry the addressing sequence three times. If the three attempts are unsuccessful, the operator should be notified.

NAK Response to Text

NAK is a valid response from the 2845 to any text transmission from the I/O channel. It indicates that a VRC or LRC error has been detected by the 2845. All NAK responses to the transmission of text should be logged by the program.

If the text was sent to a Display Station as a result of a Specific Poll, Read Addressed Full DS Buffer, Write Addressed DS, or Erase/Write Addressed DS command, the recommended recovery procedure is to issue the Erase/ Write Addressed DS command to the selected Display Station. Depending upon the application:
1. The text should be retransmitted.
2. The text should be retransmitted with notification to the operator.
3. A recovery procedure via the application program should reconstitute the entire display plus the additional message text.
4. The application program should generate a recovery display summarizing the transaction in process.

If the text transmission was addressed to the Display Station as a result of a Write DS Line Address command, the message should be retransmitted starting with STX. The 2845 will address the display line, and, if the previous transmission was correctly positioned to start on the specified line, the retransmission will overlay and replace the erroneous text.

If the text transmission was addressed to the Printer as a result of a Write Printer, a Specific Poll, or a General Poll command, a Write Printer command should be reinitiated and, following a positive 2845 response (ACK), the text retransmitted.

EOT Response to Addressing Sequence

The EOT response is a valid response to the Write Printer, Specific Poll, and General Poll commands. If EOT is received in response to commands other than these three, the program should reattempt the command up to three times. If the three attempts fail, the operator should be notified.

EOT Response to Text

The EOT response to text addressed to a Display Station is not a valid response. If this response is received, the program should reinitiate the addressing sequence and, following a positive 2845 response (ACK), retransmit the text. Should a third attempt fail, the operator should be notified.

The EOT response to text addressed to the Printer indicates that the capacity of the printer buffer has been exceeded (buffer overrun). The program must segment the Printer text into two or more shorter messages and transmit them individually.

CAN Response

The CAN control character transmitted as the last character of text (immediately preceding ETX) indicates that the transmitted text may contain characters with 2845-corrected parity, and that no operator intervention occurred prior to buffer readout. The characters are identified as those immediately preceding any transmitted Check characters. The Check characters may be corrected and eliminated by program overwrite or by keyboard overwrite. If keyboard-overwrite correction is required, the operator should be so notified.

No Response to Addressing Sequence or Text

No response from the 2845 indicates one of the following:
1. An invalid 2845 address (second byte of an addressing sequence).
2. An invalid 2265, 1053 Printer, or general address. (Third byte of an addressing sequence.)
3. An invalid command (fourth byte of an addressing sequence).
4. A malfunction in the 2845 Display Control.
5. An incorrect sequence of characters (either addressing or text) transmitted to the 2845.
6. Transmission error in a control or addressing character (for example, garbled by line noise).
7. A malfunction in the communication facilities.
8. The 2845 in Test status.
9. The 2845 in a power-off condition.

When no 2845 response is received to a command addressing sequence or to text transmitted by the 2701, the 2701 will time out. The program should log the condition and reattempt the command or text transmission up to three times. If the three attempts fail, the operator should be notified.

I/O CHANNEL COMMANDS, CCW'S, AND ENDING STATUS AND SENSE BYTES

To perform information interchanges between the central processor (via the I/O channel and 2701 Data Adapter Unit) and the 2845 Display Control, only two I/O channel commands are required: Read and Write. These commands to the I/O channel are issued under the Start I/O instruction by the central processor program. Table 7 shows the settings or contents of significant bits of the CCW's (channel control words) that direct the I/O channel operations during interchange of information between the 2701 and 2845. Command-chaining (CC bit set to 1) is specified to maintain continuity of sequences and responses. The data address portion of the CCW specifies the address of the first byte of a multiple-byte transmission or the address of the single byte when only one byte is to be transmitted. The byte count does not include the LRC byte. The LRC byte is used by the 2845 and 2701 for checking purposes only and is not transferred to or from the I/O channel.

The Chain Data (CD), Skip, and Program-Controlled Interruption (PCI) flags are not shown because their settings are optional. However, if the CD flag is on, the CC and SLI flags are ignored.

Reference to Table 7 may be helpful to the programmer when reviewing the command sequence/response diagrams shown in Figures 6 through 13. The table is not intended to show all possible responses. Its purpose is to show a typical program sequence that may be used to execute a particular operation. For example, when executing a specific poll to a display station, the Write command is issued under a Start I/O instruction to the I/O channel. As shown in Table 7, the data address of the CCW specifies the location of the first byte of the four-byte addressing sequence. In this example, the first byte is the EOT control character. A byte count of four is indicated because the addressing sequence contains four bytes.

The Write command is chained to a Read command to enable the I/O channel to receive the response from the 2845. A maximum of 960 characters can be displayed on a 2265 screen; therefore, to accommodate a maximum-length message from the Display Station, the CCW byte count must be 964. This permits receiving STX, the 2265 address, ETX, and a possible CAN character in addition to the complete message text. The first byte of the message must be STX and will be stored at the location specified by the data address of the CCW. If the 2845 has no message to send, it responds with EOT. EOT will break the command chain. Subsequent action is determined by the program. Table 7 assumes a message is sent by the 2845, and therefore indicates that the Read command is chained to send the I/O channel response to the 2845. The table indicates an STX/EOT response, but it could be any of the responses shown in Figure 6, such as EOT, ACK, SOH, etc. If it is STX/EOT, for example, then STX must be located at the address specified by the data address.

Note that the 2845 commands, such as General Poll or Write Printer, have no meaning for the I/O channel or 2701. A 2845 command byte is treated as any other text character by the I/O channel and 2701. Only when a 2845 command is received and decoded by the 2845 does the command assume control functions and then only to the 2845.

When a Read or Write command operation (initiated by the Start I/O instruction) is terminated, status and sense bytes are generated to indicate conditions under which the operation ended. The Write command is terminated with Channel End and Device End status when the CCW byte count reaches zero. On the other hand, the Read command is ended with Channel End and Device End status either when the CCW byte count reaches zero or when the ETX character is received from the 2845. Other conditions present at the time a Read operation is ended result in the setting of additional bits in the status and sense bytes of the I/O channel and further define ending conditions. Table 8 lists the control characters that may terminate the Read command and the resulting status and sense bits that are set in the I/O channel status and sense bytes.

Figure 19 in Appendix D contains information useful in computing total time required to perform an I/O operation.

Table 7. Sample CCW Formats for Information Interchange Between 2845 and I/O Channel

2845 Command	Action	I/O Channel Command	Data Address	CC Flag	SLI Flag	Byte Count
Specific Poll to Display Station	Send addressing sequence	Write	EOT	X	X	4
	Receive DS message	Read	STX	X	X	964
	Send STX/EOT	Write	STX		X	2
Specific Poll to Printer	Send addressing sequence	Write	EOT	X	X	4
	Receive positive response	Read	STX	X	X	3
	Send Printer message	Write	STX	X	X	Text plus 2 (STX and ETX)
	Receive ACK	Read	ACK	X	X	1
	Send EOT	Write	EOT		X	1
General Poll	Send addressing sequence	Write	EOT	X	X	4
	Receive positive response from Printer or receive DS message	Read	STX	X	X	964
	Send ACK	Write	ACK	X	X	1
	Receive next message (if any)	Read	STX	X	X	964
	Send STX/EOT	Write	ACK		X	2
Read Addressed Full DS Buffer	Send addressing sequence	Write	SOH	X	X	4
	Receive DS buffer contents	Read	STX	X	X	964
	Send STX/EOT	Write	STX		X	2
Write Addressed DS	Send addressing sequence	Write	SOH	X	X	4
	Receive ACK	Read	ACK	X	X	1
Erase/Write Addressed DS	Send DS message	Write	STX	X	X	Text plus 2 (STX and ETX)
	Receive ACK	Read	ACK	X	X	1
	Send EOT	Write	EOT		X	1
Write Printer	Send addressing sequence	Write	SOH	X	X	4
	Receive ACK	Read	ACK	X	X	1
	Send Printer message	Write	STX	X	X	Text plus 2 (STX and ETX)
	Receive ACK	Read	ACK	X	X	1
	Send EOT	Write	EOT		X	1
Write DS Line Address	Send addressing sequence	Write	SOH	X	X	4
	Receive ACK	Read	ACK	X	X	1
	Send DS message	Write	STX	X	X	Text plus 3 (STX, Line Address, and ETX)
	Receive ACK	Read	ACK	X	X	1
	Send EOT	Write	EOT		X	1

X = Flag bit set to 1

Table 8. I/O Channel Read Command Ending Status and Sense Bytes

Control Character	Bits Set in Ending Status Byte	Bits Set in Sense Byte
ETX (no errors detected)	Channel End, Device End	
ETX (LRC or VRC error detected)	Channel End, Device End, and Unit Check	Data Check
CAN (followed by ETX)	Channel End, Device End, and Unit Check	Remote Equipment Check
ACK	Channel End, Device End	
NAK (response to addressing sequence)	Channel End, Device End, and Unit Exception	
NAK (response to a message)	Channel End, Device End, and Unit Check	Data Check
EOT	Channel End, Device End, and Unit Exception	
No response	Channel End, Device End, and Unit Check	Timeout

Information concerning unit sizes and weights, power requirements, environmental conditions, and interunit cabling of the components comprising the 2845/2265 display system can be found in the publication *IBM Remote Multiplexers and Communications Terminals Installation Manual-Physical Planning,* Form GA27-3006.

Appendix A. Feature Charts

```
                                        ┌──────────┐
              Specify Features          │ 2265     │   Special Feature
┌─────────────────────────────────────┤ Base      ├──────────────────┐
│                                       │ Machine  │                  │
│         U.S.        World Trade       └──────────┘                  │
│         ┌───────────────┐                                           │
│         │               │                                           │
┌─────────┐  ┌─────────┐  ┌─────────┐  ┌─────────────────┐  ┌─────────────┐
│ Display │  │115V 60Hz│  │115V 60Hz│  │ American English│  │ Alphameric  │
│ Format  │  │9881     │  │9901     │  │ Language        │  │ Keyboard    │
│ 15 X 64 │  └─────────┘  └─────────┘  │ 2750            │  │ 4766        │
│ 9101    │                    │       └─────────────────┘  └─────────────┘
└─────────┘                   OR              OR
     │                    ┌─────────┐  ┌─────────────────┐
    OR                    │112.5V 50Hz│ │ United Kingdom  │
┌─────────┐               │2810     │  │ Language        │
│ Display │               └─────────┘  │ 2927            │
│ Format  │                    │       └─────────────────┘
│ 12 X 80 │                   OR              OR
│ 9102    │               ┌─────────┐  ┌─────────┐
└─────────┘               │123.5V 50Hz│ │ French  │
                          │2811     │  │ Language│
                          └─────────┘  │ 2928    │
                               │       └─────────┘
                              OR              OR
                          ┌─────────┐  ┌─────────┐
                          │195V 50Hz│  │ German  │
                          │2812     │  │ Language│
                          └─────────┘  │ 2929    │
                               │       └─────────┘
                              OR
                          ┌─────────┐
                          │220V 50Hz│
                          │2813     │
                          └─────────┘
                               │
                              OR
                          ┌─────────┐
                          │235V 50Hz│
                          │2814     │
                          └─────────┘
```

Figure 14. 2265 Feature Chart
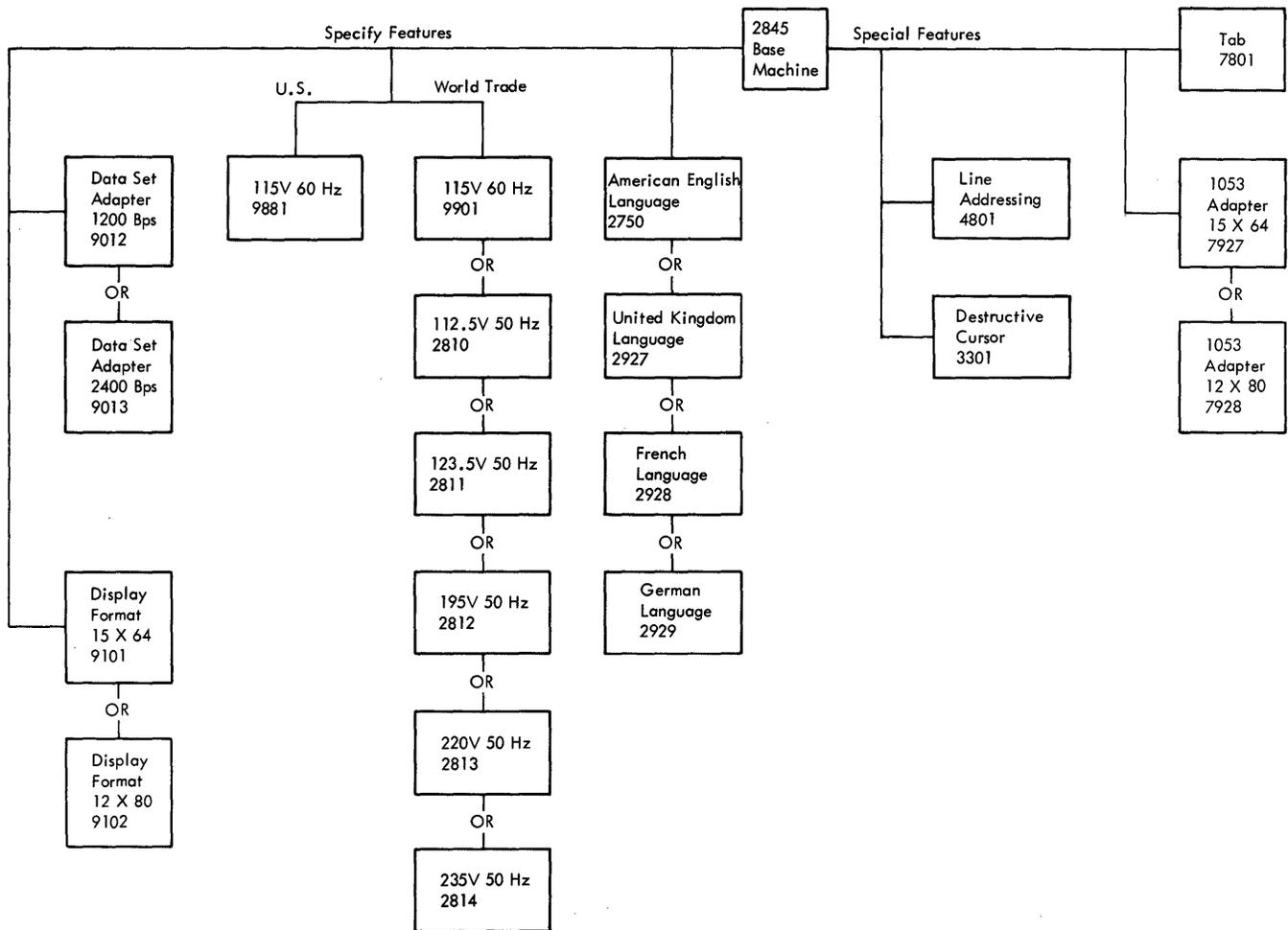
●Figure 15. 2845 Feature Chart

Appendix B. World Trade Language Features

INTRODUCTION

The American English, United Kingdom, French, or German Language Feature equips the 2265/2845 with the character set appropriate to the country for which the feature is chosen. The feature also provides the labels, switch, and indicator designations in the language of that country.

Keyboards are provided in the same language as the Language Feature specified. The keyboard arrangement, key designations, and special characters are compatible with the associated Language Feature and are shown in Figures 16, 17, and 18.

In addition, print elements are available for the IBM 1053 Model 4 Printer with character sets matching those of the four Language Features. The print elements permit the Printer Adapter Feature to be used in conjunction with any of the Language Features with complete language compatibility.

Except for differences in the graphic representation of certain codes, keyboard arrangements, control designations, etc., the operation of a 2265/2845 with a Language Feature is the same as that of an American English 2265/2845.

2265/2845 CHARACTER SETS

Table 9 shows the characters of the United Kingdom, French, and German character sets that differ from the standard American English character set (Figure 4) together with the code configuration and hexadecimal representation of each.
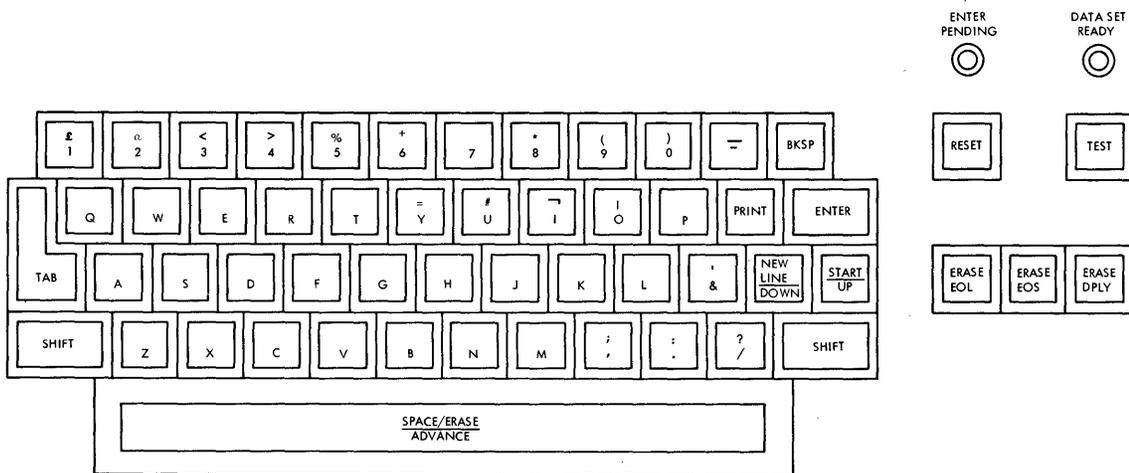
●Figure 16. 2265 United Kingdom Keyboard
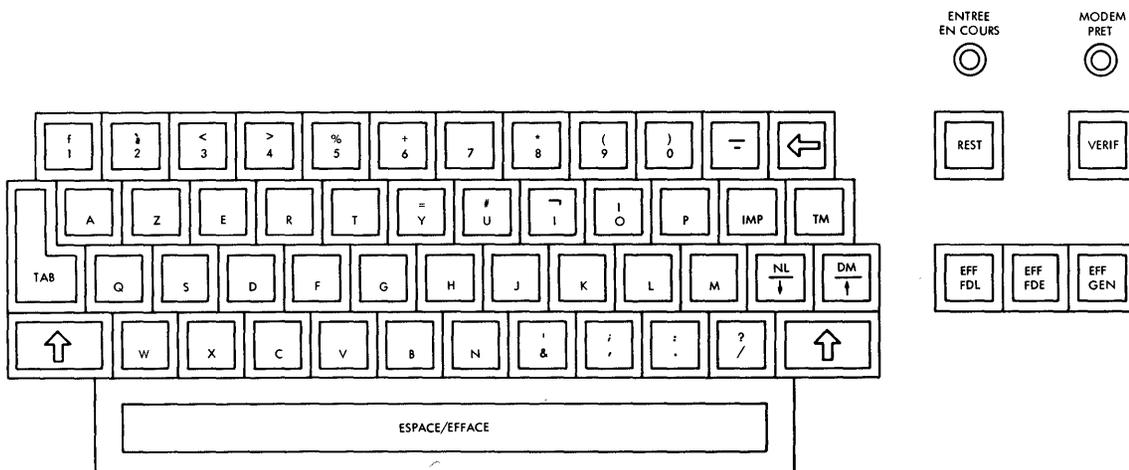
●Figure 17. 2265 French Keyboard
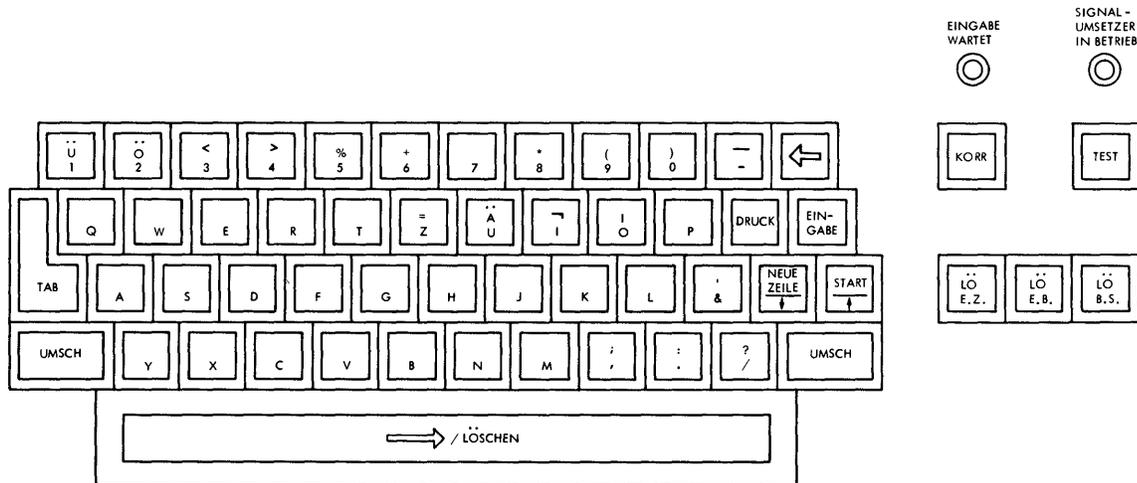
●Figure 18. 2265 German Keyboard

●Table 9. 2265/2845 and 1053 Language Feature Character Differences

American English	United Kingdom	French	German	Hexadecimal Representation	USASCII-8 Code							
					8	7	6	5	4	3	2	1
#	#	#	Ä	43	0	1	0	0	0	0	1	1
$	£	f	Ü	44	0	1	0	0	0	1	0	0
@	@	à	Ö	E0	1	1	1	0	0	0	0	0

IBM 1053 MODEL 4 PRINTER PRINT ELEMENTS

Table 9 also shows the characters of the 1053 Printer print elements that differ from those of the American English print element. Characters not shown in Table 9 are the same as those of the American English character set. (See Figure 4.)

2265/2845 LABELS, INDICATORS, AND SWITCHES

Table 10 lists the labels, indicators, and switches as they appear on the equipment when the United Kingdom, French, or German Language Feature is installed. Those shown for the United Kingdom Language Feature are identical to the American English designations.

The switches and indicators are described under "2265 Display Operator Controls and Indicators".

●Table 10. United Kingdom, French, and German Labels, Indicators, and Switches

United Kingdom	French	German
DISPLAY STATION	UNITE TERMINALE D'AFFICHAGE	OPTISCHE ANZEIGE
DISPLAY CONTROL	UNITE DE CONTROLE D'AFFICHAGE	STEUERIN-HEIT
DATA SET READY*	MODEM PRET*	SIGNAL-UMSETZER IN BETRIEB*
ENTER PENDING*	ENTREE EN COURS*	EINGABE WARTET*
POWER ON	SOUS TENSION	NETZ EIN
POWER OFF	HORS TENSION	NETZ AUS

*Indicators

Appendix C. USASCII-8 to Hexadecimal Code Conversion

Table 11 gives the USASCII-8 code structure and the hexadecimal representation for the characters that are used in data exchanges between a remote display system and the I/O channel.

Table 11. USASCII-8 to Hexadecimal Code Conversion Chart

Character	USASCII-8 87654321	Hexadecimal Code Representation	Character	USASCII-8 87654321	Hexadecimal Code Representation
SOH	00000001	01	=	01011101	5D
STX	00000010	02	>	01011110	5E
ETX	00000011	03	?	01011111	5F
EOT	00000100	04	A	10100001	A1
ACK	00000110	06	B	10100010	A2
NAK	00010101	15	C	10100011	A3
SP	01000000	40	D	10100100	A4
! (■)	01000001	41	E	10100101	A5
" (＼)	01000010	42	F	10100110	A6
#	01000011	43	G	10100111	A7
$	01000100	44	H	10101000	A8
%	01000101	45	I	10101001	A9
&	01000110	46	J	10101010	AA
'	01000111	47	K	10101011	AB
(	01001000	48	L	10101100	AC
)	01001001	49	M	10101101	AD
*	01001010	4A	N	10101110	AE
+	01001011	4B	O	10101111	AF
'	01001100	4C	P	10110000	B0
-	01001101	4D	Q	10110001	B1
.	01001110	4E	R	10110010	B2
/	01001111	4F	S	10110011	B3
0	01010000	50	T	10110100	B4
1	01010001	51	U	10110101	B5
2	01010010	52	V	10110110	B6
3	01010011	53	W	10110111	B7
4	01010100	54	X	10111000	B8
5	01010101	55	Y	10111001	B9
6	01010110	56	Z	10111010	BA
7	01010111	57	¢ (▶)	10111101	BD
8	01011000	58	‒	10111111	BF
9	01011001	59	⌐	11111100	FC
:	01011010	5A	|	11111110	FE
;	01011011	5B	LF (▲)	00001010	0A
<	01011100	5C	@	11100000	E0

INTERFACE TIMING

After receiving the final character transmitted by the 2701, the 2845 averages 23 ms in switching from receive to transmit status to allow for line settling. In addition to this turnaround time are the following Data Set Adapter turnaround times:

1. The Western Electric Data Set 202D1*, when used with Data Set Adapter 9012 (1200 bps), has a turnaround time of 200 ± 20 ms.
2. The Western Electric Data Set 201B1*, when used with Data Set Adapter 9013 (2400 bps), has a turnaround time of 150 ms, or, when appropriately strapped, has a turnaround time of 8.5 ms when operating over four-wire facilities.

---

*or equivalent

2701 LINE TIMEOUT

The 2701 line timeout period must be considered when programming the 2845. When the 2701 receives no reply from an addressed 2845 within 2 seconds after transmitting the last character of a response or sequence, the 2701 times out and the operation is terminated. It is the responsibility of the program to reinitiate the operation.

COMMAND EXECUTION TIMINGS

The timing charts shown in Figure 19 may be used to compute programming time for all I/O operations. These charts should be used in conjunction with the Sequence/Response Diagrams shown in Figures 6 through 13.

Write, Erase/Write, Write Line Address

Propagation Delay	P	P	P	P	P
2701 to 2845	A		CX		CX (EOT)
Data Set Turnaround	D				
2845 Turnaround	t		t		
2845 to 2701		CX (ACK)		CX (ACK)	
2701 Turnaround			T		T

Read Addressed Full DS Buffer, General Poll, Specific Poll

Propagation Delay	P	P	P
2701 to 2845	A		CX (STX/EOT)
Data Set Turnaround	D		
2845 Turnaround	t		
2845 to 2701			CX
2701 Turnaround			T
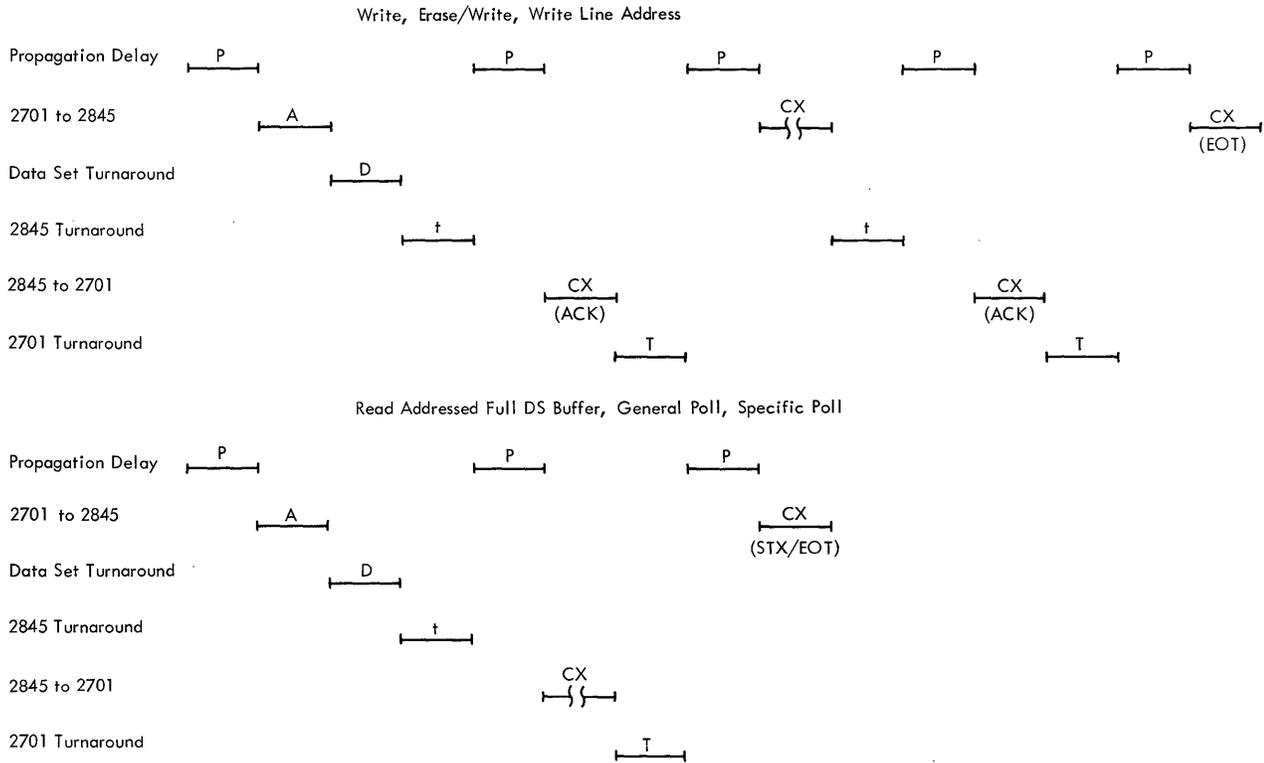
P = (0.015 ms) (number of miles one way)

A = 2X**

D = data set turnaround time [200 ms (202D1*), 150 ms (201B1*), 8.5 ms (201B1*, strapped)]

t = 23 ms average

T = dependent upon I/O channel timing, usually less than 1 ms

C = total number of characters, including address, control, and text

X = 4 ms @ 2400 bps, 8 ms @ 1200 bps

* or equivalent
**First two characters of the addressing sequence (SOH or EOT, DC address)

Figure 19. Command Execution Timings

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  As................   ☐

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  As a text:

Very Good	Good	Fair	Poor	Very Poor

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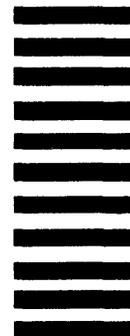
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