

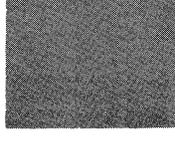
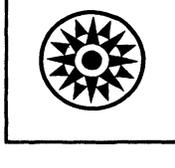
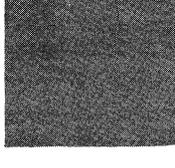
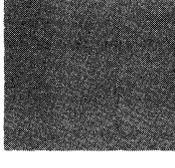
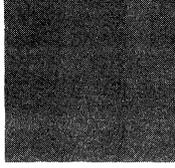
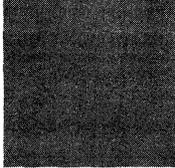
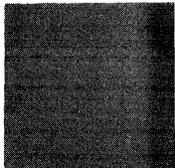
## Systems Reference Library

### **IBM System/360 Component Description:**

#### **IBM 2260 Display Station**

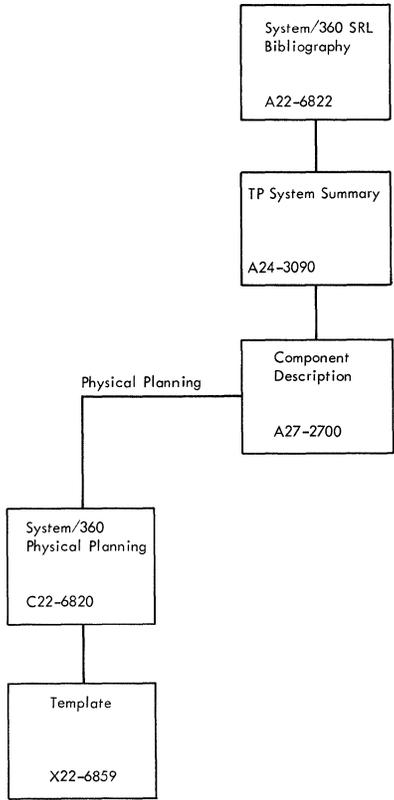
#### **IBM 2848 Display Control**

This manual describes the functional and operating characteristics of the IBM 2260 Display Station and the IBM 2848 Display Control. The two units combine to form a display complex that provides visual access to data stored in an IBM System/360. A variety of models and features permit 2260/2848 configurations that range from a 2848 with a single display-only 2260 to a multiple-station display complex, each station of which can be used as a direct-entry terminal as well as a means of rapidly accessing and displaying computer-stored data. This manual contains Principles of Operation sections for the local and remote applications of the display complex and for the "data entry" 2260/2848 configuration as well.



2848 SRL Publications Availability Guide

Use this guide to determine what available publications will best fulfill your individual requirements.



Fifth Edition (January 1969)

This edition, Form A27-2700-4, is a major revision of, and obsoletes, Form A27-2700-3. Changes to the text are indicated by a vertical line to the left of the change; changes to the illustrations or the numbering of the illustrations are denoted by the symbol • to the left of the caption.

Changes are periodically made to the specifications herein; any such changes will be reported in subsequent revisions or Technical Newsletters.

This manual has been prepared by the IBM Systems Development Division, Product Publications, Department 860, P. O. Box 12275, Research Triangle Park, North Carolina 27709. A form for readers' comments is provided at the back of this publication. If the form has been removed, comments may be sent to the above address.

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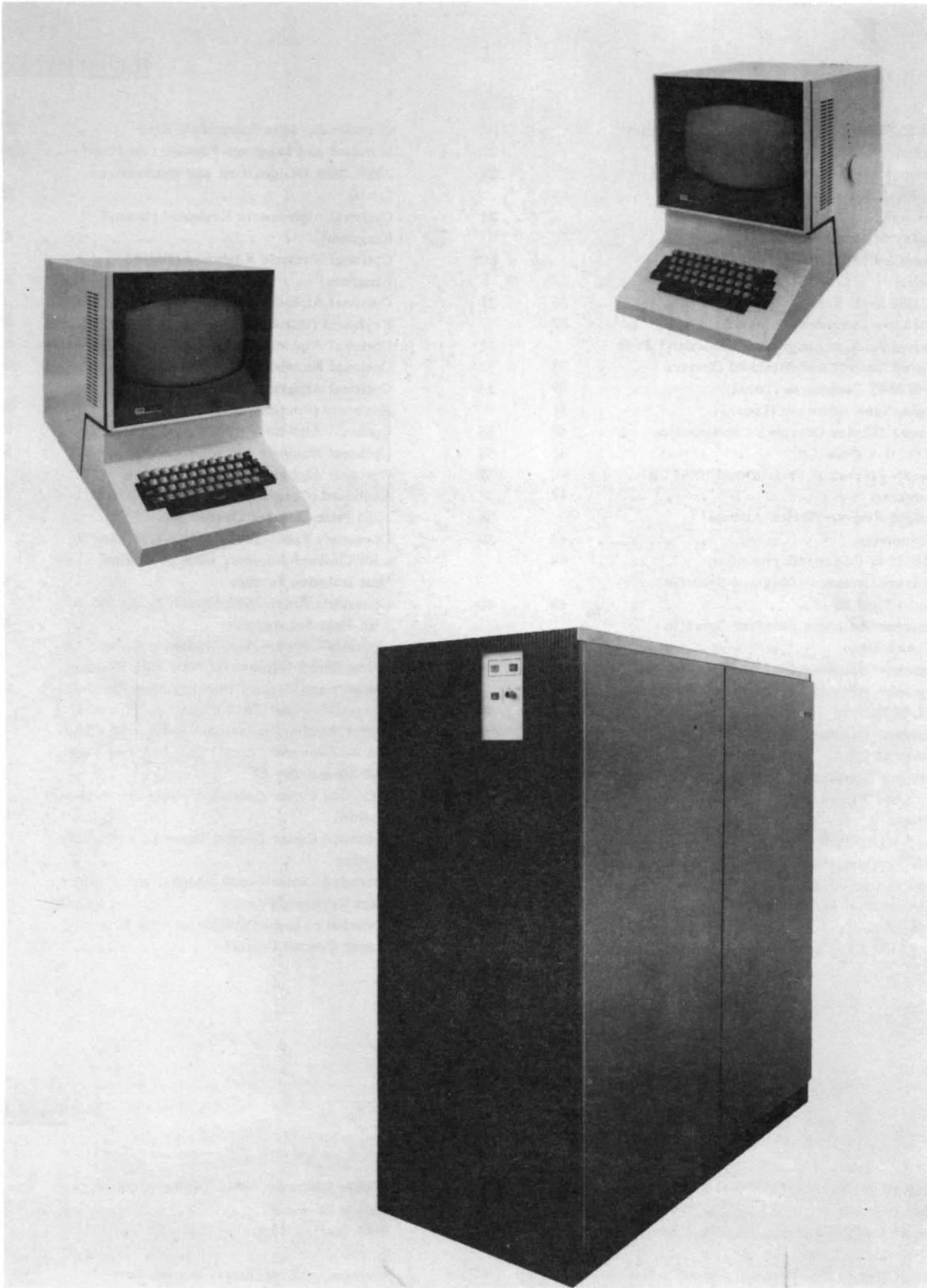
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IBM 2260 Display Station/2848 Display Control

The IBM 2260 Display Station (DS) is a compact high-speed display terminal that operates through the IBM 2848 Display Control (DC) to provide immediate visual access to computer data at locations near or removed from the computer complex.

By providing the ability to access and display computer data conveniently and faster than by more conventional means, the IBM 2260 Display Station is ideally suited for applications that require immediate data acquisition capabilities.

From the keyboard of a 2260 Display Station, an inquiry concerning an account, transaction, production schedule, etc., can quickly and easily be entered in the computer; the inquiry is processed, and the desired information is displayed on the screen of the 2260. Here the displayed data can be analyzed and, if desired, updated and returned to the computer for additional processing. The data displayed on a keyboard-equipped 2260 can also be printed if the 2260/2848 Display Complex is equipped with the optional Printer Feature. The Printer Feature is described in a later section of this manual.

Five models of the IBM 2848 Display Control (Models 1, 2, 3, 21, and 22) and two models of the IBM 2260 Display Station (Models 1 and 2) are available. This variety of models offers 2260/2848 configurations to meet the requirements of either inquiry-oriented or data entry-oriented applications, ranging from a 2848 controlling a single 2260 to one controlling a maximum of 8, 16, or 24 display stations. The 2848 Models 1, 2, and 3 are used primarily in inquiry-oriented configurations; Models 21 and 22 combine the advantages of Models 1, 2, and 3 with increased data input capabilities and are referred to as "data entry" 2848's.

Appendix A of this manual is concerned exclusively with the data entry configurations. The discussions in the body of the manual deal principally with configurations controlled by 2848 Models 1, 2, and 3, but since many similarities exist between the two types, much of the discussion on Models 1, 2, and 3 pertains also to Models 21 and 22. To avoid excessive duplication of information, these similarities are noted in Appendix A; references given in the appendix direct the reader to areas of the manual that contain information applicable to both configurations.

As summarized below, the model of the 2848 governs the model and maximum number of 2260 Display Stations it is capable of controlling as well

as the maximum number of characters that can be displayed on each 2260.

2848 Display Control, Model 1--The 2260 Display Station, Model 2, is used with the 2848 Display Control, Model 1. As many as 24 Model 2 2260 Display Stations may be attached to a Model 1 2848 Display Control, each capable of displaying 240 characters.

2848 Display Control, Model 2--The 2260 Display Station, Model 2, is used with the 2848 Display Control, Model 2. As many as 16 Model 2 2260 Display Stations may be attached to a Model 2 2848 Display Control, each capable of displaying 480 characters.

2848 Display Control, Model 3--The 2260 Display Station, Model 1, is used with the 2848 Display Control, Model 3. As many as eight Model 1 2260 Display Stations may be attached to a Model 3 2848 Display Control, each capable of displaying 960 characters.

2848 Display Control, Model 21--Described in Appendix A.

2848 Display Control, Model 22--Described in Appendix A.

All models of the 2848 permit 2260 Display Stations to operate at distances of up to 2000 cable feet from the associated 2848. This permits placement of 2260 Display Stations at strategic locations throughout an office building or similar facility, thus providing access to computer data at locations removed from the computer complex. Since each 2260 Display Station operates independently, several unrelated display operations can be performed concurrently, with no interaction between the display presentation at one display station and that at another.

The IBM 2848 DC and IBM 2260 DS model and feature variations permit assembly of display groups that range from basic-capacity groups to groups with extensive capacities and capabilities. Thus, 2848 DC and 2260 DS equipment is flexible enough to permit a display group to be tailored to each user's specific requirements.

All IBM 2848/2260 Display Groups provide rapid access to data stored in the associated computer system and make the data available as a visual display that can be read directly, with little interpretation or special knowledge required. Similarly, display groups configured to include man-to-machine

communication require minimum special operator skills of those entering data from the 2260 DS.

An antireflective display screen is used on 2260 Display Stations to minimize reflections from ambient light sources and reflective objects. This feature, standard on all 2260 Display Stations, when combined with a display brightness control, permits comfortable screen viewing in installations with light ambients of up to 50 foot-candles, measured at the base of the 2260 screen.

NOTE: Frequently, room light ambients of 100 foot-candles or more will result in a light-ambient reading of no more than 50 foot-candles, when measured at the base of the 2260 screen. In addition, the adjustable character-size and adjustable character-spacing capabilities, standard on all 2260 Display Stations, enable the display presentation of each 2260 to be adjusted to meet the character-size and -spacing requirements at that station. (Adjustments to character size and spacing must be performed by trained service personnel.)

The 2260/2848 Display Complex may be attached directly to a System/360 Selector or Multiplexer. Channel for local operation or it may be operated remotely, using communication lines as a two-way data link.

In the remote attachment, both the 2848 Display Control and the associated 2260 Display Stations are removed from the computer complex and they communicate with the computer through an IBM 2701 Data Adapter Unit and appropriate communication facilities. The 2848/2260 Display Complex in a remote attachment can extend the visual access, data input, and inquiry capabilities of the 2260 and 2848 to areas which are geographically remote from the computer complex.

The 2260 Display Station is also available without a keyboard for applications not requiring display station input and inquiry capabilities.

The 2848 Display Control, the 2260 Display Station, and the 1053 Model 4 Printer are not metered.

## IBM 2848 DISPLAY CONTROL--GENERAL DESCRIPTION

The IBM 2848 Display Control (DC) contains the storage and control logic required to interface the 2848 and associated 2260's with either a System/360 selector or multiplexer channel or with communications facilities. (The latter configuration permits remote operation of the display group.)

The 2848 DC is available in three basic models, each of which can be supplemented, through certain features, to expand its basic display capabilities and to provide the DC with special functional abilities. The 2848 DC is described in the following paragraphs, first by considering the capabilities of the three basic models and the feature combinations which can be selected to supplement each model. Then each feature is described with respect to the display capability expansion or special function it provides when added to the basic 2848 DC.

All models offer a choice of operating on a primary power input of 208vac or 230vac and have an exterior cabinet color selection of red, yellow, blue, or gray to permit aesthetic compatibility with the host System/360. These options are not discussed with respect to each model, however.

### IBM 2848 DISPLAY CONTROL, MODEL 1

The basic IBM 2848 Model 1 is capable of operating two 3355 Display Adapters, each of which can service two IBM Model 2 2260 DS's. The Model 1 can generate a display of six rows, each containing 40 characters (240 characters total), on the CRT of all 2260 DS's associated with the DC. The basic Model 1 also includes a choice of the 9011 Channel Adapter, the 9012 Data Set Adapter (1200 bps), or the 9013 Data Set Adapter (2400 bps) for interfacing with the host System/360.

By adding more optional features, 2848 Model 1 capabilities can be extended to include the following:

- The ability to operate a maximum of 24 Model 2 2260 DS's, each capable of displaying a 240-character (maximum) message.
- The ability to operate the 7927 Printer Adapter, which controls an IBM 1053 Model 4 Printer, to provide a permanent record of display group data under either program or operator control.
- A nondestructive cursor (character-entry and display-position indicator and locator) that can

be moved within the display area without disturbing or destroying the data displayed on the CRT of the 2260 DS.

- A Line-Addressing feature which enables the processor, during write operations, to select any one of the six lines within the 2260 DS CRT display under program control.
- Language features to equip the 2848 Display Control with the character set and operator control designations used in the United Kingdom, France, or Germany.

### IBM 2848 DISPLAY CONTROL, MODEL 2

The basic IBM 2848 Model 2 can operate one 3356 Display Adapter which services two IBM Model 2 2260 DS's. The Model 2 can generate a display of 12 rows, each containing 40 characters (480 characters total), on the CRT of all 2260 DS's associated with the DC.

The basic Model 2 also includes a choice of the 9011 Channel Adapter, the 9012 Data Set Adapter (1200 bps), or the 9013 Data Set Adapter (2400 bps) for interfacing with the host System/360.

Other optional features can be selected which can extend the capabilities of the basic Model 2 to include:

- The ability to operate a maximum of 16 Model 2 2260's, each capable of displaying a 480-character message.
- The Printer, Nondestructive Cursor, Line-Addressing, and Language features already described with the 2848 DC Model 1.

### IBM 2848 DISPLAY CONTROL, MODEL 3

The basic IBM 2848 Model 3 can operate one 3357 Display Adapter which services two IBM Model 1 2260 Display Stations. The Model 3 can generate a display of 12 rows, each containing 80 characters (960 characters total), on the CRT of all 2260 DS's associated with the DC.

The basic Model 3 also includes a choice of the 9011 Channel Adapter, the 9012 Data Set Adapter (1200 bps), or the 9013 Data Set Adapter (2400 bps) for interfacing with the host System/360.

Other optional features can be selected which can extend the capabilities of the basic Model 3 to include:

- The ability to operate a maximum of eight IBM 2260 DS's Model 1, with each DS displaying a 960-character (maximum) message.
- The Printer, Nondestructive Cursor, Line-Addressing, and Language features, already described with the 2848 DC Model 1.

#### IBM 2848 DISPLAY CONTROL MODEL SUMMARY

Table 1 summarizes 2848 Models 1, 2, and 3 with respect to the standard customer options, the applicable optional feature adapters, the model and number of 2260 DS's that can be serviced, and the maximum displayable message length. (Models 21 and 22 are described in Appendix A.)

#### OPTIONAL FEATURES

Each of the features that can be chosen to complement the 2848 Models 1, 2, and 3 is described in Table 2. The information provided for each feature consists of the feature code, the feature function, the 2848 models to which the features can be attached, and any prerequisite features.

In addition to the information given in Table 2, the Printer, Line-Addressing, and Nondestructive Cursor features are further described in the following paragraphs. The Language features are described in Appendix B of this manual.

#### Printer Feature

The attachment of the optional Printer feature increases the data-handling capabilities of the 2260-2848 by providing an output printer that can be used by all associated keyboard-equipped 2260 Display

Table 1. 2848 Model Summary (Models 1, 2 and 3)

Model Number	Customer Options	Optional Feature Adapters Available	Maximum Possible Associated 2260 DS's	Maximum Display Length
1	9011 Channel Adapter, 9012 Data Set Adapter (1200 bps), or 9013 Data Set Adapter (2400 bps).  Exterior colors of red, yellow, blue, or gray.  Operates on primary power of 208vac or 230vac.  Language Features (United Kingdom, French, and German)	3355 Display Adapter. 7927 Printer Adapter. 3858 Expansion Panel. 3859 Expansion Panel. 4787 Line Addressing. 5340 Nondestructive Cursor. 5341 Nondestructive Cursor Adapter.	24 (Model 2)	Six rows of 40 characters each (240 characters total).
2	Same as Model 1.	Same as for Model 1 except that 3356 Display Adapter replaces the 3355 Adapter used with Model 1.	16 (Model 2)	Twelve rows of 40 characters each (480 characters total).
3	Same as Model 1.	3357 Display Adapter. 3859 Expansion Panel. 4787 Line Addressing. 5340 Nondestructive Cursor. 5341 Nondestructive Cursor Adapter. 7928 Printer Adapter.	8 (Model 1)	Twelve rows of 80 characters (960 characters total).

Stations and the computer as well.

The IBM 1053 Model 4 Printer attaches to the 2848 Display Control via the Printer Adapter (either 7927 or 7928, depending upon the 2848 model) which contains the Printer Buffer and related control circuitry. The Printer Adapters are described in Table 2. Only one Printer feature can be attached to a 2848 Display Control.

Like the 2260 Display Stations, the IBM 1053 Model 4 Printer can be operated at distances of up to 2000 cable feet from the 2848 Display Control.

The PRINT key, found on both alphameric and numeric keyboards, is used to logically connect a 2260 Display Station to the 1053 Printer. When this key is operated, all data displayed on the associated 2260, up to and including the cursor or EOM, is transferred to the Printer Buffer and printed, except data prohibited from transfer by the NL symbol. (See NL symbol.) The 2260-to-Printer operation is described under "2260 Display Station Keyboard Operations".

Data is transmitted from the channel to the printer through the applicable command. The Write 1053 Buffer Storage command and the Write Printer command are used in the Local and Remote applications, respectively. The operation of these commands is described in the two "Principles of Operation" chapters of this manual.

### Line-Addressing Feature

The Line-Addressing feature enables program-positioning of the cursor to the first display position of a specific display line.

The Write DS Line Address command is used to select the display line when the Line-Addressing feature is installed. This command is described in the two "Principles of Operation" chapters of this manual.

The command may be used to select a line on which the accompanying data from the channel is to be displayed, or it may be used with a zero-length message to position the cursor to a display line on which it is desired that the 2260 operator enter a message.

### Nondestructive Cursor Feature

The Nondestructive Cursor feature is described in "2260 Display Station Control Symbols", under "IBM 2260 Display Station--General Description."

### Language Feature

The 2260/2848 Language Feature is described in Appendix B.

### Extended Cursor Control Feature

This feature is described in Appendix D.

● Table 2. 2848 Features (Part 1 of 2)

Feature Code	Feature Description	Can Be Attached to 2848 Models	Prerequisite 2848 Features
3355 Display Adapter	Contains storage and control logic to service two IBM 2260 . DS's, Model 2.	1 only	None for up to two 3355 adapters. 3859 for up to six additional 3355 adapters. 3858 for up to four additional 3355 adapters. 3859 and 3858 for maximum of 10 additional 3355 adapters.
3356 Display Adapter	Contains storage and control logic to service two IBM 2260 DS's, Model 2.	2 only	None for one 3356 adapter. 3859 for up to four additional 3356 adapters. 3858 for up to three additional 3356 adapters. 3859 and 3858 for the maximum of seven additional 3356 adapters.
3357 Display Adapter	Contains storage and control logic to service two IBM 2260 DS's, Model 1.	3 only	None for one 3357. 3859 for up to three additional 3357 adapters.
3901 Extended Cursor Control	See Appendix D.	1, 2, and 3	Nondestructive Cursor 5340 and 5341 required. Also, one of the following Extended Cursor Control Keyboards, 3605, 3606, or 3607 is required on each attached 2260.
9011 Channel Adapter (Selective Feature)	Contains the circuitry required to interface the 2848 DC with a System/360 selector or multiplexor channel; operates in single-byte (8 bits) mode at a rate up to 2560 characters per second.	1, 2, and 3	None
9012 Data Set Adapter (Selective Feature)	Interfaces the 2848 DC with a 1200-bit per second (120 characters per second) Western Electric Data Set 202D1*.	1, 2, and 3	Host System/360 must be equipped with a 4656 IBM Terminal Adapter, Type III (1200 bps).
9013 Data Set Adapter (Selective Feature)	Interfaces the 2848 DC with a 2400-bit per second (240 characters per second) Western Electric Data Set 201B1*.	1, 2, and 3	Host System/360 must be equipped with a 4657 IBM Terminal Adapter, Type III (2400 bps).
3859 Expansion Unit	Permits the attachment of other special features, as follows: For 2848 Model 1: Six 3355 adapters. For 2848 Model 2: Four 3356 adapters. For 2848 Model 3: Three 3357 adapters.	1, 2, and 3	None
3858 Expansion Unit	Permits the attachment of other special features, as follows: For 2848 Model 1: Four 3355 adapters. One 7927 adapters. For 2848 Model 2: Three 3356 adapters; One 7927 adapter.	1 and 2	None
4787 Line Addressing	Permits the processor of the host system to select the first displayable position of any line within the CRT display of the 2260 DS as the starting location for the display of output data. The numbers of unique starting (or line) locations are: 2848 Model 1: 6; 2848 Model 2: 12; 2848 Model 3: 12.	1, 2, and 3	None

\*or equivalent

● Table 2. 2848 Features (Part 2 of 2)

Feature Code	Feature Description	Can Be Attached to 2848 Models	Prerequisite 2848 Features
5340 Nondestructive Cursor	Provides control logic for the Nondestructive Cursor Feature represented by 5341 which is attached to the various display adapters. Allows the operator to move the cursor vertically and horizontally within the 2260 display.	1, 2, and 3	None  Note: If the 5340 Nondestructive Cursor Feature is attached to a 2848 DC, all display adapters used with the 2848 must be provided with the 5341 Nondestructive Cursor Adapter.
5341 Nondestructive Cursor Adapter	Permits movement of the cursor within the CRT display of the 2260 DS without disturbing or destroying the data displayed on the CRT.	Display Adapters 3355 (Model 1) 3356 (Model 2) 3357 (Model 3)	One 5340 per 2848.
7927 Printer Adapter	Contains a buffer storage and the logic required to control an IBM 1053 Model 4 Printer. Provides a means of obtaining a permanent printed record of display group data under either program or operator control.	1 and 2	3858 Expansion Unit
7928 Printer Adapter	Same as 7927.	3 only	None
4656 IBM Terminal Adapter, Type III	Enables System/360 to communicate with the 2848 DC via private line telephone grade channels equipped with Western Electric Data Sets 202D1*. Data transfer rate is 1200 bps (120 characters per second).	Attaches to 2701 Data Adapter Units (one 4656 or 4657 can be attached). With 2701 feature No. 3815 and feature No. 3855, two 4656 or 4657 adapters can be attached.	2848 DC's attached to the same transmission line require the 9012 Data Set Adapter Feature.
4657 IBM Terminal Adapter, Type III	Same as 4656 except that Western Electric Data Sets 201B1* must be used. Data transfer rate is 2400 bps (240 characters per second).	Same as 4656.	2848 DC's attached to the same transmission line require the 9013 Data Set Adapter Feature.
Language Features	See Appendix C.	1, 2, and 3	None
NOTE: In addition to the Features listed above, all 2848 models offer a choice of operating on a primary power input of 208vac or 230vac and an exterior color selection of red, yellow, blue, or gray.			

\*or equivalent

## OPERATOR CONTROLS AND INDICATORS

The 2848 DC controls and indicators available to the operator are those needed for the control of unit power. The function and operation of each control and the indicators are described in Appendix C.

## CE PANEL

The 2848 DC is provided with a CE (maintenance) panel to permit local operation of the unit during checks and/or maintenance.

## IBM 2260 DISPLAY STATION--GENERAL DESCRIPTION

A basic IBM 2260 Display Station contains a cathode-ray tube (CRT), which serves as a viewing screen, and the circuitry required to cause the video signals received from the 2848 DC to be projected on the screen as meaningful data.

There are two models of the IBM 2260 Display Stations: Model 1, used with the Model 3 2848 Display Control only, and Model 2, used with either the Model 1 or Model 2 2848. Each model contains the type of CRT and related circuitry that matches the data capacity and character regeneration rate of the associated 2848 Display Control. Thus, a flicker-free display is assured whether the 2848 data capacity per 2260 is 960 characters (as in the Model 3 2848) or 240 or 480 characters (as in the Models 1 and 2, respectively).

Standard features found on all 2260 Display Stations are:

1. Antireflective display screen: minimizes glare and reflections from light sources and reflective objects.
2. Brightness control: permits the operator to adjust the display intensity to his satisfaction.
3. Adjustable character size: permits the height and width of characters displayed on a 2260 screen to be adjusted to individual requirements at each display station. Adjustments must be made by trained service personnel.
4. Adjustable character spacing: permits the spaces between adjacent characters displayed on 2260 Display Stations to be adjusted to individual requirements at each display station. Adjustments must be made by trained service personnel.

NOTE: The character-spacing adjustment range is greater on the Model 1 Display Station than on the Model 2.

Optional features provide for the addition of an alphameric or numeric-only keyboard to the basic 2260 DS. This extends the capabilities of the 2260 DS to include man-to-machine communication, thus providing a complete visual I/O concept.

When an optional keyboard is included in the 2260 DS, input messages generated at the keyboard are displayed on the CRT as they are composed. This permits the operator to verify a message before it is transferred from the display group.

A total of 64 different characters can be displayed on the 2260 DS CRT:

- 26 alphabetical characters
- 10 numerical characters
- 25 special symbols (includes space and New Line symbol)
- 3 control symbols (Cursor, Check, and Start Manual Input symbols)

NOTE: 2260's attached to a 2848 equipped with the Nondestructive Cursor feature are capable of displaying 65 different characters. See "Nondestructive Cursor Feature" under "IBM 2848 Display Control--General Description", preceding.

### OPTIONAL FEATURES

#### Alphameric-Numeric Inset Keyboard Feature

Feature 4765 provides an alphabetic and numeric input capability for the associated 2260 DS, Model 2. The numeric characters are inset in the keyboard in block fashion for rapid numeric data entry.

#### Alphameric Keyboard Feature

Feature 4766 provides an alphabetic and numeric input capability for the associated 2260 DS, Model 1 or 2. The numeric characters are located on the top line of keybuttons (Figure 1).

#### Numeric Keyboard Feature

Feature 4767 provides a numeric input capability for the associated 2260 DS, Model 1 or 2. Attaching a numeric keyboard (Figure 2) does not restrict the displayable characters to numeric characters only. However, it does limit the keyboard-entered characters to numeric only.

NOTE: All keyboards are available with key designations, special characters, and keyboard arrangements required to complement the 2848 Display Control Language feature (see Appendix B).

#### Extended Cursor Control (ECC) Feature

These features (FC 3605, FC 3606, and FC 3607) are described in Appendix D. The 2848 Extended Cursor Control feature (FC 3901) and the Nondestructive Cursor features (FC 5340 and FC 5341) are also required on the associated 2848.

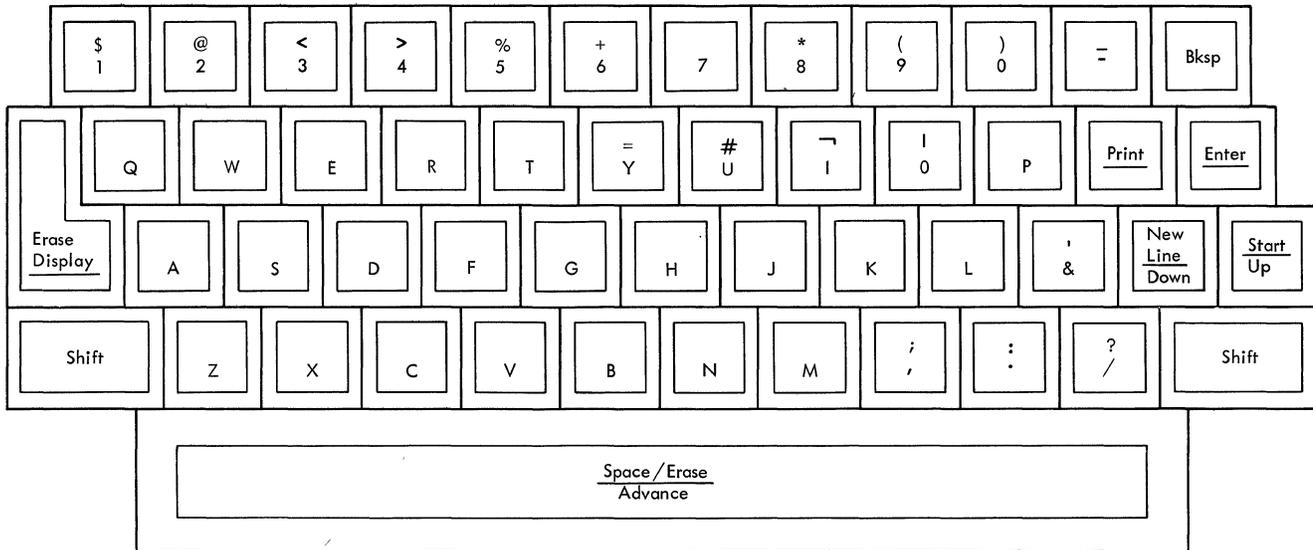


Figure 1. Optional Alphameric Keyboard for 2260 Display Station, Model 1 or 2

ECC Alphameric-Numeric Inset Keyboard Feature

Feature 3605 provides extended cursor control on an alphameric-numeric keyboard for an associated 2260 DS Model 2. The numeric characters are inset in the keyboard in block fashion for rapid numeric data entry. The control buttons necessary for operating the ECC feature are also included.

ECC Alphameric Keyboard Feature

Feature 3606 provides extended cursor control on an alphameric keyboard for an associated 2260 DS Model 1 or 2. The numeric characters are located on the top line of keybuttons; the control buttons necessary for operating the ECC feature are also included.

ECC Numeric Keyboard Feature

Feature 3607 provides extended cursor control on a numeric keyboard for an associated 2260 DS Model 1 or 2. All characters can be displayed on the 2260, but only numeric characters can be keyboard-entered. The control buttons necessary for operating the ECC feature are also included.

2260 DISPLAY STATION OPERATOR CONTROLS

Operator controls on a 2260 Display Station, other than keyboard keys, consist of the Power On/Off switch and the character brightness control. These are contained in a single push-pull/rotary control located on the right side of each 2260 Display Station.

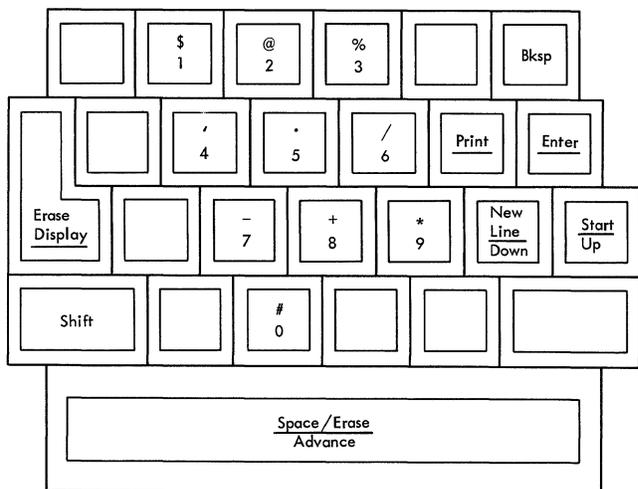


Figure 2. Optional Numeric Keyboard for 2260 Display Station, Model 1 or 2

2260 DISPLAY STATION CONTROL SYMBOLS

The following paragraphs describe the function of the Cursor, Start MI, New Line, and Check symbols used on 2260 displays. The optional Nondestructive Cursor symbol is also described in this section.

Cursor (General)

The cursor is an automatically inserted, visual, display position marker which denotes the display position on the 2260 screen that the next character entered will occupy and/or marks the end of a message.

Two types of cursor symbols, destructive and nondestructive, are available to permit selection of the cursor best suited to individual applications. Both are described below.

#### Destructive Cursor Symbol (Standard)

The Destructive Cursor symbol, standard on all models of the 2848, appears on the screen of the

2260 as a heavy horizontal bar (■) and marks the display position that the next character entered will occupy.

From the 2260 keyboard, the Destructive Cursor symbol may be advanced or backspaced one space at a time or moved to the beginning of the next line. Table 3 explains the effect of each keyboard key on



the Destructive Cursor symbol. When this symbol is advanced, backspaced, or otherwise moved to a display position containing a character, the character is erased.

The movement of the Destructive Cursor symbol and its position relative to other displayed characters during the time that data is entered from the 2260 keyboard are illustrated in the "Control Key Functions" section, following in this chapter.

### Nondestructive Cursor Symbol (Feature)

The Nondestructive Cursor feature, when installed on the 2848, replaces the Destructive Cursor symbol with the Nondestructive Cursor symbol as a 2260 display position marker. (See Programming Note.) The Nondestructive Cursor symbol appears on the 2260 screen as a vertical bar (█) below the character line and immediately to the left of the next displayable position. (As used here, the next displayable position is that immediately to the right of the Nondestructive Cursor symbol that the next character entered will occupy.)

The Nondestructive Cursor symbol, since it occupies the display area to the left of a displayable position that is not used to display other data, can be moved freely about the 2260 screen without erasing other characters. Table 3 explains the effect that each 2260 keyboard key has on the Nondestructive Cursor symbol.

The movement of the Nondestructive Cursor symbol and its position relative to other displayed characters during the time that data is entered from the 2260 keyboard are illustrated in the "Control Key Function" section, following in this chapter.

**PROGRAMMING NOTE:** As stated above, the Nondestructive Cursor symbol replaces the Destructive Cursor symbol as a 2260 display position marker. However, the Destructive Cursor symbol is still used as the End of Message (EOM) symbol and will appear on a 2260 screen when the associated keyboard Enter key is pressed (as in manual input operations) or when the PRINT key is pressed.

To insure correct manual input operations when the Nondestructive Cursor feature is installed, the EOM symbol should be deleted from the 2260 screen between message transfers. This can be accomplished through programming or from the keyboard by erasing the display, overwriting the EOM symbol, etc.

### End of Message (EOM) Symbol

The End of Message (EOM) symbol designates the end of a message and is identical in appearance with the Destructive Cursor symbol. The EOM symbol is displayed by pressing the Enter key or Print key or by transmitting its code configuration from the channel to the 2260. The latter should be avoided since the presence of both an EOM symbol and a Destructive Cursor symbol can be confusing to a

viewer and can also cause an operation to be prematurely terminated. However, when a message is transmitted from the channel to the 1053 Printer, the EOM code is printed by the 1053 Printer as an exclamation mark (!) and then causes a 1053 carriage return and line feed.

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 and/or marks the end of a message. The EOM symbol denotes only the end of a message.
2. The cursor advances as data is entered and can be moved about the 2260 screen. The EOM symbol, when displayed, remains stationary.
3. The cursor is automatically inserted and, except for certain instances, is displayed at all times. The EOM is displayed only when the Enter or Print key is pressed or when its code is transmitted from the channel to a 2260.
4. Only one cursor symbol can be displayed on a 2260 screen, but it is possible to display several EOM symbols.

While the viewer must rely on observation to distinguish the cursor from an EOM symbol, the distinction within the 2848 DC is made electronically by means of a control bit called TIC. The TIC is a nondisplayable control bit which is associated only with the cursor and enables the 2848 DC to distinguish the cursor from other data.

During write operations (either programmed or manual), the cursor symbol and the TIC advance in unison each time a character is entered and displayed on the screen.

During a read or 2260-to-printer operation, however, an EOM symbol replaces the cursor symbol (the cursor is not displayed) and the TIC (alone) advances from character to character, causing each to be transferred, until the position containing the EOM symbol is reached. Detection of the EOM symbol causes data transfer to be terminated (except for Read Full Buffer, in which case, the EOM is ignored and the data transfer is terminated when end of buffer is reached). When the data transfer is terminated, the action that occurs depends upon the operation, as follows:

1. If the operation is a Read DS MI or 2260-to-printer operation, the cursor (TIC and EOM symbol combined) replaces the EOM symbol.
2. If the operation is a Read Full DS Buffer Storage operation, the TIC is placed in the first display position of the first line, leaving the EOM sym-

bol in the display position that initially contained the cursor. If a character were entered into the 2260 buffer at this time, it would appear in the first display position, and a new cursor symbol would be generated and would appear in the display position adjacent to the character entered. This would result in the presence of both a cursor and an EOM symbol on the 2260 screen. To avoid this situation, it is recommended that an Erase command be issued to the selected 2260 following each Read Full DS Buffer Storage operation.

3. If the operation is a Short Read DS MI operation, the TIC is located one position beyond the EOM symbol. If a character were entered in the 2260 buffer at this time, it would appear one display position to the right of the EOM symbol, and a new cursor would be generated and would appear one position beyond the character entered. This would result in the presence of both an EOM symbol and a cursor on the same screen. To avoid this situation, it is recommended that the data on the screen of the selected 2260 be erased following each Short Read DS MI operation.

#### Start Manual Input (Start MI) Symbol

The Start MI symbol (▶) is used to indicate the beginning (start) of data that is to be transferred from a 2260 Buffer to the channel during the following operations:

Read DS MI or Short Read DS MI: described in "Principles of Operation - Local Application."  
Specific Poll to a 2260: described in "Principles of Operation - Remote Application."  
General Poll: described in "Principles of Operation - Remote Application."

If data is to be transferred during the above operations, the Start MI symbol must be displayed on the 2260 screen preceding the data to be transferred. Upon completion of any of the above operations, except Short Read DS MI, the Start MI symbol is deleted from the 2260 screen. Deletion of this symbol signifies to the 2260 operator that the data has been transferred from the 2260 buffer and that another message may be entered.

The Start MI symbol is made to appear on a 2260 screen by pressing the Start key on the keyboard of the particular 2260 or by transmission of the code configuration of the symbol from the channel to the 2260. (See applicable code chart, EBCDIC for Local

(Figure 4) or USASCII-8 for Remote, (Figure 10) for the code structure of the Start MI symbol.)

Additional information on the Start MI symbol is given in the descriptions of the operation just described in the two "Principles of Operation" chapters and in "2260 Display Station Keyboard Operation" under "IBM 2260 Display Station-- General Description."

#### New Line (NL) Symbol

The NL symbol (▲), when displayed on a 2260 screen, prohibits the transfer of all data displayed between the NL symbol and the end of the display line containing the symbol, during the following operations:

Read DS MI or Short Read DS MI: described in "Principles of Operation--Local Application."  
Specific Poll to a 2260: described in "Principles of Operation--Remote Application."  
General Poll: described in "Principles of Operation--Remote Application."

The NL symbol, which may be either keyboard- or program-inserted, provides the ability to transfer only a portion or portions of data displayed on a 2260 screen during any of the above operations. (See "2260 Display Station Keyboard Operations," under "IBM 2260 Display Station--General Description," for an example.)

The effect of pressing the NL symbol key is described in Table 3.

#### Check Symbol

The Check symbol (■) is used to indicate the detection of a parity error in data transferred to a 2260 Buffer, during the following operations:

Write DS Buffer Storage: local.  
Write DS Line Address: local and remote.  
Write Addressed DS: remote.

For each erroneous character detected by the 2848 Display Control during any of the above operations, a Check symbol is displayed in place of the character in error. The Check symbol can also be caused to appear on a 2260 screen by operation of certain of the associated keyboard keys (Table 3) or by transmission of the code configuration for the Check symbol from the channel to the 2260 Buffer.

● Table 3. Function of 2260 Display Station Control Keys (Part 1 of 2)

Key	Standard Destructive Cursor		Optional Nondestructive Cursor	
	No Shift	Shift	No Shift	Shift
SHIFT	Provides Shift column function for control keys or enables selection of special characters on upper half of keys.		Same	
<u>SPACE/ERASE</u> ADVANCE	Causes storage of a blank in the cursor position. Advances cursor to the next display position.	Same	Advances cursor one display position with no other modification of the display.	Erases the display position to the right of the cursor and advances the cursor one display position.
BACKSPACE	Backs cursor by one position, erasing character (if any) previously displayed in new cursor position. If cursor is in first display position, it will move to last display position.	Same	Backs cursor by one position with no erasures. If cursor is in first display position, it will move to last display position.	Same
ERASE DISPLAY (can be operated at any time)	Puts Check symbol in cursor position. Cursor moves to the next display position.	Erases entire display and locates cursor in upper left-hand corner of display (first displayable position).	Puts Check symbol in cursor position. Cursor moves to the next display position.	Erases entire display and locates cursor in upper left-hand corner of display area (first cursor position).
<u>START</u> UP	Causes a blank to be written and moves cursor one display position. When attached to a 2848 Model 21 or 22, the Keyboard will lock.	If no Start MI symbol is displayed, the Start MI symbol is placed in the position the cursor was in when the key was depressed. The cursor is advanced one display position.  If a Start MI symbol is displayed when the key is depressed, all display data between the Start MI symbol and the cursor, except data to the right of a new line character, is erased. The cursor moves to the first display position following the Start MI symbol.	Cursor moves up one line on the display. If cursor is already in top line, it will go to the last line.  The lateral position of the cursor within the display remains constant.	If no Start MI symbol is displayed, the Start MI symbol is placed in the position the cursor was in when the key was depressed. The cursor is advanced one display position.  If a Start MI symbol is displayed when the key is depressed, all display data between the Start MI symbol and the cursor, except data to the right of a new line character, is erased. The cursor moves to the first display position following the Start MI symbol.
ENTER	Puts Check symbol in cursor position. Cursor moves one display position.	Places an EOM symbol in cursor position. Cursor is "effectively" placed one display position beyond Start MI symbol. It also causes attention bit to be set in status byte and locks keyboard.	Puts Check symbol in cursor position. Cursor moves one display position.	Places EOM symbol in cursor position. Cursor is placed one display position beyond Start MI symbol. It also causes attention bit to be set in status byte and locks keyboard.
<u>PRINT</u>	Causes a Check symbol to be put in the cursor position. Cursor moves to the next position.	Causes all data from the first display position in first line, to and including the Cursor symbol, except	Causes a Check symbol to be put in the cursor position. Cursor moves to the next position.	Places the End of Message in the cursor position. Causes all data from the first display position in first line,

● Table 3. Function of 2260 Display Station Control Keys (Part 2 of 2)

Key	Standard Destructive Cursor		Optional Nondestructive Cursor	
	No Shift	Shift	No Shift	Shift
<u>NEW LINE</u> DOWN	A blank is written. Cursor moves to the next position. When attached to a 2848 Model 21 or 22, the keyboard will lock.	data to the right of an NL symbol in any line, to be printed by the 1053 Model 4 Printer.  If no print feature is attached to the 2848, a space is written in the cursor position and the cursor moves to the next position.  When attached to a 2848 Model 21 or 22, the keyboard will lock.  Places the NL symbol in the cursor position. The cursor moves to the first display position of the next lower display line. If it is already in the bottom line, it moves to the first display position of the top line. Data between the NL symbol and the end of the line is left undisturbed.		to and including the EOM symbol, in any line, to be printed by the 1053 Model 4 Printer.  If no print feature is attached to the 2848, a space is written in the cursor position and the cursor moves to the next position.  When attached to a 2848 Model 21 or 22, the keyboard will lock.  Places the NL symbol in the cursor position. The cursor moves to the first display position of the next lower display line. If it is already in the bottom line, it moves to the first display position of the top line. Data between the NL symbol and the end of the line is left undisturbed.
Single-Character Keys	Cause symbol to be displayed.	Put Check symbol in cursor position. Cursor moves to the next display position.	Cursor moves down one line. If it is already in the bottom line, it moves to the top line. The lateral position within the display remains constant.  Cause symbol to be displayed.	Places the NL symbol in the cursor position. The cursor moves to the first display position of the next lower display line. If it is already in the bottom line, it moves to the first display position of the top line. Data between the NL symbol and the end of the line is left undisturbed.  Put Check symbol in cursor position. Cursor moves to the next display position.
Double-Character Keys	Cause symbol on lower half of key to be displayed.	Cause symbol on upper half of key to be displayed.	Cause symbol on lower half of key to be displayed.	Cause symbol on upper half of key to be displayed.

## 2260 DISPLAY STATION KEYBOARD OPERATIONS

### Manual Input

The following text describes the procedures for manually entering data into a 2260 Buffer from its associated keyboard for transfer to the channel during a Read DS MI, Short Read DS MI, Specific Poll, or General Poll operation. (The Read DS MI or Short Read DS MI commands are used in a Local application; the Specific Poll and General Poll commands, in a Remote application.)

1. Position the cursor in the display position in which it is desired to begin the message. (Refer to Table 3 to select the keyboard key(s) that will best facilitate positioning the cursor.)

2. Place the keyboard in the Upshift condition and press the Start key. This action causes the Start MI symbol to be entered in the 2260 Buffer and to appear on the 2260 screen in the display position previously occupied by the cursor. The cursor is advanced to the next display position.
3. Key in the message that is to be transferred to the channel. The message data will appear on the 2260 screen as the character keys are operated. The cursor symbol automatically advances as data is displayed on the 2260 screen.
4. After the entire message is displayed on the 2260 screen and is visually verified, place the keyboard in the Upshift condition and press the Enter key. This action causes all the keys

on this keyboard, except the Erase key, to be locked, and signals the channel that a message is awaiting transfer to it from a 2260 Buffer.

The following describes the action or actions that signal completion of a manual input operation when the 2260/2848 is operated in a local environment, using the Read DS MI or Short Read DS MI command, and when operated in a remote environment, using the Specific Poll or General Poll command:

Local, using Read DS MI command--Upon completion of the transfer of data from the 2260 Buffer to the channel, using the Read DS MI command, the keyboard is restored (unlocked), and the Start MI symbol (▶) is deleted from the screen of the 2260. Deletion of this symbol and keyboard restoration should be interpreted by the operator to mean that the operation has been successfully concluded and that another message may be entered in the 2260 Buffer.

Local, using Short Read DS MI command — Upon completion of the Short Read DS MI operation, the following occur:

1. The cursor is "effectively" advanced one display position, and an End of Message (EOM) symbol (■) appears in the position previously occupied by the cursor. (See the Programming Note that follows the description of the Short Read DS MI command given in "Principles of Operation — Local Application".)
2. The Start MI symbol (▶) is not deleted from the 2260 screen, as in the Read DS MI operation, but remains in the display position it initially occupied.
3. The keyboard of the selected 2260 is restored (unlocked), indicating that the operation has concluded and that another message may be keyed and entered.

Remote, using Specific Poll or General Poll command — Upon successful completion of a Specific Poll or General Poll operation, the keyboard is restored, and the Start MI symbol (▶) is deleted from the screen of the selected 2260. Deletion of the Start MI symbol and restoration of the keyboard should be interpreted by the operator to mean that the operation has been successfully concluded and that another message may be entered in the 2260 Buffer.

PROGRAMMING NOTE: If a Write DS Buffer Storage, Read Full DS Buffer, or Erase DS Buffer Storage command is accepted by the 2848 DC while a keyboard key at the selected 2260 is being

pressed, the keyboard operation is overridden by the command. Also, during execution of a Write DS Buffer Storage command, there is a brief period of time (33.4ms) following the writing of the last display position of each display line, during which it is possible for a character to be entered from the keyboard. A character entered in this manner can appear in the first display position of any display line except the first.

To avoid the situation just described, a keyboard should not be operated while the associated 2260 is program-selected.

### Use of New Line (NL)Symbol

As previously described, the NL symbol prohibits the transfer of data displayed between the NL symbol and the end of the display line containing the symbol, during a Read DS MI, Short Read DS MI, Specific Poll, or General Poll operation. This capability has many applications, one of which is the ability to display both constant and variable data when it is desired to transfer only the variable data to the channel.

For example, constant information, such as "name", "address", and "account number", may be entered and displayed on the right side of a 2260 Display Station screen. Variable information, such as the actual name of an individual, etc., is then keyboard-entered on the appropriate line, to the left of the indicative information.

Following the entry of the last character in each line of variable information, the New Line key is pressed. This causes the NL symbol to appear between the variable and the constant information and 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 2260 Buffer and is displayed on the screen, the Enter key is pressed. Receipt of either the Read DS MI or Short Read DS MI command causes a transfer to the channel of all data between the Start MI symbol 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 constant information (name, address, and account) would be transferred to the channel. The NL symbols would be included in the data transfer, but, if more than one NL symbol is displayed on a display line, only the first symbol is transferred.

### Correction of Errors from the 2260 Keyboard

The method of correcting typographical errors and mistakes made as data is entered in the 2260 Buffer via the keyboard depends on many factors; for example, the position of the error, the type of operation, the type of cursor (destructive or nondestructive), the skill and experience of the operator, etc.

```

▶ J WOOD ▲      NAME
32 STOCK RD ▲  ADDRESS
02392015 ▲     ACCOUNT

```

Figure 3. Example Display Using New Line (NL) Symbol

Since it would be impractical to suggest corrective methods to cover every situation, this discussion concerns the keyboard keys that are particularly useful in the correction of typing errors. These keys, namely, Backspace, Erase Display, Advance, and Start, are also described in Table 3.

**Backspace (Bksp)** - The Backspace key permits the operator to backspace the cursor to the display position in error and effect the correction. The destructive cursor, when backspaced into a display position containing a character, erases the character. Backspacing the nondestructive cursor does not cause displayed data to be erased.

**Erase Display** - The Erase Display key, when operated in the Upshift condition, erases the entire display and places the cursor in the first displayable position (the upper left corner of the screen).

**Advance** - (See Table 3.)

**Start** - The Start key, when operated with a Start MI symbol, displayed on the 2260 screen and the Shift key depressed, erases all data displayed between the Start MI symbol and the cursor. It does not erase data displayed between an NL symbol and the end of the display line containing that symbol.

The Up key and Down key are also useful if the nondestructive cursor is used, because they permit rapid positioning of the nondestructive cursor.

#### 2260-to-Printer Operation

If the Printer feature is installed, the 2260 keyboard Print key, when operated with the keyboard in the Upshift condition, logically connects the 2260 and IBM 1053 Model 4 Printer and causes the following (see Table 3 for the action that occurs when the Print key is operated under other conditions);

1. An EOM is written in the cursor position for the Nondestructive Cursor feature; the cursor becomes EOM for Destructive Cursor machines.

2. All the keyboard keys are locked except the Erase key.
3. Data displayed on the 2260 from the first displayable position to, and including, the EOM is transferred from the 2260 buffer to the printer buffer and printed, except data between the NL symbol and the end of the display line containing that symbol.

NOTE: An EOM in the body of the message will cause the print operation to end prematurely.

The EOM is printed as an exclamation mark. (An exclamation mark signifies the end of a message.) If NL symbols are displayed, the first NL symbol on each display line is transferred to the printer buffer, and each causes a carriage return-line feed function.

PROGRAMMING NOTE: On the 2400 bits-per-second remote interface adapter, when a write command is issued to a 2260 while any 2260 is executing a keyboard print command, overrun might occur in the 2848 remote interface. Overrun, the condition whereby the remote interface cannot accept data as rapidly as it is received, results in the loss of write data at the interface. Overrun may occur if more than four successive lines of the 2260 display have an NL symbol in the first character position.

4. At the completion of data transfer from the 2260 Buffer to the printer buffer, the 2260 keyboard is restored.

Detection of parity errors during a 2260-to-printer operation is indicated as follows:

1. If a parity error is detected in the 2260 Buffer, the erroneous character is printed and a quote (") symbol is printed in the print position preceding the exclamation mark (end of message).
2. If a parity error is detected in the printer buffer, a space is substituted for the erroneous character, and a quote (") symbol is printed following the exclamation mark (end of message).

If the 1053 Printer is busy at the time a 2260 print request is initiated (Print key depressed), the print request is queued and accepted when the 1053 Printer becomes available. If desired, the operator can cancel the print request and restore the keyboard by pressing the Erase key. (This also erases all displayed data.) Once the transfer of data is initiated, however, the Erase key will not be accepted by the 2848.

PROGRAMMING NOTE: Any command issued to a 2260 that is performing a 2260-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 2260 is restored upon completion of the command. Printing will end with the last character transferred from the 2260 prior to the programmed command.

## CONTROL KEY FUNCTIONS

The action that occurs when the various keyboard control keys are pressed is shown in Table 3 for both the standard destructive cursor and the optional nondestructive cursor.

The display symbols associated with control key functions, where applicable, are as follows:

1. Start MI symbol ▶
2. New Line symbol ▲
3. Destructive Cursor           ABC ■  
The small horizontal bar is the Cursor symbol and denotes the next available display position. Thus, if the D character key were pressed, the display above would be extended to ABCD ■
4. Nondestructive Cursor           ABC ■  
The vertical line is the Cursor symbol. The

next available display position is above and to the right of the vertical line (cursor). Thus, if the D character key is pressed, the new display appears as ABCD ■

The control keys described in Table 3 appear on all 2260 DS keyboards, even when the feature associated with a particular key has not been attached to the 2848 Control Unit. For example, the Print key is present when the 1053 Printer Adapter has not been selected for attachment to the 2848 DC. The data provided for each control key includes a description of the effect of pressing the key when the associated feature is not present.

## 2260 DISPLAY FORMAT SHEETS

Display Format sheets (Form X20-1751) are used to aid in establishing the display format in which messages transmitted from the CPU to a 2260 are to be displayed during a particular operation.

The 2260 Display Format sheets are obtainable through the local IBM Sales Office.



The 2260/2848 Display Complex that is to be operated in a local environment can be attached, via the 2848 Display Control, to either a selector or multiplexer channel of an IBM System/360. Channel Adapter FC9011 provides the necessary circuitry to interface any of the three models of the 2848 Display Control to either channel.

The 2260/2848 operates in byte mode when connected to a multiplexer channel and in burst mode when connected to a selector channel. Transmission speed between the CPU and the 2848, in either direction, is 2560 characters per second (cps):

#### CODE SET

The display system in a local environment uses the EBCDIC code set (Extended Binary Coded Decimal Interchange Code) for data exchanges between the 2848 Display Control and the channel. The EBCDIC code set provides 256 characters, of which 64 may be used in data exchanges between the channel and the 2260/2848 Display Complex.

Figure 4 illustrates the bit configuration, the standard symbol, and the image displayed for each of the 64 EBCDIC characters used in data exchanges between the 2260/2848 and the channel.

#### DATA FLOW (DATA FLOW DIAGRAM ANALYSIS)

Data flow through the 2260/2848 is illustrated in the data flow diagram (Figure 5) and described in the following paragraphs.

##### 2848/Channel Interface

The 2848/Channel Interface contains the circuitry required to exchange control signals, data bytes, and command bytes with the associated System/360 channel.

The 2848 Display Control, fitted for direct attachment to a System/360 channel, uses the Extended Binary Coded Decimal Interchange Code (EBCDIC) for data exchanges between the channel and the 2260-2848. Data exchange occurs in eight-bit data bytes.

During a write operation, the interface receives the eight-bit data byte from the channel, checks it for parity, and converts the eight-bit EBCDIC to six-bit BCD, which is placed in the common buffer.

Conversely, during a read operation, the interface receives and converts six-bit BCD from the common buffer to eight-bit EBCDIC for transfer to the channel.

##### Common Buffer

The common buffer acts as the central point for the transfer of data between the interface and the 2848 Display Control and for the transfer of data within the 2848. Specifically, the common buffer is used for data exchanges between the following areas:

1. Interface to 2260 Display Station buffer storage.
2. 2260 Display Station buffer storage to interface.
3. 2260 Display Station keyboard to 2260 Display Station buffer storage.
4. 2260 Display Station buffer storage to 1053 Printer Buffer.
5. Interface to 1053 Printer Buffer.

##### Character Generator

The character generator contains 64 core storage matrices (one matrix for each of the 64 displayable characters). Each matrix contains the ferrite cores necessary to produce the video signals for that character. Each matrix also contains a configuration of ferrite cores to convert: (1) BCD to the Tilt-and-Rotate code used by the 1053 Printer, (2) BCD to the code (USASCII) used by the remote display complex, (3) USASCII to BCD, and (4) USASCII to Tilt-and-Rotate.

The character generator receives six-bit BCD code from the common buffer and converts it to five seven-bit data bytes that are the video equivalent of the BCD character. The five video bytes are then placed, one at a time, in the common buffer and are transferred to the display adapter.

##### Display Adapter

The display adapter contains the delay line buffer storage and associated control logic to service two 2260 Display Stations.

The delay line is used to store data for presentation on the 2260 Display Station screen. Video data bits are placed in the delay line serially and are continuously displayed and regenerated until erased

Bits 0, 1	00	01	10	11					
Bits 2, 3	00 01 10 11	00 01 10 11	00 01 10 11	00 01 10 11					
Bits 4, 5, 6, 7									
0000		SP	&	-					0
0001			/		A	J			1
0010					B	K	S		2
0011					C	L	T		3
0100					D	M	U		4
0101	NL				E	N	V		5
0110					F	O	W		6
0111					G	P	X		7
1000					H	Q	Y		8
1001					I	R	Z		9
1010				:					
1011				.	\$	/	#		
1100				<	*	%	@		
1101				(	)	_	'		
1110				+	;	>	=		
1111					~	?			

Note 1. Displayed on 2260's as the New Line (▲) symbol. Causes carriage return and line feed on the 1053 Model 4 Printer.

Note 2. Displayed on 2260's as the Start MI (▶) symbol. Prints on the 1053 Model 4 Printer as a cent sign (¢).

Note 3. Displayed on 2260's as the EOM (■) symbol. Prints on the 1053 Model 4 Printer as an exclamation mark (!).

Note 4. Displayed on 2260's as the Check (■) symbol. Prints on the 1053 Model 4 Printer as a quote (" ) symbol.

Note 5. The codes represented by the characters within the dotted outline are the EBCDIC codes for the lower case alphabetic characters. These

codes are converted to upper case by the 2848 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 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 the device for an undefined graphic bit pattern sent from channel.

Figure 4. EBCDIC Code Set

or replaced by other data. The data stored in the delay line can also be read into the common buffer for transfer to the interface during a read operation or to the 1053 Printer during a 2260 print operation.

Common Bus and MI Control

Common bus and MI (manual input) control accepts character data and keyboard-generated commands

from all associated 2260 Display Stations equipped with either the Alphameric or the Numeric Keyboard feature. The character data generated by a selected 2260 keyboard is received by the common bus, and MI control and is placed in the common buffer for processing and transfer to buffer storage. Keyboard commands are directed to control areas, where they perform specific functions, e.g., erase, backspace, enter, etc.

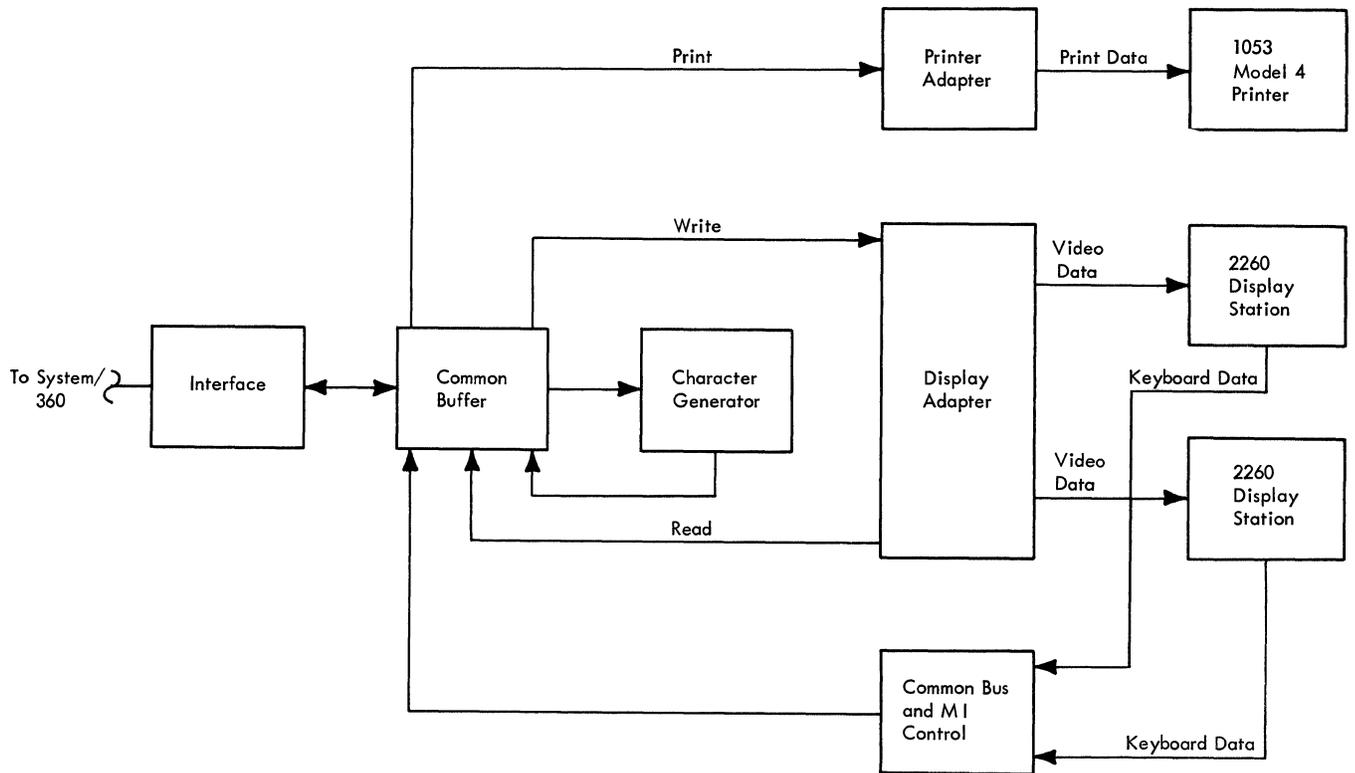


Figure 5. Data Flow Diagram

### 2260 Display Station (Model 1 or 2)

The 2260 Display Station contains the display screen (cathode-ray tube) and related circuitry and a keyboard (if equipped with a Keyboard feature).

Graphic presentation of character data on the 2260 screen is achieved by intensifying the cathode-ray beam at proper intervals as it sweeps vertically and moves horizontally across the face of the screen. The point of beam intensification on the screen is determined by the position of the video data bits in the delay line (buffer storage). The video data bits in the delay line and the CRT beam move synchronously. Thus, as the beam moves, the video data bits flow through the delay line in direct relationship to beam motion. When a video data bit is detected, the beam is intensified, causing a graphic representation (a dot) of that video data bit to appear on the screen.

To form an intelligible character on the screen, the video data bits representative of that character are placed in the delay line (again, in direct relationship to beam motion). As the video data bits flowing through the delay line are sensed, the CRT beam is intensified, and a pattern of dots forming the character is displayed.

During the interval between the detection of video data bits, the beam continues to move, but, it moves in an unintensified (blanked) state, and no image

appears on that portion of the screen. Space between characters and lines is the result of blanked beam motion.

### Printer Adapter

The printer adapter contains a buffer storage (printer buffer) and the circuitry required to control an IBM 1053 Model 4 Printer.

Data, previously converted to Tilt-and-Rotate code, is received from either the channel or a 2260 Display Station buffer. This data is placed in the printer buffer, then transferred to the printer, and printed.

### IBM 1053 Model 4 Printer

The optional 1053 Model 4 Printer is an output-only printer; when installed on the 2848, it can be used by any associated keyboard-equipped 2260 Display Station and by the computer as well.

### ADDRESSING

The 2260/2848 Display Complex in a Local environment uses standard System/360 addressing and selection sequences.

The 2848 Display Control and attached devices

(2260 Display Stations and the optional 1053 Model 4 Printer) are addressed by eight-bit address bytes of preassigned configurations. The 2848 and each of its attached devices are adapted at the time of installation to accept and respond only to an assigned address.

The 2848 is addressed by one or two (two if more than 16 devices are attached to the 2848) distinct configurations of the four high-order bits of the address byte. The attached 2260's and the 1053 Printer are assigned sequential configurations of the four low-order bits, starting at 0000. If more than 16 devices, including the 1053 Printer, are attached to a 2848, a second configuration of the four high-order bits is assigned to the 2848, and the additional devices are assigned sequential configurations of the four low-order bits, again starting with 0000. Thus, a 2848 Display Control with more than 16 devices appears to the channel as two display groups. An example of address assignments for a Model 1 2848 Display Control with the maximum number (24) of 2260 Display Stations and a 1053 Printer attached is shown in Figure 6.

Address Byte (EBCDIC)		Device Number (2260 Display Station or 1053 Printer*)
(High Order) 2848 Address	(Low Order) Device Address	
0011	0000	1
0011	0001	2
0011	0010	3
0011	Continued	↓
0011	Sequentially	
0011		
0011		
0011		
0011	1111	16
0110	0000	17
0110	0001	18
0110	0010	19
0110	0011	20
0110	0100	21
0110	0101	22
0110	0110	23
0110	0111	24
0110	1000	25

\*The 1053 Printer must be the highest addressed device.

Figure 6. Typical Address Assignments--Model 1 2848 Display Control and Attached Devices

## COMMANDS AND COMMAND OPERATION

This section discusses the basic commands that can be executed by the 2260/2848 Display Complex. The commands, their code structure, and the feature required to enable command execution are given in Figure 7.

The operation to be performed by the 2848 Display Complex is determined by an eight-bit command byte issued by the channel to the 2848. The low-order bits of a command byte define the basic operation. The high-order bits are used to expand (modify) an operation.

Each command received by the 2848 is tested for correct parity and validity. The following summarizes the action taken when an invalid command or a command byte of incorrect parity is detected by the 2848:

Invalid Command or Command Modifier — The operation is not performed. Unit Check is set in the status byte. Command Reject is set in the sense byte.

Command Parity Error — The operation is not performed. Unit Check is set in the status byte. Bus Out Check is set in the sense byte.

If a command other than Test I/O is presented to the 2848 while the 2848 interface is in the busy state (with pending status and address compare), the command is not accepted, nor is it checked for validity or parity. The Busy bit and current status are presented to the channel. The Test I/O command, however, is accepted when presented to the busy device. The Test I/O command is checked for parity and validity and it causes the 2848 Status byte to be transferred to the channel.

### Write DS Buffer Storage Command

The Write DS Buffer Storage command is used to transfer data from the channel to the 2260/2848 Display Complex for presentation on the screen of the selected 2260 Display Station.

The Write DS Buffer Storage command causes the transfer of data from the channel to the 2848 Display Control under Channel Byte Count Control. Data bytes are parity-checked by the 2848 as they are received. The data bytes are converted to video data by the 2848 and are placed in the buffer storage of the selected 2260 Display Station at the location indicated by the cursor. Character data is displayed on the 2260 screen upon entering buffer storage.

The cursor automatically advances to the next display position as each character is placed in

Command	EBCDIC Code Structure								Feature Required
	Bits								
	0	1	2	3	4	5	6	7	
Write DS Buffer Storage	0	0	0	0	0	0	0	1	Printer Feature Line Addressing Feature *Keyboard Feature *Keyboard Feature
Write 1053 Buffer Storage	0	0	0	0	0	0	0	1	
Write DS Line Address	0	0	0	0	0	1	0	1	
Read DS MI	0	0	0	0	0	0	1	0	
Short Read DS MI	0	0	0	0	1	0	1	0	
Read Full DS Buffer	0	0	0	0	0	1	1	0	
Erase DS Buffer Storage	0	0	0	0	0	1	1	1	
No Op	0	0	0	0	0	0	1	1	
Test I/O	0	0	0	0	0	0	0	0	
Sense	0	0	0	0	0	1	0	0	

\*To effect transfer of data, using the Read DS MI or Short Read DS MI command, the keyboard Enter key at the selected 2260 must be depressed.

NOTE: The keyboard of the selected 2260 is restored upon completion of all commands except No Op, Test I/O, Sense, and Write 1053 Buffer Storage.

Figure 7. 2260/2848 Commands (Local)

buffer storage and displayed on the 2260 screen. (Receipt of a New Line (NL) code causes the NL symbol to be displayed and the cursor to be positioned in the first display position of the next line.) If a message length exceeds the display positions between the cursor and the last display position on the screen, a wraparound condition occurs. That is, the message data that exceeds the display positions replaces previously written data, beginning at the first display position.

A Write DS Buffer Storage operation is terminated by Channel Byte Count Control. The byte counter is set, before execution of the Write command, with a byte count (number of characters contained in the message). As data bytes are transferred from the channel to the 2848, the byte counter is decremented by one for each data byte transfer. When the byte counter reaches zero, Channel Byte Count Control initiates the Stop Sequence. This sequence causes the transmission of data bytes to be halted and Channel End and Device End to be set in the 2848 Status byte for presentation to the channel. The character data written in the 2260 buffer storage will be continuously displayed and regenerated until erased or replaced by other data.

If a parity error is detected during a Write operation, a Check symbol is displayed in place of the character in error. The operation is not terminated when a parity error is detected. However, at the conclusion of the operation, Unit Check, along with Channel End and Device End, is set in

the 2848 status byte. Bus Out Check is set in the 2848 sense byte.

PROGRAMMING NOTES:

1. Of the 256 possible configurations of the eight-bit data byte, only those defined in Figure 4 should be used for transfer to the 2260/2848 Display Complex during a write operation.
2. If a Write DS Buffer Storage is accepted while the Enter key at the addressed 2260 is being pressed, the request for service is overridden by the command (i. e., the Attention bit is not set in the status byte). The keyboard is restored at the completion of the command.
3. The presence of more than one EOM symbol on a 2260 screen can cause a premature or incorrect termination of a Read DS MI, Short Read DS MI, or 2260-to-printer operation. For this reason, the transfer of the bit configuration for the EOM symbol (Figure 4, note 3) during a Write DS Buffer operation should be avoided. (See Programming Note following the description of Read DS MI or Short Read DS MI command.) The transfer of the bit configuration for the Start MI symbol (Figure 4, note 2) should also be avoided if it causes more than one start MI symbol to be displayed on a 2260 screen. The presence of more than one Start MI symbol on a 2260 screen may cause other than desired results during a Read DS MI or Short Read DS MI operation.

Write 1053 Buffer Storage Command

The Write 1053 Buffer Storage command is used to transfer data from the channel to the 1053 Model 4 Printer for printing.

The Write 1053 Buffer Storage command causes the transfer of data from the channel to the 2848 under Channel Byte Count Control. Data bytes are parity-checked by the 2848 as they are received, converted to the Tilt-and-Rotate code, and placed in the 1053 Buffer Storage. The required shift characters are automatically inserted.

The 1053 Printer begins printing upon receipt of the first data byte in the 1053 Buffer Storage. The 1053 Buffer Storage accepts data bytes at an average rate of 120 characters per second, up to its capacity of 1223 bytes, including control and shift bytes. Upon reaching buffer capacity, data is accepted at the output print rate of the 1053 Model 4 Printer (nominally 14 characters per second).

In response to a Write 1053 Buffer Storage command or Test I/O command to the printer address, the Busy bit is set in the 2848 status byte and will be presented to the channel if the 1053 is printing. (See Programming Note 2, following.)

The Write 1053 Buffer Storage operation is terminated when the byte counter (Channel Byte Count Control) is reduced to zero. When this occurs, the Stop Sequence is generated by the channel. The 2848 Display Control responds to the Stop Sequence by setting Channel End and Device End in the 2848 status byte. The channel is then available for other 2848 operations.

It is recommended that an EOM code be transmitted as the last character of each complete message to ensure separation of messages. The EOM code causes an exclamation mark to be printed and the print mechanism to be advanced to the first print position of the next line. The EOM code also causes a quote symbol to be printed (following the exclamation mark) when a parity error is detected in the printer buffer.

A New Line (NL) code should be used as the first character of a message when additional separation between messages is desired. The NL code also causes the print mechanism to be advanced to the first print position of the next line. However, unlike the EOM code the NL code does not cause a character to be printed.

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 NL 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.

If a data byte of incorrect parity is detected by the 2848 during a Write 1053 Buffer Storage operation, the following occurs:

1. The 1053 Printer prints a quote (") symbol (last character printed), to indicate an incomplete message, and discontinues printing. The exclamation mark, which is normally printed to signify the end of a message, is not printed.
2. The 1053 Buffer Storage is cleared.
3. Data bytes continue to be transferred from the channel to the 2848 until the channel byte counter decrements to zero. However, the bytes are not printed or placed in the buffer.
4. At the end of data transfer from the channel to the 2848, Channel End, Device End, and Unit Check are set in the 2848 DC status byte. Bus Out Check is set in the 2848 DC sense byte.

If a 1053 buffer parity error occurs during a Write 1053 Buffer Storage operation, the following occurs:

1. A space is substituted for the character in error, and printing continues.
2. When the end of message (EOM) code is received, an exclamation mark is printed, followed by a quote symbol which signifies that a printer buffer error occurred during the operation.

NOTE: If an EOM code is not received, neither the exclamation mark nor the quote symbol is printed.

3. At the conclusion of the operation, Channel End, Device End, and Unit Check are set in the 2848 status byte. Equipment Check is set in the sense byte.

If a Write 1053 Buffer Storage command is presented to the 2848 when the 1053 Printer is in a Not Ready status (out of paper or power off), Unit Check is set in the 2848 status byte. Intervention Required is set in the sense byte. When the 1053 Printer is readied, Device End alone is set in the 2848 status byte and is presented to the channel in response to a Print command, indicating its Ready status. Only the Write 1053 Buffer Storage command will detect a Printer Not Ready condition.

2260 Display Station Print requests are queued when initiated during a Write 1053 Buffer Storage operation. The 2260 Print requests are accepted when Channel End and Device End are presented to the channel (at the completion of the Write 1053 Buffer Storage operation).

**PROGRAMMING NOTES:**

1. If two successive Write 1053 Buffer Storage commands are issued, the second command will not be accepted until the 1053 has completed printing the first message, i. e., when the 1053 buffer has been emptied. For this reason, Write 1053 Buffer Storage commands should not be chained.
2. Device End, when presented with Channel End following a Write 1053 Buffer Storage command, indicates that data transfer from the channel to the printer buffer has been completed. However, it does not necessarily indicate that the printer has completed printing. Device End alone is used to signal the completion of printing and will occur in response to a print command provided a previous print command was issued while the printer was in Busy status (still printing). Device End alone is also used to signal that the printer is ready. It will occur in response to a print command issued after the printer has been readied provided a previous print command was issued while the printer was in Intervention Required status (not ready).

Write DS Line Address Command

To accept and execute the Write DS Line Address command, the 2848 Display Control must be equipped with the Line Addressing Feature. If the 2848 is not so equipped, Command Reject is set in the sense byte and Unit Check is set in the status byte.

The Write DS Line Address command combines the Write DS Buffer Storage command with line selection capabilities, thus enabling the selection of a specific 2260 display line as the beginning line of a message.

Write DS Line Address command causes the cursor to be positioned in the first displayable position of the addressed line (line address is specified

by the first data byte following the Write DS Line Address command). Subsequent message data is displayed beginning at the addressed line.

With the exception of command byte format and the positioning of the cursor (caused by the first data byte), the Write DS Line Address command is operationally the same as the Write DS Buffer Storage command.

The Write DS Line Address command provides for the selection of up to 12 line addresses (the maximum number of displayable lines on 2260's attached to a Model 2 or Model 3 2848 Display Control). However, 2260's attached to a 2848 Display Control Model 1 display only six lines. Therefore, line addresses above six should not be used in a display complex controlled by a 2848 Display Control Model 1.

Figure 8 lists the 12 possible line addresses and the data byte format for each. (Only the data byte formats given in Figure 8 should be used to select a display line. Any other format may address an unspecified line, which can vary from one machine to another.)

Read DS MI (Manual Input) Command

The Read DS MI command is used to transfer manually entered messages and data from a 2260 Display Station buffer to the channel.

The Read DS MI command should be issued in response to activating the Enter key on a 2260 keyboard. Pressing the Enter key causes Attention status to be transferred to the channel. The com-

EBCDIC Data Byte Format								Selected Line
0	1	2	3	4	5	6	7	
1	1	1	1	0	0	0	0	One
1	1	1	1	0	0	0	1	Two
1	1	1	1	0	0	1	0	Three
1	1	1	1	0	0	1	1	Four
1	1	1	1	0	1	0	0	Five
1	1	1	1	0	1	0	1	Six
1	1	1	1	0	1	1	0	Seven
1	1	1	1	0	1	1	1	Eight
1	1	1	1	1	0	0	0	Nine
1	1	1	1	1	0	0	1	Ten
1	1	1	1	1	0	1	0	Eleven
1	1	1	1	1	0	1	1	Twelve

Figure 8. Display Line Addresses (Local)

mand causes all character data displayed between the Start symbol and the cursor (EOM symbol) of the selected 2260 to be transferred to the channel, but not data between an NL symbol and the end of the line containing the symbol. The Read DS MI operation is terminated when the EOM symbol is detected by the 2848 Display Control.

NOTE: If the channel byte counter is set at a value that permits it to reach zero before the cursor is detected, data transfer is stopped, but the operation will continue to a normal ending, i. e., until the cursor is detected. If this occurs, an incomplete message will be transferred to the channel.

At the completion of the operation (EOM symbol detected), Channel End and Device End are presented to the channel, the Start symbol is deleted from the 2260 screen, and the keyboard of the selected 2260 is restored.

If a 2260 buffer parity error is detected during the operation, the operation will continue, but at the conclusion of the operation, Unit Check will be set in the 2848 status byte, along with Channel End and Device End. Equipment Check will be set in the 2848 DC sense byte.

Two conditions must prevail before a Read DS MI operation can be performed:

1. The Enter key of the selected 2260 Display Station must have been pressed and Attention status must have been accepted on the CPU.
2. A Start symbol must be displayed on the screen of the selected 2260.

If a Read DS MI command is given in the absence of one or both of these conditions, the operation is not performed. Device End and Channel End are presented to the channel. On destructive cursor machines, if the first condition is not met the SOM symbol will be erased.

#### Short Read DS MI Command

The Short Read DS MI command is similar in function to the Read DS MI command in that it is used to transfer manually entered data from a display station buffer to the channel. The Short Read DS MI command provides greater data input capabilities than the Read DS MI command because it requires less 2848 process time to execute.

The process time savings (33.0 to 49.7ms per operation) is gained by omitting the Start MI symbol deletion function performed during a Read DS MI operation. Thus, at the conclusion of a Short Read DS MI operation, the Start MI symbol is not automatically deleted, as in a Read DS MI operation, but remains on the 2260 screen.

The Short Read DS MI command, when issued in response to "Attention" status (keyboard Enter key pressed), causes all data displayed between the Start MI symbol and the cursor of the selected 2260 to be transferred to the channel, except data between an NL symbol and the right end of the display line containing the symbol. The Short Read DS MI operation is terminated when the EOM symbol is detected by the 2848 Display Control.

NOTE: If the channel byte counter is set at a value that permits it to reach zero before the cursor is detected, data transfer is stopped, but the operation will continue to a normal ending, i. e., until the cursor is detected. If this occurs, an incomplete message will be transferred to the channel.

Upon completion of the Short Read DS MI operation:

1. Channel End and Device End are presented to the channel.
2. The cursor is "effectively" advanced one display position. An EOM symbol is located in the position previously occupied by the cursor. (See the following Programming Note.)
3. The Start MI symbol is not deleted from the 2260 screen, as in the Read DS MI operation, but remains in the display position it initially occupied.
4. The keyboard of the selected 2260 is restored (unlocked), indicating that the operation has concluded.

If a 2260 buffer parity error is detected during a Short Read DS MI operation, Unit Check will be set in the 2848 Status Byte, along with Channel End and Device End. Equipment Check will be set in the 2848 DC sense byte.

Two conditions must prevail before a Short Read DS MI operation can be performed:

1. The Enter key of the selected 2260 must have been pressed.
2. A Start MI symbol must be displayed on the screen of the selected 2260.

If a Short Read DS MI command is given in the absence of one or both of these conditions, the operation is not performed. Device End and Channel End are presented to the channel.

PROGRAMMING NOTE: This programming note is presented in two parts: part 1 pertains to those 2260/2848's having the destructive cursor; part 2 pertains to those equipped with the nondestructive cursor.

Part 1 (Destructive Cursor). During manual entering operations (using the Short Read DS MI command), an EOM symbol appears

in the display position previously occupied by the cursor and, at the conclusion of the operation, the cursor is "effectively" placed one display position beyond the EOM symbol. (That is, a non-displayable control bit, used within the 2848 DC to distinguish the cursor from the EOM symbol, is located one position beyond the EOM symbol.) The cursor is not visible at this time; however, if a character were entered, the character would appear one position beyond the EOM symbol, and the cursor would be visibly displayed one position beyond the character entered.

Since the EOM symbol and the cursor look alike and both are interpreted by the 2848 DC as the end of a message, the presence of both on the same screen can cause operator confusion and, possibly, an incorrect termination of a subsequent operation. For these reasons, the EOM symbol should be deleted from the 2260 screen, either manually or by programming, following each operation.

It is also recommended that a Read DS MI command not be issued following a Short Read DS MI command unless the Start MI symbol is first deleted.

Part 2 (Nondestructive Cursor). During manual entering operations, an EOM symbol is inserted in the display position indicated by the nondestructive cursor and, at the conclusion of the operation, the cursor is placed one position beyond the EOM symbol. To avoid an incorrect termination of a subsequent operation, the EOM symbol should be deleted from the screen, either manually or by programming, following each operation.

It is also recommended that a Read DS MI command not be issued following a Short Read DS MI command unless the Start MI symbol is first deleted.

### Read Full DS Buffer Command

The Read Full DS Buffer command causes all character data displayed on the screen of the selected 2260 Display Station to be transferred to the channel. Data transfer starts at the first displayable position (upper left corner of the 2260 screen) and ends at the last displayable position (lower right corner of the screen).

Included among the characters transferred are Check symbols, Start symbol, NL symbols, and the destructive cursor (EOM symbol). The nondestructive cursor is not transferred. Spaces between characters and the blank positions between the last character displayed and the last displayable position on the screen are transferred as spaces.

The Read Full DS Buffer operation is terminated when the last position of the buffer is sensed (position 240, 480, or 960 for 2848 DC Models 1, 2, and 3, respectively). However, data transmission is stopped, at the risk of transferring an incomplete message, if the byte counter (Channel Byte Count Control) is set at a value that permits it to be reduced to zero before the last buffer position is sensed.

At the conclusion of a Read Full DS Buffer operation, Channel End and Device End are presented to the channel.

If a buffer parity error is detected during execution of the Read Full DS Buffer command, the operation continues until the last buffer position is sensed, but, at the conclusion of the operation, Unit Check, Channel End, and Device End are placed in the 2848 status byte. Equipment Check is placed in the 2848 sense byte.

PROGRAMMING NOTE: The following pertains only to those 2260/2848's having the destructive cursor.

At the conclusion of a Read Full DS Buffer operation, an EOM symbol occupies the display position that initially contained the cursor, and the cursor is "effectively" located in the first display position of the first display line. (That is, the TIC, a nondisplayable control bit used within the 2848 to distinguish the cursor from an EOM symbol, is located in the first display line.) The cursor is not visible at this time; however, if a character were entered, the character would appear in the first display position, and the cursor would be visibly displayed one position beyond the character entered.

Since the EOM symbol and the cursor are identical in appearance and both are interpreted by the 2848 DC as the end of a message, the presence of both on the same screen can cause operator confusion and, possibly, an incorrect termination of a subsequent operation. For these reasons, the EOM symbol should be deleted from the 2260 screen, either manually or by programming, following each Read Full DS Buffer operation.

If a Read Full DS Buffer command is accepted while the Enter key at the addressed 2260 is being pressed, the request for service is overridden by the command (i. e., the Attention bit is not set in the status byte). The keyboard is restored at the completion of the command.

### No Op (No Operation) Command

The presentation of the No Op command causes the 2848 Display Control to respond with the normal ending sequence, Channel End and Device End. Data is not transferred.

### Erase DS Buffer Storage Command

The Erase DS Buffer Storage command causes the erasure of all character data displayed on the screen of the selected 2260 Display Station and causes the cursor to be placed in the first displayable position.

At the conclusion of the Erase DS Buffer Storage operation, the cursor appears in the first displayable position of the 2260 screen, and the remainder of the display is blank. Channel End and Device End are placed in the 2848 status byte.

PROGRAMMING NOTE: If an Erase DS Buffer Storage command is accepted while the Enter key at the addressed 2260 is being pressed, the request for service is overridden by the command (i. e., the Attention bit is not set in the status byte). The keyboard is restored at the completion of a command.

### Sense Command

The Sense command causes the 2848 Display Control sense byte to be transferred to the channel for program analysis. The sense byte is explained under "Sense and Status Bytes," following in this chapter.

### Test I/O Command

The Test I/O command causes the 2848 Display Control status byte to be transferred to the channel. The Test I/O command also resets the status byte. The status byte is explained under "Sense and Status Bytes," following.

## CHANNEL/DISPLAY COMPLEX--SEQUENCES AND RESPONSES

This section discusses sequences and responses that occur between the channel and the 2260/2848 Display Complex and are directly related to, or influence, device operation.

### Stop Sequence

The Stop Sequence is initiated by Channel Byte Count Control and is used to terminate an operation involving data transfer. The sequence is initiated when the byte counter is decremented to zero (the byte counter is set with a value equal to the number of data bytes to be transferred and decremented by one with each character transferred).

Write commands are normally terminated by the Stop Sequence; that is, the occurrence of the Stop Sequence causes the 2848 Display Control to proceed to a normal end sequence (Channel End and Device End in the 2848 status byte).

The Stop Sequence will terminate the transfer of data from the 2848 to the channel, but it does not conclude the Read operation within the 2848. Read operations are brought to a normal end sequence by detection of the cursor or detection of the last buffer position for the Read DS MI (or Short Read DS MI) and the Read Full DS Buffer Storage commands, respectively.

The occurrence of the Stop Sequence before detection of the cursor or last buffer position may cause an incomplete message to be sent to the channel. Therefore, prior to a Read operation, the byte counter should be set at a value equal to, or greater than, the buffer capacity of the 2260 Display Station.

### Interface Disconnect Sequence

The Halt I/O instruction causes the Interface Disconnect Sequence to be generated by the channel.

This sequence causes the termination of all data and signals between the channel and the 2848 Display Control.

If a write operation is in progress at the occurrence of an Interface Disconnect Sequence, the operation is terminated (Channel End and Device End in the 2848 status byte).

If a read operation is in progress when the Interface Disconnect Sequence is generated, it is not discontinued, but data transmission from the 2848 to the channel, resulting from the read operation, is terminated. The read operation will continue until the cursor or last buffer position is detected, depending on the type of Read command. Following an Interface Disconnect Sequence, the ending sequence and the status of the 2260 display are the same as they would be had the sequence not occurred.

### Selective Reset Sequence

The Selective Reset Sequence terminates the operation being performed by the selected device and places the interface in a Not Selected status. Channel End and Device End are not presented to the channel following the Selective Reset Sequence.

The following describes the effect of the Selective Reset Sequence when it occurs during a read and a write operation.

Read Operation--When the Selective Reset Sequence occurs during a read operation, the operation is terminated when the first complete data byte following the Selective Reset Sequence is read from the 2260 buffer.

Write Operation--When the Selective Reset Sequence occurs during a write operation, data transfer from the channel to the 2260 is terminated. The last complete data byte received is stored in the 2260 buffer.

PROGRAMMING NOTE: Selective Reset cannot be performed through programming.

### System Reset Sequence

The System Reset Sequence occurs when the System RESET switch (System/360 CPU) is operated, when initial program loading is performed, or when the System Power On Sequence is completed. The occurrence of the System Reset Sequence causes the following:

1. The 2848 Display Control Interface is placed in Not Selected condition.
2. The 2848 status and sense bytes are reset.
3. All 2260 Display Station buffers are cleared. The cursor of each 2260 is placed in the first displayable position.

4. All 2260 keyboards are restored.
5. The 1053 Printer buffer is cleared.
6. The type head of the 1053 Printer is returned to the first print position of the next line.

The Ready or Not Ready status of the 1053 Printer is not changed by the System Reset Sequence.

#### Short Control Unit Busy Sequence

The Short Control Unit Busy Sequence sets the Status Modifier and Busy bits in the 2848 status byte. It is initiated by the 2848 under either of the following conditions:

1. The 2848 Interface is busy and the channel attempts to select a device other than the one creating the busy condition.
2. The channel attempts to select the device creating the busy condition and there is neither pending nor stacked status.

If the busy condition is the result of an I/O operation in progress, Control Unit End is presented at the completion of the I/O operation, along with the low-order base address of the 2848. Control Unit End also places the 2848 Interface in Busy status.

NOTE: If command-chaining is being used, or if a Unit Check condition occurred, Control Unit End is delayed until the last command of the chain is performed or until the condition causing Unit Check is cleared.

If the busy condition is the result of a pending Attention or 1053 Device End status, the Control Unit End status bit is included with the status information to clear the control unit busy condition. The address associated with Control Unit End will be that of the 2260 presenting the Attention status or, in the case of Device End status, the address of the 1053.

### SENSE AND STATUS BYTES

#### Sense Byte

The 2848 Display Control sense byte is presented to the channel in response to the Sense command. The sense byte records and provides the channel with information regarding unusual conditions that occurred during the preceding operation. The sense byte is reset by a command other than Text I/O, Sense, or No Op.

Four of the eight bits provided by the sense byte are required by the 2848 to record unusual condi-

tions that occur within the 2260/2848 Display Group. The bits (0-3) and their significance are as follows:

Command Reject (Bit 0)--Bit 0 is set in the sense byte if an invalid command or a command with an invalid modifier bit is presented to the 2848.

This occurs during initial selection sequence.  
Intervention Required (Bit 1)--Bit 1 is set in the sense byte if a Write 1053 Buffer command is given when the 1053 Printer is in a Not Ready status (out of paper or power off). Occurs during initial selection sequence.

Bus Out Check (Bit 2)--Bit 2 is set in the sense byte when a parity error in a command byte or incoming data byte is detected by the 2848. The setting of bit 2 can occur during initial selection or during the performance of the operation.

Equipment Check (Bit 3)--Bit 3 is set in the sense byte if a buffer parity error is detected by the 2848 during a Read DS MI, Short Read DS MI, or Read Full DS Buffer Storage operation. Occurs during the performance of the operation.

#### Status Byte

The status byte is used to relate to the channel the current status of the 2848 Display Control and its attached devices; for example, it may indicate detection of an error, that the 2848 is busy, that the 2848 is ready to accept a command, etc.

The status byte is presented to the channel during initial and ending sequences and is reset upon channel acceptance.

Each of the seven bits of the 2848 status byte is described below:

Attention (Bit 0)--The Attention bit is used to notify the channel that an Enter key on a 2260 keyboard has been pressed. This bit should be program-interpreted to mean that an MI message is waiting to be transferred from the 2260 buffer to the channel.

The Attention bit is set in the 2848 status byte when the Enter key has been pressed at a 2260 and the interface is not busy. If the interface is busy when the Enter key is pressed, the Attention bit is set when the interface reaches a not busy state. The Attention bit places the interface in the Busy status.

Status Modifier (Bit 1)--The Status Modifier bit is set, along with the Busy bit, during a Short Control Unit Busy Sequence.

Control Unit End (Bit 2)--Control Unit End is a delayed response to a Short Control Unit Busy Sequence. Its significance is determined by

accompanying status or, when presented alone, it signifies that the 2848 is free to accept a new command. Control Unit End can occur as the only status, or it can be accompanied by one or two other status bits, as listed below. (The address associated with each Control Unit End status is also defined.)

Control Unit End--Lowest address of the selected 2848.

Control Unit End, Attention--Address of the 2260 generating Attention.

Control Unit End, Busy--Lowest address of the selected 2848.

Control Unit End, Attention, Busy--Address of the 2260 generating Attention.

Control Unit End, Device End--Address of the 1053 Printer.

Control Unit End, Device End, Busy--Address of the 1053 Printer.

Busy (Bit 3)--The Busy bit is set whenever the 2848 Interface is in a busy state. The 2848 Interface is in a busy state from initial selection until Ending status is accepted, or from Attention, 1053 Device End, or Control Unit End set until status is accepted. In the busy state, the 2848 responds with the Short Control Unit Busy Sequence to all channel selections (provided pending status exists), with the exception of a selection of the 2260 Display Station or 1053 Printer that creates the busy state. Then, only a Test I/O command to the device creating the busy state is honored. All other command byte configurations will receive the Busy and current status bits as a status report. Device End is not presented in response to this report.

The Busy bit alone, when presented in response to a Test I/O command to the printer or Write 1053 Buffer Storage command, indicates that the printer buffer contains data. Device End alone is presented when the printer buffer is emptied. (See "Device End", following.)

Channel End (Bit 4)--Channel End is set at the completion of an operation. Channel End, when presented with Device End, indicates that the 2260/2848 Display Complex is free to accept a new command. (See Programming Note 2 following the description of the Write 1053 Buffer Storage command, preceding in this chapter.)

Device End (Bit 5)--Device End, when presented with Channel End following a 2260 command, indicates that the 2260 has completed an operation and is free to accept a command. Device End with Channel End also occurs following a Write 1053 Buffer Storage command, indicating

that data transfer from the channel to the printer buffer has been completed. It does not necessarily indicate that the printer has completed printing. Device End alone is used to signal the completion of printing and will occur in response to a print command, provided a previous print command was issued while the printer was in Busy status (still printing). Device End alone is also used to signal that the printer is ready. It will occur in response to a print command issued after the printer has been readied, provided a previous print command was issued while the printer was in Intervention Required status (not ready). Unit Check (Bit 6)--Unit Check should be program-interpreted to mean that a condition exists or has occurred that requires investigation. Unit Check is set upon occurrence of one or more of the following:

1. Invalid command or command modifier.
2. The presentation of a Write Printer command when the Printer is in a Not Ready condition (out of paper or power off).
3. Detection of a parity error in a command byte or data byte from the channel to the 2848.
4. Detection of a parity error in data being transferred from a 2260 Buffer to the 2848 Interface during a read operation.

The Sense command should be issued in response to a Unit Check. This command causes the 2848 sense byte to be transferred to the channel where a bit analysis of the byte can be performed and the cause of the Unit Check determined. The sense byte is described in "Sense and Status Bytes", preceding in this chapter. The presence of Unit Check in the status byte prohibits setting Attention, Device End, or Control Unit End until the next command to the 2848 (excluding Test I/O and No Op) is completed. This prevents the 2848 Interface from being placed in a busy state before receiving the Sense command.

## INTERRUPTS AND ERROR RECOVERY PROCEDURES

### General

The number of successive errors and retries to be used as a criterion for abandoning an operation is contingent upon the application, the system configuration, and the user. Since the number of error retries may vary from one operation to another, the

program errors routines should be easily changeable. All errors should be recorded.

### Normal Conditional Interrupts

The following explains the conditional interrupts that may occur during normal operation:

1. Channel End and Device End in the Status Byte--Normal end to an I/O operation. Signifies that the command has been completed and that no detectable errors occurred during the operation.
2. Device End alone in the Status Byte--The 2848 and the 1053 Printer are ready and free to perform an operation.
3. Attention in the Status Byte--Depression of an Enter key has been detected at the accompanying 2260 address. This condition should be program-interpreted to mean that an MI message is waiting to be transferred from the 2260 buffer to the channel.
4. Busy in the Status Byte--Indicates that the addressed device is performing an operation. The only command honored under this condition is the Test I/O command to the busy device. Busy status as a response to a Write 1053 Buffer Storage command indicates that the 1053 buffer contains data. When the printer buffer is emptied, Device End (alone) is set in the 2848 status byte. The Write 1053 Buffer Storage command should be reissued as soon as possible after Device End is presented to select the printer before it is again engaged by a display station.
5. Status Modifier and Busy in the Status Byte--This signifies a Short Control Unit Busy Sequence. Commands will not be honored until Control Unit End (alone) or Control Unit End and current status appear in the status byte.
6. Control Unit End can occur alone or with other status bits. Alone, it indicates that the 2848 is free to accept a command. With other status, its significance is determined by the accompanying status bits.

### Error Conditional Interrupts

The following explains the error conditional interrupts that may occur during an operation:

1. Unit Check in the Status Byte--With Command Reject in the sense byte, indicates the detection of an invalid command or command modifier. The command was not performed. When

this occurs, the operation should be terminated and the operator notified.

2. Unit Check in the Status Byte--With Bus Out Check in the sense byte, indicates the detection of a parity error in the command byte. The program should record the required maintenance and diagnostic data. If, after at least one retry, the operation is unsuccessful, it should be terminated and the operator notified.
3. Unit Check in the Status Byte--With Intervention Required in the Sense byte, indicates that the 1053 Printer is in a Not Ready status (power off or out of paper). The operator should be notified. The operation may be aborted or queued until Device End (alone) appears in the status byte, indicating that the 1053 Printer is ready.
4. Channel End, Device End, Unit Check in the Status Byte/Bus Out Check in the Sense Byte--Indicates the detection (by the 2848) of a data byte parity error on the Bus Out lines. If this condition occurs during a Write DS Buffer Storage operation, the Check symbol is substituted for the incorrect data byte, and the operation continues. The Check symbol is displayed on the 2260 Display Station screen. If this condition occurs during a Write 1053 Buffer operation, a quote (") symbol is printed, and the operation is terminated. The quote symbol signals the receipt of an incomplete message. Suggested recovery procedures for the two situations are:  
Write DS Buffer Storage or Write DS Line Address--Issue an Erase DS Buffer Storage command, followed by the Write DS Buffer Storage or Write DS Line Address command.  
Write 1053 Buffer Storage--Reattempt the Write 1053 Buffer Storage command. It may be desirable to indicate that the preceding message was in error and was incomplete.
5. Channel End, Device End, and Unit Check in the Status Byte/Equipment Check in the Sense Byte--Indicates that a buffer parity error was detected by the 2848 during a Read command. If this condition occurred during a Read DS MI or Short Read DS MI operation, a suggested error recovery procedure is to issue an Erase DS Buffer Storage command, followed by a request to the 2260 operator to reenter the message.
6. Incorrect Length (write operations)--The Incorrect Length bit is set on all write operations. The Suppress Length Indication (SLI) flag should be used to suppress the incorrect length condition.

7. **Incorrect Length (read operations)**--The Incorrect Length bit will be set during a read operation if the Channel Byte Counter is at a value that is less than or greater than the number of data bytes received.
8. **Interface Control Check**--This is indicative of an equipment malfunction. Standard error-recovery procedures should be initiated.
9. **Channel Data Check (read operation)**--If a Channel Data Check is detected during a Read DS MI or Short Read DS MI operation, an Erase DS Buffer Storage command should be issued followed by a request to the 2260 operator to reenter the message.
10. **Channel Data Check (write operations)**--If a Channel Data Check occurs during a Write DS Buffer Storage or Write DS Line Address command, an Erase DS Buffer Storage command should be issued and the Write command re-issued.  
  
If a Channel Data Check occurs during a Write 1053 Buffer Storage command, the command should be reattempted. (It may be desirable to indicate that the preceding message was in error and incomplete.)

The 2260/2848 Display Complex operating in a remote environment communicates with the IBM System/360, in half-duplex mode, using four-wire common-carrier facilities, through an IBM 2701 Data Adapter Unit and appropriate data sets. Figure 9 shows the 2260/2848 Display Complex in a remote configuration. Multidrop configurations are also permissible; that is, two or more display complexes can be connected to the same communications lines. A choice of two data set adapters permits data transmission at the rate of 1200 or 2400 bits per second (120 or 240 characters per second). A description of the two data set adapters follows:

Data Set Adapter--9012: permits operation at 1200 bits per second (bps) over common carrier, four-wire, leased private-line telephone service (AT&T Type 3002 Private Line Service with Type C1 conditioning or Western Union Class G Service, with Type C1 conditioning). Western Electric Data Set 202D1 (or equivalent) is used to attach a 2848 Display Control, fitted with Data Set Adapter 9012, to the communications channel. Clocking is provided by the 2848. In World Trade countries, the IBM Type 3977 Model 1 Modem is used where permitted.

Data Set Adapter--9013: permits operation at 2400 bps over common carrier, four-wire, leased private-line telephone service (AT&T Type 3002, Private Line Service with Type C2 conditioning, or Western Union Class G Service, with Type C2 conditioning). Western Electric Data Set 201B1 (or equivalent) is used to attach a 2848 Display Control, fitted with Data Set Adapter 9013, to the communications channel. Clocking is provided by the data set. Data Set Adapter 9013 is not available in World Trade countries (except Canada).

#### 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 channel and the remote display complex. This code, approved by the United States of America Standards Institute (USASI), is a seven-bit code that provides 128 possible characters, of which 71 are used in data exchanges between the System/360 channel and the 2848 Display Control.

Since USASCII is a seven-bit code and all data transmitted or received over the System/360 channel must be of eight-bit structure, it is necessary to modify the USASCII code to an eight-bit structure. This modified version is called USASCII-8. Modification is accomplished by adding an X-bit between bits 5 and 6 of the USASCII code, e. g., 76x54321. The X-bit is always the same as bit 7. For example, the USASCII code for the letter A is 1000001. When modified to an USASCII-8 structure, the letter A is represented as 10100001.

USASCII-8 is used only within the channel and for data transmission between the channel and the 2701. Data transmission between the 2701 and 2848 is in USASCII. The 2701 converts USASCII-8 to USASCII for transmission to the 2848. Conversely, the 2701 converts USASCII to USASCII-8 for transmission to the channel.

The 71 USASCII characters used in data exchanges between the channel and the 2848 are shown in Figure 10. The characters are shown in USASCII-8 structure. A USASCII-8 to hexadecimal code conversion chart appears in a later section of this manual.

#### BLOCK DIAGRAM ANALYSIS

As an aid to understanding the operation of the remote 2260/2848 Display Complex, the function of the 2701 Data Adapter Unit (DAU) and the data sets shown in Figure 9 are described below. Data flow through the display system itself, with the exception of the code structure used, is the same as that given in the Data Flow Diagram Analysis of the display system found in Figure 5 under "Principles of Operation--Local Application."

#### IBM 2701 Data Adapter Unit

The IBM 2701 Data Adapter Unit (DAU) serves as a data buffer, data converter, and synchronizer. The 2701 also provides the channel with 2848 Display Control status and sense information through the 2701 status and sense registers.

Data transferred from the channel and intended for the 2848 Display Control is received by the 2701 DAU in data bytes of USASCII-8 code structure. The 2701 converts each USASCII-8 data byte to USASCII (seven bits) and places it in a transmit adapter (XA) register for transfer to the 2848. The

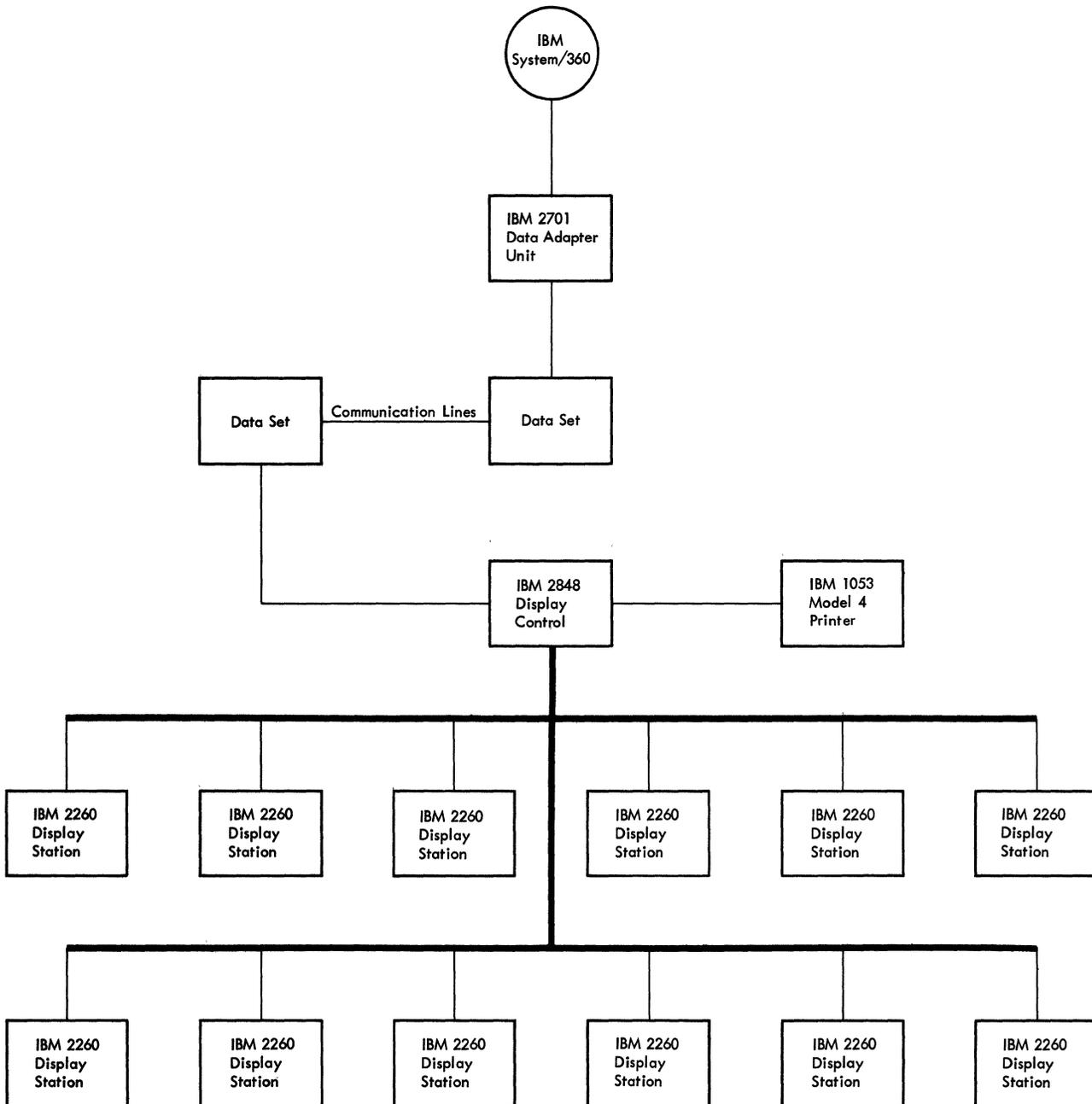


Figure 9. Remote Display Complex Configuration

2701 transfers the seven bits of the USASCII character serially (one bit at a time) to the 2848. The seven bits are preceded by a Start bit and followed by a Vertical Redundancy Check (VRC) bit and a Stop bit. The Start, VRC, and Stop bits are developed by the 2701 and accompany the seven bits of every USASCII character transmitted to the 2848 in the order shown in Figure 11. The data received from the 2848 is also in the same ten-bit format. All ten bits are of the same signal length and are

transmitted at the speed (1200 or 2400 bps) specified by the data set adapter and data sets used. The ten-bit format which every character transmitted between the 2701 DAU and 2848 assumes is illustrated in Figure 11.

NOTE: For additional information pertaining to the IBM 2701 Data Adapter Unit, refer to IBM Component Description, IBM 2701 Data Adapter Unit, Form A22-6864.

Bits	B7 → B6 → Bx → B5 →				Col	0	1	2	3	4	5	6	7
	B4	B3	B2	B1	Row								
	0	0	0	0	0	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	S
	0	1	0	0	4	EOT			\$	4	D	T	T
	0	1	0	1	5		NAK	%	5	E	U	E	U
	0	1	1	0	6	ACK			&	6	F	V	V
	0	1	1	1	7				'	7	G	W	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	10	LF		*	:	J	Z	J	Z
	1	0	1	1	11			+	;	K		K	
	1	1	0	0	12			,	<	L		L	
	1	1	0	1	13			-	=	M		M	
	1	1	1	0	14			.	>	N		N	
	1	1	1	1	15			/	?	O	-	O	-

USASCII-8 is converted to USASCII by deleting bit X.

Note 1. Displayed on 2260's as the EOM (■) symbol. Prints on the 1053 Model 4 Printer as the exclamation mark (!).

Note 2. Displayed on 2260's as the Check (■) symbol. Prints on the 1053 Model 4 Printer as the quote symbol (").

Note 3. Displayed on 2260's as the New Line (▲) symbol. Causes a carriage return and line feed on the 1053 Model 4 Printer.

Note 4. Displayed on 2260's as the Start MI (▶) symbol. Prints on the 1053 Model 4 Printer as a cent sign (¢).

Note 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 2848 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 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 channel.

Figure 10. USASCII-8 Code Set

Seven Bits of  
USASCII Data Byte

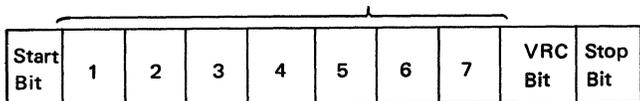


Figure 11. Ten-Bit Format of Transmitted USASCII Characters

Data Sets

Data sets, also known as subsets or modems (a contraction of modulator-demodulator), are used at each termination of the communications lines and provide the necessary compatibility between the 2701 Data Adapter Unit, 2848 Display Control, and the communications facilities. The basic function of the data sets is modulation and demodulation of 2701 and 2848 signals for data transmission.

USASCII COMMUNICATIONS CONTROL CHARACTERS

To establish and maintain an orderly flow of traffic over communications lines, particularly in multi-drop applications (where more than one 2848 is attached directly to the same line), a method of controlling line traffic is necessary. Line traffic between the System/360 channel and the remote display system is controlled by the use of six of the USASCII communications control characters. These six codes, used singly or in sequences, perform all the control functions necessary to establish and maintain an orderly flow of traffic between the channel and I/O devices attached to the communications lines.

In addition to the six USASCII communications control characters, a USASCII format effector (LF) and a USASCII control character (CAN) are used in data transmissions between a remote display complex and the channel.

The definition of each of these eight USASCII characters is given below. The code structure for each is given in Figure 10. For a detailed description of each (when it is used, and its significance and interpretation), see "Summary of Sequences and Responses", following in this chapter.

STX (Start of text)--A communications control character which precedes a sequence of characters which is to be treated as an entity. This entity will usually be terminated by ETX.

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

CAN (Cancel)--A control character used to indicate that the data with which it is sent is in error. The CAN control character is transmitted, following text and before ETX, if a buffer parity error is detected by the 2848 Display Control during transmission. CAN is transmitted only by the 2848.

ACK (Acknowledge)--A communications control character transmitted by a receiver as an affirmative response to the sender.

NAK (Negative acknowledge)--A communications control character transmitted by a receiver as a negative response to the sender.

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

EOT (End of transmission)--A communications control character used to indicate the conclusion of a transmission which may have contained one or more texts and any associated heading (addresses). EOT is also used, instead of SOH, as the first byte of the addressing sequences in the Specific Poll, General Poll, and read operations.

LF (Line feed)--The LF is a format effector and should be included only as part of text (message). The LF character causes the New Line symbol to be displayed and the cursor of the selected 2260 Display Station to move to the first display position in the next display line. If the cursor is in the bottom line, it will be caused to move to the first display position of the top line. If more than four consecutive LF's are sent to a selected 2260, loss of data may result. The LF character received by the channel from the 2848 Display Control indicates that less than a complete line is being transmitted and that the following data byte is the first character of the next 2260 display line.

2848 DISPLAY CONTROL MODES OF OPERATION

A remote 2848 Display Control operates in two modes. These modes, control and text, are described below.

Control Mode

Control mode is the mode in which the 2848 Display Control is placed preparatory to receiving an addressing sequence or control data. The 2848 enters control mode, while in selected or nonselected status, upon receipt of transmission of an SOH, EOT, or ETX control character. Receipt of an STX control character by a 2848 in selected status switches that 2848 from control mode to text mode.

Text Mode

Text mode is the mode in which a 2848 Display Control is placed while it is receiving or transmitting text data. The 2848 enters text mode, while in selected status only, upon receipt or transmission of an STX control character. (Read command addressing sequence or positive response to a Poll command.) Receipt of an ETX, EOT, or SOH control character switches the 2848 from text mode to control mode.

In a multidrop application, only one 2848 can be in text mode at a given time.

**ADDRESSING SEQUENCES**

Each command issued by the channel to the remote display complex is transmitted to the 2848 Display Control in four sequential bytes of a definite format, called an addressing sequence. The addressing sequence places the 2848 in control mode, defines the address of the 2848 and 2260 or 1053 Printer, and specifies the operation to be performed.

The addressing sequences for each command are given in Figures 14 through 21.

The following describes the specific function of each of the four bytes of the addressing sequences.

First Byte--The first byte of an addressing sequence must be either an SOH or EOT communications control character. The SOH or EOT communications control character places the 2848 Display Control in control mode, Non-Selected status.

Second Byte--The second byte in the addressing sequence contains the address of the 2848. Any configurations of the USASCII-8 code, except configurations in which bit positions 6 and 7 are zero, may be assigned the 2848. This structure provides 96 possible addresses, any one of which may be assigned as the address of the 2848.

Third Byte--The third byte contains the address of the device (2260 DS or 1053 Printer) to be selected. Device addresses are assigned in consecutive order, starting at 10100000. Figure 12 illustrates address assignments for 24 2260 Display Stations and a 1053 Printer (the maximum number of devices that can be attached to a Model 1 2848 Display Control). Note that bit position 7 is a 1-bit. This is necessary to prevent a 2260 or 1053 Printer address from being interpreted as a USASCII communications control character.

Fourth Byte--The fourth byte of an addressing sequence specifies the command to be executed by

Address Byte (USASCII-8)								Device Number (2260 Display Station or 1053 Printer)*
7	6	X	5	4	3	2	1	
1	0	1	0	0	0	0	0	Device 1
1	0	1	0	0	0	0	1	Device 2
Continued Sequentially								
1	0	1	0	1	1	1	1	Device 16
1	0	1	1	0	0	0	0	Device 17
Continued Sequentially								
1	0	1	1	1	0	0	0	Device 25

\*The 1053 Printer must be the highest addressed device.

Note:

Bit positions 7 and X must be 1 bits.

Figure 12. Typical Remote Device Address Assignments

the selected 2848 Display Control and 2260 Display Station or 1053 Printer.

Each of the four bytes of every addressing sequence is parity-checked by the 2848 as it is received. The address bytes are also checked for address validity, and the command byte is checked for command validity.

To maintain operational continuity, the 2848 must respond to an addressing sequence within 2 seconds after the addressing sequence is transmitted to the 2848. Failure to respond (no response) results in a 2701 line timeout condition. (See "2701 Timeouts" in "Channel Sequences and Responses" under "Principles of Operation--Remote Application." Also see description of No Response under "Summary of Sequences and Responses", following in this chapter.)

The 2848 response to an addressing sequence depends on the nature of the command and conditions at the 2848 and selected device. The various 2848 responses to an addressing sequence are shown in Figures 14 through 21 and described in "Summary of Sequences and Responses", following.

**COMMANDS AND COMMAND OPERATION**

The remote display system equipped with Keyboard, Line Addressing, and Printer features can execute eight commands. These commands, their USASCII-8 bit structure, and the feature required (if any) to enable command execution are shown in Figure 13.

Command	USASCII-8 Code Structure								Feature Required
	7	6	X	5	4	3	2	1	
Specific Poll — 2260	0	1	0	0	0	0	0	0	Keyboard Feature
Specific Poll — Printer	0	1	0	0	0	0	0	0	Printer Feature
General Poll*	0	1	0	0	0	0	0	0	Keyboard Feature or Printer Feature
Read Addressed Full DS Buffer	0	1	0	1	0	0	0	0	
Write 2260	1	0	1	0	0	0	0	0	
Write Printer	1	0	1	0	0	0	0	0	Printer Feature
Line Address Write	1	0	1	1	0	0	0	0	Line Addressing Feature
Erase/Write	1	1	1	0	0	0	0	0	

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

Figure 13. 2260/2848 Commands (Remote)

The operation of each command is controlled and monitored by exchanges, between the channel and the 2848 Display Control, of a single USASCII communications control character or a sequence of characters of which one (or more) is a USASCII communications 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 complex, and the program. The sequence/response diagrams (Figures 14 through 22) illustrate the possible sequences and responses that may occur during each operation. Each figure is divided vertically by a broken line. The sequences and responses to the left of the line represent those that may be transmitted by the channel to the 2848. The sequences and responses to the right of the line represent those that may be transmitted by the 2848. The heavy lines depict the sequences and responses that normally occur during each operation; the lighter line indicates other possible responses and sequences. For example, in the Specific Poll operation (Figure 14), the addressing sequence is initiated, and the 2848 responds with a transmission sequence (STX, device address, text, ETX, and LRC). Upon receipt of the transmission sequence, the channel responds with ACK, indicating correct receipt of the transmission sequence. The 2848 responds to ACK with EOT, and the operation is concluded. As determined by the program, the channel, instead of responding to the transmission sequence with ACK, could respond with one of the following:

- NAK
- SOH
- EOT
- STX, EOT
- 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 normally occur (as shown in Figures 14 through 22) and descriptions that are necessary to explain each operation. All sequences and responses are described under "Summary of Sequences and Responses", following in this chapter.

#### Specific Poll to a 2260 Display Station

The Specific Poll, when directed to the 2260 Display Station (Figure 14), tests for the presence of a manually entered message awaiting transfer to the channel. If a message is pending, the Specific Poll command causes the message to be transferred to the channel.

The Specific Poll command to a 2260 causes the 2848 to sample the Enter key at the selected 2260. If the Enter key has been pressed, the 2848 transmits the STX line control character, the address of the selected 2260, and all the character data displayed between the Start symbol and the cursor; however, it does not transmit data between an NL symbol and the end of the display line containing the symbol. The message data is followed by the ETX line control character and an LRC byte. The CAN character is transmitted following the text and prior to ETX only if a buffer parity error is detected during the transmission. If a Start symbol is not present on the display, the STX is followed by the device address, ETX, and LRC.

Upon receipt of the transmission sequence, the channel responds with ACK, indicating to the 2848 that the message was received correctly. The ACK response causes the Start symbol to be erased from the screen of the selected 2260 and the keyboard to be restored. The 2848 responds to ACK with EOT, and the operation is concluded.

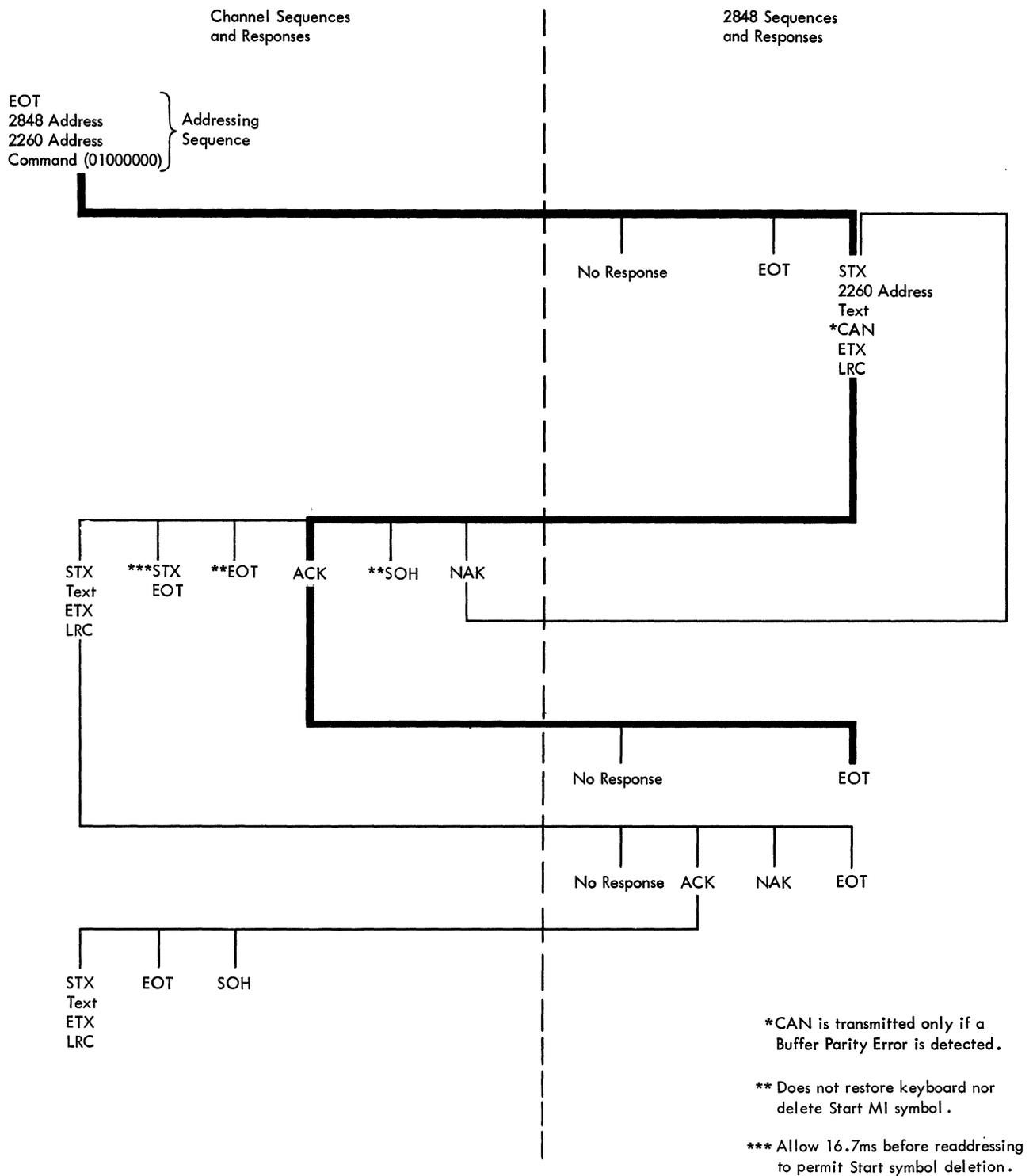


Figure 14. Sequence/Response Diagram--Specific Poll to 2260 DS

The 2848 will respond to the Specific Poll addressing sequence with EOT if the Enter key of the selected 2260 has not been pressed.

All responses that can occur during a Specific

Poll to a 2260 operation are shown in Figure 14. Each is explained under "Summary of Sequences and Responses", following.

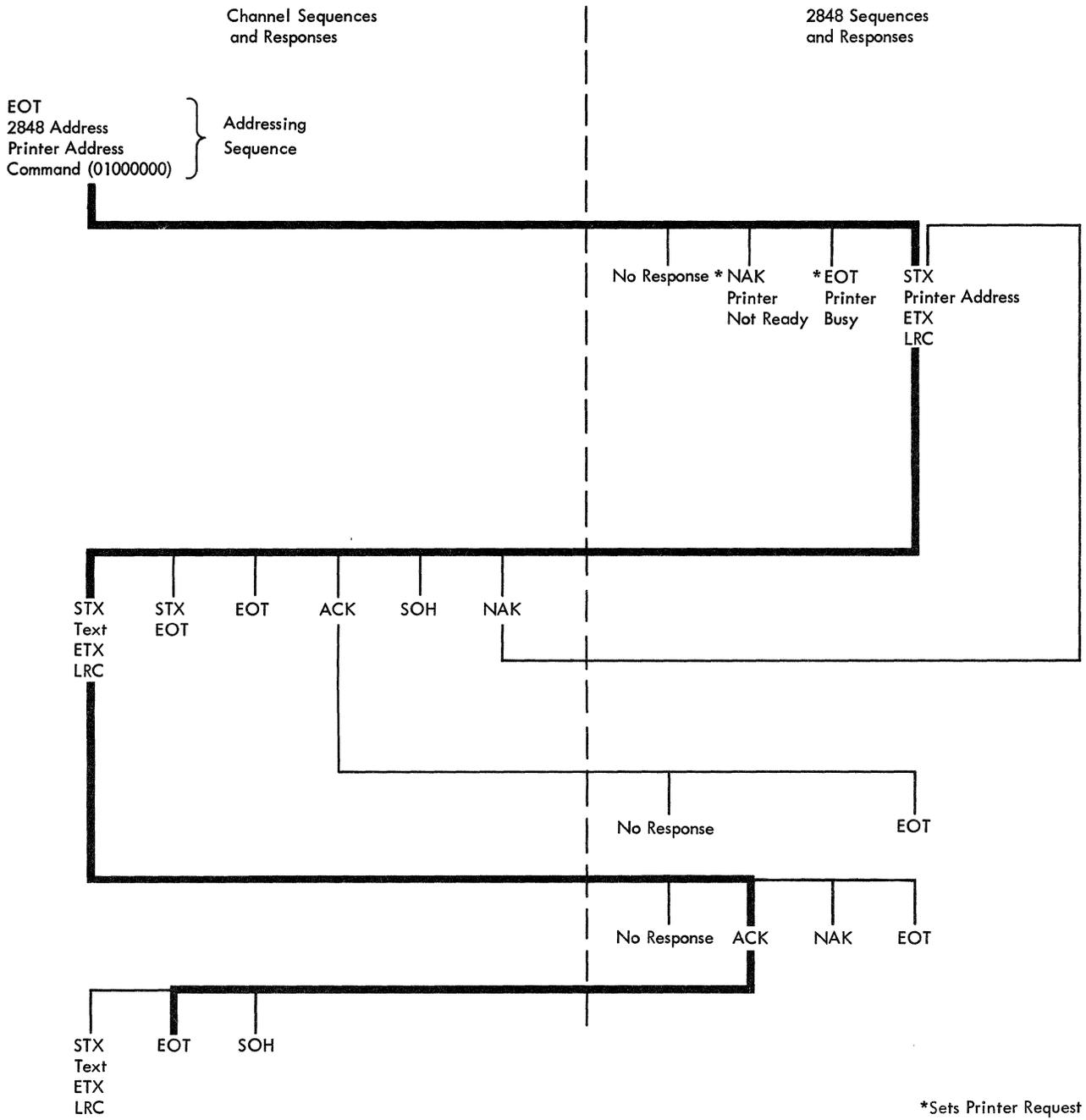


Figure 15. Sequence/Response Diagram--Specific Poll to Printer

Specific Poll to the 1053 Printer

The Specific Poll Sequence (Figure 15), when directed to a 1053 Model 4 Printer, causes the 2848 Display Control to test the readiness and busy status of the Printer and to respond accordingly.

Three 2848 responses to the Specific Poll Sequence provide the channel with the Busy and Ready status of the Printer:

NAK--The NAK response from the 2848 indicates that the Printer is not ready. The 2848, upon responding with NAK, also sets Printer Request (described under Printer Request Condition).  
EOT--The EOT response from the 2848 indicates that the Printer is busy. The 2848, upon responding with EOT, also sets Printer Request (described under "Printer Request Condition", following in this chapter.)

STX, Printer Address, ETX, LRC Byte--This sequence response from the 2848 indicates to the channel that the Printer is ready and free to accept a message. Subsequent action is determined by the program. Normal channel response will be an STX communication control character, the message (text) to be printed, an ETX communications control character, and the LRC byte. This response (and all other possible responses) is shown in Figure 15 and explained under "Summary of Sequences and Responses", following.

### General Poll

The General Poll command (Figure 16) causes the 2848 to test each 2260 Display Station for the presence of a manually entered message pending transfer to the channel. If one or more messages are present and the Enter key(s) is pressed, the message or messages are transferred to the channel. Each message is accompanied by the address of the 2260 from which it originated.

If the Printer Feature is installed, the General Poll also determines Printer Request status. Printer Request is set as a result of a previous attempt to select the Printer while it was busy or not ready (see "Printer Request Condition", following).

Upon receipt of the General Poll sequence, the 2848 first tests the Printer Request condition. If Printer Request is not set, polling of the 2260's is performed.

The 2848 tests the Enter key circuit of each attached 2260. Upon detection of a depressed Enter key, the 2848 responds with the following transmission sequence:

STX  
2260 DS address  
Text (message between Start symbol and cursor)  
ETX  
LRC byte

The text will contain all the character data (except data on the same line as, and to the right of, a New Line code) displayed between the Start symbol and the cursor. The CAN character is transmitted following the text and prior to ETX if a buffer parity error is detected by the 2848 during the transmission.

Upon completion of the message transfer, the channel responds with ACK, and the General Poll continues until all 2260's have been polled and pending messages have been transferred. When this occurs, the 2848 responds with EOT, indicating that no further messages are awaiting transfer, and that the operation is concluded.

The following describes the General Poll operation as it occurs when the Printer Request condition is set.

As previously stated, the 2848, upon receipt of the General Poll, first tests the Printer Request condition. If Printer Request is set, the 2848 tests the Ready and Busy status of the 1053 Printer. If the Printer is busy or not ready, the 2848 continues the General Poll, as described in the preceding paragraphs. If the Printer is ready and not busy, the 2848 responds with the following sequence:

STX  
Printer address  
ETX  
LRC byte

Receipt of this sequence indicates to the channel that the Printer is ready and free to receive a message. Normal channel response to this sequence will be the following transmission sequence to the 2848, containing the message to be printed:

STX  
Text (message to be printed)  
ETX  
LRC byte

Upon completion of data transfer to the printer buffer, the 2848 responds with ACK. The General Poll was terminated by the STX line control character which preceded the message to be printed. To poll the 2260's, the General Poll must be re-initiated.

PROGRAMMING NOTE: If, at any time during the General Poll operation, the channel responds with STX, EOT, or SOH, the General Poll is terminated.

### Read Addressed Full DS Buffer

The Read Addressed Full DS Buffer command (Figure 17) causes all character data stored in the buffer of the selected 2260 Display Station to be transferred to the channel in the following sequence:

STX  
Address of the selected 2260 DS  
Text (all character data displayed except non-destructive cursor)  
ETX  
LRC byte

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

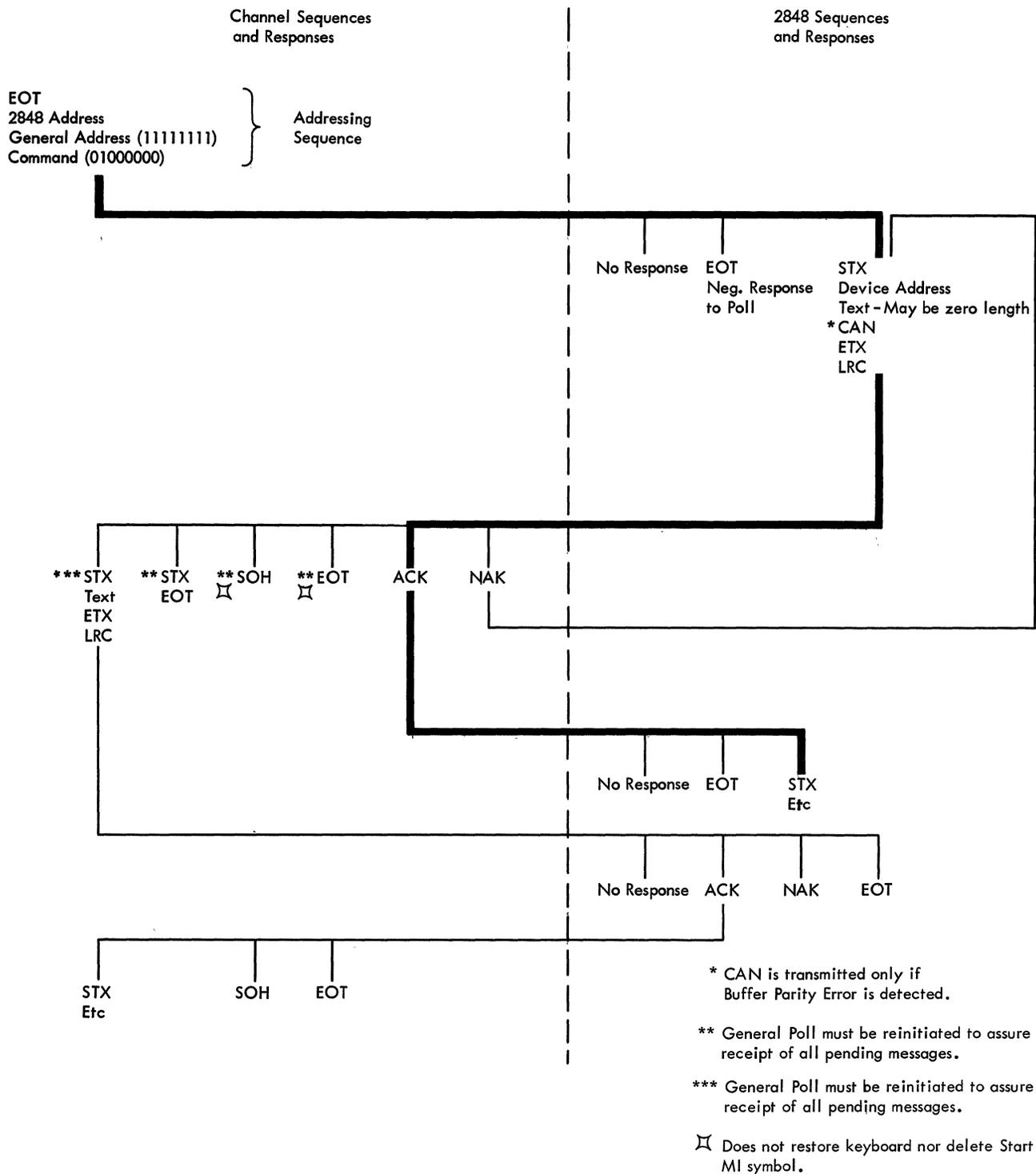


Figure 16. Sequence/Response Diagram--General Poll

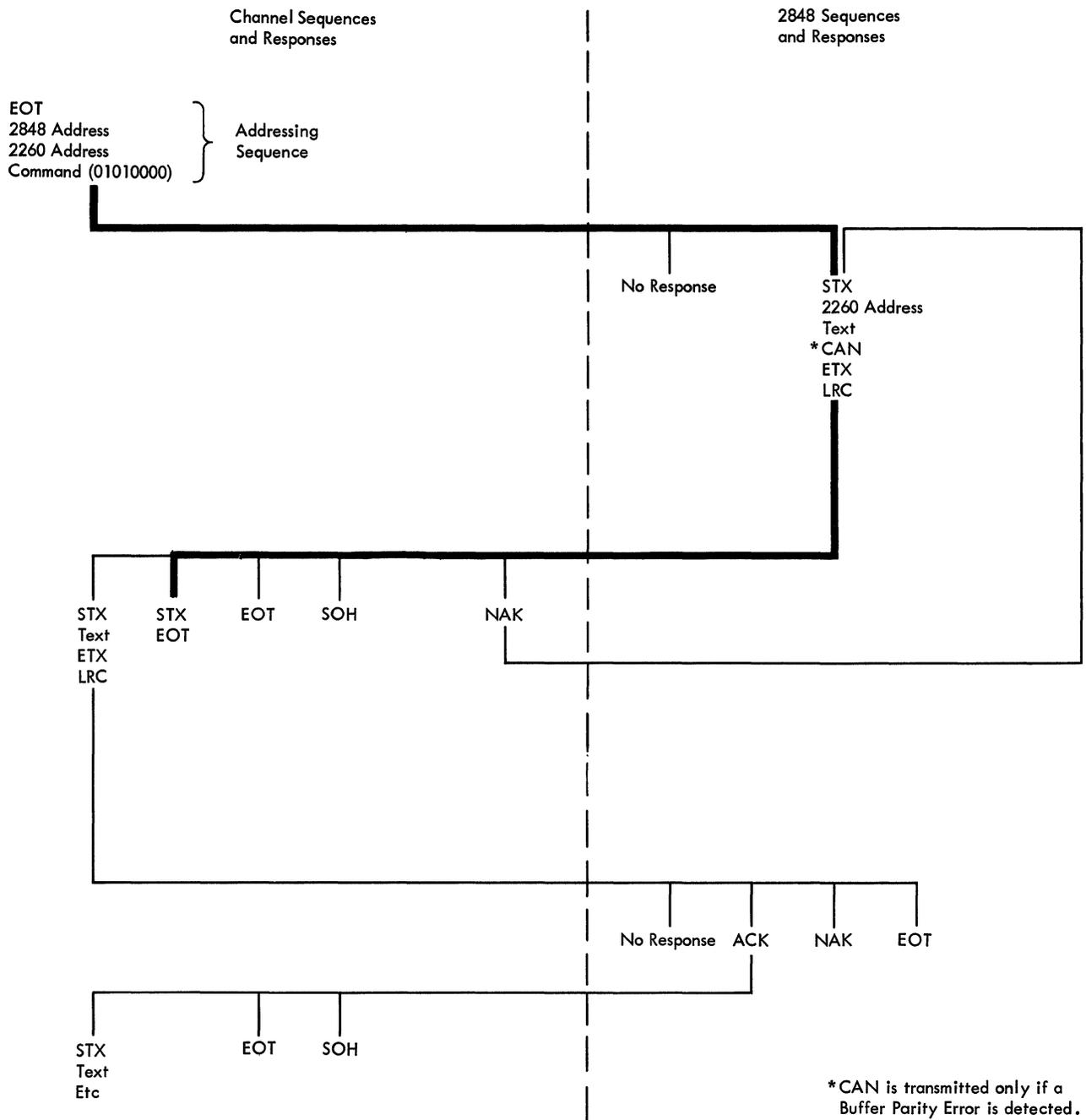


Figure 17. Sequence/Response Diagram--Read Addressed Full DS Buffer

Included among the characters transferred, if they are displayed, are Check symbols, Start symbol, NL symbols, and the destructive cursor (EOM symbol). The nondestructive cursor is not transferred.

The normal channel response to the receipt of the transmission sequence will be STX/EOT, indicating to the 2848 that the message sequence was received correctly. The cursor is "effectively"

placed in the first displayable position (upper-left corner) of the screen at the end of the Read Full Buffer operation.

If a parity error is detected by the 2848 during transmission of the message from the selected 2260 to the channel, the 2848 transmits the CAN control character following the text. The sequence is as follows:

STX  
2260 DS address  
Text (message)  
CAN (indicates detection of a parity error by the 2848)  
ETX  
LRC byte

The CAN control character indicates to the channel that a buffer parity error was detected by the 2848 in the preceding message (note that the character in error is assigned correct parity by the 2848 before it is transmitted to the channel). Subsequent channel response to the CAN line control character is determined by the program.

If an error was detected (by the channel) in the message as it was being received, a NAK response from the channel causes the 2848 to retransmit the message.

**PROGRAMMING NOTE:** Following a Read Addressed Full DS Buffer operation, the next character entered in the buffer of the selected 2260 will cause a second cursor (EOM) symbol to appear on the 2260 screen. (This does not occur if the 2848 is equipped with the Nondestructive Cursor feature.)

Thus, an Erase/Write DS Buffer Storage command should be issued to the selected 2260 immediately following a Read Addressed Full DS Buffer operation. In lieu of the Erase/Write DS Buffer Storage command, the keyboard Erase key can be used, or the original EOM symbol can be overwritten. Operation with two EOM symbols is not defined.

### Write Addressed DS

The Write Addressed DS command is used to transfer data from the channel for presentation on the screen of the selected 2260 Display Station.

Upon receipt of the Write Addressed DS addressing sequence, the 2848 Display Control responds with ACK (Figure 18). The ACK response indicates that the 2848 and addressed 2260 are selected and ready to receive the message. Upon receiving the ACK response, the normal channel response is the following transmission sequence containing the message to be written on the screen of the selected 2260:

STX  
Text (message to be written)  
ETX  
LRC byte

The 2848 receives the character data contained in the message in bit-serial form (ten bits for every character). (See Figure 11.) The 2848 assembles the seven USASCII bits that form a character. The Start and Stop bits perform control functions, and the VRC bits are used for parity checking only.

These bits are not assembled as part of the USASCII character.

The assembled USASCII characters are parity-checked, converted to video data, and placed in the buffer of the selected 2260 at the location indicated by the cursor. Upon entering buffer storage, the character is displayed on the screen of the selected 2260. The cursor automatically advances to the next displayable position as character data is placed in buffer storage and displayed on the screen.

**PROGRAMMING NOTE 1:** If a message length exceeds the displayable positions on the screen, a screen wraparound condition occurs. That is, the message data that exceeds the displayable positions replaces previously written data, beginning at the first displayable position.

If a parity error is detected by the 2848 during the transmission sequence, a Check symbol is displayed in place of the character in error.

Upon receipt of the ETX line control character, indicating the end of text, and the LRC byte, the 2848 performs an LRC accumulation check by comparing the LRC byte with the accumulated LRC. If the LRC byte agrees with the accumulated LRC and no parity errors were detected during the operation, the 2848 responds with ACK. The ACK response indicates to the channel that the message was received correctly. Subsequent channel response is determined by the program (Figure 18).

The NAK line control character is transmitted by the 2848, in response to the transmission sequence, if one or both of the following conditions occur during the write operation:

1. A parity error is detected by the 2848 during receipt of the message (also indicated at the 2260 by a Check symbol being displayed in place of the character in error).
2. A disparity exists between the LRC byte and the accumulated LRC.

The NAK response indicates to the channel that an error was detected during the operation. Subsequent action is determined by the program.

**PROGRAMMING NOTE 2:** On the 2400 bits-per-second remote interface adapter, when a write command is issued to a 2260 while any 2260 is executing a keyboard print command, overrun might occur in the 2848 remote interface. Overrun, the condition whereby the remote interface cannot accept data as rapidly as it is received, results in the loss of write data at the interface. It might occur if more than four successive lines of the 2260 display have an NL symbol in the first character position.

### Write Printer

The Write Printer command is used to transfer data from the channel to the 1053 Printer buffer.

The Write Printer addressing sequence (Figure 19) causes the 2848 Display Control to test the Ready and Busy status of the 1053 Printer. If the Printer is operational and not being used, the 2848 responds with ACK. In response to ACK, the fol-

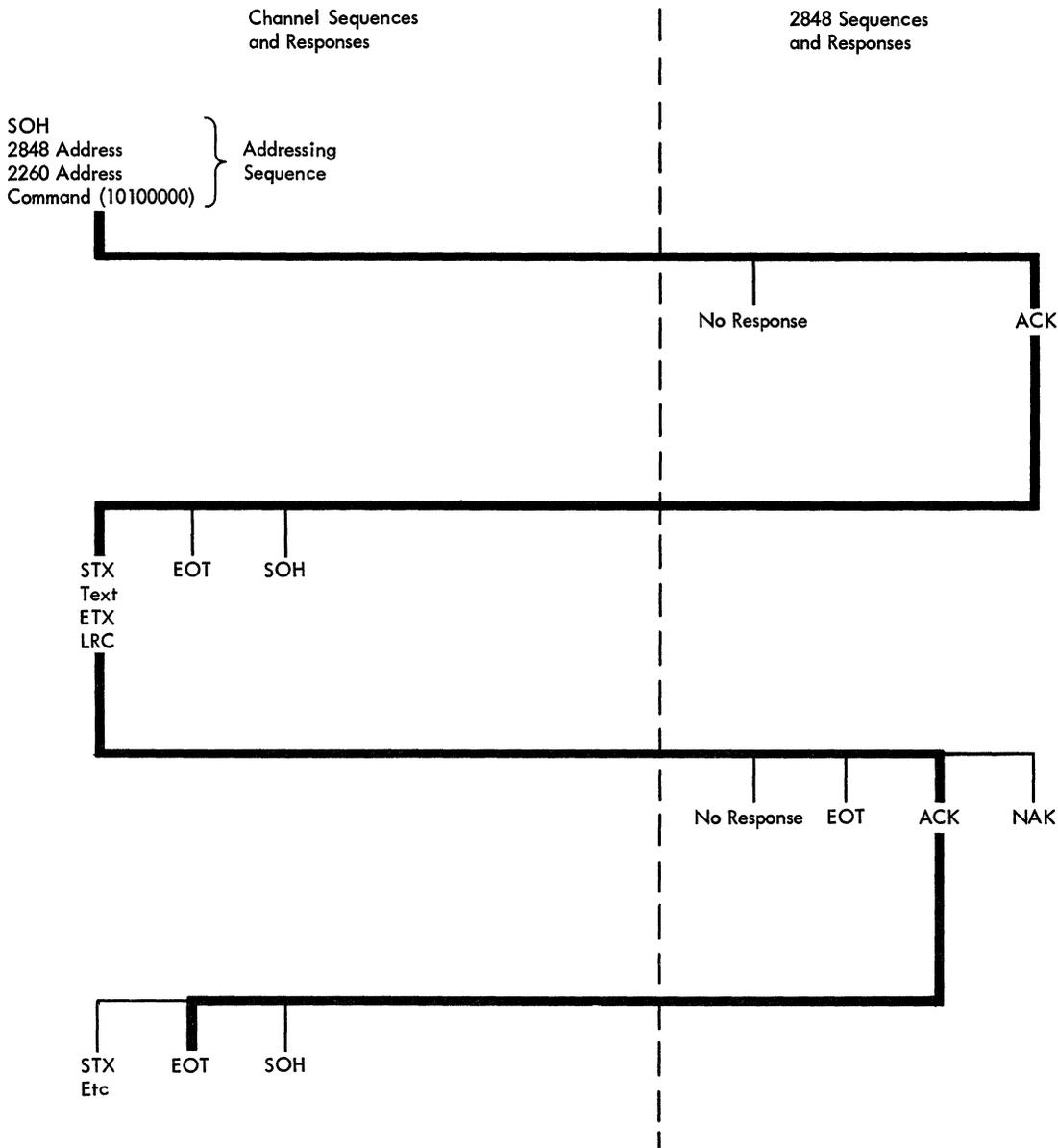


Figure 18. Sequence/Response Diagram--Write Addressed DS

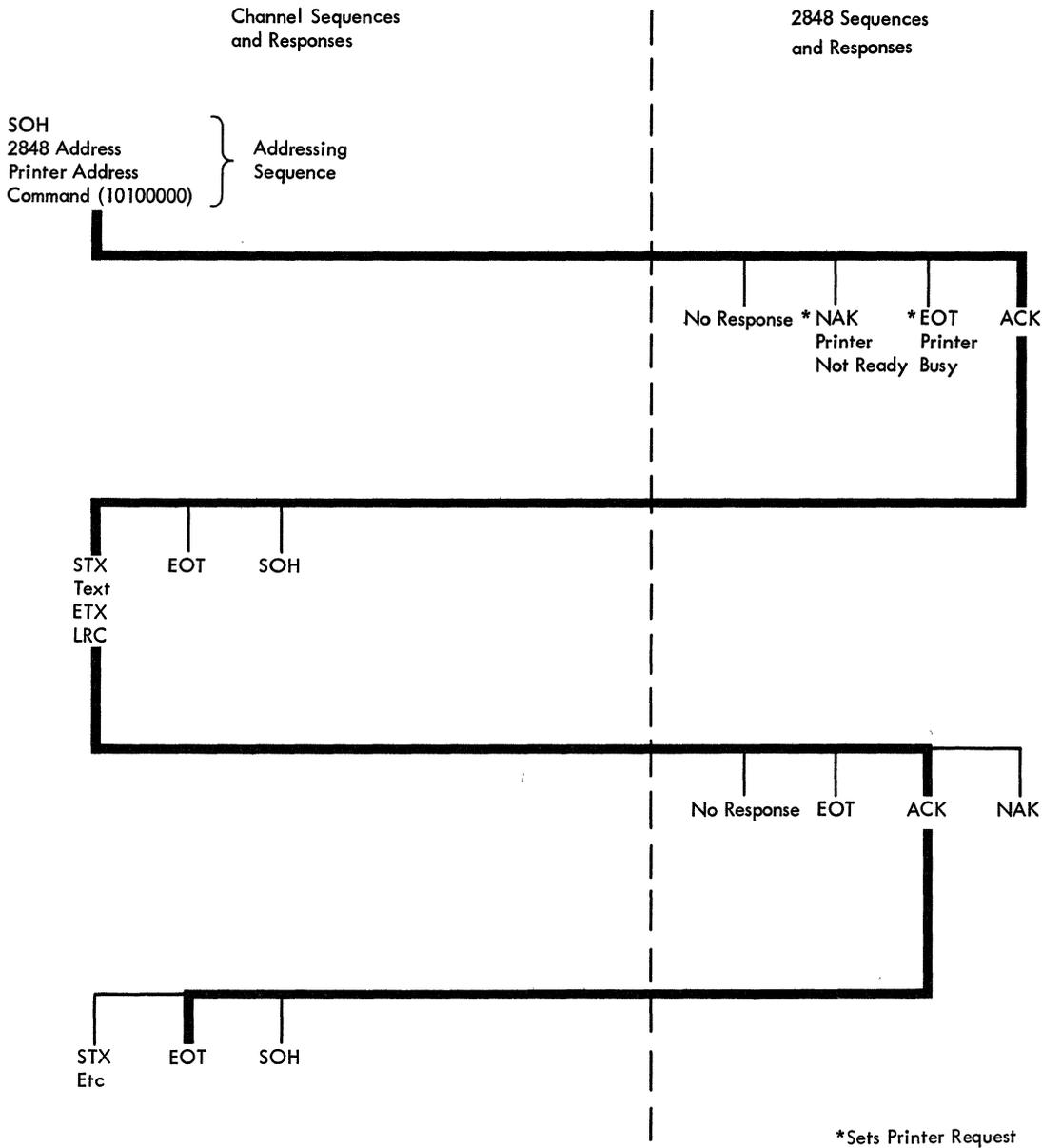
Following transmission sequence containing the message to be printed is transmitted by the channel:

- STX
- Text (message to be printed)
- ETX
- LRC byte

The 2848 receives the character data of the message in bit-serial form (ten bits for every character; Figure 11) and assembles the seven USASCII bits that form a character. The start and stop bits perform control functions and are not part of the character.

The assembled USASCII characters are parity-checked, converted to the Tilt-and-Rotate code used by the 1053 Printer, and placed in the printer buffer along with the required shift characters. The printer begins printing upon receipt of the first character in the 1053 Buffer Storage.

Upon receipt of the ETX line control character, indicating the end of text, and the LRC byte, the 2848 performs the LRC accumulation check by comparing the LRC byte with the accumulated LRC. If the LRC byte agrees with the accumulated LRC, the 2848 responds with ACK. The ACK response from the 2848 indicates to the channel that the message was received correctly.



● Figure 19. Sequence/Response Diagram--Write Printer

An EOM code should be transmitted as the last character of each complete message, to ensure separation of messages. The EOM code causes an exclamation mark to be printed and the print mechanism to be advanced to the first print position of the next line. A New Line (NL) code should be used as the first character of a message when additional separation between messages is desired. The NL code also causes the print mechanism to be advanced to the first print position of the next line. Unlike the EOM code, however, the NL code does not cause a character to be printed.

If, during transmission of the message, the 2848 detects an error or the printer storage capac-

ity is exceeded (see Programming Note, following), the following occurs:

1. The 2848 causes the printer to print a quote (") symbol. The quote symbol is the last character printed and indicates an incomplete message.
2. Printing is discontinued, the type head is restored to the first print position, and the Printer advances to a new line.
3. The 1053 Printer buffer is cleared.
4. Data will continue to be transferred until the end of the message (ETX), but the data is not placed in the 1053 buffer.

5. Upon receipt of the ETX and the LRC byte, the 2848 responds with the EOT line control character, indicating to the channel that a parity error was detected in the message or that a buffer overrun condition occurred. Channel response to the EOT line control character is determined by the program error routine.

PROGRAMMING NOTE: The 1053 Buffer Storage accepts characters up to its capacity of 1223, including control and shift characters. When Printer Buffer Storage capacity is exceeded (buffer overrun), the print operation is immediately terminated.

### Printer Request Condition

The Printer Request condition is a means of indicating to the 2848 Display Control that the channel has a message for transmission to the 1053 Printer. Printer Request is set as a result of an attempt (by channel) to use the Printer while it is busy or not ready (out of paper or power off).

The Printer Request condition is set by an NAK or EOT response from the 2848 to a Specific Poll or Write Printer sequence.

The Printer Request condition causes the 2848, upon receipt of a General Poll sequence, to test the Printer ready and busy status. If the printer is ready and not busy, the first transmission sequence to the channel in response to the General Poll is the following:

```
STX
Printer address
ETX
LRC byte
```

This sequence indicates to the channel that the printer is ready and free to receive a message.

The Printer Request prevents the transfer of messages from the 2260 Display Station to the Printer until the Channel replies to the Printer Available sequence. The next successfully completed addressing sequence to the 2848 following the Printer Available sequence cancels Printer Request.

If the printer is still not ready or is still busy when the General Poll sequence causes the 2848 to test the printer status, the Printer Request condition is unchanged.

### Write DS Line Address

To accept and execute the Write DS Line Address command, the 2848 Display Control must be equipped with the Line Addressing feature.

The Write DS Line Address command combines

the Write DS Buffer Storage command with line selection capabilities, thus enabling the selection of a particular line on the display as the beginning line of a message.

The Write DS Line Address command causes the cursor of the selected 2260 Display Station to be positioned in the first displayable position of the specified line. The line address is specified by the first character following the STX line control character (Figure 20). Subsequent message data (text) is displayed beginning at the line indicated by the cursor.

The Write DS Line Address command provides for the selection of up to 12 line addresses (the maximum number of display lines on 2260's attached to a Model 2 or Model 3 2848 Display Control). Since 2260's attached to a Model 1 2848 display only six lines, line addresses numbering more than six should not be used in a display complex controlled by a Model 1 2848.

With the exception of the command sequence and the positioning of the cursor, the Write DS Line Address command operates the same as the Write DS Buffer Storage command. All sequences and responses, other than those specified above, that apply to the Write DS Buffer Storage operation apply also to the Write DS Line Address operation.

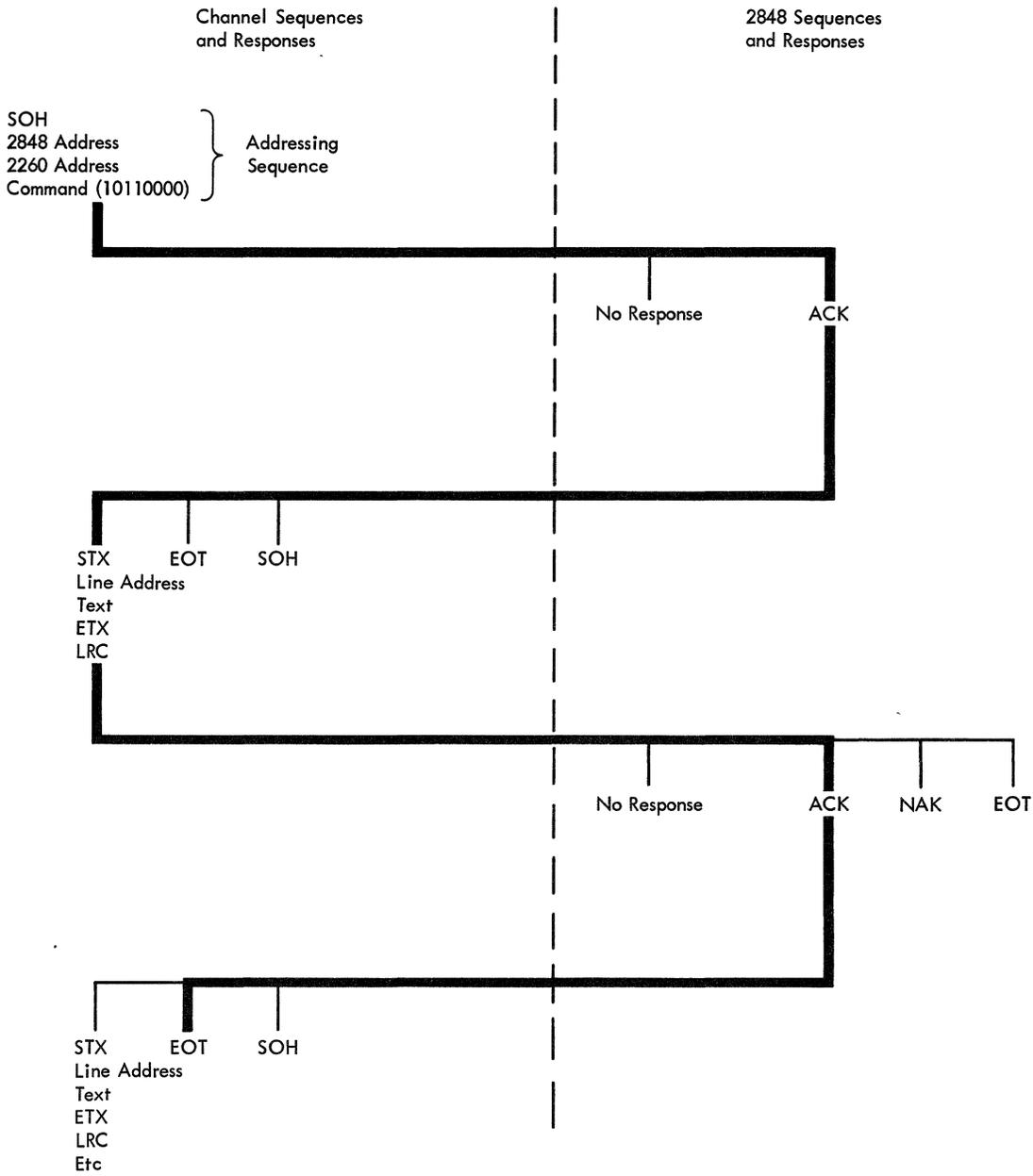
Figure 21 lists the 12 possible line addresses and the USASCII-8 bit format for each. (Only the data byte formats listed in Figure 21 should be used to select display lines. Any other format may address an unspecified line which can vary from machine to machine.)

### Erase/Write Addressed DS

The Erase/Write command sequence is essentially an Erase command combined with a Write sequence.

The Erase/Write command causes the 2848 Display Control to erase the message displayed on the screen of the selected 2260 Display Station and causes the cursor to be positioned in the first displayable 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 2260, beginning at the first displayable position.

Normal 2848 response to the Erase/Write addressing sequence is ACK. The ACK line control character indicates to the channel that the screen of the selected 2260 is erased and that the cursor is in the first displayable position. Channel response to ACK may be an EOT or SOH (either terminates the operation), or it may be the trans-



● Figure 20. Sequence/Response Diagram--Write Line Address

USASCII-8 Data Byte Format								Selected Line	
			Bits						
7	6	X	5	4	3	2	1		
0	1	0	1	0	0	0	0	One	
0	1	0	1	0	0	0	1	Two	
0	1	0	1	0	0	1	0	Three	
0	1	0	1	0	0	1	1	Four	
0	1	0	1	0	1	0	0	Five	
0	1	0	1	0	1	0	1	Six	
0	1	0	1	0	1	1	0	Seven	
0	1	0	1	0	1	1	1	Eight	
0	1	0	1	1	0	0	0	Nine	
0	1	0	1	1	0	0	1	Ten	
0	1	0	1	1	0	1	0	Eleven	
0	1	0	1	1	0	1	1	Twelve	

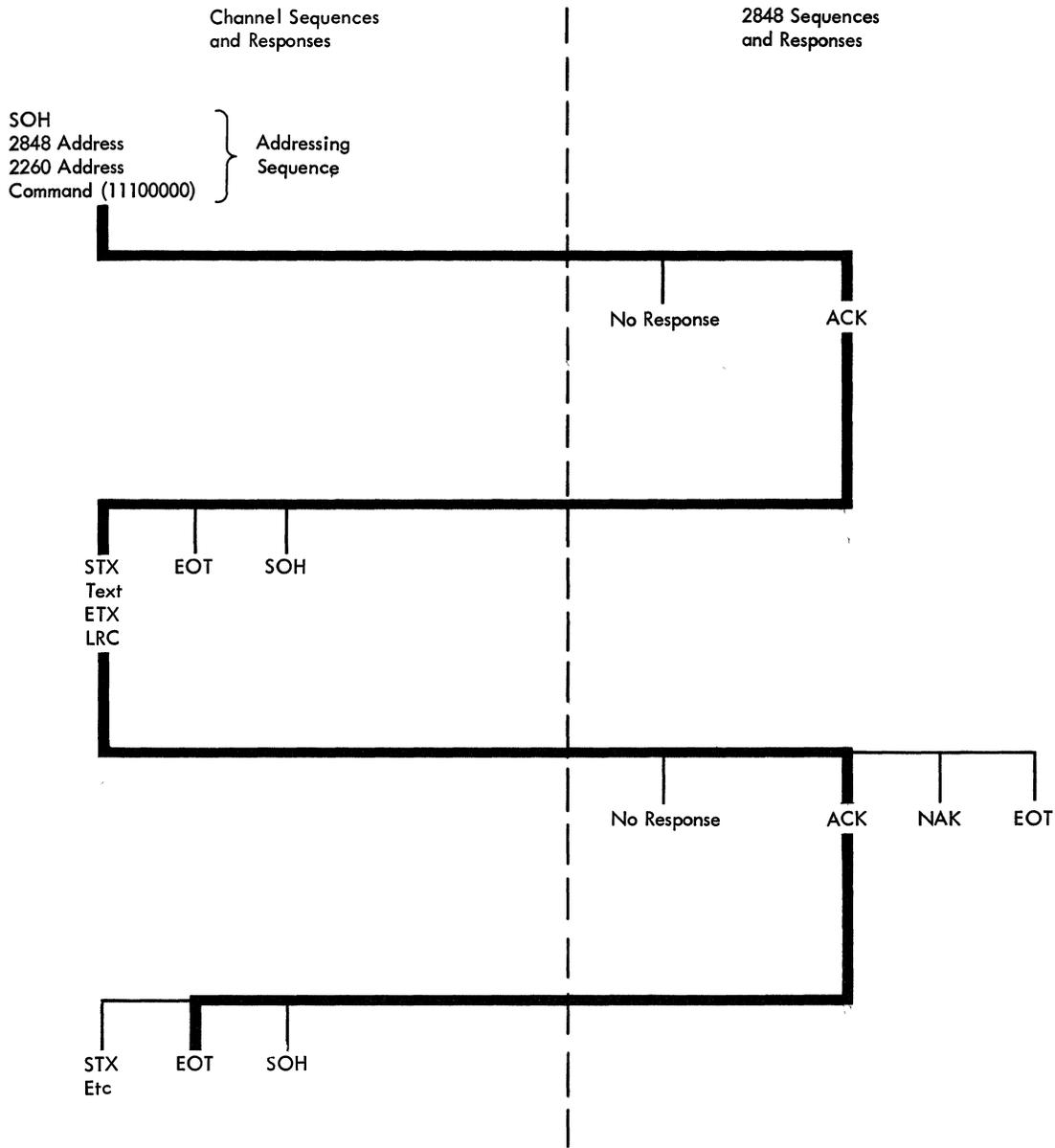
● Figure 21. Display Line Addresses (Remote)

mission of a message beginning with STX (Figure 22). The sequences and responses that occur during the write portion of the operation are the same as those described in the Write Addressed DS Buffer Storage operation.

The erase function is performed only following the addressing sequence containing the Erase/Write

command (SOH, 2848 Display Control address, etc.). Subsequent erasures require reinitiating the addressing sequence.

PROGRAMMING NOTE: The Erase/Write addressing sequence, when used by itself (not followed by a write sequence), is employed to erase a particular 2260 Display Station.



● Figure 22. Sequence/Response Diagram--Erase/Write

## SUMMARY OF SEQUENCES AND RESPONSES

The sequences and responses that occur between the channel and the 2848 Display Control are composed of seven of the eight USASCII control characters. These characters, used singly or in sequences, facilitate or are directly responsible for the following:

1. Performing line control functions.
2. Maintaining operational continuity.
3. Providing the channel with the current status of an operation or a specific device.
4. Signaling the detection of an error or unusual condition to the channel or the 2848 DC.
5. Providing the 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 the receiver; i. e., a specific response received at the 2848 may be interpreted differently from the same response directed to the channel. Thus, the sequences and responses are described for their significance both to the channel and the 2848 Display Control.

### 2848 Display Control Sequences and Responses

#### STX

The STX communications control character precedes all transmission sequences transmitted by the 2848 Display Control. The receipt of STX at the 2701 signals the beginning of a message and causes the 2701 to begin the LRC accumulation.

#### ETX

The ETX communications control character, as part of a 2848 Display Control transmission sequence response, indicates the end of a message. Upon receipt of the ETX and the LRC byte following the ETX 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 register, and the status byte is presented to the channel. Unit Check is also in the 2701 status byte and it is presented to the channel along with Channel End and Device End if a VRC or LRC error is detected by the 2701.

#### CAN

The CAN control character is transmitted by the 2848 Display Control only if a buffer parity error is

detected by the 2848 during a read operation (Read Full DS Buffer Storage or a positive response to a General or Specific Poll).

The 2848 inserts the CAN character between the message and the ETX communications control character, as follows:

STX  
2260 address  
Text (message)  
CAN--indicates detection of buffer parity error  
ETX  
LRC byte

The receipt of the CAN character at the 2701 Data Adapter Unit causes Unit Check to be set in the 2701 status register and Equipment Check to be set in the 2701 sense register.

When a CAN character is received by the channel during a read, Specific Poll, or General Poll operation, the data displayed on the 2260 containing the error should be erased and the message reentered. Otherwise, a subsequent attempt to read the message will result in a recurrence of the original error indication.

#### ACK

An ACK response from the 2848 Display Control to an addressing sequence beginning with SOH indicates that the address has been accepted and that the device is ready to receive the message.

An ACK response from the 2848 to a message sequence beginning with STX is an affirmative response, indicating that the message was received correctly. The ACK response in this case sets Channel End and Device End in the status register of the 2701.

#### NAK

The 2848 responds with NAK upon completion of a write operation if, during the operation, the 2848 detects a VRC or LRC error. Channel End, Device End, and Unit Check are set in the status register of the 2701. Data Check is set in the sense register.

The 2848 responds with NAK if an addressing sequence is directed to the 1053 Printer while the printer is in a Not Ready condition. Channel End, Device End, and Unit Exception are set in the status register of the 2701.

#### EOT

The EOT, as a 2848 Display Control response, has more than one interpretation. The following de-

scribes the situations under which the 2848 responds with EOT, and the significance of the response in each case:

1. EOT, as a negative response from the 2848 to a Specific or General Poll, indicates the absence of a message pending transfer to the channel. Channel End, Device End, and Unit Exception are set in the status register of the 2701.
2. EOT, as a 2848 response to ACK, following a Poll operation, indicates the end of transmission (no further messages). Channel End, Device End, and Unit Exception are set in the 2701 status register.
3. EOT, as a 2848 response to the transmission of a message during a write operation, indicates loss of data. Channel End, Device End, and Unit Exception are set in the 2701 status register.
4. EOT, as a 2848 response to the transmission of a message to the printer, indicates a printer buffer overrun condition; that is, the message has exceeded printer buffer capacity. Channel End, Device End, and Unit Exception are set in the 2701 status register.
5. The 2848 responds with EOT if an addressing sequence is directed to the 1053 Printer while the printer is busy. Channel End, Device End, and Unit Exception are set in the 2701 status register.

#### No Response

If a response from the 2848 is operationally anticipated but is not forthcoming within the time allotted (2 seconds), the 2701 Data Adapter Unit times out (see "2701 Timeouts", following in this chapter). When this occurs, Channel End, Device End, and Unit Check are set in the 2701 status register. Time Out is set in the 2701 sense register.

The causes of a No Response condition are:

1. An illegal command (fourth byte of an addressing sequence).
2. An illegal 2848 address (second byte of an addressing sequence).
3. An illegal 2260 or printer address (third byte of an addressing sequence).
4. Detection of a parity error in the addressing sequence.
5. Detection of a parity error in a line control character or an improperly transmitted line control character.
6. Defective communications facility.

#### Channel Sequences and Responses

##### STX

STX is transmitted by the channel as the first character of a transmission sequence. The receipt of STX by the 2848 causes the 2848 to initiate the LRC accumulation. STX may also be used as a positive response from the channel, in substitution for ACK, following a Poll operation. In this case, it causes the keyboard of the selected 2260 Display Station to be restored and the Start symbol to be erased.

##### ETX

ETX, as a channel response to the 2848, indicates the end of a message. Upon receipt of ETX and the LRC byte following the ETX character, the 2848 performs an LRC accumulation check. Channel End and Device End are set in the status register of the 2701, upon transmission of ETX and the LRC byte from the channel.

##### ACK

An ACK response from the channel to a message received from the 2848, as a result of a Specific or General Poll, is an affirmative response indicating that the message was received correctly. Upon receipt of the ACK response at the 2848, the keyboard of the selected 2260 Display Station is restored and the Start symbol is deleted.

##### NAK

A NAK response from the channel indicates that an error was detected in a message sequence transmitted by the 2848 Display Control. The NAK response from the channel causes the 2848 to retransmit the message.

##### SOH

The SOH communications control character is transmitted by the channel only and is used as the first character of all addressing sequences containing a Write command. This control character may also be used as a negative response to a message sequence from the 2848. In this case, it terminates the operation but does not restore the keyboard of the selected 2260.

##### EOT

The EOT is used as the first character of the Specific Poll, General Poll, and the Read Addressed Full DS Buffer addressing sequences.

EOT concludes an operation.

An EOT response from the channel to a transmission sequence from the 2848 ending in ETX and LRC indicates a negative response to the transmission sequence and terminates the operation. (It does not restore the keyboard of the selected 2260.)

#### STX/EOT

The STX/EOT sequence may be used as a positive response, substituting for ACK, following a Specific Poll, General Poll, or Read Addressed Full DS Buffer operation. This sequence concludes the operation and does not require a reply from the 2848. When used following a Specific Poll or General Poll, it also causes the Start symbol to be erased from the screen of the selected 2260 and causes the associated keyboard to be restored.

#### Auxiliary Reset (Write/Break)

An auxiliary reset can be accomplished by sending a Write/Break command to the 2701. When the Write/Break command is received, the 2701 causes the Receive Data line at the 2848 to rise to the space level for a minimum of 20ms. Upon detecting this condition, the 2848 terminates any I/O operation then in progress and drops its Request to Send to the attached data set. Approximately 1.5ms following the drop of the Receive Data line to the marking level, the 2848 resets to the control mode and nonselected status.

Loss of data may result through the use of the Write/Break command. This possibility can be minimized if the Write/Break command to the 2701 is preceded by a Read Clear command (960 characters).

The auxiliary reset provides a tool for automatic error recovery and should be used only when it becomes apparent that the 2848 will not respond to the normal ASCII commands.

#### 2701 Timeouts

A 2-second timeout is provided between data characters during a receive operation if a Read or Read Clear command has been accepted. The timeout process is interrupted by a received start-bit and is restarted at the following stop-bit time, or immediately if a false start-bit is detected.

A 2-second timeout is provided following the rise of the Request to Send interface line by the adapter and this timeout is interrupted by the rise of Clear to Send from the data set.

A 2-second timeout is provided when the 2701 is internally jumpered for multipoint operation and the remote terminal(s) does not drop Request to Send within 2 seconds after the 2701 sends EOT or SOH.

A 2-second timeout is provided when a Write/Break command fails to cause the remote terminal(s) to drop Request to Send within 2 seconds after the command is decoded.

Timeout causes Channel End, Device End, and Unit Check to be set in the 2701 status register. Timeout is set in the 2701 sense register.

#### USASCII-8 TO HEXADECIMAL CODE CONVERSION

Table 4 gives the USASCII-8 code structure and the hexadecimal representation for the characters used in data exchanges between a remote display complex and the channel.

● Table 4. USASCII-8 to Hexadecimal Code Conversion Chart

Character	USASCII-8 76X54321	Hexadecimal Code Representation	Character	USASCII-8 76X54321	Hexadecimal Code Representation
SOH	0000001	01	=	01011101	5D
STX	0000010	02	>	01011110	5E
ETX	0000011	03	?	01011111	5F
EOT	0000100	04	A	10100001	A1
ACK	0000110	06	B	10100010	A2
CAN	00011000	18	C	10100011	A3
NAK	00010101	15	D	10100100	A4
SP	01000000	40	E	10100101	A5
!	01000001	41	F	10100110	A6
”	01000010	42	G	10100111	A7
#	01000011	43	H	10101000	A8
\$	01000100	44	I	10101001	A9
%	01000101	45	J	10101010	AA
&	01000110	46	K	10101011	AB
,	01000111	47	L	10101100	AC
(	01001000	48	M	10101101	AD
)	01001001	49	N	10101110	AE
*	01001010	4A	O	10101111	AF
+	01001011	4B	P	10110000	B0
	01001100	4C	Q	10110001	B1
-	01001101	4D	R	10110010	B2
.	01001110	4E	S	10110011	B3
/	01001111	4F	T	10110100	B4
0	01010000	50	U	10110101	B5
1	01010001	51	V	10110110	B6
2	01010010	52	W	10110111	B7
3	01010011	53	X	10111000	B8
4	01010100	54	Y	10111001	B9
5	01010101	55	Z	10111010	BA
6	01010110	56		10111101	BD
7	01010111	57	·	10111111	BF
8	01011000	58	┘	11111100	FC
9	01011001	59		11111110	FE
:	01011010	5A	LF	00001010	0A
;	01011011	5B	@	11100000	E0
<	01011100	5C			

## LOCAL DISPLAY COMPLEX (CHANNEL ADAPTER)

The time required for synchronization of the channel and 2848 Display Control prior to data transfer averages 8.4ms. Following synchronization, the transfer of data (either to or from a 2848) requires approximately 0.4ms per character for the characters on a given display line.

During the transfer of data between the channel and 2848 (in either direction), data transfer is halted for a period of 33.4ms before the start of each display line except the first. During this pause, the 2848 services 2260 Display Station keyboards.

A 2260/2848 attached to a multiplexer channel operates in byte mode. When attached to a selector channel, the 2260/2848 operates in burst mode. If the channel does not maintain the 0.4ms data rate, a pause of 33.4ms will occur before the next character transfer.

Command Execution Time Formulas

## ● Write DS Buffer Storage:

$$T = S + (*40N) 0.4\text{ms} + (N-1) 33.4\text{ms} - (*40-Y) 0.4\text{ms}$$

Where: S=Synchronizing Time, 0 to 16.7ms  
(8.4ms average)

N=Number of lines

Y=Number of used character positions  
in the last line

## ● Write 1053 Buffer Storage:

$$T = C^1 2.75\text{ms} + C^2 65\text{ms}$$

Where:  $C^1$ =Number of characters transferred  
(up to 1223 minus number of case insertions made by the 2848)

$C^2$ =Number of characters in excess of  
 $C^1$

## ● Write DS Line Address:

$$T = S + (*40N) 0.4\text{ms} + (N-1) 33.4\text{ms} - (*40-Y) 0.4\text{ms}$$

Where: S=Synchronizing Time, 0 to 16.7ms  
(8.4ms average)

N=Number of lines

Y=Number of used character positions in the  
last line

## ● Read DS MI:

$$T = S + (*40N) 0.4\text{ms} + (N-1) 33.4\text{ms} + E - (*40-Y) 0.4\text{ms}$$

Where: S=Synchronizing Time, 0 to 16.7ms  
(8.4ms average)

N=Number of lines

E=Ending Sequence, 33.4 to 49.7ms (41.5 average)

Y=Number of used character positions in the  
last line

## ● Short Read DS MI:

$$T = S + (*40N) 0.4\text{ms} + (N-1) 33.4\text{ms} + E - (*40-Y) 0.4\text{ms}$$

Where: S=Synchronizing Time, 0 to 16.7ms  
(8.4ms average)

N=Number of lines

E=Short Ending sequence, 0.4ms

Y=Number of used character positions  
in the last line

● Read Full DS Buffer:

$$T=S + L + M + E$$

Where: S=Synchronizing Time, 0 to 16.7ms  
(8.4ms average)

L=Find first character time, 1.2 to  
16.7ms (9ms average)

M=Model 1--339.6ms  
Model 2--646.2ms  
Model 3--825.0ms

E=RFB Ending Sequence, 16.7ms

● Erase DS Buffer Storage:

T=8ms + P (16.4ms is average time for this  
command)

Where: P=Place cursor in first character posi-  
tion, 0 to 16.7ms (8.4ms average)

REMOTE DISPLAY COMPLEX (DATA SET  
ADAPTER)

Data Set Adapter 9012

Data Set Adapter 9012 operates at the rate of 1200 bits per second (120 bytes of data or control characters per second). This adapter, when used with Western Electric Data Set 202D1 (or equivalent), has an initial communications line turnaround time of  $200 \pm 20$ ms.

Data Set Adapter 9013

Data Set Adapter 9013 operates at the rate of 2400 bits per second (240 bytes of data or control characters per second). This adapter, when used with Western Electric Data Set 201B1 (or equivalent), has an initial communications line turnaround time of about 150ms. The Western Electric Data Set 201B1 provides an optional initial communications line turnaround time of 8.5ms when operating over four-wire facilities.

Remote Operation Timing Charts

Figure 23 depicts the time required to perform the indicated operations when using a 2848 with a data set adapter.

KEYBOARD TIMING

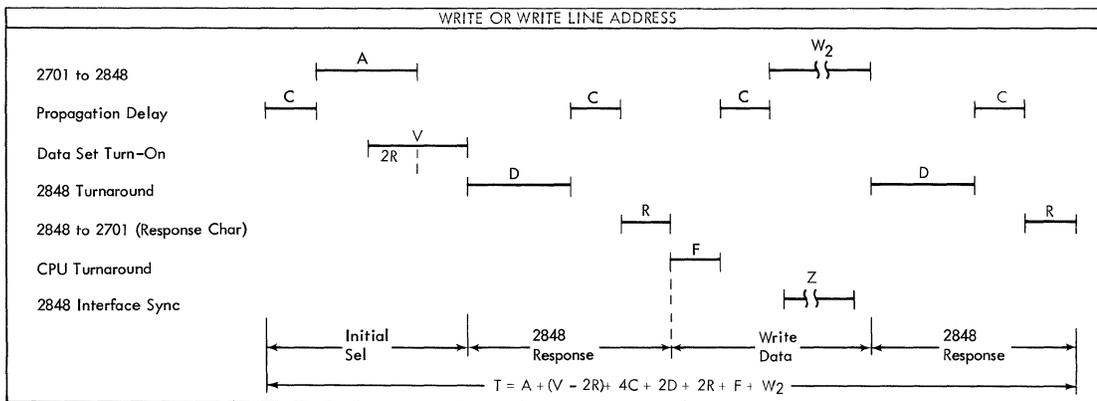
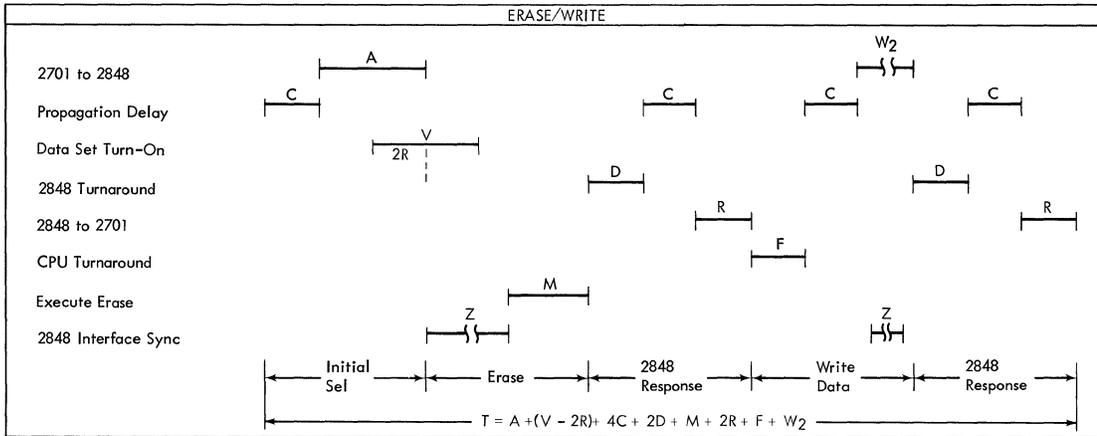
Pressing an alphabetic, numeric, or special character key requires a maximum of 0.8ms of control unit time to write the selected character and advance the cursor to the next position.

The time required for each keyboard key to perform its function is as follows:

Character	0.8ms
Space/Advance	0.8ms
Backspace	16.7ms
Start MI*	16.7 to 400ms
Erase	8 to 24.5ms
New Line	1.8ms to 16.7ms
Up	16.7ms
Down	65.1usec or 16.7ms (if on bottom line)
Enter	16.7ms (Start Time) + 0--16.7ms max. (synchronization of channel and 2848) + I/O Time** + Ending Time.
Print	2.2ms to 17.5ms for the first two characters; additional characters require 1.2ms per pair, every 16.7ms. When the printer buffer is full, additional characters require 0.8ms per character, every 67.5ms.
Tab	0.4ms per character between the cursor and the colon character (Tab stop). The operation is interrupted at the start of each line, for multiples of 16.7ms, to allow servicing of other keyboards.
Erase to End of Line	0.4ms per character between the cursor and the end of the line.
Erase to End of Screen	16.7ms for 2848 Models 1 & 2; 33.4ms for 2848 Model 3.
Rapid Cursor	0.8ms, occurring at a rate of approximately 10 cps.

\*16.7ms, if a Start MI symbol is not displayed before pressing the Start key; up to 400ms, if a Start MI symbol is displayed before pressing the Start key.

\*\*The I/O Time is approximately 0.4ms/character. All lines except the starting and ending lines take a multiple of 16.7ms, regardless of the number of characters on the line. A 33.4ms pause occurs after each line is transferred. The Ending Time for a Read MI command is 33.4-50.1ms. The Ending Time for a Short Read DS MI command is 0.4ms. The Ending Time for a Read Full DS Buffer command is 16.7ms.



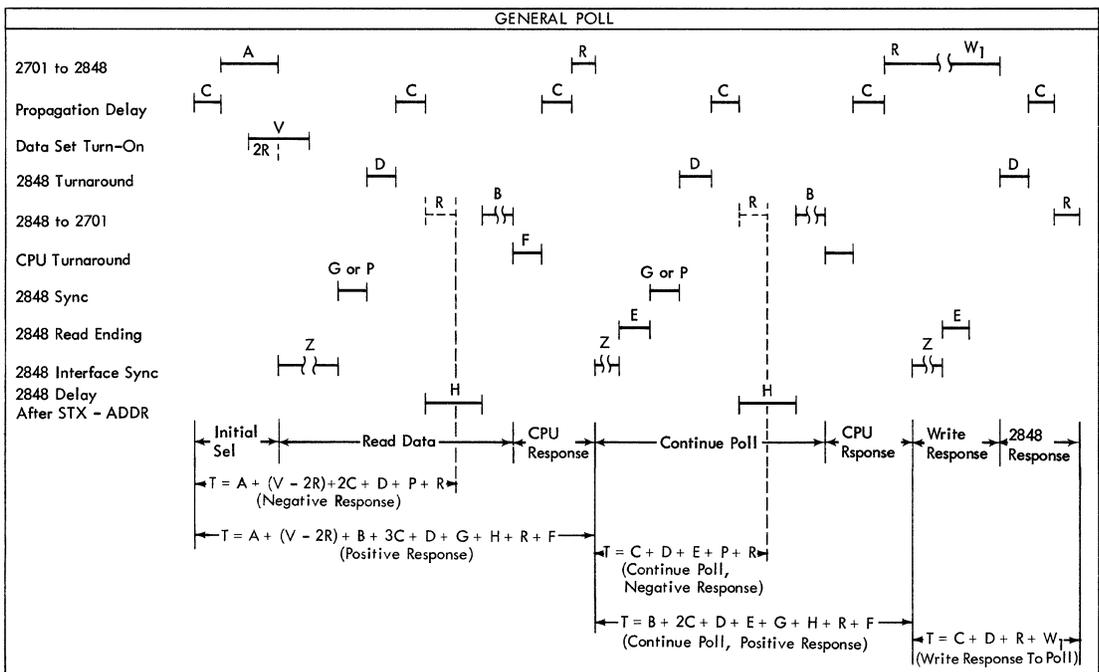
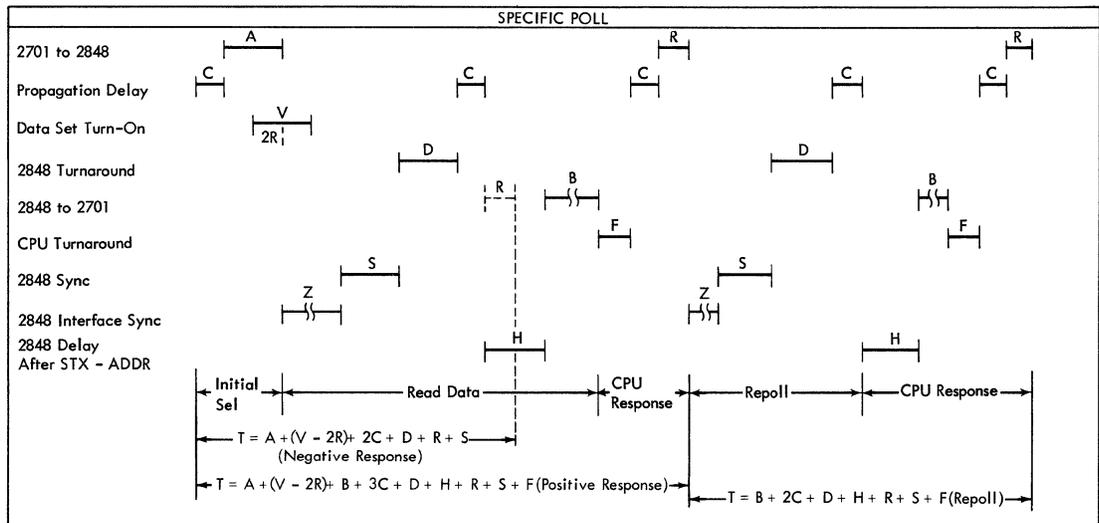
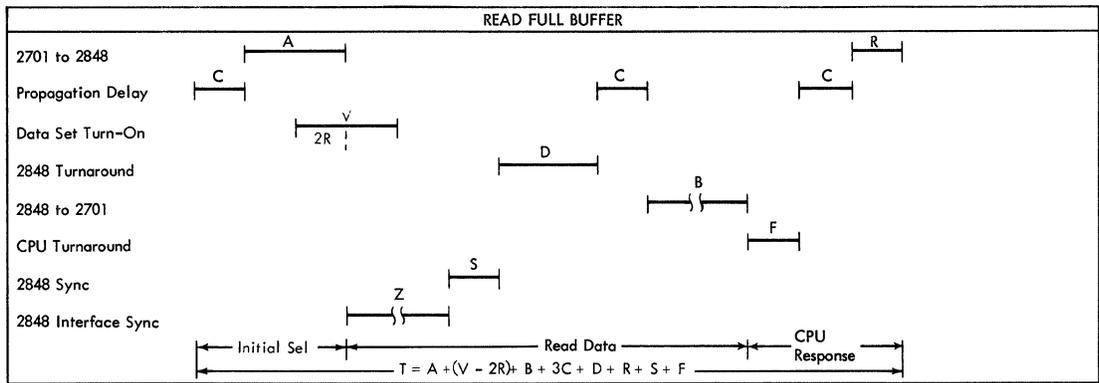
**PARAMETERS**

- A = Selection Sequence -- 6R (Note 1)
- B = Message Transfer Time (Read) -- (N + 4)R
- C = Line Propagation Delay -- .015ms times the number of miles one way  
(Typical; varies with type and length of Communications Facility)
- D = 2848 Delay in Transmit -- 17ms
- E = 2848 Read Ending Time (average) -- 34ms
- F = CPU Delay -- Program Dependent
- G = 2848 Time to Find Enter Key (average) --  $\frac{17ms}{(Y + 1)}$  (Note 2)
- H = 2848 Delay Between STX-ADDR and First Character (average) -- 25.5ms - 2R
- M = 2848 Erase Time (average) -- 17ms
- N = Number of Characters in Message
- P = 2848 Time to Poll All Addresses -- 17ms
- R = Single Character Transmission Time -- 4.167ms (2400 BPS) or 8.334ms (1200 BPS)
- S = 2848 Synchronization Time (average) -- 8.5ms
- V = Data Set Turn-On -- 8.5ms, strapped 201B1; 200ms, 202D1 (Nominal; data set dependent)
- W<sub>1</sub> = Message Transfer Time (Write after Poll) -- (N + 2)R
- W<sub>2</sub> = Message Transfer Time (Write or Write Line Address) -- (N + 3)R
- Y = Average Number of DS's with Enter Key Pressed at the Same Time
- Z = 2848 Interface Synchronization Time -- 400ms maximum (normally not a factor)

**Notes:**

1. Includes sending two EOT characters before the address selection sequence. An additional delay of 9.5ms occurs if the carrier is up at the 2848 at the start of the selection sequence.
2. Use only if the input format gives a random position of the cursor on the DS at enter time. Use 8.5ms if the position is not random.

Figure 23. Remote Operation Timing Charts (Part 1 of 2)



Note: See the specific poll for repoll of the last message (NAK response from 2701)

● Figure 23. Remote Operation Timing Charts (Part 2 of 2)

INSTALLATION PLANNING DATA

For installation planning data, see IBM System/360  
Installation Manual--Physical Planning, Form  
C22-6820.

## INTRODUCTION

This appendix discusses the "data entry" version of the IBM 2260/2848 Display Complex. Comprising an IBM 2848 Display Control, Model 21, 22, and IBM 2260 Display Stations, Model 2, the "data entry" display combines the advantages of the inquiry-oriented display complex with increased data input capabilities. When attached to a Model 21 or Model 22 Display Control, each keyboard-equipped 2260 Display Station can be used as a high-volume data entry terminal as well as a means of rapidly accessing and displaying computer-stored data.

A special keyboard, Alphameric-Numeric Inset, is available to enhance the capabilities afforded by the data entry 2260/2848. The data entry keyboard is alphameric and features a blocked-numeric key layout that permits rapid keying of numeric data. This keyboard is particularly well-suited for applications where a high proportion of the input data is numeric and the ability to process alphabetic data is also required. The optional alphameric and numeric keyboards are also available for attachment to the data entry 2260/2848. The three keyboards may be intermixed on the same 2848 Model 21 or 22 to satisfy the requirements of customer applications.

The data entry 2260/2848 is supported by the basic 2260/2848 commands and by six additional (data entry) commands which permit a close alliance between display station operators and the operating program during data entry operations. Unlike the basic commands, the data entry commands do not cause a keyboard restore function at the selected 2260. This provides an effective means of monitoring (by CPU program) data entry operations at each display station.

Once the ENTER key at a 2260 keyboard is pressed, the keyboard becomes inoperative and remains so until a command (other than a data entry command) is issued to the 2260, causing the keyboard to be restored (or until a manual keyboard restore is performed). This permits a programmed examination of the input data and appropriate responses to be made to the display station before a subsequent message can be entered via its keyboard.

For example, if the data is found to be correct, the keyboard can be restored (by means of a command that causes keyboard restoration), and data entry can be continued virtually without interruption. However, if the data is found to be incorrect, the

keyboard can be left in an unrestored condition to prevent further data entry and to alert the operator to an abnormal condition. The unique characteristic of the data entry commands permits internally composed messages to be displayed on the screen of a 2260, advising the operator of special considerations or of corrective actions to be taken, with a high degree of assurance that each message will receive attention.

The two models of the data entry 2848 Display Control permit 2260/2848 configurations that extend from a 2848 controlling a single display station to one controlling a maximum of 16 or 24 display stations. As summarized below, the 2848 model governs the maximum number of 2260's that can be attached and the maximum number of characters that can be displayed on each 2260:

2848 Display Control, Model 21--The 2260 Display Station, Model 2, is used with the 2848 Display Control, Model 21. As many as 24 Model 2 Display Stations may be attached to a Model 21 Display Control, each capable of displaying 240 characters.

2848 Display Control, Model 22 -- The 2260 Display Station, Model 2, is used with the 2848 Display Control, Model 22. As many as 16 Model 2 Display Stations may be attached to a Model 22 Display Control, each capable of displaying 480 characters.

Both models of the data entry 2848 permit the operation of 2260 Display Stations at distances of up to 2000 cable-feet from the associated 2848. This permits placement of 2260's at strategic locations throughout an office building or similar facility, thus providing direct data input and access to computer data at locations removed from the computer complex. Since each 2260 operates independently, several unrelated data entry operations can be performed concurrently, with no interaction between the display presentation at one display station and that at another.

An antireflective display screen is used on 2260's to minimize reflections from ambient light sources and reflective objects. This feature, standard on all 2260's, combined with a display brightness control, permits the 2260 to be operated in an environment with light ambients of up to 50 foot-candles. In addition, the adjustable character size and adjustable character-spacing capabilities, standard on all

2260's, enable the display presentation of each 2260 to be adjusted to meet the character size and spacing requirements at that station. (Adjustments to character size and spacing must be performed by trained service personnel.)

The data entry 2260/2848 must be attached to either a selector or multiplexer channel via the 2848 channel adapter. It cannot be attached via a data set adapter.

## IBM 2848 DISPLAY CONTROL, MODELS 21 AND 22, GENERAL DESCRIPTION

The IBM 2848 Display Control, Models 21 and 22, contain the delay line storage, keyboard buffers, and the control logic required to interface the 2848 with either a System/360 selector or multiplexer channel. Both Model 21 and 22 can be supplemented, through other features to expand their basic display capabilities and to provide them with special functional abilities. These are described in the following paragraphs together with the capabilities provided by the basic models.

Both models offer a choice of operating on a primary power input of 208vac or 230vac and have an exterior cabinet color selection of red, yellow, blue, or gray to permit color compatibility with the associated System/360.

### IBM 2848 Display Control, Model 21

The basic IBM 2848 Model 21 is capable of operating six 3368 Display Adapters, each of which can service two IBM 2260 Model 2 Display Stations. The Model 21 can generate a display of six rows, each containing 40 characters (240 characters total), on the screen of each 2260 DS associated with the DC. The Model 21, which must be equipped with the 9011 channel adapter to permit attachment to the associated System/360, is designed for direct channel attachment only.

Through incorporation of additional optional features, 2848 Model 21 capabilities can be extended to include the following:

- The ability to operate six additional 3368 Display Adapters (via the 3868 Expansion Unit). A maximum of 24 Model 2 Display Stations, each displaying a 240-character (maximum) message, can thus be accommodated.
- The ability to operate the 7938 Printer Adapter, which controls an IBM 1053 Model 4 Printer, to provide a permanent record of display group data, under either program or operator control.

- A nondestructive cursor (character-entry and display-position indicator and locator) that can be moved within the display area without disturbing or destroying the data displayed on the screen of the 2260 Display Station.
- A Line-Addressing feature which enables the processor, during write operations, to select the first display position of any display line within 2260 display under program control.

### IBM 2848 Display Control, Model 22

The basic Model 22 also must be equipped with the 9011 Channel Adapter to enable its attachment 2260 Model 2 Display Stations. The Model 22 can generate a display consisting of 12 rows, each containing 40 characters (480 characters total), on the screen of each 2260 associated with the DC.

The basic Model 22 also must be equipped with the 9011 Channel Adapter to enable its attachment to the associated System/360. It cannot be equipped with the Data Set Adapter.

Other optional features that can be selected to extend the capabilities of the basic Model 22 include:

- The ability to operate four additional 3369 Display Adapters (via the 3868 Expansion Unit). Thus, the Model 22 DC can accommodate a maximum of 16 Model 2 Display Stations, with each associated 2260 capable of displaying a 480-character message.
- The printer, nondestructive cursor, and Line-Addressing features already described for the 2848 DC Model 21.

### IBM 2848 Display Control Model Summary

Table 5 summarizes both models of the data entry 2848's with respect to the standard customer options, the applicable optional feature adapters, the number of 2260's that can be serviced, and the maximum displayable message length.

### Optional Features

Each of the features that can be chosen to complement the two data entry 2848 models is described in Table 6. The information provided for each feature consists of the feature code, the feature function, the 2848 models to which the feature can be attached, and any prerequisite features.

In addition to the information given in Table 6, the Printer, Line Addressing, and Nondestructive

Table 5. Model Summary, 2848 Display Control, Models 21 and 22

Model Number	Customer Options	Optional Feature Adapters Available	Maximum Possible Associated 2260 DS's	Maximum Display Length
21	<p><b>*9011 Channel Adapters.</b>  Exterior colors or red, yellow, blue, or gray.</p> <p>Operates on primary power of 208vac or 230vac at 60Hz.</p>	<p>3368 Display Adapter.  7938 Printer Adapter.  3868 Expansion Panel.  4787 Line Addressing.  5340 Nondestructive Cursor.  5341 Nondestructive Cursor Adapter.</p>	<p>24  (Model 2)</p>	<p>Six rows of 40 characters each (240 characters total).</p>
22	<p>Same as Model 21.</p> <p><b>*Required</b></p>	<p>Same as for Model 1 except that 3369 Display Adapter replaces the 3368 Adapter used with Model 21.</p>	<p>16  (Model 2)</p>	<p>Twelve rows of 40 characters each (480 characters total).</p>

Cursor features are further described in the following paragraphs.

#### Printer Feature

The attachment of the optional Printer feature increases the data handling capabilities of the 2260/2848 by providing an output printer that can be used by all associated keyboard-equipped 2260 Display Stations and by the computer as well.

The IBM 1053 Model 4 Printer attaches to the 2848 Display Control via the Printer Adapter (7938) which contains the printer buffer and related control circuitry. The Printer Adapter is described in Table 6. Only one Printer feature can be attached to a 2848 Display Control.

Like the 2260 Display Stations, the IBM 1053 Model 4 Printer can be operated at distances of up to 2000 cable-feet from the 2848 Display Control.

The PRINT key, found on the data entry, alphanumeric, and numeric keyboards, is used to logically connect a 2260 Display Station to the 1053 Model 4 Printer. When this key is operated, all data displayed on the associated 2260, from the first character to the cursor, is transferred to the printer buffer and printed, except data prohibited from transfer by the NL symbol. (Refer to "New Line (NL) Symbol" in a preceding chapter.) The 2260-to-printer operation is described under "2260 Display Station Keyboard Operations" in the same chapter.

Data is transmitted from the channel to the printer by the Write 1053 Buffer Storage command.

#### Line-Addressing Feature

The Line-Addressing feature enables program positioning of the cursor to the first display position of a specific display line.

The Write DS Line Address or the Write DS Line Address Without Keyboard Restore command is used to select the display line when the Line-Addressing feature is installed. Either command may be used to select a line on which the accompanying data from the channel is to be displayed, or either may be used with a zero-length data message to position the cursor to a display line on which the 2260 operator is to enter a message.

#### Nondestructive Cursor Feature

The Nondestructive Cursor feature is described under "Nondestructive Cursor Symbol (Feature) in "IBM 2260 Display Station--General Description", preceding.

#### Extended Cursor Control Feature

These features (FC 3605, FC 3606, and FC 3607) are described in Appendix D. The 2848 Extended Cursor Control feature (FC 3901) and the Nondestructive Cursor features (FC 5340 and FC 5341) are also required on the associated 2848.

#### Operator Controls and Indicators

The 2848 controls and indicators available to the operator are those needed for the control of unit power. Each control (or indicator) and its function are described in Appendix C.

#### CE Panel

The 2848 DC is provided with a CE (maintenance) panel to permit off-line operation of the unit during checks and/or maintenance.

● Table 6. 2848 Display Control, Models 21 and 22 Features

Feature Code	Feature Description	Model Attached To	Prerequisite 2848 Features
3368 Display Adapter	Contains storage and control logic to service two IBM 2260's.	21 only	None for up to six 3368 adapters. 3868 for up to six additional 3368 adapters.
3369 Display Adapter	Contains storage and control logic to service two IBM 2260's.	22 only	None for up to four 3369 adapters. 3868 for up to four additional 3369 adapters.
3901 Extended Cursor Control	See Appendix D.	21 and 22	Nondestructive Cursor 5340 and 5341 required. Also, one of the following Extended Cursor Control Keyboards, 3605, 3606, or 3607 is required on each attached 2260.
9011 Channel Adapter	Contains circuitry required to interface 2848 with a System/360 selector or multiplexer channel; operates in single-byte (8 bits) mode at a rate up to 2560 characters per second.	21 and 22	None
3868 Expansion	Permits attachment of other special features, as follows: For 2848 Model 21: Six 3368 adapters. For 2848 Model 22: Four 3369 adapters.	21 and 22	None
4787 Line Addressing	Permits processor of host system to select first displayable position of any line within CRT display of 2260 as starting location for display of output data. The number of unique starting (or line) locations are: 2848 Model 21: 6; 2848 Model 22: 12.	21 and 22	None
5340 Nondestructive Cursor	Provides control logic for Nondestructive Cursor Feature represented by 5341 which is attached to various display adapters. Allows operator to move cursor vertically and horizontally within 2260 display.	21 and 22	None  NOTE: If 5340 Nondestructive Cursor Feature is attached to a 2848 DC, all display adapters used with 2848 must be provided with 5341 Nondestructive Cursor Adapter.
5341 Nondestructive Cursor Adapter	Permits movement of cursor within CRT display of 2260 without disturbing or destroying data displayed on CRT.	21 and 22	One 5340 per 2848.
7938 Printer Adapter	Contains a buffer storage and logic required to control an IBM 1053 Model 4 Printer. Provides a means of obtaining a permanent printed record of display group data under either program or operator control.	21 and 22	

NOTE: In addition to the Features listed above, both 2848 models offer a choice of operating on a primary power input of 208vac or 230vac and have an exterior color selection of red, yellow, blue, or gray. Side covers are available to accommodate above-floor cable entry.

## IBM 2260 DISPLAY STATION, MODEL 2, GENERAL DESCRIPTION

The IBM 2260 Display Station, Model 2, is used with either the Model 21 or Model 22 2848.

A basic IBM 2260 Display Station, Model 2 contains a cathode-ray tube (CRT), which serves as a viewing screen, and the circuitry required to cause the video signals received from the 2848 to be displayed on the screen as meaningful data.

The basic 2260 Model 2 can operate with either model of the data entry 2848, including models that contain any combination of optional features. The 2260 can display the 240-character message of the 2848 Model 21 or the 480-character message of the 2848 Model 22, with equal efficiency.

Standard features found on all Model 2 Display Stations are:

1. Antireflective display screen: minimizes glare and reflections from ambient light sources and reflective objects.
2. Brightness control: permits display intensity to be adjusted to the operator's satisfaction.
3. Adjustable character size: permits the height and width of characters displayed on a 2260 screen to be adjusted to individual requirements at each display station. Adjustments must be made by trained service personnel.
4. Adjustable character spacing: permits the spaces between adjacent characters displayed on 2260 Display Stations to be adjusted to individual requirements at each display station. Adjustments must be made by trained service personnel.

When an operational keyboard is included in the 2260 DS, input messages generated at the keyboard are displayed on the screen as they are composed. This permits the operator to verify a message before it is transferred to the CPU. A total of 64 different characters can be displayed on the 2260 DS screen:

- 26 alphabetical characters
- 10 numerical characters
- 25 special symbols (includes space and New Line symbol)
- 3 control symbols (Cursor, Check, and Start Manual input symbols)

NOTE: 2260's attached to a 2848 equipped with the Nondestructive Cursor feature are capable of displaying 65 different characters. The Nondestructive Cursor feature is described in "Nondestructive Cursor Symbol (Feature)" under "IBM 2260 Display Station--General Descriptions."

## Optional Features

### Alphameric-Numeric Inset (Data Entry) Keyboard

The optional Alphameric-Numeric Inset (data entry) keyboard is offered only on 2260's that are attached to a Model 21 or 22 Display Control. The data entry keyboard is alphameric and features blocked numeric keys that permit fast and efficient entry of numeric data and additional control keys, SHIFTLOCK and RESTORE, not found on the alphameric or numeric keyboards.

The SHIFTLOCK key allows the operator to place the keyboard in upper case, where it will remain until the Shift key is depressed and released. The RESTORE key is used in conjunction with the data entry commands and permits the operator to restore the keyboard without erasing data displayed on the 2260.

The Data entry keyboard contains the 26 letters of the English alphabet, arabic numerals 0 through 9, special symbol keys, and the control keys required to format and enter data.

The key arrangement of the data entry keyboard is illustrated in Figure 24. Table 7 describes the function of the data entry keyboard keys.

The Alphameric-Numeric Inset keyboard is also available with the key designations, special characters, and keyboard arrangements required to complement the 2848 DC Language Features. (See Appendix B for a description of the Language Features.)

### Alphameric Keyboard Feature

The alphameric keyboard is described and illustrated under "IBM 2260 Display Station--General Description". See Table 3 for a description of its operation.

### Numeric Keyboard Feature

The numeric keyboard is described and illustrated under "IBM 2260 Display Station--General Description." See Table 3 for a description of the operation.

### Extended Cursor Control

These features (FC 3605, FC 3606, and FC 3607) are described in Appendix D. The 2848 Extended Cursor Control feature (FC 3901) and the Nondestructive Cursor features (FC 5340 and FC 5341) are also required on the associated 2848.

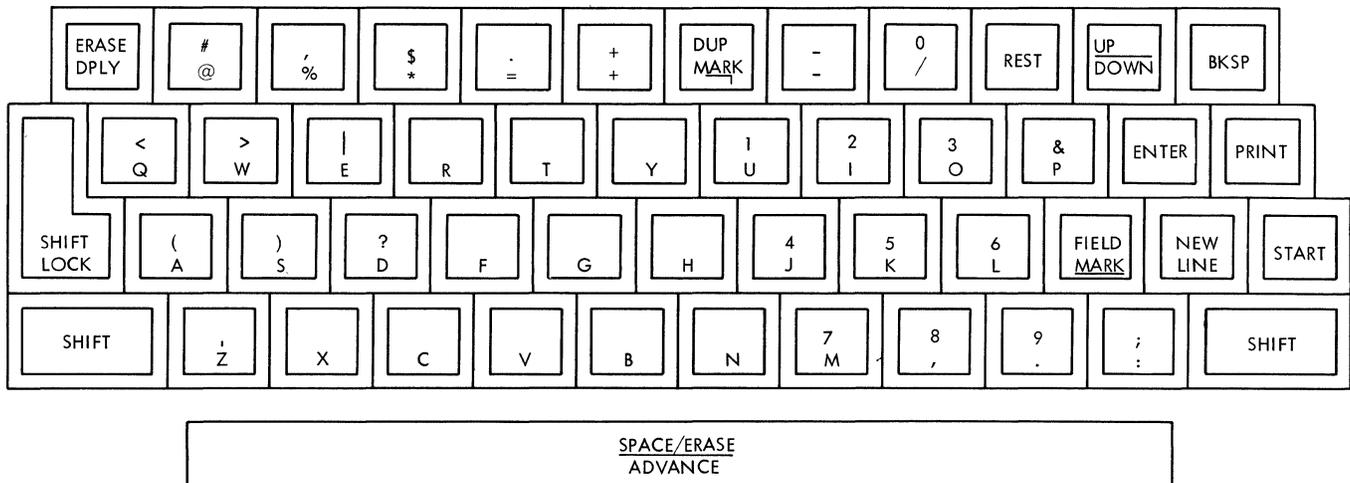


Figure 24. Alphameric-Numeric Inset (Data Entry) Keyboard

### 2260 Display Station Operator Controls

Operator controls on a Model 2 Display Station, other than keyboard keys, consist of the POWER ON/OFF switch and the character brightness control. These are contained in a single rotary control located on the right side of each 2260 Display Station.

### 2260 Display Station Control Symbols

The control symbols are described under "2260 Display Station Control Symbols" in the chapter, "IBM 2260 Display Station--General Description."

### 2260 Display Station Data Entry Keyboard Operations

#### Manual Input

The following text describes the procedures for manually entering data into a 2260 buffer from its associated data entry keyboard for transfer to the channel during a Read DS MI or Short Read DS MI operation. Manual input operations using the alphameric or numeric keyboard are described under "2260 Display Station Keyboard Operations" in the chapter, "IBM 2260 Display Station--General Description."

1. Position the cursor in the display position in which it is desired to begin the message. Refer to Table 6 to select the keyboard key(s) that will best facilitate cursor positioning.
2. Press the START key. This action causes the Start MI symbol to be entered into the 2260 buffer and to appear on the 2260 screen in the

display position previously occupied by the cursor. The cursor is advanced to the next displayed position.

3. Key in the message that is to be transferred to the channel. The message data will appear on the 2260 screen as the character keys are operated. The cursor symbol automatically advances as data is displayed on the 2260 screen.
4. After the entire message is displayed on the 2260 screen, press the ENTER key. This action causes all the keys on this keyboard to be locked, except ERASE and RESTORE, and signals the channel that a message is awaiting transfer to it from a 2260 buffer.

Depending on the type of command used to transfer the data, the operator will be signaled that the operation has been completed and that another data entry operation may be started as follows:

Read DS MI. Upon completion of data transfer from the 2260 buffer to the channel using this command, the keyboard is restored, and the Start MI symbol is deleted from the 2260 screen. Deletion of this symbol and keyboard restoration should be interpreted by the operator to mean that the message was successfully transferred and that another message may be entered in the 2260 buffer.

Read DS MI Without Keyboard Restore. This command is identical with the Read DS MI command except that it does not restore the key. The keyboard remains locked until a command that causes

● Table 7. Function of 2260 Display Station Data Entry Keyboard Keys

Key	Standard Destructive Cursor		Optional Nondestructive Cursor	
	No Shift	Shift	No Shift	Shift
SHIFTLOCK SHIFT	Places and locks keyboard in upper case. 1. Places keyboard in momentary upper case. 2. Releases SHIFTLOCK key to return keyboard to lower case.	Same	Places and locks keyboard in upper case. 1. Places keyboard in momentary upper case. 2. Releases SHIFTLOCK key to return keyboard to lower case.	Same
<u>SPACE/ERASE</u> ADVANCE	Causes storage of a blank in the cursor position. Advances cursor to next display position.	Same	Advances cursor one display position with no other modification of display.	Erases display position to right of cursor and advances cursor one display position.
BKSP	Backs cursor by one position, erasing character (if any) previously displayed in new cursor position. If cursor is in first display position, it will move to last display position.	Same	Backs cursor by one position with no erasures. If cursor is in first display position, it will move to last display position.	Same
ERASE DPLY	Erases entire display and locates cursor in upper left corner of display (first displayable position).	Same	Erases entire display and locates cursor in upper left corner of display area (first cursor position).	Same
RESTORE	Restores (unlocks) keyboard for operator use.	Same	Restores (unlocks) keyboard for operator use.	Same
<u>UP</u> <u>DOWN</u>	A blank is written, cursor moves to next position, and keyboard is mechanically locked.	Same	Cursor moves down one line. If it is already in bottom line, it moves to top line.	Cursor moves up one line on display. If cursor is on top line, it will move to bottom line.
Single-Character Keys	Cause symbol to be displayed.	Keyboard locks.	Cause symbol to be displayed.	Keyboard locks.
Double-Character Keys	Cause symbol on lower half of key to be displayed.	Cause symbol on upper half of key to be displayed.	Cause symbol on lower half of key to be displayed.	Cause symbol on upper half of key to be displayed.
START	If no Start MI symbol is displayed, Start MI symbol is placed in position cursor was in when key was depressed. Cursor is advanced one display position.  If a Start MI symbol is displayed when key is depressed, all display data between Start MI symbol and cursor, except data to right of a new line character, is erased. Cursor moved to first display position following Start MI symbol.	Same	If no Start MI symbol is displayed, Start MI symbol is placed in position cursor was in when the key was depressed. The cursor is advanced one display position.  If a Start MI symbol is displayed when key is depressed, all display data between Start MI symbol and cursor, except data to right of a new line character is erased. Cursor moved to first display position following Start MI symbol.	Same
Field Mark	Causes a “_” (EBCDIC,HEX 6D) to be sent to CPU. Through programming, this character is usually used to cause a field to be skipped (similar to Skip Key on Keypunch).			
Dup Mark	Causes a “=” (EBCDIC,HEX 5F) to be sent to CPU. Through programming, this character is usually used to cause a field to be duplicated into the next record (similar to Dup Key on Keypunch).			

Table 7. Function of 2260 Display Station Data Entry Keyboard Keys (Continued)

Key	Standard Destructive Cursor		Optional Nondestructive Cursor	
	No Shift	Shift	No Shift	Shift
ENTER	Places an EOM symbol in cursor position. Cursor is "effectively" placed one display position beyond Start MI symbol. It also causes attention bit to be set in status byte and locks keyboard.	Same	Places EOM symbol in cursor position. Cursor is placed one display position beyond Start MI symbol. It also causes attention bit to be set in status byte and locks keyboard.	Same
PRINT	Causes all data from the first display position in first line to and including the Cursor symbol, except data to right of an NL symbol in any line, to be printed by 1053 Model 4 Printer.  If no print feature is attached to 2848, a space is written in cursor position, and cursor moves to next position, and keyboard locks.	Same	Places End of Message in cursor position. Causes all data from the first display position in first line to and including the EOM symbol, in any line, to be printed by 1053 Model 4 Printer.  If no print feature is attached to 2848, a space is written in cursor position and cursor moves to next position, and keyboard locks.	Same
NEW LINE	Places NL symbol in cursor position. Cursor moves to first display position of next lower display line. If it is already in bottom line, it moves to first display position of top line. Data between NL symbol and end of line is left undisturbed.	Same	Places NL symbol in cursor position. Cursor moves to first display position of next lower display line. If it is already in bottom line, it moves to first display position of top line. Data between NL symbol and end of line is left undisturbed.	Same

keyboard restoration is issued or until RESTORE or ERASE is pressed. Thus, this command permits the transferred data to be program-verified and, if incorrect, permits corrective action to be taken before the operator can enter the next message. The corrective action is determined by the procedures applicable to the operation.

Assuming a normal condition (i.e., the data, upon verification, is found to be correct), the keyboard is unlocked (via a command which will cause keyboard restoration), and the operator is permitted to resume data entry.

**Short Read DS MI.** This command operates in the same manner as the Read DS MI command, except that the Start MI symbol is not deleted from the screen. Restoration of the keyboard signals the successful completion of the operation. (See the Programming Note which follows the description of the Short Read DS MI command in the chapter, "Principles of Operation--Local Application.")

**Short Read DS MI Without Keyboard Restore.** This command operates in the same manner as the Read DS MI Without Keyboard Restore except that the Start MI symbol is not deleted from the screen. Programmed restoration of the keyboard signals the successful completion of the operation. (See the Programming Note which follows the description of the Short Read DS MI command in the chapter, "Principles of Operation --Local Application.")

**Correction of Errors from 2260 Data Entry Keyboard**

The method of correcting typographical errors and mistakes made as data is entered in the 2260 buffer via the data entry keyboard depends on many factors, such as the type of cursor (destructive or nondestructive), the skill and experience of the operator, etc. Since it would be impractical to suggest corrective methods to cover every situation, this discussion will concern the keyboard keys that are particularly useful in the correction of typing errors. These

keys, BKSP, ERASE DPLY, ADVANCE, RESTORE, START, and UP/DOWN are also described in Table 7.

**BKSP.** Permits the operator to backspace the cursor to the display position in error and to eliminate the error. The destructive cursor, when backspaced into a display position containing a character, erases the character. Backspacing the nondestructive cursor does not cause displayed data to be erased.

**ERASE DPLY.** When operated, erases the entire display and places the cursor in the first displayable position (upper-left corner of the screen).

**ADVANCE.** (See Table 7.)

**START.** When operated with a Start MI symbol displayed on the 2260 screen, START erases all data displayed between the Start MI symbol and the cursor. It does not erase data displayed between an NL symbol and the end of the display line containing that symbol.

**RESTORE.** Unlocks the keyboard.

**UP/DOWN.** Is useful if the nondestructive cursor is used, because it permits rapid positioning of the nondestructive cursor.

#### 2260-to-Printer Operation

If the Printer feature is installed, the 2260 data entry keyboard PRINT key, when operated, logically connects the 2260 and IBM 1053 Model 4 Printer and causes the following (see Table 7 for the action that occurs when the PRINT key is operated under other conditions):

1. An EOM is written in cursor position for the Nondestructive Cursor feature; the cursor becomes the EOM for destructive cursor machines.
2. All the keyboard keys are locked except ERASE and RESTORE.
3. Data displayed on the 2260 from the first displayable position to, and including, the EOM is transferred to the printer buffer and printed, except data between the NL symbol and the end of the display line containing that symbol.

NOTE: An EOM in the body of the message will cause the print operation to end prematurely.

The EOM is printed as an exclamation mark. If NL symbols are displayed, the first NL symbol on each display line is transferred to the printer buffer, and each causes a carriage return-line feed function.

4. At the completion of data transfer from the 2260 buffer to the printer buffer, the 2260 keyboard is restored.

Detection of parity errors during a 2260-to-printer is indicated as follows:

1. If a parity error is detected in the 2260 buffer, the erroneous character is printed and a quote (") symbol is printed in the print position preceding the exclamation mark.
2. If a parity error is detected in the printer buffer, a space is substituted for the erroneous character, and a quote (") symbol is printed following the exclamation mark.

If the 1053 Printer is busy at the time a 2260 print request is initiated (PRINT is pressed), the print request is queued and accepted when the 1053 Printer becomes available. If desired, the operator can cancel the print request and restore the keyboard by pressing ERASE.

#### Control Key Functions

The action that occurs when the various data entry keyboard control keys are pressed is discussed below for both the standard destructive cursor and the optional nondestructive cursor.

The display symbols associated with control key functions, where applicable, are as follows:

1. Start MI symbol ▶
2. New Line symbol ▲
3. Destructive Cursor ABC █  
The small horizontal bar is the cursor symbol; it denotes the next available display position. Thus, if the D character key were depressed, the display above would be extended to ABCD█.
4. Nondestructive Cursor ABC █  
The vertical bar is the Cursor symbol. The next available display position is above and to the right of the vertical bar (cursor). Thus, if the D character key is pressed, the new display appears as ABCD █.

The control keys described in Table 7 appear on all 2260 data entry keyboards, even when the feature associated with a particular key has not been attached to the 2848 Display Control. For

example, the PRINT key is present when the 1053 Printer Adapter has not been selected for attachment to the 2848. The data provided for each control key includes a description of the effect of pressing the key when the associated feature is not present.

**PRINCIPLES OF OPERATION--2260/2848 DATA ENTRY APPLICATIONS**

The IBM 2848 Display Control, Model 21 or 22, and associated 2260's can be attached, via the 2848, to either a selector or multiplexer channel of an IBM System/360. Channel Adapter FC9011 provides the necessary circuitry to interface either of the two "data entry" models of the 2848 Display Control to either channel.

Code Set

The 2260/2848 Data Entry Display Complex uses the Extended Binary Coded Decimal Interchange Code (EBCDIC). This code set is described under "Principles of Operation--Local Application."

Data Flow Analysis

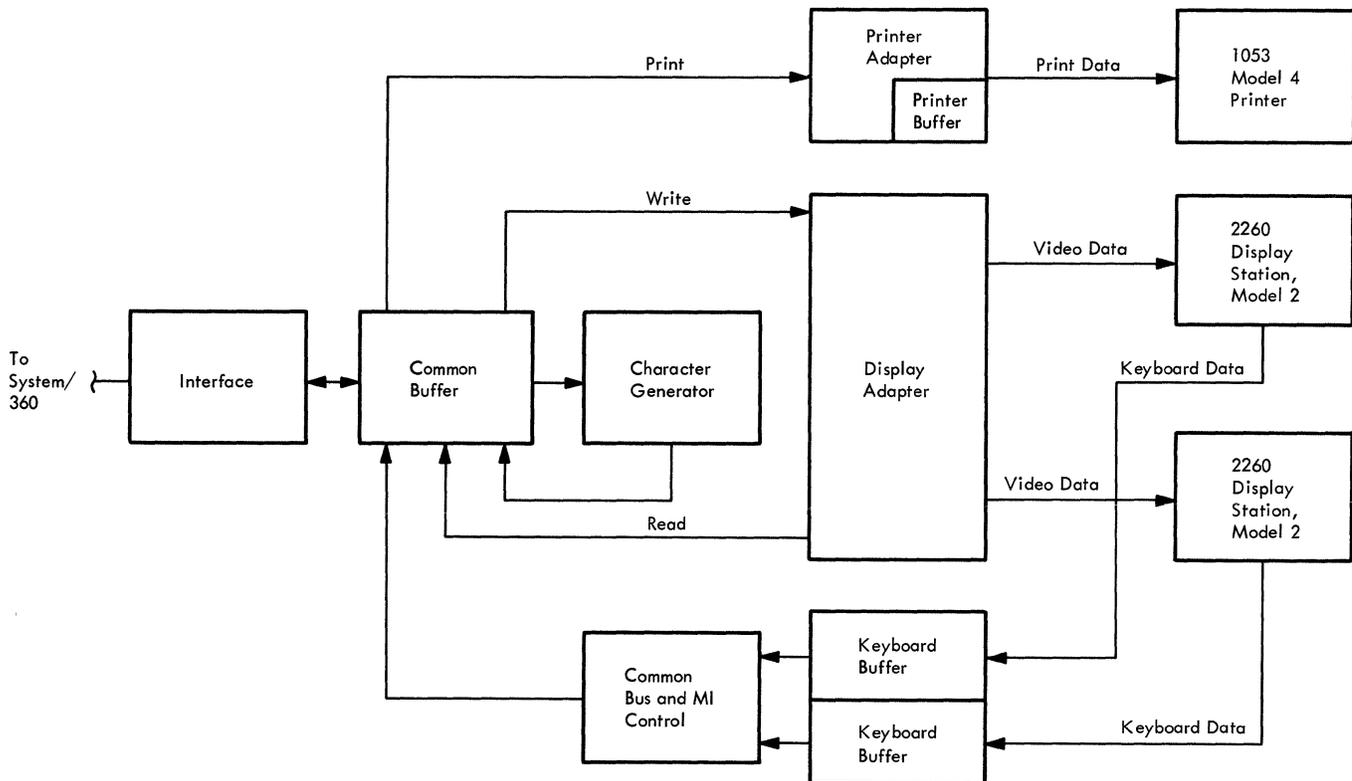
Data flow through the data entry 2260/2848 is illustrated in the data flow diagram (Figure 25) and described in the following text.

**2848/Channel Interface**

The 2848/Channel Interface contains the circuitry required to exchange control signals, data bytes, and command bytes with the associated System/360 channel.

The 2848 Display Control fitted for direct attachment to a System/360 channel uses the EBCDIC for data exchanges between the channel and the 2848. Data exchange occurs in eight-bit data bytes.

During a write operation, the interface receives the eight-bit data byte from the channel, checks it for parity, and converts the eight-bit EBCDIC to six-bit code which is placed in the common buffer. Conversely, during a read operation, the interface receives and converts six-bit code from the common buffer to eight-bit EBCDIC for transfer to the channel.



● Figure 25. Data Flow Diagram (Data Entry)

## Common Buffer

The common buffer acts as the central point for the transfer of data between the interface and the 2848 Display Control and for the transfer of data within the 2848. Specifically, the common buffer is used for data exchanges between the following areas:

1. Interface to 2260 buffer storage.
2. 2260 buffer storage to interface.
3. 2260 keyboard to 2260 buffer storage.
4. 2260 buffer storage to 1053 printer buffer.
5. Interface to 1053 printer buffer.

## Character Generator

The character generator contains 64 core storage matrices (one matrix for each of the 64 displayable characters). Each matrix contains the ferrite cores necessary to produce the video signals for that character. Each matrix also contains a configuration of ferrite cores to convert the six-bit code to the Tilt-and-Rotate code used by the 1053 Printer.

The character generator receives the six-bit code from the common buffer and converts it to five seven-bit data bytes that are the video equivalent of the coded character. The five video bytes are then placed, one at a time, in the common buffer and transferred to the display adapter.

## Display Adapter

The display adapter contains the delay line buffer storage and associated control logic to service two 2260 Display Stations. The delay line is used to store data for presentation on the 2260 screen. Video data bits are placed in the delay line serially and are continuously displayed and regenerated until erased or replaced by other data. The data stored in the delay line can also be read into the common buffer for transfer to the interface during a read manual input operation or to the 1053 Printer during a 2260 print operation.

## Common Bus and MI Control

Common bus and manual input (MI) control accepts character data and keyboard-generated commands from the keyboard buffers of all associated 2260 Display Stations equipped with any of the Keyboard features.

The character data generated by a selected 2260 keyboard and stored in its keyboard buffer is received by the common buffer and MI control and placed in the common buffer for processing and transfer to delay line buffer storage. Keyboard commands are

directed to control areas where they perform specific functions such as erase, backspace, enter, etc.

## Keyboard Buffer

The keyboard buffer is a five-character storage buffer that buffers keyboard-generated data before the data is transferred to common bus and MI control. This buffer minimizes interaction between keyboards attached to the same 2848 by providing temporary storage for data when the common buffer is unable to accept it immediately, i.e., when the common buffer is busy. The keyboard buffer and its associated control logic form the principal distinction between a data entry 2260/2848 and the inquiry-oriented 2260/2848.

## 2260 Display Station Model 2

The 2260 Display Station contains the display screen (CRT) and related circuitry and a keyboard (if equipped with a Keyboard feature).

Graphic presentation of character data on the 2260 screen is achieved by intensifying the cathode-ray beam at proper intervals as it sweeps vertically and moves horizontally across the face of the screen. The point of beam intensification on the screen is determined by the position of the video data bits in the delay line (buffer storage). The video data bits flow through the delay line in direct relationship to beam motion. When a video data bit is detected, the beam is intensified, causing a graphic representation (a dot) of that video data bit to appear on the screen.

To form an intelligible character on the screen, the video data bits representative of that character are placed in the delay line (again, in direct relationship to beam motion). As the video data bits flowing through the delay line are sensed, the CRT beam is intensified, and a pattern of dots forming the character is displayed.

During the interval between the detection of video data bits, the beam continues to move. However, it moves in an unintensified (blanked) state, and no image appears on that portion of the screen. Space between characters and lines is the result of blanked beam motion.

## Printer Adapter

The printer adapter contains a buffer storage (printer buffer) and the circuitry required to control an IBM 1053 Model 4 Printer. Data (received either from the channel or from a 2260 buffer) to be printed is converted to the Tilt-and-Rotate code, placed in the printer buffer, and transferred to the printer.

## IBM 1053 Model 4 Printer

The optional IBM 1053 Model 4 Printer is an output-only printer; when installed on the 2848, it can be used by any associated keyboard-equipped 2260 Display Station and by the computer as well.

### Addressing

The data entry 2260/2848 uses the same addressing and selection sequences as described in "Addressing" under "Principles of Operation--Local Application."

### Commands and Command Operation

Figure 26 lists the commands that can be executed by the data entry 2260/2848 and the code structure for each. The six commands listed in Figure 26 with the suffix "W/O Kybd Rstr" (without keyboard restore) are data-entry-associated commands and can be executed only by a data entry 2848, i.e., a Model 21 or Model 22. The remaining are basic commands which can be executed by any 2260/2848. These are described in "Commands and Command Operation" under "Principles of Operation--Local Application."

The commands unique to the data entry 2260/2848 are similar in function and operation to their basic counterparts except that they do not cause 2260 keyboard restoration (unlocking). This permits transferred data to be program-verified and, if incorrect, allows corrective action to be taken before the operator can initiate a subsequent operation.

The locked keyboard, by prohibiting the pressing of keys, prevents the entering of data and alerts the operator to the need for corrective action.

A locked keyboard can be restored by the issuance of a command that causes keyboard restoration or by pressing RESTORE or ERASE located on the data entry keyboard (ERASE key only on the alphameric and numeric keyboards).

The Write DS Buffer Storage Without Keyboard Restore command can be used with any of the read commands to display instructions to the 2260 operator, informing her of the nature of an error, what corrective action is to be taken, or of any special instructions.

Since the operation of the data entry commands (those with the suffix "Without Keyboard Restore"), except for prohibiting keyboard restore, is the same as that of their basic counterparts (for example, the Read DS MI Without Keyboard Restore is the same as the Read DS MI command, etc.), data entry commands are not described here. The basic commands are described in "Commands and Command Opera-

tion" under "Principles of Operation--Local Application."

### Channel/Display Complex, Sequences and Responses

Refer to "Channel/Display Complex--Sequences and Responses" under "Principles of Operation--Local Application", for a discussion of sequences and responses.

### Sense and Status Bytes

Refer to "Sense and Status Bytes" under "Principles of Operation--Local Application", for a discussion of sense and status bytes.

### Interrupts and Error Recovery Procedures

Refer to "Interrupts and Error Recovery Procedures" under "Principles of Operation--Local Application", for interrupts and error recovery procedures.

Command	EBCDIC Code Structure							
	0	1	2	3	4	5	6	7
Write DS Buffer Storage	0	0	0	0	0	0	0	1
Write DS Buffer Storage W/O Kybd Restr	0	0	0	1	0	0	0	1
Write 1053 Buffer Storage	0	0	0	0	0	0	0	1
Write DS Line Address	0	0	0	0	0	1	0	1
Write DS Line Address W/O Kybd Restr	0	0	0	1	0	1	0	1
Read DS MI	0	0	0	0	0	0	1	0
Read DS MI W/O Kybd Restr	0	0	0	1	0	0	1	0
Short Read DS MI	0	0	0	0	1	0	1	0
Short Read DS MI W/O Kybd Restr	0	0	0	1	1	0	1	0
Read Full DS Buffer	0	0	0	0	0	1	1	0
Read Full DS Buffer W/O Kybd Restr	0	0	0	1	0	1	1	0
Erase DS Buffer Storage	0	0	0	0	0	1	1	1
Erase DS Buffer Storage W/O Kybd Restr	0	0	0	1	0	1	1	1
No Op	0	0	0	0	0	0	1	1

● Figure 26. Commands, Data Entry 2260/2848

## INSTALLATION PLANNING DATA

Installation planning data is given in IBM System/360 Installation Manual--Physical Planning, Form C22-6820.

### TIMING, DATA ENTRY 2260/2848

The time required for synchronization of the channel and 2848 Display Control, prior to data transfer, averages 8.4ms. Following synchronization, the transfer of data (either to or from a 2848) requires approximately 0.4ms per character for the characters (including spaces) on a given display line.

If the channel does not maintain the 0.4ms data rate, a pause of 16.7ms will occur before the next character transfer. If the channel transfer time plus the 2848 common processing time for keyboard buffers with data exceeds 480ms, the channel transfer will be interrupted until all keyboard buffers are serviced.

### Command Execution Time Formulas

#### ● Write DS Buffer Storage:

$$T=S + (40N) 0.4ms - (40-Y) 0.4ms$$

Where: N=Number of lines

Y=Number of used character positions  
in the last line

#### ● Write 1053 Buffer Storage:

$$T=C 0.1ms + \left(\frac{C}{50}\right) 275ms$$

Where: C=Number of characters

$\frac{C}{50}$  =Whole number division, disregarding  
remainder

#### ● Write DS Line Address:

$$T=S + (40N) 0.4ms - (40-Y) 0.4ms$$

Where: S=Synchronizing Time, 0 to 16.7ms  
(8.4 average)

N=Number of lines

Y=Number of used character positions  
in the last line

#### ● Read DS MI:

$$T=S + (40N) 0.4ms + E - (40-Y) 0.4ms$$

Where: S=Synchronizing Time, 0 to 16.7ms  
(8.4ms average)

N=Number of lines

E=Ending Sequence, 33.4 to 49.7ms  
(41.5ms average)

Y=Number of used character positions  
in the last line

#### ● Short Read DS MI:

$$T=S + (40N) 0.4ms + E - (40-Y) 0.4ms$$

Where: S=Synchronizing Time, 0 to 16.7ms  
(8.4ms average)

N=Number of lines

E=Short Ending Sequence, 0.4ms

Y=Number of used character positions of  
the last line

#### ● Read Full DS Buffer:

$$T=S + L + M + E$$

Where: S=Synchronizing Time, 0 to 16.7 (8.4 ms  
average)

L=Find first character time, 1.2 to  
16.7ms (9ms average)

M=Model 21--100ms  
Model 22--200ms

E=RFB Ending Sequence, 16.7ms

#### ● Erase DS Buffer Storage:

T=8ms + P (16.4ms is average time for  
this command.)

Where: P=Place cursor in first character posi-  
tion, 0 to 16.7ms (8.4ms average)

### Keyboard Timing

Data transfer from a keyboard to its respective keyboard buffer is performed every 3.5ms; i.e., the 2848 tests each 2260 keyboard for the presence of keyed data every 3.5ms. If data is present (keyboard key pressed), the 2848 causes the data to be entered in the appropriate keyboard buffer. The 2848, Models 21 and 22, will handle keying rates of up to 6.8 characters per second, with burst rates of up to 40 characters per second.

The time required to transfer data from a keyboard buffer to the associated 2260 delay line buffer is computed as follows:  $(0\text{ms to }16.7\text{ms}) + 0.4\text{ms} \times (\text{number of characters} + 1)$ . The following lists the keyboard-initiated 2260 functions (commands) and the time required to perform each:

N/L	$(0 \text{ to } 16.7)\text{ms}^* + (1.8 \text{ to } 16.7)\text{ms}$
Backspace	$(0 \text{ to } 16.7)\text{ms}^* + 16.7\text{ms}$
Erase	$(8 \text{ to } 24.5)\text{ms}$
Up	$(0 \text{ to } 16.7)\text{ms}^* + 16.7\text{ms}$
Down	$(0 \text{ to } 16.7)\text{ms}^* + 65.1 \text{ usec}$ or $16.7\text{ms}$ if cursor is on bottom line.
Start	$(0 \text{ to } 16.7)\text{ms}^* + 16.7\text{ms}$ if Start MI symbol is not displayed prior to pressing START. $(1.8 \text{ to } 200)\text{ms}$ if Start MI symbol is displayed prior to pressing START.
Enter	$(0.8 \text{ to } 33.4)\text{ms} + [(0 \text{ to } 16.7)\text{ms} + \text{I/O time}^{**} + \text{ending time}]^{***}$
Print	$(1.2 \text{ to } 16.7)\text{ms} + 0.4\text{ms}$ per character + $(0 \text{ to } 16.7)\text{ms} + 0.4\text{ms} \times \text{number of characters}$ .

Tab	$(0 \text{ to } 16.7)\text{ms}^* + 0.4\text{ms}$ per character between the cursor and the colon character (Tab stop), or last character position of the screen.
Erase to End of Line	$(0 \text{ to } 16.7)\text{ms}^* + 0.4\text{ms}$ per character between the cursor and the end of the line.
Erase to End of Screen	$(0 \text{ to } 16.7)\text{ms}^* + 16.7\text{ms}$ .
Rapid Cursor	Same as for characters. The keyboard buffer is loaded at a rate of approximately 10 cps.

\*Only if the command is in the first character position of the keyboard buffer.

\*\*I/O time--Approximately 0.4ms/character. All lines except the starting and ending lines take a multiple of 16.7ms. The ending time for Read DS MI is 33.4 to 50.1ms. For Short Read DS MI, ending time is 0.4ms. (Short Read DS MI should be followed by an erase.) For Read Full DS Buffer, ending time is 16.7ms. I/O time for Read Full DS Buffer requires an additional 1.2 - 16.7ms at the beginning.

\*\*\*Time required to perform the read operation.

### Channel to 1053 Printer

Data can be transferred from the channel to the printer at a maximum rate of 65usec/character. After each group of 50 characters, there is a 275ms pause during which data is not accepted by the printer buffer. If the 1223 character storage capacity is exceeded, the pause after each group of characters is determined by the 1053 Printer rate. This pause can be approximately 3.5 seconds.

INTRODUCTION

The United Kingdom, French, or German Language feature equips the 2260/2848 with the character set appropriate to the country for which the feature is chosen and with instruction labels, control designations, etc., in the language of that country.

The 2260 Alphameric, Numeric, and Alphameric-Numeric Inset Keyboard features are also available to complement any of the three Language features selected. (The Alphameric-Numeric Inset Keyboard can be used only on 2260's attached to a Model 21 or 22 2848 DC.) These keyboards feature the keyboard arrangement, key designations, and special characters required for compatibility between the Language feature and associated keyboard.

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

Except for differences in the graphic representations of certain codes, keyboard arrangements, control designations, etc., the operation of a 2260/2848 with a Language feature is the same as that of a standard 2260/2848. (See "Principles of Operation--Local Application" or "Principles of Operation--Remote Application" in this manual.) The following paragraphs contain comparative descriptions of the areas affected when each of the Language features is installed. Comparisons are between a standard 2260/2848 and those equipped with each of the Language features.

NOTE: The Language features can be installed only on 2260/2848's equipped to operate on 50Hz input power.

CHARACTER SETS

Figure 27 lists the characters of the United Kingdom, French, and German character sets that differ from the standard character set, and the code configuration for each. The remaining characters, those not shown in Figure 27, are the same as those contained in the standard character set. (See Figure 4, EBCDIC Code Set, or Figure 10, USASCII-8 Code Set.)

2260/2848 CONTROL DESIGNATIONS, IDENTIFICATION/INSTRUCTION LABELS

Figure 28 lists 2260/2848 control designations and instruction labels as they appear when the United Kingdom, French, or German Language feature is installed. Those of the United Kingdom are the same as those on a standard 2260/2848.

The switches and indicators are described (by standard nomenclature) under "Operator Controls and Indicators" in the first chapter of this manual or in Appendix A.

2260 DISPLAY STATION KEYBOARDS

The optional Alphameric, Numeric, and Alphameric-Numeric Inset 2260 keyboards, available for use in association with the United Kingdom, French, and German Language features, are shown in Figures 29 through 37. Each Language-feature-associated keyboard uses the keyboard arrangement familiar in the country for which the feature is selected and the key designations in the language of that country.

Standard Character	United Kingdom	French	German	EBCDIC Code							USASCII-8 Code*								
				0	1	2	3	4	5	6	7	7	6	X	5	4	3	2	1
#	#	#	Ä	0	1	1	1	1	0	1	1	0	1	0	0	0	0	1	1
\$	£	f	Ü	0	1	0	1	1	0	1	1	0	1	0	0	0	1	0	0
@	@	@	Ö	0	1	1	1	1	1	0	0	1	1	1	0	0	0	0	0

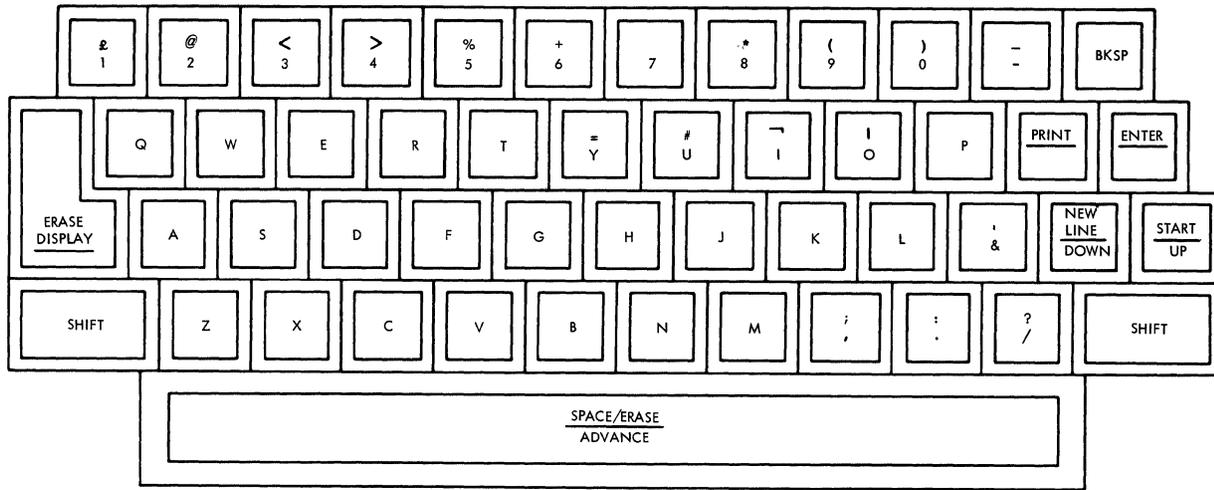
\*Not applicable for Models 21 and 22.

Figure 27. Standard and Language Feature Characters

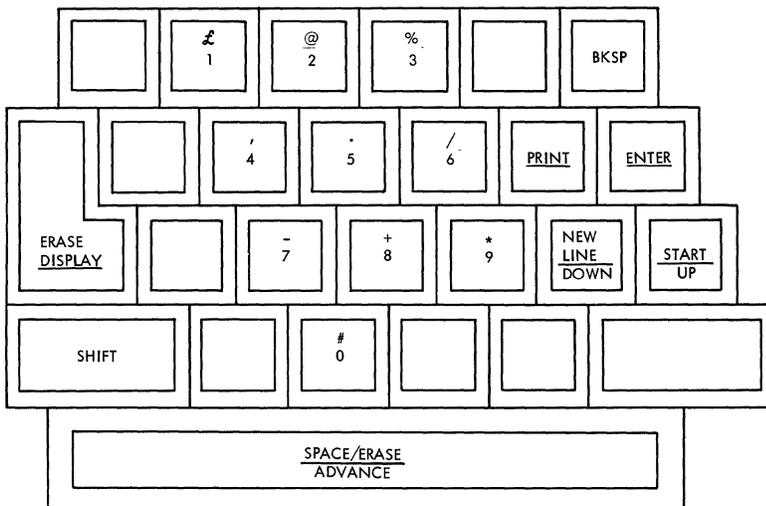
United Kingdom	French	German
DISPLAY CONTROL	UNITE DE CONTROLE D'AFFICHAGE	STEUREINHEIT
MODEL	MODELE	MODELL
DISPLAY STATION	UNITE TERMINALE D'AFFICHAGE	OPTISCHE ANZEIGE
POWER ON	SOUS TENSION	NETZ EIN
POWER OFF	HORS TENSION	NETZ AUS
POWER OFF IF IN LOCAL	HORS TENS SI EN CDE LOC	NETZ AUS BEI STELLUNG INTERN
DATA* SET READY	MODEM* PRET	SIGNAL-* UMSETZER IN BETRIEB
LOCAL TEST  REMOTE OPERATE	COMMANDE LOCALE TEST  A DISTANCE OPERAT	INTERN TEST  EXTERN ÜBERTRAGUNG
MOTOR ON  OFF	MOTEUR EF  HF	MOTOR EIN  AUS
ENABLE  DISABLE  DISABLE 	EN SERVICE  HORS SERVICE  HORS SERVICE 	SYSTEM  WARTUNG  WARTUNG 
United Kingdom TO UNLATCH COVER: INSERT SCREWDRIVER IN SLOT AND PRY TAB IN DIRECTION OF ARROWS.	German VERKLEIDUNG MIT SCHRAUBENZIEHER IN PFEILRICHTUNG ÖFFNEN.	French POUR DELOQUETER LE COUVERCLE: INTRODUIRE UN TOURNEVIS DANS L'ENCOCHE ET SOULEVER DANS LE SENS DE LA FLECHE.

\*Not applicable for Models 21 and 22.

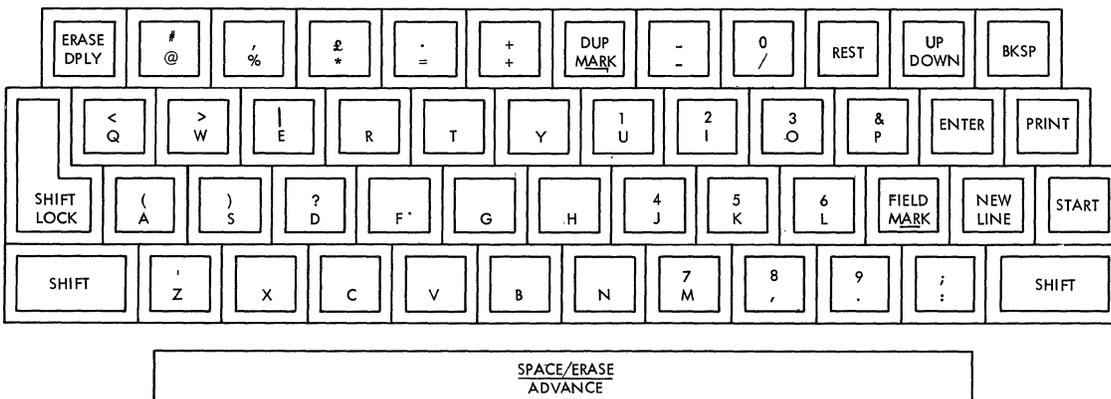
● Figure 28. 2260/2848 Designations and Instruction Labels



● Figure 29. Optional Alphanumeric Keyboard (United Kingdom)

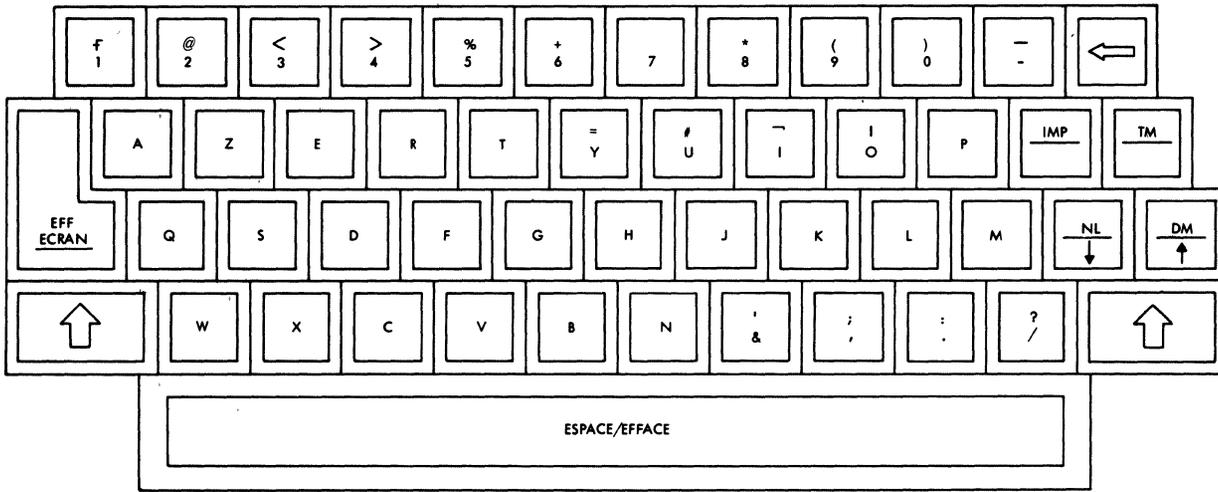


● Figure 30. Optional Numeric Keyboard (United Kingdom)

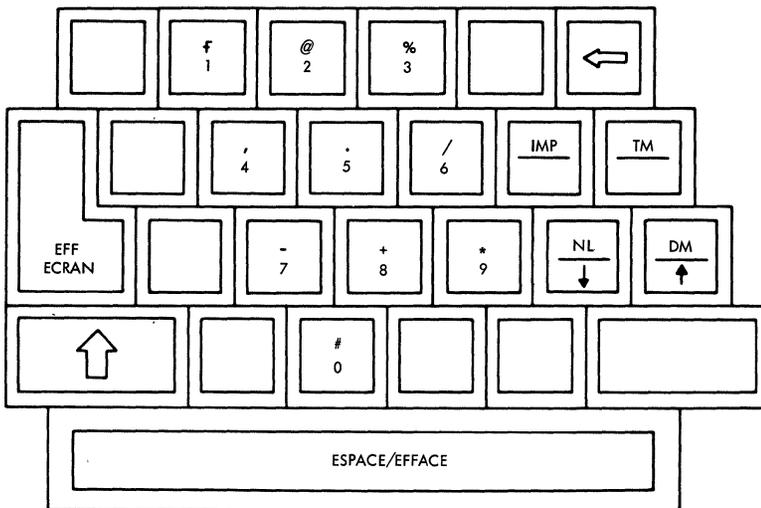


NOTE: This keyboard can be used only on 2260's attached to a 2848, Model 21 or 22.

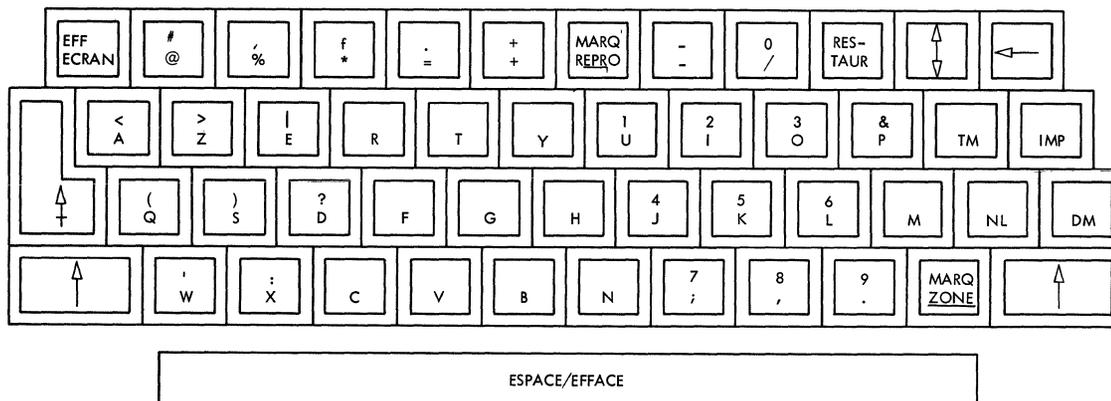
● Figure 31. Optional Alphanumeric-Numeric Inset Keyboard (United Kingdom)



● Figure 32. Optional Alphanumeric Keyboard (French)

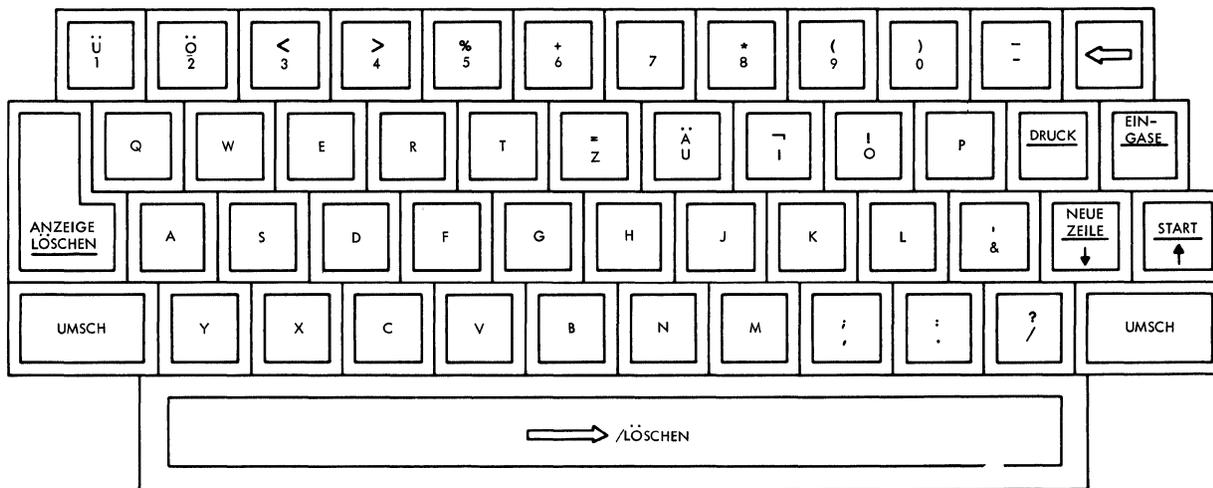


● Figure 33. Optional Numeric Keyboard (French)

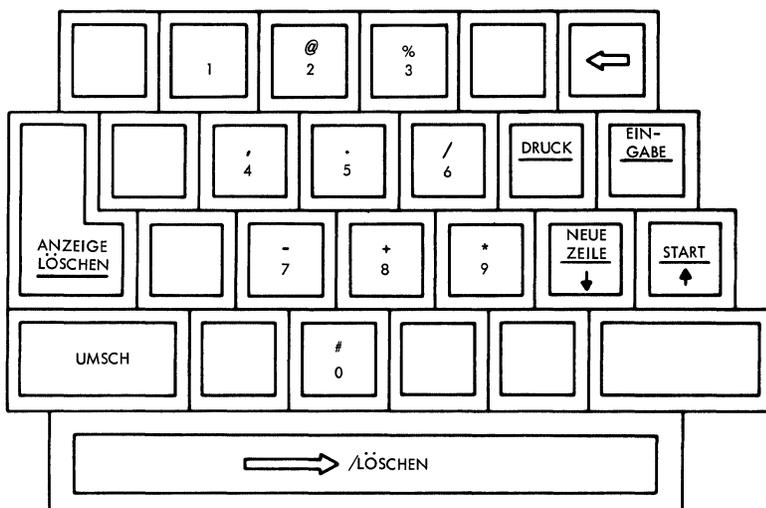


NOTE: This keyboard can be used only on 2260's attached to a 2848, Model 21 or 22.

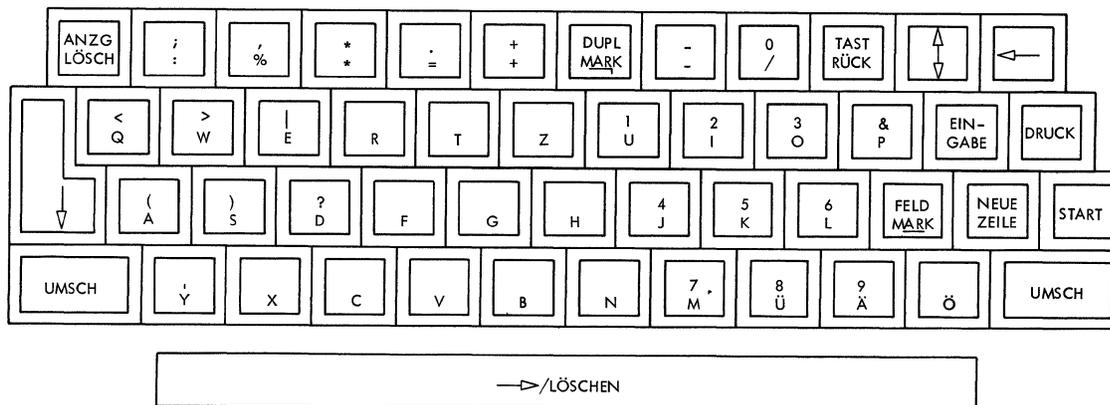
● Figure 34. Optional Alphanumeric-Numeric Inset Keyboard (French)



● Figure 35. Optional Alphanumeric Keyboard (German)



● Figure 36. Optional Numeric Keyboard (German)



NOTE: This keyboard can be used only on 2260's attached to a 2848, Model 21 or 22.

● Figure 37. Optional Alphanumeric-Numeric Inset Keyboard (German)

## IBM 1053 MODEL 4 PRINTER PRINT ELEMENTS

Figure 38 illustrates the characters of the Language-feature-associated 1053 Printer print elements that differ from those of a standard print element. The remaining characters, those not shown in Figure 38 are the same as those contained on a standard print element.

Print Character on Standard Print Element	Print Character on United Kingdom Print Element	Print Character on French Print Element	Print Character on German Print Element
#	#	#	Ä
@	@	@	Ö
\$	£	f	Ü
"	■ (Check)	■	■
!	— (EOM)	—	—
ç	▶ (Start)	▶	▶

● Figure 38. 1053 Print Element Characters

INTRODUCTION

The 2848 operator's panel varies according to the features, model, and serial number, as follows:

1. 2848 Models 1, 2 and 3 with the Channel Adapter but without the Control Unit(CU) Isolation feature, shown in Figure 39.
2. 2848 Models 1, 2, and 3 with the Data Set Adapter, shown in Figure 40.
3. 2848 Models 1, 2, and 3, below serial number 70,000 with the Channel Adapter and the CU Isolation feature, shown in Figure 41.
4. 2848 Models 1, 2, and 3, serial number 70,000 and above, with the Channel Adapter and the Control Unit Isolation feature, and 2848 Models 21 and 22, shown in Figure 42.

Each of the four types of 2848 operator's panels is described separately in the following paragraphs, and details are given on the operation of the controls and indicators.

2848 MODELS 1, 2, 3 WITH CHANNEL ADAPTER, WITHOUT CONTROL UNIT ISOLATION

Operator's panel is shown in Figure 39 and described in the text following.

POWER ON Switch/Indicator

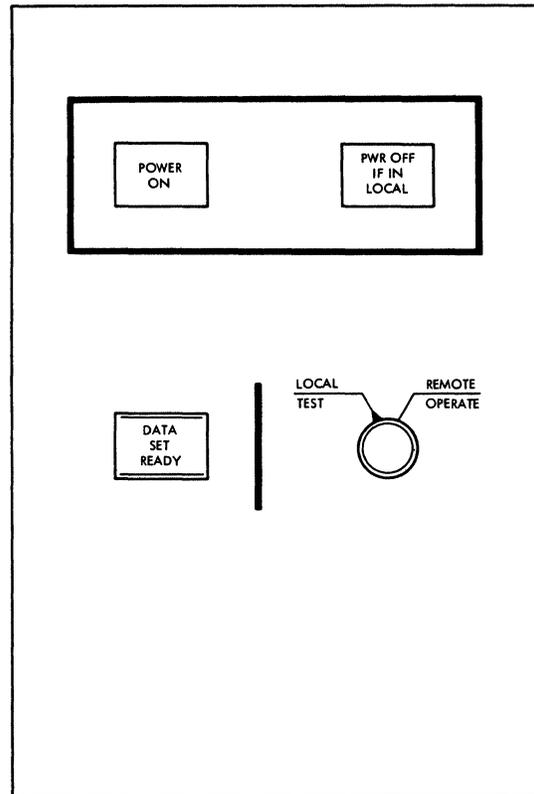
This is an indicating switch that turns the 2848 power on and resets the 2848 controls. The switch contains an indicating lamp that lights when the 2848 power is on. This switch is ineffective unless the LOCAL TEST/REMOTE OPERATE switch is in the LOCAL TEST position. (See "Power On/Off Procedures", following.)

POWER OFF IF IN LOCAL Switch

This switch removes power from the 2848 when the LOCAL TEST/REMOTE OPERATE switch is in the LOCAL TEST position. (See "Power On/Off Procedures.")

DATA SET READY Indicator

This indicator is active only on 2848's equipped with a Data Set Adapter



● Figure 39. Operator's Panel--2848 Models 1,2, and 3 with Channel Adapter, without Control Unit Isolation Feature

LOCAL TEXT/REMOTE OPERATE Switch

This switch is used to logically connect or disconnect the 2848 and the channel (i.e., it places the 2848 on-line or off-line). When this switch is in the REMOTE OPERATE position, the 2848 is logically connected to the channel; i.e., it is on-line. Conversely, when this switch is in the LOCAL TEST position, the 2848 is off-line, or logically disconnected from the channel.

NOTE: The LOCAL TEST/REMOTE OPERATE switch must be in the LOCAL TEST position before either the POWER ON or the POWER OFF IF IN LOCAL switch is effective. When in the REMOTE OPERATE position, power on/off is performed from the processor.

Power On/Off Procedures

Power can be removed from, or applied to, a 2848 in either of two ways:

1. Remotely, via the System/360 processor.
2. Locally, through the power controls on the 2848 operator's panel.

Normally, power is controlled remotely, i.e., via the processor power controls. This requires that the 2848 be in On-Line status; that is, with the LOCAL TEST/REMOTE OPERATE switch in the REMOTE OPERATE position. When the switch is in this position, 2848 powering is under control of the system.

When it is desired to remove or apply 2848 power independently of the system, this is done as described in the following paragraphs.

NOTE: The LOCAL TEST/REMOTE OPERATE switch is for Customer Engineer use only.

#### Power On

1. Place the LOCAL TEST/REMOTE OPERATE switch in the LOCAL TEST position.
2. Press the POWER ON pushbutton. The POWER ON indicator lights when the 2848 attains Power On status.

#### Power Off

1. Place the LOCAL TEST/REMOTE OPERATE switch in the LOCAL TEST position.
2. Press the POWER OFF IF IN LOCAL pushbutton.

#### Power Hold Control

Normally, 2848 power is controlled by the connected computer unless the LOCAL TEST/REMOTE OPERATE switch is set to LOCAL/TEST. When the 2848 is attached to two computers through a two channel switch, however, only one of the computers can have power control. If the controlling computer's power should drop, 2848 power would also drop, thus preventing the 2848's use with the other computer.

To prevent this condition, the Power Hold Control switch (at the rear of the operator's panel) is used to place power control at the 2848. This is accomplished by placing the Power Hold Control switch at LOCAL. Either computer's dropping power has no effect on the 2848 (except Emergency Power Off). Power is brought up or dropped by using the Power On/Power Off switches at the 2848.

The Power Hold Control switch is left in the REMOTE position when a single computer is connected to the 2848.

## 2848 MODELS 1, 2, AND 3 WITH DATA SET ADAPTER

The operator's panel for this type 2848 is shown in Figure 40 and is described in the text following.

#### POWER ON Switch/Indicator

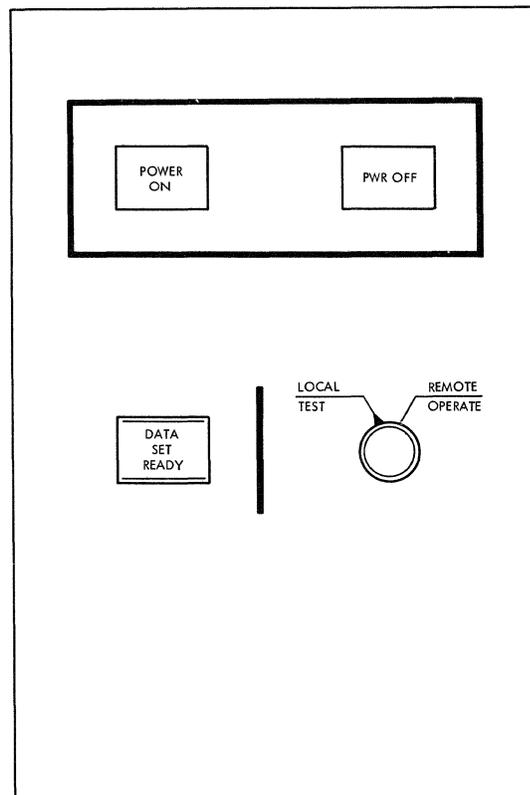
POWER ON, shown in Figure 40, is an indicating switch that turns 2848 power on and resets 2848 controls. The switch contains an indicating lamp that lights when 2848 power is on. (This switch is effective regardless of the position of the LOCAL TEST/REMOTE OPERATE switch.)

#### POWER OFF Switch

This switch removes power from the 2848 and is effective regardless of the position of the LOCAL TEST/REMOTE OPERATE switch.

#### LOCAL TEST/REMOTE OPERATE Switch

This switch is used to logically connect or disconnect the 2848 and associated data set; that is, it places the 2848 on-line or off-line. When this switch is in the REMOTE OPERATE position, the 2848 is on-line,



● Figure 40. Operator's Panel--2848 Models 1, 2, and 3 with Data Set Adapter

and when in the LOCAL TEST position, the 2848 is off-line. 2848 power can be removed or applied with this switch in either position.

NOTE: The LOCAL TEST/REMOTE OPERATE switch is for Customer Engineer use only.

### DATA SET READY Indicator

This indicator is used to indicate the Power On/Off status of the associated data set. The indicator lights when the data set power is on.

### 2848 MODELS 1, 2, AND 3, BELOW SERIAL 70,000, WITH CHANNEL ADAPTER AND CONTROL UNIT ISOLATION FEATURE

The operator's panel for 2848 Models 1, 2, and 3 (below serial number 70,000) equipped with a Channel Adapter and the Control Unit Isolation Feature is shown in Figure 41 and described in the text following.

### POWER ON Switch/Indicator

Pressing POWER ON turns 2848 power on and resets 2848 controls. The switch contains an indicator lamp which lights when 2848 power is on. (The POWER ON switch is not effective unless the LOCAL TEST/REMOTE OPERATE switch is in the LOCAL TEST position.) (See "Power On/Off Procedures", following.)

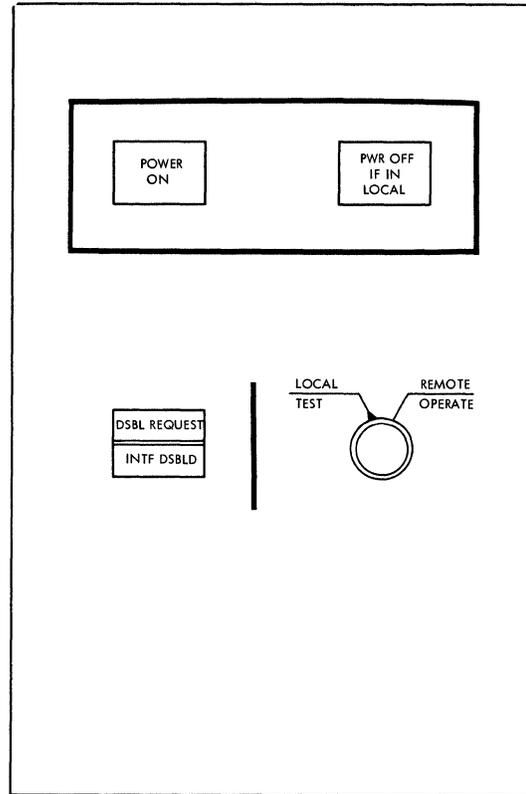
### POWER OFF IF IN LOCAL Switch

The POWER OFF IF IN LOCAL switch removes power from the 2848. (This switch is effective only when the LOCAL TEST/REMOTE OPERATE switch is in the LOCAL TEST position.) (See "Power On/Off Procedures", following.)

### LOCAL TEST/REMOTE OPERATE Switch

This switch is used to logically connect or disconnect the 2848 and the channel; that is, it places the 2848 on-line or off-line. When this switch is in the REMOTE OPERATE position, the 2848 is logically connected to the channel; it is on-line. Conversely, when this switch is in the LOCAL TEST position, the 2848 is off-line, or logically disconnected from the channel.

NOTE: This switch must be in the LOCAL TEST position before either the POWER ON or POWER OFF IF IN LOCAL switch is



● Figure 41. Operator's Panel--2848 Models 1, 2, and 3, below Serial Number 70,000, with Channel Adapter and Control Unit Isolation Feature

effective. When the switch is in the REMOTE OPERATE position, power on/off is performed from the processor. (See "Power On/Off Procedures", following.)

When transferring between on-line and off-line status, this switch must be used with the DSBL REQUEST switch, as described in "On-Line/Off-Line Transitions", following.

NOTE: The LOCAL TEST/REMOTE OPERATE switch is for Customer Engineer use only.

### DSBL REQUEST/INTF DSBLD Switch/Indicators

This switch and indicators combination permits on-line/off-line transitions and the application or removal of 2848 power without generating spurious electrical signals which can induce error conditions on the CPU, channel, or other control unit. It is used with the LOCAL TEST/REMOTE OPERATE switch, as described in "On-Line/Off-Line Transition."

## On-Line/Off-Line Transition

To transfer the 2848 between On-Line and Off-Line status, follow the appropriate procedure. Performance of the procedures requires that 2848 power be on.

### On-Line to Off-Line

1. Press the DSBL (disable) REQUEST switch. The DSBL REQUEST indicator (upper indicator) should light.
2. Wait for the INTF DSBLD (interface disabled) indicator (lower indicator) to light. The INTF DSBLD indicator lights when the CPU enters a wait or stopped state.
3. When the INTF DSBLD indicator lights, set the LOCAL TEST/REMOTE OPERATE switch to the LOCAL TEST position. After this, the 2848 is in Off-Line status.

### Off-Line to On-Line

1. The DSBL REQUEST and INTF DSBLD indicators must be on. If not on, operate the DSBL REQUEST and wait until both indicators are lit.
2. Set the LOCAL TEST/REMOTE OPERATE switch from the LOCAL TEST to the REMOTE OPERATE position.
3. Press DSBL REQUEST switch. The DSBL REQUEST indicator should go off. Wait for the INTF DSBLD indicator to go off.
4. When the INTF DSBLD indicator goes off, the 2848 is in On-Line status.

## Power On/Off Procedures

Power can be removed or applied to a 2848 in either of two ways:

1. Remotely, via the System/360 processor.
2. Locally, through the power controls on the 2848 operator's panel.

Normally, power is controlled remotely, via the processor power controls. This requires that the 2848 be in On-Line status, that is, with the LOCAL TEST/REMOTE OPERATE switch in the REMOTE OPERATE position. When the switch is in this position, 2848 powering is under control of the system.

When it is desired to remove or apply 2848 power independently of the system, it is performed as described in the following paragraphs.

## Power On

1. Place the LOCAL TEST/REMOTE OPERATE switch in the LOCAL TEST position.
2. Press the POWER ON pushbutton. The POWER ON indicator lights when the 2848 attains Power On status.
3. To place the 2848 on-line, see "On-Line/Off-Line Transition," following.

## Power Off

1. Place the 2848 in Off-Line status. See "On-Line/Off-Line Transition."
2. Press the POWER OFF IF IN LOCAL switch.

## Power Hold Control

Normally, 2848 power is controlled by the connected computer unless the LOCAL TEST/REMOTE OPERATE switch is set to LOCAL/TEST. When the 2848 is attached to two computers through a two channel switch, however, only one of the computers can have power control. If the controlling computer's power should drop, 2848 power would also drop, thus preventing the 2848's use with the other computer.

To prevent this condition, the Power Hold Control switch (at the rear of the operator's panel) is used to place power control at the 2848. This is accomplished by placing the Power Hold Control switch at LOCAL. Either computer's dropping power has no effect on the 2848 (except Emergency Power Off). Power is brought up or dropped by using the Power On/Power Off switches at the 2848.

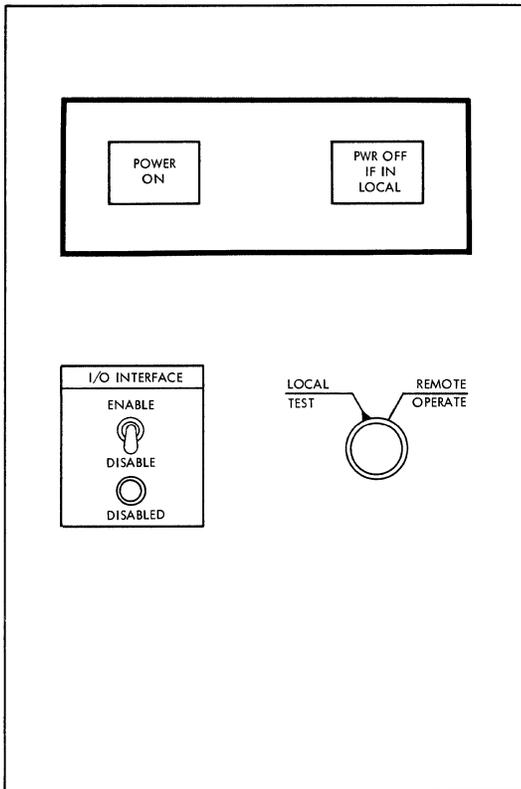
The Power Hold Control switch is left in the REMOTE position when a single computer is connected to the 2848.

2848 MODELS 1, 2, AND 3, SERIAL 70,000 AND ABOVE, WITH CHANNEL ADAPTER AND CONTROL UNIT ISOLATION, AND 2848 MODELS 21, 22

The operator's panel for these 2848's is shown in Figure 42 and described in the following text.

## POWER ON Switch/Indicator

Pressing POWER ON turns 2848 power on and resets 2848 controls. The switch contains an indicator lamp which lights when 2848 power is on. (The POWER ON switch is not effective unless the LOCAL TEST/REMOTE OPERATE switch is in the LOCAL



● Figure 42. Operator's Panel--2848 Models 1, 2, and 3, Serial Number 70,000 and above, with Channel Adapter and Control Unit Isolation Feature, and Models 21 and 22

TEST position.) (See "Power On/Off Procedures," following.)

#### POWER OFF IF IN LOCAL Switch

The POWER OFF IF IN LOCAL switch removes power from the 2848. (This switch is effective only when the LOCAL TEST/REMOTE OPERATE switch is in the LOCAL TEST position.) (See "Power On/Off Procedures", following.)

#### LOCAL TEST/REMOTE OPERATE Switch

This switch is used to logically connect or disconnect the 2848 and the channel; that is, it places the 2848 on-line or off-line. When this switch is in the REMOTE OPERATE position, the 2848 is logically connected to the channel; it is on-line. Conversely, when this switch is in the LOCAL TEST position, the 2848 is off-line, or logically disconnected from the channel.

NOTE: This switch must be in the LOCAL TEST position before either the POWER ON switch or the POWER OFF IF IN LOCAL switch is effective. When it is in the REMOTE OPERATE position, power on/off is performed from the processor. (See "Power On/Off Procedures", following.)

When transferring between On-Line and Off-Line status, this switch must be used with the ENABLE/DISABLE switch, as described in "On-Line/Off-Line Transition," following.

NOTE: The LOCAL TEST/REMOTE OPERATE switch is for Customer Engineer use only.

#### ENABLE/DISABLE Switch

This switch permits on-line/off-line transitions and the application or removal of 2848 power without generating spurious electrical signals which can induce error conditions on the CPU, channel, or other control unit. It is used with the LOCAL TEST/REMOTE OPERATE switch and the DISABLED indicator, as described in "On-Line/Off-Line Transition."

#### DISABLED Indicator

The DISABLED indicator is used with the ENABLE/DISABLE switch during on-line/off-line transitions and power on/off operations.

The indicator lights when the ENABLE/DISABLE switch is in the DISABLE position and the CPU enters a wait or stopped state. (See "On-Line/Off-Line Transition," following.)

#### On-Line/Off-Line Transition

To transfer the 2848 between On-Line and Off-Line status, follow the appropriate procedure. Performance of the procedures requires that 2848 power be on.

#### On-Line to Off-Line

1. Place the ENABLE/DISABLE switch in the DISABLE position.
2. Wait for the DISABLED indicator to light. The indicator lights when the CPU enters a wait or stopped state.
3. When the DISABLED indicator lights, transfer the LOCAL TEST/REMOTE OPERATE switch to the LOCAL TEST position. After this, the 2848 is in Off-Line status.

#### Off-Line to On-Line

1. The ENABLE/DISABLE switch should be in the DISABLE position, and the DISABLED indicator should be lit.
2. Set the LOCAL TEST/REMOTE OPERATE switch from the LOCAL TEST to the REMOTE OPERATE position.

3. Place the ENABLE/DISABLE switch in the ENABLE position. When the DISABLED indicator goes off, the 2848 is in On-Line status.

NOTE: The DISABLED indicator will go off when the CPU enters a wait or stopped state.

#### Power On/Off Procedures

Power can be removed or applied to a 2848 either of two ways:

1. Remotely, via the System/360 processor.
2. Locally, using the power controls on the 2848 operator's panel.

Normally, power is controlled remotely, i.e., via the processor power controls. This requires that the 2848 be in On-Line status; i.e., the LOCAL TEST/REMOTE OPERATE switch is in the REMOTE OPERATE position. When the switch is in this position, 2848 powering is under control of the system.

To remove or apply 2848 power, independent of the system, follow the instructions given in the following paragraphs.

#### Power On

1. Place the ENABLE/DISABLE switch in the DISABLE position.
2. Place the LOCAL TEST/REMOTE OPERATE switch in the LOCAL TEST position.
3. Press the POWER ON switch. The POWER ON indicator lights when the 2848 attains Power On status.

4. To place the 2848 on-line, see "On-Line/Off-Line Transition," preceding.

#### Power Off

1. Place the 2848 in Off-Line status. (See "On-Line/Off-Line Transition.")
2. When the 2848 is in Off-Line status, press the POWER OFF IF IN LOCAL switch.

#### Power Hold Control

Normally, 2848 power is controlled by the connected computer unless the LOCAL TEST/REMOTE OPERATE switch is set to LOCAL/TEST. When the 2848 is attached to two computers through a two channel switch, however, only one of the computers can have power control. If the controlling computer's power should drop, 2848 power would also drop, thus preventing the 2848's use with the other computer.

To prevent this condition, the Power Hold Control switch (at the rear of the operator's panel) is used to place power control at the 2848. This is accomplished by placing the Power Hold Control switch at LOCAL. Either computer's dropping power has no effect on the 2848 (except Emergency Power Off). Power is brought up or dropped by using the Power On/Power Off switches at the 2848.

The Power Hold Control switch is left in the REMOTE position when a single computer is connected to the 2848.

APPENDIX D. EXTENDED CURSOR CONTROL FEATURE

**EXTENDED CURSOR CONTROL FEATURE  
 (FC 3605, FC 3606, FC 3607, and FC 3901)**

Features 3605, 3606, and 3607 are available for 2260 Display Station Models 1 or 2. Feature 3605 is the Extended Cursor Control Alphameric-Numeric Inset Keyboard, Feature 3606 is the Extended Cursor Control Alphameric Keyboard, and 3607 is the Extended Cursor Control Numeric Keyboard.

Feature 3901 and Nondestructive Cursor features 5340 and 5341 are prerequisites on the associated 2848. Functions provided by these features are described in the following paragraphs. Figures 43, 44, and 45 show the three possible 2260 keyboards; Figure 46 shows the location of the erase pushbuttons.

NOTE: The TAB key occupies the erase key position. The erase key is added to the vertical portion of the keyboard housing above the 2260 keyboard.

As a feature, labeling is available on the new key and pushbuttons in a choice of three languages, as follows:

<u>United Kingdom</u>	<u>French</u>	<u>German</u>
TAB	Tab	Tab
ERAS-EOS	EFF-FDE	LO- E. B.
ERAS-EOL	EFF-DFL	LO- E. Z.

Tab Function

This function permits keyboard indexing of the cursor. Pressing the Tab key causes the cursor to advance and search for a colon. Upon detecting a colon, the cursor stops in the character position immediately following the colon. There is no change in the display other than the repositioning of the cursor. 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.

The tab operation on the 2260 Display Station is performed in a manner similar to the tab operation on a conventional typewriter. A colon, displayed on the 2260 screen, serves the same purpose as the typewriter tab stops. Colons are entered in the desired locations on the display, either by pressing the colon key on the 2260 or, under program control, as part of transmitted text from the CPU.

When the Tab key on the 2260 keyboard is pressed, the keyboard is locked, and a search for a colon is initiated, beginning at the cursor's present position.

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 repositioned to the character location immediately following the colon, but if checking is continued to the end of the screen and no colon is found, the cursor is repositioned 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 character 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 tab operation can be initiated from the 2260 keyboard only. No provision is made for a remote tab operation by means of any USASCII or unique control characters.

The Tab key is mechanically interlocked to prevent erroneous operation of the display if another key on the keyboard is pressed before 2848 acceptance of the Tab key function. The keyboard remains locked until the colon-search operation is completed.

During colon-search operations, the character-by-character comparison is performed at a rate of approximately 0.4ms per character for characters on the same line of the display. For the 2848 Models 1, 2, or 3, a pause occurs at the start of the search operation on each new line. This pause is a multiple of 16.7ms, during which other keyboards on the same 2848 or the 2848 interface with the CPU can be serviced. The pause duration depends on the number and priority of other 2260's waiting for service. A pause does not occur in the 2848 Models 21 or 22.

Rapid Cursor Function

When the SPACE bar is pressed fully to its final stop (in either upper or lower case), the cursor moves forward (advances) at a rate of approximately ten characters per second. Repeated spacing continues as long as the SPACE bar is fully pressed. (The cursor is advanced one character position when the SPACE bar is pressed lightly.) If the Shift key is pressed while the SPACE bar is fully pressed, each character position through which the cursor passes is erased (rapid space/erase function); otherwise, if the Shift key is not pressed, cursor movement does not cause an erase (rapid advance function).

Cursor movement is accomplished by generation (in the 2260) of a series of advance functions (advance only) or space functions (space/erase) to the 2848, at intervals of approximately 100ms. Other 2260's can be serviced between each space function or blank character. In the 2848 Models 21 and 22, up to five advance or space functions may be stored in the keyboard buffer before actual spacing occurs.

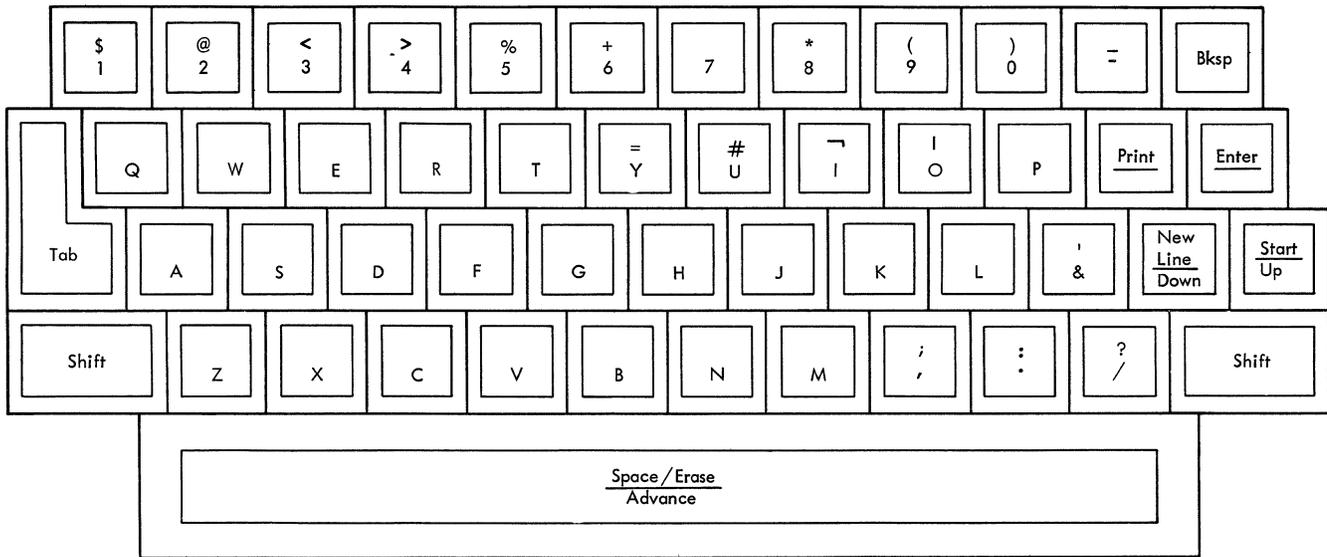
Erase to End of Screen (EOS) Function

An erase pushbutton, labeled ERAS-EOS, is added to the vertical portion of the keyboard housing above the 2260 keyboard. When this noninterlocked pushbutton is pressed, erasing of the display begins at

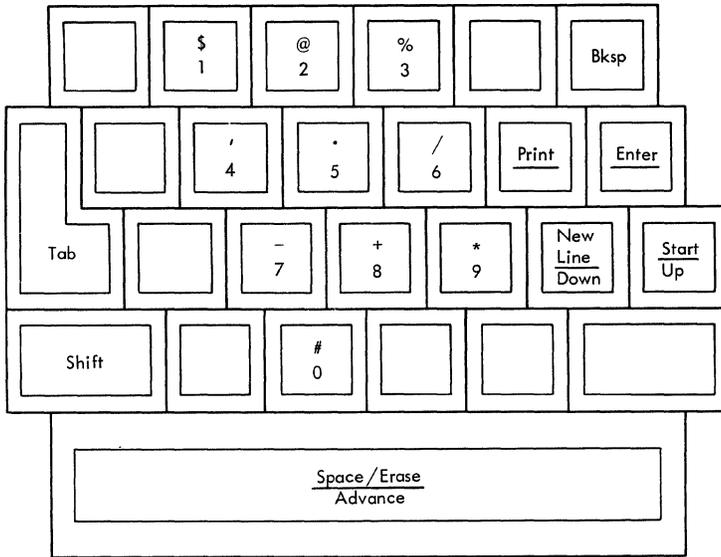
the present position of the cursor and continues, by row, to the end of the screen. After the erase function is completed, the cursor returns to the character position from which it started.

Erase to End of Line (EOL) Function

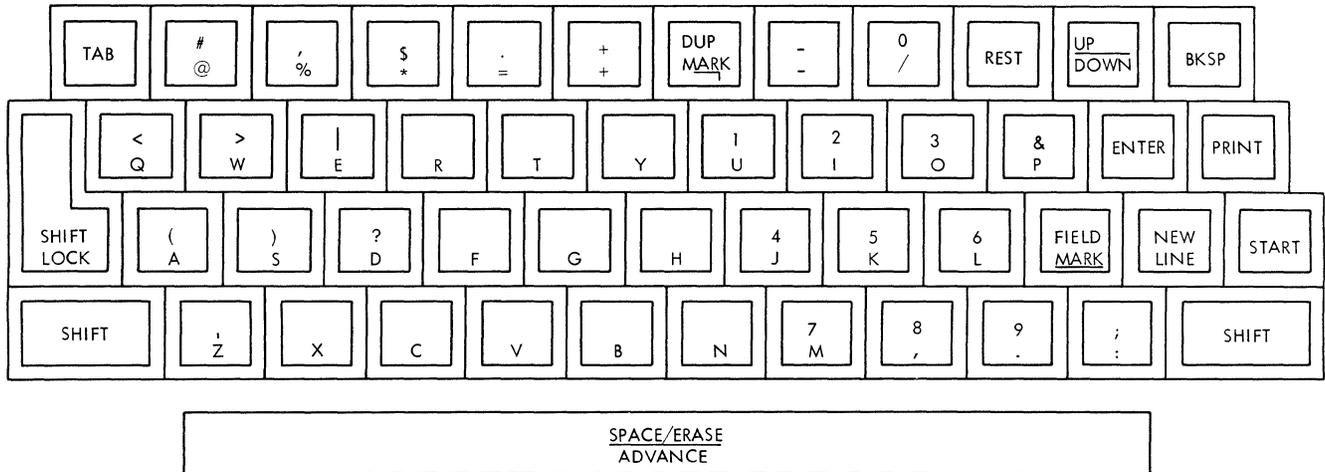
A second noninterlocked erase pushbutton, labeled ERAS-EOL, is added to the vertical portion of the keyboard housing above the keyboard. When this pushbutton is pressed, erasing of the display begins at the cursor position and continues to the end of the line containing the cursor. After the erase function is completed, the cursor returns to the character position from which it started.



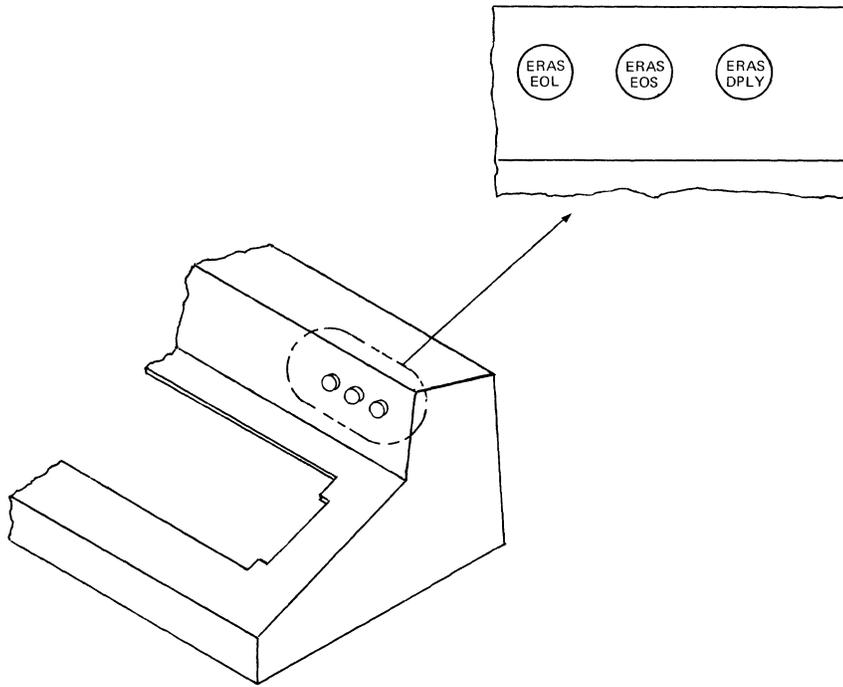
● Figure 43. Extended Cursor Control Alphameric Keyboard Feature



● Figure 44. Extended Cursor Control Numeric Keyboard Feature



● Figure 45. Extended Cursor Control Alphanumeric-Numeric Inset Keyboard Feature



● Figure 46. Location of Erase Pushbuttons with Extended Cursor Control Feature

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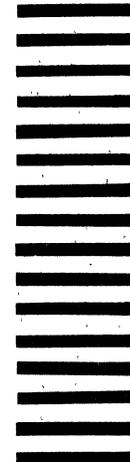
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## IBM SYSTEM/360 COMPONENT DESCRIPTION:

IBM 2260 DISPLAY STATION

IBM 2848 DISPLAY CONTROL

This Technical Newsletter provides replacement pages for the IBM System/360 Component Description: IBM 2260 Display Station/IBM 2848 Display Control manual, Form A27-2700-4. Pages to be inserted and/or removed are listed below.

iii, iv  
v, Frontispiece  
11, 12  
15, 16  
16.1 (added)  
63, 64  
69, 70  
71, 72  
79, 80  
92.1, 92.2 (added)  
92.3, 92.4 (added)  
93, 94  
95, blank

A change to the text or a small change to an illustration is indicated by a vertical line to the left of the change; a changed or added illustration is denoted by the symbol ● to the left of the caption.

### Summary of Amendments

This Technical Newsletter contains a description of the Extended Cursor Control feature for the 2260 Display Station/2848 Display Control.

File this cover letter at the back of the manual to provide a record of changes.

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