

# Displaywriter System

## Communications Service Manual

Revised February, 1983  
S241-6439-2



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Revised February, 1983  
S241-6439-

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This publication is for use by persons repairing the IBM Displaywriter System Communications hardware.

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## **PREFACE**

### **PURPOSE**

This manual contains information and procedures necessary to repair the IBM Displaywriter System Communications equipment.

### **AUDIENCE**

The primary audience for this book are IBM Customer Service Representatives who are trained to repair the IBM Displaywriter System Communications equipment.

The secondary audience for this book are other persons repairing the IBM Displaywriter System communications equipment.

### **CONTENTS**

- Chapter one is a general introduction to communications. This chapter describes line types, modems, and features.
- Chapters two and describe the ASYNC protocol and diagnostics.
- Chapters four and five describe the BES protocols and diagnostics.
- Chapter six describes the 3270 Data Stream Compatibility feature protocol and operations.
- Chapter seven describes the Electronic Document Distribution feature and its operating characteristics.
- Chapter eight describes the 3270 DSC and EDD diagnostics.
- Chapters nine and ten describe the X.21 interface and the diagnostics.
- Chapter eleven describes the tools and test procedures used to service the Displaywriter communications equipment.
- Chapter thirteen contains cable, connector, and test point diagrams used to service the Displaywriter communications equipment.

## RELATED PUBLICATIONS

- IBM Displaywriter Product Support Manual, S241-6248.
- IBM Systems Network Architecture Handbook Customer Service Division, S229-4522.
- IBM Displaywriter System Asynchronous Communications Feature Operating Guide, S544-2026.
- IBM Displaywriter System Operating Guide BSC Features, S544-2027.
- IBM Displaywriter 3270 Emulation General Information Manual, G544-2049.
- IBM Displaywriter 3270 Data Stream Compatibility Feature Licensed Program Feature Operator's Guide, S544-2081.
- IBM Displaywriter System Electronic Document Distribution Operator's Guide, S544-2184.
- IBM Implementation of X.21 Interface General Information Manual, GA27-3287.

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## CHAPTER 1. COMMUNICATIONS INTRODUCTION

### COMMUNICATION CAPABILITIES

The IBM Displaywriter System has four communication licensed programs; Asynchronous (ASYNC), Binary Synchronous (BSC), 3270 Data Stream Compatibility Feature (3270 DSC) and Electronic Document Distribution (EDD). The ASYNC and BSC applications enable a Displaywriter to conduct communication sessions in terminal-to-terminal and terminal-to-host operating modes. The 3270 DSC facility enables a Displaywriter to access IBM host computers using 3270 application programs. EDD allows the Displaywriter to electronically distribute and exchange documents with compatible equipment.

### COMMUNICATION FACILITY

The communications facility is defined as the modems and line (usually a voice grade telephone line) over which a terminal such as Displaywriter can exchange information with a remote station (see Figure 1-1).

Modems are electronic devices that convert digital information signals used by terminals to and from voice compatible (analog) signals that can be sent over a telephone line.

Duplex is the transmission of information in both directions at the same time.

Half-duplex is the transmission of information in both directions, but not at the same time.

The Displaywriter is capable of duplex operation using ASYNC Communications and requires a communication facility providing duplex service. BSC and SDLC communications never exchange information in both directions simultaneously, thus either a duplex or half-duplex facility can be used.

A facility providing half-duplex service consists of half-duplex modems and a single (2-wire) telephone line. A facility providing duplex service might consist of duplex modems and either a single (2-wire) telephone line or two telephone lines (4-wire), depending on the modem.

### COMMUNICATION LINE TYPES

The Displaywriter can operate over a switched line or a nonswitched line. The type of line installed determines many of the machine's functions and operating procedures for communications.

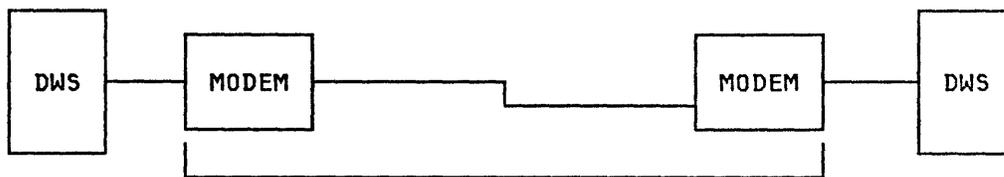


Figure 1-1. Communication Facility Example

## SWITCHED NETWORK

A switched network station can communicate with any other compatible station. A connection is made by placing a telephone call from one switched network station to another. When transmission has been completed, the connection can be terminated either manually or automatically. See Figure 1-2.

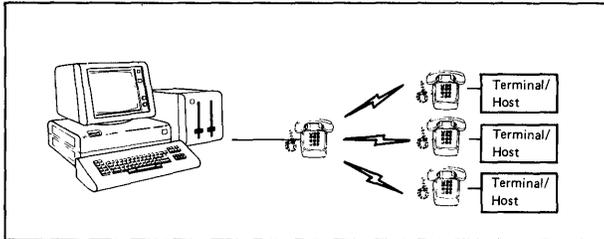


Figure 1-2. Switched Network Operations

## NONSWITCHED LINE

A nonswitched line provides a permanent, continuous connection between two stations. A telephone call is not necessary to start communications. Communications are only between the two connected points. See Figure 1-3.

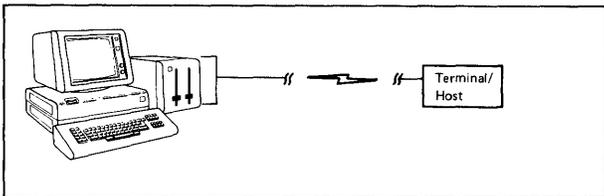


Figure 1-3. Nonswitched Line Operations

## SWITCHED NETWORK BACKUP (SNBU)

A Displaywriter can be set up for both nonswitched line and switched network operations if the Displaywriter is equipped with the switched network backup (SNBU) feature which uses the Select Standby lead on the EIA interface. This dual line arrangement allows the machine to operate over a nonswitched line, with a switched network as a backup. See Figure 1-4.

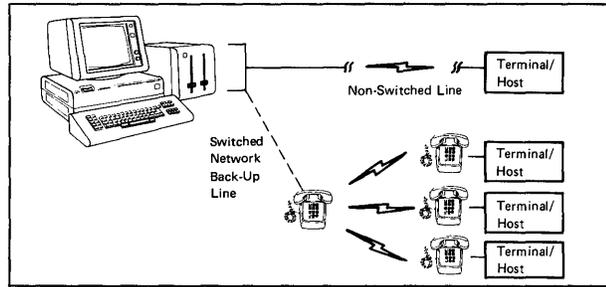


Figure 1-4. Switched Network Backup Operations

## CCITT X.21 INTERFACE

The X.21 interface allows the connection of the Displaywriter to Public Data Networks.

## EXTERNAL MODEMS

External modems are attached to a Displaywriter workstation by an EIA RS-232C (CCITT V.24) interface. External modems such as the IBM 3863 or 3872 and non-IBM modems compatible with EIA RS-232C (CCITT V.24) interfaces may be attached. The external modem may be attached by an external cable directly to the EIA/CCITT Interface Port (Port 4) of the electronics module.

When a Displaywriter System is configured for anything other than a single EIA, the communications adapter card is always in the diskette unit. The first external modem is attached to the EIA/CCITT interface on the communications adapter card by cabling through Port 4a of the diskette unit. An additional EIA/CCITT Interface Converter card is used to attach the second external modem cable. This external modem cable goes through Port 4b to the EIA/CCITT Interface Converter Card. The EIA/CCITT Interface Converter Card converts the internal modem interface signals to EIA/CCITT levels and the EIA/CCITT levels to internal modem interface signals.

## INTERNAL MODEMS

Internal modems are driven by the internal modem interface of the communications adapter card. This interface, which is available only when the communications adapter is located in the Displaywriter diskette unit, supports only a Local Device Controller (LDC).

## Local Device Controller (LDC)

The Local Device Controller feature is an integrated modem device within the Displaywriter that is used to transmit and receive data over a customer-provided twinaxial cabling system. The maximum length of this cabling system is 1538 meters (5000 feet). See Figure 1-5.

The LDC allows the Displaywriter to communicate with another Displaywriter in a half-duplex, point-to-point mode. Each Displaywriter attaches to the communications line through an isolation transformer on the LDC. The communications line is terminated at each end with 55 ohm resistors.

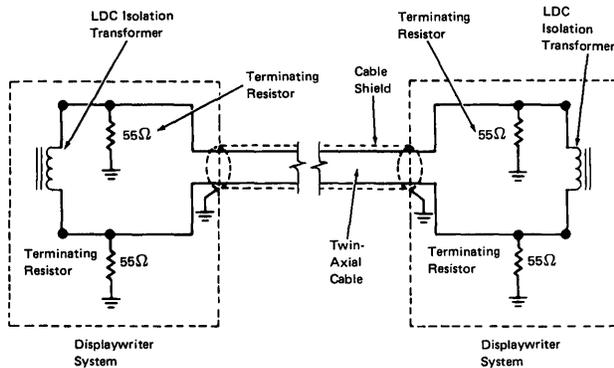


Figure 1-5. Local Device Controller Communications

The LDC converts one cycle of 40 KHz sine wave to a single data bit. The phase of the sine wave determines the value of the data bit (one or zero). This is shown in Figure 1-6.

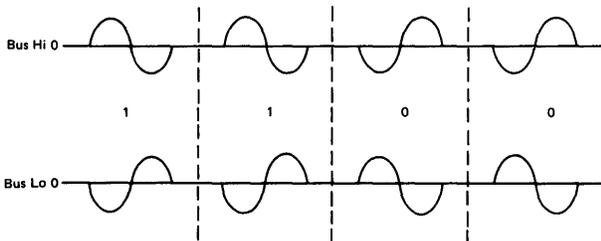


Figure 1-6. Phase of Sine Wave Determines Value of Data Bit

The LDC also converts a single data bit to one cycle of a 40 kHz sine wave and transmits it over the communications line. The data bit rate may be switched to operate at speeds of 1200, 2400, or 4800. In addition, the

LDC supplies clocking for itself and the communications adapter card. The LDC converts (serializes) the communications line signals into logic level signals and passes the serial data to the communications adapter card. The adapter card converts the serial data into the parallel format used by the rest of the Displaywriter System.

## EIA INTERFACE CABLE

A shielded EIA/CCITT external cable is used to connect the Displaywriter to an external modem. This cable is labeled '4' and can be used on EIA/CCITT Port 4, 4a or 4b depending upon the hardware configuration. Figure 1-7 is an illustration of the connector at the end of the communications cable. It is a 25-pin modem plug that is compatible with an EIA RS-232C connector.

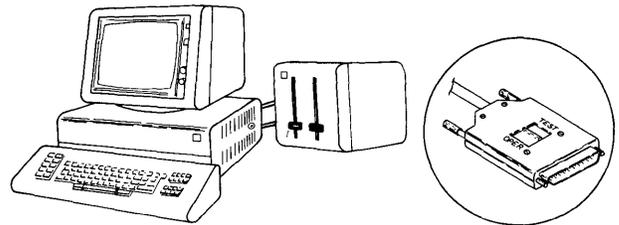


Figure 1-7. EIA Interface Cable.

The following signal circuits are provided by Displaywriter:

- Circuit AB - CCITT 102 - Pin 7. Signal Ground
- Circuit BA - CCITT 103 - Pin 2 - Transmitted Data (TD). This circuit sends data which the modem/DCE modulates and transmits.
- Circuit BB - CCITT 104 - Pin 3 - Received Data (RD). On this circuit, the modem/DCE sends received data to the Displaywriter.
- Circuit CA - CCITT 105 - Pin 4 - Request to Send (RTS). Request to Send is active when the Displaywriter is ready to transmit. If DSR is on, RTS brings up carrier. In half-duplex operation, the ON condition maintains the DCE in the transmit mode and inhibits the receive mode.

- Circuit CB - CCITT 106 - Pin 5 - Clear to Send (CTS). Clear to Send indicates the local modem/DCE is ready to transmit. It is started by RTS (Pin 4), but there is a delay before Clear to Send goes active and data transmission begins (called RTS-CTS delay). This delay occurs only in half-duplex mode.
- Circuit CC - CCITT 107 - Pin 6 - Data Set Ready (DSR). This circuit indicates to the system there is power at the modem. On a switched network, DSR indicates a dialed connection has been completed.
- Circuit CF - CCITT 109 - Pin 8 - Received Line Signal Detector (RLSD). This circuit is active when the modem/DCE is receiving a valid signal from the communications line. An inactive condition indicates no signal is being received or the received signal is not valid.
- CCITT 116 - Pin 11 - Select Standby (SS). This circuit is active when the SNBU option is selected.
- Circuit DB - CCITT 114 - Pin 15 - Modem/DCE Transmit Clock: Signal Element Timing. A clock signal produced by the modem/DCE. This signal is used to clock out Transmit Data. When business machine clocking is used, this circuit is not used.
- Circuit DD - CCITT 115 - Pin 17 - Modem/DCE Receive Clock: Signal Element Timing. The receive clock signal is sent from the modem/DCE. The Displaywriter receive data rate is regulated by this circuit. When business machine clocking is used, this circuit is not used.
- CCITT 141 - Pin 18 - Test. Local Loop Back.
- Circuit CD - CCITT 108 - Pin 20 - Data Terminal Ready (DTR). This circuit signals the Displaywriter is ready for operation.
- Circuit CE - CCITT 125 - Pin 22 - Ring Indicate (RI). This circuit indicates a ringing signal is on the communications channel. This circuit determines the calling or called status.
- Circuit CH - CCITT 111 - Pin 23 - Data Signal Rate Select (DSRS).

This circuit selects the modem/DCE data transmission rate, if the modem/DCE supports an optional rate. If the signal is active, normal speed is selected. If the signal is inactive, half-speed is selected.

**Note:** For some local attachments, the Displaywriter can operate with modem eliminators and null modem connectors that strictly comply with the EIA RS-232C specifications.

#### COMMUNICATION HARDWARE

The communications feature hardware can interface with switched or non-switched (leased) networks. Depending on which Displaywriter communications feature is used, the communications hardware is located in either the electronics module or the diskette unit. The possible hardware configurations are:

- Single EIA Interface (One external modem)
- Dual EIA Interface (Two external modems)
- LDC (Local Device Controller)
- LDC and EIA Interface (One Local Device Controller and one external modem)
- X.21 Interface

When a single external modem is used, the hardware is in the electronics module. For all other configurations, the hardware is in the diskette unit.

When two modems, or a LDC and a modem are configured, only one can be used at a time.

#### **SINGLE EIA**

When a single external modem is used, the external modem cable is attached to the EIA/CCITT Port 4 of the electronics module as shown in Figure 1-8

The communications adapter card is located in position A of the electronics package and is connected to the base panel as shown in Figure 1-9 .

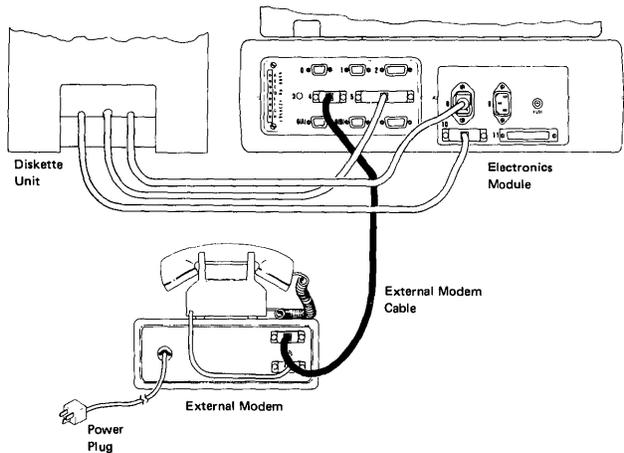


Figure 1-8. Single EIA Configuration

The communications adapter card (position C) and the EIA card (position D) are located in the diskette distribution board and connected to the back panel as shown in Figure 1-11.

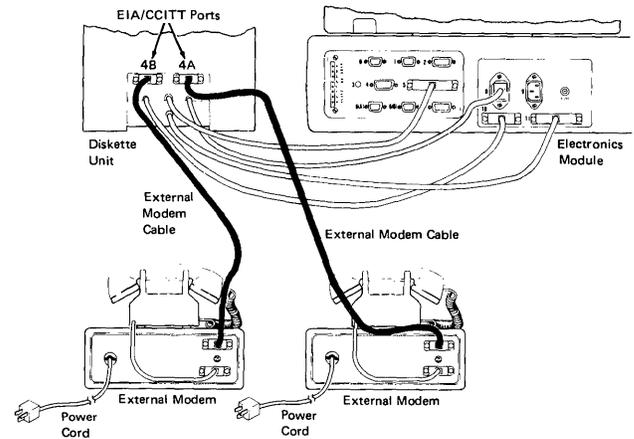


Figure 1-10. Dual EIA Configuration

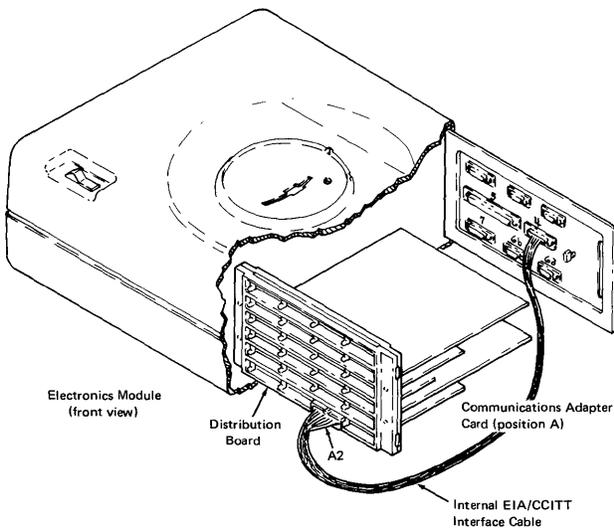


Figure 1-9. Electronics Module - Single EIA Configuration

### DUAL EIA INTERFACE

When dual external modems are used two external modem cables are attached to the EIA/CCITT Ports 4a and 4b of the diskette unit as shown in Figure 1-10.

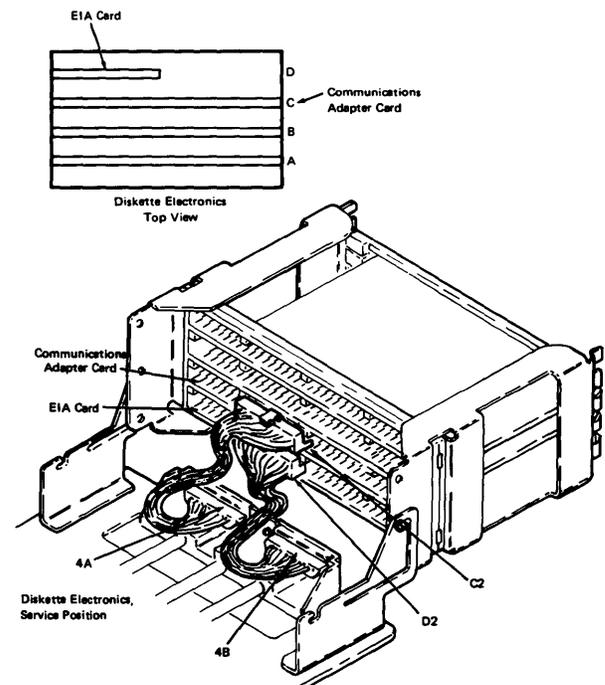


Figure 1-11. Diskette Electronics - Dual EIA Configuration

## X.21 CONFIGURATION

Displaywriters using the X.21 interface will have the communication adapter card installed in position C of the diskette distribution board and the X.21 interface adapter card located in position D.

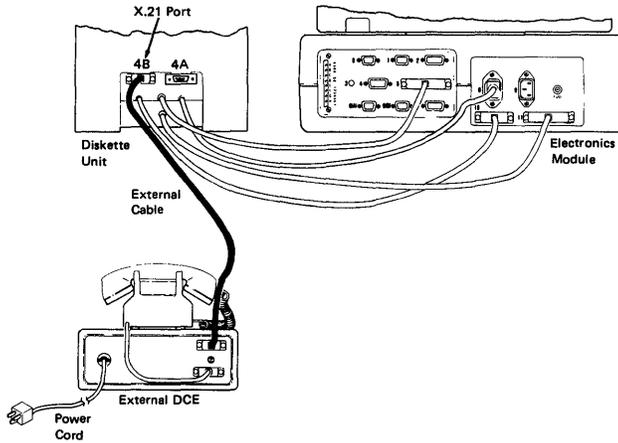


Figure 1-12. X.21 Configuration

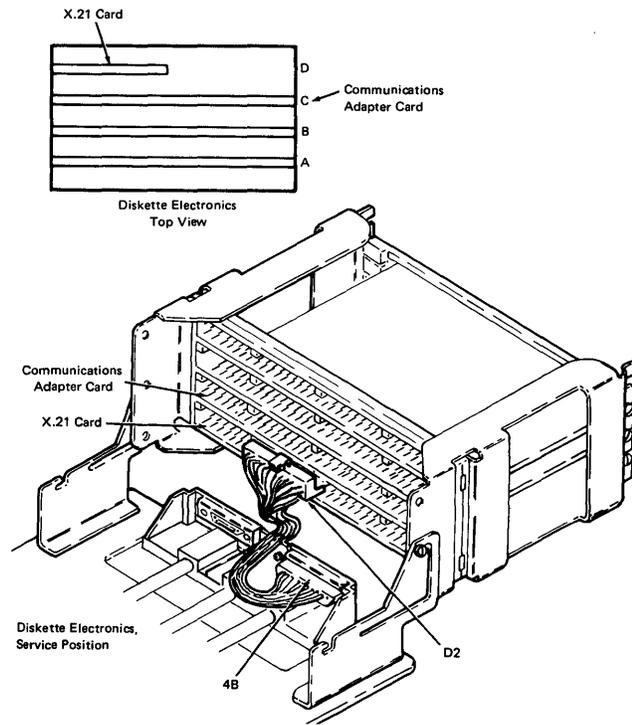


Figure 1-13. Diskette Electronics - X.21 Configuration

## LOCAL DEVICE CONTROLLER CONFIGURATION

An LDC is an internal card that allows for synchronous communication between two locally-attached machines. A twinaxial cable, which can have a maximum length of 1538 meters (5000 feet), is used for the local line attachment. Line speeds of up to 4800 bps are supported.

### LDC AND OPTIONAL EIA

When the LDC is used, an optional EIA/CCITT interface can also be installed to connect the communications adapter card EIA/CCITT interface (C2) to Port 4a. The LDC is attached internally from D3 to Port 4b. The LDC cable is attached to Port 4b and the external modem cable is attached to Port 4a of the diskette unit as shown Figure 1-14.

The communications adapter card and the LDC card are located in positions C and D of the diskette distribution board and connected to the back panel as shown in Figure 1-15.

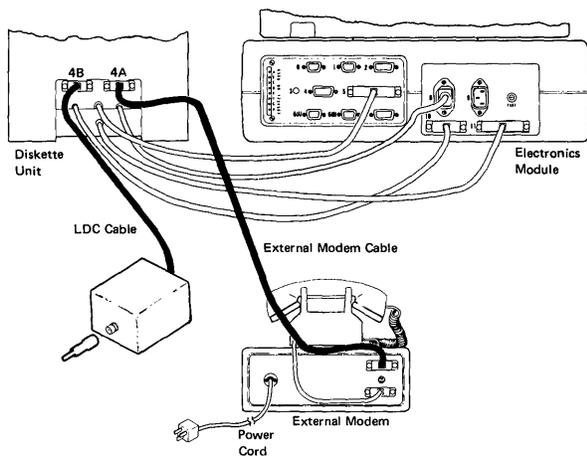


Figure 1-14. LDC and Optional EIA

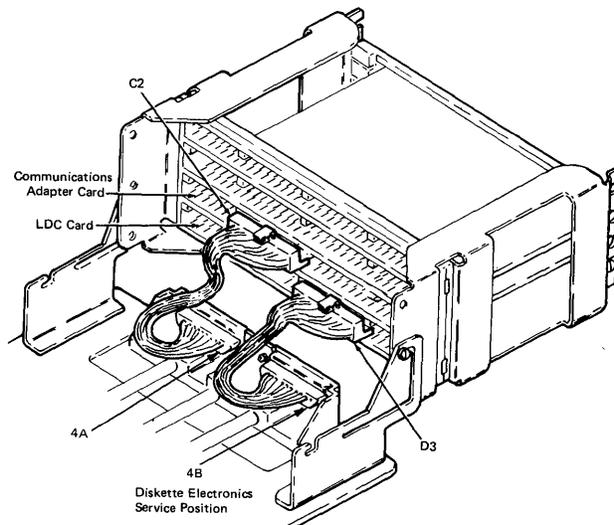
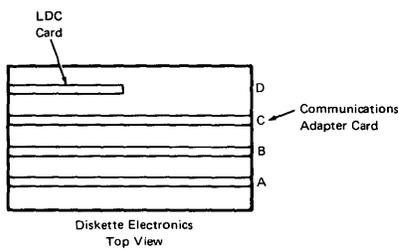


Figure 1-15. Diskette Electronics - LDC and Optional EIA

## KEYLOCK

A keylock is provided as an option to the communications feature. The keylock is mounted on the right side corner of the system electronics module (Figure 1-16). If a system has this option, the communications feature will be inoperative until the operator inserts the correct key and turns the keylock. Once the keylock has been turned on and the machine placed in the communication mode, the key can be removed. However, once the system is taken out of the communication mode, the key must be inserted again before the communication mode can be reactivated.

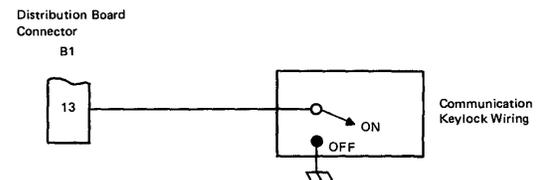
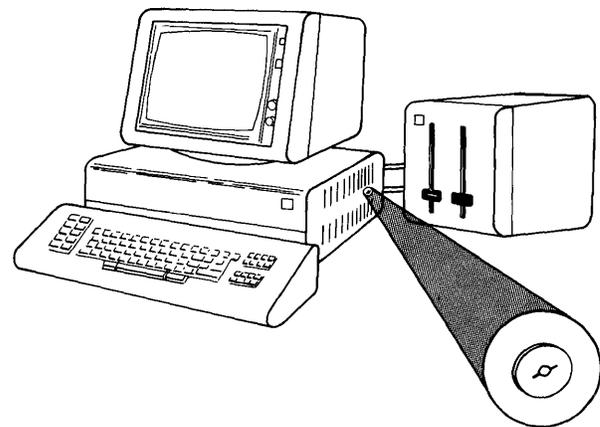


Figure 1-16. Keylock



## CHAPTER 2. ASYNCHRONOUS COMMUNICATIONS

### ASYNCH FACILITY OVERVIEW

The IBM Displaywriter System Asynchronous Communications Program (IBM Licensed Program 5608-SR1) enables a Displaywriter to communicate terminal-to-terminal with remote stations such as an IBM 2741 Communications Terminal, an IBM Communicating Mag Card "Selectric" Typewriter, a teletypewriter similar to the Teletype<sup>1</sup> Models 33, 35, or 43 Keyboard Send/Receive (KSR) models, or another Displaywriter. Terminal-to-host means a communication link can be established between a Displaywriter and an IBM System/370 or similar central processing unit (CPU). The Displaywriter appears to the host as an IBM 2741. Figure 2-1 shows the possible communication links available with ASYNC communication.

Using the ASYNC program, a Displaywriter can exchange data with a remote station for many different types of applications. Examples of these application types include:

- Time Sharing
- Data Entry
- Report Generation
- Text Processing

With the ASYNC program, documents can be sent and received over common telephone lines at speeds up to 1200 bits per second (bps). The communications link is point-to-point duplex on switched or nonswitched lines.

Half-duplex operation with reverse channel and multipoint (polled) lines are not supported.

The ASYNC licensed program is provided on a Displaywriter feature program diskette, and IBM will periodically distribute maintenance updates for it as required.

### ASYNCH EQUIPMENT REQUIREMENTS

In addition to the licensed program, the following equipment is required for asynchronous communication:

1. An external duplex modem capable of supporting asynchronous data transmission. The modem is

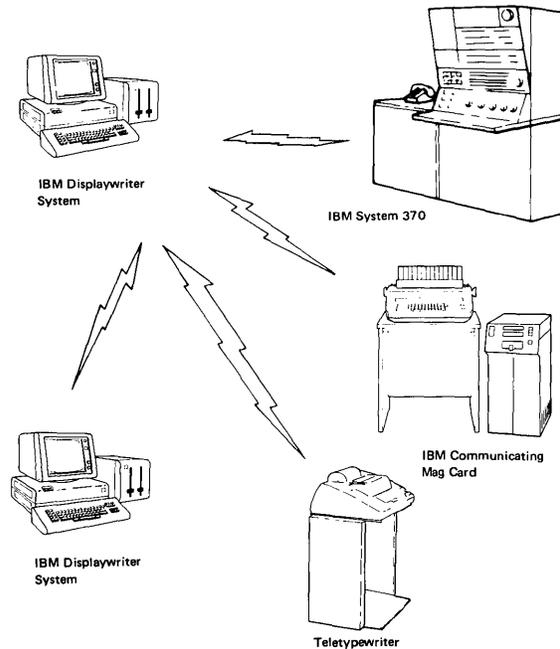


Figure 2-1. Asynchronous Communications

attached to the Displaywriter by a cable.

2. A communications adapter. The adapter provides an Electronics Industry Association (EIA) RS-232C compatible interface required for operation with an external modem.

**Note:** Depending on machine configuration, up to two external modems can be attached to a Displaywriter when the communications adapter is in the diskette unit.

3. A telephone line.
4. A minimum processor storage (memory) size. Minimum requirement for ASYNC is 192K (Model A02).

### COMMUNICATION ADAPTER CARD ASYNCH OPERATION

The communications adapter card, through its interface cable, connects

<sup>1</sup> Trademark of the Teletype Corporation

the electronics of the Displaywriter to the modem/Data Communications Equipment (DCE). The communications adapter card provides timing and other electronic control functions for the modem/DCE. The card is located in either the electronics module or the diskette unit.

The adapter card is programmable through the use of menus with respect to line speed and protocol. Line speeds of 110, 134.5, 150, 200, 300, and 1200 bps are the operating speeds when business machine clocking is used. Protocols requiring 1 or 2 stop bits are used.

The communications adapter detects parity, overrun and framing errors. Examples of these are:

- **Vertical Redundancy Checking.** For most ASYNC data streams, the adapter indicates a parity error when a character with wrong parity is received. Even, odd, or no parity checking is selectable.
- **Overrun Condition.** The adapter indicates this condition when the system does not read a received character sent by the adapter before the next character sent.
- **Framing Error.** The adapter indicates when a valid stop bit(s) is not detected at the end of a character during ASYNC communication.

#### ASYNC COMMUNICATION LINE SPEED REQUIREMENT

The IBM Displaywriter requires a duplex modem and a line facility capable of asynchronous data transmission. Speeds of 300 bits per second (bps) or less require the use of a duplex modem and a standard telephone line (either switched or nonswitched). 1200 bps transmission requires a standard telephone line (2-wire) with some duplex modems and two nonswitched lines (4-wire) with other duplex modems. It may or may not be possible to use a single 1200 bps duplex modem and line for both ASYNC and BSC.

#### DATA LINK ESTABLISHMENT

The Displaywriter activates the communication hardware by turning on the Data Terminal Ready (DTR) circuit when a setup is selected from the SETUP SELECTION menu. READY will appear in the display Link Status subfield. This indicates the DTR circuit is ready for communications.

To initiate the communications link on a switched line, the Data Set Ready (DSR) circuit must be on. DSR is activated when one of the following occurs:

- A dial connection is made to the network, and the modem is manually placed in data mode.
- An incoming call from a remote station is answered manually, and the modem is manually placed in data mode.
- A Displaywriter modem with auto answer receives an incoming call.

CONNECTED will replace READY in the Link Status field when DSR becomes active. ON-LINE will indicate reception of a carrier frequency from a remote modem.

DSR is active with modem power on for nonswitched lines. After a setup is selected, the communications link is established automatically as long as the modem remains on. No further operator intervention is necessary.

For both switched and nonswitched lines, the local Displaywriter modem establishes the communications link by sending a continuous transmit carrier signal to the remote station. Once the local station receives a remote carrier signal, the operational status is completed between the local and remote modems, and the link is established.

#### DATA LINK DISCONNECT

A data link is disconnected when one of the following occurs:

- The Displaywriter operator takes the modem out of data mode, turns off power to the modem, or presses the Disconnect key.
- The active communications setup used specifies Yes in the COMMUNICATIONS SETUP menu for Inactivity Disconnect, and the line is inactive for 30 seconds.
- An active TTY communications setup specifies Yes in the COMMUNICATIONS SETUP menu for circle C Disconnect, and the remote station sends an ASCII circle C control code.
- The Displaywriter detects a remote modem disconnect (loss of remote carrier frequency).

Both Data Terminal Ready and Request to Send are turned off by the disconnect on nonswitched lines. DSR must

also turn off within 10 seconds on a switched line.

On both types of lines, if DSR drops during a session, DTR is turned off immediately for at least 250 milliseconds. The Displaywriter then automatically turns on DTR again to re-establish the link.

## **PROTOCOL CHARACTERISTICS**

The Displaywriter can be connected over a point-to-point data link as an IBM 2741, an IBM CMC, or a standard ASCII TTY terminal. The data link protocols conform to the characteristics established by the IBM 2741, the IBM CMC, and the TTY KSR 33, 35 and 43.

### **IBM 2741 OPERATING MODE**

The IBM 2741 operating mode is used primarily for Displaywriter/host communication. In this mode, the Displaywriter can communicate with computing systems that support the IBM 2741 using correspondence code. This mode does not support word processing codes.

The IBM 2741 protocols allow for alternating send and receive states, as if communications were in a half-duplex environment. Because the communications link actually is duplex, however, the receiving station can spontaneously send an interrupt signal to the sending station. Assignment of the send and receive states is managed through the exchange of the circle D and circle C line control codes.

### **IBM 2741 LINE CONTROL DISCIPLINE**

The IBM Displaywriter operating in the IBM 2741 mode uses the circle D and circle C control codes in the same manner as the IBM 2741.

The Displaywriter automatically sends circle D, or Start of Transmission when the data link is first established, before each block of data sent, or after the reception of a circle C. When received, circle D causes the Displaywriter to switch from Standby state to Receive-Originate state.

Circle C, or End of Transmission, follows a block of text. The Displaywriter sends circle C automatically after transmitting a line-end code. When received, circle C causes the Displaywriter to switch from

Receive-Originate state to Standby state.

The IBM 2741 mode has three states: Send-Originate, Standby, and Receive-Originate.

**SEND-ORIGINATE STATE:** After sending a circle D, the Displaywriter enters the Send-Originate state. It remains in this state until it sends a circle C or receives a Break sequence. The circle C, or Break sequence, causes the Displaywriter to enter the Standby state.

**Line Turnarounds.** The Displaywriter sends a circle C after each line-end character such as a Return, a Required Return, an Index Return, or a Page End. The circle C causes a line turnaround, turns off the SEND indicator, and places the Displaywriter in the Standby state. While SEND is off, the keyboard is functionally inactive. Normally, the remote station will send circle D, circle C immediately back. The circle D causes the Displaywriter to briefly enter the Receive-Originate state. The circle C then causes the Displaywriter to send a circle D (after a 50 millisecond delay) and reenter the Send-Originate state.

**Remote Intervention.** Because the reception of circle D puts the Displaywriter in the Receive-Originate state, a remote station can send data to the Displaywriter between the circle D and circle C codes. No line turnarounds occur while the Displaywriter receives this data, and the Displaywriter remains in the Receive state until the remote station sends a circle C.

If the Displaywriter operator presses the ATTN key during an intervention period, the Displaywriter sends a Break signal to the remote station. If the signal is honored, the remote station sends a circle C to end the intervention period.

**Line Abort.** When sending data, a Displaywriter operator can press the ATTN key to indicate to the remote station that it should abort the line currently being sent. Pressing ATTN sends a circle C that is not preceded by a line-end code and causes a normal line turnaround.

**STANDBY STATE:** The Displaywriter enters the Standby state each time it sends a circle C (sending a line ending or aborting the line) or receives a Break sequence. In Standby, the Displaywriter waits for either a circle D or a circle C. Circle D causes it to enter the Receive-Originate state. Circle C causes it to send circle D and reenter the Send-Originate state.

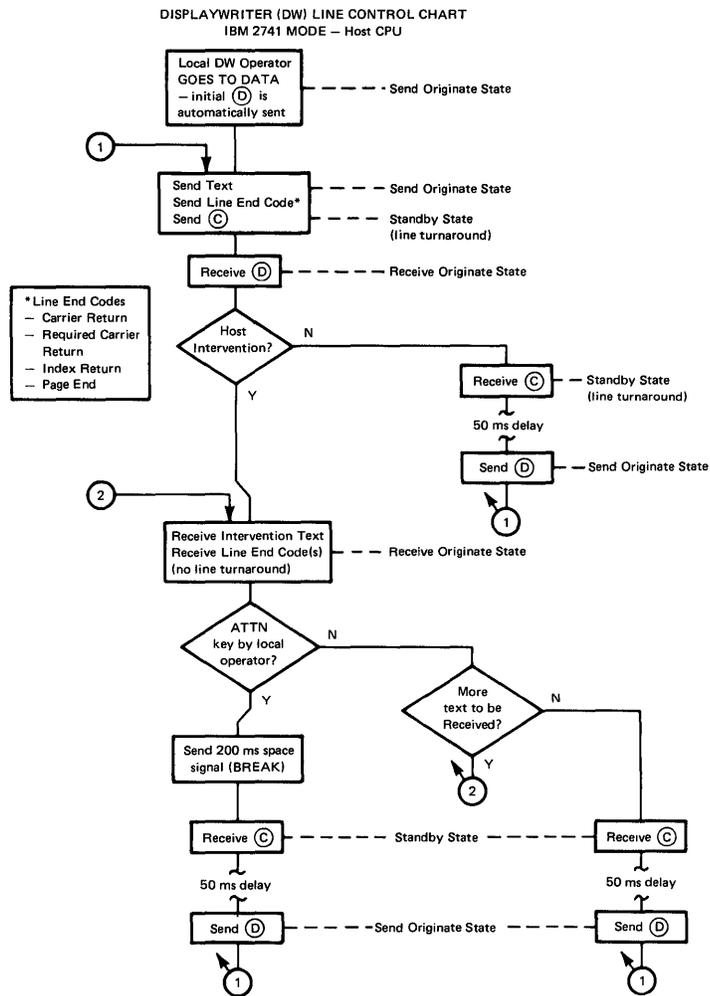


Figure 2-2. Line Control in IBM 2741 Operating Mode

**RECEIVE-ORIGINATE STATE:** The Displaywriter enters the Receive-Originate state each time it is in the Standby state and receives a circle D. In this state, the Displaywriter will accept any amount of data from the remote station. No line turnarounds occur at line-end boundaries, and if the remote station sends IDLE characters after a line-end code, the Displaywriter deletes them from the received data stream. When the remote station sends a circle C, the Displaywriter reenters the Send-Originate state.

When the Displaywriter is in the Receive-Originate state and the operator presses ATTN, the Displaywriter sends a Break (a long space of 200

milliseconds) to the remote station. If the Break is honored, the remote station sends a circle C, which causes the Displaywriter to reenter the Send-Originate state.

Figure 2-2 is a summary of line control in the IBM 2741 operating mode.

### Transmission Format

Transmission is asynchronous by character. A start bit (0) precedes each 7-bit character, and a stop bit (1) follows each 7-bit character. The 7-bit characters have six data bits and a least-significant odd parity bit. The Displaywriter transmits each

character serially by bit with the most significant bit first. "Data Stream Translation Tables" lists the control codes and graphics associated with the Displaywriter operating modes.

When sending data in the IBM 2741 mode, the Displaywriter does not support the correspondence codes for:

- TRACK LINK (TKLK)
- ERROR CORRECT BACKSPACE (ECBS)
- TRACK SKIP (TKSK)

### Parity

In the IBM 2741 operating mode, the Displaywriter supports the sending and checking of odd parity on each character.

### Line Speed

The IBM 2741 mode supports line speeds of 134.5, 300 and 1200 bps over a duplex data link.

### Error Detection

In the IBM 2741 mode, character parity is always sent and checked, and any character received in error is converted to a substitute code. Displaywriter hardware also provides both false start bit detection (glitch filtering) and deletion of characters received without a valid stop bit (framing error).

The operator must visually detect other types of errors and manually correct them.

### Break

The Displaywriter detects a Break whenever it receives a continuous space signal (all zeroes) for at least two character times. When the Displaywriter is in the Send-Originate state, the Break signal causes the Displaywriter to immediately stop sending data; enter the Standby state; and wait for a circle D or a circle C. Normal operation resumes when the Displaywriter receives a circle C, a circle D, or the Displaywriter operator presses the Start key.

In the Receive-Originate state, pressing the ATTN key sends a 200 millisecond space signal to the remote station. This Break signal is sent at the next character boundary and is

separated from any following character or Break signal by at least 100 milliseconds of line inactivity.

### Terminal Identification

The terminal ID, found in the communications setup, is a four-character sequence that identifies the Displaywriter to the remote station. The first character of the sequence is an identification code that designates terminal type. At least one of the three remaining characters should be a non-print code.

The Displaywriter will automatically send a circle D ID circle C sequence whenever it receives a PRE j circle C sequence from the remote station.

The following codes should not be used in the terminal ID sequence:

- RETURN (CR)
- DELETE (DEL)

### Remote Controlled Output Suppression

The Displaywriter supports the IBM 2741 "Print Inhibit" function. Through it, the remote station can cause the Displaywriter to inhibit the display or printing of any selected data field.

When the Displaywriter receives a BYPASS code, it displays all subsequent sent or received graphic codes as substitute codes. Output suppression continues until the Displaywriter receives a RESTORE code, the data link is lost, or the session is terminated.

**Note:** The correspondence codes for REPEAT and RESTORE are identical. When the Send All Codes option is active, and the Displaywriter receives a BYPASS code, it treats a subsequent REPEAT code as RESTORE.

### IBM COMMUNICATING MAG CARD (CMC) OPERATING MODE

The IBM CMC mode, which is compatible with the IBM CMC operating in non-CPU mode, is used for sessions with IBM CMC terminals or other Displaywriters. The Displaywriter's IBM 2741 operating mode is basically a subset of the IBM CMC operating mode.

Transmission format, parity, line speed, error detection, and break are identical to the IBM 2741 operating mode.

## IBM CMC LINE CONTROL DISCIPLINE

Like the IBM 2741 mode, the line control discipline of the IBM CMC operating mode uses the circle D and circle C control codes.

In IBM CMC mode, the Displaywriter does not automatically send circle D when a data link is first established. The operator must manually control its initial transmission via the COMM START key. During a session, the Displaywriter automatically sends circle D before each block of data it sends and after it receives a circle C.

When received at the beginning of a session, circle D causes the Displaywriter to switch from the Control state to the Receive-Answer state. When received during a session, circle D causes the Displaywriter to switch from the Standby state to the Receive-Originate state.

When transmitted, circle C indicates the end of the desired text. The Displaywriter sends circle C automatically after sending a line-end code.

The IBM CMC operating mode has six states: Control, Send Originate, Standby, Receive-Originate, Receive-Answer, and Send Answer.

**CONTROL STATE:** When the data link is established in the IBM CMC mode, both the Displaywriter and the remote station enter the Control state. In this state, the stations contend for originate status. The first station to send circle D enters the Send Originate state; the other station enters the Receive-Answer state.

**SEND ORIGINATE STATE:** When both stations are in the Control state, and the local Displaywriter sends circle D first, the local Displaywriter enters the Send Originate state. It remains in this state until it sends a circle C, or receives a circle C after the operator uses the RESET key.

The Displaywriter sends a circle C after each line-end character (such as a Carrier Return, a Required Carrier Return, an Index Return, or a Page End). The circle C causes a line turnaround, turns off the SEND indicator, and places the Displaywriter in the Standby state. While SEND is off, the keyboard is functionally inactive.

Normally, the remote station will send circle D circle C immediately back. The circle D causes the Displaywriter to briefly enter the Receive-Originate state. After the Displaywriter receives the circle C, it delays for 50 milliseconds before sending a cir-

cle D and re-entering the Send Originate state.

**Note:** If the Displaywriter is in the Send Originate state and the operator presses the RESET key, the circle C causes the Displaywriter to enter the Control state instead of returning to the Send Originate state.

**Remote Intervention.** Because the reception of circle D puts the Displaywriter in the Receive-Originate state, a remote station can send data to the Displaywriter between the circle D and circle C codes. No line turnarounds occur while the Displaywriter receives this data, and the Displaywriter remains in the Receive-Originate state until the station sends a circle C.

**Line Abort.** When sending data, a Displaywriter operator can press the ATTN key to instruct the remote station to abort the line currently being sent. Pressing ATTN sends a circle C that is not preceded by a line-end code. A normal line turnaround then occurs.

**Delays.** When operating at 134.5 bps, the Displaywriter automatically sends IDLE characters after certain carriage control characters to allow sufficient time for a receiving IBM CMC to execute the function.

One IDLE character is sent after every Index, Subscript, and Superscript. The number of IDLE characters sent after an HT is constant and is determined by the longest distance between any two tab stops currently set for the display format. If the longest distance is five characters (the default setting), two IDLE characters are sent. For each additional ten character positions (or fraction), one additional IDLE character is sent after each HT.

**STANDBY STATE:** The Displaywriter enters the Standby state each time it sends a circle C. In Standby, the Displaywriter waits for either a circle D or a circle C. Circle D causes the Displaywriter to enter the Receive-Originate state; Circle C causes the Displaywriter to send circle D and re-enter the Send-Originate state.

**RECEIVE-ORIGINATE STATE:** The Displaywriter enters the Receive-Originate state each time it is in the Standby state and receives a circle D. In this state, the Displaywriter will accept any amount of data from the remote station. No line turnarounds occur at line-end boundaries, and if the remote station sends IDLE characters after a line-end code, the Displaywriter deletes them.

When the remote station sends a circle C, the Displaywriter re-enters the Send Originate state.

**RECEIVE-ANSWER STATE:** The Displaywriter enters the Receive Answer state each time it is in the Control state and receives a circle D. Unlike the Receive-Originate state, line turnaround sequences occur at each line boundary.

**Note:** The Displaywriter cannot send a Break sequence while it is in the Receive Answer state. It can interrupt the remote station only at a line turnaround.

**SEND ANSWER STATE:** After receiving a line ending code and circle C in Receive Answer state, the Displaywriter enters the Standby state. It then automatically sends a circle D as the first half of the line turnaround and enters the Send Answer state. On a normal line turnaround, the Displaywriter also automatically sends a circle C to complete the line turnaround. These two actions return the receiving Displaywriter to the Receive Answer state.

The receiving Displaywriter operator may send intervening text at a line turnaround. To do this, prior to the line turnaround (and while still in

Receive Answer state), the receiving operator can press the ATTN key. This prevents sending the automatic circle C at line turnaround time, and allows the receiving machine (now in Send Answerback state) to send intervention text from the keyboard. Any data sent in the Send Answerback state will not be interrupted by line turnarounds at line endings. To complete the line turnarounds and return the Displaywriter to the Receive Answer State, the operator must press the ATTN key again. This action completes the line turnaround by sending the second turnaround character, a circle C.

When in the Send Answer state, and operating at 134.5 bps, the Displaywriter automatically sends 16 IDLE characters after:

- Index, Subscript, Superscript, and Tab Control characters
- Normal line endings (Carrier Return, Required Carrier Return, or Index Return)

These IDLEs allow time for the remote station's carrier to return from the farthest right margin.

Figure 2-3 is a summary of line control in the IBM CMC operating mode.

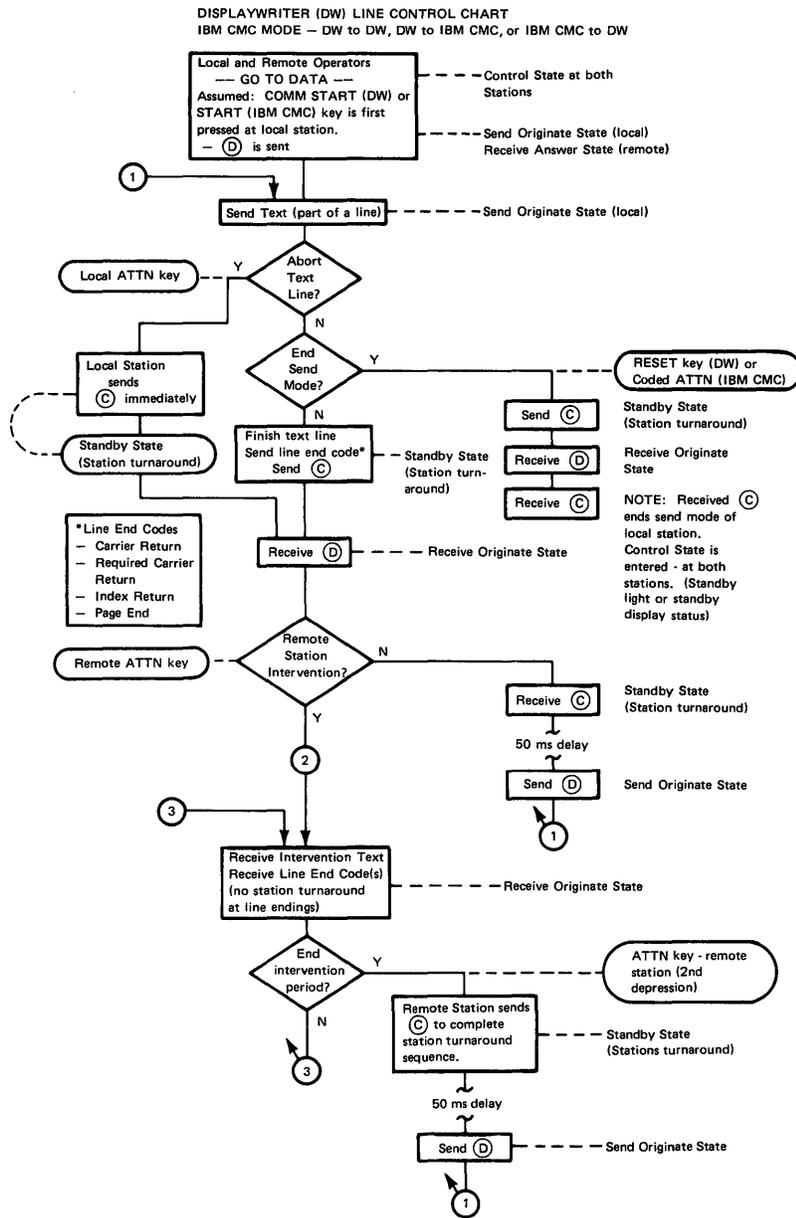


Figure 2-3. Line Control in IBM CMC Operating Mode

### TTY OPERATING MODE

The TTY mode enables the Displaywriter to communicate with terminals like the TTY KSR models 33, 35 or 43 that use ASCII (7-bit) line code, or a suitably programmed host that supports TTY terminals. In the TTY mode, both stations can transmit data simultaneously and independently in a true duplex operation.

### Transmission Format

Transmission of ASCII (7-bit) control codes and graphics is asynchronous (start/stop) by character. When oper-

ating at 100 bps, a start bit (0) precedes each 8-bit character, and two stop bits (1) follow. (One stop bit is used when operating at line speeds in excess of 110 bps.) The 8-bit characters have seven data bits and a parity bit. The Displaywriter transmits each character serially by bit, and the parity bit is the last bit of the 8-bits transmitted.

In the TTY mode, the Displaywriter can generate all 128 ASCII graphics and control codes (see "Data Stream Translation Tables"). Creation of some graphics codes may be limited, however, by the active Displaywriter keyboard arrangement.

## Parity

Through the COMMUNICATIONS SETUP menu, the Displaywriter operator can select one of three parity modes for TTY operation:

1. Send and check even parity.
2. Send and check odd parity.
3. Send a mark ("1") parity bit with each transmitted character and ignore all received character parity bits. This is the parity "None" option in the COMMUNICATIONS SETUP menu.

## Line Speed

The TTY mode supports line speeds of 110, 150, 200, 300 and 1200 bps over a duplex data link.

## Time Filling Delays

The Displaywriter delays after sending certain control codes to allow remote terminals to complete mechanical functions in TTY mode. At line speeds below 1200 bps, the Displaywriter sends one DEL character after each Backspace (BS) character and 10 DEL characters after each Form Feed (FF) character.

In addition, at line speeds of 110, 150, or 200 bps, the Displaywriter sends the three-character sequence: CR (Carrier Return), LF (Line Feed), DEL (Delete) after each CR (Carrier Return), RCR (Required Carrier Return), or IRT (Index Return) line-end code. This sequence delays the new line function.

The Displaywriter also sends one or more DEL characters after each Horizontal Tab (HT) code. If the longest distance between any two active tab stops for the display format is six characters or less, the Displaywriter sends one DEL character. For each additional three character positions (or fraction) between tab stops, the Displaywriter sends an additional DEL.

## Notes:

1. The Displaywriter does not delay automatically after it transmits a CR code that is not followed by LF. The operator can provide time-filling codes in this case.
2. The Displaywriter does not send time-filling codes after Vertical Tab (VT) characters.

3. The Displaywriter deletes all time-filling codes it receives, including all DEL and NUL codes and all consecutive CR codes that immediately follow a CR or ZICR (Zero Index Carrier Return).

## Echoplex

The COMMUNICATIONS SETUP menu for TTY mode has an option for echoplex operation. In an echoplex mode, data does not automatically appear on the display as it is sent. Instead, the remote station returns an image of all the data it receives, and the Displaywriter displays this data. All data displayed to the operator is from the receive data stream, and this enables the operator to monitor the integrity of the data sent from the Displaywriter.

## Error Detection

In TTY mode, the Displaywriter offers a parity checking option, and any character received in error is converted to a Substitute code. In addition, Displaywriter hardware provides both false start bit detection (glitch filtering) and the deletion of characters received without a valid stop bit (framing error).

The Displaywriter operator must visually detect other types of data stream errors and manually correct them.

## Answer-Back

In TTY mode, the Displaywriter provides an Answer-Back terminal identification feature like the one for the TTY 33. Through the COMMUNICATIONS SETUP menu, the Displaywriter operator can preset any sequence of 1 to 31 ASCII control codes or graphic characters which will identify the Displaywriter to a remote station.

Any time the Displaywriter receives an ENQ (Enquiry) control code or the Displaywriter operator presses the local HERE IS key, it automatically returns the Answer-Back character identification sequence defined by the active communications setup. If the Automatic Answer-Back option is specified in the active communications setup and the Displaywriter is the called party, the Answer-Back sequence is sent automatically upon establishment of the data link.

## Break

The Displaywriter detects a Break whenever it receives a continuous space signal (all zeroes) for at least two character-times. The signal causes the Displaywriter to immediately stop sending data. Data can still be received, however.

Normal operation resumes when the Displaywriter operator presses the Break Release key and sends a 200 millisecond space signal to the remote station. This Break signal is sent at the next character boundary and is separated from any following character or Break signal by at least 100 milliseconds of line inactivity.

## Auto Disconnect

In TTY mode, an automatic disconnect occurs if:

- The active communications setup specifies Yes for Inactivity Disconnect, and the line is inactive for 30 seconds.
- The active communications setup specifies Yes for circle C disconnect, and an ASCII circle C control code is received.
- The modem is set to disconnect immediately (approximately 250 milliseconds) after the loss of the received carrier.

**Note:** The transmission and honoring of "long space" (1.5 to 3 seconds) disconnect signals depends on individual modems.

The operator can initiate a disconnect sequence by manually pressing the DISC (Disconnect) key.

## Timeouts

Figure 2-4 summarizes the timeouts that can occur at the Displaywriter during an ASYNC session.

Timeout Length	Timeout Purpose	Displaywriter Action After Timeout Expires
50 ms	When a circle C is received in Receive Originate State, a circle D is automatically sent 50 ms later.	Send a circle D
100 ms	Minimum duration of sending a marking tone after sending a break.	Displaywriter is conditioned to send data, if any.
200 ms	Duration of sending break (space tone).	Disable sending of break.
250 ms	Minimum time DTR is turned off after DSR is turned off.	Turn on DTR, if enabled.
1.0 s	Minimum delay before sending data after RTS is turned on.	Displaywriter is conditioned to send data, if any.
5.0 s	Maximum length of time CTS can stay off before DTR is turned off, disconnecting the communications link.	Turn off DTR.
10.0 s	On a switched line, if DSR does not turn off within 10.0 seconds after DTR is turned off, a hardware failure is reported and the communications link is not re-established.	Present message to operator.
30.0 s	When selected, if data is not sent or received within 30.0 seconds, DTR is turned off, disconnecting the communication link.	Turn off DTR.

Figure 2-4. Timeouts

## DATA STREAM CHARACTERISTICS

When sending a document from a data diskette, the Displaywriter only transmits the document's formatted text. No format information or controls are sent. The Displaywriter does, however, convert and send a number of one-byte text and formatting controls embedded in the text of the document. The converted controls are:

- **Indexes.** The Displaywriter automatically inserts indexes to specify the document's first printing line.
- **Margin Text and Page Numbering.** As the Displaywriter converts each page of a document for sending, it inserts any header and footer text into the data stream. It also creates page numbering where required.
- **Character Overstrike and Block Underscore.** The Displaywriter generates the necessary number of required backspaces and overstrike characters or underscores for these controls.
- **Word Underscore.** The Displaywriter generates the necessary backspace/underscore sequences in the send data stream. In all three operating modes, word underscores keyed directly from the display are sent without being converted.
- **Keyboard and Typestyle Changes.** The Displaywriter generates Stop codes for these parameters.

- **Centering and Alignment.** The Displaywriter generates the appropriate combination of tabs, spaces, and backspaces for these controls.

The Displaywriter does not convert the controls for line spacing, line density, margin changes, or tab changes.

After the Displaywriter finishes converting these controls, it translates the entire data stream to the correspondence or 7-bit line code that is appropriate for the active communications link. The translation is based on: (a) the character graphic set indicated by the display's keyboard ID, and (b) the communications protocol selected by the operator.

### Line Code Translations

When sending or receiving data, the Displaywriter translates data according to the character graphic set associated with the display's active keyboard ID. Because the Displaywriter does not have display representations for certain graphics (GBG/I Data Processing, Correspondence and 7-bit codes) these graphics are not preserved over the communications line.

### IBM 2741 Correspondence Line Code

Correspondence code is a 6-bit code set that has 64 possible code point combinations. Because of lower case (LC) and upper case (UC) control codes, the 6-bit code is effectively expanded to 128 code point possibilities. For letters of the alphabet, transmitted shift codes depend on the case of the following characters. For other codes, shift codes depend on the definition of the particular following code point. Lower case automatically is assumed following transmission of circle D.

Correspondence line code translation for the IBM 2741 mode involves:

- specific control codes (Figure 2-7)
- fixed codes for alphabetic graphics
- variable codes for non-alphabetic graphics. These variable codes are assigned according to the character graphic set of the active keyboard ID (Figure 2-13).

### IBM CMC Correspondence Line Code

Correspondence line code translation for the IBM CMC mode is similar to that for the IBM 2741 mode. The only major difference is in the translation of certain control codes (Figure 2-6).

Through the "Send All Codes" option of the IBM 2741 Communications Setup menu, the Displaywriter operator can request IBM CMC correspondence line code be used in the IBM 2741 mode. In this instance, the Displaywriter sends normal IBM CMC transmit codes (except for the SWITCH code).

### TTY Mode 7-Bit Line Code

Line code translation for the TTY mode involves:

- Specific control codes. (Figure 2-8 through Figure 2-11)
- Fixed codes for alphanumeric graphics and some special graphics.
- Variable codes for non-alphanumeric graphics. These variable codes are assigned according to the character graphic set of the active keyboard ID. (See Figure 2-14)

The Displaywriter sends the NL (new line) function in 7-bit code via the sequence: CR (Carrier Return), LF (Line Feed). When the Displaywriter receives this two-code sequence, it always converts it to NL.

### Displaywriter Internal Data Stream

The Displaywriter's internal data stream is based on EBCDIC Multilingual which is a code set that is different from the Correspondence or the ASCII/7-Bit code sent across the data link. Because of this, the Displaywriter must translate the internal EBCDIC to either Correspondence or ASCII/7-Bit code. This translation is based on:

- The Displaywriter's current send/receive state.
- The current Character Graphic Set ID (Keyboard ID).
- The communications protocol (TTY, IBM 2741, or IBM CMC).

### Control Codes

Figure 2-6 through Figure 2-11 show the CMC, 2741, and the TTY protocol correspondence codes.

### Graphics Codes

Figure 2-12 shows those transmission codes, by protocol, that have multiple keyboard assignments. Figure 2-13 shows the online hex representation of the character (upper and lower case versions of each), plus eight additional prefixed graphics for all supported keyboards. Figure 2-14, 7-Bit Line Code for Variable Graphics, shows the online representation of the character (no upper or lower case) for all supported keyboards. The last two columns show graphics that are not supported because there are not enough ASCII positions to put those code points in.

#### BYTE PATTERN FOR TTY PROTOCOL 7-BIT CODE

P	7	6	5	4	3	2	1
---	---	---	---	---	---	---	---

#### BYTE PATTERN FOR CMC PROTOCOL CODE

B	A	8	4	2	1	ck
---	---	---	---	---	---	----

#### BINARY TO HEX CONVERSION CHART

HEX	BINARY
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001
A	1010
B	1011
C	1100
D	1101
E	1110
F	1111

NOTE: The byte pattern for 2741 protocol is the same as CMC

Figure 2-5. Byte Patterns and Conversion Chart for CMC, 2741 and TTY

HEX	LC	UC	*
01	space	req space	
02	1	!	yes
04	2	@	yes
07	3	#	yes
08	5	%	yes
0B	7	&	yes
0D	6	¢	yes
0E	8	*	yes
10	4	¢	yes
13	0	)	yes
15	z	Z	
16	9 or circle D	(	yes yes
19	subscript	Note 1	
1A	superspt	Note 1	
1C	UC	UC	
1F	circle C	circle C	
20	t	T	
23	x	X	
25	n	N	
26	u	U	
29	e	E	
2A	d	D	
2C	k	K	
2F	c	C	
31	l	L	
32	h	H	
34	STOP	Note 1	
37	b	B	
38	Note 1	Note 1	
3B	index	index return	

HEX	LC	UC	*
3D	Switch	Note 1	
3E	prefix	prefix	
40	1/2	1/4	
43	m	M	
45	.	.	
46	v	V	
49	'	"	
4A	r	R	
4C	i	I	
4F	a	A	
51	o	O	
52	s	S	
54	req hyph	unit BS	
57	w	W	
58	Note 1	repeat	
5B	CRE	req CRE	
5D	req BS	req BS	
	Note 3		
5E	Note 2	Note 2	
61	j	J	
62	g	G	
64	=	+	
67	f	F	
68	p	P	
6B	;	:	
6D	q	Q	
6E	,	,	
70	/	?	
73	y	Y	
75	word under score	numeric back- space	

HEX	LC	UC	*
76	syllable hyphen	under- score	
79	req spa	page end	
7A	Tab	Rea Tab	
7C	LC	LC	
7F	Note 1	Note 2	

\* Variable Graphics (Keyboard 1 graphics shown, for other keyboard see Figure 30).

NOTES.

1. Not sent by Displaywriter. Recorded upon receipt as sub.
2. IDLE code not sent by Displaywriter; deleted when received.
3. Not sent by Displaywriter.

Figure 2-6. CMC Protocol Correspondence Code

HEX	LC	UC	*
01	space	space	
02	1	!	yes
04	2	@	yes
07	3	#	yes
08	5	%	yes
0B	7	&	yes
0D	6	¢	yes
0E	8	*	yes
10	4	¢	yes
13	0	)	yes
15	z	Z	
16	9 or circle D	(	yes yes
19	subscript Note 3	Note 1	
1A	superspt Note 3	Note 1	
1C	UC	UC	
1F	circle C	circle C	
20	t	T	
23	x	X	
25	n	N	
26	u	U	
29	e	E	
2A	d	D	
2C	k	K	
2F	c	C	
31	l	L	
32	h	H	
34	STOP Note 3	Note 1	
37	b note 3	B Note 4	

HEX	LC	UC	*
38	Note 1	Note 1	
3B		index	
3D	Switch Note 3	Note 1	
3E	prefix	prefix	
40	1/2	1/4	yes
43	m	M	
45	.	.	yes
46	v	V	
49	'	"	yes
4A	r	R	
4C	i	I	
4F	a	A	
51	o	O	
52	s	S	
54	req hyph Note 3	unit BS Note 3	
57	w	W	
58	Note 5	Note 5	
5B	CRE	req CRE Note 6	
5D	req BS Note 3	req BS	
5E	Note 2	Note 2	
61	j	J	
62	g	G	
64	=	+	yes
67	f	F	
68	p	P	
6B	;	:	yes
6D	q	Q	
6E	,	,	

HEX	LC	UC	*
70	/	?	
73	y	Y	
75	word under score Note 3	numeric bksp Note 3	
76	syllable hyphen Note 3	under- score	
79	req. spa Note 3	page end Note 3	
7A	Tab	Req. Tab Note 6	
7C	LC	LC	
7F	Note 1	Note 2	

\* Variable Graphics (Keyboard 1 graphics shown, for other keyboards see Figure 30).

NOTES

1. Not sent by Displaywriter; recorded upon receipt as sub.
2. IDLE code not sent by Displaywriter, deleted when received.
3. Not sent by Displaywriter.
4. BYPASS CODE when received. Not sent by Displaywriter.
5. RESTORE CODE when received. Not sent by Displaywriter.
6. Lower Case assumed when received.

Figure 2-7. 2741 Correspondence Code Protocol

HEX	CODE	*
00	NUL	
81	SOH	
82	STX	
03	ETX	
04	EOT	
05	ENQ	
06	ACK	
87	BEL	
88	BS	
09	HT	
0A	LF	
8B	VT	
0C	FF	
8D	CR	
8E	SO	
0F	SI	
90	DEL	
11	DC1	
12	DC2	
93	DC3	
14	DC4	
95	NAK	
96	SYN	
17	ETB	
18	CAN	
99	EM	
9A	SUB	
1B	ESC	
9C	FS	
1D	GS	
1E	RS	
9F	ITB	
A0	SPACE	

HEX	CODE	*
21	!	yes
22	"	yes
A3	#	yes
24	\$	yes
A5	%	yes
A6	&	yes
27	'	yes
A8	(	yes
A9	)	yes
AA	*	yes
2B	+	yes
AC	,	
2D	-	
2E	.	
AF	/	
30	0	
B1	1	
B2	2	
33	3	
B4	4	
35	5	
36	6	
B7	7	
B8	8	
39	9	
3A	:	
BB	;	yes
3C	\$	yes
BD	=	yes
BE	∞	yes
3F	?	
B0	@	yes
41	A	

HEX	CODE	*
42	B	
C3	C	
44	D	
C5	E	
C6	F	
47	G	
48	H	
C9	I	
CA	J	
4B	K	
CC	L	
4D	M	
4E	N	
CF	O	
50	P	
D1	Q	
D2	R	
53	S	
D4	T	
55	U	
56	V	
D7	W	
D8	X	
5A	Z	
DB	[	yes
5C	1/4	yes
DD	]	yes
DE	†	yes
5F	—	
60	+	yes
E1	a	
E2	b	
63	c	

HEX	CODE	*
E4	d	
65	e	
66	f	
E7	g	
6E	h	
69	i	
6A	j	
6B	k	
6C	l	
ED	m	
EE	n	
6F	o	
F0	p	
71	q	
72	r	
73	s	
74	t	
F5	u	
F6	v	
77	w	
78	x	
F9	y	
FA	z	
7B	2	yes
FC	1/2	yes
7D	3	yes
7E	o	yes
FF	DEL	

\* Variable Graphics (Keyboard 1 graphics shown, for other key-boards see Figure 31).

Figure 2-8. TTY Protocol 7-Bit Code (No Parity Mark)

HEX	CODE	*
80	NUL	
01	SOH	
02	STX	
83	ETX	
04	EOT	
85	ENQ	
86	ACK	
07	BEL	
08	BS	
89	HT	
8A	LF	
0B	UT	
8C	FF	
0D	CR	
0E	SO	
8F	SI	
10	DEL	
91	DC1	
92	DC2	
13	DC3	
94	DC4	
15	NAK	
16	SYN	
97	ETB	
98	CAN	
19	EM	
1A	SUB	
9B	ESC	
1C	FS	
9D	GS	
9E	RS	
1F	ITB	
20	SPACE	

HEX	CODE	*
A1	!	yes
A2	"	yes
23	#	yes
A4	\$	yes
25	%	yes
26	&	yes
A7	'	yes
A8	(	yes
29	)	yes
2A	*	yes
AB	+	yes
2C	,	
AD	-	
AE	.	
2F	/	
B0	0	
31	1	
32	2	
B3	3	
34	4	
B5	5	
B6	6	
37	7	
38	8	
B9	9	
BA	:	
3B	;	
BC	\$	yes
3D	=	yes
3E	∞	yes
BE	?	
40	@	yes
C1	A	

HEX	CODE	*
C2	B	
43	C	
C4	D	
45	E	
46	F	
C7	G	
C8	H	
49	I	
4A	J	
CB	K	
4C	L	
CD	M	
CE	N	
4F	O	
D0	P	
51	Q	
52	R	
D3	S	
54	T	
D5	U	
D6	V	
57	W	
58	X	
D9	Y	
DA	Z	
5B	[	yes
DC	1/4	yes
5D	]	yes
5E	†	yes
DF	—	
E0	+	yes
61	a	
62	b	

HEX	CODE	*
E3	c	
64	d	
E5	e	
E6	f	
67	g	
68	h	
E9	i	
EA	j	
6B	k	
EC	l	
6D	m	
6E	n	
EF	o	
70	p	
F1	q	
F2	r	
73	s	
F4	t	
75	u	
76	v	
F7	w	
F8	x	
79	y	
7A	z	
FB	2	yes
7C	1/2	yes
FD	3	yes
FE	o	yes
7F	DEL	

\* Variable Graphics, Keyboard 1 graphics shown, for other key-boards see Figure 31).

Figure 2-9. TTY Protocol 7-Bit Code (No Parity Space)

HEX	CODE	*
80	NUL	
81	SOH	
82	STX	
83	ETX	
84	EOT	
85	ENQ	
86	ACK	
87	BEL	
88	BS	
89	HT	
8A	LF	
8B	UT	
8C	FF	
8D	CR	
8E	SO	
8F	SI	
90	DEL	
91	DC1	
92	DC2	
93	DC3	
94	DC4	
95	NAK	
96	SYN	
97	ETB	
98	CAN	
99	EM	
9A	SUB	
9B	ESC	
9C	FS	
9D	GS	
9E	RS	
9F	ITB	
A0	SPACE	

HEX	CODE	*
A1	!	yes
A2	"	yes
A3	#	yes
A4	\$	yes
A5	%	yes
A6	&	yes
A7	'	yes
A8	(	yes
A9	)	yes
AA	*	yes
AB	+	yes
AC	,	
AD	-	
AE	.	
AF	/	
B0	0	
B1	1	
B2	2	
B3	3	
B4	4	
B5	5	
B6	6	
B7	7	
B8	8	
B9	9	
BA	:	
BB	;	yes
BC	\$	yes
BD	=	yes
BE	¶	yes
BF	?	
C0	@	yes
C1	A	

HEX	CODE	*
C2	B	
C3	C	
C4	D	
C5	E	
C6	F	
C7	G	
C8	H	
C9	I	
CA	J	
CB	K	
CC	L	
CD	M	
CE	N	
CF	O	
D0	P	
D1	Q	
D2	R	
D3	S	
D4	T	
D5	U	
D6	V	
D7	W	
D8	X	
D9	Y	
DA	Z	
DB	[	yes
DC	1/4	yes
DD	]	yes
DE	¢	yes
DF	—	
E0	+	yes
E1	a	
E2	b	

HEX	CODE	*
E3	c	
E4	d	
E5	e	
E6	f	
E7	g	
E8	h	
E9	i	
EA	j	
EB	k	
EC	l	
ED	m	
EE	n	
EF	o	
F0	p	
F1	q	
F2	r	
F3	s	
F4	t	
F5	u	
F6	v	
F7	w	
F8	x	
F9	y	
FA	z	
FB	2	yes
FC	1/2	yes
FD	3	yes
FE	o	yes
FF	DEL	

\* Variable Graphics (Keyboard 1 graphics shown, for other keyboards see Figure 31).

Figure 2-10. TTY Protocol 7-Bit Code (Even Parity)

HEX	CODE	*
00	NUL	
01	SOH	
02	STX	
03	ETX	
04	EOT	
05	ENQ	
06	ACK	
07	BEL	
08	BS	
09	HT	
0A	LF	
0B	VT	
0C	FF	
0D	CR	
0E	SO	
0F	SI	
10	DEL	
11	DC1	
12	DC2	
13	DC3	
14	DC4	
15	NAK	
16	SYN	
17	ETB	
18	CAN	
19	EM	
1A	SUB	
1B	ESC	
1C	FS	
1D	GS	
1E	RS	
1F	ITB	
20	SPACE	

HEX	CODE	*
21	!	
22	"	
23	#	
24	\$	yes
25	%	yes
26	&	yes
27	'	yes
28	(	yes
29	)	yes
2A	*	yes
2B	+	yes
2C	,	
2D	-	
2E	.	
2F	/	
30	0	
31	1	
32	2	
33	3	
34	4	
35	5	
36	6	
37	7	
38	8	
39	9	
3A	:	
3B	;	yes
3C	\$	yes
3D	=	yes
3E	¶	yes
3F	?	
40	@	yes
41	A	

HEX	CODE	*
42	B	
43	C	
44	D	
45	E	
46	F	
47	G	
48	H	
49	I	
4A	J	
4B	K	
4C	L	
4D	M	
4E	N	
4F	O	
50	P	
51	Q	
52	R	
53	S	
54	T	
55	U	
56	V	
57	W	
58	X	
59	Y	
5A	Z	
5B	[	yes
5C	1/4	yes
5D	]	yes
5E	¢	yes
5F	—	
60	+	yes
61	a	
62	b	

HEX	CODE	*
63	c	
64	d	
65	e	
66	f	
67	g	
68	h	
69	i	
6A	j	
6B	k	
6C	l	
6D	m	
6E	n	
6F	o	
70	p	
71	q	
72	r	
73	s	
74	t	
75	u	
76	v	
77	w	
78	x	
79	y	
7A	z	
7B	2	yes
7C	1/2	yes
7D	3	yes
7E	o	yes
7F	DEL	

\* Variable Graphics (Keyboard 1 graphics shown, for other keyboards see Figure 31).

Figure 2-11. TTY Protocol 7-Bit Code (Odd Parity)

TTY MULTIPLE TRANSMISSION CODE KEYBOARD ASSIGNMENTS		2741 MULTIPLE TRANSMISSION CODE KEYBOARD ASSIGNMENTS		CMC MULTIPLE TRANSMISSION CODE KEYBOARD ASSIGNMENTS	
Control Codes & Hex Values	Keyboard Assignments	Control Code & Hex Value	Keyboard Assignments	Control Code & Hex Value	Keyboard Assignments
HT 09 or 89	Tab Code + Tab (req.) Control + I	CRE 5B	Control + J Control + Ret (CR) Ret (Non-required) Index	CRE 5B	Control + Ret Ret Control + J
FF 0C or 8C	Page End Code + Page End (req.) Control + L	RCR 3B	Ret (required) Code + Index	PE 79	Code + Page End Page End Control + L
SP 20 or A0	Space Code + Space (req.)	SP 01	Space Code + Space (req.)	HT 7A	Tab Control + I
CR + LF 0D 0A  8D 8A	Ret Required Ret  Code + Index	Syllable Hyphen 76	Hyphen Code + Hyphen (req.)	RBS 5D	Code + Backspace Control + H
Syllable Hyphen 2D or AD	Hyphen Code + Hyphen	RBS 5D	Backspace Code + Backspace Control + H		
BS 08 or 88	Backspace Code + Backspace Control + H				

Figure 2-12. Multiple Transmission Code Keyboard Assignments

COUNTRY	HEX KBID	02		04		07		08		0B		0D		0E		10		13		16		40		45		49		64		6B		6E		70	
		1	u	1	u	1	u	1	u	1	u	1	u	1	u	1	u	1	u	1	u	1	u	1	u	1	u	1	u	1	u	1	u	1	u
USA	1	!	2	@	3	#	5	%	7	&	6	¢	8	*	4	\$	0	)	9	(	½	¾	.	.	'	"	=	+	;	:	,	.	/	?	
USA	2	!	2	@	3	#	5	%	7	&	6	¢	8	*	4	\$	0	)	9	(	½	¾	.	.	'	"	=	+	;	:	,	.	/	?	
USA	3	!	2	@	3	#	5	%	7	&	6	¢	8	*	4	\$	0	)	9	(	½	¾	.	.	'	"	=	+	;	:	,	.	/	?	
USA	4	]	[	2	@	3	#	5	%	7	&	6	¢	8	*	4	\$	0	)	9	(	!	°	.	.	'	"	=	+	;	:	,	.	/	?
USA	5	!	2	@	3	#	5	%	7	&	6	¢	8	*	4	\$	0	)	9	(	!	°	.	.	'	"	=	+	;	:	,	.	/	?	
USA	6	]	[	2	¶	3	#	5	%	7	&	6	§	8	*	4	\$	0	)	9	(	!	°	.	.	'	"	=	+	;	:	,	.	/	?
USA	7	!	°	2	¶	3	#	5	%	7	&	6	§	8	*	4	\$	0	)	9	(	]	[	.	.	'	"	=	+	;	:	,	.	/	?
USA	8	!	°	2	¶	3	#	5	%	7	&	6	§	8	*	4	\$	0	)	9	(	½	¾	.	.	'	"	=	+	;	:	,	.	/	?
USA	17	!	€	2	@	3	#	5	%	7	&	6	¢	8	*	4	\$	0	)	9	(	=	+	.	.	'	"	½	=	;	:	,	.	/	?
USA	18	!	!	2	@	3	#	5	%	7	&	6	+	8	€	4	\$	0	)	9	(	¢	*	.	.	'	"	=	=	;	:	,	.	/	?
USA	19	!	±	2	@	3	#	5	%	7	&	6	¢	8	*	4	\$	0	)	9	(	½	¾	.	.	'	"	=	+	;	:	,	.	/	?
PUERTO RICO	24	!	!	2	í	3	#	5	%	7	&	6	/	8	*	4	\$	0	)	9	(	-	°	.	.	'	"	=	+	ñ	Ñ	.	.	/	?
PUERTO RICO	25	!	!	2	°	3	#	5	%	7	&	6	/	8	*	4	\$	0	)	9	(	=	+	.	.	'	"	½	¾	ñ	Ñ	.	.	/	?
GERMANY	26	!	;	2	"	3	=	5	&	7	)	6	(	8	+	4	%	0	/	9	§	ü	Ü	.	.	'	"	ä	Ä	ö	Ö	.	.	/	?
GERMANY	27	!	!	2	"	3	§	5	%	7	/	6	&	8	(	4	\$	0	=	9	)	ü	Ü	.	.	'	"	ä	Ä	ö	Ö	.	.	/	?
GERMANY-AUSTRIA	29	!	!	2	"	3	§	5	%	7	/	6	&	8	(	4	\$	0	=	9	)	ü	Ü	.	.	'	"	ä	Ä	ö	Ö	.	.	/	?

  BLANK BOXES MAPPED INTO GRAPHIC  
\_ UNDERScore IN TRANSMIT AND RECEIVE.

Figure 2-13 (Part 1 of 5). Correspondence Line Code Assignments For Variable Graphics

COUNTRY	HEX KBID	02		04		07		08		0B		0D		0E		10		13		16		40		45		49		64		6B		6E		70		
		1	u	1	u	1	u	1	u	1	u	1	u	1	u	1	u	1	u	1	u	1	u	1	u	1	u	1	u	1	u	1	u	1	u	
FRANCE	31	&	!	€	2	"	3	(	5	è	7	§	6	!	8	'	4	à	0	¢	9	=	+	;	:	,	.	/	?	)	°	.	.	'	"	
FRANCE	32	&	!	é	2	"	3	(	5	è	7	§	6	!	8	'	4	à	0	¢	9	=	+	;	:	,	.	/	?	)	°	.	.	'	"	
FRANCE	33	!	!	2	"	3	§	5	%	7	/	6	+	8	(	4	\$	0	=	9	)	ü	ü	.	.	'	"	ä	ä	é	é	.	.	/	?	
FRANCE	251	&	!	é	2	"	3	(	5	è	7	§	6	!	8	'	4	à	0	¢	9	=	+	;	:	,	.	/	?	)	°	.	.	'	"	
CANADA-ENG	36	!	!	2	@	3	#	5	%	7	&	6	¢	8	*	4	\$	0	)	9	(	½	¾	.	.	'	"	=	+	;	:	,	.	/	?	
CANADA-ENG	37	!	!	2	@	3	#	5	%	7	&	6	¢	8	*	4	\$	0	)	9	(	½	¾	.	.	'	"	=	+	;	:	,	.	/	?	
CANADA-FR	38	!	±	2	"	3	/	5	%	7	&	6	?	8	¾	4	\$	0	)	9	(	¢	*	.	.	'	"	½	¾	.	.	'	"	é	é	¢
CANADA-FR	39	!	!	2	@	3	#	5	%	7	&	6	¢	8	*	4	\$	0	)	9	(	-	'	.	.	'	"	=	+	;	:	,	.	/	?	
ITALY	41	&	!	"	2	'	3	ç	5	)	7	è	6	+	8	(	4	é	0	à	9	§	°	;	.	ü	%	:	/	-	...	.	?	ò	!	
ITALY	46	&	!	"	2	'	3	ç	5	)	7	è	6	+	8	(	4	é	0	à	9	ì	=	;	.	:	/	ò	!	-	...	.	?	ü	%	
NETHERLANDS	42	!	½	2	¾	3	3	5	%	7	&	6	f	8	(	4	€	0	¾	9	)	+	=	.	.	'	"	/	:	^	...	.	?	'	"	
NETHERLANDS	43	!	!	2	"	3	3	5	%	7	/	6	&	8	(	4	€	0	=	9	)	¾	§	.	.	'	"	½	¾	:	f	.	.	'	"	
SPAIN	44	!	ç	2	í	3	§	5	/	7	=	6	%	8	(	4	&	0	9	9	)	-	...	.	.	'	"	?	!	ñ	Ñ	.	.	/	?	
SPAIN	45	!	!	2	"	3	€	5	%	7	/	6	&	8	(	4	\$	0	=	9	)	°	a	.	.	'	"	ñ	ñ	ñ	ñ	.	.	/	?	
SWITZERLAND-FR	48	!	\$	2	"	3	*	5	&	7	)	6	(	8	?	4	%	0	¾	9	¾	'	/	.	.	'	"	=	ä	:	è	ü	.	.	/	?
SWITZERLAND-FR	49	!	+	2	"	3	*	5	%	7	/	6	&	8	(	4	ç	0	=	9	)	è	ü	.	.	'	"	=	ä	:	è	ü	.	.	/	?

  BLANK BOXES MAPPED INTO GRAPHIC  
\_ UNDERScore IN TRANSMIT AND RECEIVE.

Figure 2-13 (Part 2 of 5). Correspondence Line Code Assignments For Variable Graphics





NO PARITY (MARK)	HEX	A1	A2	A3	A4	A5	A6	A7	A8	A9	AA	AB	B8	BC	BD	BE	CO	DB	DC	DD	DE	EO	FB	FC	FD	FE		
EVEN PARITY	HEX	21	22	A3	24	A5	A6	27	28	A9	AA	2B	BB	3C	BD	BE	CO	DB	DC	DD	DE	60	7B	FC	70	7E		
ODD PARITY	HEX	A1	A2	23	A4	25	26	A7	A8	29	2A	AB	3B	BC	3D	3E	40	5B	DC	5D	5E	EO	FB	7C	FD	7E		
NO PARITY (SPACE)	HEX	21	22	23	24	26	25	28	27	29	2A	2B	3B	3C	3D	3E	40	5B	5C	5D	5E	60	7B	7C	70	7E		
COUNTRY	KEY BD																											
FRANCE	31	°	<	(	+	!	&	§	\$	*	)	;	~	ù	%	>	£	#	à	'	=	"	..	é	è	ç	³	²
FRANCE	32	°	<	(	+	!	&	§				;	~	ù	%				à	'	=	"	..	é	è	ç		
FRANCE	33	°	<	(	+	!	&	§	\$	*	)	;	~	ù	%	>	£	#	à	'	=	"	..	é	è	ç	³	²
FRANCE	251	°	<	(	+	!	&	§	\$	*	)	;	~	ù	%	>	£	µ	à	'	=	"	..	é	è	ç	³	²
CANADA-ENG	36			(	+	!	&		\$	*	)	;	c	½	%			#	@	'	=	"						
CANADA-ENG	37	[	£	(	+	!	&	]	\$	*	)	;	c	½	%	¶	±	#	@	'	=	"	°	2	3	½		
CANADA-FR	38	¢		(	+	!	&		\$	*	)	;	~	½	%				'		=	"	ç	é				
CANADA-FR	39	¢	«	(	+	!	&		\$	*	)	;	~	°	%	»		#	@	'	=	"	2	°	é	3	.	
ITALY	41	°	<	(	+	!	&	é	\$	*	)	;	~	ò	%	>	ù	£	§	'	=	"	ì	à	è	ç	°	½
ITALY	46			(	+	!	&	é				;	~	ò	%	ù			'	=	"	ì	à	è	ç	°		
NETHERLANDS	42			(	+	!	&		\$			;	~	½	%			£	f	'	=	"	..					
NETHERLANDS	43	§	±	(	+	!	&		\$	*	)	;	~	½	%	°		£	f	'	=	"	..	2	3	½		
SPAIN	44	¢	º	(	+	!	&		\$			;	~	ñ	%			¿	'	=	"	..						
SPAIN	45	¢	º	(	+	!	&		\$	*	)	;	~	ñ	%	ª		ñ	¿	'	=	"	..	½	i	ñ	£	
SWITZERLAND-FR	48	à	½	(	+	!	&	è	\$	*	)				%	¾	ù	ç	'	=	"	..						
SWITZERLAND-FR	49	à	§	(	+	!	&	è	\$	*	)	;	~	ö	%	°		£	ç	'	=	"	..	ä	ü	é	[	]
SWITZERLAND-GR	50	§		(	+	!	&		\$	*	)				%			ç	'	=	"	..	ä	ü	é	-		

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 MAPPED INTO INTERNAL DELETE IN RECEIVE

Figure 2-14 (Part 2 of 5). 7-Bit Line code Assignments For Variable Graphics

NO PARITY (MARK)	HEX	A1	A2	A3	A4	A5	A6	A7	A8	A9	AA	AB	B8	BC	BD	BE	CO	DB	DC	DD	DE	EO	FB	FC	FD	FE		
EVEN PARITY	HEX	21	22	A3	24	A5	A6	27	28	A9	AA	2B	BB	3C	BD	BE	CO	DB	DC	DD	DE	60	7B	FC	70	7E		
ODD PARITY	HEX	A1	A2	23	A4	25	26	A7	A8	29	2A	AB	3B	BC	3D	3E	40	5B	DC	5D	5E	EO	FB	7C	FD	7E		
NO PARITY (SPACE)	HEX	21	22	23	24	26	25	28	27	29	2A	2B	3B	3C	3D	3E	40	5B	5C	5D	5E	60	7B	7C	70	7E		
COUNTRY	KEY BD																											
SWITZERLAND-GR	51	à	§	(	+	!	&	è	\$	*	)	;	~	ö	%	°		£	ç	'	=	"	..	ä	ü	é	[	]
SWEDEN-FINLAND	52	ä		(	+	!	&	ä		ü					%			£	§	'	=	"	..	ä	ä	ö		
SWEDEN-FINLAND	53	ä	<	(	+	!	&	ä	\$	*	)	;	~	ö	%	>		£	§	'	=	"	..	ä	ä	ö	°	½
NORWAY	54	æ		(	+	!	&	æ	\$						%			£	-	'	=	"	..	æ	æ	ø	½	
NORWAY	55	æ	<	(	+	!	&	æ	\$	*	)	;	~	ø	%	>		£	-	'	=	"	..	æ	æ	ø	§	½
DENMARK	56	æ		(	+	!	&	æ	\$						%			£	-	'	=	"	..	æ	æ	ø	½	
DENMARK	57	æ	<	(	+	!	&	æ	\$	*	)	;	~	ø	%	>		£	-	'	=	"	..	æ	æ	ø	§	½
PORTUGAL	62	§		(	+	!	&		\$						%			£		'	=	"	..	º		ç		
PORTUGAL	63	§	¸	(	+	!	&		\$	*	)	;	~	ç	%	°		£	ª	'	=	"	..	º		ç	[	]
UNITED KINGDOM	66	½		(	+	!	&	½	\$	*	)	;			%			£	@	'	=	"						
UNITED KINGDOM	67	[	<	(	+	!	&	]	\$	*	)	;	µ	#	%	>	±	£	@	'	=	"	°	2	3	½		
UK (LEGAL)	20	[		(	+	!	&	]	\$	*	)	;			%			£	@	'	=	"						
UNITED KINGDOM	253	§	<	(	+	!	&	!	£	*	)	;	µ	]	%	>	±	£	@	'	=	"	°	2	3	½		
UNITED KINGDOM	254	§		(	+	!	&	!	£	*	)	;	½	%				@	'	=	"							
JAPAN	68	£		(	+	!	&	°	\$	*	)	;			%			#	@	'	=	"						
JAPAN	69	£	β	(	+	!	&	°	\$	*	)	;	~	~	%	ç		#	@	'	=	"	..					

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 IN TRANSMIT AND RECEIVE.

Figure 2-14 (Part 3 of 5). 7-Bit Line code Assignments For Variable Graphics

NO PARITY (MARK)	HEX	A1	A2	A3	A4	A5	A6	A7	A8	A9	AA	AB	B8	BC	BD	BE	CO	DB	DC	DD	DE	EO	FB	FC	FD	FE			
EVEN PARITY	HEX	21	22	A3	24	A5	A6	27	28	A9	AA	2B	BB	3C	BD	BE	CO	DB	5C	DD	DE	60	7B	FC	70	7E			
ODD PARITY	HEX	A1	A2	23	A4	25	26	A7	A8	29	2A	AB	3B	BC	3D	3E	40	5B	DC	5D	5E	EO	FB	7C	FD	FE			
NO PARITY (SPACE)	HEX	21	22	23	24	26	25	28	27	29	2A	2B	3B	3C	3D	3E	40	5B	5C	5D	5E	60	7B	7C	70	7E			
COUNTRY	KEY BD																												
GREECE	74			(	+	'	&	'	\$	*	)	;	~	%	>	#	@	'	=	"	"	"	"	"	"	"			
GREECE	75	§	±	(	+	'	&	'	\$	*	)	;	~	½	%	°	~	£	f	'	=	"	"	2	3	¼			
HONG KONG	119	[	§	(	+	'	&	]	\$	*	)	;	£	½	%	¶	±	#	@	'	=	"	"	o	2	3			
SOUTH AFRICA	80			(	+	'	&	'	\$	*	)	;	~	½	%	~	£	f	'	=	"	"			¼	¾			
SOUTH AFRICA	81	÷	°	(	+	'	&	l	\$	*	)	;	~	n	%	½	~	£	@	'	=	"	"	2	3	'			
CZECHOSLOVAKIA	82	é		+	'	ú	ě	š	ů					č	§	ř	ž	'	=	"	"	ý	á	í					
CZECHOSLOVAKIA	83	°	é	(	+	'	ú	ě	š	ů	)	;	~	č	%	§	ř	ž	'	=	"	"	ý	á	í	3	2		
CZECHOSLOVAKIA	84	é		+	'	ú	ě	š	ů					č	§	ř	ž	'	=	"	"	ý	á	í					
CZECHOSLOVAKIA	85	°	é	(	+	'	ú	ě	š	ů	)	;	~	č	%	§	ř	ž	ň	=	"	"	ä	ý	á	í	3	2	
RUMANIA	86	ş		(	+	'			ş	ţ	)	;	~	î	%	~	£		'	=	"	"	ă	â					
RUMANIA	87	Ă	ş	(	+	'	&	Ă	\$	ţ	)	;	~	î	%	ş	~	£	T	'	=	"	"	ă	â	İ	3	2	
HUNGARY	90	É	ű	+	'	Ó	ű						Á	ö	%	ó	ó	§		=	"	"	á	é	ü	ö			
HUNGARY	91	É	ó	(	+	'	Ó	ű	ű	ű	)	;	Á	ö	%	ó	ó	İ	§	ú	=	"	"	á	é	ü	ö	í	ű
POLAND	93	ź	<	(	+	'	&	ń	ł	*	)	;	ś	ł	%	>	ł	#	ę	'	=	"	"	ć	ó	ż	ł	ó	
YUGOSLAVIA	94	š		(	+	'	&	ć	*	)			č	%	ž	ž	'	=	"	"	"	č	š	ć					
YUGOSLAVIA	95	š	ě	(	+	'	&	ć	\$	*	)	;	č	đ	%	č	ž	#	ž	'	=	"	"	č	š	ć	đ	ć	ě

BLANK BOXES NOT GENERATED IN TRANSMIT  
 MAPPED INTO INTERNAL DELETE IN RECEIVE

Figure 2-14 (Part 4 of 5). 7-Bit Line code Assignments For Variable Graphics

NO PARITY (MARK)	HEX	A1	A2	A3	A4	A5	A6	A7	A8	A9	AA	AB	B8	BC	BD	BE	CO	DB	DC	DD	DE	EO	FB	FC	FD	FE
EVEN PARITY	HEX	21	22	A3	24	A5	A6	27	28	A9	AA	2B	BB	3C	BD	BE	CO	DB	5C	DD	DE	60	7B	FC	70	7E
ODD PARITY	HEX	A1	A2	23	A4	25	26	A7	A8	29	2A	AB	3B	BC	3D	3E	40	5B	DC	5D	5E	EO	FB	7C	FD	FE
NO PARITY (SPACE)	HEX	21	22	23	24	26	25	28	27	29	2A	2B	3B	3C	3D	3E	40	5B	5C	5D	5E	60	7B	7C	70	7E
COUNTRY	KEY BD																									
USA-EBCDIC	100	¢	<	(	+	'	&	'	\$	*	)	;	~	%	>	#	@	'	=	"	"	"	"	"	"	"
USA-EBCDIC	101	¢	<	(	+	'	&	'	\$	*	)	;	~		%	>	~	#	@	'	=	"	"	{	}	\
USA-ASCII	102	[	<	(	+	'	&	]	\$	*	)	;	~	%	>	#	@	'	=	"	"	"	"	"	"	"
USA-ASCII	103	[	<	(	+	'	&	]	\$	*	)	;	~		%	>	~	#	@	'	=	"	"	{	}	\

BLANK BOXES NOT GENERATED IN TRANSMIT  
 MAPPED INTO INTERNAL DELETE IN RECEIVE

Figure 2-14 (Part 5 of 5). 7-Bit Line code Assignments For Variable Graphics

**ASYNCHRONOUS OPERATING INSTRUCTIONS**

This section describes how to perform basic communication tasks when using the IBM Displaywriter ASYNC licensed program. The functions of the ASYNC keyboard, the TASK SELECTION menu sequences, the PROGRAM DISKETTE TASK

menu sequences and the ASYNC Setup options are discussed.

This is not a complete operator's manual. If further information is needed, refer to IBM Displaywriter System Asynchronous Communications Feature Operating Guide.

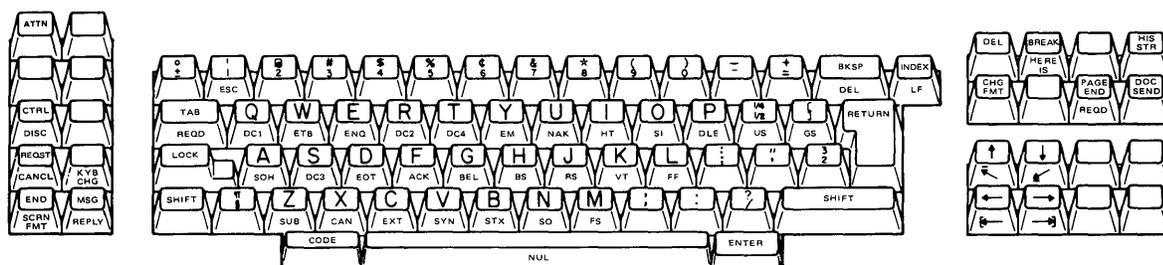


Figure 2-15. Basic Keyboard Layout for ASYNC

### KEYBOARD OPERATION

This section describes the operation of the work station control and the function keys for ASYNC communication. The ASYNC basic keyboard layout is also shown.

### Function Keys for ASYNC

The operation of the function keys for ASYNC operations are described as follows:

- Attention (ATTN) (IBM CMC/2741 mode) or Break (TTY mode). Generates the Attention function when communicating in IBM CMC/2741 protocol. While using the TTY protocol, this key causes a break signal to be sent or released.
- Change Format (CHG FMT). Used to change Communication Console line parameters.
- COMM START. Valid only in IBM CMC and 2741 Standby mode and determines which of the two communicating terminals will be put into Send mode.
- Delete (DEL). Used only in MARGINS AND TABS menu processing.
- Document Send (DOC SEND) ON/OFF. A toggle key used to start and stop transmission from a specified document. The state of the key is displayed on the Communication Indicator line.

- History Store (HIS STR) ON/OFF. A toggle key which activates and deactivates the storage of displayed session history to a specified document. The state of this key is displayed on the Communication Indicator line.
- Page End. Used to generate a Card Eject code for IBM CMC/2741 mode or a Form Feed (FF) code for TTY mode.
- Required Page End (CODE + PAGE END). Used to generate a Card Eject code for IBM CMC/2741 mode or a Form Feed (FF) code for TTY mode.
- Reset. Valid only in the IBM CMC Send mode and causes a circle C to be sent.

### Work Station Control Keys

The work station control keys are located on the left side of the keyboard and have the following functions:

- Disconnect (CODE + DISC). Causes the local station to disconnect from the communication line and to drop DTR. The current setup is not altered. The Communication Status field is cleared and the local station is unable to answer incoming calls. The local operator cannot initiate outgoing calls after the DISC key is pressed. The DISC key is active any time the Communication Status field is not blank.

- **Message (MSG).** Used to display background messages from the message queue.
- **Message Reply (CODE + MSG).** Used to clear an Insert Diskette message and to indicate that the required diskette will not be inserted.
- **Request (REQST).** Used to show a list of additional functions that may be invoked during the current foreground task.
- **Keyboard Change (KBY CHG).** Used to alter the current keyboard arrangement.
- **Screen Format (SCRN FMT).** Used to alter the current format of the viewport.

### **Control Key**

ASYNC uses a Control (CTRL) key to generate the 33 ASCII control codes. This key is located in the left row, third key from the top, of the left bank of outboard keys. These control codes are produced by pressing and holding the Control key while pressing the inboard key. Figure 2-15 shows the control codes.

The Control key is also used with the History Store (HIS STR) key to control the monitor trace capability.

### **ACCESSING THE ASYNC COMMUNICATION SET-UP**

This menu sequence is used to define the setup for the three ASYNC Communications protocols (TTY, IBM CMC and 2741).

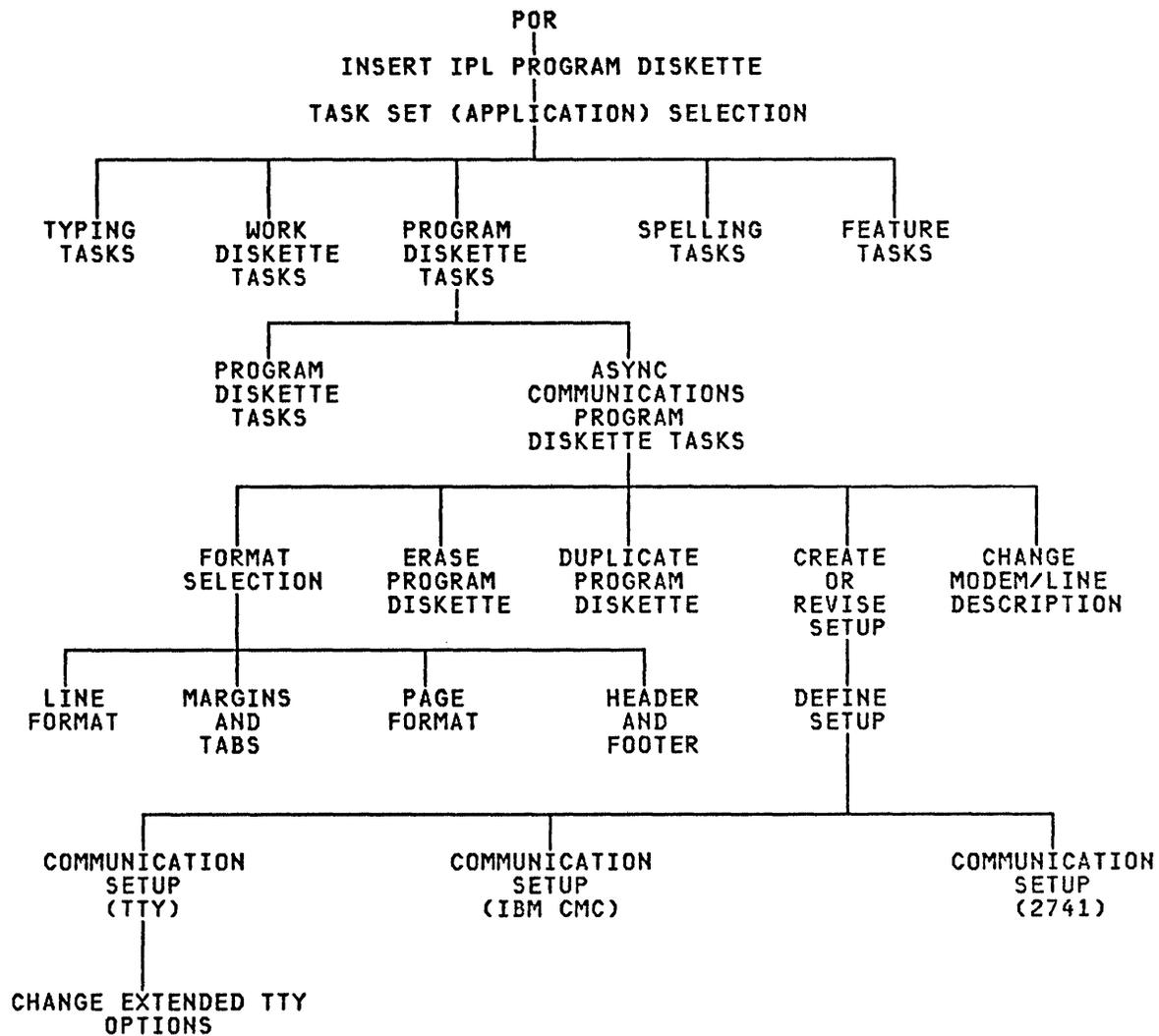


Figure 2-16. ASYNC Communications Program Diskette Tasks Menu Sequence



lowing 30 seconds of line inactivity.

- Valid Answers: Yes, No
- Default: No
- Echoplex (available on TTY setups only). When this parameter is set to yes, the Displaywriter operates in echoplex mode. In this mode, transmitted data is not automatically displayed in the History viewport. The remote station may retransmit an image of the data received. The data will then be displayed as received data.
  - Valid Answers: Yes, No
  - Default: No
- Parity (available on TTY setups only). This option specifies which type of parity will be sent and checked. If "None" is specified, then a "1" bit (mark) will be sent in the parity field and received parity bits will be ignored.
  - Valid Answers: Even, Odd, None
  - Default: Even
- EOT Disconnect (available on TTY setups only). This option specifies whether or not the Displaywriter will automatically initiate disconnect upon reception of the control code EOT. Additionally, if this option is selected, an EOT will be transmitted prior to each operator selected disconnection via the Disconnect Key.
  - Valid Answers: Yes, No
  - Default: No
- Send All Codes (available on 2741 setups only). Selecting this option will cause all of the control codes (except the Switch code) which are transmitted in IBM CMC mode to also be transmitted in 2741 mode.
  - Valid Answers: Yes, No
  - Default: No
- Automatic Answer Back (available on TTY setups only). Selecting this option will cause Displaywriter to automatically

transmit the terminal ID (if not blank) upon establishment of the data link.

- Valid Answers: Yes, No
- Default: Yes
- Change Extended TTY Option (available on TTY setups only). This option allows the operator to specify the pacing and new line options from the CHANGE EXTENDED TTY OPTIONS menu. See Figure 2-20.

#### CHANGE EXTENDED TTY OPTIONS Menu

The options on the CHANGE EXTENDED TTY OPTIONS menu provide some extended function for use in interacting with host application programs.

The options and a description of them follows:

- Send New Line. Specifies the sequences of Carrier Return, Required Carrier Return, and Index Return.
  - Valid Answers: CR LF, CR, LF, X-OFF (DC3), CR X-OFF.
  - Default: CR LF
- Display Send New Line. This option specifies what is to be displayed for the send new line sequence.
  - Valid Answers: New Line, CR, LF, None (Do not display)
  - Default: New Line (CRE, RCR, IRT)
- Receive New Line. This option specifies what online sequence is to be translated into a new line (X '15') when receiving.
  - Valid Answers: CR LF, CR, LF, X-OFF (DC3).
  - Default: CR LF
- Send Pacing. This option specifies the form of send pacing to be used for both keyed data and send document data.
  - Valid Answers: None, Stop at Line End, Stop when X-OFF received
  - Default: None

## ACCESSING THE ASYNC COMMUNICATION TASK

After defining the communication setup this menu sequence is used for the ASYNC communication task (Figure 2-21).

CHANGE EXTENDED TTY OPTIONS			
ID	ITEM	YOUR CHOICE	POSSIBLE CHOICES
a	Send New Line	1	1 = CR LF 2 = CR 3 = LF 4 = XOFF 5 = CR XOFF
b	Display Send New Line	1	1 = New Line 2 = CR 3 = LF 4 = None
c	Receive as New Line	1	1 = CR LF 2 = CR 3 = LF 4 = XOFF
d	Send Pacing	1	1 = None 2 = Stop at Line End, Wait for XON 3 = Stop When XOFF Received, Wait for XON

When finished with this menu, press ENTER.  
Type ID letter to choose ITEM; press ENTER:

Figure 2-20. CHANGE EXTENDED TTY OPTIONS Menu

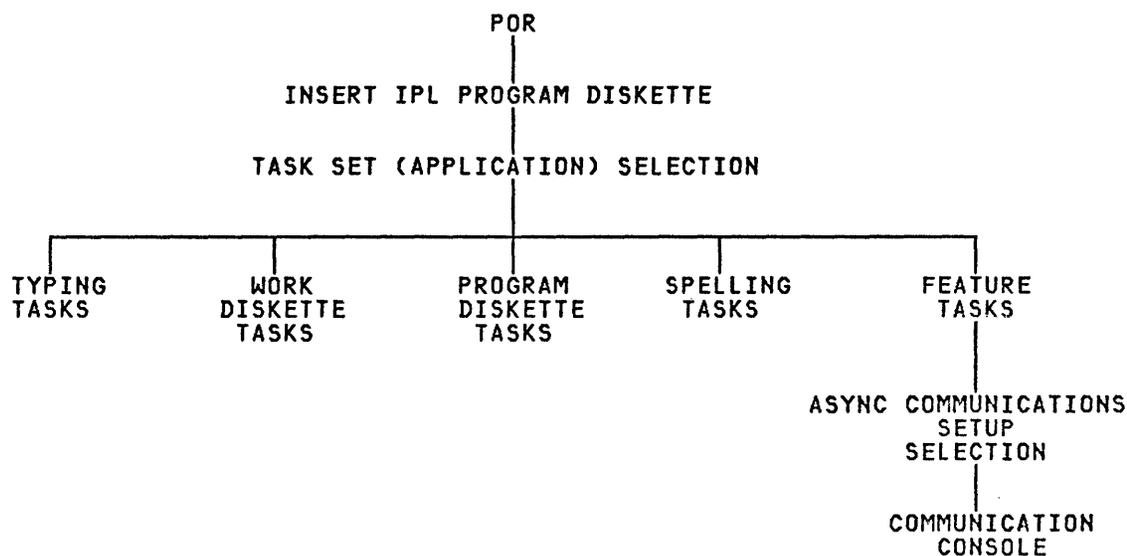


Figure 2-21. ASYNC Communication Task Menu Sequence

## CHAPTER 3. ASYNC COMMUNICATIONS DIAGNOSTICS

### INTRODUCTION

The communications diagnostic support package for the IBM Displaywriter System consists of:

- Loadable Diagnostics
- Maintenance Analysis Procedures (MAPs)
- Online Diagnostics
- Customer Loadable Diagnostics
- Customer Link Analysis Utilities
- Communications Link Analysis Guide

**Note:** This section contains display formats and printed outputs that should be considered as samples only.

### MDIS

The MDIs are test units and directions for service action that operate when selected. The first test unit requests the input of a Communication ID which describes the hardware configuration.

These MDIs test the communication components within the Displaywriter and the external components such as the external EIA and LDC cables.

The chart in Figure 3-1 lists the Communication IDs for different hardware configurations. The MDIs check whether the communication adapter card is located in the electronics module or the diskette unit. When the diagnostic controller has determined the configuration of the communication features, a set of test units operate automatically to test the function of these particular features.

### MDI OPERATION

The communication MDIs are on the ABC diagnostic diskette. Before this diskette can be loaded, the MDI supervisor must first be loaded from the Displaywriter System diagnostic diskette. An interface to the MDIs is provided through the keyboard and display.

Follow these steps to run the MDIs.

1. Insert the Displaywriter system diagnostic diskette. The program loads and the FUNCTION SELECTION menu displays.
2. Select MDIs from the FUNCTION SELECTION menu. The DEVICE SELECTION menu displays.
3. Select Communications from the DEVICE SELECTION menu.
4. Insert the Displaywriter system ABC diagnostic diskette and press Enter.

If a single diskette drive system is used, the Displaywriter system diagnostic diskette must be removed and the Displaywriter system ABC diagnostic diskette inserted.

If a dual diskette drive is used, the Displaywriter system ABC diagnostic diskette may be inserted in the right drive. A flowchart for Displaywriter system diagnostics and Displaywriter system communications diagnostics is shown in Figure 3-2.

For further information on MDI operation, refer to the IBM Displaywriter System Product Support Manual.

The Displaywriter is also equipped with a feature known as RESUME that can be used as a marker, or stopping point, while running the MDIs.

RESUME can be used in two ways:

- Automatic RESUME is written into the MDIs. When an automatic RESUME occurs, a prompt occurs.
- Optional or real time RESUME is entered by keying the letter 'r' at any MDI stopping point. When in 'Step' mode, an optional RESUME can be placed at any point within the MDIs. Once the RESUME has been entered, either Power Off the Displaywriter, or press END to return to the FUNCTION SELECTION menu. To return to the RESUME point, access the FUNCTION SELECTION menu and select MDIs. From this menu the RESUME option is taken by pressing ENTER. Pressing END or CANCEL at this point will erase the optional RESUME.

ID	Communications Configuration
a	Port 4: Communications Adapter EIA port Electronics Module EIA
d	Port 4a: Communications Adapter EIA port Port 4b: Local Device Controller
e	Port 4a: Communications Adapter EIA port Port 4b: X.21 Switched line
f	Port 4a: Communications Adapter EIA port Port 4b: X.21 Leased line
g	Port 4a: Communications Adapter EIA port Port 4b: 38LS modem for switched line
h	Port 4a: Communications Adapter EIA port Port 4b: 38LS modem for nonswitched line with SNBU
i	Port 4a: Communications Adapter EIA port Port 4b: 38LS modem for nonswitched line
m	Port 4a: Communications Adapter EIA port Port 4b: EIA Adapter Card EIA port
p	Port 4b: Local Device Controller
p	Port 4b: X.21 Switched line
q	Port 4b: X.21 Leased line
s	Port 4b: 38LS modem for switched line
t	Port 4b: 38LS modem for nonswitched line with SNBU
u	Port 4b: 38LS modem for nonswitched line
z	Communications tests inhibited

Figure 3-1. Communications ID Chart

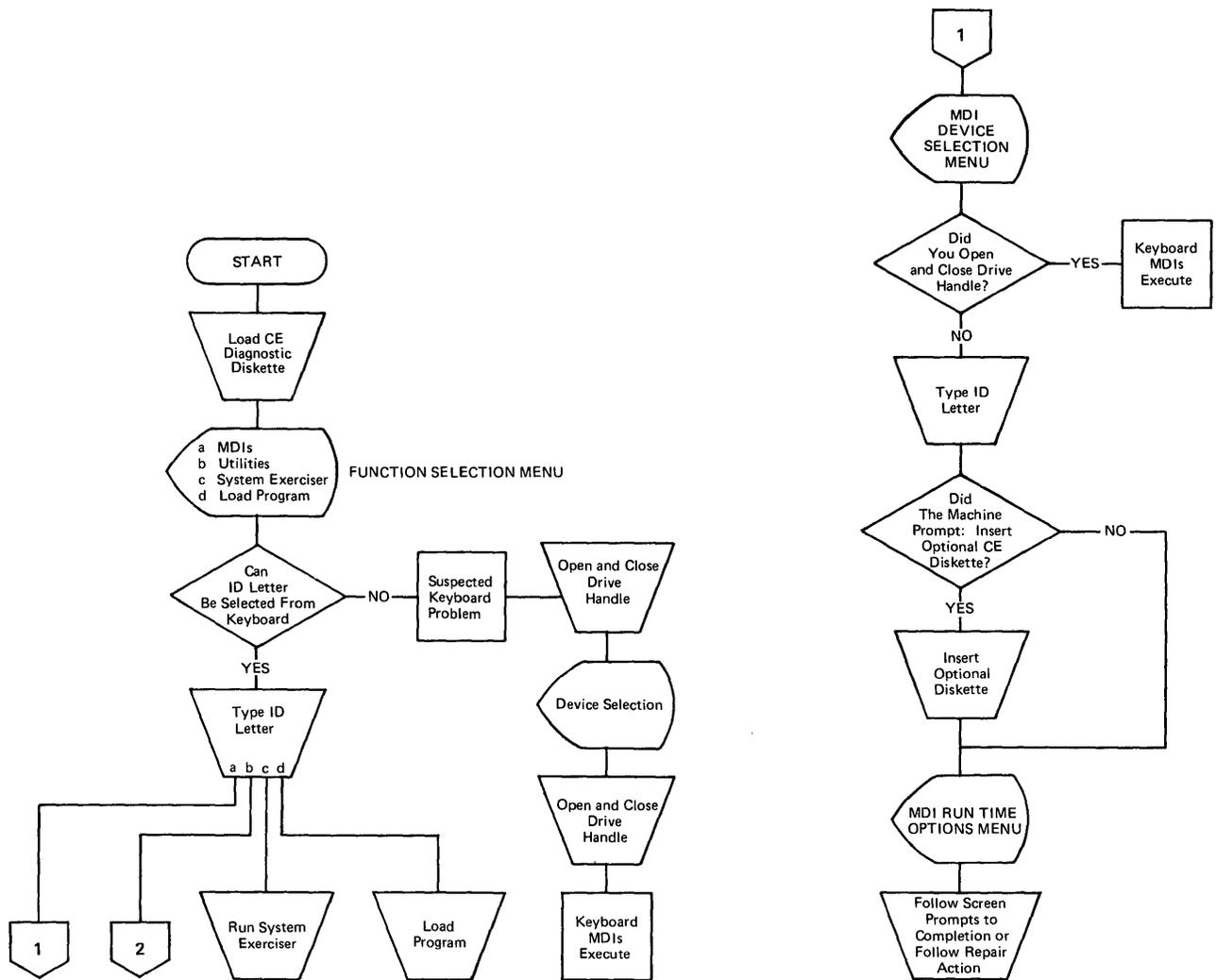


Figure 3-2 (Part 1 of 2). Loadable Diagnostics Flowchart

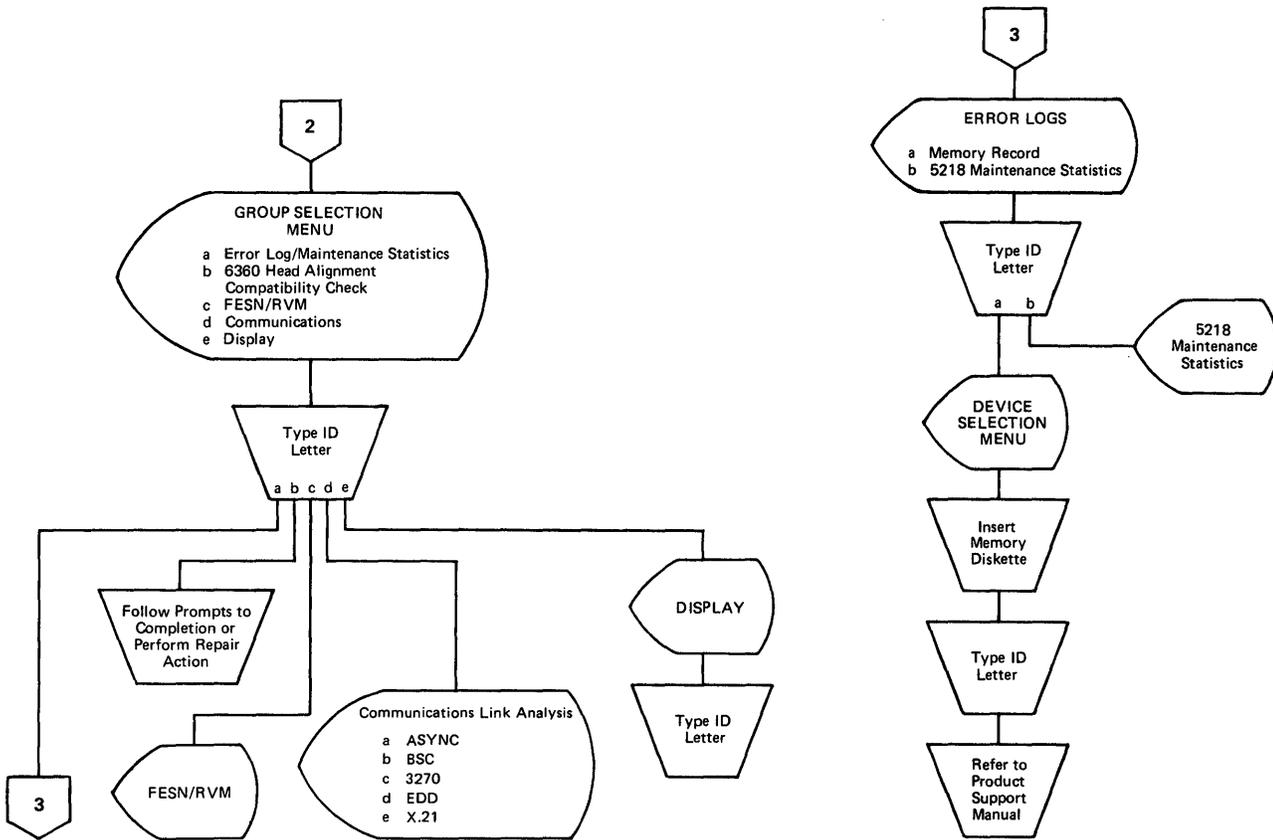


Figure 3-2 (Part 2 of 2). Loadable Diagnostics Flowchart

**ONLINE TEST SUPPORT (OLTS)**

The Online Test Support is used to verify ASYNC and BSC link and protocol operations. To run OLTS you must send a Request for Test (RFT) document to the connected host. The RFT selects the test to be executed. Displaywriter supports the creation and transmission of any valid RFT. (Slight formatting differences may exist depending on the host.)

To create a RFT, use normal operating procedures to create a document.

Enter all information for the RFT into the document using the keyboard.

A standard job setup, which allows any RFT to be transmitted, is provided on all communications feature diskettes. The standard setup is non-displayable, non-alterable, and is selected through normal operator menus.

The four basic steps to conduct an Online Test (OLT) are summarized below. Each step is described in detail in the pages that follow.

1. Create the RFT document to be sent during the online test.
2. Personalize the Modem and Line Description on the communications feature diskette to be compatible with the supporting host system.
3. Call the host system and conduct the test.
4. Verify the data from the test.

The ASYNC Online Test can also be run with a procedure that allows the RFT to be entered while online with the host. Instructions for using this procedure are found later in this chapter.

Before conducting the OLTS make sure you have the following available:

- a. The Textpack program diskettes
- b. The communications feature diskette
- c. An initialized work diskette.
- d. Pencil and paper.

**Note:** The Textpack diskette and the communications feature diskette must be compatible; for example, the third character from the left in the Textpack diskette name must be the same or higher than the Communications feature diskette.

#### CREATING THE RFT DOCUMENT

1. Load the Volume 01 Textpack Program diskette; TASK SELECTION menu will display.
2. Choose **Typing Tasks** from the TASK SELECTION menu.
3. Follow the prompt and load Volume 2 of the Textpack Program diskette. The TYPING TASKS menu will display.
4. Choose **Create Document** from the TYPING TASKS menu.
5. Follow the prompt and type the document name: rft. Press Enter.

**Note:** If rft has already been selected, choose another job name.

6. Type the diskette name and press Enter.
7. Remove the Textpack program diskette and insert the work diskette. The work diskette name will appear in the upper left corner of the display.

8. Type the name of the work diskette. The CREATE OR REVISE DOCUMENT menu will display.
9. Choose **Change Document Format** from the CREATE OR REVISE DOCUMENT menu and press enter. The FORMAT SELECTION menu will display.
10. Choose **Change Page Format** from the FORMAT SELECTION menu. The PAGE FORMAT menu will appear.
11. Choose **First Typing Line, First Page** from the PAGE FORMAT menu.
12. Type the number 1, and then press enter. YOUR CHOICE is highlighted.
13. Press ENTER three times to go to the typing area.
14. Type the Message Format on line 1. Your Message Format should look similar to this typed line, except personalized with your branch office number, security code and number of times the test runs. No spaces are allowed in the Message Format Line.

```
//nnn/sss/6580echotC/R
```

```
// = Header
nnn = B/O number
/ = Required Separator
sss = Current month security
      code for your branch
/ = Required Separator
6580 = Machine Type
ECHO = Test Type
t = Number of times test
     runs (Valid entries 1-9)
C/R = Carrier Return
      (Press Return)
```

15. Type the message you want transmitted on line 2. It should not exceed 160 characters. This is a sample message: The quick brown fox jumped over the lazy dog.
16. Press END. This key must be pressed in order to store the RFT document on the work diskette.
17. Choose **Go to TASK SELECTION** from the menu that displays.

#### PERSONALIZING THE ASYNC MODEM AND LINE DESCRIPTION

In order to conduct the ASYNC OLT, the MODEM AND LINE DESCRIPTION menu must be personalized. The procedure below lists the steps for personalizing the ASYNC modem and line description.

1. Remove any Textpack program diskettes from the diskette unit.

2. Choose **Program Diskette Tasks** from the **TASK SELECTION** menu.
3. Follow the prompt and insert the **ASYNC Feature Diskette**. The **ASYNC COMMUNICATIONS PROGRAM DISKETTE TASKS** menu displays.
4. Choose **Create or Revise Modem or Line Description** from the **ASYNC COMMUNICATIONS PROGRAM DISKETTE TASKS** menu. Press **ENTER**. The **MODEM AND LINE DESCRIPTION** menu displays.
5. Compare the **YOUR CHOICE** column shown in Figure 3-3 with the existing application choices.
6. Write down the existing application choices on a piece of paper. When the **OLTS** is finished, you will need to restore the **MODEM AND LINE DESCRIPTION** menu to match the existing application.
7. Change only those items necessary to match the **YOUR CHOICE** column on your screen with that column in Figure 3-3. Your changes are highlighted.
8. When finished with this menu, press **ENTER** to return to the **ASYNC COMMUNICATIONS PROGRAM DISKETTE TASKS** menu.
9. Choose **Go To Task Selection**.

Chg Description		YOUR CHOICE		POSSIBLE CHOICES	
ID	ITEM				
a	Switched Network	1	1 = Yes	2 = No	
b	CTS/RLSD (CB/CF) Option	1	1 = Common	2 = Separate	
c	Modem Port	1	1 = Port 4	2 = Port 4A	3 = Port 4B

When finished with this menu, press ENTER.

Type ID letter to choose ITEM; press ENTER: #

Figure 3-3. ASYNC MODEM AND LINE DESCRIPTION SETUP menu

## CALLING THE HOST SYSTEM AND CONDUCTING THE ASYNC OLTS

Before calling the host system to conduct the **OLTS** you must first create an **ASYNC RFT** document and personalize the **ASYNC** modem and line description. These procedures are described above. After performing the steps above you should be in the **TASK SELECTION** Menu. To call the host system and conduct the **OLTS** follow these steps.

1. Choose **Feature Tasks** from the **TASK SELECTION** menu.
2. Following the prompt, insert the **ASYNC Feature Diskette** if it is not already loaded. The **ASYNC COMMUNICATION SETUP SELECTION** menu displays.
3. Type the letter **T**; then press **ENTER**. (The letter "T" will not display.) The **Communications** frame displays; the **Communications Status Field** indicates **READY**. The "T" setup defaults are shown in Figure 3-4.
4. Press **HIS STOR** and insert the work diskette. If using a dual diskette unit, insert the work diskette in the left slot. Type today's date and the work diskette name. **HISTORY STORE ON** appears in the session header line (Line 3).
5. **NOTE:** This is an optional step performed only to display data in **ASYNC Trace Format**. Press **TRACE** (Control key + **HIS STOR**).

6. Call the host system.

**Note:** There should be no pauses longer than 20 seconds between the three steps after "going to data", or the host may automatically disconnect the line.

7. Go to data **AFTER** the host system goes to data. **CONNECTED** appears briefly in the communications status field and then changes to **ON-LINE SEND**.
8. Press **DOC SEND**. **DOCUMENT: SEND ON** displays in the session header line.

**Note:** To communicate without creating a document, key each character of the test message. No backspaces or corrections are allowed in the first line. A maximum of 20 seconds is allowed between keystrokes.

9. Type the name of the **Online Test** document: **rft**. The **SEND DOCUMENT** menu displays.

10. Press ENTER twice to return to the communications frame. After the test has finished, ON-LINE SEND reappears in the communications status field.
11. When communications have finished, end the session by pressing DISC and then pressing END. The ASYNC COMMUNICATIONS PROGRAM DISKETTE TASK menu displays.
12. Choose **Go To Task Selection** from the ASYNC COMMUNICATIONS PROGRAM DISKETTE TASKS menu.

**Note:** If the Error Log is to be recorded, use the Memory Record Diskette(s) immediately after the communication session ends. The Error Log can then be accessed from the ABC Diagnostic Diskette.

SETUP ITEM	DEFAULT
Job Name	OLT
Speed	134.5 BPS
Inactivity Disconnect	No
Send All Codes	No
Terminal ID	No

Figure 3-4. "T" Setup Defaults

#### ASYNC OLTS ONLINE PROCEDURE

This procedure may be used to create the RFT and conduct the OLTS while online with the host. The steps to perform this procedure are:

1. Call the host system.
2. Go to data after the host goes to data.
3. Press COMM START within 10 seconds after data mode is entered.
4. Type the Request for TEST (RFT) message:
 

```
//nnn/sss/6580ECHOtCR
```

nnn = Branch Office Number  
 sss = Security Code  
 6580 = Machine Type  
 ECHO = Test Type  
 t = Number of times test runs (Valid numbers 1-9)  
 CR = Carrier Return (Press RETURN)
5. Type the message you want to transmit, then press RETURN.  
 EXAMPLE: The quick brown fox ran fast.
6. The message you sent will return highlighted to your screen the requested number of times.

#### VERIFYING THE ASYNC OLTS DATA

Verifying the OLTS data is the last step in ASYNC OLTS. There are two ways to verify the data that was recorded on the work diskette during OLTS. One is to review the data on the display. Another way is to print the RFT document. Procedures for both methods of verifying OLTS data follow. After you have verified the ASYNC OLTS data, always return the ASYNC MODEM AND LINE DESCRIPTION menu to its existing application.

#### REVIEWING OLTS DATA ON THE DISPLAY

Follow these steps to review OLTS data on the display.

1. Choose **Typing Tasks** from the TASK SELECTION menu.
2. Follow the prompts and insert Volume 2 of the Textpack program diskettes. The TYPING TASKS menu displays.
3. Choose **Revise Document** from the TYPING TASKS menu. Insert the work diskette.
4. Type in today's date.
5. Press ENTER to go to the typing area.
6. Review the document.
7. When finished reviewing, press END.

This completes the ASYNC OLTS procedure.

#### PRINTING THE OLTS DATA

Follow the steps below to print the ASYNC RFT document.

1. Press REQST. Displaywriter displays the REQUEST TASKS menu.
2. Choose **Print Document**.
3. Type today's date.
4. Follow the prompts on the display to print the document.

This completes the ASYNC OLTS procedure.

## ASYNCR LINK ANALYSIS UTILITIES

There are several ASYNCR Communication Link Analysis Utilities that aid in network problem determination. These utilities are used to test and exercise the modem, the communications adapter, and the link. The ASYNCR utilities are:

- Send Continuous Data. Used to continuously transmit known data on the link.
- Receive Continuous Data. Used to receive a continuous known data pattern, detect errors in the pattern, and log the error.
- Return Data to Sender. Used to return all receive data back to the sender.
- Control Modem Interface. Used to control and display the EIA interface.
- Display Error Log. Used to format and display the ASYNCR error log.
- Change Link Description. Used to define the ASYNCR environment.
- Wrap Modem. Used to test modems which support a wrap capability.

In most cases, you must follow a setup procedure for an individual utility before the utility will execute.

Figure 3-5 shows how to access the utilities.

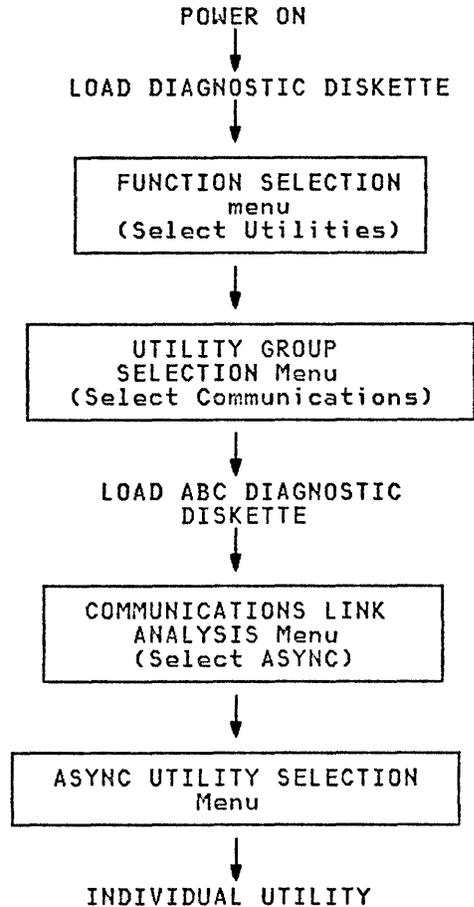


Figure 3-5. Menu Path for ASYNCR Link Analysis Utilities

The steps to accessing the individual ASYNC Utilities are as follows:

1. Power ON and load the Displaywriter System Diagnostic Diskette.
2. Select **Utilities** from the FUNCTION SELECTION menu. The UTILITY GROUP SELECTION menu displays.
3. Select **Communications** from the UTILITY GROUP SELECTION menu.
4. Load the ABC Diagnostic Diskette. The COMMUNICATIONS LINK ANALYSIS menu displays.
5. Select **ASYNC Link Analysis** from the COMMUNICATIONS LINK ANALYSIS menu. The ASYNC UTILITY SELECTION menu appears.
6. Select the individual utility.

### ASYNC LINK ANALYSIS MENU

Figure 3-6 shows the ASYNC LINK ANALYSIS menu. The Link Description Status line (Line 3) indicates:

- the line protocol in effect
- line speed
- parity field (TTY only)
- the modem port in use.

Once the ASYNC UTILITIES SELECTION menu appears, a communications link can be established or an individual utility can be selected.

**Note:** After a link is established, press DISC if you wish to disconnect the link.

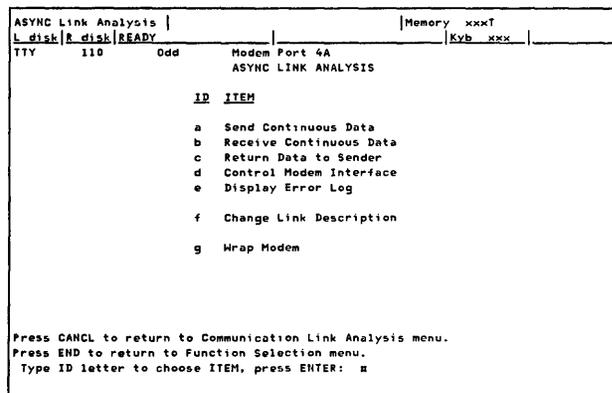


Figure 3-6. ASYNC UTILITY SELECTION Menu

### SEND CONTINUOUS DATA UTILITY

The Send Continuous Data Utility is used to test the integrity of the data link. The utility enables the Displaywriter to send a continuous selectable bit pattern across the link and to optionally check any received data that is wrapped back. Points from which data can be wrapped back are:

- local EIA/CCITT cable wrap switch
- local modem (if it supports a local wrap)
- remote modem (if it supports a remote wrap)
- remote Displaywriter.

The receiving station can monitor the pattern sent from the Displaywriter for errors.

To select the utility, choose **Send Continuous Data** from the ASYNC LINK ANALYSIS Menu (Figure 3-6). The ASYNC SEND CONTINUOUS DATA menu (Figure 3-7) will display.

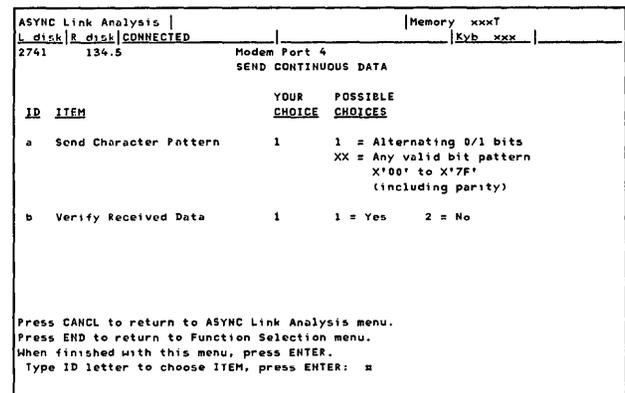


Figure 3-7. SEND CONTINUOUS DATA Menu (Setup)

After ENTER is pressed, the format of the display changes (Figure 3-8).

```

ASYNC Link Analysis | Sending Continuous Data | Memory xxxT
L_disk | R_disk | On-LINE SEND | | kyb xxx |
2741 134.5 Modem Port 4

TS
DTR DSR RTS CTS RLSD RI TD RD SS DSRS          = On
  * * * * * * * * * * * * * * * * * * * * * * = Off
Character Pattern - Alternating 0/1 bits          Non-Matches - ' '
                Receive Status
Parity Errors   Framing Errors   Overrun Errors   DSR Dropouts   Breaks
' 0'           ' 0'             ' 0'           ' 0'             ' 0'
                Received Data

Error Characters -

Press CANCL to return to setup menu.
Press END to return to Function Selection menu.
Press ENTER key to start or stop the displaying of data.

```

Figure 3-8. SEND CONTINUOUS DATA Menu (Execution)

'TS' (Line 5) stands for Test Score. The numbers displayed represent a ratio of the number of errors to the number of characters received. The higher the Test Score, the lower the quality of the link. The test scores and what they stand for are as follows:

- Blank. No data received
- 0. No errors or less than one error per 32,768 characters
- 1. Less than one error per 16,384 characters, but more than one error per 32,767 characters
- 2. Less than one error per 8,192 characters, but more than one error per 16,384
- 3. Less than one error per 4096 characters, but more than one error per 8,192 characters
- 4. Less than one error per 1,024 characters, but more than 1 error per 4,096 characters
- 5. Less than one error per 1,024 characters, but more than one error per 2,048 characters
- 6. Less than 1 error per 512 characters, but more than one error per 1,024 characters
- 7 through 15. The error rate was very high
- 16. Almost all characters were errors.

The Modem Interface Status lines give the state of the modem interface signal:

- DTR = Data Terminal Ready
- DSR = Data Set Ready
- RTS = Request to Send
- CTS = Clear to Send
- RLSD = Receive Line Signal Detect
- RI = Ring Indicator
- TD = Transmit Data
- RD = Receive Data
- SS = Select Standby
- DSRS = Data Signaling Rate Select

If a CCITT interface is being used, all EIA terms are replaced by CCITT numbers.

The next line indicates: (a) the pattern being sent and (b) the number of received characters that do not match the pattern (if Verify Received Data = Yes).

The following line contains a count of each error detected.

The Received Data field indicates what--if any--data is being received. The last received byte is displayed video-reversed.

The Error Character field displays the character(s) received if there is a non-match. This line is not displayed if the 'any data' option was selected.

**RECEIVE CONTINUOUS DATA UTILITY**

The Receive Continuous Data Utility is used to receive a continuous bit pattern from the link, compare it to a stored pattern and indicate if any errors are detected. The utility can also optionally wrap the pattern.

To select this utility select **Receive Continuous Data** from the ASYNC LINK ANALYSIS menu (Figure 3-6). The ASYNC RECEIVE CONTINUOUS DATA menu (Figure 3-9) menu displays.



### CONTROL MODEM INTERFACE UTILITY

The Control Modem Interface utility is used to control and display the modem interface and to aid in diagnosing modem and modem interface problems.

To select this utility choose **Control Modem Interface** from the ASYNC LINK ANALYSIS menu (Figure 3-6). The CONTROL MODEM INTERFACE menu displays (Figure 3-12).

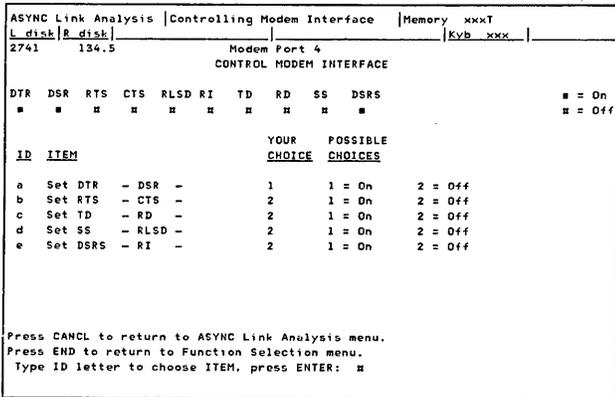


Figure 3-12. CONTROL MODEM INTERFACE Menu

To change the state of a signal, enter the ID and either '1' (to turn the signal On) or '2' (to turn the signal Off).

### ERROR LOG HISTORY DISPLAY UTILITY

The Error Log History Display Utility is used to format and display the error log. The utility presents the Error History Log data in three different sections:

1. Error Log Session Description (Figure 3-13)
2. Error History Log (Figure 3-14)
3. Error Log Last Adapter Status (Figure 3-16)

To select this utility, choose **Display Error History Log** from the ASYNC LINK ANALYSIS menu (Figure 3-6). The Error Log Session Description will appear. To scroll forward through the log, use the arrow up (↑). To scroll backward, the operator can use the arrow down (↓) key.

**Note:** You will be prompted for a Memory Record diskette(s) in this utility.

The PRINT key can be used to print any Error History Log frame.

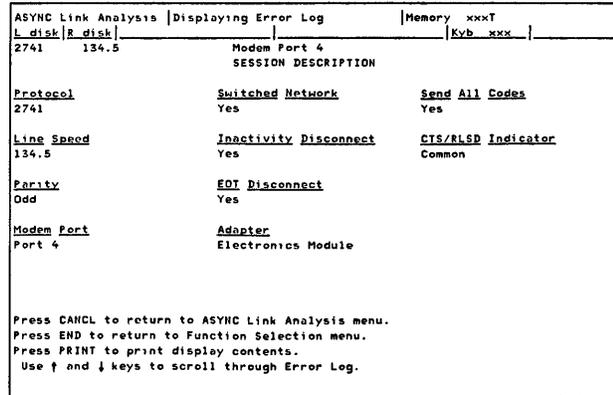


Figure 3-13. Sample Session Description Display

As the Sample Error History Log shows, each recorded error is entered on a separate line and identified as to error type.

Besides specifying error type, an entry also provides additional information about the error:

- Parity error. The hexadecimal representation of the character, minus the parity bit
- DSR dropout, unexpected CTS dropout, unexpected RLSD dropout, disconnect timeout error, or transmit failure. The state of the error log hardware status byte.

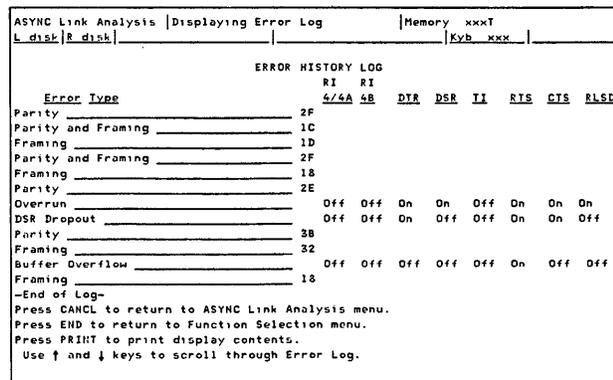


Figure 3-14. Sample Error History Log Display

The Last Adapter Status display (Figure 3-16) shows the last adapter status recorded by the ASYNC software.

If a CCITT interface is being used, all EIA terms are replaced by CCITT numbers.

Status Register 1 is decoded and displayed. A description of the bits in registers 2 and 3 are shown in Figure 3-15.

#### Status Register 2

```

.....1 --> Programmable Timer
                Enable
.....1. --> Wrap Test
                Data = MARK
.....1.. --> Test Control Status
....1... --> Modem Interrupt
                Pending
...1.... --> Modem Interrupts
                Enabled
..1..... --> Modem Status Available
                (Port A)
.0..... --> Programmable Timer
                IRQ Pending
1..... --> Received
                Data = MARK

```

#### Status Register 3

```

.....1 --> Transmit Ready
.....1. --> Receive Ready
.....1.. --> Transmit Empty
....1... --> Parity Error
...1.... --> Overrun Error
..1..... --> Framing Error
.1..... --> Break Detect
1..... --> DSR

```

Figure 3-15. Bit Descriptions for Status Registers 2 and 3

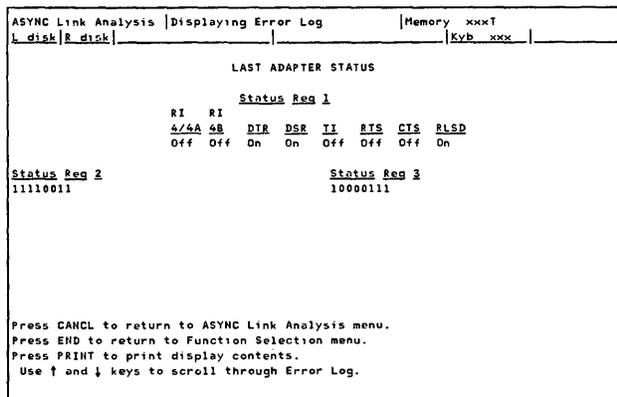


Figure 3-16. Sample Last Adapter Status Display

## ASYNC TRACE

The ASYNC Trace (Figure 3-17) is a special mode of the communication application history. The trace provides an exact picture of the data stream as it appears on the link. The trace is used to diagnose procedural errors and incompatibilities within the data stream. The ASYNC Trace data can be scanned on the display for problem analysis or saved on diskette for printing or problem analysis later.

A communication session can be placed in ASYNC Trace mode any time after the Displaywriter operator selects a communication profile by pressing History Stor (HIS STOR) and Control simultaneously.

## ASYNC TRACE FORMAT

Figure 3-17 shows an example of 2741 Display Trace output. Figure 3-18 shows an example of Display Trace output for TTY emulation with no parity. ASYNC Trace mode data is formatted as follows:

- Transmitted data is preceded by an S in column one and a space in columns two and three.
- Received data is preceded by an R in column one and a space in columns two and three.
- Alphabetic characters are represented as alphabetic characters with two spaces.
- Spaces are represented by three spaces.
- All other code points are represented by their hexadecimal representation with one space.
- Status information is a hexadecimal character that is underscored and followed by a space.

A list of the status information presented in the ASYNC Trace and its hexadecimal value follows:

- RI-P4/4A transition to active state. 'F1'
- RI-P4B transition to active state. 'F2'
- DSR transition to active state. 'F3'
- CD transition to active state. 'F4'

- CD transition to non-active state. 'F5'
- CTS transition to active state. 'F6'
- CTS transition to non-active state. 'F7'
- Break interrupt. 'F0'
- DSR transition to non-active state. 'E4'
- Parity error. 'E1'
- Framing error. 'E2'
- Overrun error. 'E8'
- Buffer overflow. 'D1'

As indicated, all functional status is represented by hexadecimal 'F\_'. All error status is indicated by hexadecimal 'E\_'. All data lost errors are indicated by a hexadecimal 'D\_'.  
 Although not necessarily an error, a DSR dropout is indicated as an error. All error status information is followed by a status byte (Figure 3-19) which provides additional information at the time of the error. The status byte is dependent upon the error type and corresponds to the byte stored in the ASYNC History Log.

### CHANGE LINK DESCRIPTION UTILITY

The Change Link Description utility is used to temporarily or permanently change the diagnostics diskette's ASYNC link description.

To select this utility, choose **Change Link Description** from the ASYNC LINK ANALYSIS menu (Figure 3-6). The CHANGE LINK DESCRIPTION menu (Figure 3-20) displays. The options of this menu are:

- Protocol. Specifies one of three types of asynchronous protocols (IBM CMC, 2741, or TTY). The default is 1, IBM CMC.
- Line Speed. Specifies the bit rate at which the Displaywriter transmits characters. The default is 2, 134.5.
- Parity. Specifies (for TTY only) the type of parity to be sent and checked. The default is 2, Odd.
- Modem Port. Indicates the modem port to be used. The default is 1, Port 4.
- Interface Status. Specifies if the modem interface signals should be EIA or CCITT. The default is 1, EIA.
- Store Link Description. Specifies whether changes made here are to be temporary or stored on the ABC diagnostic diskette. The default is 2, No.

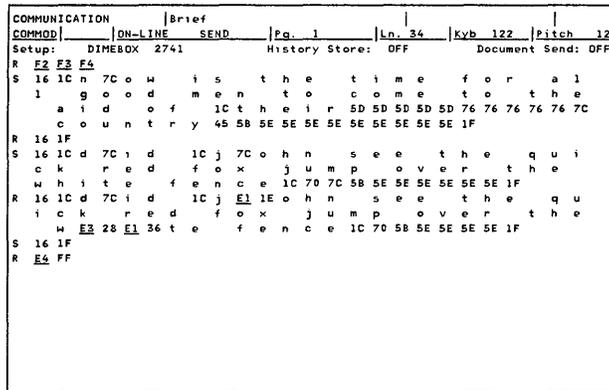


Figure 3-17. Sample 2741 Display Trace

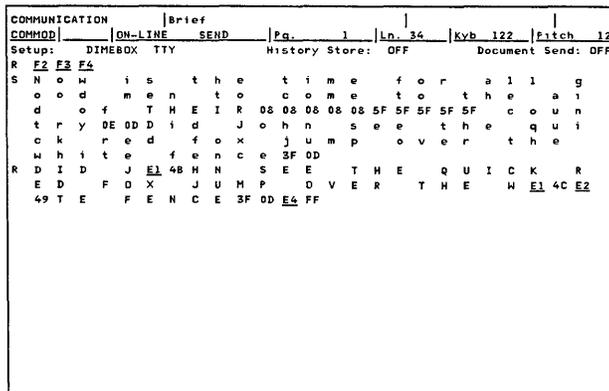


Figure 3-18. Sample TTY Display Trace

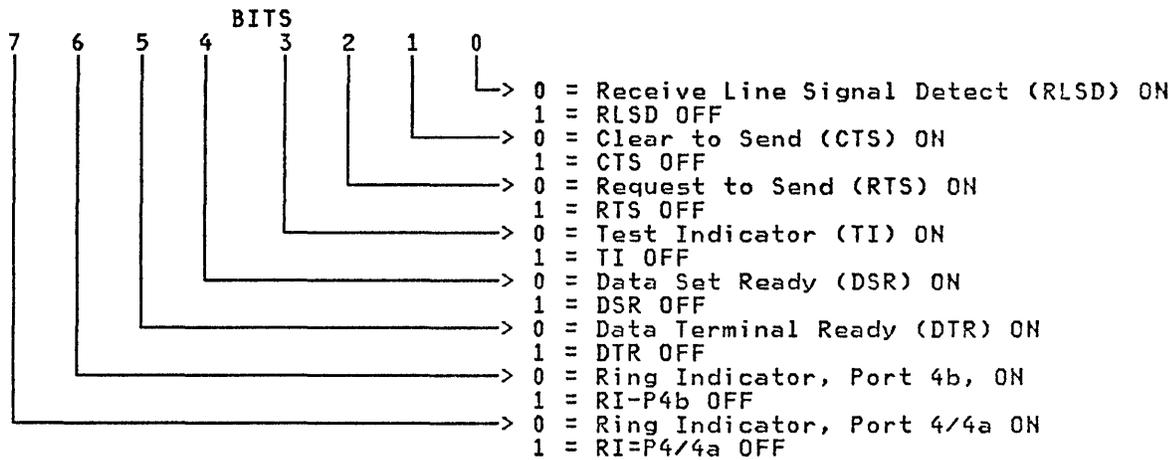


Figure 3-19. Trace Status Byte

ID	ITEM	YOUR CHOICE	POSSIBLE CHOICES
a	Protocol	1	1 = IBM CMC 2 = 2741 3 = TTY
b	Line Speed	2	1 = 110 2 = 134.5 3 = 150
c	Parity	2	4 = 200 5 = 300 6 = 1200
d	Modem Port	1	1 = Even 2 = Odd 3 = None
e	Interface Status	1	1 = Port 4 2 = Port 4A 3 = Port 4B
f	Store Link Description	2	1 = EIA 2 = CCITT
			1 = Yes 2 = No

Press CANCEL to return to ASYNC Link Analysis menu.  
Press END to return to Function Selection menu.  
When finished with this menu, press ENTER.  
Type ID letter to choose ITEM, press ENTER: #

Figure 3-20. CHANGE LINK DESCRIPTION Menu

### WRAP MODEM UTILITY

The Wrap Modem Utility is used to test modems that support modem wrap and any point from which transmitted data can be wrapped back.

To select this utility, choose Wrap Modem from the ASYNC LINK ANALYSIS menu (Figure 3-6). The WRAP MODEM menu (Figure 3-21) displays. The options of the WRAP MODEM menu are:

- Mode. Specifies the number of times the wrap will occur. The default is 1, One pass.
- Wrap to Remote Modem. Controls the state of the test signal and allows remote modems and

Displaywriters to be tested via a modem wrap. If Yes is specified, the utility will not turn the test signal on. If No is specified, the utility will turn the test signal on.

### Notes:

1. In some cases, the remote modem must be set up for the remote wrap at the remote location.
2. If the local modem does not support the test signal, this parameter has no effect upon it. The modem then must be controlled via its switches.

After ENTER is pressed, the utility begins execution. The format of the display changes (Figure 3-22).

ID	ITEM	YOUR CHOICE	POSSIBLE CHOICES
a	Mode	1	1 = One wrap 2 = Continuous 3 = Continuous-stop on error
b	Wrap to Remote Modem	2	1 = Yes 2 = No

Press CANCEL to return to ASYNC Link Analysis menu.  
Press END to return to Function Selection menu.  
When finished with this menu, press ENTER.  
Type ID letter to choose ITEM, press ENTER: #

Figure 3-21. Modem Wrap Display Frame



## CHAPTER 4. BINARY SYNCHRONOUS COMMUNICATIONS

### BSC FACILITY OVERVIEW

The IBM Displaywriter System Binary Synchronous Communications Program (IBM Licensed Program 5608-SR2) enables a Displaywriter to communicate terminal-to-terminal with a number of processors. Examples of these processors include the IBM 6640, the IBM 6670 Information Distributor or another Displaywriter.

Terminal-to-host communications allows the Displaywriter to communicate with an IBM System 370 or a similar CPU.

Figure 4-1 shows the possible communication link available with BSC communications. The Displaywriter appears to the remote stations as an IBM 2770/3780 or an IBM 2780 terminal. The BSC licensed program allows the Displaywriter to use many different applications for data exchange. Examples of these applications are:

- Time Sharing
- Data Entry
- Report Generation
- Text Processing

With the BSC facility, data can be sent and received over common switched or nonswitched lines. Half-duplex and duplex data links operate at speeds from 600 to 4800 bits per second (bps). The BSC facility operates only in half-duplex mode on a point-to-point connection.

BSC is managed by a set of rules for the transmission of synchronized binary-coded data. The station-to-station synchronization of data ensures the receiving station operates in step with the transmitting station. Synchronization is accomplished by identifying a special bit pattern and a synchronization (SYN) character sequence at the start of each transmission.

In BSC transmission, all data is coded in binary form and sent as a series of eight bits (one byte). Each byte represents one graphic character or control code. Bytes of data are sent in groups called blocks. One or more blocks are sent in each message. Each block or message will be started with binary-coded bytes of synchronization data and optional ID, or leading graphics, and followed by data-link control codes and error-checking data.

The BSC licensed program is provided on a Displaywriter feature program diskette, and IBM will periodically distribute maintenance updates for it as required.

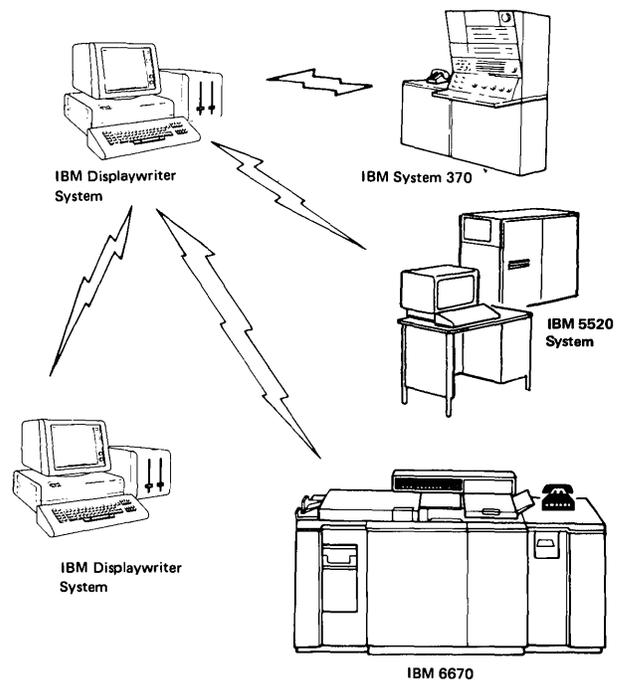


Figure 4-1. Binary Synchronous Communications

### BSC EQUIPMENT REQUIREMENTS

In addition to the licensed program, the following equipment is required for binary synchronous communication:

1. A modem. The modem must be capable of half-duplex or duplex operation and synchronous data transmission. The modem may be internal (located inside the Displaywriter System) or external. An external modem is attached to the Displaywriter by a 3.8 meter (12.5 feet) cable. The Displaywriter can support either two external modems, or one internal and one external modem. The two modems can support different line protocols. The modems are selected by a menu provided by the licensed program. Only one modem can be active at one time.

2. A communications adapter. The adapter provides both an Electronics Industry Association (EIA) RS-232C compatible interface and an internal modem interface. The EIA interface is required for operation with any external modem. The internal modem interface provides all the signals necessary to drive IBM internal modems.
3. A telephone line. A telephone is necessary, except for local attachments that use a Local Device Controller (LDC), or when using modem eliminators.
4. A minimum processor storage (memory) size. The minimum for BSC is 224K (Model A03).

#### COMMUNICATION ADAPTER CARD BSC OPERATION

The communications adapter card, through its interface cable, connects the electronics of the Displaywriter to the modem/Data Communications Equipment (DCE). The communications adapter card provides timing and other electronic control functions for the modem/DCE. The card is located in either the electronics module or the diskette unit.

The communications adapter card's functions are programmable through the use of menus with respect to line speed and modem controls. The adapter can operate at speeds from 600 bps to 4800 bps. The adapter also allows two DCE interfaces, an EIA RS-232C/CCITT V.24 compatible interface and an internal modem interface (VLT).

The communications adapter detects parity and overrun errors. Examples of these are:

- Vertical Redundancy Checking. Checks for parity errors in 7-bit character framing.
- Overrun Condition. This error is detected if the Displaywriter does not receive a character from the adapter before the next character is sent.

**Note:** For BSC communications using EBCDIC code sets, Cyclic Redundancy Checking is done by programming. No character bit checking is performed by the adapter in this case.

#### BSC COMMUNICATION LINE SPEED REQUIREMENT

The IBM Displaywriter is not capable of duplex transmission using BSC communications. The use of duplex modems and duplex lines will reduce the line turn-around time. Line turn-around time allows the modems and network equipment to switch the direction of transmission in order to assure that all data has reached its destination.

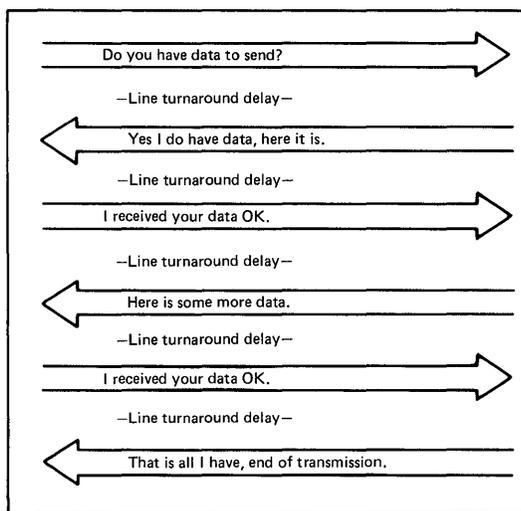


Figure 4-2. Line Turn-around

If duplex modems are used, the modems and the network equipment are always ready to transmit or receive, and the line turn-around is minimal. Modems that provide duplex service at BSC speed usually require nonswitched lines. However, modems are available that offer duplex services at 1200 bps over normal, switched telephone lines. Turn-arounds can cause significant delay in non-duplex mode. Figure 4-2 shows how line turn-around can affect transmission.

#### BSC DATA SYNCHRONIZATION

Communicating BSC modems must be synchronized before data transmission can take place. BSC uses "pad" characters and "synchronization" (SYN) patterns to ensure synchronization.

**PAD CHARACTERS:** Pad characters ensure the first and last bits in each block of a transmission are sent and received. Two types of pad characters are used:

- Leading Pads. All BSC sending stations must send one leading pad before each sync pattern. This pad character is sent to ensure the other station is ready to

receive. The leading pad consists of alternate 0 and 1 bits (X'55' or X'AA') (Figure 4-3). Machines using business machine clocking also send two additional leading pads to establish bit sync. (See BSC Sync Patterns later in this section.)

**Note:** The trace display or print-out shows only the two leading pads sent to establish bit sync for business machine clocking. The first leading pad sent by all machines to indicate the start of transmission is placed in the output data stream but does not show up on the trace display or print-out. All received leading pads are removed from the data stream and do not show up on the trace display or printout.

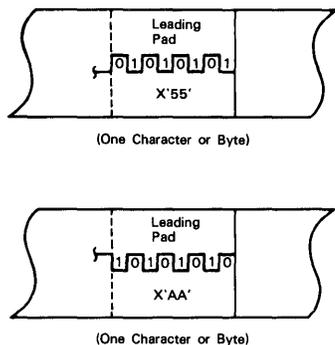


Figure 4-3. Leading Pads

- **Trailing Pads.** A trailing pad character (X'FF') is the last byte transmitted before a line turnaround. (A line turnaround is the point at which transmission direction reverses.) The trailing pad follows a data link control code or a block-check character. The data set may be turned off before transmission of the final byte is complete. The trailing pad is inserted as the final byte to prevent a data link control code or block-check character from being cut off. The receiving station also uses this trailing pad to check certain data link control codes.

Since the trailing pad consists of all 1-bits (Figure 4-4), the receiving station checks for the first four 1-bits of the trailing pad after an EOT or a NAK. If the receiving station does not find these four 1-bits after an EOT or NAK, it will not accept the con-

trol code. This is done to prevent some other byte from being incorrectly received as an EOT or NAK and causing an unnecessary termination of transmission.

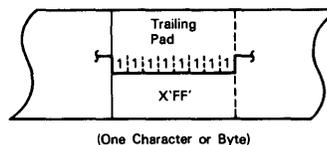


Figure 4-4. Trailing Pad

**BSC SYNC PATTERNS:** Synchronization of data sent between BSC machines is established with a transmitted sync pattern. The sync pattern must be sent at the start of each transmission. This ensures that the receiving station is in step with the sending station. Synchronization of all transmitted data is established by clocking at both bit level (bit sync) and character level (character sync). The sync pattern is normally represented by the symbol (0). (See Figure 4-5.)

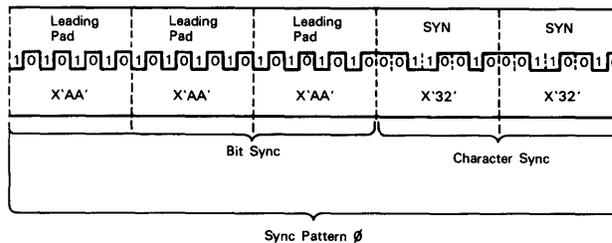


Figure 4-5. BSC Sync Pattern

- **Bit Sync.** Only machines with business machine clocking (BMC) require extra bit sync considerations to get the remote BMC in step with the local BMC. Business machine clocking must be synchronized (bit sync) before the character sync pattern is received. Establishing bit sync requires at least twelve received signal changes (on-to-off or off-to-on). Bit sync is normally established by sending two leading pads after the single leading pad required to start transmission. Some stations alternately send multiple PAD patterns to establish bit sync. Two PAD characters contain the required sixteen signal changes.
- **Character Sync.** After bit sync is ensured, character sync must be

established. Character sync for both business machine clocking and modem clocking requires two SYN characters in a row. To ensure the maintenance of character sync, additional SYN (DLE SYN in transparent mode) codes are inserted into the transmission blocks. If the sync pattern is not received within a certain time, character sync may be lost, and transmission may be aborted. SYN is sometimes used in BSC as a time fill.

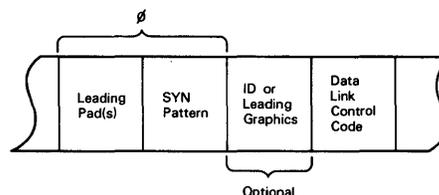


Figure 4-7. BSC Identification/Leading Graphics

### BSC IDENTIFICATION AND LEADING GRAPHICS

After establishing synchronization, the Displaywriter (BSC) will accept two types of optional data (Figure 4-7). This data can be:

- **Identification.** Terminal identification (ID) is often required when communicating with a host system. The Displaywriter can send or receive a terminal ID. However, it does not require or recognize any received terminal ID. A series of 2 to 15 characters may be used by different machines to provide terminal ID information as required by certain applications. The Displaywriter's ID is determined by the job setup menu for sending. The other station will only respond if it accepts the Displaywriter's ID.
- **Leading Graphics.** All BSC machines must be capable of receiving from 2 to 15 leading graphics in the initialization state, before an initial bit (ENQ) and its response (ACK 0 or NAK). The leading graphics are used as identification. In the message transfer state, all BSC machines must be capable of receiving up to seven leading graphics before an ACK 0, ACK 1, or NAK response to a transmission block.

### BSC TRANSMISSION BLOCKS

A Displaywriter BSC transmission block consists of 128, 256, or 512 bytes. The size of the block is chosen in the JOB SETUP menu. A line turnaround occurs at the end of each transmission block to allow the receiving station to respond to the transmission. Data-link control codes define the beginning and end of all transmission blocks (Figure 4-6). A transmission block can be either a heading block or a text block.

- **Heading Block.** A heading block consists of one or more header characters. These characters may provide special message control and processing information. This processing information, includes host sign-on information, distribution information, security class, date and time of message, and priority or other message identification.
- **Text Block.** A text block contains a part or all of the body of the transmission.

### BSC DATA LINK CONTROL CODES

Data-link control (DLC) codes control transmission of data between stations. These codes consist of one-byte and two-byte sequences. (See Figure 4-8.) They provide synchronization data, indicate particular line activities, or wait states, and define the beginning and end of all messages (message blocks). The following data-link control codes are used either separately

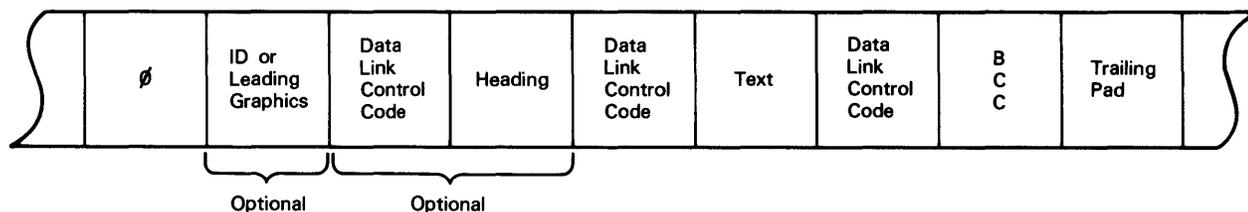


Figure 4-6. BSC Transmission Blocks

or in combination for data link control.

SYN	Synchronization Character *
PAD	PAD *
DLE	Data Line Escape **
SOH	Start of Header
STX	Start of Text ***
ETB	End of Transmission block ***
ETX	End of Text ***
ITB	Intermediate Transmission Block ***
EOT	End of Transmission ***
ENQ	Enquiry ***
NAK	Negative Acknowledgement

\* SYN and PAD are covered under Sync Patterns in this section.

\*\* DLE is never used separately. It is used as the first byte of a two-byte control character sequence to form additional data-link control code capabilities.

\*\*\* These data-link control codes may be used separately or with certain other bytes, for example DLE, to form additional data-link codes.

Two-byte Sequences - The following two-byte sequences provide additional data-link control codes:

STX ENQ	TTD. Temporary Text Delay
DLE '6B'	WACK. Wait Before Transmitting
DLE '7C'	RVI. Reverse Interrupt
DLE '70'	ACK 0. Positive Acknowledgement of Even Block
DLE '61'	ACK 1. Positive Acknowledgement of Odd Block
DLE EOT	DISC. Required disconnect for Switched Network

**Note:** The above two-byte data-link control codes are valid only when used with EBCDIC code sets. They may be different in ASCII. When hexadecimal notation is used to indicate a hex code in the hex code chart, it is normally located after an upper case X. Two hex codes used together can be identified as 'xxxx' or X'xxxx'.

**TRANSPARENT TEXT MODE:** This optional transmission mode allows all possible (256) EBCDIC hex positions (bytes) to be accepted as text at the receiver. This includes any control bit combinations that would normally be used as data-link control codes. Message beginning and ending of valid data-link controls within the text during transparent text mode is controlled by two-byte 'DLE' sequences:

DLE STX	Transparent Start of Text
DLE ETB	Transparent End of Transmission Block
DLE ETX	Transparent End of Text
DLE ITB	Transparent Intermediate Transmission Block
DLE SYN	Transparent Synchronization Character
DLE ENQ	Transparent Request to Cancel Last Block of Data

A DLE DLE code allows transmission of DLE as text. The receiving station removes from the data stream the first DLE of every DLE sequence. The second DLE remains in the message stream and is processed as text data by the receiving station.

**Note:** Transparent operation is not possible for use with heading blocks.

CONTROL CODE	EBCDIC HEX	USASCII HEX	DLC FUNCTION	IBM D/W CAN SEND/RECEIVE
ACK 0 (DLE 0)	1070	10B0*/1030	Indicates that an even block has been successfully received and requests that the next block be transmitted. It is also the positive acknowledgement to a line bid.	Both
ACK 1 (DLE 1)	1061	1031	Indicates that an odd block has been successfully received and requests that the next block be transmitted.	Both
DISC (DLE EOT)	1037	1004	Indicates a required disconnect.	Both
DLE DLE	1010		Allows the transmission of DLE as data in transparent mode.	Both
DLE ENQ	102D		Used in transparent text to request that the latest text block be ignored, and that the data link be returned to the normal mode.	Both
DLE EOT			(See DISC)	
DLE ETB	1026		Indicates transparent ETB. Returns the data link to the normal mode.	Both
DLE ETX	1003		Indicates transparent ETX. Returns the data link to the normal mode.	Both
DLE ITB	100F		Indicates end of transparent intermediate block. DLE ITB does not cause a line turnaround or require an immediate response. The DLE ITB BCC sequence causes the BCC summation counters to be cleared just after receiving the two BCC characters (any detected BCC error conditions at this time are "remembered" at the receiving station until the next DLE ETB or DLE ETX). The new BCC accumulation is reinitiated with the first non-DLE SYN character(s) transmitted or received following the two BCC characters. Either of the DLE ITB or DLE ETB/ETX BCC error conditions will be indicated in the DLE ETB/ETX response.	Both
DLE STX	1002		Indicates transparent STX. Is required at the beginning of every transparent block.	Both
DLE SYN	1032		Indicates transparent SYN.	Both
DLE 0			(See ACK 0)	
DLE 1			(See ACK 1)	
DLE @			(See RVI)	
DLE,			(See WACK)	
ENQ	2D	85*/05	Indicates an enquiry. Used to bid for a line, to request a repeat of a response, and (if used in text) to request that the latest block be ignored.	Both
<p>* Some USASCII bytes have two hex values. In this table, the value on left of the "/" is the USASCII hex value for an 8-bit byte (the 7-bit value plus the parity bit). The value on the right of the "/" is the USASCII hex value for a 7-bit byte. This second value is the one used in the code set chart (in this section) and seen on the display or printout.</p>				

Figure 4-8 (Part 1 of 2). BSC Data-Link Control Codes

CONTROL CODE	EBCDIC HEX	USASCII HEX	DLC FUNCTION	IBM D/W CAN SEND/RECEIVE
EOT	37	04	Indicates end of transmission and causes immediate termination of transmission. The trailing pad following EOT is used to ensure that this control code is valid.	Both
ETB	26	97*/17	Indicates end of transmission block and causes line turnaround. Is followed by BCC. Cannot be used to end the final block of a message.	Both
ETX	03	83*/03	Indicates end of text (heading or text) and causes line turnaround. Is followed by BCC. The final block of a transmission must be ended with an ETX.	Both
ITB	1F	1F	Indicates end of intermediate block. ITB does not cause a line turnaround or require an immediate response. The ITB BCC sequence causes the BCC summation counters to be cleared just after receiving the two BCC characters (any detected BCC error conditions at this time are "remembered" at the receiving station until the next ETB or ETX).	Both
NAK	3D	15	Is a negative acknowledgement, indicating a receiving station is not ready (answer to a line bid) or that a receiving station did not receive the last block of data correctly (request for the block to be transmitted again). The trailing pad following NAK is used to ensure that this control code is valid.	Both
PAD	55 or AA	55 or AA	Indicates a leading pad. (See "Synchronization Data")	Both
	FF	FF	Indicates a trailing pad. (See "Synchronization Data")	
RVI (DLE in EBCDIC; DLE, in ASCII)	107C	103C/10BC*	Indicates a reverse interrupt, used as a positive response in place of ACK 0 or ACK 1. Causes interrupt of the sending station.	Receive Only
SOH	01	01	Indicates the start of heading block.	Both
STX	02	02	Indicates start of text block, and can be used to end a heading block. Can be used as the first character after an ITB BCC sequence but is not required.	Both
STX ENQ			(See TTD)	
SYN	32	16	Synchronization character, sometimes used as a time fill.	Both
TTD (STX ENQ)	022D	0285*/0205	TTD-Indicates a temporary text delay when the sending station is not ready to transmit. Receiver should respond NAK and wait. TTDs may be repeated at approximately two second periods until wait condition is cleared.	Both
WACK	106B	103B	WACK-Wait, ACKnowledgement by receiver to a previous block block or transmission. Sender sends ENQ as often as necessary to obtain a proper ACK and authority to continue. Receiver will repeat WACK (to ENQ) approximately every two seconds until its wait state is cleared, and then send proper ACK (0 or 1).	Both
<p>* Some USASCII bytes have two hex values. In this table, the value on left of the "/" is the USASCII hex value for an 8-bit byte (the 7-bit value plus the parity bit). The value on the right of the "/" is the USASCII hex value for a 7-bit byte. This second value is the one used in the code set chart (in this section) and seen on the display or printout.</p>				

Figure 4-8 (Part 2 of 2). BSC Data-Link Control Codes

## BSC ERROR CHECKING

All data sent using BSC is error-checked at the receiving station by either a Cyclic Redundancy Check (CRC) or a combination of a Vertical Redundancy Check (VRC) and a Longitudinal Redundancy Check (LRC) (see Figure 4-9). The code set (EBCDIC or ASCII) determines the way data is checked.

**ASCII (7-BIT) ERROR CHECKING:** ASCII code is error checked by:

- **Vertical Redundancy Check (VRC).** This is an odd parity check of each byte. Each byte is produced at the sending station with odd parity and is sent over the data link. The receiving station checks each byte for this odd parity as it is received. If odd parity is not found in a byte, a VRC error is flagged and remembered until line turnaround at the end of the transmission block.
- **Longitudinal Redundancy Check (LRC).** LRC requires a block check character (BCC) to be produced at the sending station and sent over the data link (Figure 4-10). This BCC is a one-byte hex value accumulated from all the bits sent in a particular transmission block. The accumulated LRC bit combination is then sent as the last byte (BCC) of the transmission block and line turnaround occurs (Figure 4-11). The receiving station also produces a BCC as the bits of the block are received and compares it to the received BCC. If the received BCC is not the same value as the BCC produced at the receiving station, an LRC error is flagged at the end of the transmission block.

Transmission Code	Type of Checking		
	No Transparency Installed	Transparency Installed and Operating	Transparency Installed not Operating
EBCDIC	CRC-16	CRC-16	CRC-16
USASCII	VRC & LRC	N/A	N/A

Figure 4-9. BSC Error Checking for EBCDIC and ASCII

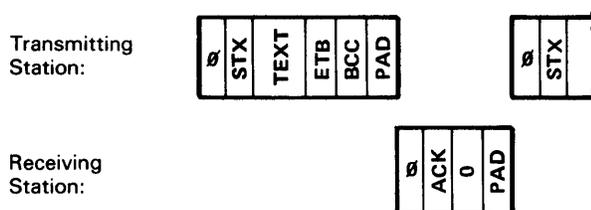


Figure 4-10. BCC After Message Text Block

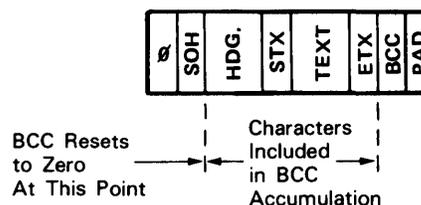


Figure 4-11. BCC Accumulated for Heading and Text Block

**EBCDIC ERROR CHECKING:** EBCDIC code is error checked by Cyclic Redundancy Checking (CRC). The Displaywriter uses a mathematical algorithm called CRC-16 to produce a two-byte value which is added to the end of each transmission block and sent as two block check characters (BCC). The receiving station also produces a two-byte CRC value (BCC) for the received data. The receiving station compares its BCC to the received BCC. If the BCCs are not the same, a CRC error is flagged.

BCCs (both LRC and CRC) are error checked by the receiving station after it receives an ETB or ETX data-link control code. A line turnaround occurs, allowing the receiving station to respond to the transmission block.

The receiving station will respond to the BCC in one of four ways:

- It sends an ACK 0 as a positive response (send next odd block).
- It sends an ACK 1 as a positive response (send next even block).
- It sends a NAK as a negative response (error detected, repeat last block).
- It sends a WACK as a positive response (send next even/odd block).

The sending station saves the data of each message block until the receiving

station responds with a positive acknowledgement. This is necessary in case a NAK response is received and a retransmission of the data block is to be made.

### BSC TIMEOUTS

Timeouts prevent a data link from being held too long. Incorrectly received DLC sequences or periods of data link inactivity cause timeouts. A list of the timeouts that can occur follows:

- **Transmit Timeout (One Second).** The primary station, when bidding, waits one second between transmission of ENQs.
- **Continue Timeout (Two Seconds).** If a secondary station is not ready or busy and cannot give a positive response within two seconds after receiving an ETB or ETX block-check sequence, it "times-out" and sends a WACK (Figure 4-12). The timeout resets after an ENQ is received in response to the WACK. If an EOT is received in response to the WACK, transmission is terminated, and the timeout is not restarted.

If a primary station cannot transmit another block within two seconds after receiving an acknowledgement, the two-second timeout occurs, and a TTD is sent (Figure 4-13).

- **Receive Timeout (One Second or Three Seconds).** After a secondary station receives an SOH, STX, or SYN, the station will wait three seconds for an ETB, ETX, or another SYN. If one of these is not received within that time, synchronization will be aborted.

The timeout is reset every time a SYN is received.

A secondary station waits three seconds for a response to a line bid ENQ. If it receives no response, another ENQ is sent. If NAK is received in response to the bid, another ENQ is immediately sent. The Displaywriter will send up to 15 ENQs (line bids) before posting a message.

A primary station waits three seconds for an answer to a block-check sequence, and then sends ENQ to request a response. If a valid response is not received within that time, the primary station will send an EOT, or try again. The Displaywriter will send up to 15 ENQs before sending an EOT.

A primary station will wait one second after sending an ENQ as a line bid. If ACK 0 is not received by the end of this time, ENQ is sent again. If NAK is received as a response to a line bid, another ENQ is sent immediately. The Displaywriter will send up to 15 ENQs before posting a message.

- **Disconnect Timeout (Twenty Seconds, Switched Network).** This timeout drops the line after 20 seconds of no protocol activity. This prevents holding the connection for long periods of time with no activity. Machine failure or wrong calls (with auto-answer feature) will cause this timeout.
- **Ten Minute Switched Network Timeout.** After ten minutes of no successful data (text) transfer, the line will drop. Successful transmission or reception of a data block resets this timeout.

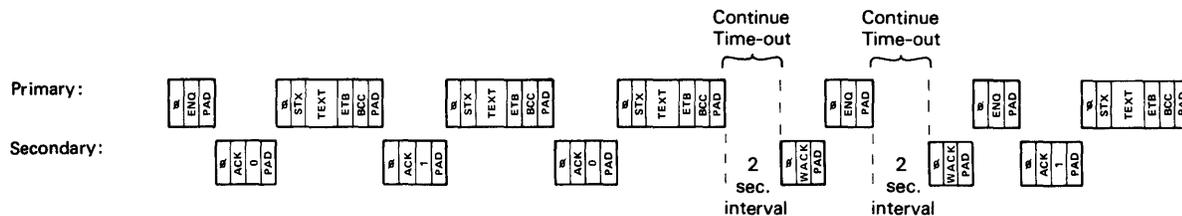


Figure 4-12. Continue Timeout (Secondary Station)

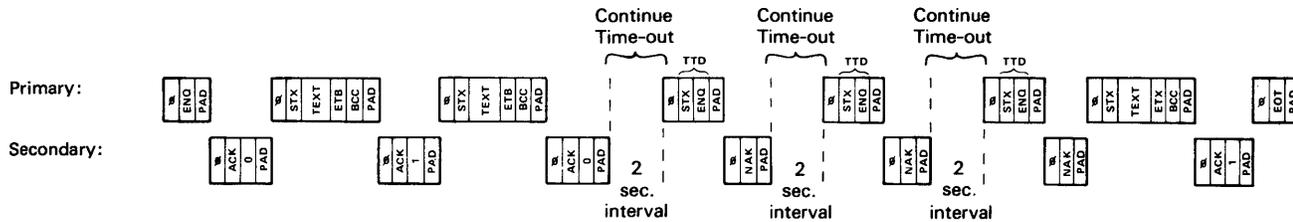


Figure 4-13. Continue Timeout (Primary Station)

### BSC DATA LINK COMMUNICATIONS STATES

The Displaywriter (BSC) communicates point-to-point over switched or non-switched networks. A communications operation can be separated into three states.

**INITIALIZATION STATE:** Initialization is the process of establishing communications. A contention system determines the direction of transmission between two point-to-point stations.

When the line is inactive, a station is waiting for a bid (ENQ sequence). If two stations bid for the line at the same time, contention occurs. When this happens, neither station hears the other's ENQ. To prevent this, stations are given a primary or secondary status. Bidding continues until contention is broken.

In a terminal-to-host system environment, the host system is usually a primary station. The Displaywriter can be either a primary or secondary station. The Displaywriter will send ENQ sequences (up to 15) until it receives a response. The primary station gets control by sending bids at a quicker rate than a secondary station.

After a secondary station receives and accepts a bid, it will answer with ACK 0, WACK, NAK, or EOT. When ACK 0 or WACK has been received, the primary station becomes the master station for the transmission of the first message.

**MESSAGE TRANSFER STATE:** The message transfer state begins after a successful completion of the initialization state. The initial heading block in a message may begin with SOH and will end with ETB or ETX. A heading block cannot be sent unless text data follows it. (See Figure 4-14.)

A text block begins with STX and ends with ETB, (unless it is the final block of the message). If it is the final block, it ends with ETX. ITB (followed by an optional STX) can be used within a text block to delimit a part of the block. Data-link control codes other than ITB (with optional STX) and SYN are not allowed within a text block. Error checking for text

blocks requires the text block to end with ETB or ETX (followed by the BCC). This will also cause line turnaround and a response to be sent.

ACK responses to a block are alternating ACK 0's and ACK 1's, starting with ACK 1 after the first text block. If this alternating pattern of ACK 0 and ACK 1 is not received in the correct order by the master station, an error is indicated. This error must be corrected before transmission can continue. If the receiving station detects an error in a text block, it responds with a NAK. The sending station may choose to send the previous block again. The final block of text must always end with ETX to show normal termination of text.

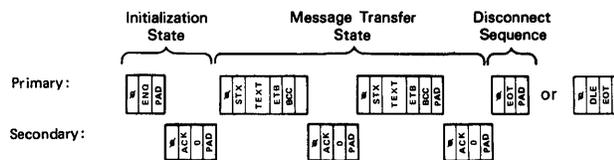


Figure 4-14. Normal BSC Message Transmission

**DISCONNECT SEQUENCE:** EOT ends the message transmission and returns the line to an inactive state. DLE EOT is sent as the disconnect (DISC) sequence when switched lines are used.

Several examples of message transmission formats are shown in Figure 4-15 through Figure 4-19.

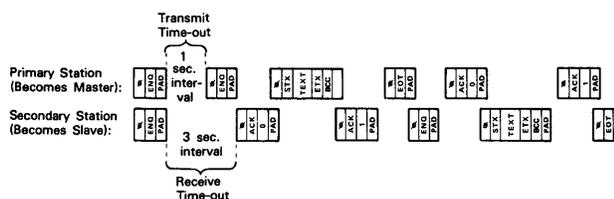


Figure 4-15. Contention for Primary Status

## BSC TRANSMISSION CODE SETS

The basic unit of communications is the binary bit (0 or 1). Eight bits form a data byte. The bit content of each byte can be translated into a two-digit hexadecimal value (hex code). The hex code of each byte represents one character or control code. A group of these hex codes with their particular code/character assignments is called a code set. The Displaywriter has several basic and extended code sets available for communications (Figure 4-20). The codes and characters included in each code set can be alphabetic, numbers, symbols, function codes, and communications control codes.

Figure 4-21 through Figure 4-25 on the following pages show the characters available in the EBCDIC and ASCII code sets, the BSC byte pattern and the binary to hex conversion charts. The Displaywriter communicates only with another compatible station using the same code set.

**Note:** These charts are only the U.S. domestic character sets.

Code Set	Byte Format	Possible Characters	Primary Use
EBCDIC/DP	8-bit	256	DP
EBCDIC/WP	8-bit	256	WP
ASCII	7-bit*	128	US Standard

### Note

An eighth bit is produced for error-checking purposes and affects the hexadecimal value of certain characters.

Figure 4-20. Transmission Code Set

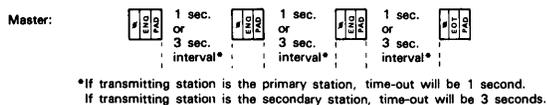


Figure 4-16. Unanswered Line Bid

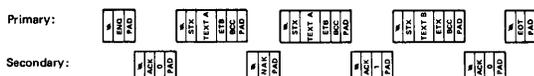


Figure 4-17. Initial Text Block Not Accepted, Retransmission Accepted

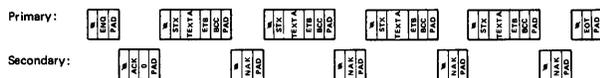


Figure 4-18. Text Block Not Accepted, Retransmission Not Accepted.

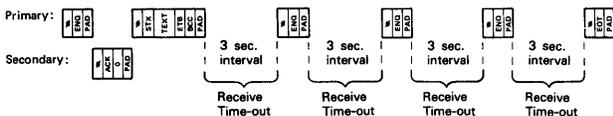


Figure 4-19. Unanswered Text Block (Receive Timeout, Primary Station)

BYTE PATTERNS  
FOR BSC PROTOCOL CODE

7	6	5	4	3	2	1	0
---	---	---	---	---	---	---	---

8 4 2 1 8 4 2 1  
(Binary Values)

BINARY TO HEX  
CONVERSION CHART

HEX	BINARY
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001
A	1010
B	1011
C	1100
D	1101
E	1110
F	1111

Figure 4-21. BSC Byte Pattern and Conversion Charts

HEX	CODE	*
00	NUL Note 1, 3	
01	SOH Note 2	
02	STX Note 2	
03	ETX Note 2	
04	SEL Note 1	
05	HT	
06	RNL Note 5	
07	DEL Note 3	
08	GE Note 1	
09	SPS Note 4	
0A	RPT Note 4	
0B	VT	
0C	FF Note 4	
0D	CR Note 1	
0E	SO	
0F	SI	
10	DLE Note 2	
11	DC1 Note 2	
12	DC2 Note 2	
13	DC3 Note 2	
14	RES Note 1	
15	NL Note 4	
16	BS	
17	POC Note 1	
18	CAN	
19	EM Note 1	
1A	UBS Note 4	
1B	CU1 Note 1	
1C	IFS	
1D	IGS Note 1, 2	
1E	IRS Note 5	
1F	ITB Note 2	
20	DS Note 1	

HEX	CODE	*
21	SOS Note 1	
22	FS Note 1	
23	WUS Note 4	
2C	-- Note 1, 3	
2D	ENQ Note 2	
2E	ACK	
2F	BEL	
30	-- Note 1, 3	
31	-- Note 1, 3	
32	SYN Note 2	
33	IRT Note 4	
34	PP Note 1	
35	TRN Note 1	
36	NBS Note 4	
37	EOT Note 2	
38	SRS Note 4	
39	IT Note 4	
3A	RFF Note 1	
3B	CU3 Note 1	
3C	DC4 Note 3	
3D	NAK Note 2	
3E	-- Note 1, 3	
3F	SUB	
40	SPACE	
41	Req. Space	
42-49	(invalid)	
4A	[	
4B	.	
4C		
4D	(	
4E	+	
4F	!	
50	&	

HEX	CODE	*
51-59	(invalid)	
5A	}	yes
5B	\$	yes
5C	*	yes
5D	)	yes
5E	;	yes
5F	†	yes
60	Reg. Hyphen	
61	/	
62-69	(invalid)	
6A		yes
6B	,	
6C	%	yes
6D	-	
6E		yes
6F	?	
70-7	(invalid)	
79		yes
7A	:	
7B	#	yes
7C	@	yes
7D	'	yes
7E	=	yes
7F	"	yes
80	(invalid)	
81	a	
82	b	
83	c	
84	d	
85	e	
86	f	
87	g	
88	h	

HEX	CODE	*
98	q	
99	r	
9A-A0	(invalid)	
A1		yes
A2	s	
A3	t	
A4	u	
A5	v	
A6	w	
A7	x	
A8	y	
A9	z	
AA-BF	(invalid)	
C0		yes
C1	A	
C2	B	
C3	C	
C4	D	
C5	E	
C6	F	
C7	G	
C8	H	
C9	I	
CA	Syllable Hyphen	
	Note 4	
CB-CF	(invalid)	
DO		yes
D1	J	
D2	K	
D3	L	
D4	M	
D5	N	

HEX	CODE	*
D6	O	
D7	P	
D8	Q	
D9	R	
89	i	
8A-90	(invalid)	
91	j	
92	k	
93	l	
94	m	
95	n	
96	o	
97	p	
DA	Note 4	yes
DB-DF	(invalid)	yes
E0		yes
E1	NSP Note 4	
E2	S	
E3	T	
E4	U	
E5	V	
E6	W	
E7	X	
E8	Y	
E9	Z	
EA	Note 4	yes
EB-EF	(invalid)	
F0	0	
F1	1	
F2	2	
F3	3	
F4	4	

HEX	CODE	*
F5	5	
F6	6	
F7	7	
F8	8	
F9	9	
FA-FE	(invalid)	
FF	Note 1, 3	

\* Variable Graphics, (Keyboard 1 graphics shown; for others see Variable Graphics chart Figure 53.

NOTES:

1. Not sent by Displaywriter.
2. Deleted from received Data Stream when used as data-link control.
3. Deleted from received data stream.
4. Not sent by Displaywriter in card image.
5. Not sent by Displaywriter 2770/3780 transparent, or 2780/card image.

Figure 4-22. BSC Protocol EBCDIC WP/DP

HEX	CODE	*
80	NUL Note 1,3	
01	SOH Note 2	
02	STX Note 2	
83	ETX Note 2	
04	EOT Note 2	
85	ENQ Note 2	
86	ACK	
07	BEL STOP	
08	BS	
89	HT	
8A	LF	
0B	VT	
8C	FF Note 4	
0D	CR Note 5	
0E	SO	
8F	SI	
10	DEL Note 2	
91	DC1 Note 2	
92	DC2 Note 2	
13	DC3 Note 2	
94	DC4 Note 2	
15	NAK Note 2	
16	SYN Note 2	
97	ETB Note 2	
98	CAN	
19	EM Note 1	
1A	SUB	
9B	ESC Note 2	
1C	FS	
9D	GS Note 2	
9E	RS Note 2	
1F	ITB Note 2	
20	SPACE	

HEX	CODE	*
A1	!	yes
A2	"	yes
23	#	yes
A4	\$	yes
25	%	yes
26	&	yes
A7	'	yes
A8	(	yes
29	)	yes
2A	*	yes
AB	+	yes
2C	,	
AD	-	
AE	.	
2F	/	
B0	0	
31	1	
32	2	
B3	3	
34	4	
B5	5	
B6	6	
37	7	
38	8	
B9	9	
BA	:	
3B	;	yes
BC		yes
3D	=	yes
3E		yes
BF	?	
40	@	yes
C1	A	

\* Variable Graphics, (Keyboard One graphics shown; for other keyboards see the Variable Graphics chart Figure 54.

NOTES:

1. Not sent by Displaywriter.
2. Deleted from received data stream when used as data link control.
3. Deleted from received data stream.
4. Not sent by Displaywriter in card image.
5. Not sent by Displaywriter in 2770/3780 transparent or 2780 card image.

HEX	CODE	*
C2	B	
43	C	
C4	D	
45	E	
46	F	
C8	H	
49	I	
4A	J	
CB	K	
4C	L	
CD	M	
CE	N	
4F	O	
D0	P	
51	Q	
52	R	
D3	S	
54	T	
D5	U	
D6	V	
57	W	
58	X	
D9	Y	
DA	Z	
5B	[	yes
DC	1/4	yes
5D	]	yes
5E	†	yes
DF	—	
E0	+	yes
61	a	
62	b	
E3	c	

HEX	CODE	*
64	d	
E5	e	
E6	f	
67	g	
68	h	
E9	i	
EA	j	
C7	G	
6B	k	
EC	l	
6D	m	
6E	n	
EF	o	
70	p	
F1	q	
F2	r	
73	s	
F4	t	
75	u	
76	v	
F7	w	
F8	x	
79	y	
7A	z	
FB		yes
7C	1/2	yes
FD		yes
FE		yes
7F	DEL Note 3	

\* Variable Graphics

Figure 4-23. BSC 7-Bit Code (Odd Parity)

HEX	5B	BC	A8	AB	A1	26	5D	A4	2A	29	3B	5E	7C	25	3E	E0	23	40	A7	3D	A2	FE	FB	FD	DC	
USA	1	[	\$	(	+	!	&	]	\$	*	)	;	C	½	%	¶	±	#	@	'	=	"	°	2	3	¼
USA	2			(	+	!	&		\$	*	)	;	C	½	%			#	@	'	=	"				¼
USA	3			(	+		&		\$	*	)	;	C	½	%		±	#	@	'	=	"				¼
USA	4	[		(	+	!	&	]	\$	*	)	;	C		%			#	@	'	=	"	°			
USA	5			(	+	!	&		\$	*	)	;	C		%		±	#	@	'	=	"	°			
USA	6	[	\$	(	+	!	&	]	\$	*	)	;			%	¶		#		'	=	"	°			
USA	7	[	\$	(	+		&	]	\$	*	)	;			%	¶		#		'	=	"	°			
USA	8		\$	(	+		&		\$	*	)	;		½	%	¶		#		'	=	"	°			¼
USA	17			(	+	£	&		\$	*	)	;	C	=	%			#	@	'	=	"				¼
USA	18	£		(	+	!	&		\$	*	)	;	C	=	%			#	@	'	=	"				
USA	19			(	+		&		\$	*	)	;	C	½	%		±	#	@	'	=	"				¼

BLANK BOXES NOT GENERATED IN TRANSMIT  
MAPPED INTO INTERNAL DELETE IN RECEIVE

**Note:**

All blank positions (code points) are not produced in Display-writer send operations. They are processed the same as X '3F' (SUB) in receive operations. All SUB characters will be output to Display-writer displays or printers as an underscore (\_).

Figure 4-24. EBCDIC Character Set Symbols (BSC)

HEX	4A	4C	4D	4E	4F	50	5A	5B	5C	5D	5E	5F	6A	6C	6E	79	7B	7C	7D	7E	7F	A1	CO	DO	EO	DA	EA
USA	1	[	\$	(	+	!	&	]	\$	*	)	;	C	½	%	¶	±	#	@	'	=	"	°	2	3	¼	NOTE 1
USA	2			(	+	!	&		\$	*	)	;	C	½	%			#	@	'	=	"					¼
USA	3			(	+		&		\$	*	)	;	C	½	%		±	#	@	'	=	"					¼
USA	4	[		(	+	!	&	]	\$	*	)	;	C		%			#	@	'	=	"	°				
USA	5			(	+	!	&		\$	*	)	;	C		%		±	#	@	'	=	"	°				
USA	6	[	\$	(	+	!	&	]	\$	*	)	;			%	¶		#		'	=	"	°				
USA	7	[	\$	(	+		&	]	\$	*	)	;			%	¶		#		'	=	"	°				
USA	8		\$	(	+		&		\$	*	)	;		½	%	¶		#		'	=	"	°				¼
USA	17			(	+	£	&		\$	*	)	;	C	=	%			#	@	'	=	"					¼
USA	18	£		(	+	!	&		\$	*	)	;	C	=	%			#	@	'	=	"					
USA	19			(	+		&		\$	*	)	;	C	½	%		±	#	@	'	=	"					¼

NOTE 1: DA and EA columns not used in Card Image (EBCDIC/DP)

BLANK BOXES NOT GENERATED IN TRANSMIT  
MAPPED INTO INTERNAL DELETE IN RECEIVE

**Note:**

All blank positions (code points) are not produced in send operations. They are processed the same as X '1A' (SUB) in receive operations. All SUB characters will be output to Displaywriter displays or printers as an underscore (\_).

Figure 4-25. ASCII Character Set Symbols (BSC)



field is cleared and the local station is unable to answer incoming calls. The local operator cannot initiate outgoing calls after the DISC key is pressed. The DISC key is active any time the Communication Status field is not blank.

**Note:** For BSC the Link Status field and the Transmission Indicator field are cleared by disconnect. The Disconnect key is active any time the Link Status field is not blank.

- Message (MSG). Used to display background messages from the message queue.
- Reply (CODE + MSG). Used to clear an Insert Diskette message and to

indicate that the required diskette will not be inserted.

- Request (REQST). Used to show a list of additional functions that may be invoked during the current foreground task.
- Keyboard Change (KYB CHG). Used to alter the current keyboard arrangement.

#### ACCESSING THE BSC COMMUNICATION SETUP

This menu sequence is used to define the setup for the two BSC communication protocols (2770/3780, 2780).

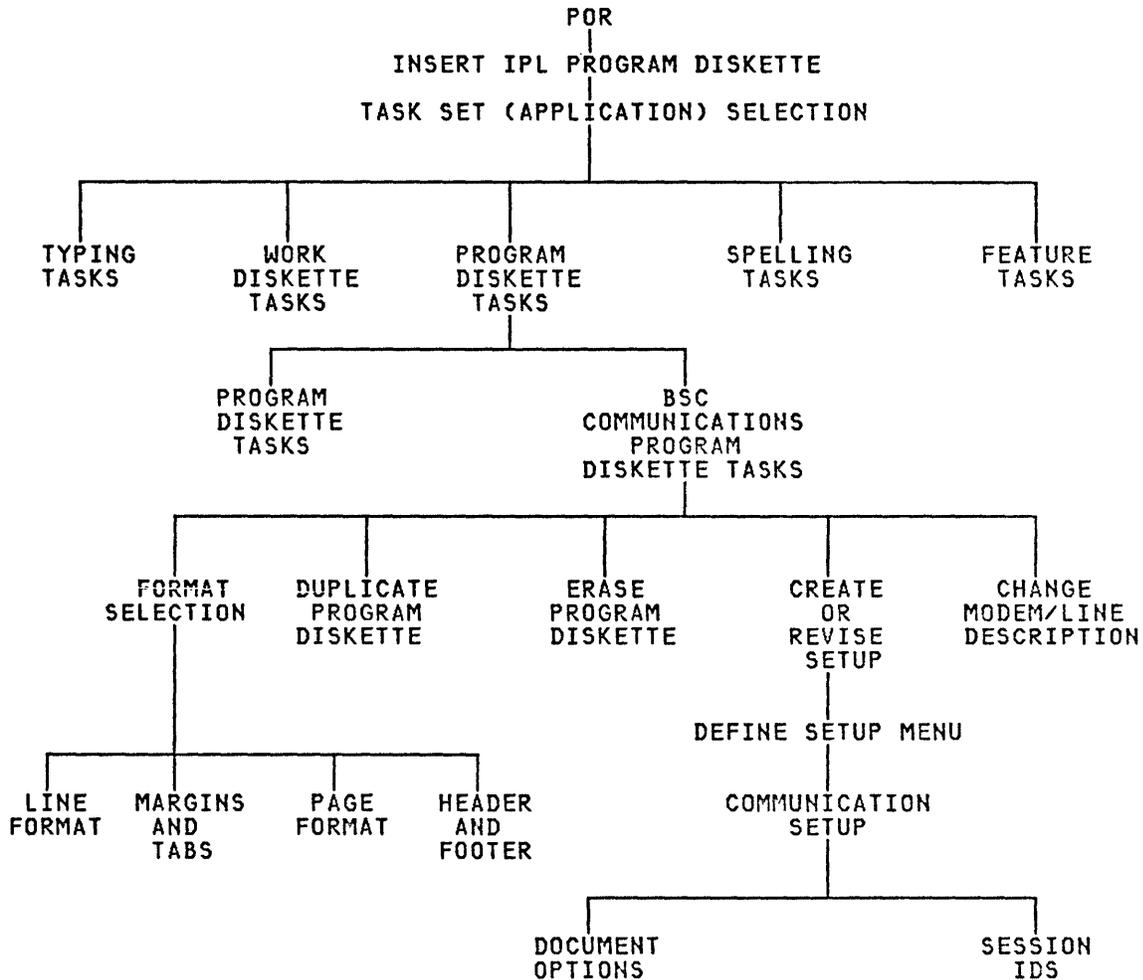


Figure 4-27. BSC Communications Program Diskette Tasks Menu Sequence

## BSC Setup General Characteristics

Selecting an ID from the CREATE OR REVISE SETUP menu causes the DEFINE SETUP menu (Figure 4-28) to display. This menu is used to specify a setup's name, protocol, and send format. The selections made here determine the options that appear in the COMMUNICATION SETUP menu (Figure 4-29) and the SETUP SESSION OPTIONS menu.

Chg Setup PRODSKI			
DEFINE SETUP			
ID	ITEM	YOUR CHOICE	POSSIBLE CHOICES
a	Setup Name	KGN	Up to 10 letters or numbers.
b	Protocol	1	1 = 2770/3780 2 = 2780
c	Send Format	3	1 = Card Image 2 = Page Image Text Only 3 = Page Image with OCL 4 = Page Image with Format Line 5 = Media Image 6 = Select on Job Basis

When finished with this menu, press ENTER.  
Type ID letter to choose ITEM; press ENTER: \_

Figure 4-28. Sample DEFINE SETUP Menu

The options on this menu are:

- **Setup Name.** Indicates the name given to the setup. The default is the current name. When an unused setup is first defined, a name must be specified in this menu.
- **Protocol.** Specifies whether the Displaywriter emulates the protocol characteristics of an IBM 2770/3780 or an IBM 2780. The default is 1, 2770. If 2780 is selected, 6670 Print options will not be included in the SETUP SESSION OPTIONS menu and will default to No.
- **Send Format.** Specifies which data stream format the Displaywriter uses to send data. The default is 3, Page Image with OCL.

- If Media Image is selected, the Code Set and Transparency options will not be included in the COMMUNICATION SETUP menu (Figure 4-29). The default for Code Set will be EBCDIC, and the default for Transparency will be Yes.
- If either Page Image with Format Line or Select on Job Basis is selected, Code Set

will not be included in the COMMUNICATION SETUP menu and will default to EBCDIC.

- If Page Image with OCL is specified, 6670 Print Options will be included in the SETUP SESSION OPTIONS menu. For all other send format choices, the default is No for 6670 Print Options.
- If Select on Job Basis is selected, the operator will specify the send format when adding a job to the send queue. In this case, the valid send formats will appear in the SEND DOCUMENT menu.

## BSC Communication Setup

The COMMUNICATION SETUP menu (Figure 4-29) appears automatically after an operator finishes with the DEFINE SETUP menu and presses ENTER. In this menu, several operating parameters for the communication link are specified.

**Note:** If Media Image is selected for Send Format in the DEFINE SETUP menu, the COMMUNICATION SETUP menu will not have options for transparency or code set as shown in Figure 4-29.

Chg Setup PROGDSI				
COMMUNICATION SETUP				
ID	ITEM	YOUR CHOICE	POSSIBLE CHOICES	
a	Modem Port	1	1 = Port 4	2 = Port 4A
b	Primary	2	3 = Port 4B	
c	Block Size	2	1 = Yes	2 = No
d	CPU mode	2	1 = 128	2 = 256
e	Insert New Line Codes	2	1 = Yes	2 = No
f	Transparency	2	1 = Yes	2 = No
g	Code Set	1	1 = EBCDIC	2 = 7-Bit
h	Change Setup Session Options			
i	Create or Revise Session ID's			

When finished with this menu, press ENTER.  
Type ID letter to choose ITEM; press ENTER: 0

Figure 4-29. COMMUNICATION SETUP Menu

Options on this menu are:

- **Modem Port.** Identifies the modem and the corresponding modem and line description used during a session. Port 4 = EIA interface in the electronics module; Port 4A = EIA interface in the diskette unit; and Port 4B = Internal modem/EIA adapter interface in the diskette unit.

- **Primary.** Specifies whether the Displaywriter bids as a BSC primary station. The default is 2, No.
- **Block Size.** Specifies the block size that the Displaywriter will use when sending data. The default is 2, 256 bytes.
- **CPU Mode.** Determines certain protocol characteristics used by the Displaywriter during a session. Yes normally is selected for Displaywriter/host sessions. CPU Yes keeps EOT from being sent every 10 seconds. ETX + EOT is a job boundary. The default is 2, No.
- **Insert New Line Codes.** Indicates whether the Displaywriter inserts New Line (NL) control codes at record (line) boundaries of a received data stream. The default is 2, No.

If Yes is specified and the Displaywriter is emulating a 2770/3780 terminal, a NL control code is inserted into a transparent received data stream after each 80 characters and at transparent block boundaries. If Yes is specified and the Displaywriter is emulating a 2780 terminal, a NL control code is inserted into the received data stream for each Intermediate End of Transmission Block (ITB), End of Transmission Block (ETB), or ETX control sequence.

- **Transparency.** Specifies whether the Displaywriter sends data in BSC transparency mode. The default is 2, No. If Yes, is selected, Code Set must be EBCDIC.

If the Send Format option of the DEFINE SETUP menu specifies Media Image, this option defaults to Yes and is not displayed here.

- **Code Set.** Specifies the code set that the Displaywriter uses when sending data. The default is 1, EBCDIC.

If 7-Bit is specified, Yes is invalid for Transparency.

If the Send Format option of the DEFINE SETUP menu specifies either Media Image or Page Image with Format Line, this option defaults to EBCDIC and will not be displayed here.

- **Change Setup Options.** Causes the SETUP SESSION OPTIONS menu to appear.
- **Create or Revise Session IDs.** Causes the Session IDs to appear.

## Sending From a Displaywriter to a Displaywriter (BSC)

Before starting the communications session, ensure that the remote Displaywriter has:

- A BSC Communications Feature
- A compatible modem
- A compatible communication setup
- A compatible level BSC feature diskette.

Prior to loading the BSC feature diskette, the Textpack Volume 01 or 02 program diskette must be loaded with the TASK SELECTION menu showing on the display.

1. Remove the Textpack program diskette.
2. Choose **Feature Tasks** from the TASK SELECTION menu.
3. When **Insert desired feature or program diskette**, and then press ENTER prompts, insert the BSC feature diskette, and then press ENTER.

If you have a dual diskette unit, insert the BSC feature diskette in the right diskette slot.

The SETUP SELECTION menu displays.

4. Insert the work diskette in the left slot.
5. Choose a communication setup. Choose a setup that is exactly like the setup on the Displaywriter you are sending to.

When the Session Summary frame is displayed, start building a send queue (a list of documents to be sent) by following the steps below.

6. Press REQST; the communications REQUEST TASKS menu displays.
7. Choose **Send Document** from the REQUEST TASKS menu.
8. Type the document and diskette names when prompted. The message (document name) added to send queue displays.

**Note:** The message SEND DOCUMENT OPTIONS menu may display if the active communication setup specifies that certain send options will be made at the time a docu-

ment is added to the send queue. The active communication setup determines which items are presented in this menu. The items presented depend on the type of equipment and how the document is to be processed at the remote location.

9. Press ENTER enough times until the Session Summary frame displays.
10. Press COMM START. READY displays in the communication status field.

**Note:** If using a dedicated communication line, CONNECTED displays and is followed by ON-LINE SEND. The document is received automatically. After the last document is sent, a completion message is entered in the Session Summary and "end of Session" displays. Press DISC; then press END.

**Note:** If your communication system requires a telephone call to the remote location; go to Talk on the telephone and call the remote station. Tell the location that you are ready to communicate and then give any necessary information about the session. Go to Data on the telephone after the remote location. You should hear a high-pitched tone or hum after the remote location goes to data.

CONNECTED BID displays in the communication status field and is replaced by ON-LINE SEND. Sending begins and a summary entry is made in the Session Summary frame.

After the last document is sent, a completion message is entered in the Session Summary, and End of Session displays. To end the session press DISC, then press END.

The communication line disconnects and the SETUP SELECTION menu displays.

### Receiving from Another Displaywriter (BSC)

The sending Displaywriter must have:

- A BSC Communications Feature
- A compatible modem
- A compatible communication setup
- A compatible level BSC feature diskette.

### Receive Format Consideration

Media Image is the send format used to transmit documents from one

Displaywriter to another Displaywriter. The document is not reformatted when sent using Media Image. You receive an exact copy of the document data on the sender's work diskette.

The following steps to receive assume that an individual is at the receiving Displaywriter, and that the Displaywriter is only receiving during the communication session.

1. Go to Talk on the telephone and answer the call from the remote location.

**Note:** Omit this step if using a dedicated communication line.

2. Load the Textpack Volume 01 of 02 program diskette (unless it is already loaded). The TASK SELECTION menu displays.
3. Remove the Textpack program diskette.
4. Choose Feature Tasks.
5. Following the prompts, insert the BSC feature diskette; press ENTER. THE BINARY SYNCHRONOUS COMMUNICATIONS SETUP SELECTION menu displays.
6. Choose the appropriate setup (the same setup the sending Displaywriter is using). The Session Summary frame displays and the communications status field is blank.
7. Insert a work diskette in the designated diskette slot. The work diskette name appears on the first status line.
8. Press COMM START. READY displays in the communications status field.

9. Go to Data on the telephone before the remote location. CONNECTED BID displays in the communication status field and is replaced by ON-LINE RECEIVE.

Receiving begins and a summary entry is made in the Session Summary frame.

After the last document is received, a completion message is entered in the session summary and End of Session displays.

10. At the end of the session, press DISC; then press END to disconnect the communications line. The SETUP SELECTION menu displays.

## CHAPTER 5. BSC COMMUNICATIONS DIAGNOSTICS

### INTRODUCTION

The communications diagnostic support package for the IBM Displaywriter System consists of:

- Service Diagnostics
- Maintenance Analysis Procedures (MAPs)
- Online Diagnostics
- Customer Loadable Diagnostics
- Customer Link Analysis Utilities
- Communication Link Analysis Guide

**Note:** This section contains display formats and printed outputs that should be considered as samples only.

### MDIS

The MDIs are test units and directions for service action that operate when selected. The first test unit requests the input of a Communication ID which describes the hardware configuration.

These MDIs test the communication components within the Displaywriter and the external components such as the external EIA and LDC cables.

The chart in Figure 5-1 lists the Communication IDs for different hardware configurations. The MDIs check whether the communication adapter card is located in the electronics module or the diskette unit. When the diagnostic controller has determined the configuration of the communication features, a set of test units operate automatically to test the function of these particular features.

### MDI OPERATION

The communication MDIs are on the ABC diagnostic diskette. Before this diskette can be loaded, the MDI supervisor must first be loaded from the Displaywriter system diagnostic diskette. An interface to the MDIs is provided through the keyboard and display.

Follow these steps to run the MDIs.

1. Insert the Displaywriter system diagnostic diskette. The program loads and the FUNCTION SELECTION menu displays.
2. Select MDIs from the FUNCTION SELECTION menu. The DEVICE SELECTION menu displays.
3. Select Communications from the DEVICE SELECTION menu.
4. Insert the Displaywriter system ABC diagnostic diskette and press ENTER.

If a single diskette drive system is used, the Displaywriter system diagnostic diskette must be removed and the Displaywriter system ABC diagnostic diskette inserted.

If a dual diskette drive is used, the ABC diskette may be inserted in the right drive. A flowchart for Displaywriter Loadable Diagnostics and Displaywriter System Communications Diagnostics is shown in Figure 5-2.

For further information on MDI operation, refer to the IBM Displaywriter System Product Support Manual.

The Displaywriter is also equipped with a feature known as RESUME that can be used as a marker, or stopping point, while running the MDIs.

RESUME can be used in two ways:

- Automatic RESUME is written into the MDIs. When an automatic RESUME occurs, a prompt occurs.
- Optional or real time RESUME is entered by keying the letter 'r' at any MDI stopping point. When in 'Step' mode, an optional RESUME can be placed at any point within the MDIs. Once the RESUME has been entered, either power off the Displaywriter, or press END to return to the FUNCTION SELECTION menu. To return to the RESUME point, access the FUNCTION SELECTION menu and select MDIs. From this menu, the RESUME option is taken by pressing ENTER. Pressing END or CANCEL at this point will erase the optional RESUME.

ID	Communications Configuration
a	Port 4: Communications Adapter EIA port Module EIA
d	Port 4a: Communications Adapter EIA port Port 4b: Local Device Controller
e	Port 4a: Communications Adapter EIA port Port 4b: X.21 switched line
f	Port 4a: Communications Adapter EIA port Port 4b: X.21 leased line
g	Port 4a: Communications Adapter EIA port Port 4b: 38LS modem for switched line
h	Port 4a: Communications Adapter EIA port Port 4b: 38LS modem for nonswitched line with SNBU
i	Port 4a: Communications Adapter EIA port Port 4b: 38LS modem for nonswitched line
m	Port 4a: Communications Adapter EIA port Port 4b: EIA Adapter Card EIA port
p	Port 4b: Local Device Controller
q	Port 4b: X.21 switched line
r	Port 4b: X.21 leased line
s	Port 4b: 38LS modem for switched line
t	Port 4b: 38LS modem for nonswitched line with SNBU
u	Port 4b: 38LS modem for nonswitched line
z	Communications tests inhibited

Figure 5-1. Communications ID Chart

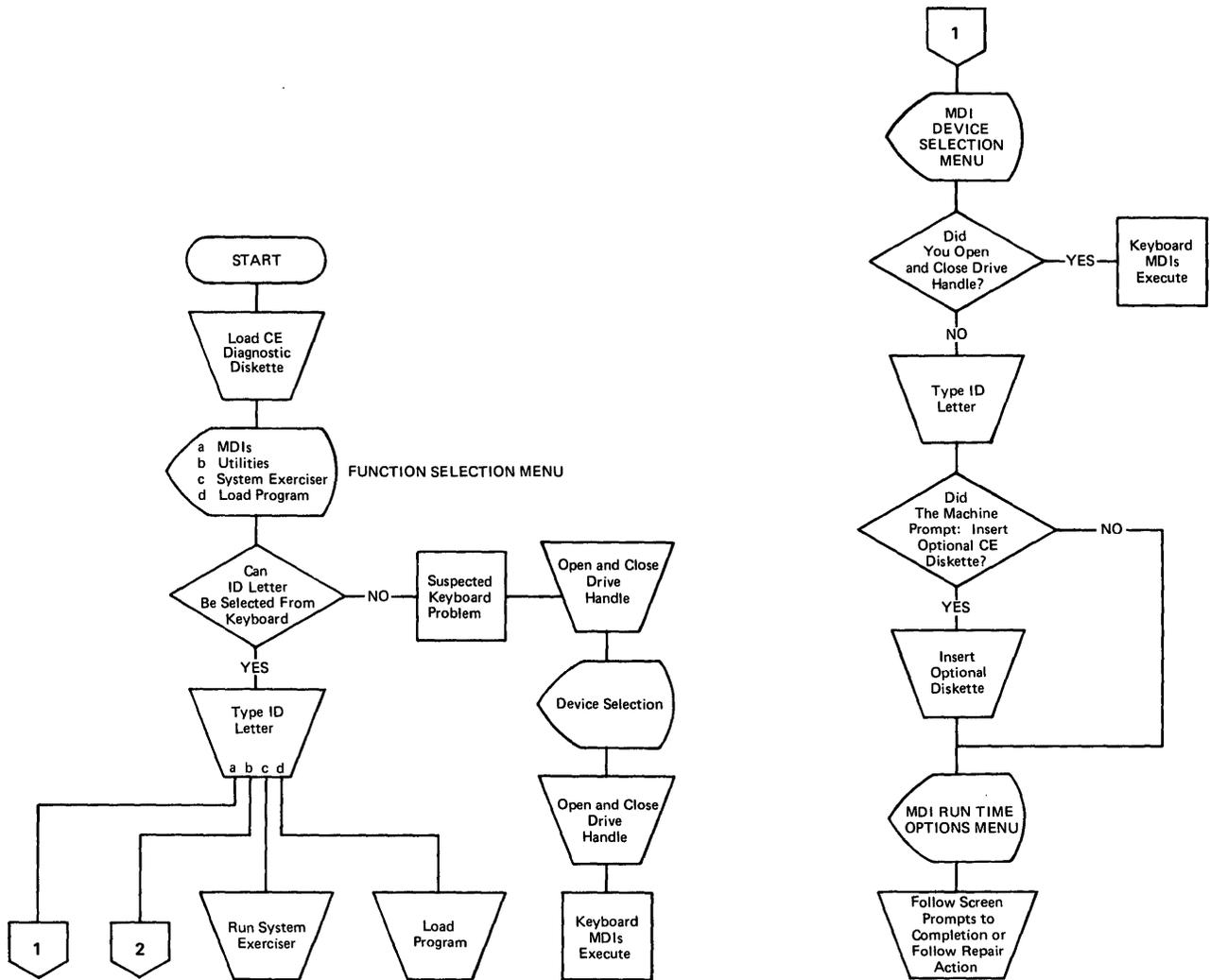


Figure 5-2 (Part 1 of 2). Loadable Diagnostics Flowchart

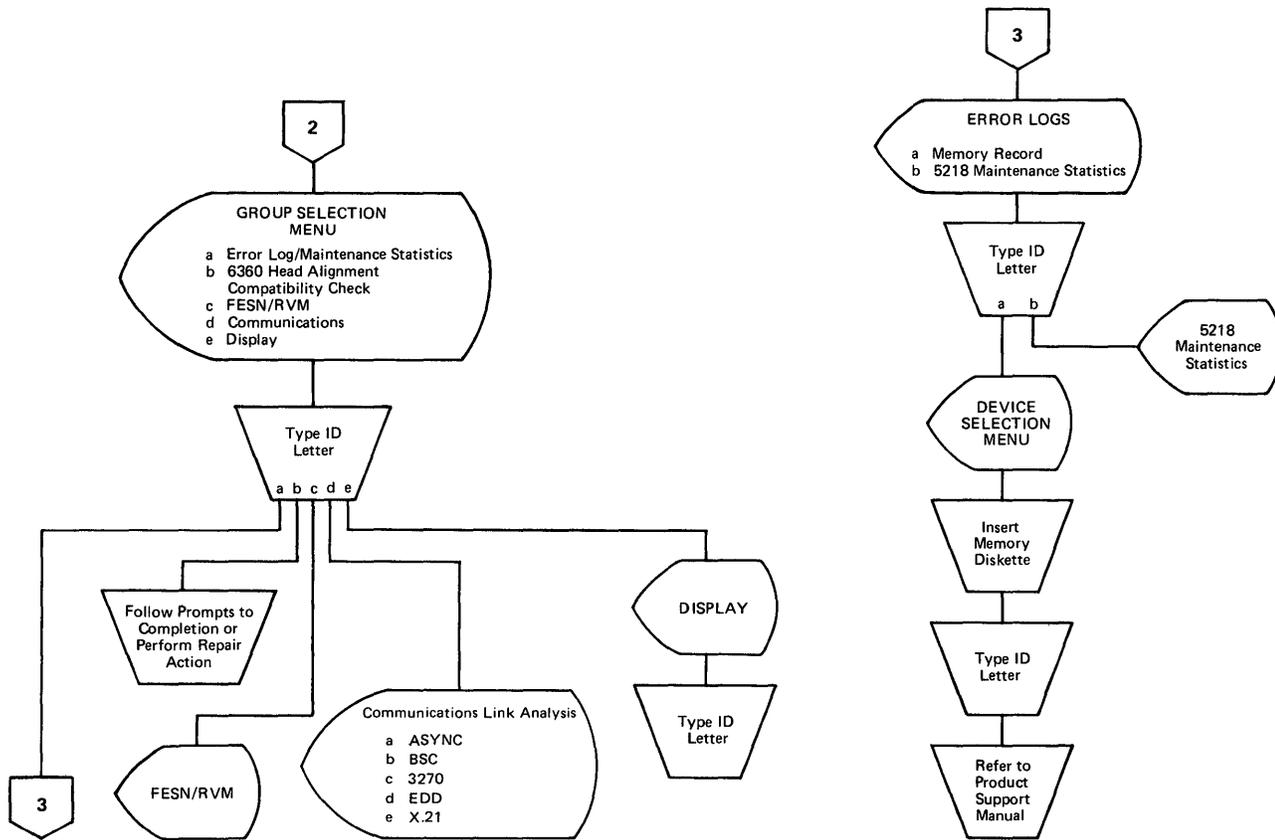


Figure 5-2 (Part 2 of 2). Loadable Diagnostics Flowchart

**ONLINE TEST SUPPORT (OLTS)**

The Online Test Support is used to verify ASYNC and BSC link and protocol operations. To run OLTS you must send a Request for Test (RFT) document to the connected host. The RFT selects the test to be executed. Displaywriter supports the creation and transmission of any valid RFT. (Slight formatting differences may exist depending on the host.)

To create a RFT, use normal operating procedures to create a document.

Enter all information for the RFT, including the Start of Header (SOH), into the document using the keyboard.

A standard job setup, which allows any RFT to be transmitted, is provided on all communications feature diskettes. The standard setup is non-displayable, non-alterable, and is selected through normal operator menus.

The four basic steps to conduct an Online Test (OLT) are summarized below. Each step is described in detail in the pages that follow.

1. Create the RFT document to be sent during the online test.
2. Personalize the Modem and Line Description on the communication feature diskette to be compatible with the supporting host system.
3. Call the host system and conduct the test.
4. Verify the data from the test.

**Note:** The Textpack diskette and the communications feature diskette must be compatible; for example, the third character from the left in the Textpack diskette name must be the same or higher than the communications feature diskette.

#### CREATING THE BSC RFT DOCUMENT

1. Load Volume 01 Textpack Program diskette; TASK SELECTION menu will display.
2. Choose **Typing Tasks** from the TASK SELECTION menu.
3. Follow the prompt and load Volume 2 of the Textpack Program diskette. The TYPING TASKS menu will display.
4. Choose **Create Document** from the TYPING TASKS menu.
5. Follow the prompt and type the document name: rft. Press ENTER.  
**Note:** If rft has already been selected, choose another job name.
6. Type the diskette name and press ENTER.
7. Remove the Textpack program diskette and insert the work diskette. The work diskette name will appear in the upper left corner of the display.
8. Type the name of the work diskette. The CREATE OR REVISE DOCUMENT menu will display.
9. Choose **Change Document Format** from the FORMAT SELECTION menu and press ENTER. The PAGE FORMAT menu will appear.
10. Choose **First Typing Line, First Page** from the PAGE FORMAT menu.
11. Type the number 1, and then press ENTER. YOUR CHOICE is highlighted.
12. Press ENTER three times to go to the typing area.

13. Type the message format on line 1 using the following description. Your Message Format should look similar to the following typed line, except personalized with your branch office number, security code, the test number, and the number of times the test runs. No spaces are allowed in the Message Format line.

DISPLAYED EXAMPLE:  
%01250/678/PSZ/6580

**Note:** Control characters will not be displayed.

SOH = Start of Header (Press Control key = a) nothing displays and the cursor does not move.

% = (Type % sign) Indicates this is an RFT message.

xx = Test Number (Choose correct test from the BSC OLTS chart and type the two digit number).

yy = Number of times test runs (Valid entries 01 to 99).

0 = Point to Point mode (Type 0)

STX = Start of Text (Press Control key + b) nothing displays and cursor does not move.

DC1 = Device Code 1 (Press Control key + q) nothing displays and cursor does not move.

/ = Required separator (Type /)

nnn = Branch Office Numbr (Type your B/O number).

/ = Required separator (Type /)

sss = Current month B/O security code (Type your B/O security code)

/ = Required separator (Type /)

6580 = Machine Type (Type 6580)

CR = Carrier Return (Press Return), nothing displays.

14. If you are using test 01, type the message you want to transmit on line 2. The message should not exceed 160 characters. A sample message is: The quick brown fox jumped over the lazy dog. If you are using tests 02 to 15 the remote station will send you the data. See Figure 5-3.

TEST NO.	DATA SOURCE	TEST DESCRIPTION
01	User	Requester sends one message block (400 bytes maximum) containing RFT, followed by test data (text). Responder returns the data yy times.
02	CPU Station	Receive two 128 byte character blocks (total 256 characters), EBCDIC transparency. DLE, STX, 256 8-bit bytes (00 thru FF0, DLE, ETX.
06	CPU Station	Receive 36 characters, ASCII. STX, A thru Z, 0 thru 9, ETX.
14	CPU Station	Receive 36 characters, EBCDIC. STX, A thru Z, 0 thru 9, ETX.
15	CPU Station	Receive 80 characters, weak pattern, EBCDIC. STX, 74 bytes of hex 00, 6 bytes of SYN, ETX. Hex 00 is a null character which does not print or display.

Figure 5-3. BSC OLTS Test Numbers (XX Tests)

15. Press END. This key must be pressed in order to store the RFT document on the work diskette.
16. Choose **Go To Task Selection** from the TYPING TASKS menu.
17. The RFT document has been completed.

#### PERSONALIZING THE BSC MODEM AND LINE DESCRIPTION

After you have created a RFT document, the second step is personalizing the BSC modem and line description and creating a communication setup.

During BSC communications the modem may be plugged into one of three different ports. You need to determine in which port the modem is plugged to determine two things:

1. Which ITEM in the MODEM AND LINE DESCRIPTION menu you will choose, in order to create a modem and line description compatible with the host system.
2. Which Test Setup Option (T, U, or V) in the BSC COMMUNICATIONS SETUP SELECTION menu you will choose, in order to run the Online Test.

After following the steps to create the BSC RFT document you should be in the TASK SELECTION menu. Follow the steps below to personalize the BSC modem and line description and create a communication setup.

1. Remove any Textpack program diskettes from the diskette unit.

2. Choose **Program Diskette Tasks** from the TASK SELECTION menu.
3. Following the prompts and insert the BSC Feature Diskette.
4. Choose **Create or Revise Modem or Line Description** from the BSC COMMUNICATIONS PROGRAM DISKETTE TASKS menu. Press ENTER. The MODEM AND LINE DESCRIPTION menu displays.
5. Note which port the modem is plugged into. Choose the correct ID to Create or Revise that Port's Modem and Line Description; then press ENTER. The appropriate MODEM AND LINE DESCRIPTION menu displays.
6. Compare the YOUR CHOICE column in Figure 5-4 with the YOUR CHOICE column displayed.
7. Write down the existing application choices on a piece of paper. You will need to return any changed items in the YOUR CHOICE column back to their existing application.
8. Change only those items that need to be changed in order to match the two YOUR CHOICE columns. YOUR CHOICE changes will be highlighted.
9. When finished with this menu, press ENTER twice to return to the BSC COMMUNICATIONS PROGRAM DISKETTE TASKS menu.
10. Choose **Go To Task Selection**. Press ENTER. The TASK SELECTION menu displays.

Chg Description	PORT MODEM AND LINE DESCRIPTION		Kyb 1
PROGDS	ID	ITEM	YOUR CHOICE
	a	Terminal ID	1
	b	Network Facility	1
	c	Continuous Carrier	2
	d	Bit Clocking	2
	e	Half Speed Capability	2
	f	Answer Tone Generation	2

When finished with this menu, press ENTER.

Type ID letter to choose ITEM; press ENTER: 0

Figure 5-4. BSC MODEM and LINE DESCRIPTION SETUP Menu

### CALLING THE HOST SYSTEM AND CONDUCTING THE BSC OLTS

After you have created a BSC RFT document, and personalized the BSC modem and line description, you are ready to call the host system to conduct the OLTS. The TASKS SELECTION menu should be displayed. Follow the steps below.

1. Choose **Feature Tasks** from the TASK SELECTION menu. Press ENTER.
2. Following the prompts, insert the BSC feature diskette if it is not already loaded. The BSC COMMUNICATION SETUP SELECTION menu displays.
3. Choose the ID letter to describe your modem port from the BSC COMMUNICATION SETUP SELECTION menu. The choices will be:

T = Modem Port 4  
 U = Modem Port 4a  
 V = Modem Port 4b

**Note:** These ID Letters do not display. The "T", "U", and "V" setup defaults are shown in Figure 5-5. The Session Summary Field displays; the Communications Status Field is blank.

4. Press REQST to start building a send queue. Insert the work diskette. If using a dual diskette unit, insert the work diskette in the left slot. The COMMUNICATIONS REQUEST TASK menu displays.

SETUP ITEM	DEFAULT
Job Name	T = OLT4 U = OLTa V = OLTb
Modem Port	T = 4 U = 4a V = 4b
Protocol	2770 (all)
Send Format	Card Image (all)
Primary	Yes (all)
Block Size	256 (all)
CPU Mode	Yes (all)
Insert New Line Codes	No (all)
Transparency	No (all)
Character Set ID	1 (all)
Use This Character ID	Yes (all)
For All Send Jobs	
Recive Default Format	Your Document Default Format
6670 Print Options	No (all)
Append Next Document	No (all)

Figure 5-5. "T", "U", "V" Setup Defaults

5. Choose **Send Document** from the REQUEST TASK menu.
6. Following the prompt, type document name: rft.
7. Following the prompt, type the diskette name. Rft added to the send queue displays.
 

**Note:** Read the remaining steps before you continue. They must be completed within 20 seconds after pressing COMM START or the host system may automatically disconnect the line.
8. Press COMM START. READY displays in the communication status field.
9. Call the host system.
10. Go to Data after the host system's modem answertone ends. CONNECTED BID displays in the communication status field. CONNECTED BID is replaced by ON-LINE SEND. Sending begins and a summary entry is made in the Session Summary frame.
 

**Note:** The entry in the Session Summary frame is the name under which your BSC OLTS data is recorded on your work diskette. You will need to make a note of that name in order to verify your BSC OLTS data later. After the document is sent, a completion message is entered in the Session Summary and End of Session displays.
11. (OPTIONAL) Repeat steps 4 through 7 for additional OLTS. Remember that steps 8 through 10 should be

completed within 20 seconds or the host system may automatically disconnect the line.

12. To end the session press DISC, then press END. The communication line disconnects and BSC COMMUNICATIONS SETUP SELECTION menu displays.

**Note:** If the Error Log and TRACE are to be recorded use the Memory Record Diskette(s) immediately after the communication session ends. Error Log and TRACE may then be accessed through the Displaywriter System ABC Diagnostic diskette.

### VERIFYING THE BSC OLTS DATA

The final step in performing the BSC OLTS is verifying the data. You may verify the BSC OLTS data by viewing it on the display or by printing it. After verifying the BSC OLTS data, always return the BSC MODEM AND LINE DESCRIPTION menu to the existing applications.

### REVIEWING BSC OLTS DATA ON THE DISPLAY

Follow the steps below to review BSC OLTS data on the display.

1. Choose **Typing Tasks** from the TASK SELECTION menu.
2. Following the prompts, insert Volume 2 of the Textpack program diskettes. The TYPING TASKS menu displays.
3. Choose **Revise Document** from the TYPING TASKS menu. Insert the work diskette.
4. Following the prompts, type document name. Press ENTER.

**Note:** The document name is the name that appeared in the Session Summary frame after the communication session began. You should have recorded that name.

5. Following the prompts, type the diskette name. Press ENTER to go to the typing area.
6. Review the document; when finished, press END.

### PRINTING THE BSC OLTS DATA

Follow these steps to print the BSC OLTS data:

1. Ensure that the printer is on.
2. Press REQST.
3. Choose **Print Document**.
4. Type the document name. (This is the name that was in the Session Summary frame when the communication session began.)
5. Type diskette name; press ENTER.
6. Follow the prompts on the display to print the document.

### BSC LINK ANALYSIS UTILITIES

There are several BSC Communication Link Analysis Utilities that aid in network problem determination. These utilities are used to test and exercise the modem, the communications adapter, and the link. The BSC utilities are:

- **Send Continuous Data.** Used to continuously transmit known data on the link.
- **Receive Continuous Data.** Used to receive a continuous known data pattern, detect errors in the pattern, and log the error.
- **Measure RTS/CTS Delay.** Used to measure the delay from the time RTS is made active to the time CTS becomes active.
- **Select Switched Network Backup/Half Speed.** Used to select switched network backup and half speed operating modes.
- **Control Modem Interface.** Used to control and display the EIA interface.
- **Display Error Log.** Used to format and display the BSC error log data.
- **Display Trace.** Used to format and display the BSC Trace data.
- **Change Link Description.** Used to define the BSC environment.
- **Wrap Modem.** Used to test modems which support a wrap capability.

## ACCESSING THE BSC LINK ANALYSIS UTILITIES

In most cases, you must follow a setup procedure for an individual utility before it will execute. The steps to access the utilities are as follows:

1. Power ON.
2. Load the Service Diagnostic diskette.
3. Select **Utilities** from the FUNCTION SELECTION menu.
4. Select **Communications** from the UTILITY GROUP SELECTION menu.
5. Load the ABC diagnostic diskette.
6. Select **BSC** from the COMMUNICATIONS LINK ANALYSIS menu. The BSC LINK ANALYSIS menu displays.
7. Select an individual utility.

Figure 5-6 shows how the BSC utilities are accessed.

Once the BSC LINK ANALYSIS menu appears a communications link can be established or an individual utility can be selected. If switched network backup or half speed is to be used for the network diagnostic tests, they must be specified in the Select Switched Network Backup/Half Speed Utility before the link can be established.

**Note:** After a link is established, press DISC if you wish to disconnect the link.

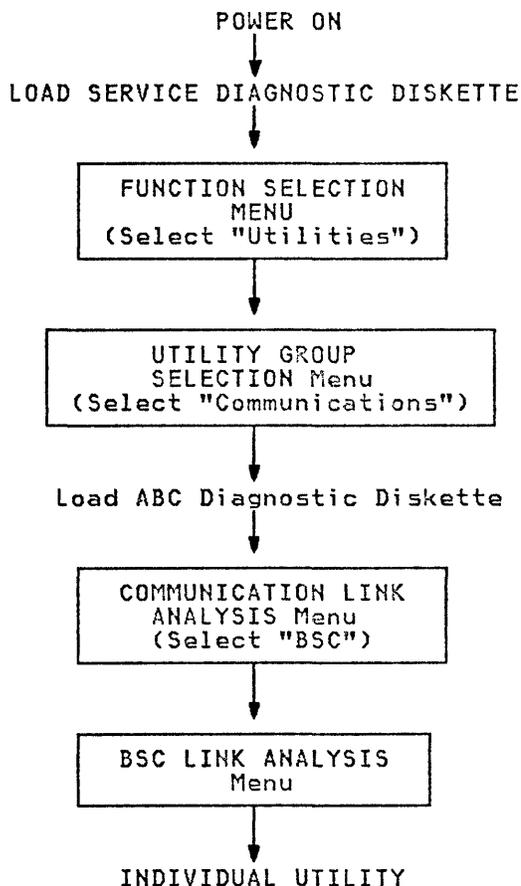


Figure 5-6. Menu Path for BSC Link Analysis Utilities

## SEND CONTINUOUS DATA UTILITY

The Send Continuous Data utility is used to test the integrity of the link, to send a continuous selectable bit pattern across the link and to optionally check any received data that is wrapped back. Points from which data can be wrapped back are:

- local modem cable wrap switch
- Local modem (if it supports a local wrap)
- remote modem (if it supports a remote wrap and a duplex facility is being used)
- remote Displaywriter (if a duplex facility is being used).

When a wrap is not possible, the receiving station can monitor the pattern sent from the Displaywriter for errors.

To choose this utility select **Send Continuous Data** from the BSC LINK ANALYSIS menu. The SEND CONTINUOUS DATA SETUP menu will appear.

**Note:** NRZI is not supported for this utility.

**Note:** If a CCITT interface is being used, all EIA terms are replaced by CCITT numbers.

### Send Continuous Data Setup

Figure 5-7 shows the menu used to set-up for Send Continuous Data.

The BSC code set is 7-bit, ID a reads:

- a Send Character Pattern
  - 1 = SYN Character
  - 2 = Alternating 0/1 bits
  - xx = Any valid bit pattern X'00' to X'FE' (including party)

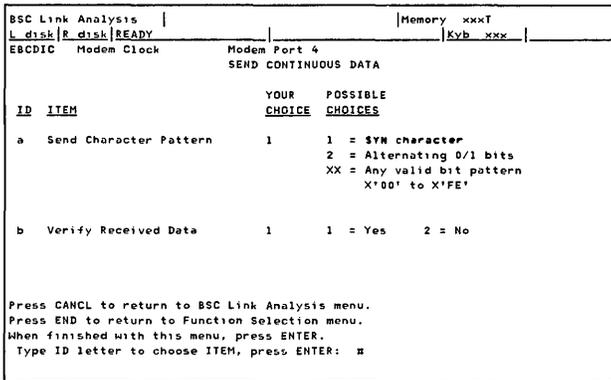


Figure 5-7. BSC Send Continuous Data Setup Frame

### Send Continuous Data Execution

Press ENTER after the setup and the utility executes. Figure 5-8 shows the BSC Send Continuous Data frame.

The BSC Send Continuous Data frame Modem Interface Status lines gives the state of the modem interface signals:

- DTR = Data Terminal Ready
- DSR = Data Set Ready
- RTS = Request to Send
- CTS = Clear to Send
- RLSD = Receive Line Signal Detect
- RI = Ring Indicate
- TD = Transmit Data
- RD = Receive Data
- SS = Select Standby
- DSRS = Data Signaling Rate Select

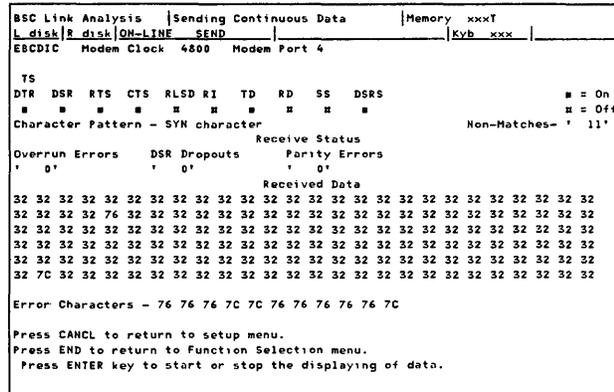


Figure 5-8. BSC Send Continuous Data Execution Frame

This frame also shows:

- The pattern being sent.
- The number of received characters that do not match the pattern (if Verify Received Data = Yes).
- The data being received (the last received byte is displayed video-reversed).
- The non-match characters (if 'verify received data' option was selected).

### RECEIVE CONTINUOUS DATA UTILITY

The Receive Continuous Data utility is used to receive a continuous bit pattern from the link, compare it to a stored pattern, and indicate if any errors are detected. This utility can also optionally wrap the pattern.

The utility is selected by choosing Receive Continuous Data from the BSC LINK ANALYSIS menu.

To display a received pattern and to indicate an error, the Displaywriter must receive at least one pattern that corresponds to the pattern specified in the RECEIVE CONTINUOUS DATA menu.





Session Description appears first. To scroll forward through the log, use the arrow down (↓) key. To scroll backward, use the arrow up (↑) key.

Use the PRINT key to print any Error Log frame.

### Session Description

Use Session Description information to verify that the session setup was correct at the time the Error History Log was recorded.

```

BSC Link Analysis | Displaying Error Log | Memory xxxT
L disk | R disk | | Kvb xxx |
-----
7-bit 1200 Modem Port 4A Continuous Carrier
SESSION DESCRIPTION

Code Set Protocol Network Facility
7-bit 2770 ***
Bit Clocking CPU Mode Switched Network Backup
BMC Yes No
Modem Port Primary Half Speed
Port 4A Yes No
Continuous Carrier Transparency Terminal ID
Yes Yes XX
Answer Tone Generation Insert New Line Codes Adapter
Yes Yes Diskette Unit
Block Size 256 Character Set ID
Send/Receive Format XXX
**

Press CANCL to return to BSC Link Analysis menu.
Press END to return to Function Selection menu.
Press PRINT to print display contents.
Use ↑ and ↓ keys to scroll through Error Log.
  
```

Figure 5-14. Sample BSC Session Description Frame

**Note:** When Session Description is displayed, the Machine Configuration within memory is updated to match that display.

The operational information in the BSC Session Description Frame includes:

- Code Set
- Protocol
- CPU Mode or not (yes/no)
- Primary (yes/no)
- Insert new line codes (yes/no)
- Transparency mode (yes/no)
- Send Format (Data Stream Type)
- Block size
- Terminal ID
- Current character set ID if applicable

The modem information in the BSC Session Description Frame includes:

- Type of Clocking
- Modem Port
- Continuous Carrier (yes/no)
- Answer Tone (yes/no)
- Network Facilities
- Switched Network Backup (yes/no)
- Half Speed (yes/no)

### BSC Counters

There are two types of counters. Operational counters are used to determine the relative health of the communication network. Error counters are used to identify specific communication network problem areas.

```

BSC Link Analysis | Displaying Error Log | Memory xxxT
L disk | R disk | | Kvb xxx |
-----
COUNTERS

Blocks Received Blocks Sent
XXXXX XXXXX

CRC Errors Invalid Blocks NAKs Received Receive Timeouts
XXXXX XXXXX XXXXX XXXXX

Overruns Parity Errors Underruns CTS Dropouts
XXXXX XXXXX XXXXX XXXXX

Aborts
XXXXX

Press CANCL to return to BSC Link Analysis menu.
Press END to return to Function Selection menu.
Press PRINT to print display contents.
Use ↑ and ↓ keys to scroll through Error Log.
  
```

Figure 5-15. BSC Counters Frame

The BSC counters are shown in Figure 5-15. The two BSC operational counters are:

- Text Block Received. Counts good text blocks that have been received by the Displaywriter. The count is updated whenever a text block is received with valid CRC characters.
- Text Blocks Sent. Counts good text blocks that have been sent by the Displaywriter. The count is updated whenever a valid positive response is received for a text block.

There are nine BSC error counters. These counters are divided between receiving data counters and sending data counters. The five used when receiving data are:

- CRC Errors. Counts CRC errors detected
- Overruns. Overrun errors detected by the communication adapter
- Aborts. Number of aborted data blocks received
- Invalid Blocks. Counts received blocks that do not conform to the BSC protocol (invalid control characters, for example)

- Parity Errors. Parity errors detected by the communications adapter.

The four BSC counters used when sending data are:

- NAKs Received. NAKs received for valid transmitted text blocks
- Underruns. Underrun errors detected by the communication adapter
- Received Timeouts. Receive timeouts that have occurred for both text and control blocks
- CTS Dropouts. Unexpected CTS dropouts.

**Note:** If a CCITT interface is being used, all EIA terms are replaced by CCITT numbers.

### BSC Error History Log

The BSC Error History Log provides a history of the last errors that have been detected. The log is used to analyze modem interface problems, adapter problems, protocol incompatibilities and link problems.

Two bytes of information are recorded for each error. The first byte represents the error type; the second byte provides additional information.

BSC Link Analysis		Displaying Error Log		Memory xxxT	
L disk	R disk			Kyb	xxx
ERROR HISTORY LOG					
		125	125		
Error Type		4/4A	4B	108	107
Invalid Control	13			11	105
106 Dropout		Off	Off	On	On
109 Dropout		Off	Off	On	On
106 Stuck High		Off	Off	On	On
Slave Abort Received	ACK0				
Master Abort Sent	ACK0				
Master Abort Received	ETB				
Slave Abort Received	ACK1				
Transmit Failure	ACK1				
BID Failure	NAK				
Disconnect Timeout		Off	Off	On	On
107 Dropout		Off	Off	Off	Off
-End of Log-					
Press CANCL to return to BSC Link Analysis menu.					
Press END to return to Function Selection menu.					
Press PRINT to print display contents.					
Use ↑ and ↓ keys to scroll through Error Log.					

Figure 5-16. Sample BSC Error History Log Frame

The possible errors recorded in the BSC Error Log are:

- Parity Error
- Invalid Control (Invalid Control Character)

- Bid Failure
- Master Abort Sent (Master EOT Aborts Sent)
- Master Abort Received (Master EOT Abort Received)
- Slave Abort Sent (Slave EOT Aborts Sent)
- Slave Abort Received (Slave EOT Aborts Received)
- Transmit Failure
- Disconnect Timeout
- DSR Dropout (Unexpected DSR Dropout)
- CTS Dropout (Unexpected CTS Dropout)
- RLSD Dropout (Unexpected RLSD Dropout)
- CTS Stuck High.

The information provided in the second byte depends upon the type of error.

**PARITY ERROR:** If the error is a parity error, the second byte is the hexadecimal representation of the character, minus the parity bit.

**INVALID CONTROL CHARACTER:** If the error is an Invalid Control Character, the second byte contains the hexadecimal representation of the invalid control character.

**BID FAILURE:** If the error is a Bid Failure the second byte contains the last control character received. Those possible are:

- Null. Nothing received
- NAK
- ACK1. Wrong ACK response received
- EOT
- DISC
- ENQ. Remote trying to bid

**MASTER ABORT SENT:** If the error is a Master Abort Sent the second byte contains the last control character received by the Displaywriter. Those possible are:

- NAK. Received after fifteenth transmit attempt
- Null. Fifteen ENQs transmitted to solicit a response to a block of text without obtaining a response

- ACK0/ACK1. Wrong ACK response to a block of text received after fifteen ENQ requests.

**SLAVE ABORT SENT:** If the error is Slave Abort Sent, the second byte contains the last control character received by the Displaywriter.

**MASTER ABORT RECEIVED:** If the error is a Master Abort Received, the second byte contains information identifying the last control character sent. Those possible are:

- ETX
- ENQ
- TTD
- ETB

**SLAVE ABORT RECEIVED:** If the error is a Slave Abort Received, the second byte contains information identifying the last control character sent by the Displaywriter. Those possible are:

- NAK
- ACK0
- ACK1
- WACK

**DSR, CTS, RLSD, DISCONNECT TIMEOUT, OR TRANSMIT FAILURE:** If the error is a DSR Dropout, unexpected CTS Dropout, unexpected RLSD Dropout, Disconnect Timeout Error, or Transmit Failure the second byte contains additional hardware status information.

### BSC Last Adapter Status

The BSC Last Adapter Status contains the last adapter status recorded by the BSC software. Figure 5-17 shows how the BSC last adapter status displays.

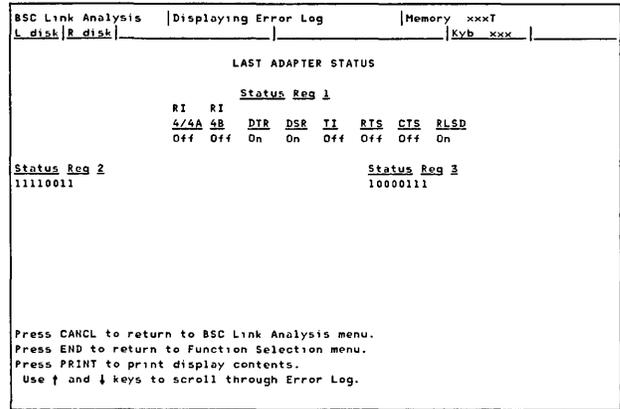


Figure 5-17. Sample BSC Last Adapter Status Display

Note: If a CCITT interface is being used, all EIA terms are replaced by CCITT numbers.

Status Register 1 is decoded and displayed on the screen. A description of the bits in status registers 2 and 3 are shown in Figure 5-18.

### Status Register 2

- .....1 --> Programmable Timer Enabled
- .....1. --> Wrap Test Data = MARK
- .....1.. --> Test Control Status
- ....1... --> Modem Interrupt Pending
- ...1.... --> Modem Interrupts Enabled
- ..1..... --> Modem Status Available (Port a)
- .0..... --> Programmable Timer IRQ Pending
- 1..... --> Received Data = MARK

### Status Register 3

- .....1 --> Transmit Ready
- .....1. --> Receive Ready
- .....1.. --> Transmit Empty
- ....1... --> Parity Error
- ...1.... --> Overrun Error
- ..1..... --> Reserved
- .1..... --> SYNC Detect
- 1..... --> DSR

Figure 5-18. Bit Discriptions for Status Registers 2 and 3

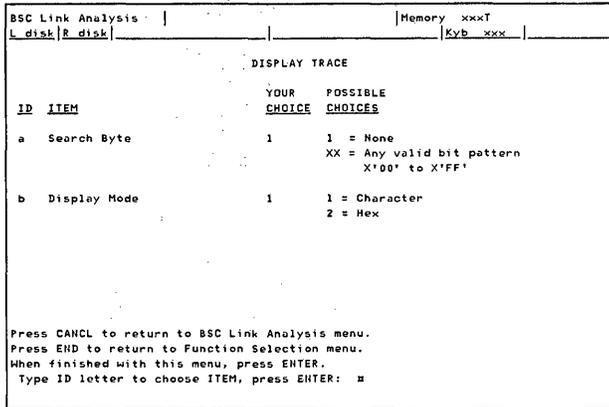


Figure 5-19. DISPLAY TRACE SETUP MENU

### BSC TRACE UTILITY

The BSC Trace is a record (approximately 1675 bytes in length) of recently sent/received data and modem status information. The BSC Trace (see Figure 5-19) provides an exact picture of the data stream as it appears on the link. Use the trace to diagnose procedural errors and incompatibilities.

The BSC Trace defaults to On when a session is established. To obtain the trace data, a memory record must be performed. For further memory record procedures, refer to the Displaywriter System Product Support Manual.

Figure 5-19 shows the BSC Trace modes for scrolling trace data. These modes are:

- Normal Mode. Scrolls all data, from the oldest to the latest entry.
- Search Mode. Scrolls for a search byte. Trace data is searched from the oldest entry to the latest entry. Whenever the search byte is detected, the trace is displayed, starting with that byte.

The utility also allows two modes of displaying the data:

- Character Mode. Displays all alpha characters (52 graphics) as alpha characters and two spaces, spaces as three spaces, and all other code points by their hex representation and a space.
- Hex Mode. Displays all code points by their hex representation and a space.

### BSC Display Trace Execution

Press ENTER after the setup and the trace displays ( Figure 5-20 ).

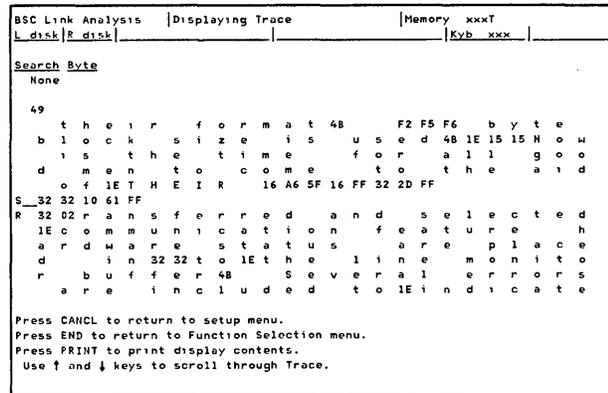


Figure 5-20. Sample BSC Display Trace

When the Trace Display appears, the oldest data in the trace is displayed first.

- All sent data is preceded by an "S" in the first column.
- All received data is preceded by an "R".
- All modem status information is represented in hex, underscored, and followed by a space. Functional status is represented by X'F\_', and error status is represented by X'E\_'. (Although not necessarily an error, a DSR drop-out is indicated as an error.) Some of the Functional status codes and errors are:

- X'F1' = RI-P4/4a transition
- X'F2' = RI-P4b transition
- X'F3' = DSR transition to active state
- X'E0' = Unexpected RLSD transition to non-active state
- X'E1' = Parity Error
- X'E2' = Unexpected CTS transition to non-active state
- X'E4' = DSR transition to non-active state
- X'E8' = Overrun error

When error status information is displayed, it is followed by a second byte that identifies the cause of the error. Figure 5-21 shows what the bit settings for this second byte indicate.

Figure 5-20 is a line trace example when no search byte has been

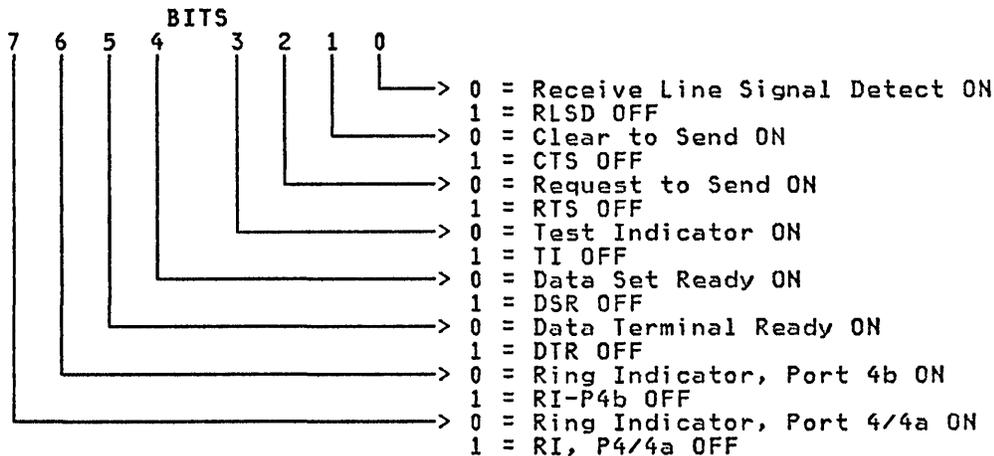


Figure 5-21. BSC Trace Status Byte

specified. The example message was received by the Displaywriter.

**Note:** For Media Image data, the Display Trace shows only BSC protocol and status information. All other data is replaced by underscores.

All data transferred and selected communication feature hardware status information is placed into the trace buffer. Figure 5-22 is a line trace example when a search byte has been specified. Note that in this mode, line 24 is a prompt for locating the next occurrence of the search byte.

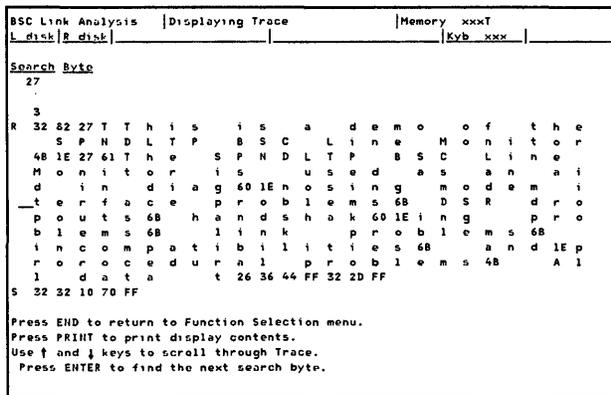


Figure 5-22. Sample BSC Display Trace (Search Mode)

### BSC CHANGE LINK DESCRIPTION UTILITY

**Note:** Session Description may change automatically when displaying Error Log.

The Change Link Description utility is used to change the BSC link description temporarily or permanently. To select this utility, choose Change Link Description from the BSC LINK ANALYSIS menu. The CHANGE LINK DESCRIPTION menu (Figure 5-23) appears.

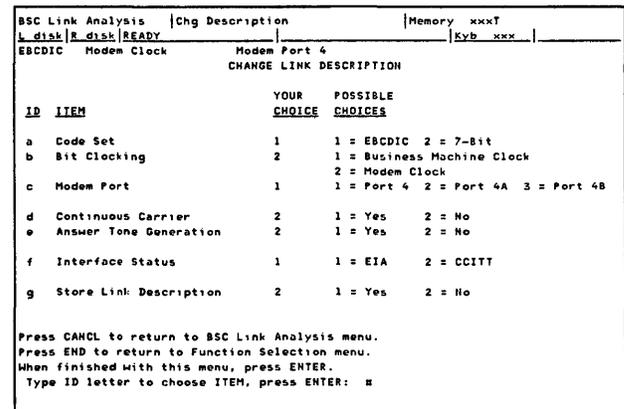


Figure 5-23. BSC CHANGE LINK DESCRIPTION Menu

The utility options are:

- **Code Set.** Specifies the code set to be used. The default is 1, EBCDIC.
- **Bit Clocking.** Specifies either business machine or modem clocking.



## CHAPTER 6. 3270 DATA STREAM COMPATIBILITY FEATURE

### 3270 DATA STREAM COMPATIBILITY FEATURE OVERVIEW

The IBM Displaywriter System 3270 Data Stream Compatibility (3270 DSC) feature program (IBM Licensed Program 5608-SR6) enables the Displaywriter to communicate with an IBM host which uses IBM- and customer-written 3270 application programs. This feature enables the Displaywriter to appear to a host as an IBM 3274 Model 51C Controller with an IBM 3278 Display Model 2 or 4. IBM 5218 or 5228 Printwheel Printers attached to an IBM Displaywriter appear to the host as an IBM 3287 Printer Model 1 or 2.

The Displaywriter can exchange data to perform many applications with the 3270 DSC feature licensed program. Examples include:

- Inquiry and Update. Part of a displayed record can be modified by the 3270 DSC feature operator.
- Data Entry. Data keyed at the Displaywriter using the 3270 DSC feature is sent to the host.
- Personal Computing. Personal computing is the use of the host computer by non-data processing professionals. The Displaywriter operator performs end-user-oriented applications with the 3270 DSC feature.
- Program Development. A Displaywriter can be used to create, compile, test and update programs using application development facilities of the IBM host system.
- Data Processing and Word Processing. The 3270 DSC feature operator can store information from the display screens on a diskette as pages of a document.

The IBM Displaywriter can be attached to such hosts as the IBM System 370, the IBM 4300 Processors, and the IBM 3031/3032/3033/3081.

The 3270 DSC feature communicates in a SNA/SDLC network. Data can be sent and received over switched or non-switched lines. The 3270 DSC feature operates only in half-duplex. Connections may be point-to-point or multipoint. Figure 6-1 is an example of a communication link utilizing Displaywriter 3270 DSC feature.

The 3270 DSC feature is on a Displaywriter feature program

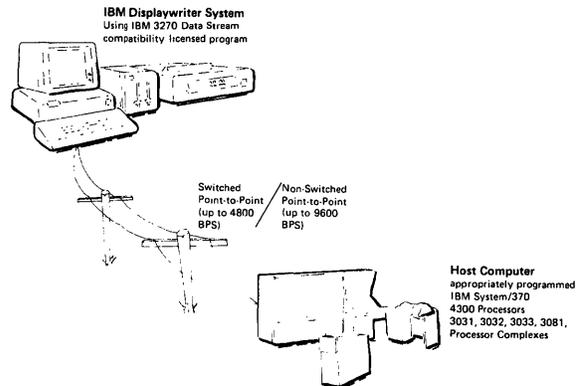


Figure 6-1. 3270 DSC Feature Communication Link (Point-to-Point)

diskette. IBM will periodically distribute maintenance updates for this feature.

### 3270 DSC FEATURE EQUIPMENT REQUIREMENTS

In addition to the licensed program, the following equipment is required for Synchronous Data Link Communications (SDLC):

1. A modem. The modem must be capable of half duplex or duplex operation and synchronous data transmission. An external modem is attached to the Displaywriter by a 3.8 meter (12.5 foot) cable. The Displaywriter can support as many as two external modems. The modems are menu selected through the licensed program. Only one modem can be active at one time.
2. A communications adapter. The adapter provides both an Electronics Industry Association (EIA) RS-232C compatible interface and an internal modem interface. The EIA interface is required for operation with any external modem.
3. A telephone line. A telephone line is necessary, except for local attachments that use a Local

Device Controller (LDC), or when using modem eliminators.

4. A minimum processor storage (memory) size. The minimum for the 3270 DSC Feature is 256K (Model A04).
5. A workstation equipped to support the Bright Function display.
6. A B-Level system card (66-line processor card)

#### **3270 FEATURES NOT SUPPORTED BY 3270 DSC FEATURE**

The following 3270 Information Display System features and capabilities are not supported by Displaywriter the 3270 DSC feature:

- Attachment of more than one emulated display
- Binary Synchronous Communications
- Emulation of IBM 3278 Display Models 1, 3, or 5
- Loop controlled by IBM 8100 or IBM 4331 Processors
- Attachment to Local or Remote R-Loop
- Magnetic Stripe Reader
- Mono/Case Switch
- Selector Pen
- Extended Data Stream
- All IBM 3278 Keyboard Types, except 3278 87-Key EBCDIC type-writer keyboard
- Certain IBM 3278 Keys (Normal/Test Switch, Alternate Cursor, Click, Ident, Cursor Blink, Extended Function Keys, Test Request)
- Certain IBM printer capabilities (see IBM Displaywriter 3270 Emulation General Information Manual).

#### **COMMUNICATIONS ADAPTER CARD 3270 OPERATION**

The communications adapter can operate at speeds up to 9600 bits per second (bps) on a leased line and 4800 bps on a switched line. Leased and switched lines are required to operate at 1200 bps with internal (DTE) clocking.

During a SDLC session the adapter does the following things:

- Generates and recognizes flags
- Performs Cyclic Redundancy Checking (CRC)
- Performs the DMA function
- Performs zero-bit-insertion and deletion
- Performs Idle detection
- Performs Abort detection
- Performs address compare on receive
- Detects DMA overrun and underrun errors
- Detects framing errors
- Detects Clear-To-Send errors
- Detects Receive-Interrupt-Overrun

#### **3270 DSC FEATURE COMMUNICATION LINE SPEED REQUIREMENTS**

The 3270 DSC feature supports line speeds up to 9600 bps. A half speed option is also supported by this program.

#### **SYNCHRONOUS DATA LINK CONTROL**

The Displaywriter 3270 DSC feature uses SDLC for data transmission. SDLC is a discipline for serial-by-bit information transfer over a data communication channel. Transmission exchanges may be duplex or half duplex. The communication channel may be point-to-point or multipoint.

#### **SDLC TRANSMISSION FRAME**

All SDLC transmission frames have the same format. Each frame is made up of:

- A beginning flag (F) that indicates the beginning of the frame.
- An address (A) field that identifies the secondary station that is sending (or is to receive) the frame
- A control (C) field that specifies the purpose of the particular frame
- An optional information (I) field that contains information data
- A frame check sequence (FCS) field that enables the receiving station

to check the transmission accuracy of the frame

- An ending flag (F) that signals the end of the frame.

For further explanation of SDLC protocol see the IBM Systems Network Architecture Handbook Customer Service Division.

Figure 6-2 shows the SDLC transmission frame.

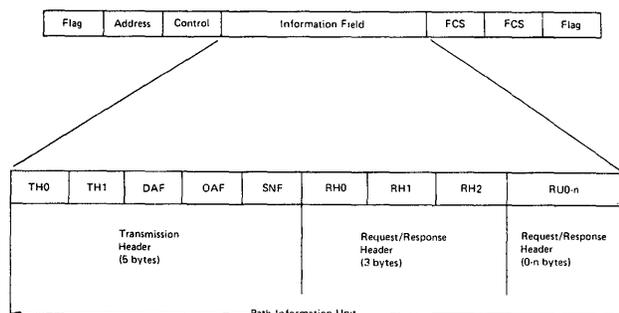


Figure 6-2. SDLC Transmission Frame

## SYSTEMS NETWORK ARCHITECTURE

3270 DSC feature communication must occur in an IBM Systems Network Architecture (SNA) environment. A Displaywriter using the 3270 DSC feature will always appear as a cluster controller supporting Physical Unit (PU) Type 2. It will use a Transmission Subsystem (TS) Profile 3 with a Format Identifier 2 (FID2) type Transmission Header, a Function Management (FM) Profile 3 (without FM headers), and a Logical Unit Type 2. Optional attached printers will appear as Logical Unit Type 1 or 3.

For a description of SNA see the IBM Systems Network Architecture Handbook Customer Service Division.

## SDLC COMMANDS SUPPORTED BY THE 3270 DSC FEATURE

In SDLC, a transmission frame that is received by a secondary station is a command. Figure 6-3 lists and describes the SDLC commands supported in 3270 DSC feature communications.

ABBREV.	COMMAND	DEFINITION
RR	Receive Ready	Supervisory polling frame valid in NRM only
RNR	Receive Not Ready	Supervisory polling frame valid in NRM only
DISC	Disconnect	Unnumbered mode setting frame that signals a logical disconnect, and if appropriate, performs a physical disconnect of the link.
SNRM	Set Normal Response Mode	Unnumbered mode setting frame that places the secondary station into NRM. Valid in both NRM and NDM.
TEST	Test	Unnumbered frame used to solicit a TEST response including an optional information field.
XID	Exchange Station Identification	Unnumbered frame used to solicit an XID response which provides station identification of the addressed secondary station. Valid in both NRM and MDM.
I-frame	Information	A numbered frame containing information data

Figure 6-3. SDLC Commands supported by 3270 DSC Feature

**SDLC RESPONSES SUPPORTED BY THE 3270 DSC FEATURE**

In SDLC, when a transmission frame is received by a primary station the

frame is a response. Figure 6-4 lists and describes the SDLC responses supported in 3270 DSC feature communications.

ABBREV.	RESPONSE NAME	DEFINITION
RR	Receive Ready	Supervisory response frame valid in NRM only
RNR	Receive Not Ready	Supervisory response frame valid in NRM only
UA	Unnumbered Acknowledgment	Unnumbered frame that signals acceptance of of SNRM or DISC command received by the secondary station
DM	Disconnected Mode	Unnumbered frame sent by the secondary station to signal that the secondary is in disconnected mode.
FRMR	Frame Reject	Unnumbered frame sent by the secondary station to signal that the secondary detected a problem in a frame received with a valid FCS. Types of FRMR supported are: Type 01. Invalid or non-implemented command received. Type 03. Invalid I-frame attached to command received. Type 08. The received (NR) sequence count is out of range.
TEST	Test	Unnumbered frame used by the secondary station to echo the primary's TEST command frame, including any attached information. Valid in both NRM and NDM.
I-frame	Information	A numbered frame containing information data
XID	Exchange Station Identification	Unnumbered frame used to respond to the secondary station's identification. Valid in both NRM and NDM.

Figure 6-4. SDLC Responses Supported by 3270 DSC Feature

**SNA COMMANDS SUPPORTED BY THE 3270 DSC FEATURE**

In SNA a command is any field set in the transmission header (TH), request

header (RH), or portions of a request unit, that initiates an action. Figure 6-5 lists and describes the SNA commands supported in 3270 DSC communication.

COMMAND ABBREV.	COMMAND NAME	DEFINITION
ACTLU	Activate Logical Unit	Requests session activation between SSCP and SLU.
ACTPU	Activate Physical Unit	Requests session activation between the SSCP and the SPU.
BID	Bid	Used by the bidder to request permission to initiate a bracket.
Bind	Bind Session	Used to activate a session between LUs.
CANCEL	Cancel	Sent by an LU to terminate a partially sent chain of FM data requests.
CHASE	Chase	Sent by the primary logical unit to be sure all outstanding responses have been received.
CLEAR	Clear	Is sent by the primary session control to reset the data traffic subtrees and FMSs in the primary, secondary and boundary function.
DACTLU	Deactivate Logical Unit	Is sent from a SSCP to a SLU to end the session.
DACTPU	Deactivate Physical Unit	Is sent to end the session between SSCP and the SPU.
Lustat	Logical Unit Status	Used by one LU to send information to its session partner.
NOTIFY	Notify	Sent after a valid ACTLU has been received or whenever a power On/Off status change.
RECFMS	Record Formatted Maintenance Statistics	This is the format of the Status Information Counters sent from a SPU to the SSCP when the SSCP requests an Error Log, or on an overflow.
REQ-DISCONT	Request Discontact	Sent by the SPU to request the host to deactivate all of the secondary SNA/SDLC sessions, and, (on a nonswitched connection only) repoll the secondary with a SHRMM command.
REQMS	Request Maintenance Statistics	Requests the SPU to transmit maintenance statistics for the resource indicated by the network address.
RTR	Ready To Receive	Sent by the secondary logical unit to notify the primary logical unit that the printer session is now ready to receive.
SDT	Start Data Traffic	Is sent by primary session control to complete a Data Traffic Recovery or initialization sequence.
SHUTC	Shutdown Complete	Sent by the secondary to indicate that it is in the shutdown state (quiesced).
SHUTD	Shutdown	Sent from the primary to request that the secondary enter the shutdown state (quiesced) as soon as convenient.
Signal	Signal	Permits an expedited signal to be sent regardless of the status of the normal flow.
Unbind	Unbind Session	Is sent from the PLU to the SLU to end a session between them.

Figure 6-5. SNA Commands Supported by 3270 DSC Feature

## SNA RESPONSES SUPPORTED BY 3270 DSC FEATURE

In SNA a response is a message unit that acknowledges receipt of a request. The response consists of a response header (RH), and sometimes a response unit (RU), or both. There are three types of SNA responses supported in 3270 DSC feature communications:

- Positive Response (+RSP)
- Negative Response (-RSP)
- Isolated Pacing Response (IRP)

IRP is used by the Primary Logical Unit and/or the Secondary Logical Unit to send a pacing response when a response to a request is not pending.

See the IBM Systems Network Architecture Handbook Customer Service Division, for a description of the Response Headers.

## 3270 OPERATIONS

This section describes how to perform basic communication tasks when using the IBM Displaywriter 3270 DSC Feature licensed program. The functions of the 3270 DSC Feature keyboard, the TASK SELECTION menu sequences, the PROGRAM DISKETTE TASK menu sequences and the 3270 DSC feature communication session are described.

This is not a complete operator's manual. If further information is needed, refer to the IBM Displaywriter 3270 Data Stream Compatibility Feature Licensed Program Feature Operator's Guide.

## KEYBOARD OPERATION

The following section describes the operation of the workstation control keys and the function keys for 3270 DSC feature mode. Also shown, is the 3270 basic keyboard layout.

## 3270 DSC FEATURE FUNCTION KEYS

The following keys are used in 3270 DSC Feature mode and function differently than in regular operating mode. The numbers in Figure 6-6 reference these keys.

- 1 PF Select. Press PF Select along with the PF keys to transfer operator input to the application program.

- 2 Save. Causes the screen to be stored in a document on a diskette.
- 3 System Request (ALT + ATTN). Tells the application code that the Displaywriter 3270 DSC feature operator wants to establish or end a session with the application program.
- 4 Attention (ATTN). Tells the host program that the 3270 DSC feature wants to send something. This is accomplished by sending the host a SNA command.
- 5 Cursor Select (CURSR SEL). Used to select fields as an alternative to Selector Pen.
- 6 Clear (ALT + CURSR SEL). Erases the screen and notifies the application program.
- 7 Erase End of Field (ERASE EOF). Erases from the cursor location to the end of the field.
- 8 Erase input (ALT + ERASE EOF). Erases all unprotected data on the screen.
- 9 Print. Used to print the screen.
- 10-21 Program Function. Pressed along with PF Select to transfer operator input to the application program for processing.
- 22 Back Tab. Moves the cursor back to the beginning of the current or previous unprotected field.
- 23 Insert Key. Allows characters to be inserted at the current cursor position.
- 24 Delete. Deletes the character at the current cursor position.
- 25-31 Program Function. Pressed along with PF Select, transfers operator input to the application program for processing.
- 32 Duplicate (DUP). Used to duplicate information in a field.
- 33 Field Mark. Used on an unformatted screen to define the end of a field.

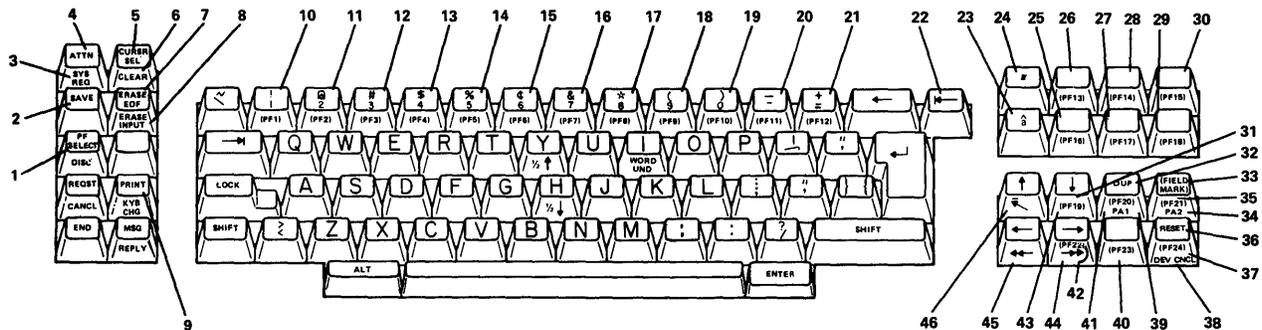


Figure 6-6. 3270 DSC Feature Basic Keyboard

- |   |  |
|---|--|
| <p><b>34</b> Program Access 2 (PA2). Tells the application program that PA2 has been pressed.</p> <p><b>35</b> Program Function. Pressed along with PF select, transfers operator input to the application program for processing.</p> <p><b>36</b> Reset. Restores the keyboard after input inhibited, or to end Insert Mode.</p> <p><b>37</b> Program Function 24 (PF24). Pressed along with PF Select, transfers operator input to the application program for processing.</p> <p><b>38</b> Device Cancel. Cancels an unsuccessful Save or print operation.</p> <p><b>39-40</b> Program Function. Pressed along with PF select, transfers operator input to the application program for processing.</p> <p><b>41</b> Program Access 1 (PA1). Tells the application program that PA1 has been pressed.</p> <p><b>42-43</b> Program Function. pressed along with PF select, transfers operator input to the application program for processing.</p> <p><b>44</b> Cursor Right Double Speed. Moves the cursor to the right two locations at a time.</p> | <p><b>45</b> Cursor Left Double Speed. Moves the cursor to the left two spaces at a time.</p> <p><b>46</b> Home. Moves the cursor to the first unprotected location in the display buffer.</p> |
|---|--|

**3270 DSC FEATURE OPERATING MODE**

Perform the following steps to enter the 3270 DSC Feature Mode:

1. Turn Displaywriter power ON.
2. Load Volume 01 of Textpack 4 program diskette; the TASK SELECTION menu displays.
3. Remove the Textpack 4 diskette when the TASK SELECTION menu displays. (Omit this step if you have combined the Textpack 4 and 3270 DSC Feature diskettes on a dual density diskette.)
4. Select Feature Tasks from the TASK SELECTION menu. See Figure 6-7.
5. When Insert desired feature diskette; press ENTER: prompts, insert the 3270 DSC Feature diskette, and press ENTER.

The TASK SELECTION menu is replaced by a screen with a 4 in the system connection field followed by a communication check message. See Figure 6-8.



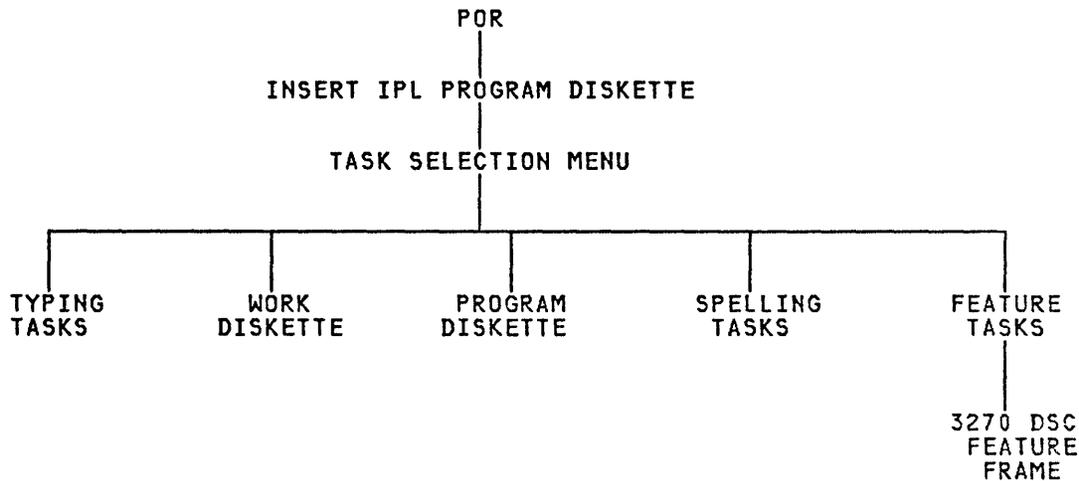


Figure 6-9. 3270 Feature Task Menu Sequence

### 3270 DSC Operator Information Line

The 3270 DSC Operator Information Line (Figure 6-10) appears at the bottom of the blank screen in 3270 DSC mode.

The first three fields (ABC) in the Operator Information Line are the System Connection Indicators. These indicators describe the status of the Displaywriter with the host.

The next field (D) in the Operator Information Line displays the Reminders and Input Inhibited messages. When messages appear in this field, input is inhibited. The messages explain what operator action can be taken to reset the keyboard.

Field (E) is the Numeric Lock Indicator. When this indicator is on, it indicates that numeric lock is active.

Field (F) is the Insert Mode Indicator. When this indicator is on, the display is in insert mode.

Field (G) is the Printer Connection Indicator. This indicator shows if the printer is connected and indicates if screen print is authorized.

Figure 6-11 describes all the fields in the Operator Information Line, and all the symbols or messages that can appear in those fields.

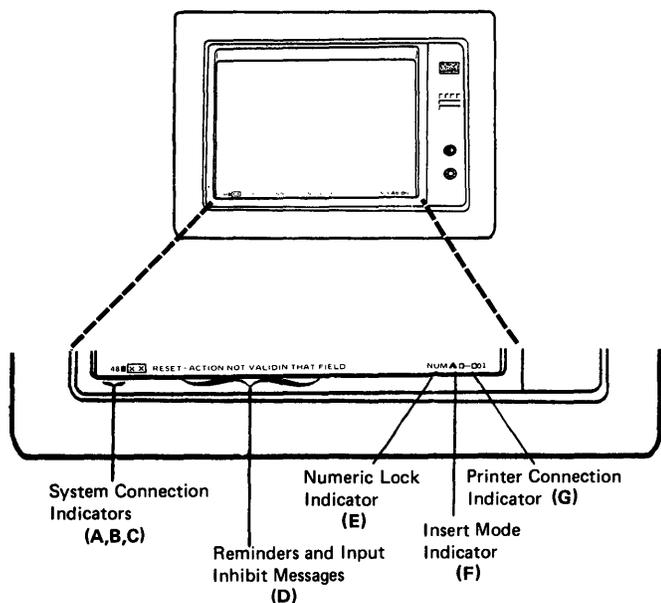


Figure 6-10. 3270 DSC Feature Operator Information Line

Field	Symbol or Message	Definition
A	<u>4</u>	Displaywriter is in 3270 DSC Feature mode.
B	<u>B</u>	Command sequence has been completed for the display session.
	(blank)	Command sequence has not been completed for the display session
C	(blank)	Displaywriter is not communicating with a host.
	?	Displaywriter is communicating with the host but is not using a host program.
	Ψ	The display is connected to the control program system operator.
	■	The display is connected to your application program job.
ABC	=> (Blinking)	Displaywriter message is waiting. Press MSG key.
D	3270 Operator Messages	Reference the IBM 3270 DSC Feature Operator's Guide.
E	NUM	Indicates that numeric lock is active.
F	^	Indicates the display is in insert mode
G	(blank)	Screen print not authorized.
	□-□	Indicates screen print not authorized.
	□-■	Indicates screen is printing.

Figure 6-11. 3270 DSC Feature Operator Information Line Symbols and Messages.

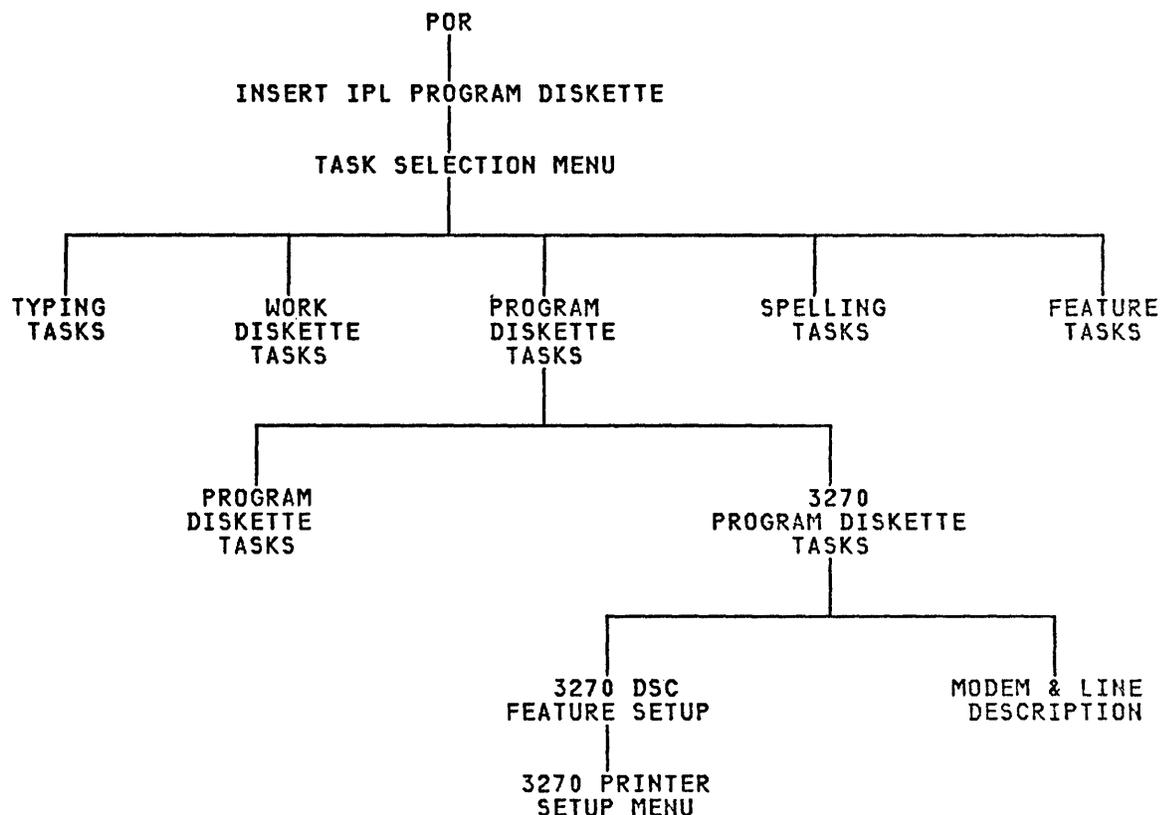


Figure 6-12. 3270 Program Diskette Tasks Menu Sequence

#### ACCESSING THE 3270 DSC FEATURE PROGRAM DISKETTE TASKS

The menu sequence used to access the 3270 DSC Feature Program Diskette Tasks is shown in Figure 6-12.

#### TERMINATING THE 3270 TASK

Press the END key to end the 3270 Feature DSC session normally. The task will end immediately if a LU to LU session is not active. RESET or END will display if an LU to LU session is active (the operator has not logged off). In this case you must press END a second time to end the task and return to the TASK SELECTION menu.

The DISC key causes an immediate end to communications with the host. You must still press END to end the task. DISC should be used only as advised by the communication network coordinator.

#### CREATING OR REVISING THE 3270 SETUP

The 3270 communication setup is defined to interface specifically with the individual host. To create or revise the communication setup, choose **Create or Revise Setup** from the 3270 PROGRAM DISKETTE TASKS. The 3270 CREATE OR REVISE menu appears (Figure 6-13).

None. Neither Screen Print operations or Host printer sessions allowed.

Chg Setup PROGDS			
CREATE OR REVISE SETUP			
ID	ITEM	YOUR CHOICE	POSSIBLE CHOICES
a	Physical Unit ID	00000	
b	Keyboard ID		1 - 999
c	Data Trace Feature	1	1 = Short      2 = Long
d	Numeric Lock	2	1 = Yes      2 = No
e	3270 Printer Use	3	1 = Screen Print 2 = Host 3 = Screen Print and Host 4 = None

When finished with this menu, press ENTER.

Type ID letter to choose ITEM; press ENTER: #

Figure 6-13. 3270 CREATE OR REVISE SETUP Menu

Options on this menu are:

- **Physical Unit ID.** A special code that identifies the 3270 DSC Feature Displaywriter to the host. The ID is supplied by the system programmer.
- **Keyboard ID.** Specifies the keyboard layout active when in 3270 DSC Feature mode and the 3270 character set to be used.
- **Data Trace Feature.** Specifies the amount of transmission data that is to be saved for diagnostic purposes. The short form records more PIUs but some will be abbreviated. The long form records fewer PIUs but none are abbreviated. The amount is supplied by the system programmer.
- **Numeric Lock.** Determines whether or not input is inhibited if you key in a character other than a number, a minus sign, or a decimal point in a display field specified as Numeric Only by the host application programmer.
- **3270 Printer Use.** Specifies which one of the following four 3270 printer support modes will be in effect during the 3270 DSC task:

**Screen Print.** Operator- or host-initiated printing of the display screen via the Print key or a write command.

**Host.** Only host applications initiating remote (LU1 or LU3) sessions with the 3270 DSC printer allowed.

**Screen Print and Host.** Both Screen Print operations and Host printer sessions allowed.

### 3270 DATA STREAM COMPATIBILITY FEATURE MODEM AND LINE DESCRIPTION

The 3270 DSC Feature Modem and Line Description is setup to interface specifically with the individual host. To create or revise the Modem and Line Description choose Create or Revise Modem and Line Description from the 3270 PROGRAM DISKETTE TASKS menu. The 3270 MODEM AND LINE DESCRIPTION menu appears (Figure 6-14).

Chg Description PROGDS			
MODEM AND LINE DESCRIPTION			
ID	ITEM	YOUR CHOICE	POSSIBLE CHOICES
a	Modem Port	1	1 = Port 4      2 = Port 4A 3 = Port 4B
b	Network Facility	1	1 = Switched      2 = Dedicated 3 = Switched Backup
c	SDLC Link Address		
d	Continuous Carrier	2	1 = Yes (Dedicated only)      2 = No
e	Bit Clocking	2	1 = Business Machine Clock 2 = Modem Clock
f	Half Speed	2	1 = Yes      2 = No
g	NRZI Encoding	2	1 = Yes      2 = No
h	Answer Tone Generation	2	1 = Yes (Switched only)      2 = No
i	End With REQDISCONT	2	1 = Yes      2 = No

When finished with this menu, press ENTER.

Type ID letter to choose ITEM; press ENTER: #

Figure 6-14. 3270 MODEM AND LINE DESCRIPTION Menu

The system programmer uses the IBM Displaywriter System 3270 DSC Feature Host Attach Programming Guide to obtain the information to setup the modem and line description.

### Communication System Error Messages

The SNA/SDLC protocol errors are presented to the 3270 operator in the form of numbers displayed on the Operator Information Line. These errors also cause the keyboard to lock. The communication system error messages may be referenced in the IBM 3270 Data Stream Compatibility Feature Operator's Guide.

### Program Check Error Messages

Program check error messages are displayed to the 3270 operator on the Operator Information Line in numeric





LINK STATUS	3270 STATUS MESSAGE
DTR Off	(blank)
DTR On and DSR Off	READY
DTR and DSR On	CONNECTED
SDLC Link Active	ON-LINE (See Note 1)
SNA Session Active	SESSION (See Note 2)

**Notes**

1. Indicates after an SDLC link has been established in the Normal Response Mode (NRM).
2. Indicated that a successful BIND of the Logical Unit (LU) has occurred.

Figure 6-18. 3270 Link Status Field Messages



## CHAPTER 7. ELECTRONIC DOCUMENT DISTRIBUTION

### EDD OVERVIEW

The Electronic Document Distribution (EDD) communications feature is a batch-oriented, foreground application. The Displaywriter with the EDD feature supports communications at speeds up to 9600 bps (4800 bps over switched lines).

With EDD, Displaywriter is compatible with the IBM Distributed Office Support System Program Product (DISOSS), and other Displaywriters. The Displaywriter will also communicate with other products that use DCA Level 2 or 3 text and records data streams, the Document Interchange Architecture (DIA) and Converged SNA LU Type 6 protocols.

### EDD OPERATING MODES

EDD supports three operating modes:

- Document Distribution. Provides the Displaywriter with the capability to distribute documents to network terminals, to obtain documents distributed to it from other terminals, to obtain distribution information, and to cancel delivery of documents.

This mode also enables the user to change the Sign\_On or personal document passwords stored in the distribution node. An automatic "obtain all" option and option menus are used to obtain non-personal, personal, and status documents.

- Document Distribution plus Library Services. Provides the Displaywriter with the capability of distributing documents from diskette or library, filing a document or document profile in the library, obtaining documents from other terminals or the library, to obtain distribution information, and deleting documents stored in the library.

This mode also has the ability to perform a library search, cancel document delivery, and to remotely change Sign\_On or personal document passwords in the distribution node.

- Document Exchange. Provides the capability to exchange documents and messages with another Displaywriter or any other compat-

ible terminal which supports EDD protocols and data streams.

A queue consisting of up to 20 documents or commands is provided for all modes. The queue can be set up or modified prior to establishing the communication link or while online.

The queue and associated session options can be temporarily saved on the EDD program diskette to allow the operator to return to another foreground task. The queue and session options will automatically be reinstated when the EDD task is accessed.

All documents are sent from the diskette or the library and received documents are recorded on a diskette. An option allowing the operator to queue the documents to print can be used after receiving the documents.

### EDD EQUIPMENT REQUIREMENTS

The necessary equipment to operate EDD, besides the EDD licensed program, is listed below.

1. 320K processor storage (memory) size (Model A06/B06)
2. Single Diskette Drive
3. Communications Adapter.

### EDD ADAPTER CARD OPERATIONS

The communications adapter card can operate at speeds up 9600 bits per second on a leased line. During a SDLC session the adapter does the following things:

- Generates and recognizes flags
- Performs Cyclic Redundancy Checking (CRC)
- Performs the DMA function
- Performs zero-bit-insertion and deletion
- Performs Idle detection
- Performs Abort detection
- Performs address compare on receive
- Detects DMA overrun and underrun errors
- Detects framing errors

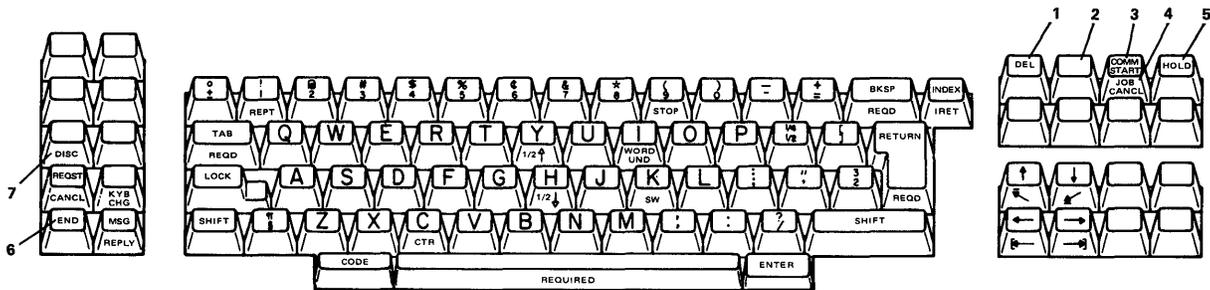


Figure 7-1. EDD Basic Keyboard

- Detects Clear-to-Send errors
- Detects Receive Interrupt Overrun.

### EDD OPERATIONS

This section describes how to perform basic communication tasks when using the IBM Displaywriter EDD licensed program. The functions of the EDD keyboard, the TASK SELECTION menu sequences, the PROGRAM DISKETTE TASK menu sequences and the EDD communication session are described.

This is not a complete operator's manual. If further information is needed, refer to the IBM Displaywriter System Electronic Document Distribution Operator Reference Guide.

### KEYBOARD OPERATION

The following section describes the operation of the work station control keys and the function keys for EDD mode. Also shown, is the EDD basic keyboard layout.

### EDD FUNCTION KEYS

The following keys are used in EDD mode and function differently than in regular operating mode. The numbers in Figure 7-1 reference these keys.

- 1 Delete (DEL). Used only in Command Queue menu processing.

- 2 Move. Used only in Command Queue menu processing.
- 3 Communication Start. Used to start an EDD session or to restart a suspended EDD session.
- 4 Job Cancel (JOB CANCL). Only valid when SESSION is displayed in the Link Status Field and the Transmission Indicator Field contains either SEND or RECEIVE. The current send or receive document will be terminated.
- 5 Hold (HOLD). Used to suspend an EDD session. Valid only when SESSION is displayed in the link status field.
- 6 End (END). Used to end a foreground task.
- 7 Disconnect (DISC). Used to begin termination of an EDD session. Session terminates when the current sending command completes. If pressed again during termination, the local terminal disconnects and drops DTR.

### TASK SELECTION MENU SEQUENCES

Perform the following steps to enter the EDD Mode:

1. Turn Displaywriter power ON.
2. Load Volume 01 of Textpack 4 or 6 program diskette; the TASK SELECTION menu displays.



## ESTABLISHING AN EDD SESSION

All EDD sessions are established by the operator pressing the Comm Start key while the EDD SESSION SUMMARY menu is displayed.

For leased line sessions, pressing the Comm Start key is the only action required. If the communication link fails the message **Unsuccessful link establishment**. Press **COMM START** to retry. (C13) will be displayed.

For switched line sessions, pressing Comm Start will cause "READY" to be displayed in the Link Status subfield of the SESSION SUMMARY menu. At this time the operator may dial the remote station or answer incoming calls from the remote station. If auto answer is supported by the modem, incoming calls will be answered without operator intervention.

## ESTABLISHING AN X.21 EDD SESSION

In an X.21 environment, when the operator presses Comm Start and the network is available, the operator is prompted to press Call or Direct Call.

If Call is pressed, the operator will see the following prompt: **Type network request; press ENTER:** (if a default number or request is available, the number or request will be displayed). After ENTER has been pressed the X.21 network is requested to establish the session.

If Direct Call is pressed, the X.21 network is requested to establish the session without the operator intervention.

For both X.21 modes, a message **Network Problem: Timeout ZZ** will be displayed if the call request is unsuccessful.

## TERMINATING A SESSION

EDD sessions may be terminated by the operator or the system.

The operator terminates the session by pressing the DISCONNECT key. SESSION is displayed blinking in the Link Status Field until a command boundary is reached, then the session terminates and the Link Status Field is blanked. The operator then presses the END key to display the Setup Selection Menu.

The Displaywriter terminates the session when any of the following conditions occur:

In unattended mode on a switched line, neither partner has any more

to send or an SNA or SDLC timeout occurs.

The remote station disconnects.

The modem drops Data Set Ready.

An unrecoverable error occurs.

## PROGRAM DISKETTE TASKS

Document Distribution Program Diskette tasks are used by the operator to create or revise communication setups, modem and line descriptions, and distribution lists.

Perform the following steps to enter the EDD program diskette tasks:

1. Turn Displaywriter power ON.
2. Load Volume 01 of Textpack 4 or 6 program diskette; the TASK SELECTION menu displays.
3. Remove the Textpack 4 or 6 diskette when the TASK SELECTION menu displays. (Omit this step if you have combined the Textpack and EDD diskettes on a dual density diskette.)
4. Select Program Diskette Tasks from the TASK SELECTION menu. (See Figure 7-3.)
5. Insert the EDD feature diskette and press enter.
6. The DOCUMENT DISTRIBUTION PROGRAM DISKETTE TASKS menu (Figure 7-6) will be displayed. From this menu the operator can select options to create or revise EDD setups, modem and line descriptions, or distribution lists.

The menu sequence to access the EDD program diskette tasks is shown in Figure 7-7.

PROGDS	KEY
DOCUMENT DISTRIBUTION PROGRAM DISKETTE TASKS	
ID	ITEM
a	Create or Revise Communication Setup
b	Create or Revise Modem or Line Description
c	Create or Revise Stored Distribution List
d	Duplicate Machine Setup
e	Duplicate Program Diskette
f	Erase Program Diskette
g	Go to Task Selection

Type ID letter to choose ITEM; press ENTER: #

Figure 7-6. EDD PROGRAM DISKETTE TASKS SELECTION Menu

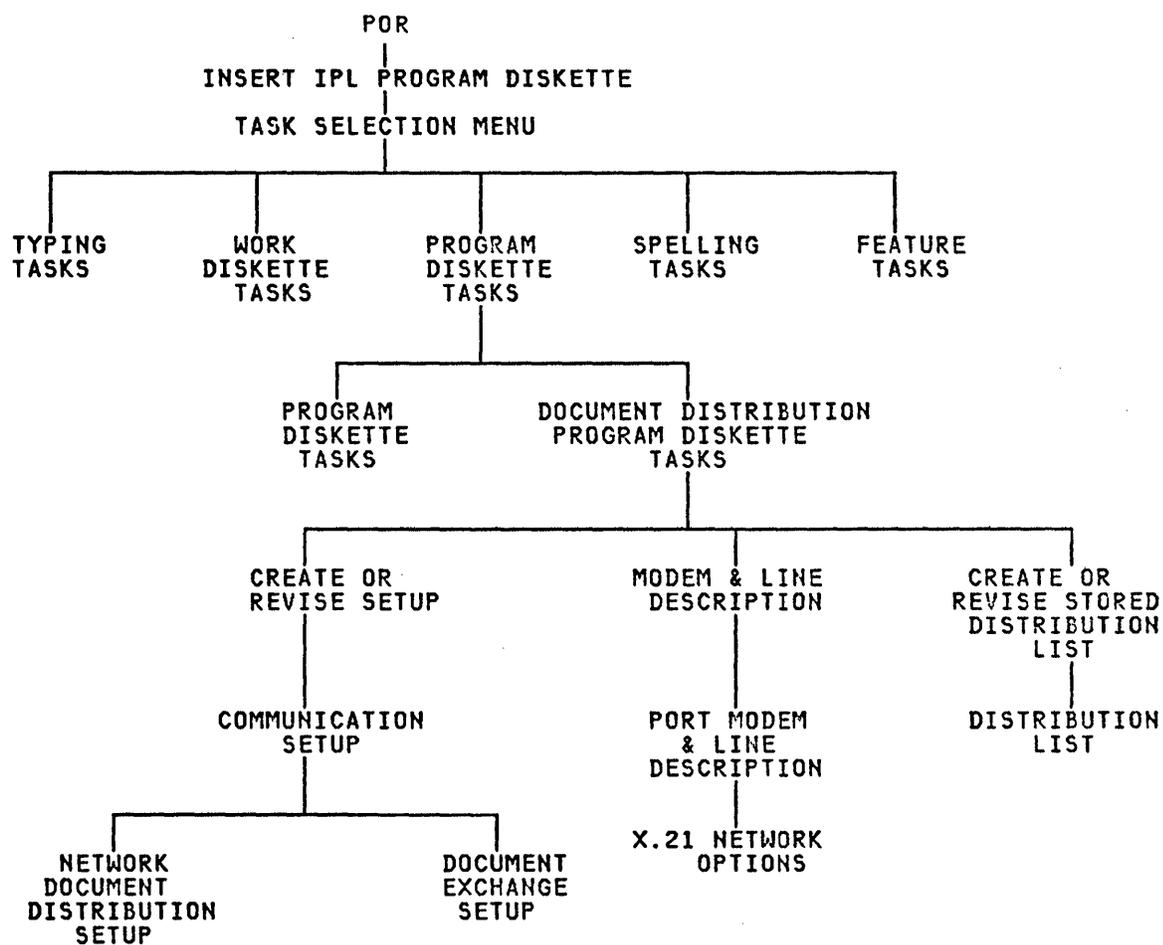


Figure 7-7. EDD Program Diskette Menu Sequence



## SDLC Transmission Frame

All SDLC transmission frames have the same format. Each frame is made up of:

- A beginning flag (F) that indicates the beginning of the frame.
- An address (A) field that identifies the secondary station that is sending (or is to receive) the frame
- A control (C) field that specifies the purpose of the particular frame
- An optional information (I) field that contains information data
- A frame check sequence (FC) field that enables the receiving station to check the transmission accuracy of the frame
- An ending flag (F) that signals the end of the frame.

Figure 7-10 shows the SDLC transmission frame.

For further explanation of SDLC protocol see the IBM Systems Network Architecture Handbook Customer Service Division.

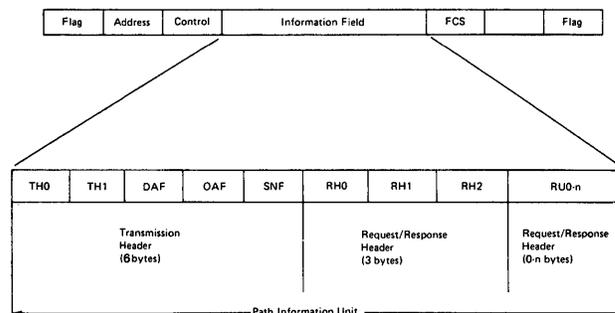


Figure 7-10. SDLC Transmission Frame

### SDLC Commands Supported by EDD

In SDLC, a transmission frame that is received by a secondary station is a

command. Figure 7-11 lists and describes the SDLC commands supported in EDD communications.

ABBREV.	COMMAND	DEFINITION
RR	Receive Ready	Supervisory polling frame valid in NRM only
RNR	Receive Not Ready	Supervisory polling frame valid in NRM only
DISC	Disconnect	Unnumbered mode setting frame that signals a logical disconnect, and if appropriate, performs a physical disconnect of the link.
SNRM	Set Normal Response Mode	Unnumbered mode setting frame that places the secondary station into NRM. Valid in both NRM and NDM.
TEST	Test	Unnumbered frame used to solicit a TEST response including an optional information field.
XID	Exchange Station Identification	Unnumbered frame used to solicit an XID response which provides station identification of the addressed secondary station. Valid in both NRM and NDM.
I-frame	Information	A numbered frame containing information data

Figure 7-11. SDLC Commands supported by EDD

**SDLC Responses Supported by EDD**

In SDLC, when a transmission frame is received by a primary station the

frame is a response. Figure 7-12 lists and describes the SDLC responses supported in EDD communications.

ABBREV.	RESPONSE NAME	DEFINITION
RR	Receive Ready	Supervisory response frame valid in NRM only
RHR	Receive Not Ready	Supervisory response frame valid in NRM only
UA	Unnumbered Acknowledgment	Unnumbered frame that signals acceptance of of SNRM or DISC command received by the secondary station
DM	Disconnected Mode	Unnumbered frame sent by the secondary station to signal that the secondary is in disconnected mode.
FRMR	Frame Reject	Unnumbered frame sent by the secondary station to signal that the secondary detected a problem in a frame received with a valid FCS. Types of FRMR supported are: Type 01. Invalid or non-implemented command received. Type 03. Invalid I-frame attached to command received. Type 08. The received (NR) sequence count is out of range.
TEST	Test	Unnumbered frame used by the secondary station to echo the primary's TEST command frame, including any attached information. Valid in both NRM and NDM.
I-frame	Information	A numbered frame containing information data
XID	Exchange Station Identification	Unnumbered frame used to respond to the secondary station's identification. Valid in both NRM and NDM.

Figure 7-12. SDLC Responses Supported by EDD

**SYSTEMS NETWORK ARCHITECTURE**

A Displaywriter operating with EDD uses the Converged LU (LU\_C) subset of IBM Systems Network Architecture to support communications between two DIA processes. The Displaywriter will appear as a Logical Unit (LU) 6 and a Converged Physical Unit Type 2.1. Printers attached to the Displaywriter

appears as Converged Physical Units Type 4 and 5. In a LU-LU session the Displaywriter using the EDD feature will use a Function Manager Profile 19 and a Transmission Subsystem Profile 7.

For a description of SNA see the IBM Systems Network Architecture Handbook Customer Service Division.

COMMAND ABBREV.	COMMAND NAME	DEFINITION
ACTLU	Activate Logical Unit	Requests session activation between SSCP and SLU
ACTPU	Activate Physical Unit	Requests session activation between the SSCP and the SPU.
BIS	Bracket Initiation Stopped	Used to indicate that a half session has no intention of initiating a new bracket.
Bind	Bind Session	Used to activate a session between LUs.
CINIT	Control Initiate	Used by the SSCP to request the PLU to activate, via the bind command, an LU session with a SLU.
INIT-SELF	Initiate-Self	Sent to request the SSCP to authorize and assist in the initiation of a LU-LU session.
DACTLU	Deactivate Logical Unit	Is sent from a SSCP to a SLU to end the session.
DACTPU	Deactivate Physical Unit	Is sent to end the session between SSCP and the SPU.
Lustat	Logical Unit Status	Used by one LU to send information to its session partner.
NOTIFY	Notify	Used to send session status from SSCP to SLU
REQ-DISCONT	Request Discontact	Sent by the SPU to request the host to deactivate all of the secondary SNA/SDLC sessions, and, (on a nonswitched connection only) repoll the secondary with a SNRM command.
RECFMS (Type0)	Record Formatted Maintenance Statistics	Provides the mechanism for reporting maintenance statistics between products.
RTR	Ready To Receive	Sent by first speaker to indicate that bidder is now allowed to initiate a bracket.
Signal	Signal	Permits an expedited signal to be sent regardless of the status of the normal flow.
Unbind	Unbind Session	Is sent from the PLU to the SLU to end a session between them.

Figure 7-13. SNA Commands Supported by EDD

## SNA Responses Supported by EDD

In SNA a response is a message unit that acknowledges receipt of a request. It consists of a response header (RH), and sometimes a response unit (RU). There are three types of SNA responses supported in EDD communication:

- Positive Response (+RSP)
- Negative Response (-RSP)
- Isolated Pacing Response (IPR).

IPR is used by the Primary Logical Unit and/or the Secondary Logical Unit to send a pacing response indicator when a response to a request is not pending.

See the IBM Systems Network Architecture Handbook Customer Service Division, for a description of the Response Headers.

## SNA Sense Codes

The Displaywriter EDD feature will return the following sense codes as device specific (user) data:

### FMH7 Responses.

X'10086006' unrecognized command code  
X'10086021' unsupported TPN  
X'10086031' unsupported PIP  
X'10086034' conversation type mismatch  
X'10086041' unsupported sync check point  
X'10086042' unsupported restart level

### Unbind Responses.

X'1008200E' invalid concatenation indicator  
X'10084001' invalid FMH type  
X'10084002' inactivity timeout  
X'10086000' FMH length not correct  
X'10086009' invalid fixed parameter length  
X'10086040' invalid sync check point level

## DIA CHARACTERISTICS

Three basic modes of DIA processes are supported by Displaywriter:

- Document Exchange
- Document Distribution
- Document Distribution plus Library Services

The following support rules apply to all DIA processes:

- Only Function Sets Two, Five, Seven, Eight, and Ten are supported.
- The DIU ID for Displaywriter is always X'6580'. Format Two is the only supported DIU ID.
- Recovery is supported at the DIU level only.
- Encryption is not supported.
- Commands and operands other than Format One will cause the command in the DIU to be rejected.
- Only Type One and Two DIU suffixes are supported.
- Displaywriter supports the receipt of back-to-back DIUs only in the case where the first DIU contains an NRR command. The NRR commands supported are SIGN\_ON, ACKNOWLEDGE and SIGN\_OFF.
- Optional operands not supported by Displaywriter are not processed.

The Displaywriter supports the interchange of three types of documents.

- Final Form (L2DCA)
- Revisable Form Text (L3DCA)
- WP Information Files (Records)

## DIA Commands

The IBM Displaywriter EDD feature supports the following DIA commands:

Document Distribution and Document Distribution plus Library Services Modes

- Sign\_On
- Request\_Distribution
- Obtain
- List
- Set\_Control\_Value
- Cancel\_Distribution
- Acknowledge
- Sign\_off
- Deliver

Document Distribution plus Library Services Mode

- Retrieve

- Delete
- File
- Search

Document Exchange Mode

- Sign\_On
- Deliver
- Acknowledge
- Sign\_Off

## CHAPTER 8. 3270 DSC AND EDD COMMUNICATIONS DIAGNOSTICS

**Note:** Since 3270 DSC and EDD diagnostics are interchangeable, both are covered in this chapter. The term EDD should be substituted for 3270 when running EDD diagnostics. All displays used in the chapter are for 3270 DSC diagnostics and will be replaced with EDD displays when EDD diagnostics are used.

### INTRODUCTION

The communications diagnostic support package for the IBM Displaywriter System consists of:

- Loadable Diagnostics
- Maintenance Analysis Procedures (MAPs)
- Online Diagnostics
- Customer Loadable Diagnostics
- Customer Link Analysis Utilities
- Communication Link Analysis Guide.

**Note:** This section contains display formats and printed outputs that should be considered as samples only.

### MDIS

The MDIs are test units and directions for service action that operate when selected. The first test unit requests the input of a Communication ID which describes the hardware configuration.

These MDIs test the communication components within the Displaywriter and the external components such as the external EIA and LDC cables.

The chart in Figure 8-1 lists the Communication IDs for different hardware configurations. The MDIs check whether the communication adapter card is located in the electronics module or the diskette unit. When the diagnostic controller has determined the configuration of the communication features, a set of test units operate automatically to test the function of these particular features.

### MDI OPERATIONS

The communication MDIs are on the ABC diagnostic diskette. Before this diskette can be loaded, the MDI supervisor must first be loaded from the Displaywriter system diagnostic diskette. An interface to the MDIs is provided through the keyboard and display.

Follow these steps to run the MDIs.

1. Insert the Displaywriter system diagnostic diskette. The program loads and the FUNCTION SELECTION menu displays.
2. Select MDIs from the FUNCTION SELECTION menu. The DEVICE SELECTION menu displays.
3. Select Communications from the DEVICE SELECTION menu and press ENTER.
4. Insert the Displaywriter System ABC diagnostics diskette and press ENTER.

If a single diskette drive system is used, the Displaywriter system diagnostics diskette must be removed and the Displaywriter ABC diagnostic diskette inserted.

If a dual diskette drive is used, the ABC diskette may be inserted in the right drive. A flowchart for Displaywriter System Diagnostics and Displaywriter System Communications Diagnostics is shown in Figure 8-2.

For further information on MDI operation, refer to the IBM Displaywriter System Product Support Manual.

The Displaywriter is also equipped with a feature known as RESUME that can be used as a marker, or stopping point, while running the MDIs. RESUME can be used in two ways:

- Automatic RESUME is written into the MDIs. When an automatic RESUME occurs, a prompt occurs.
- Optional or real time RESUME is entered by keying the letter 'r' at any MDI stopping point. When in 'Step' mode, an optional RESUME can be placed at any point within the MDIs. Once the RESUME has been entered, either power off the Displaywriter, or press END to return to the FUNCTION SELECTION menu. To return to the RESUME point, access the FUNCTION

ID	COMMUNICATIONS CONFIGURATION
a	Port 4: Communications Adapter EIA port Electronics Module EIA
d	Port 4a: Communications Adapter EIA port Port 4b: Local Device Controller
e	Port 4a: Communications Adapter EIA port Port 4b: X.21 switched line
f	Port 4a: Communications Adapter EIA port Port 4b: X.21 leased line
g	Port 4a: Communications Adapter EIA port Port 4b: 38LS modem for switched line
h	Port 4a: Communications Adapter EIA port Port 4b: 38LS modem for nonswitched line with SNBU
i	Port 4a: Communications Adapter EIA port Port 4b: 38LS modem for nonswitched line
m	Port 4a: Communications Adapter EIA port Port 4b: EIA Adapter Card EIA port
p	Port 4b: Local Device Controller
q	Port 4b: X.21 switched line
r	Port 4b: X.21 leased line
s	Port 4b: 38LS modem for switched line
t	Port 4b: 38LS modem for nonswitched line with SNBU
u	Port 4b: 38LS modem for nonswitched line
z	Communications tests inhibited

Figure 8-1. Communications ID Chart

SELECTION menu and select MDIs.  
From this menu, the RESUME option  
is taken by pressing ENTER.

Pressing END or CANCEL at this  
point will erase the optional  
RESUME.

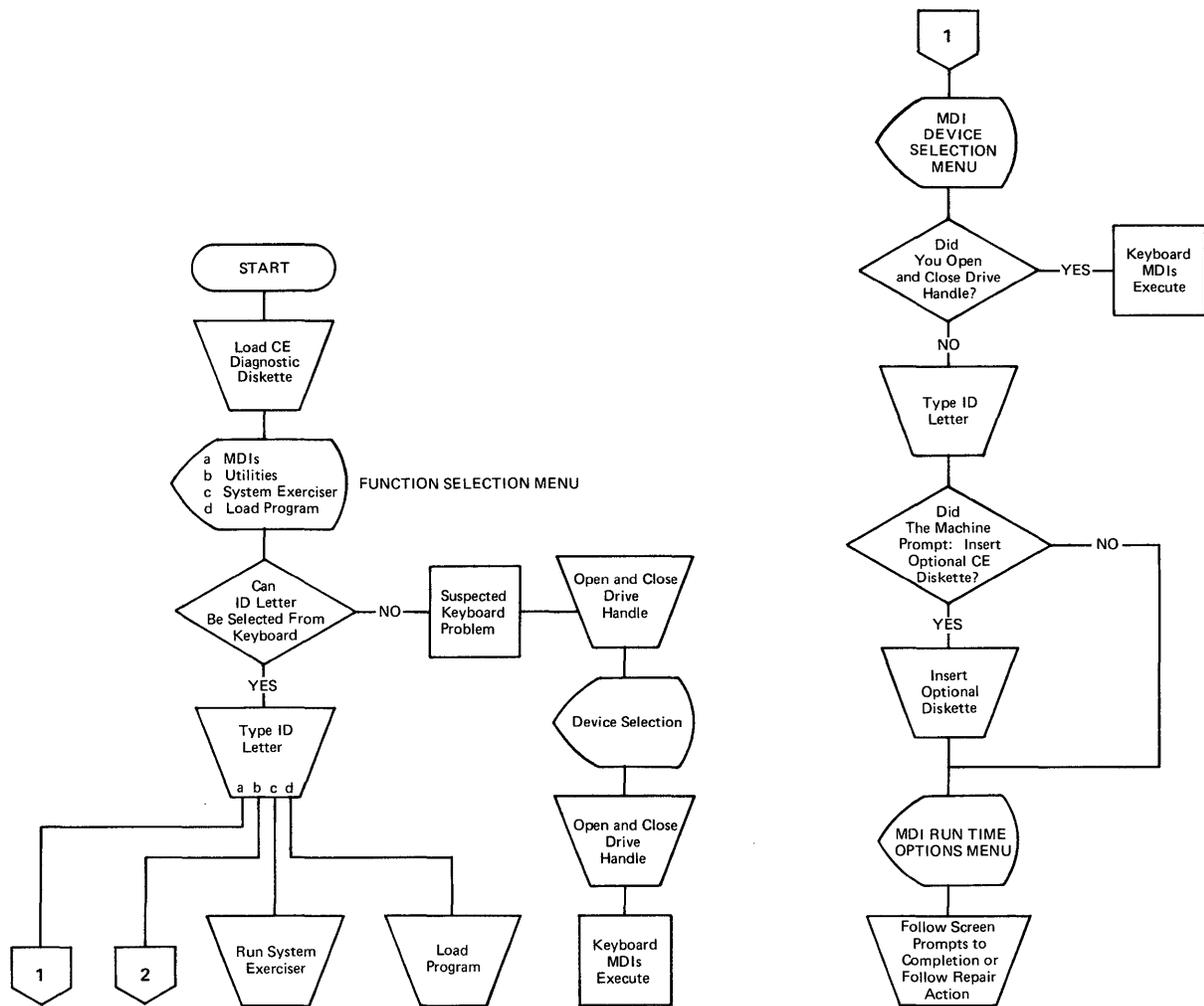


Figure 8-2 (Part 1 of 2). Loadable Diagnostics

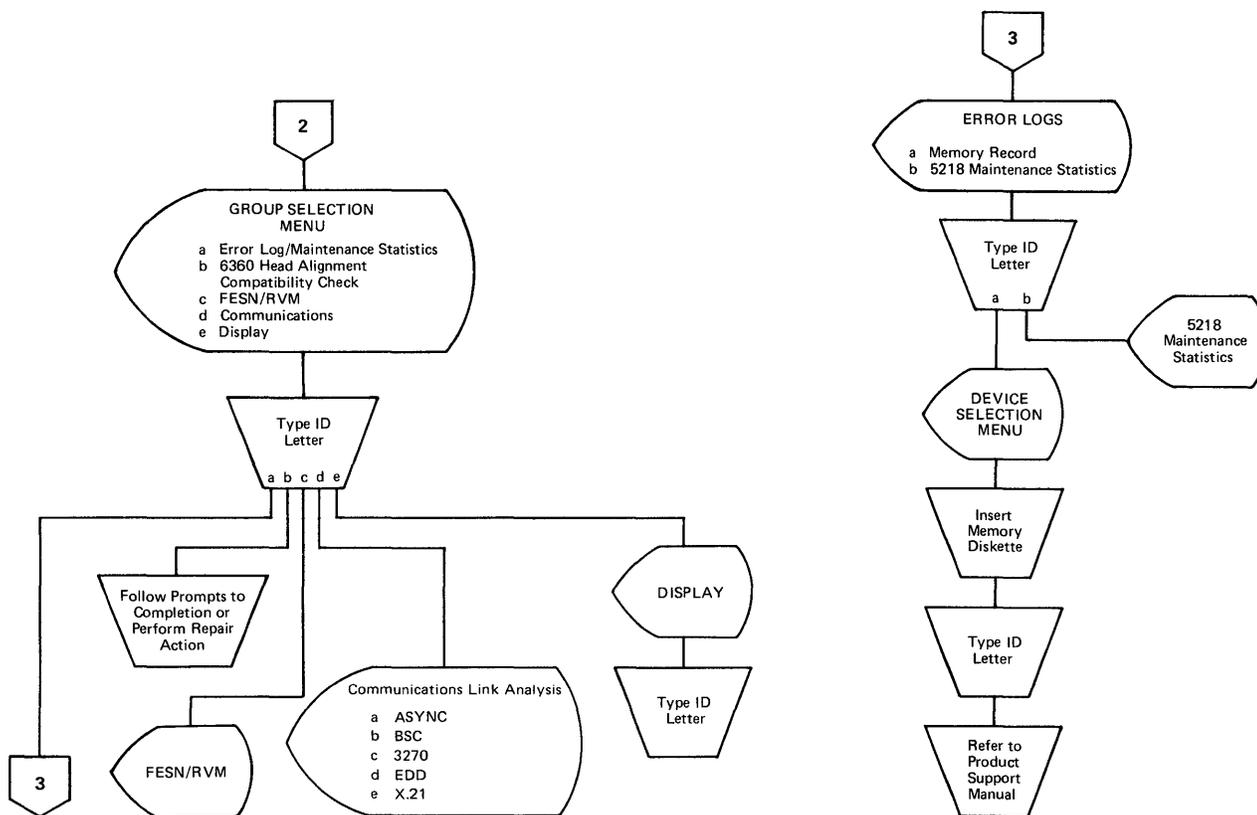


Figure 8-2 (Part 2 of 2). Loadable Diagnostics

### 3270 DSC LINK ANALYSIS UTILITIES

There are several 3270 Communication Link Analysis Utilities that aid in network problem determination. These utilities are used to test and exercise the modem, the communications adapter, and the link. The 3270 DSC feature utilities are:

- **Send Continuous Data.** Used to continuously transmit known data on the link.
- **Receive Continuous Data.** Used to receive a continuous known data pattern, detect errors in the pattern, and log the error.
- **Measure RTS/CTS Delay.** Used to measure the delay from the time RTS is made active to the time CTS becomes active.
- **Select Switched Network Backup/Half Speed.** Used to select switched network backup and half speed operating modes.
- **Control Modem Interface.** Used to control and display the EIA interface.
- **Display Error Log.** Used to format and display the SDLC or the 3270 error log data.
- **Display PIU Trace.** Used to format and display the PIU Trace Data.
- **Change Link Description.** Used to define the SDLC environment.

- SDLC Exerciser. Used by to host to exercise the Displaywriter.
- Display SDLC Trace. Used to format and display SDLC trace data.
- Wrap Modem. Used to test modems which support a wrap capability.

#### ACCESSING THE 3270 LINK ANALYSIS UTILITIES

In most cases, you must follow a setup procedure for an individual utility before it will execute. The steps to access the utilities are as follows:

1. Power ON.
2. Load the diagnostic diskette.
3. Select **Utilities** from the FUNCTION SELECTION menu.
4. Select **Communications** from the UTILITY GROUP SELECTION menu.
5. Load the ABC diagnostic diskette.
6. Select **3270 DSC** from the COMMUNICATIONS LINK ANALYSIS menu to access the 3270 DSC LINK ANALYSIS menu.
7. Select an individual utility.

Figure 8-3 shows how the utilities are accessed for 3270 DSC.

Once the 3270 DSC LINK ANALYSIS menu appears a communications link can be established or an individual utility can be selected. If switched network backup or half speed is to be used for the network diagnostic tests, they must be specified in the Select Switched Network Backup/Half Speed Utility before the link is established.

**Note:** After a link is established, press DISC if you wish to disconnect the link.

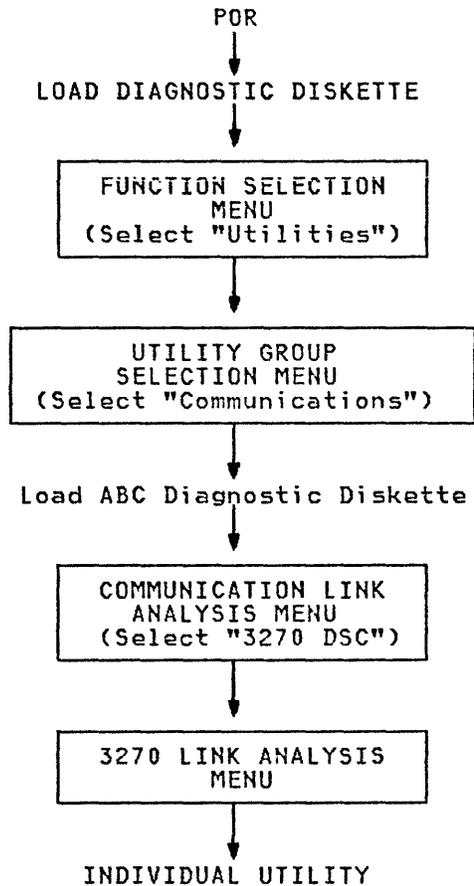


Figure 8-3. 3270 DSC Link Analysis Utilities Menu Path

#### SEND CONTINUOUS DATA UTILITY

The Send Continuous Data utility is used to test the integrity of the link, to send a continuous selectable bit pattern across the link and to optionally check any received data that is wrapped back. Points from which data can be wrapped back are:

- local modem cable wrap switch
- local modem (if it supports a local wrap)
- remote modem (if it supports a remote wrap and a duplex facility is being used)
- remote Displaywriter (if a duplex facility is being used).

When a wrap is not possible, the receiving station can monitor the pattern sent from the Displaywriter for errors.

**Note:** NRZI is not supported for this utility.



## Receive Continuous Data Setup

Figure 8-6 shows the RECEIVE CONTINUOUS DATA SETUP menu.

ID a for the 3270 utility reads:

- a Receive Character pattern 1 1 = Flag
- 2 = Alternating 0/1 bits
- XX = Any valid bit pattern
- X'00' to X'FE'.

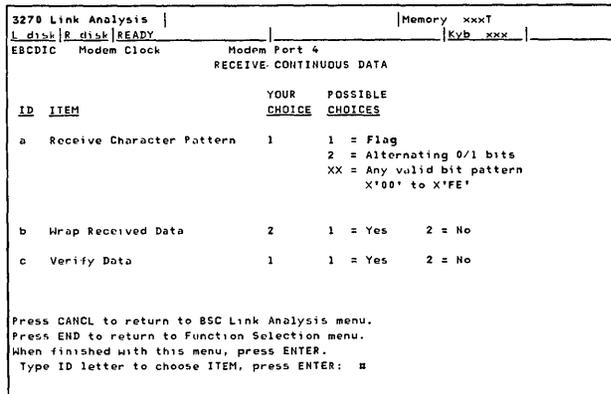


Figure 8-6. RECEIVE CONTINUOUS DATA SETUP Menu

Use the following information to setup the Receive Continuous Data utility:

- Yes is valid for Wrap Received Data only if a duplex facility is being used.
- When Verify Data = No, the utility can be used to trace incoming activity from a remote machine when the remote machine is bidding. In this instance the Displaywriter does not return a response for any received data.

### Receive Continuous Data Execution

Press ENTER after the setup and the utility executes. Figure 8-7 shows the 3270 Receive Continuous Data execution frame. The Modem Interface Status lines give the state of the modem interface signal.

**Note:** If a CCITT interface is being used, all EIA terms are replaced by CCITT numbers.

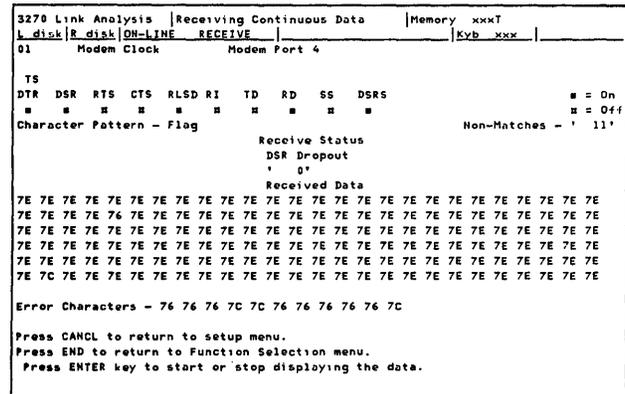


Figure 8-7. 3270 Receive Continuous Data Execution Frame

The following information is included in this frame:

- The pattern that was selected to be received.
- The number of received characters that do not match the pattern (if Verify Data = Yes).
- The data being received (the last byte is displayed video-reversed)
- The non-matched characters received (if there is a non-match and the 'verify data' option was selected).

### SDLC EXERCISER UTILITY

The SDLC Exerciser utility allows online SDLC testing from the primary to the secondary. This utility will transmit the Test command, wait for a response, and verify the response, or receive the Test command and transmit a response. This utility also verifies the path from the local site to the remote site.

**Note:** 3270 DSC is in secondary mode only.

The SDLC Exerciser is used for diagnostic purposes only and supports the following:

- Test (TEST). The Test command is used to transmit a frame of test data from the primary to the secondary. A Test response will be generated and returned by the secondary if a Test command is received.

- **Disconnected Mode (DM).** If a DM is received, a SNRM will be transmitted.
- **Set Normal Response Mode (SNRM).** A SNRM will only be sent if a DM is received. If a SNRM is received, an unsequenced acknowledgment will returned.

To select this utility, choose **SDLC Exerciser** from the 3270 LINK ANALYSIS menu. The SDLC EXERCISER SETUP menu appears.

### SDLC Exerciser Setup Menu

Figure 8-8 shows the SDLC EXERCISER SETUP menu.

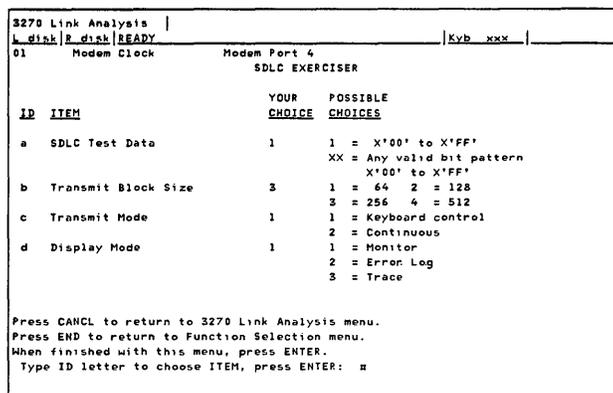


Figure 8-8. 3270 SDLC EXERCISER SETUP MENU

The valid menu options are:

- **SDLC Test data.** Allows the selection of test data. Default is X'00' to X'FF'.
- **Transmit block size.** Allows the selection of the transmit block size. Default is 256.
- **Transmit mode.** Allows the selection of the transmit mode. Default is Keyboard Control.
- **Display mode.** Allows the selection of the display mode. Default is Monitor.

The options you select from this menu determine which frame will be displayed after you press ENTER. If you select **MONITOR MODE** the monitor frame

displays (Figure 8-9). If you select **Trace** or **Error Log** either the Trace frame (Figure 8-10) or the Error Log frame (Figure 8-11) displays.

### 3270 SDLC Exerciser Monitor Frame

The 3270 Monitoring SDLC Exerciser frame (Figure 8-9) contains the following information:

- **The number of seconds before another block can or will be transmitted if a response is not received (line 5).**
- **Test Frames Sent counter.** Indicates the total Test Frames sent
- **Test Response Received counter.** Indicates the total valid test responses received.
- **Test Frame Received counter.** Indicates the total valid Test frames received.
- **FCS Errors counter.** Indicates the total FCS errors detected.
- **Adapter Errors counter.** Indicates the total number of adapter errors detected.
- **Aborts Received counter.** Indicates the total number of abort errors detected.
- **Interface Errors counter.** Indicates the total number of interface errors detected (DSR Dropouts, CTS Dropouts, or Transmit Failures).
- **Protocol Errors counter.** Indicates the total of protocol errors detected (frame less than 32, frame off byte boundary, buffer overflow).
- **Link Data field.** Indicates if any and what data is being transmitted and received.
  - All code points are represented by their hex representation and a space.
  - All received data is underscored. Transmitted data is not underscored.
  - There are three spaces between blocks. Two of the last three spaces are video-reversed following the last block received.



## SELECT SWITCHED NETWORK BACKUP/HALF SPEED UTILITY

The Select Switched Network Backup/Half Speed utility is used to specify Switched Network Backup (SNBU) or Half Speed for utility execution.

**Note:** Both Select Standby (SS) and Data Signaling Rate Selector (DSRS) are the EIA terms for Select Switched Network Backup/Half Speed.

```

3270 Link Analysis | Memory xxxT
L disk R disk READY | Kvb xxx
EBCDIC Modem Clock Modem Port 4
SELECT SWITCHED NETWORK BACKUP/HALF SPEED

ID ITEM          YOUR CHOICE POSSIBLE CHOICES
a Switched Network Backup 2 1 = On 2 = Off
b Half Speed 2 1 = On 2 = Off

Press CANCL to return to BSC Link Analysis menu.
Press END to return to Function Selection menu.
When finished with this menu, press ENTER.
Type ID letter to choose ITEM, press ENTER: #
    
```

Figure 8-13. SELECT SWITCHED NETWORK BACKUP/HALF SPEED Menu

The options on this menu (see Figure 8-13) are:

- Switched Network Backup. Indicates whether switched network backup is to be used. The default is OFF.
- Half Speed. Indicates whether the modem is to operate at half speed. The default is OFF.

## CONTROL MODEM INTERFACE UTILITY

The Control Modem Interface utility is used to control and display the current modem interface. This utility aids in diagnosing modem problems and modem interface problems.

To run the utility, select **Control Modem Interface** from the 3270 LINK ANALYSIS menu. Figure 8-14 shows the CONTROL MODEM INTERFACE menu.

Enter the ID and either '1' (to turn the signal ON), or '2' (to turn the signal OFF).

```

3270 Link Analysis | Controlling Modem Interface | Memory xxxT
L disk R disk READY | Kvb xxx
EBCDIC Modem Clock Modem Port 4
CONTROL MODEM INTERFACE

DTR DSR RTS CTS RLSD RI TD RD SS DSRS      # = On
# # # # # # # # # # # # # # # # # # # # # # # = Off

ID ITEM          YOUR CHOICE POSSIBLE CHOICES
a Set DTR - DSR - 1 1 = On 2 = Off
b Set RTS - CTS - 2 1 = On 2 = Off
c Set TD - RD - 2 1 = On 2 = Off
d Set SS - RLSD - 2 1 = On 2 = Off
e Set DSRS - RI - 2 1 = On 2 = Off

Press CANCL to return to BSC Link Analysis menu.
Press END to return to Function Selection menu.
Type ID letter to choose ITEM, press ENTER: #
    
```

Figure 8-14. CONTROL MODEM INTERFACE Menu

## DISPLAY ERROR LOG

The Display Error Log utility is used to format and display error log data. To run the utility, select **Display Error Log** from the 3270 LINK ANALYSIS menu. The system will then prompt for a Memory Record (dump) diskette(s).

SDLC error log data is presented in three different sections:

1. SDLC Session Description (see Figure 8-15)
2. Operational Counters and Error Counters (see Figure 8-16 and Figure 8-17)
3. Error History Log (see Figure 8-18)

Session Description appears first. To scroll forward through the log, use the arrow down (↓) key. To scroll backward, use the arrow up (↑) key.

Use the PRINT key to print any Error Log frame.

## Session Description

Use Session Description information to verify that the session setup was correct at the time the Error History Log was recorded.

```

3270 Link Analysis | Displaying Error Log | Memory xxxT
| disk | disk | | Kvb xxx |
01 Modem Clock Modem Port 4
SESSION DESCRIPTION
SDLC Link Address Network Facility Adapter Location
01 Switched Diskette Unit
Bit Clocking Switched Network Backup Physical Unit ID
Modem No 1
Modem Port Half Speed
4A No
Continuous Carrier Dedicated Connection
No Secondary
NRZI Encoding
Yes
Answer Tone Generation
Yes
XID Sent
***
XID Received
****
Press CANCL to return to 3270 Link Analysis menu.
Press END to return to Function Selection menu.
Press PRINT to print display contents.
Use ↑ and ↓ keys to scroll through Error Log.

```

Figure 8-15. Sample SESSION DESCRIPTION Frame

**Note:** When Session Description is displayed the Machine Configuration within memory is updated to match that display.

The SDLC operational information in the SDLC Session Description frame includes (see Figure 8-15):

- SDLC Link Address
- Last XID sent if applicable
- Last XID received if applicable
- Dedicated Connection (whether primary or secondary)
- Communication Adapter Location
- Physical Unit (PU) Identification

The modem information in the SDLC Session Description frame includes:

- Type of Clocking
- Modem Port
- Continuous Carrier (yes/no)
- NRZI Encoding (yes/no)
- Answer Tone (yes/no)
- Network Facilities
- Switched Network Backup (yes/no)
- Half Speed (yes/no)

### SDLC Counters

There are two types of counters, operational and error counters. Operational counters are used to determine the relative health of the communication network. Error counters are used to identify specific communication network problem areas.

```

3270 Link Analysis | Displaying Error Log | Memory xxxT
| disk | disk | | Kvb xxx |
SDLC COUNTERS
I-Frames Received I-Frames Sent
XXXXX XXXXX
Test Frames Received I-Frames/Burst Resent
XXXXX XXXXX
Invalid Frames Received Transmit Failures
XXXXX XXXXX
FCS Errors DSR Dropouts
XXXXX XXXXX
Protocol Errors CIS Dropouts
XXXXX XXXXX
Inactivity Timeouts Invalid Interrupts
XXXXX XXXXX
Adapter Errors
XXXXX
Press CANCL to return to 3270 Link Analysis menu.
Press END to return to Function Selection menu.
Press PRINT to print display contents.
Use ↑ and ↓ keys to scroll through Error Log.

```

Figure 8-16. SDLC COUNTERS Frame

There are three operational counters for SDLC communications (see Figure 8-16 ). These counters are:

- I-Frame Received Counter. Counts the total number of I-frames received with valid Frame Check Sequence (FCS) fields.
- Test Frame Received Counter. Counts the total number of valid test frames received.
- I-Frame Sent Counter. Counts the total number of I-frames transmitted without any detectable transmit error.

There are ten SDLC Error Counters. These counters are:

- Invalid Frame Received Counter. Counts the number of frames received with an invalid SDLC control byte, invalid I-field, or invalid NR-count. This includes all non-supported commands/responses and the supported DM and FRMR responses.
- Frame Check Sequence Error Counter. Counts the total number of FCS errors detected.
- Protocol Error Counter. Counts the number of frames received in error due to a SDLC protocol violation or an XID violation.
- Inactivity Timeout Counter. Counts the number of inactivity timeouts which occurred.
- Adapter Error Counter. Counts the number of adapter related errors which were detected (overruns, underruns, interrupt buffer overruns).

- **I-Frame/Burst Resent Counter.** Counts the number of I-frames or burst, if more than one I-frame, which were retransmitted without any detectable transmit error.
- **Transmit Failure Counter.** Counts the number of times a transmit complete interrupt did not occur within ten seconds.
- **Data Set Ready (DSR) Dropouts Counter.** Counts the number of DSR dropouts detected.
- **Clear to Send (CTS) Dropouts Counter.** Counts the number of CTS dropouts detected while a frame was transmitted.
- **Invalid Interrupts Counter.** Counts the number of Displaywriter interrupts that occurred and were not for communication.

### SNA Counter

The SNA Counter (Figure 8-17) presents the data from the Record Formatted Maintenance Statistics (RECFMS) Type 2 Program Check Counter. The SNA counter is used to detect SNA protocol problems.

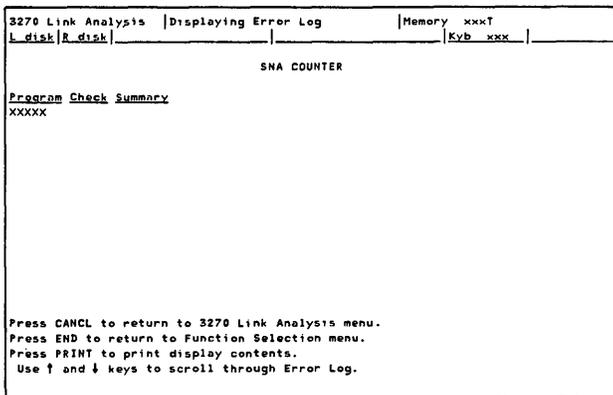


Figure 8-17. SNA COUNTER Frame

### SDLC Error History Log

There are three classes of errors recorded in the SDLC Error Log:

- Adapter Error (AE)
- Interface Error (IE)
- Protocol Error (PE)

Figure 8-19 shows the possible entries into the SDLC Error History Log (Figure 8-18), their error type and the additional information stored with them.

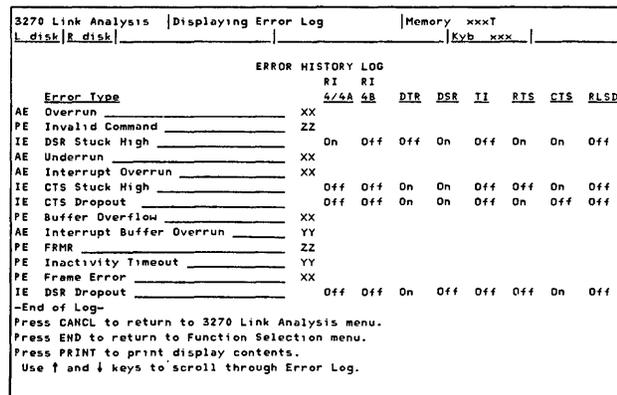


Figure 8-18. Sample ERROR HISTORY LOG Frame

ERROR TYPE	ERROR NAME	STATUS INFO
AE	Overrun	XX
AE	Underrun	XX
AE	Interrupt Overrun	XX
AE	Interrupt Overrun Buffer	YY
IE	DSR Stuck High	YY
IE	DSR Dropout	YY
IE	Transmit Failure	YY
IE	CTS Stuck High	YY
IE	CTS Dropout	YY
PE	Buffer Overflow	XX
PE	Frame Error	XX
PE	Invalid Command	ZZ
PE	FRMR	ZZ
PE	Inactivity Timeout	YY

NOTE: XX = Status Register 4

YY = Status Register 1 -- it is displayed as  
Off Off On On Off On Off On

ZZ = FRMR Reason Code:

X'01' = Invalid Command Received

X'03' = Invalid I-field Received

X'04' = Overflowed Buffer (FRMR Received Only)

X'08' = NR-Count Out of Range

Figure 8-19. SDLC Error Summary

### SDLC TRACE UTILITY

The SDLC Trace is a record of the last events detected on the line. The trace provides an exact picture of the data stream as it appears on the link. Use this utility to diagnose procedural errors and incompatibilities.

To save space, a "trace inhibit" is activated after the first pair of back-to-back send or receive s-frames are stored. This inhibit is deactivated when something other than an s-frame is sent or received. Each entry in the trace is several bytes. The first byte indicates the event type. The additional bytes provide more information about that event.

A memory record is performed to obtain the trace data. For further memory record procedures refer to the IBM Displaywriter System Product Support Manual. Once the memory record is performed, select **Display SDLC Trace** from the 3270 LINK ANALYSIS menu.

This causes the SDLC DISPLAY TRACE Menu to appear.

### SDLC Display Trace Setup

The SDLC Display Trace Setup (Figure 8-20) allows nine modes of scrolling trace data:

- Mode one. Scrolls all data, from the oldest to latest entry.
- Mode two through nine. Allows a SDLC command or event to be defined as the search data. Valid choices are: None, SHRM, XID, FRMR, I-frame, Adapter Error, Interface Error, Protocol Error and Timeout.

Trace data is searched from the oldest entry to the latest entry. Whenever the search data is detected, the trace is displayed, starting with that data.

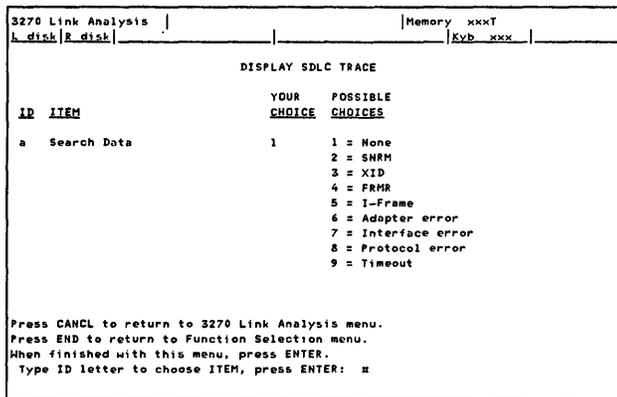


Figure 8-20. SDLC DISPLAY TRACE Setup Menu

### SDLC Display Trace Execution

Press ENTER after setup and the utility executes ( Figure 8-21 ).

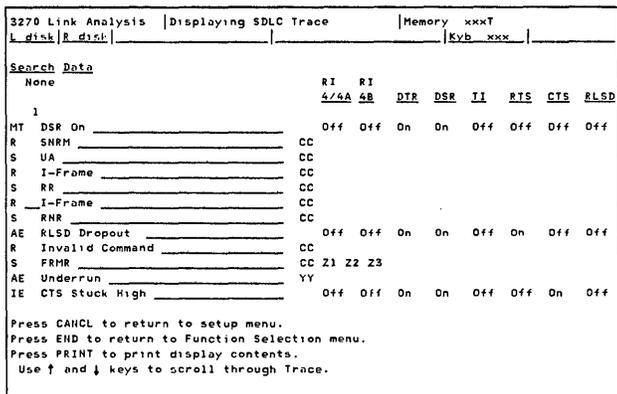


Figure 8-21. Displaying SDLC Trace Frame (Normal Mode)

Lines 4 through 7 of the SDLC Display Trace frame indicate:

- If the utility is in Search Mode, and if so what data is being searched.
- Which line within the trace is being displayed on line one of the SDLC Trace Display frame.

Lines 8 through 19 contain the line events and additional information. The possible events, the additional information stored with them, and their display format are:

- SEND COMMANDS/RESPONSES

```

S SNRM ..... CC
S DISC ..... CC
S DM ..... CC
S FRMR ..... CC Z1 Z2
                                     Z3
S Test ..... CC
S UA ..... CC
S XID ..... CC
S RR ..... CC
S RNR ..... CC
S I-frame..... CC
S Invalid..... CC
S ABORT ..... YY

```

- RECEIVE COMMAND/RESPONSES

The same as SEND commands above except preceded by and 'R' instead of an 'S'. There are two additional commands:

```

R FCS Error ..... YY
R IDLE ..... YY

```

- ADAPTER ERRORS

```

AE Overrun ..... XX
AE Interrupt OverrunXX
AE DMA Underrun ... XX
AE RLSD Dropout ... YY

```

- INTERFACE ERRORS

```

IE Stuck High .... YY
IE Transmit Failure YY
IE CTS Dropout .... YY

```

- PROTOCOL ERRORS

```

PE Buffer Overflow XX
PE Frame Error .... XX

```

- TIMEOUTS

TO Inactivity TimeoutYY

- MODEM TRANSITIONS

```

MT DSR Off ..... YY
MT DSR On ..... YY

```

**NOTE:** CC = SDLC Command Byte  
(See Figure 8-22 on page 8-15)

XX = Status Register

YY = Port A Modem  
Status -- displayed as:  
Off Off On On Off On Off Off

Z1 = SDLC Command Byte which was in error

Z2 = Sender's Ns and Nr counts as shown:  
--0--0  
| |  
Nr Ns

Z3 = FRMR Reason Code:  
x'01' = Invalid Command Received  
x'03' = Invalid I-field

Received  
 x'04' = Overflowed Buffer  
 (FRMR Received Only)  
 x'08' = Nr-count Out of  
 Range

Bit								Comment
7	6	5	4	3	2	1	0	
NR	NR	NR	P/F	NS	NS	NS	0	I-Frame CMD/RSP
NR	NR	NR	P/F	0	0	0	1	RR CMD/RSP
NR	NR	NR	P/F	0	1	0	1	RNR CMD/RSP
0	1	0	P/F	0	0	1	1	DISC CMD
1	0	0	P/F	0	0	1	1	SNRM RSP
1	0	1	P/F	1	1	1	1	XID CMD/RSP
1	1	1	P/F	0	0	1	1	TEST CMD/RSP
0	1	1	P/F	0	0	1	1	UA RSP
0	0	0	P/F	1	1	1	1	DH RSP
1	0	0	P/F	0	1	1	1	FRMR RSP

NOTE: NR = Number Received sequence count.  
 NS = Number Sent sequence count.  
 P/F = Poll/Final indicator.

Figure 8-22. SDLC Command Byte

### 3270 PIU TRACE UTILITY

The 3270 PIU Trace provides an exact picture of the SNA protocol and data stream as it appears at the SDLC/SNA interface. This utility is used to diagnose procedural errors and incompatibilities within the SNA protocol.

To use this utility, select **3270 PIU Trace** from the 3270 LINK ANALYSIS menu. A Display PIU Trace frame prompts: **Insert Memory Record Diskette(s)**, press ENTER. After inserting the Memory Record Diskette(s) and pressing ENTER, the PIU TRACE SETUP menu displays (see Figure 8-23).

The PIU TRACE menu options are:

- **Search Data.** This allows the selection of the search data. Valid choices are: None, -RSP, CD, any valid bit pattern X'00' to X'FF'. Default is None.
- **Search Area.** This allows the selection of the search area. Valid choices are: TH, RH, RU, and ALL. Default is ALL.
- **Display Mode.** This allows the selection either character or hex display mode. Default is Hex (which displays all code points by their hex representations and a space).

3270 Link Analysis		Memory xxxT	
L disk	R disk	Kyb	xxx
DISPLAY PIU TRACE			
ID	ITEM	YOUR CHOICE	POSSIBLE CHOICES
a	Search Data	1	1 = None 2 = -RSP 3 = CD XX = Any valid bit pattern X'00' to X'FF'
b	Search Area	4	1 = TH      2 = RH 3 = RU      4 = ALL
c	Display Mode	2	1 = Character 2 = Hex
Press CANCL to return to 3270 Link Analysis menu. Press END to return to Function Selection menu. When finished with this menu, press ENTER. Type ID letter to choose ITEM, press ENTER: █			

Figure 8-23. DISPLAY PIU TRACE Setup Menu

Press ENTER after the setup and the 3270 Display PIU Trace utility executes. Figure 8-24 shows the 3270 PIU Display Trace frame.

3270 Link Analysis		Displaying PIU Trace		Memory xxxT	
L disk	R disk	Kyb	xxx	Kyb	xxx
<b>Search Data</b>					
None					
	RUC	RRI	CD	CMD	TH       RH       RU
1					
R	SC	RQ		BIND	3F 4A 6C 22 C0 22 67 80 C0 31 00 07 07 80 02 86 00 00
					00 02 02 00 00 00 00
S	SC	RSP		BIND	3D C0 33 21 4F 22 E7 80 C0 31
R	FM	RQ			3C C0 33 21 4F 22 02 01 C0 T h i s ---
S	FM	RSP			3C C0 33 21 4F 22 83 01 00
R	FM	RQ		CD	3C C0 33 21 4F 22 01 21 C0 w h e r e ---
S	FM	RSP		CD	3C C0 33 21 4F 22 81 81 C0
R	SC	RQ			3D C0 33 21 4F 33 E7 90 C0 32 01
S	SC	RSP		UNBIND	3C C0 33 21 4F 33 02 01 C0 32
-End of Log-					
Press CANCL to return to setup menu. Press END to return to Function Selection menu. Press PRINT to print display contents. Use ↑ and ↓ keys to scroll through Trace.					

Figure 8-24. Displaying PIU Trace Frame

Lines 4 and 5 indicate if the utility is in search mode and if so, what byte is being searched for.

Line 6 is the format field and is displayed as:

|RUC|RRI|CD|CMD|TH|RH|RU

Line 7 is the line count field.

Lines 8 through 19 are the PIU Display Trace areas. Information in this area is formatted as follows:

- Column 1 contains an S for all sent data and an R for all received data.

- Columns 4 through 7 are the Response/Unit Category (RUC) field and may contain the following:

- NC. For Network Control
- SC. For Session Control
- DFC. For Data Flow Control
- FM. For Function Management
- (BLANK). For Segmented PIU (no RH field)

- Columns 9 through 12 are the Request/Response Indicator (RRI) field and may contain the following:

- RQ. For request
- RSP. For positive response
- RSP. For negative response

- Columns 14 through 16 are the Change Direction (CD) field and will contain CD if the CD bit was on and blank if the CD bit is off.

- Columns 18 through 25 are the SNA Command (CMD) field.

- Columns 27 to 43 are the Transmission Header (TH) field.

- Columns 45 to 52 are the Response Header (RH) field.

- Columns 54 to 79 are the Response Unit (RU) field.

**Note:** If the PIU is segmented (no RH) then the RU will begin in column 45.

In Character Mode RM RU data is represented as follows:

- Characters are represented by alpha characters and two spaces.
- Spaces are represented by three spaces; all other code points are represented by their hex equivalent and a space.

In Hex Mode data is formatted as in the Character Mode with one exception, all code points are represented by their hex equivalent and one space. "End of Log" is displayed when all the trace has been displayed.

The oldest data in the trace is displayed first. If the trace contains more data than can be presented on one frame, use the up (↑) and down (↓) scroll keys. Press the PRINT key to print any trace frame.

### 3270 CHANGE LINK DESCRIPTION UTILITY

The 3270 Change Link Description utility is used to change the 3270 communication link description temporarily or permanently.

To use the utility, select **Change Link Description** from the 3270 LINK ANALYSIS menu. The CHANGE LINK DESCRIPTION menu (Figure 8-25) appears.

**Note:** Session Description may change automatically when displaying Error Log.

3270 Link Analysis		Chg Description	Memory	xxxT
L disk	R disk	READY		Kyb xxx
01	Modem Port 4			
CHANGE LINK DESCRIPTION				
		YOUR CHOICE	POSSIBLE CHOICES	
a	SDLC Link Address	01	01 = FE	
b	Bit Clocking	2	1 = Business Machine Clock 2 = Modem Clock	
c	Modem Port	1	1 = Port 4 2 = Port 4A 3 = Port 4B	
d	Continuous Carrier	2	1 = Yes 2 = No	
e	NRZI Encoding	2	1 = Yes 2 = No	
f	Answer Tone Generation	2	1 = Yes 2 = No	
g	Interface Status	1	1 = EIA 2 = CCITT	
h	Store Link Description	2	1 = Yes 2 = No	
Press CANCEL to return to 3270 Link Analysis menu.				
Press END to return to Function Selection menu.				
When finished with this menu, press ENTER.				
Type ID letter to choose ITEM, press ENTER: #				

Figure 8-25. 3270 CHANGE LINK DESCRIPTION Menu

The options on the 3270 CHANGE LINK DESCRIPTION menu are:

- SDLC Link Address. Identifies a secondary station on a link. The default is, 01.
- Bit Clocking. Specifies either business machine or modem clocking. The default is 2, Modem Clock.
- Modem Port. Indicates the modem port to be used. The default is 1, Port 4.
- Continuous Carrier. Indicates whether the communications utilities are duplex. The default is 2, No.
- NRZI Encoding. Specifies whether Non-Return-to-Zero-Inverted encod-

ing is to be used in transmission. The default is No.

- Answer Tone Generation. Indicates whether an answer tone is generated. The default is 2, No.
- Interface Status. Specifies if the modem interface signals should be EIA or CCITT. The default is 1, EIA.
- Store Link Description. Specifies whether changes made here are to be temporary or stored on the diskette. The default is 2, No.

### WRAP MODEM UTILITY

The Wrap Modem utility is used to test modems that support modem wrap and to test any point from which transmitted data can be wrapped back. To select this utility choose Wrap Modem from the 3270 LINK ANALYSIS menu; the WRAP MODEM SETUP menu (Figure 8-26) appears.

**WRAP MODEM SETUP:** The options on the WRAP MODEM SETUP menu are:

- Mode. Specifies the number of times the wrap will occur. The default is 1, One wrap.
- Wrap to remote mode. Controls the state of the test signal and allows remote modems and Displaywriters to be tested by a modem wrap. If Yes is specified, the utility will not turn the test signal on. If No is specified, the utility will turn the test signal on.

**Note:** In some cases the remote modem must be set up for the remote wrap at the remote location. If the local modem does not support the test signal, this parameter has no effect upon it. The modem then must be controlled by its switches.

```

3270 Link Analysis | Memory xxxT
L disk | R disk | READY | Kvb xxx |
-----
EBCDIC Modem Clock Modem Port 4
WRAP MODEM

YOUR POSSIBLE
ID ITEM CHOICE CHOICES

a Mode 1 1 = One wrap
2 = Continuous
3 = Continuous-stop on error

b Wrap to Remote Modem 2 1 = Yes
2 = No

Press CANCL to return to BSC Link Analysis menu.
Press END to return to Function Selection menu.
When finished with this menu, press ENTER.
Type ID letter to choose ITEM, press ENTER: #
  
```

Figure 8-26. 3270 WRAP MODEM Setup Menu

### Wrap Modem Execution

Press ENTER after setup and the utility executes. The WRAP MODEM DISPLAY frame appears (Figure 8-27)

```

3270 Link Analysis | Wrapping Modem | Memory xxxT
L disk | R disk | ON-LINE SEND | Kvb xxx |
-----
EBCDIC Modem Clock Modem Port 4
WRAP MODEM

DTR DSR RTS CTS RLSI RI TD RD SS DSRS # = On
# # # # # # # # # # # # # # # # # = Off

Mode - Continuous
Failures detected - 0
Number of wraps - 10

Received Data

Press CANCL to return to setup menu.
Press END to return to Function Selection menu.
Press ENTER key to start or stop the displaying of data.
  
```

Figure 8-27. WRAP MODEM Display Frame

If a CCITT interface is being used, all EIA terms are replaced by CCITT numbers.



## CHAPTER 9. CCITT X.21 INTERFACE

### X.21 INTERFACE

CCITT recommendation X.21 is a definition of a general-purpose interface between terminals and public data networks (PDNs). X.21 defines the interchange circuits and a 15-pin connector between data terminal equipment (DTE) and data circuit equipment (DCE) for operation on public data networks.

This manual is intended to define the operation of the IBM Displaywriter on a X.21 interface, not to give the user an understanding of CCITT recommendation X.21. For information on X.21 refer to IBM Implementation of X.21 Interface General Information Manual.

**Note:** The X.21 interface is available in World Trade countries only.

### NETWORK SERVICES

Displaywriter supports the following Public Data Network services:

- Address Calling
- Auto-Answer
- Direct Call
- Leased Line
- Call Progress Signal
- Calling Line Identification
- Called Line Identification
- Automatic Registration
- Connect When Free

No special Displaywriter support is required for these Public Data Network services:

- Calls Barred
- Multiple Lines
- Charge Transfers
- Multi-Address Calling

Displaywriter does not support the following Public Data Network services:

- Charge Advice
- Selective Direct Call
- Unattended Auto-Call

- Short Hold Mode
- Control Not Ready State

### OUT-GOING CALL ESTABLISHMENT ON A SWITCHED LINE

These are the steps required for the Displaywriter to initiate a call:

- The operator presses COMM START
- READY is displayed in the comm status field.
- Displaywriter monitors the network for 16 or more consecutive 1's.
- If 16 1's are received, NETWORK AVAILABLE is posted.
- If other than 16 1's are received, WAITING FOR NETWORK TO BE AVAILABLE is posted.
- The operator presses CALL or DIR CALL
- The operator is prompted for a number (this step is skipped if DIR CALL was pressed).
- CALLING is displayed in the comm status field and a three second timer is started.
- If the three seconds elapse before "proceed to select" is received, network error T1 is posted.
- If "proceed to select" is received, the number is transmitted and a six second timer is started.
- If the six second timer elapses before the selection is complete, network error F1 is posted and the call is cleared.
- If the selection sequence completes, the Displaywriter enters DTE waiting state and starts a twenty second timer.
- If the twenty second timer elapses before a "call progress", "called line ID", or "ready for data" is received, network error T2 is posted and the call is cleared.
- If a signal is received before the timer elapses, a sixty second timer is set waiting for "called line ID". This timer is reset by "call progress" or "ready for data".

- If "called line ID" is received, a sixty second timer is set waiting for "ready for data".
- If either sixty second timer elapses, network error T3 is posted and the call is cleared.
- When "ready for data" is received, CONNECTED is displayed in the comm status field and CALL ESTABLISHED is posted.
- If the two second timer elapses before "calling line ID" or "ready for data" network error T4 is posted.
- When "ready for data" is received, CONNECTED is displayed in the comm status field and CALL ESTABLISHED is posted.

#### INCOMING CALL ESTABLISHMENT ON A SWITCHED LINE

These are the steps required for the Displaywriter to establish a call initiated by the network:

- The operator presses COMM START
- READY is displayed in the comm status field.
- Displaywriter monitors the network for 16 or more consecutive 1's.
- If other than 16 1's are received, WAITING FOR NETWORK TO BE AVAILABLE is posted.
- If 16 1's are received, NETWORK AVAILABLE is posted.
- When "syn syn bel" is received, Displaywriter turns on call accepted and sets a two second timer.
- The two second timer is reset when "calling line ID" is received and the Displaywriter waits for "ready for data".

#### CALL CLEARING AT DISPLAYWRITER REQUEST

The Displaywriter will perform the following steps if session is terminated or error state is noted.

- The Displaywriter drops call accepted and starts a two second timer.
- If the two second timer elapses before CTS drops, network error F2 is posted.
- If call clearing is completed in two seconds READY is displayed in the comm status field and NETWORK ACTIVITY TERMINATED is posted.

#### CALL CLEARING AT DCE REQUEST

- The DCE drops Indication and the Displaywriter starts a two second timer.
- If the two second timer elapses before CTS drops, network error F2 is posted.
- If call clearing is completed in two seconds READY is displayed in the comm status field and NETWORK ACTIVITY TERMINATED is posted.

## CHAPTER 10. X.21 INTERFACE DIAGNOSTICS

### INTRODUCTION

The communications diagnostic support package for the IBM Displaywriter System consists of:

- Loadable Diagnostics
- Maintenance Analysis Procedures (MAPs)
- Online Diagnostics
- Customer Loadable Diagnostics
- Customer Link Analysis Utilities
- Communication Link Analysis Guide

**Note:** This section contains display formats and printed outputs that should be considered as samples only.

### MDIS

The MDIs are test units and directions for service action that operate when selected. The first test unit requests the input of a Communication ID which describes the hardware configuration.

These MDIs test the communication components within the Displaywriter and the external components such as the external EIA and LDC cables.

The chart in Figure 10-1 lists the Communication IDs for different hardware configurations. The MDIs check whether the communication adapter card is located in the electronics module or the diskette unit. When the diagnostic controller has determined the configuration of the communication features, a set of test units operate automatically to test the function of these particular features.

ID	COMMUNICATIONS CONFIGURATION
a	Port 4: Communications Adapter EIA port Module EIA
d	Port 4a: Communications Adapter EIA port Port 4b: Local Device Controller
e	Port 4a: Communications Adapter EIA port Port 4b: X.21 switched line
f	Port 4a: Communications Adapter EIA port Port 4b: X.21 leased line
g	Port 4a: Communications Adapter EIA port Port 4b: 38LS modem for switched line
h	Port 4a: Communications Adapter EIA port Port 4b: 38LS modem for nonswitched line with SNBU
i	Port 4a: Communications Adapter EIA port Port 4b: 38LS modem for nonswitched line
m	Port 4a: Communications Adapter EIA port Port 4b: EIA Adapter Card EIA port
p	Port 4b: Local Device Controller
q	Port 4b: X.21 switched line
r	Port 4b: X.21 leased line
s	Port 4b: 38LS modem for switched line
t	Port 4b: 38LS modem for nonswitched line with SNBU
u	Port 4b: 38LS modem for nonswitched line
z	Communications tests inhibited

Figure 10-1. Communications ID Chart

## MDI OPERATIONS

The communication MDIs are on the ABC diagnostic diskette. Before this diskette can be loaded, the MDI supervisor must first be loaded from the Displaywriter system diagnostic diskette. An interface to the MDIs is provided through the keyboard and display.

Follow these steps to run the MDIs.

1. Insert the Displaywriter system diagnostic diskette. The program loads and the FUNCTION SELECTION menu displays.
2. Select MDIs from the FUNCTION SELECTION menu. The DEVICE SELECTION menu displays.
3. Select Communications from the DEVICE SELECTION menu and press ENTER.
4. Insert the Displaywriter System ABC diagnostics diskette and press ENTER.

If a single diskette drive system is used, the Displaywriter system diagnostics diskette must be removed and the Displaywriter System ABC diagnostic diskette inserted.

If a dual diskette drive is used, the ABC diskette may be inserted

in the right drive. A flowchart for Displaywriter System Diagnostics and Displaywriter System Communications Diagnostics is shown in Figure 10-2

For further information on MDI operation, refer to the IBM Displaywriter System Product Support Manual.

The Displaywriter is also equipped with a feature known as RESUME that can be used as a marker, or stopping point, while running the MDIs. RESUME can be used in two ways:

- Automatic RESUME is written into the MDIs. When an automatic RESUME occurs, a prompt occurs.
- Optional or real time RESUME is entered by keying the letter 'r' at any MDI stopping point. When in 'Step' mode, an optional RESUME can be placed at any point within the MDIs. Once the RESUME has been entered, either power off the Displaywriter, or press END to return to the FUNCTION SELECTION menu. To return to the RESUME point, access the FUNCTION SELECTION menu and select MDIs. From this menu, the RESUME option is taken by pressing ENTER. Pressing END or CANCEL at this point will erase the optional RESUME.

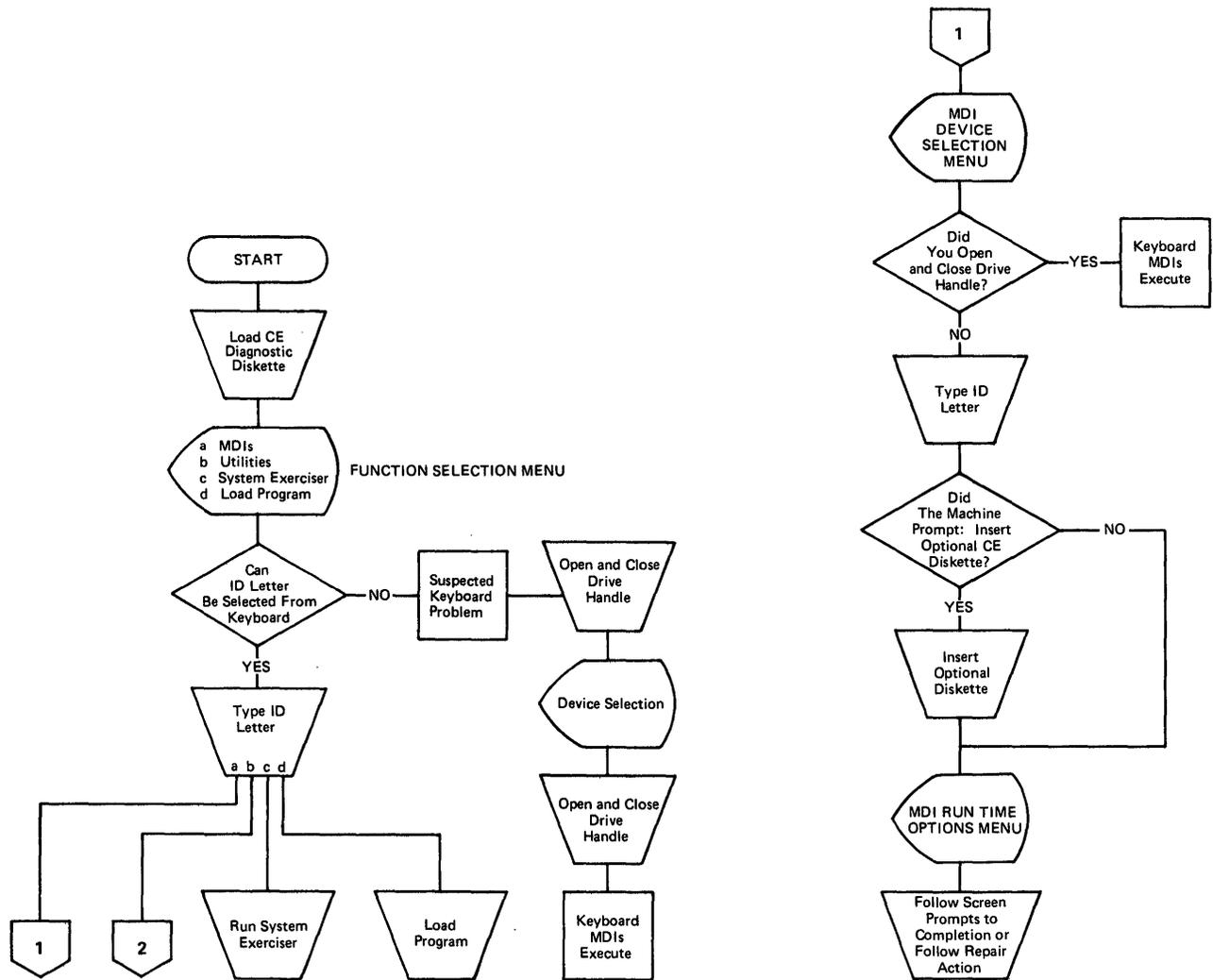


Figure 10-2 (Part 1 of 2). Loadable Diagnostics

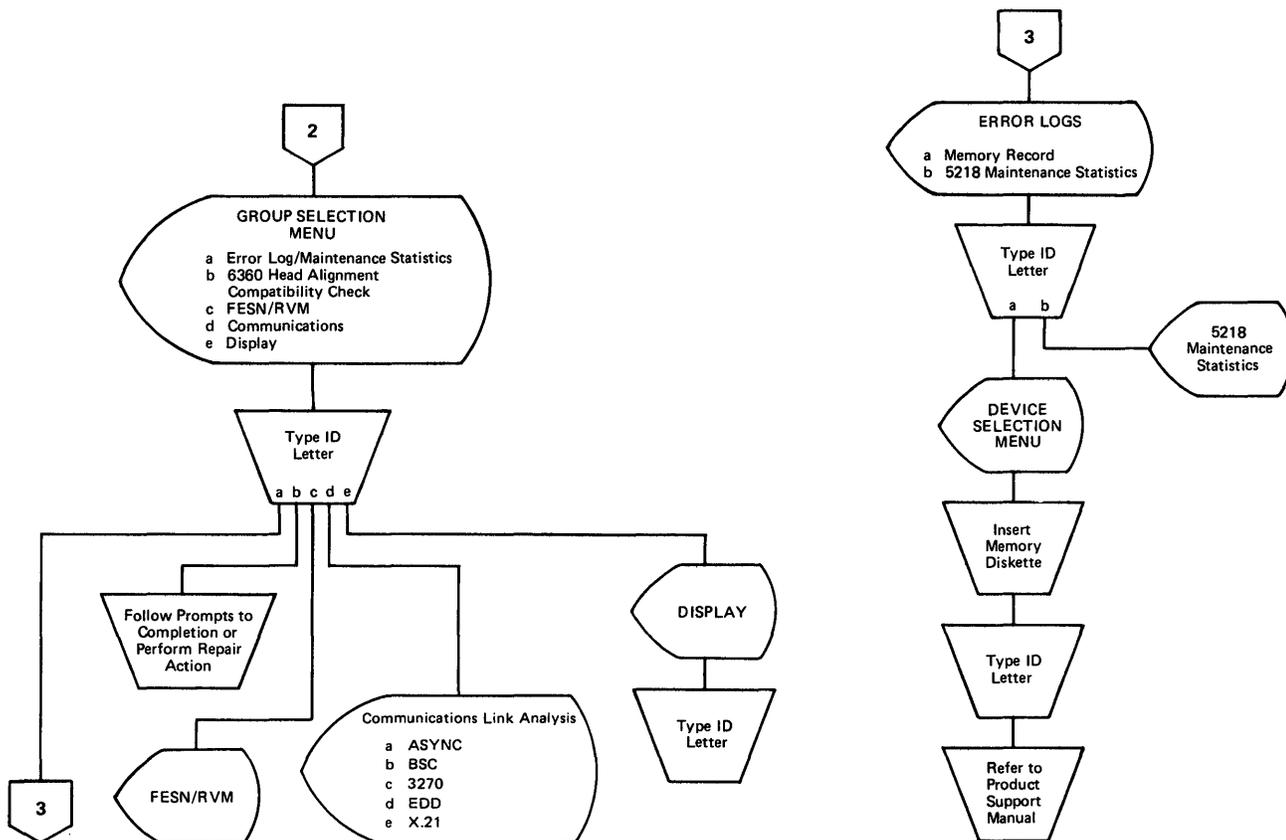


Figure 10-2 (Part 2 of 2). Loadable Diagnostics

**X.21 LINK ANALYSIS UTILITY**

The Wrap X.21 Network Utility is the only X.21 interface utility available for Displaywriter. The utility wraps the C (control) interface line to the I (indication) line and wraps X'00' to X'FF' characters with odd parity. The utility also measures the line speed.

**ACCESSING THE WRAP X.21 NETWORK UTILITY**

In most cases, you must follow a setup procedure for an individual utility before it will execute. The steps to access the utilities are as follows:

1. Power ON.
2. Load the diagnostic diskette.
3. Select Utilities from the FUNCTION SELECTION menu.
4. Select Communications from the UTILITY GROUP SELECTION menu.
5. Load the ABC diagnostic diskette.
6. Select X.21 from the COMMUNICATIONS LINK ANALYSIS menu to access the X.21 LINK ANALYSIS menu.

Figure 10-3 shows how the utilities are accessed for X.21





## CHAPTER 11. SERVICE INFORMATION TOOLS, ADJUSTMENTS AND CHECKS

### SERVICE INFORMATION

**WARNING:** Remove power from the Displaywriter before removing or replacing any machine parts. Never turn power on until machine parts are properly installed and all electrical/electronic parts are properly grounded.

### TOOLS

There are several special tools for checking communications operations and making adjustments:

- The IBM VOM (P/N 1749231) and dB Adapter (P/N 1749299) measure the transmit and receive dB levels of a modem. To attach the dB adapter to the VOM, set the polarity switch to the +DC position. Set the range selector switch to .06 milliamp VDC. Insert the adapter plug assembly into the "+" and "-" jacks. Align the dB Adapter and press down until it is seated on the VOM.

Always check the dB adapter battery before use. To do this, set the range selector to the test position. The LED will light if the battery is good.

A 600 BRIDGE slide switch on the front panel of the dB Adapter provides a dual function of dB levels. When the switch is in the 600 position the input jacks are terminated with a 600 ohm input impedance. In the Bridge position, the LISTEN circuit is activated and an earphone (P/N 2728115) may be used to listen during on-line checks. The dB Adapter is powered by a NEDA type 1604 battery. Adjustments and Checks at the end of this section tells how to use the VOM and dB adapter for making different checks. Leads for the dB adapter may be ordered (P/N 453697).

- The IDS Model 60 Modem and Terminal Interface Tester (Blue Box) monitors activity on all 25 lines of the EIA RS-232 interface. The Blue Box attaches in series with the EIA interface cable, between the business machine and the external modem/DCE.

A ribbon cable and 25 pin connector attach the Blue Box to the modem/DCE. The EIA interface cable plugs into a 25 pin jack on the

face of the Blue Box. Switches on the face of the Blue Box open and close the interface circuits. Test points on either side of the switches allow the circuits to be monitored under normal conditions.

Pin #	Circuit	Description
1	AA	Protective Ground
2	BA	Transmitted Data
3	BB	Received Data
4	CA	Request to Send
5	CB	Clear to Send
6	CC	Data Set Ready
7	AB	Signal Ground (Com. Ret.)
8	CF	Received Line Signal Det.
9	--	(Reserved for Data Set testing)
10	--	(Reserved for Data Set testing)
11		Unassigned
12	SCF	Sec. Rec'd Line Sig. Det.
13	SCB	Sec. Clear to Send
14	SBA	Sec. Transmitted Data
15	DB	Trans. Signal Element Timing (DCE SOURCE)
16	SBB	Sec. Received Data
17	DD	Sec. Sig. Element Timing (DCE Source)
18		Unassigned
19	SCA	Sec. Request to Send
20	CD	Data Terminal Ready
21	CG	Signal Quality Detector
22	CE	Ring Indicator
23	CH/CI	Data Signal Rate Selector (DTE/DCE Source)
24		
25	DA	Unassigned

Figure 11-1. EIA Interface Connector Pin Assignments

Voltage at the data set or terminal device can also be observed. Pins 2, 3, 4, 5, 6, 8, 15, 17, 20, 21, 22 and 25 have monitor circuits fix-wired to the Modem side. If a +3 VDC minimum is applied to these Modem pins, monitor lamps will light. These circuits are patch panel wired to cross connect any interface circuits. Three terminal patch cords are provided. Auxiliary circuits monitor positive voltage and negative voltage in those interface leads that do not have a permanent monitor. If a patch cord is placed between pin IN+ and pin 23 (on either modem or terminal side) an ON (+3 VDC) condition will light the associated lamp. If a patch cord is placed

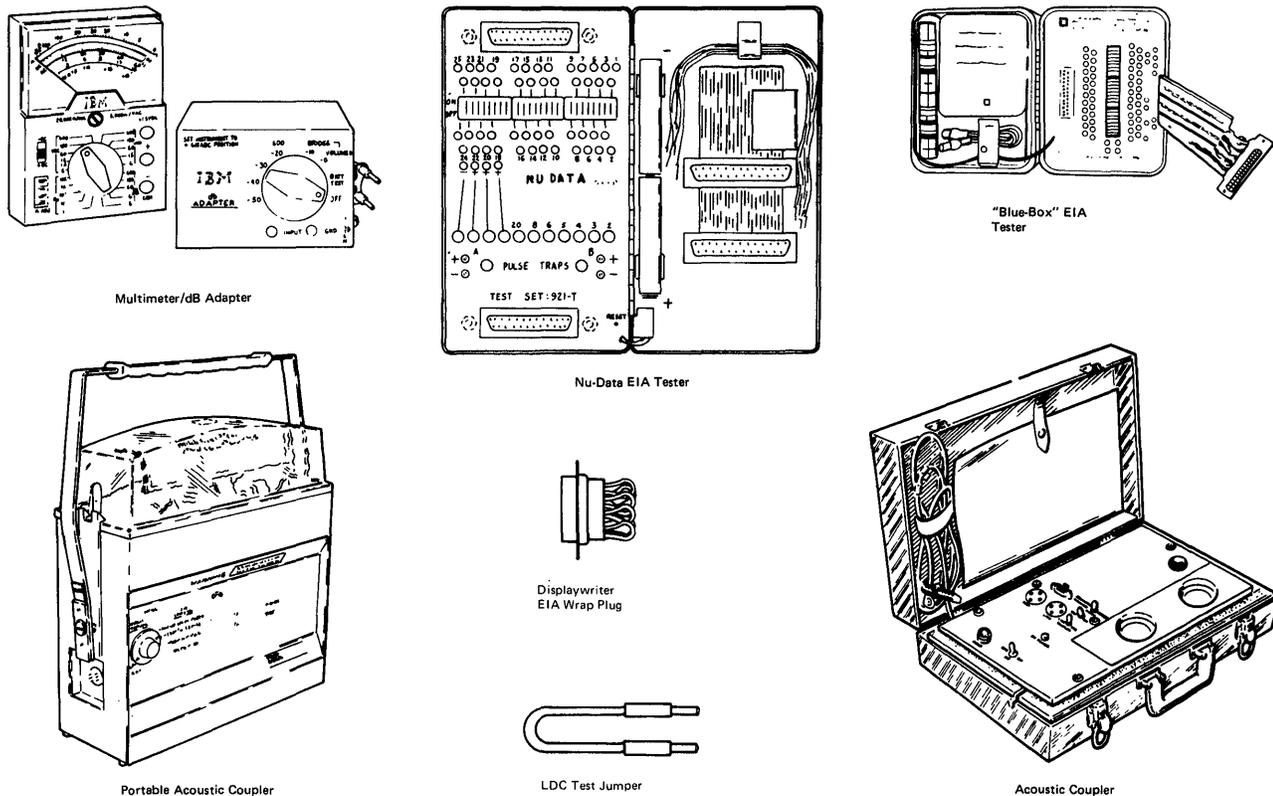


Figure 11-2. Tools

between pin IN- and any pin from the modem and terminal side, a voltage of -3 VDC (or more negative) will light an associated lamp. The Blue Box uses two 1.5 volt d.c. cells (size AA). Figure 11-1 shows the EIA Interface connector pin assignments.

- The Nu-Data Interface Tester also monitors all 25 EIA lines. It attaches in series with the EIA Interface cable, between the business machine and the external modem/DCE. It functions similarly to the Blue Box, but has 7 permanent monitor lamps instead of 12. The Nu-Data has pulse trap detection circuits that are not available on the Blue Box.
- The IBM acoustic (Black case) coupler bypasses a switched network external modem/DCE or the communications line of a non-switched IBM 38LS modem. It operates at 1200 bps. It allows either clocked or non-clocked operation. Acoustic coupler functions are controlled through:
  - Coupler On/Off Switch. Activates acoustic coupler for telephone handset attachment.
  - AC ON/Off Switch. Activates AC power to the unit.
  - Line/EIA Coupler Switch. Selects line jack input or EIA interface connector input to acoustic coupler.
  - Business Machine/Modem Clock Switch. Selects type of clocking.
  - EIA Connector. Connects EIA cable to coupler.
  - Line Jack. Connects non-switched (leased) line plug to acoustic coupler.
  - Test Jack. Used for acoustic coupler maintenance.
- The US Portable Acoustic Coupler (UPAC) bypasses a switched network external modem/DCE or the communications line of a non-switched IBM 38LS modem. It operates at 0-1200

bps and allows either clocked or non-clocked operation and may be used with Async or BSC communications features. UPAC functions are controlled through:

- Mode Switch. Selects mode of operation
- UPAC Power Supply. Provides operating voltages
- EIA Interface Connector. Connects the EIA cable to the UPAC
- Modem Interface Connector. Connects the modem cable to the UPAC

A Test Mode exists to functionally test all units of the the UPAC except the EIA interface receivers and drivers. It checks transmit, receive, and clock functions. If the light does not appear when operating the UPAC, switch to Test Mode to check the UPAC. Test mode requires operating with the handset in the coupler with a "quiet" line (no tone present), or while the remote site is quiet (no RX light on). Dial one digit (1-7) for a 1-minute "quiet" line. During the test procedure the Test Light should be very dim or completely off. If not, either the UPAC or the handset is marginal or defective. Figure 11-3. shows the Test Mode indicators during a good test operation.

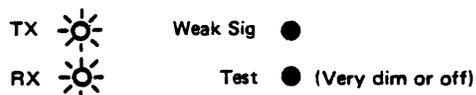


Figure 11-3. UPAC Test Mode Indicators During A Good Test Operation

- The European Portable Acoustic Coupler (EPAC) has the same functions as the UPAC except the interface. The EPAC has a CCITT V23-V24 compatible interface. The power supply of the EPAC is the standard European 220V/50HZ.
- The LDC Test Jumper is used to continuity check the customer's twinaxial cable. Use the jumper to connect the two center connectors at one end of the twinaxial cable. Measure the resistance at the other end of the cable.
- The Displaywriter EIA Wrap Plug can be used to verify the Displaywriter EIA interface at the Electronics Module, port 4, or the

Diskette Unit, port 4A or port 4B. Figure 11-4 shows the wiring of the 15 pin Displaywriter EIA Wrap Plug.

Displaywriter EIA Wrap Plug Wiring	
From	To
3 (rts)	4 (cts)
5 (dsr)	13 (dtr)
1 (txd)	2 (rxd)
7 (cd)	8 (sstby)
15 (drsel)	14 (ri)
12 (test)	10 txc
12 (test)	11 rxc

Figure 11-4. Displaywriter EIA Wrap Plug Wiring

### ADJUSTMENTS AND CHECKS

#### **USING THE IBM ACOUSTIC COUPLER (BLACK CASE) TO BYPASS THE EXTERNAL MODEM**

1. Remove business machine EIA cable from modem/ DCE. Attach it to the EIA connector on the acoustic coupler.
2. Set the Line/EIA switch to EIA position.
3. Set the Business Machine/Modem Clock switch of the acoustic coupler to simulate the application being bypassed.
4. Connect acoustic coupler power cord to outlet. Turn AC power switch to On position.
5. Set up the local Displaywriter to run OLTS using the communication application diskettes, or run the continuous transmit using the CEDD.
6. Place call to remote station. When the remote station goes to data mode (answer tone present, if other end auto-answers), place the handset in the cups with the mouth piece toward the slot in the case.
7. Turn the Coupler On/Off switch to On position.
8. Start the Displaywriter communications.
9. When communications are completed, reconnect the EIA cable to the modem/DCE.

**Note:** In noisy locations, the handset and acoustic coupler pick up unit should be protected by

closing the top cover of the case.  
(Place handset cord through groove  
in lower case unit.)

**USING THE IBM UPAC TO BYPASS THE  
EXTERNAL MODEM**

1. Remove the business machine EIA cable from modem/DCE and attach it to the EIA connector on the UPAC.
2. Set the mode switch to the mode of compatibility.
3. Connect the UPAC power pack (weak signal and test lights on).
4. Set up the Displaywriter to communicate.
5. Place call to the remote station. When the remote station goes to data mode (answer tone present, if other end auto answers), place the hand set in the cups, in the same position as shown on the UPAC. Use the strap to hold in place, then place plastic cover over the hand set and snap in place.
6. Start Displaywriter communications.
7. When communications are completed, remove EIA cable from UPAC and connect to the modem.

**LOCAL DEVICE CONTROLLER (LDC) RATE  
SELECTION**

The switches on the LDC may be set to rates of 1200, 2400 bps, or 4800 bps (factory setting for CSU is 4800 bps). To obtain the desired rate, set the switches as shown in Figure 11-6 .

**Note:** Because the clock rate is set on the LDC, the menu option for modem clocking should be used for all LDC operations.

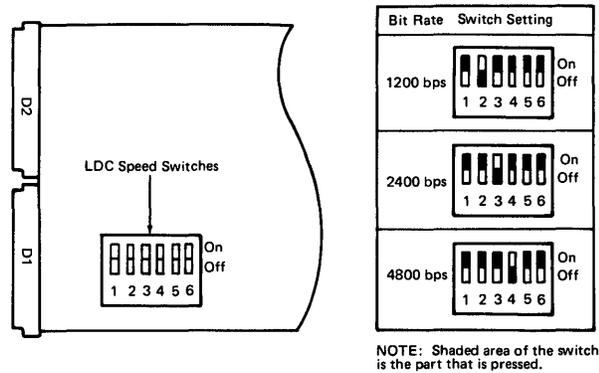


Figure 11-6. LDC Switch Settings

**CHECKING THE LDC CABLE RESISTANCE**

To check the Displaywriter LDC cable and the customer's twinaxial cable verify the resistances in Figure 11-5.

Measure from:	LDC Stub Cable Resistance	Customer Twinaxial Cable Resistance
One Center Conductor to the other center conductor	maximum: 30 ohms	minimum: 1 megohm (without jumper) maximum: 115 ohms (with jumper installed at remote end)
Center conductor to Conductor Shell.	50 - 60 ohms	minimum: 1 megohm

Figure 11-5. LDC Cable Resistance Chart.

## CHAPTER 12. CABLES, CONNECTORS AND TEST POINTS

### LOCATOR CHART

This section will aid in locating cards, cables, connectors, and test points, for communications in the IBM Displaywriter work station. Wire termination points are also given for doing continuity checks. Use the Point To Point Wiring Locator Chart Figure 12-7 for tracing wires through the Displaywriter System.

When instructed by MAPs to measure a voltage:

- Refer to the Locator Chart Figure 12-1 to find the name of the card or connector to be measured. The cards and connectors are listed by module.
- Refer to the figure number in the "Go To Figure" column for the location of the connector or card test point to be measured.

Signal Ground is to be used when measuring voltages.

Frame Ground is earth ground and is used only for electrostatic discharge grounding. The use of frame ground when measuring voltages should only be used when instructed by MAPs.

**Note:** Only use a Fluke<sup>1</sup> digital multimeter or it's equivalent for all

voltage readings while servicing the IBM Displaywriter System. The use of any other multimeter to check voltages may cause circuit damage.

ELECTRONICS MODULE	
Connector/Card	Go to Figure
4 Panel 1 Communications	12-8
11 Communications DC Connector	12-9
A2	12-8
S1	12-10
Distribution Board	12-11
DISKETTE UNIT	
Connector/Card	Go to Figure
A1	12-12
B1	12-13
C1	12-14
C2	12-15
D1	12-16
D2	12-15
Distribution Board	12-11
D3	12-16
4B	12-15, 16
D1 (X.21 Only)	12-17
D2 (X.21 Only)	12-17

Figure 12-1. Locator Chart (For Use With MAPs)

<sup>1</sup> Trademark of John Fluke Manufacturing, Inc.

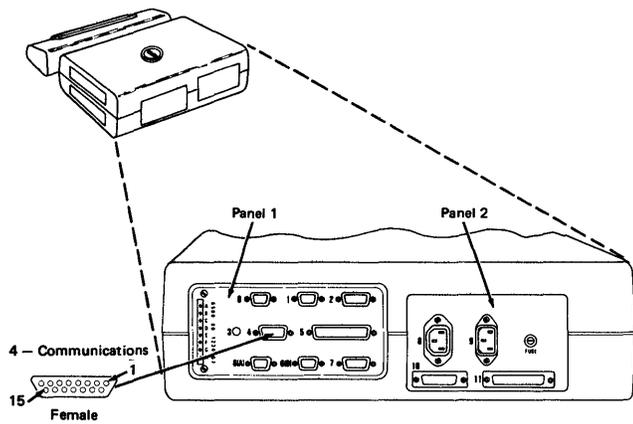


Figure 12-2. Electronics Module Panel 1 Pin Locator

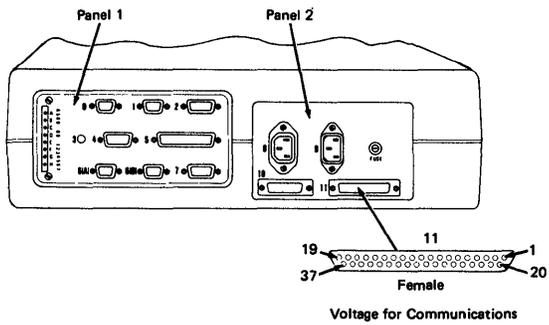


Figure 12-3. Power Supply (Panel 2) Connector Pin Locators

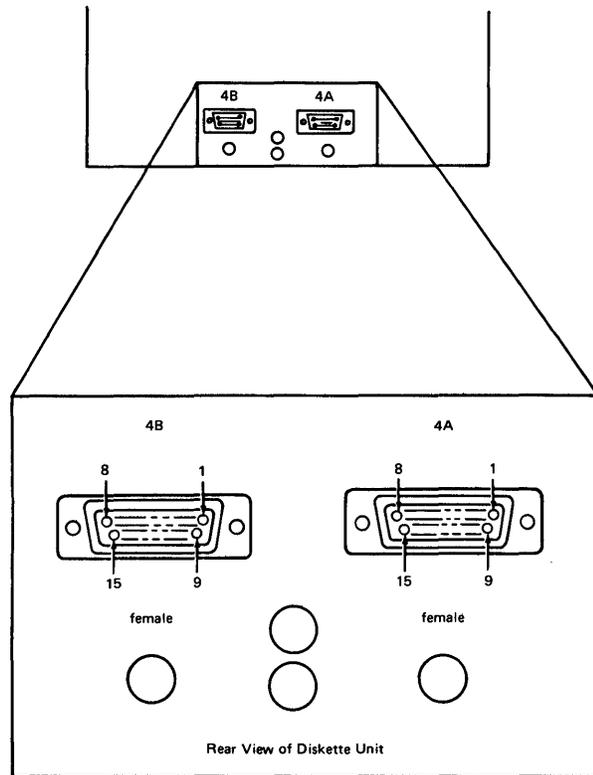


Figure 12-4. Diskette Unit Connectors 4A and 4B Pin Locator

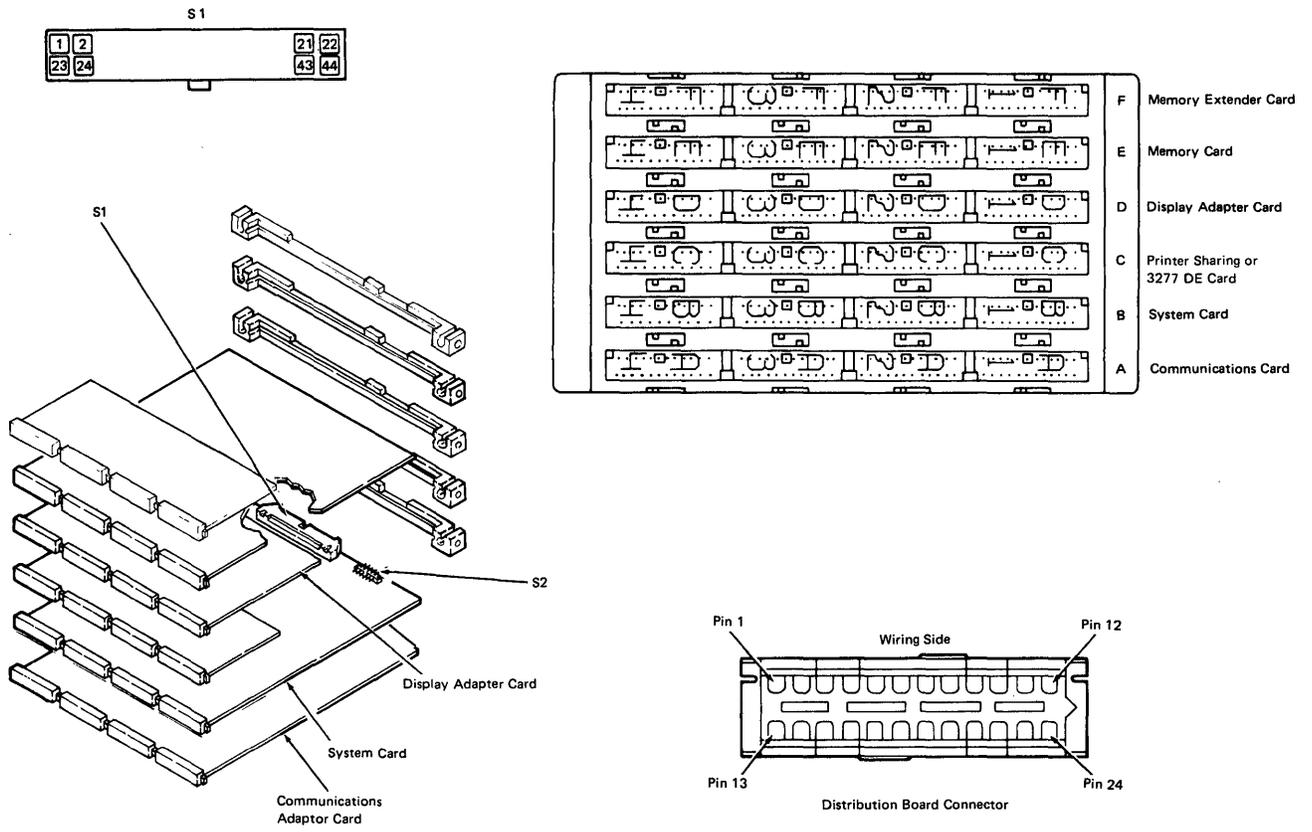
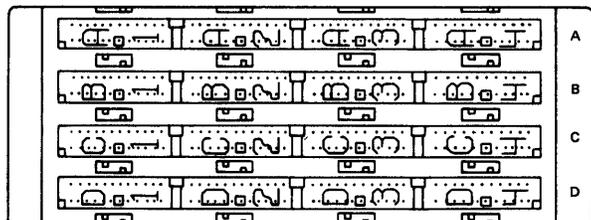


Figure 12-5. Electronics Module Distribution Board Connector Pin Locators



Diskette Unit Distribution Board  
Service Position

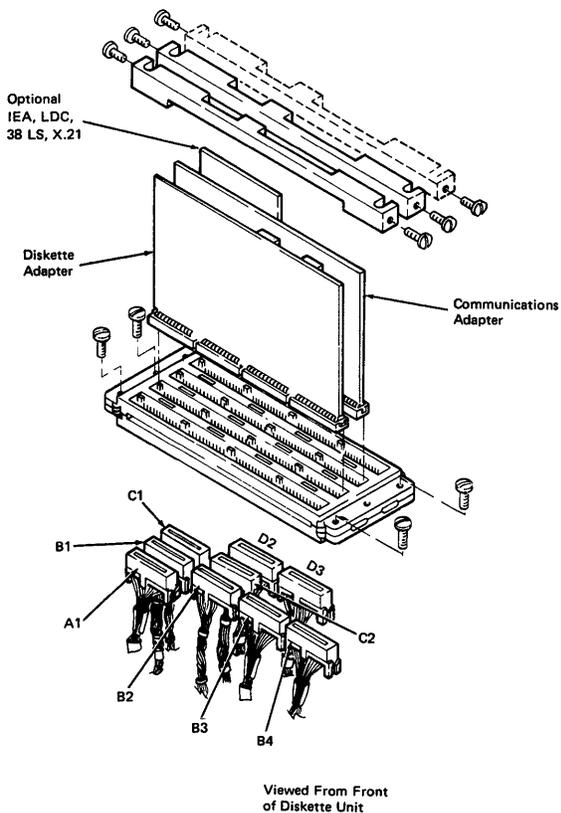
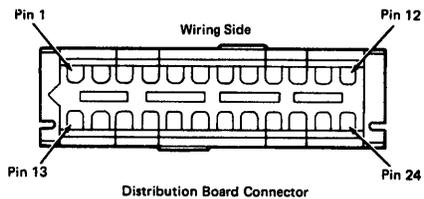


Figure 12-6. Diskette Unit Communication Cards Connector Pin Locators

**LOCATOR CHART FOR POINT TO POINT WIRING**

The Point To Point Wiring Locator Chart will aid service personnel locate connector wires when doing continuity checks, tracing wires in cables, and checking voltages. All Displaywriter connectors except Panel 1 connectors 5, 6A, 6B, and 7 can be used as a starting point for wiring checks.

Signal Ground is to be used when measuring voltages.

Frame Ground is earth ground and is used only for electrostatic discharge grounding. The use of frame ground when measuring voltages should only be used when instructed by MAPs.

**Note:** Only use a Fluke digital multimeter or it's equivalent for all voltage readings while servicing the IBM Displaywriter System. The use of any other multimeter to check voltages may cause circuit damage.

ELECTRONICS MODULE	
Connector/Card	Go to Figure
4 Panel 1	12-8
11 Communications	12-9
Power	
A2	12-8
S1	12-10
5	12-10
Distribution Board	12-11
DISKETTE UNIT	
Connector/Card	Go to Figure
A1	12-12
B1	12-13
C1	12-14
C2	12-15
D2 For Dual EIA	12-15
D3 LDC	12-16
D3 38LS	12-16

Figure 12-7. Locator Chart (For Point To Point Wiring)

**ELECTRONICS MODULE**

**PANEL 1 CONNECTOR 4, DISTRIBUTION BOARD CONNECTOR A2, AND MODEM CABLE CONNECTOR**

All Panel 1 Connectors are shown from the outside rear view of the Electronics Module.



Conn/Pin	Conn/Pin	Conn/Pin	Identification
A2-19	4-1	Modem-2	Transmit Data
A2-22	4-2	Modem-3	Receive Data
A2-23	4-3	Modem-4	Request To Send
A2-16	4-4	Modem-5	Clear To Send
A2- 5	4-5	Modem-6	Data Set Ready
A2-	4-6	Modem-1	Protective Ground
A2- 2	4-7	Modem-8	Receive Line S.D.
A2-21	4-8	Modem-11	Select Standby
A2- 6	4-9	Modem-7	Signal Ground
A2-10	4-10	Modem-15	Transmit S.E.T.
A2- 4	4-11	Modem-17	Receive S.E.T
A2- 7	4-12	Modem-18	Test
A2-12	4-13	Modem-20	Data Terminal Ready
A2-13	4-14	Modem-22	Ring Indicate
A2- 8	4-15	Modem-23	Data Select R.D.

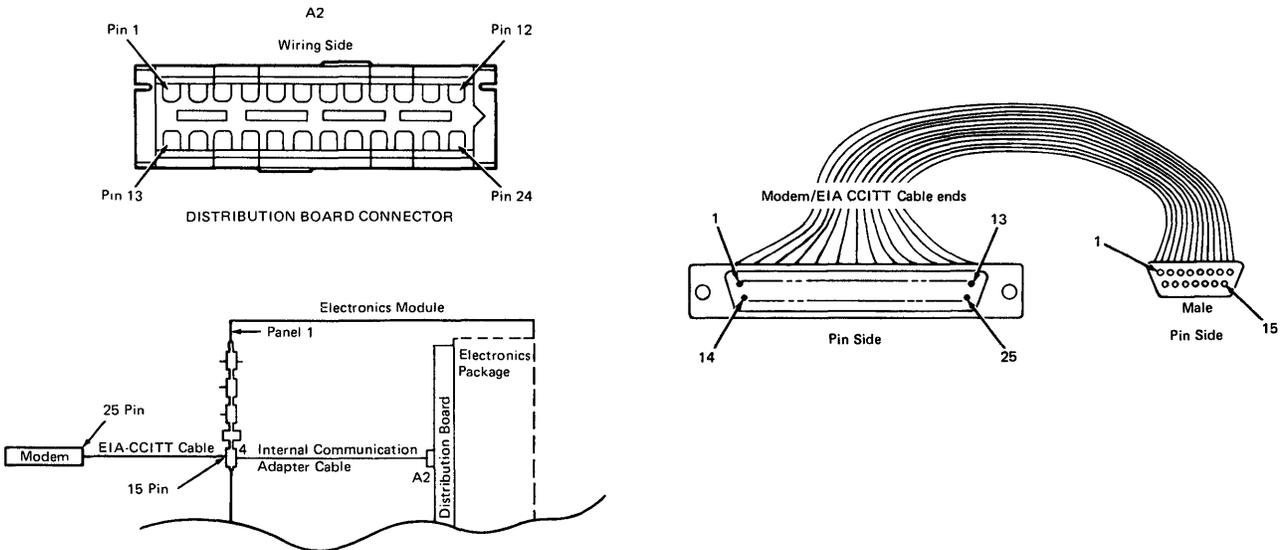
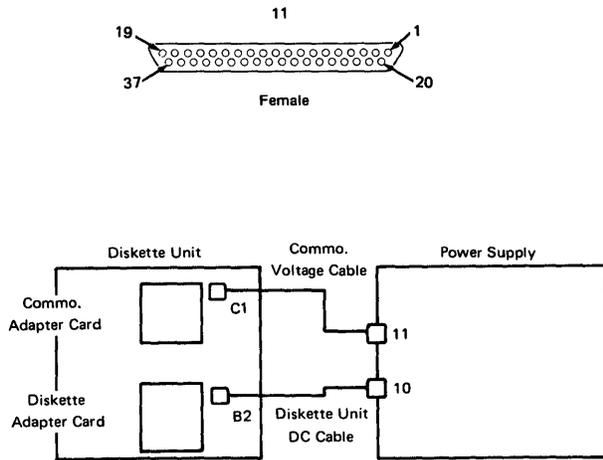


Figure 12-8. Panel 1 Connector

## POWER SUPPLY CONNECTORS 11

All Panel 1 Connectors are shown from the outside rear view of the Electronic Module. All other connectors are shown from the wiring side.



Conn/Pin	Conn/Pin	Identification
11-1	C1-6	Signal Ground
11-2	C1-7	Signal Ground
11-3	C1-8	Signal Ground
11-4	C1-9	Signal Ground
11-5	C1-19	Signal Ground
11-6	C1-20	Signal Ground
11-7		Signal Ground
11-8		Signal Ground
11-9	C1-5	+12.0 VDC
11-10	C1-13	+ 5.0 VDC
11-11	C1-14	+ 5.0 VDC
11-12	C1-15	+ 5.0 VDC
11-13	C1-16	+ 5.0 VDC
11-14	C1-1	+ 5.0 VDC
11-15	C1-2	+ 5.0 VDC
11-16	C1-10	+ 8.5 VDC
11-17		+ 8.5 VDC
11-18	C1-12	- 5.0 VDC
11-19	C1-17	-12.0 VDC

Note: Pins 20 through 37 not used

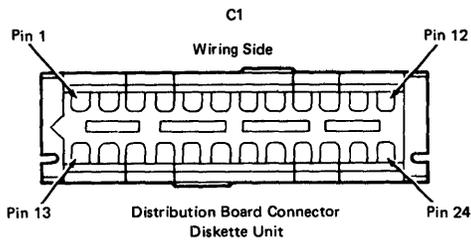
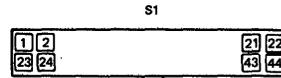
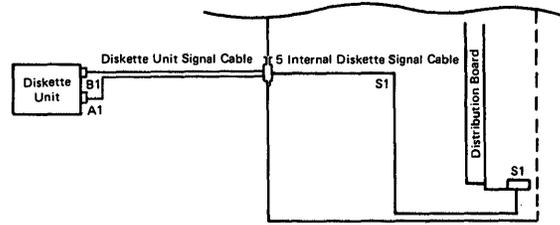


Figure 12-9. Power Supply Connectors

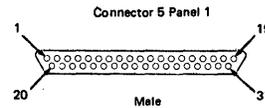
## SYSTEM CARD CONNECTORS S1

All Panel 1 Connectors are shown from the outside rear view of the Electronics Module. All other connectors are shown from the wiring side.

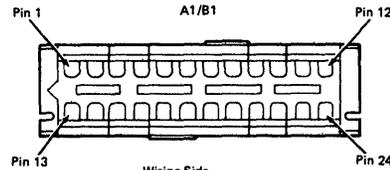
Conn/Pin	Conn/Pin	Conn/Pin	Conn/Pin	Identification
S1-1				
S1-2				
S1-3				
S1-4				
S1-5	5-5		A1-10	Address Bit 8
S1-6	5-20		A1-23	DMA Request Receive
S1-7				
S1-8	5-22		A1-11	DMA Request Transmit
S1-9	5-36	B-11		Data Bus Bit 2
S1-10	5-37	B1-12		Data Bus Bit 0
S1-11	5-27	B1-2		Interrupt 4
S1-12	5-26		A1-22	Interrupt 1
S1-13	5-29	B1-4		DMA Request
S1-14	5-30		A1-12	Reset
S1-15	5-31	B1-6	A1-6	I/O Read
S1-16	5-32	B1-7	A1-7	Address Bit 4
S1-17				
S1-18				
S1-19				
S1-20	5-8		A1-21	Select
S1-21	5-33	B1-8	A1-8	Address Bit 2
S1-22				
S1-23				
S1-24				
S1-25				
S1-26				
S1-27	5-34	B1-9		Data Bus Bit 6
S1-28	5-1		A1-18	DMA Acknowledge Receive
S1-29	5-4, 5-13		A1-19	Twisted Pair Ground
S1-30	5-19	B1-24		Data Bus Bit 1
S1-31	5-35	B1-10		Data Bus Bit 4
S1-32	5-18	B1-23		Data Bus Bit 3
S1-33	5-7		A1-17	Interrupt 7
S1-34	5-10	B1-15		Diskette Ready
S1-35	5-11	B1-16		DMA Acknowledge
S1-36	5-12	B1-17		Diskette Select
S1-37	5-9	B1-14	A1-16	I/O Write
S1-38	5-14	B1-18		Address Bit 3
S1-39	5-15	B1-20	A1-20	Address Bit 1
S1-40	5-16	B1-21		Data Bus Bit 7
S1-41	5-17	B1-22		Data Bus Bit 5
S1-42	5-28	B1-3		Terminal Count
S1-43	5-21		A1-24	DMA Acknowledge Transmit
S1-44				



Wiring Side



Male



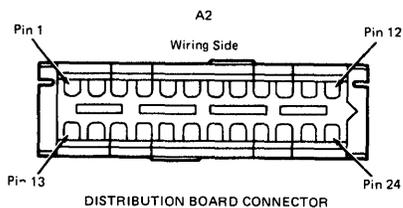
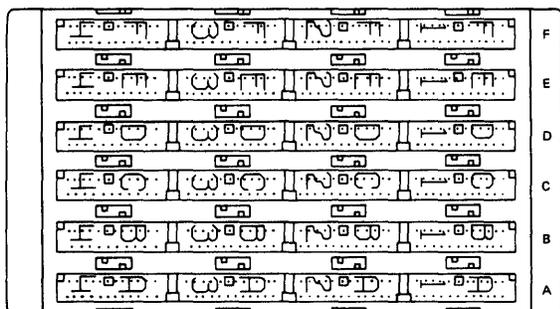
Wiring Side  
Diskette Distribution  
Board Connector

Figure 12-10. System Card Connector S1

**Note: All Grounds Are Signal Grounds**

**Distribution Board**

F4	F3	F2	F1	Memory Extender Card (Position F)
E4	E3	E2	E1	Memory Card (Position E)
D4	D3	D2	D1	Display Adapter Card (Position D)
C4	C3	C2	C1	Printer Sharing Card or 3277 DE Card (Position C)
B4	B3	B2	B1	System Card (Position B)
A4	A3	A2	A1	Communications Card (Position A)



Pin	Voltage	Pin	Voltage	Pin	Voltage	Pin	Voltage
6	Ground	6	Ground	6	Ground	6	Ground
11	+5 VDC	11	+5 VDC	11	+5 VDC	11	+5 VDC
				13	-5 VDC	13	-5 VDC
				15	+8.5 VDC	15	+8.5 VDC
				20	+12 VDC	20	+12 VDC
E4		E3		E2		E1	
6	Ground	6	Ground	6	Ground	6	Ground
11	+5 VDC	11	+5 VDC	11	+5 VDC	11	+5 VDC
				13	-5 VDC	13	-5 VDC
				15	+8.5 VDC	15	+8.5 VDC
				20	+12 VDC	20	+12 VDC
D4		D3		D2		D1	
6	Ground	6	Ground	6	Ground	6	Ground
11	+5 VDC	11	+5 VDC	11	+5 VDC	11	+5 VDC
						13	-5 VDC
						15	+8.5 VDC
						20	+12 VDC
C4		C3		C2		C1	
6	Ground	6	Ground	6	Ground	6	Ground
11	+5 VDC	11	+5 VDC	11	+5 VDC	11	+5 VDC
						13	-5 VDC
						15	+8.5 VDC
B4		B3		B2		B1	
6	Ground	6	Ground	6	Ground	6	Ground
11	+5 VDC	11	+5 VDC	11	+5 VDC	11	+5 VDC
A4		A3		A2		A1	
		6	Ground	6	Ground	Pin	Voltage
						3	Ground
						4	Ground
						5	Ground
						6	Ground
						8	-12 VDC
						9	+5 VDC
						10	+5 VDC
						11	+5 VDC
						12	+5 VDC
						13	-5 VDC
						15	+8.5 VDC
						16	Ground
						17	Ground
						18	Ground
						20	+12 VDC
						22	+5 VDC
						23	+5 VDC
						24	+5 VDC

**Figure 12-11. Distribution Board and Distribution Board Connectors**

## DISKETTE UNIT

All Panel 1 Connectors are shown from the outside rear view of the Electronics Module. All other connectors are shown from the wiring side.

### DISKETTE UNIT CONNECTOR A1

Conn/Pin	Conn/Pin	Conn/Pin	Identification
A1-1	-	-	-
A1-2	-	-	-
A1-3	-	-	-
A1-4	-	-	-
A1-5	-	-	-
A1-6	5-31	S1-15	I/O Read
A1-7	5-32	S1-16	Address Bit 4
A1-8	5-33	S1-21	Address Bit 2
A1-9	-	-	-
A1-10	5-5	S1-5	Address Bit 8
A1-11	5-22	S1-8	DMA Request Trans.
A1-12	5-30	S1-14	Reset
A1-13	-	-	-
A1-14	-	-	-
A1-15	-	-	-
A1-16	5-9	S1-37	I/O Write
A1-17	5-7	S1-33	Interrupt 7
A1-18	5-1	S1-28	DMA Ack. Rec.
A1-19	5-13	-	Ground
A1-20	5-20	S1-39	Address Bit 1
A1-21	5-8	S1-20	Select
A1-22	5-26	S1-12	Interrupt 1
A1-23	5-15	S1-6	DMA Request Receive
A1-24	5-21	-	DMA Ack. Transmit

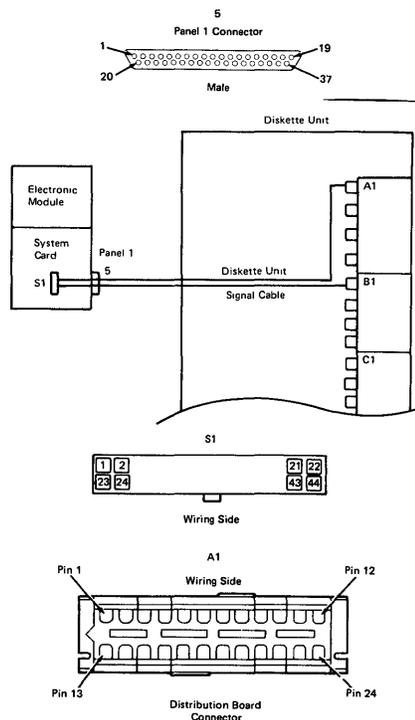


Figure 12-12. Diskette Unit Connector A1

### DISKETTE UNIT CONNECTOR B1

All Panel 1 Connectors are shown from the outside rear view of the Electronics Module. All other connectors are shown from the wiring side.

All Panel 1 Connectors are shown from the outside rear view of the Electronics Module. All other connectors are shown from the wiring side.

Conn/Pin	Conn/Pin	Conn/Pin	Identification
B1-1	-	-	-
B1-2	5-27	S1-11	Interrupt 4
B1-3	5-28	S1-42	Terminal Count
B1-4	5-29	S1-13	DMA Request
B1-5	-	-	-
B1-6	5-31	S1-15	I/O Read
B1-7	5-32	S1-16	Address Bit 4
B1-8	5-33	S1-21	Address Bit 2
B1-9	5-34	S1-27	Data Bus Bit 6
B1-10	5-35	S1-31	Data Bus Bit 4
B1-11	5-36	S1-9	Data Bus Bit 2
B1-12	5-37	S1-10	Data Bus Bit 0
B1-13	-	-	-
B1-14	5-9	S1-37	I/O Write
B1-15	5-10	S1-34	Diskette Ready
B1-16	5-11	S1-35	DMA Acknowledge
B1-17	5-12	S1-36	Diskette Select
B1-18	5-14	S1-38	Address Bit 3
B1-19	5-4, 13, 24	S1-29	Twisted Pair Ground
B1-20	5-15	S1-39	Address Bit 1
B1-21	5-16	S1-40	Data Bus Bit 7
B1-22	5-17	S1-41	Data Bus Bit 5
B1-23	5-18	S1-32	Data Bus Bit 3
B1-24	5-19	S1-30	Data Bus Bit 1

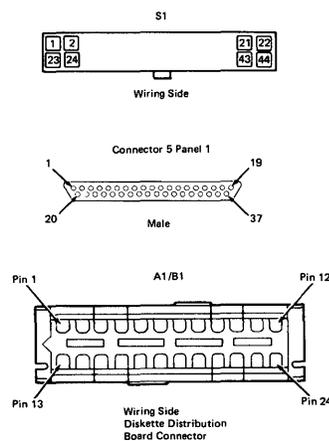
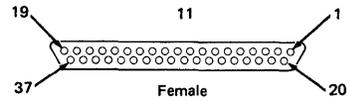


Figure 12-13. Diskette Unit Connector B1

**DISKETTE UNIT CONNECTOR C1**

All panel 1 Connectors are shown from the outside rear view of the Electronics Module. All other connectors are shown from the wiring side.



Conn/Pin	Conn/Pin	Identification
C1-1	11-14	+5.0 VDC
C1-2	11-15	+5.0 VDC
C1-3		+5.0 VDC
C1-4		-
C1-5	11-9	+12.0 VDC
C1-6	11-1	Signal Ground
C1-7	11-2	Signal Ground
C1-8	11-3	Signal Ground
C1-9	11-4	Signal Ground
C1-10	11-16	+8.5 VDC
C1-11		-
C1-12	11-18	-5.0 VDC
C1-13	11-10	+5.0 VDC
C1-14	11-11	+5.0 VDC
C1-15	11-12	+5.0 VDC
C1-16	11-13	+5.0 VDC
C1-17	11-19	-12.0 VDC
C1-18		-
C1-19	11-5	Signal Ground
C1-20	11-6	Signal Ground
C1-21		-
C1-22		-
C1-23		-
C1-24		-

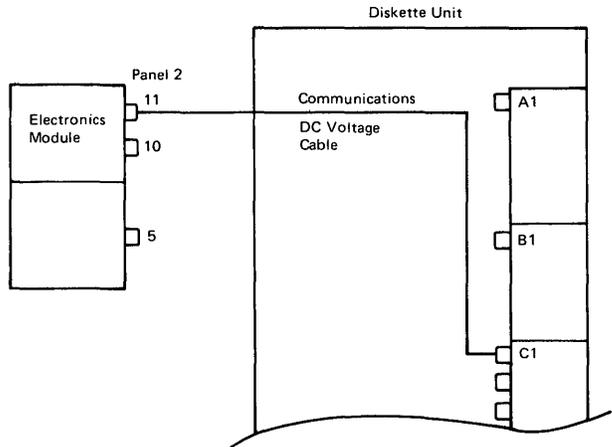
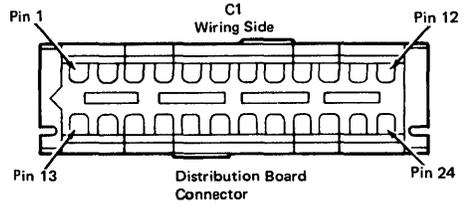
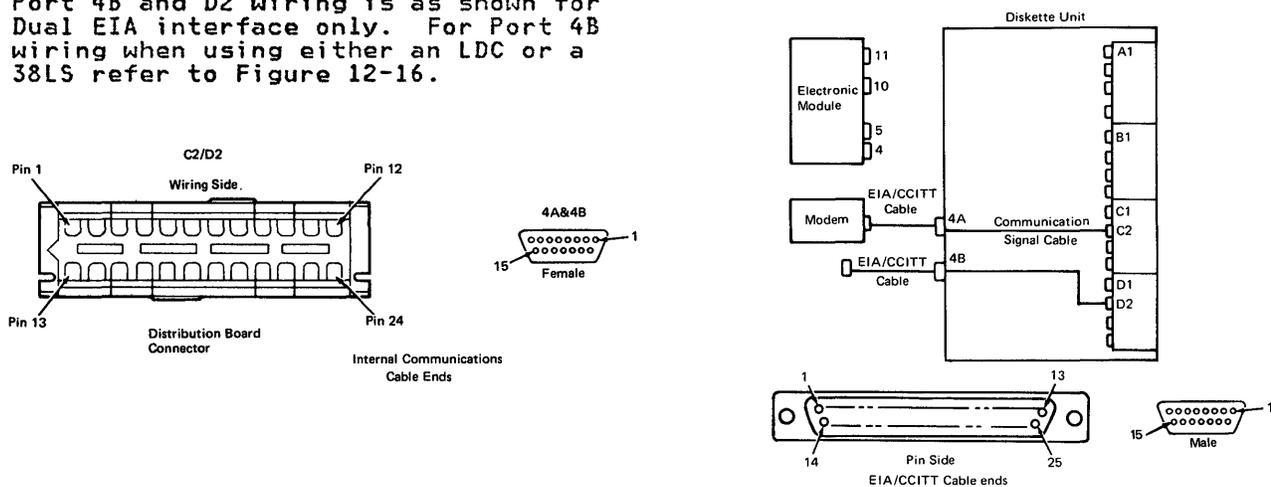


Figure 12-14. Diskette Unit Connector C1

## DISKETTE UNIT CONNECTORS C2, D2, 4A, 4B

Port 4B and D2 wiring is as shown for Dual EIA interface only. For Port 4B wiring when using either an LDC or a 38LS refer to Figure 12-16.



Conn/Pin	Conn/Pin	Conn/Pin	Identification
C2-6	4A-1	Modem-2	Transmit Data
C2-3	4A-2	Modem-3	Receive Data
C2-2	4A-3	Modem-4	Request to Send
C2-9	4A-4	Modem-5	Clear to Send
C2-20	4A-5	Modem-6	Data Set Ready
-	4A-6	Modem-1	Shield Ground
C2-23	4A-7	Modem-8	Carrier Detect
C2-4	4A-8	Modem 11	Select Standby
C2-19	4A-9	Modem 7	Signal Ground
C2-15	4A-10	Modem 15	Transmit Clock
C2-21	4A-11	Modem 17	Receive Clock
C2-18	4A-12	Modem 18	Test
C2-13	4A-13	Modem-20	Data Terminal Ready
C2-12	4A-14	Modem-22	Ring Indicate
C2-17	4A-15	Modem-23	Data Rate Select

Conn/Pin	Conn/Pin	Conn/Pin	Identification
D2-6	4B-1	Modem-2	Transmit Data
D2-3	4B-2	Modem-3	Receive Data
D2-2	4B-3	Modem-4	Request to Send
D2-9	4B-4	Modem-5	Clear to Send
D2-20	4B-5	Modem-6	Data Set Ready
-	4B-6	Modem-1	Shield Ground
D2-23	4B-7	Modem-8	Carrier Detect
D2-4	4B-8	Modem-11	Select Standby
D2-19	4B-9	Modem-7	Signal Ground
D2-15	4B-10	Modem-15	Transmit Clock
D2-21	4B-11	Modem-17	Receive Clock
D2-18	4B-12	Modem-18	Test
D2-13	4B-13	Modem-20	Data Terminal Ready
D2-12	4B-14	Modem-22	Ring Indicate
D2-17	4B-15	Modem-23	Data Rate Select

Figure 12-15. Diskette Unit Connectors C2, D2, 4A & 4B (Dual EIA)

## DISKETTE UNIT CONNECTORS D3, AND 4B

Port 4B and D3 wiring is as shown for LDC or 38LS interface only. For Port 4B wiring when using a dual EIA interface refer to Figure 12-15.

Conn/Pin	Conn/Pin	Identification
D3-3	4B-2	Leased Line Transmit
D3-15	4B-10	Leased Line Transmit
D3-6	4B-1	Leased Line Receive
D3-23	4B-7	Leased Line Receive

38LS

Conn/Pin	Conn/Pin	Identification
D3-3	4B-2	Bus High
D3-15	4B-10	Bus Low

LDC

Figure 12-16. Diskette Unit Connectors D3, and 4B for LDC or 38LS

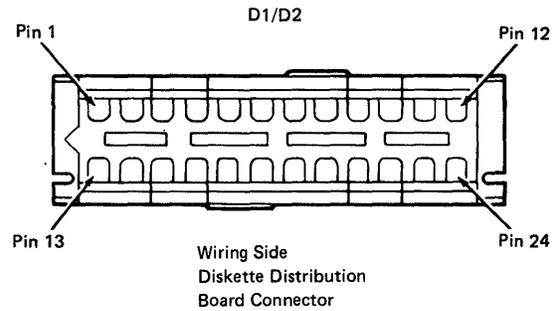
Conn/Pin	Conn/Pin	Identification
D3-2	4B-3	OH
D3-9	4B-4	SH
D3-12	4B-14	RI
D3-13	4B-13	DA
D3-19	4B-9	DT and SG
D3-20	4B-5	CCT
D3-21	4B-11	DR

Conn/Pin	Conn/Pin	Identification
C3-1	D1-1	Data Terminal Ready
C3-2	D1-2	Select Standby
C3-3	D1-3	Data Rate Select
C3-4	D1-4	Test
C3-6	D1-6	Transmit Clock
C3-7	D1-7	Receive Clock
C3-8	D1-8	New Sync
C3-9	D1-9	Receive Data
C3-11	D1-11	Carrier Detect
C3-12	D1-12	Data Set Ready
C3-13	D1-13	Request to Send
C3-15	D1-15	Transmit Data
C3-17	D1-17	Ground
C3-19	D1-19	Ground
C3-21	D1-21	Test
C3-23	D1-23	Ring Indicate
C3-24	D1-24	Clear to Send

Internal Signals to Optional Cards

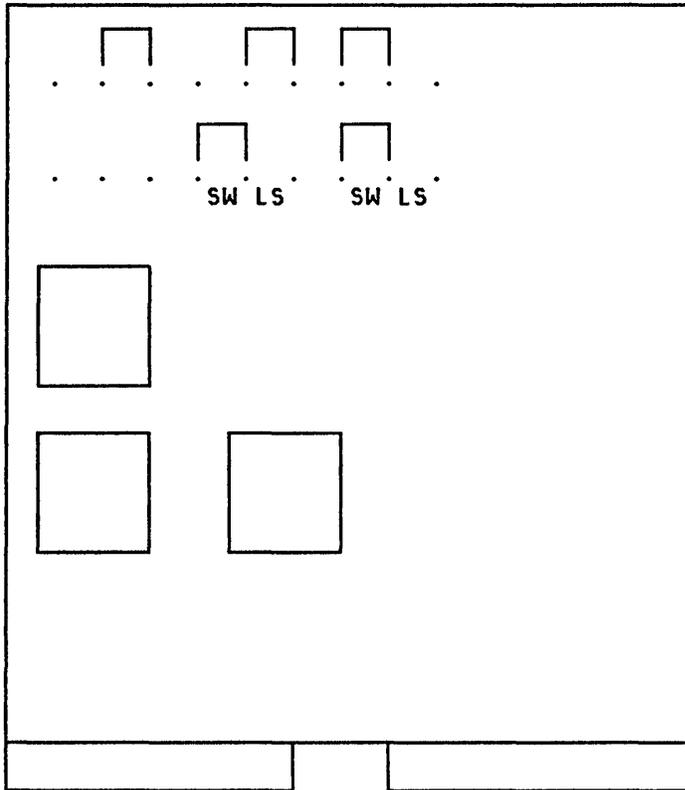
## X.21 D1 AND D2 CONNECTORS

Conn/Pin	Conn/Pin	Identification
C3-1	D1-1	Data Terminal Ready
C3-2	D1-2	Select Standby
C3-3	D1-3	Data Rate Select
C3-4	D1-4	Test
C3-5	-	-
C3-6	D1-6	Transmit Clock
C3-7	D1-7	Receive Clock
C3-8	D1-8	New Sync
C3-9	D1-9	Receive Data
C3-10	-	-
C3-11	D1-11	Carrier Detect
C3-12	D1-12	Data Set Ready
C3-13	D1-13	Request to Send
C3-14	-	-
C3-15	D1-15	Transmit Data
C3-16	-	-
C3-17	-	-
C3-18	-	-
C3-19	D1-19	Ground
C3-20	D1-20	Diag Clock Input
C3-21	-	-
C3-22	D1-22	Reset (POR)
C3-23	D1-23	Ring Indicate
C3-24	D1-24	Clear to Send



Conn/Pin	Conn/Pin	Conn/Pin	Identification
D2-1	4B-2	DCE-10	T-A Transmit
D2-2	-	-	-
D2-3	4B-15	DCE-5	I-B Indication
D2-4	4B-3	DCE-12	C-A Control
D2-5	-	-	-
D2-6	4B-7	-	Diag Clock - A
D2-7	4B-5	-	Diag Clock - B
D2-8	4B-1	DCE-11	R-A Receive
D2-9	-	-	-
D2-10	-	-	-
D2-11	-	-	-
D2-12	4B-13	DCE-7	S-B Signal Element Timing
D2-13	-	-	-
D2-14	-	-	-
D2-15	4B-8	DCE-15	S-A Signal Element Timing
D2-16	4B-10	DCE-2	T-B Transmit
D2-17	4B-14	DCE-4	C-B Control
D2-18	-	-	-
D2-19	4B-9	DCE-8	Ground
D2-20	-	-	-
D2-21	4B-4	DCE-13	I-A Indication
D2-22	-	-	-
D2-23	-	-	-
D2-24	4B-11	DCE-3	R-B Receive

Figure 12-17. X.21 Connectors



Note: Top row of jumpers are fixed jumpers and should not be removed. The two jumpers on the bottom row are factory-set for a switched line. For a leased line setting move to appropriate pins as shown in card diagram.

SW=Switched Line LS=Leased Line

Figure 12-17. X.21 Adapter Card



## GLOSSARY

The terms in this glossary are associated with the Displaywriter's ASYNC, BSC, and 3270 DSC applications and are defined as used in this publication.

The glossary includes definitions from:

- American National Standard Vocabulary for Information Processing (copyright 1970 by American National Standards Institute, Inc.). Definitions taken from ANSI are preceded by an asterisk (\*).
- ISO Vocabulary of Data Processing, developed by the International Standards Organization, Technical Committee 97, Subcommittee 1. ISO

precedes definitions from this source.

- IBM Data Processing Glossary, GC20-1699.
- IBM Systems Network Architecture Handbook Customer Service Division, S239-4522.
- IBM Implementation of X.21 Interface General Information Manual, GA27-3287.

The glossary does not include terms that are defined in nontechnical dictionaries and that have no special meaning in data processing. Some terms may have different meanings in other contexts.

**Activate Logical Unit (ACTLU).** Starts a session between SSCP and the LU addressed and places the LU in an active state.

**Activate Physical Unit (ACTPU).** Starts a session between SSCP and the PU addressed and places the PU in an active state.

**ASync.** Asynchronous Communication.

**ASCII.** \* American National Standard Code for Information Interchange. The standard code, using a coded-character set consisting of 7-bit coded characters (8 bits including parity check), used for information interchange among data processing systems, data communication systems, and associated equipment. The ASCII set consists of control and graphic characters.

**asynchronous.** Data transmission in which each information character is individually synchronized (usually by the use of start bits and stop bits).

**Basic Information Unit (BIU).** The combination of the RH and RU.

**Basic Link (BLU).** The data unit transmitted between nodes by the DLC element

**BCC.** Block Check Character

**Begin Bracket (BB).** A bit in the RH indicating this PIU is beginning a bracket.

**BEL.** Bell

**BID.** An SNA command sent from a LU to its session partner requesting permission to start a bracket.

**Binary Synchronous Communication (BSC).** (1) Communication using synchronous transmission. (2) A uniform procedure, using a standardized set of control characters and control sequences, for synchronous transmission of binary-coded data between stations.

**BIND.** A request to start a session between two logical units. Parameters passed with the BIND define all of the protocols that must be observed during this session.

**BIS.** Bracket Initiation Stopped

**Block Check Character.** A one byte LRC (ASCII) or a two byte CRC (EBCDIC) used for BSC error checking.

**bps.** Bits per second. The number of bits sent (per unit of time) between transmission of the first bit and delivery of the last bit.

**Bracket.** One or more chains of requests/responses that represent a transaction or unit of work.

**BS.** Backspace.

**BS (UC).** Backspace Upper Case.

**BSC.** Binary Synchronous Communication  
**business machine clocking.** A time base oscillator supplied by the business machine for regulating the bit rate of transmission.

**CAN.** Cancel.

**CCITT Recommendation V.28.** A standard electrical interface for data communications terminals and their interface with signal converters implemented by the International Telephone and Telegraph Consultative Committee (CCITT). CCITT is an international organization that promotes the standardization and coordination of worldwide communications facilities.

**Chain.** A set of related RUs that are consecutively transmitted on a particular normal or expedited flow.

**Chase.** In SNA, a command sent by an LU to request the receiving LU to return all outstanding normal flow responses to requests previously received from the issuer of CHASE.

**Change Direction (CD).** An indicator in the RH specifying the receiving LU can start sending.

**Clear.** In SNA, a command set by primary session control to reset the traffic FSMs and subtrees in both secondary and primary function

**code set.** (ISO) The complete set or representations defined by a code or by a coded character set.

**communications adapter.** A hardware device used with the Displaywriter that provides both an EIA RS-232C compatible interface and an integrated modem interface for the Displaywriter System.

**communications controller.** A type of communication control unit (for example an IBM 3705) whose operations are controlled by a program stored and executed in the unit.

**communications link.** The electrical path between data processing devices in a communications configuration.

**communications setup.** A stored profile that defines the operating characteristics (such as protocol and code set) of a communications session between a Displaywriter and a remote station. For any communication to

take place, at least one setup must be stored on the BSC program diskette.

**Connection Point Manager.** A component of the transmission control layer that coordinates the normal and expedited flows for a half-session; functions performed include session pacing, sequence numbering, routing, building/interpreting the RH.

**CPU.** Central processing unit.

**CR.** Carrier Return.

**CRC.** Cyclic Redundancy Check Character.

**CRE.** Carriage Return.

**CRV.** Cryptography Verification

**CUn.** Customer use number (the letter n represents a numeric value).

**Cyclic Redundancy Check (CRC).** A system of error checking performed at both the sending and receiving station after a block check character has been accumulated.

**DACTCDRM.** Deactivate Cross-domain Resource Manager

**DACTLU (Deactivate Logical Unit).** Ends a session between SSCP and the LU addressed.

**DACTPU (Deactivate Physical Unit).** Ends a session between SSCP and the PU addressed.

**DAF (Destination Address Field).** In SNA, a field in a transmission head that contains the network address of the destination.

**Data Flow Control (DFC).** In SNA, a request/response unit (RU) category used for requests and responses exchanged between the data flow control layer in one half-session and the data flow control layer in the session partner.

**Data Communication Equipment (DCE).** The common carrier's lines, devices and facilities that interconnect data terminal equipment.

**Data Link Control (DLC).** The layer which schedules data transfer on the link and performs error control for the link.

**Data Signaling Rate.** The aggregate signaling rate in the transmission path of a data transmission system, expressed in normalized form in binary digits (bits) per second (BPS).

**Data Set Ready (DSR).** A circuit that initiates the communications link once DTR has been activated.

**Data Terminal Equipment (DTE).** That part of a business machine that serves as a source, data sink, or both, and provides for the data communication control function according to protocols.

**Data Terminal Ready (DTR).** A circuit that activates the communications hardware.

**DCE.** Data Communication Equipment.

**Data Link Escape Character (DLC).** A transmission control character that changes the meaning of a limited number of contiguously following characters or coded representations and that is used exclusively to provide supplementary transmission control characters.

**DCn.** Device Control number (the letter n represents a numeric value).

**Dead Key.** A function on World Trade keyboards that prevents the machine from advancing to the next key when the "dead key" is pressed. The dead key function allows the typist to insert special punctuation, such as an accent mark, above the dead-key character.

**Definite Response (DR1-DR2).** A form of response requested in the RH which requires the receiver to send a response whether positive or negative.

**DEL.** Delete.

**Destination Address Field (DAF).** A field in the TH that contains the network address of the destination.

**DS.** Digit Select.

**DTE.** Data Terminal Equipment

**duplex line.** A communications line with two independent data paths over which data can be transmitted in both directions simultaneously.

**EBCDIC.** Extended binary coded decimal interchange code. A coded character set consisting of 8-bit coded characters. See code set.

**ECBS.** Error Correct Backspace.

**EIA.** Electronics Industries Association. An organization that promotes standardization and cooperation among electronic equipment industries.

**EIA RS-232C Interface.** The standard interface for communications that provides signal conversion for obtaining the voltage levels specified in the EIA Specification RS-232C and the CCITT Recommendation V.28. For the

Displaywriter system, the interface is packaged on the communications adapter card and is connected to an external modem via a cable.

**EM.** End of Medium.

**End Bracket (EB).** A bit in the RH indicating this PIU is ending the bracket.

**End User (EU).** The ultimate source or destination of information flowing within a network.

**ENQ.** Enquiry.

**EOT.** End of Transmission.

**ESC.** Escape.

**ETB.** End of Transmission Block.

**ETX.** End of Text.

**Exception Response (EXR).** A form of response requested in the RH which requires the receiver to only return a response if it is negative.

**Expedited Data Flow.** A data flow designated in the TH which carries NC, SC, and some DFC RUs. It is separate from and receives priority over normal flow.

**FCS (Frame Check Sequence).** In SDLC, sixteen bits in a frame that contain transmission-checking information.

**FF.** Form Feed.

**First in Chain (FIC).** A bit in the RH indicating this PIU is the first element in a chain of PIUs.

**FMD (Function Management Data).** In SNA, an RU category used for end-user data exchanged between logical units (LUs) and for requests and responses exchanged between network services components of LUs, PUs, and SSCPs.

**FMT.** Format.

**Format Identification Type (FID).** Indicates the format of the Transmission Header (TH).

**Frame.** The SDLC transmission unit.

**FRMR.** Frame Reject.

**FS.** Field Separator.

**full duplex line.** See duplex line

**Function Management Header (FMH).** A header in the RU which conveys specific information about the RU destination or characteristics.

**Function Management Profile.** A specification of data flow protocols supported for a particular session.

**GE.** Graphic Escape.

**GS.** Group Separator.

**half-duplex line.** A communications line with a single data path over which data can be transmitted in either direction (but not simultaneously).

**Half-Session.** A component that provides FMD services, DFC, and TC for one NAU in a session.

**HT.** Horizontal Tab.

**HYP.** Hyphen.

**IDLE.** Idle. A control character that is sent where there is no information to be sent.

**I-field.** An optional field in the SDLC frame. It contains data to be transferred over the data link.

**IFS.** Interchange File Separator.

**IGS.** Interchange Group Separator.

**INP.** Inhibit Presentation (Bypass)

**INX.** Index.

**IPR.** Isolated Pacing Response.

**IRS.** Interchange Record Separator.

**IRT.** Index Return.

**IT.** Indent Tab.

**ITB.** Intermediate Transmission Block

**IUS.** Interchange Unit Separator.

**Last in Chain (LIC).** A bit in the RH indicating this PIU is the last element in a chain.

**LC.** Lower Case.

**LF.** Line Feed or Index.

**Local Device Controller (LDC).** An integrated 2W-3H card that allows communication between locally-attached machines.

**Logical Session Identifier (LSID).** The address in th FID 3 Transmission Header (TH).

**logical unit.** An NAU having protocol boundaries with end users. A port through which an end user accesses the network.

**Longitudinal Redundancy Check (LRC).** A system of error checking

performed at the receiving station after a block check character has been accumulated.

**LU.** Logical Unit

**LUSTAT.** An SNA command used by one LU to send status information to its session partner.

**Mapping Field (MPF).** Two bits in the TH which tell path control whether that PIU contains a whole BIU or only a segment of a BIU.

**Middle in Chain (MIC).** A bit in the RH which indicates this PIU is a middle element of a chain.

**modem clocking.** A time base oscillator supplied by the data set for regulating the bit rate of transmission.

**multipoint network.** A configuration in which more than two terminal installations are connected. The network may include switching facilities.

**NAK.** Negative Acknowledge.

**NAU.** Network Addressable Unit

**NBS.** Numeric Backspace.

**NCP.** Network Control Program

**NDM.** Normal Disconnect Mode.

**Network Addressable Unit (NAU).** An LU, PU, or SSCP. It is the origin or destination of information transmitted by the path control network.

**Network Control Program (NCP).** A program which resides in the 3704/3705 communication controller and controls its operation.

**NL.** New Line.

**Node.** An end point of a link or junction common to two or more links in a network.

**non-switched communications network.** A network in which a communications line is permanently connected to a station.

**NRM.** Normal Response Mode.

**NSP.** Numeric Space.

**NUL.** Null.

**OCL.** Operator Control Language.

**Only In Chain (OIC).** A bit in the RH which indicates this PIU is a single element chain.

**Operator Control Language (OCL).** A programming language used with the

Office System 6 family of word processors.

**Origin Address Field (OAF).** A field in the TH that contains the address of the originating NAU.

**padding.** A technique by which a receiving station controls the rate of transmission of a sending station to prevent overrun.

**Path Information Unit (PIU).** A message unit in an SNA network consisting of the TH, RH, and RU.

**physical unit.** An NAU that provides a variety of network services related to session, configuration, maintenance and management, and network operator services.

**PIU.** Path Information Unit.

**POC.** Program-Operator Communication.

**point-to-point.** A data link that connects a single remote station to a host; it may either be switched or non-switched.

**PP.** Presentation Position.

**PRE.** Prefix.

**Primary LU (PLU).** The LU that sends the session activation request.

**PU.** Physical Unit.

**QC.** Quiesce Complete

**QEC.** Quiesce at End of Chain

**quiesce.** An SNA protocol that stops the sending of normal flow requests.

**RCR.** Required Carrier Return.

**Ready to Receive (RTR).** An SNA command used in bracket protocol by the first speaker to give the bidder permission to start a bracket.

**REQMS.** Request Maintenance Statistics

**RELQ.** Request Quiesce

**Remote Job Entry (RJE).** Submission of a job through an input unit that has access to a computer through a data link.

**REQDISCONT.** Request Discontact

**Request Definite Response (RQD).** Indicates an LU has coded the RH to request a definite response from its session partner.

**Request Exception Response (RQE).** Indicates an LU has coded the

RH to request a response from its session partner only if it is negative.

**Request/Response Header (RH).** Control information preceding an RU that contains information concerning that RU.

**Request/Response Unit (RU).** The basic unit of information transferred in an SNA Network.

**Request Shutdown (RSHUTD).** An SNA command sent by the secondary LU to its session partner indicating it would like to end the session.

**RES.** Restore.

**RFF.** Required Form Feed.

**RH.** Response Header.

**RJE.** Remote Job Entry.

**RNL.** Required New Line.

**RNR.** Receive Not Ready (SDLC)

**RPT.** Repeat.

**RQR.** Request Recovery

**RR.** Receive Ready (SDLC)

**RRI.** Request/response Indicator

**RS.** Record Separator.

**RSHUTD.** Request Shutdown

**RSP.** Required Space.

**+RSP.** Positive Response

**-RSP.** Negative Response

**RU.** Response Unit.

**RUC.** Response Unit Category

**SBI.** Start Bracket Initiation

**SBS.** Subscript.

**SC.** Session Control

**SDLC.** Synchronous Data Link Control

**SDT.** Start Data Traffic

**Secondary LU (SLU).** The LU that receives the session activation request.

**Segmenting.** An optional function of PC that divides a BIU into two or more PIUs.

**SEL.** Select.

**Session.** A logical connection established between two NAUs to allow them to communicate with each other.

**Session History document.** A record of the data that is sent or received during an active communications session. This document can be printed and edited off-line.

**Session ID.** An identification code that can be exchanged between a Displaywriter and a remote station during a communications session. If the exchanged ID's are validated, the session is started; if not, the session is terminated.

**Session Summary.** A permanent record of a session's activity.

**Set-and-Test Sequence Numbers (STSN).** An SNA command used to set-and-test the SNA sequence number for a session.

**Set Normal Response Mode (SNRM).** An SDLC command which sets a station in the mode required to poll it.

**Shutdown Complete (SHUTC).** An SNA command sent by the secondary LU to its session partner to indicate that it has completed session processing.

**Shutdown (SHUTD).** An SNA command sent by the Primary LU to its session partner to request that it enter a quiesce state as soon as it has completed the "end of session" processing.

**SI.** Shift In.

**Signal.** (TC97) A variation of a physical quantity, used to convey data. See inhibiting signal, selection signal, start signal, stop signal.

**SLU.** Secondary Logical Unit.

**SNA.** System Network Architecture

**SNRM.** Set Normal Response Mode.

**SO.** Shift Out.

**SOH.** Start of Heading.

**SOS.** Start of Significance.

**SP.** Space.

**SPS.** Superscript.

**SSCP.** System services control point.

**Start Data Traffic (SDT).** Completes the initialization sequence or the data traffic recovery operation. Normally, it is the first request sent after a successful Bind.

**STP.** Stop or Bell.

**STSN.** Set and Test Sequence Numbers

**STX.** Start of Text.

**SUB.** Substitute.

**SW.** Switch.

**switched communications network.** A single communications facility with only one station. The station may be disconnected when the facility is not in use.

**SYN.** Synchronous Idle.

**Synchronous Data Link Control (SDLC).** A discipline for managing synchronous, code-transparent, serial-by-bit information transfer over a link connection. Transmission exchanges may be duplex or half-duplex over switched or nonswitched links. The configuration of the link connection may be point-to-point, multipoint, or loop. SDLC conforms to subsets of the Advanced Data Communication Control Procedures of the American National Standards Institute and High-level Data Link control (HDLC) of the International Standards Organization.

**system network architecture.** A set of rules that govern the format, definition, and sequencing of information sent through a communication network.

**System Services Control Point (SSCP).** The NAU in the host that provides services supporting PUs and LUs. The SSCP is the focal point in the network.

**Terminal ID.** An identification code used by the remote station to identify authorized terminals and terminal types.

**Test.** A predetermined series of data against which to run a system or program to establish its acceptability.

**TH.** Transmission Header.

**TKLK.** Track Link.

**TKSK.** Track Skip.

**Transmission Header (TH).** Control information preceding the BIU that is created and used by PC to route and control the flow of messages.

**TRN.** Transparent.

**TTD.** Temporary Text Delay

**UA.** Unnumbered Acknowledge

**UBS.** Unit Backspace.

**UC.** Uppercase.

**Unbind.** Stops a session between two logical units.

**US.** Unit Separator.

**Vertical Redundancy Check (VRC).** In data communication, an odd parity check performed on each character of a block contrast with ASCII-coded data as a block is received.

**VT.** Veritical Tab.

**WUS.** Word Underscore.

**XID.** Exchange Station Identification.

**38LS Internal Modem.** The integrated modem used with the Displaywriter System.

**5608-SR1.** The IBM Displaywriter System Asynchronous Communications Program.

**5608-SR2.** The IBM Displaywriter System Binary Synchronous Communication Program.

**5608-SR6.** The IBM Displaywriter System 3270 Data Stream Compatibility





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