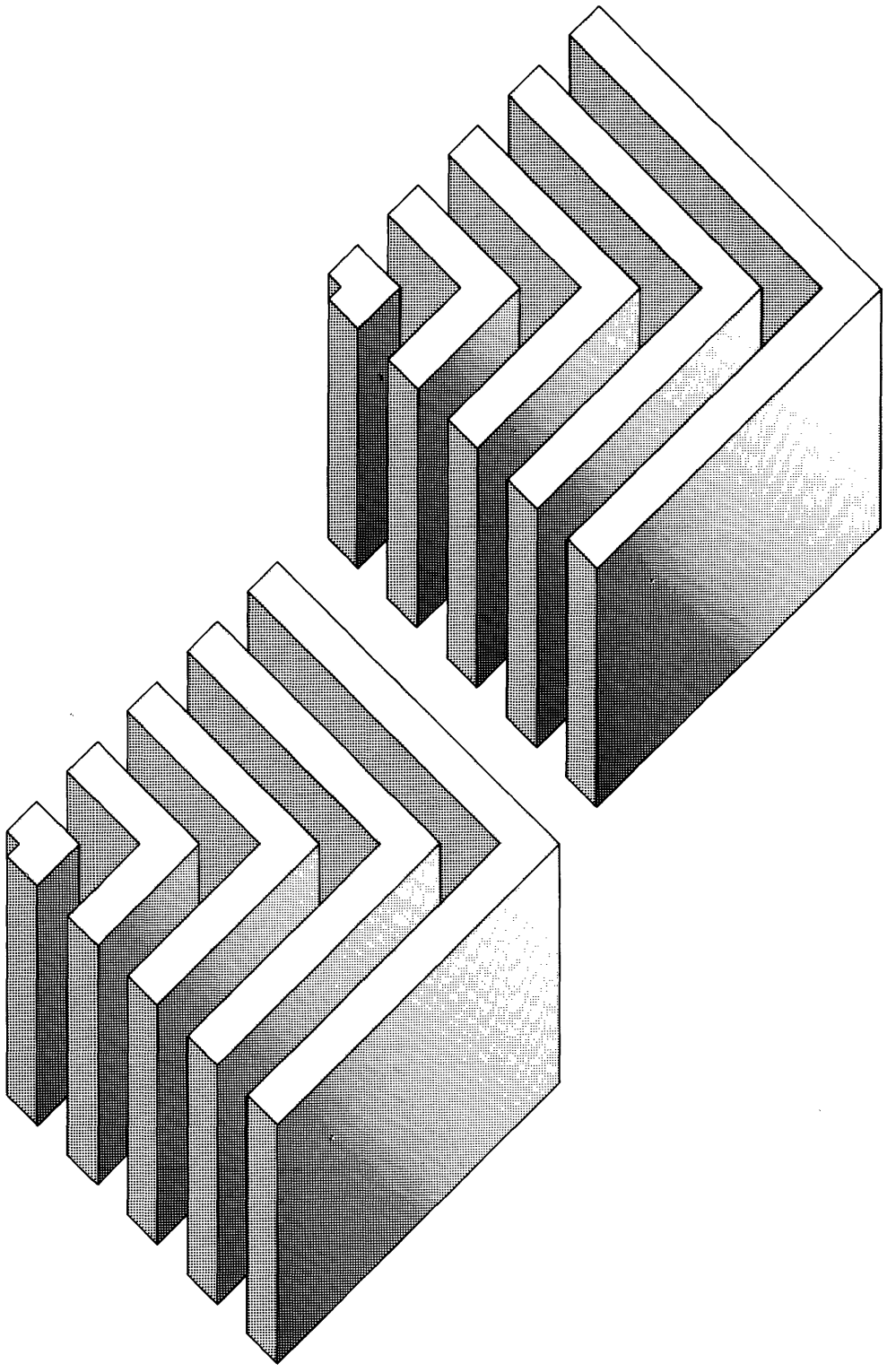
IBM Displaywriter System
Host Attach Programming Guide

Asynchronous Communication



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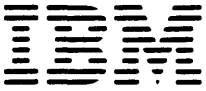

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First Edition, September 1981

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Preface

PURPOSE

This manual provides a detailed description of the IBM Displaywriter System's asynchronous communications (ASYNC) facility. It also describes programming requirements for host system and application programmers who use ASYNC protocols to communicate with a Displaywriter.

KEY TERMS

In this publication:

"Displaywriter" refers to the IBM Displaywriter System with the asynchronous communications program (IBM Licensed Program 5608-SR1) and a supporting textpack program.

"Host" generally refers to an IBM System/370, IBM 4300, or 303X processor. The term also can apply to a number of compatible IBM and non-IBM processors.

"OS/VS1" refers to Release 7 of Operating System/Virtual Storage, Option 1.

"OS/VS2" refers to Release 3.8 of Operating System/Virtual Storage, Option 2.

"DOS/VSE" refers to Release 2 of the Disk Operating System/Virtual Storage Extended.

"VM/370" refers to Virtual Machine Facility/370.

"CMS" refers to the Conversational Monitor System.

"TSO" refers to Release 3.8 of the Time Sharing Option.

"CICS/VS" refers to Version 1, Release 5.0 of the Customer Information Control System/Virtual Machine.

"VSPC" refers to VS Personal Computing.

"NTO" refers to the Network Terminal Option.

AUDIENCE

This manual is intended primarily for host system and application programmers. Familiarity with asynchronous communication and data processing concepts is helpful in understanding the contents of this manual.

CONTENTS

The contents of this publication are:

Part 1. ASYNC Facility Guide

Chapter 1, "An Introduction to the IBM Displaywriter System's Asynchronous Communications Facility," a basic overview of the ASYNC facility.

Chapter 2, "Menus and Procedures," an explanation of the menus and procedures a Displaywriter operator uses to establish and conduct an ASYNC session.

Chapter 3, "Data Link and Protocol Characteristics," a description of the interface to a remote station and the ASYNC data stream.

Chapter 4, "Programming Considerations," programming recommendations for system and application programmers who use ASYNC protocols to communicate with an IBM Displaywriter System. This includes examples of generation statements for initializing a Displaywriter into a host system.

Part 2. ASYNC Facility Reference

Chapter 5, "Data Stream Translation Tables," the line code translates for ASYNC control codes and graphic characters.

Chapter 6, "Problem Determination Guidelines," suggestions for isolating problems with Displaywriter/host communication.

Chapter 7, "Displaywriter Communications Utilities," a description of the communications utilities available with the Displaywriter.

Appendix A, "Supported Keyboards," a list of supported keyboards for asynchronous communication.

Appendix B, "Communications Hardware," a general description of the hardware used with the ASYNC facility.

Glossary, definitions of terms associated with asynchronous communication.
Bibliography, a list of related publications.

RELATED READING

This publication discusses topics such as CMS or TCAM only in relation to their connection with the Displaywriter's ASYNC facility. If necessary, consult the publications listed in the Bibliography for further information about these topics.

The following manuals have more information about using the Displaywriter in a distributed systems network:

IBM Displaywriter Host Attach Programming Guide: Binary Synchronous Communication, G544-2039

IBM Displaywriter System Asynchronous Communications Feature Operating Guide, S544-2026

IBM Displaywriter System Binary Synchronous Communications Feature Operating Guide, S544-2027

For information about the Displaywriter as a standalone system, see:

General Information Manual for the IBM Displaywriter System, G544-0851

Customer Planning Guide for the IBM Displaywriter System, G544-0852

IBM Displaywriter System Operator Reference Guide, S544-0859

Contents

Part One. ASYNC Facility Guide

Part One of this manual contains:

- A basic overview of the ASYNC facility (Chapter 1)
- An explanation of the menus and procedures used to establish and conduct an ASYNC session (Chapter 2)
- A description of the interface to a remote station and the ASYNC data stream (Chapter 3)
- Programming considerations for system and application programmers who use ASYNC protocols to communicate with an IBM Displaywriter System (Chapter 4)

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Chapter 1. An Introduction to the IBM Displaywriter System's Asynchronous Communications

SYSTEM OVERVIEW

Figure 1 shows the major components of the IBM Displaywriter System, a diskette-based text processing system.

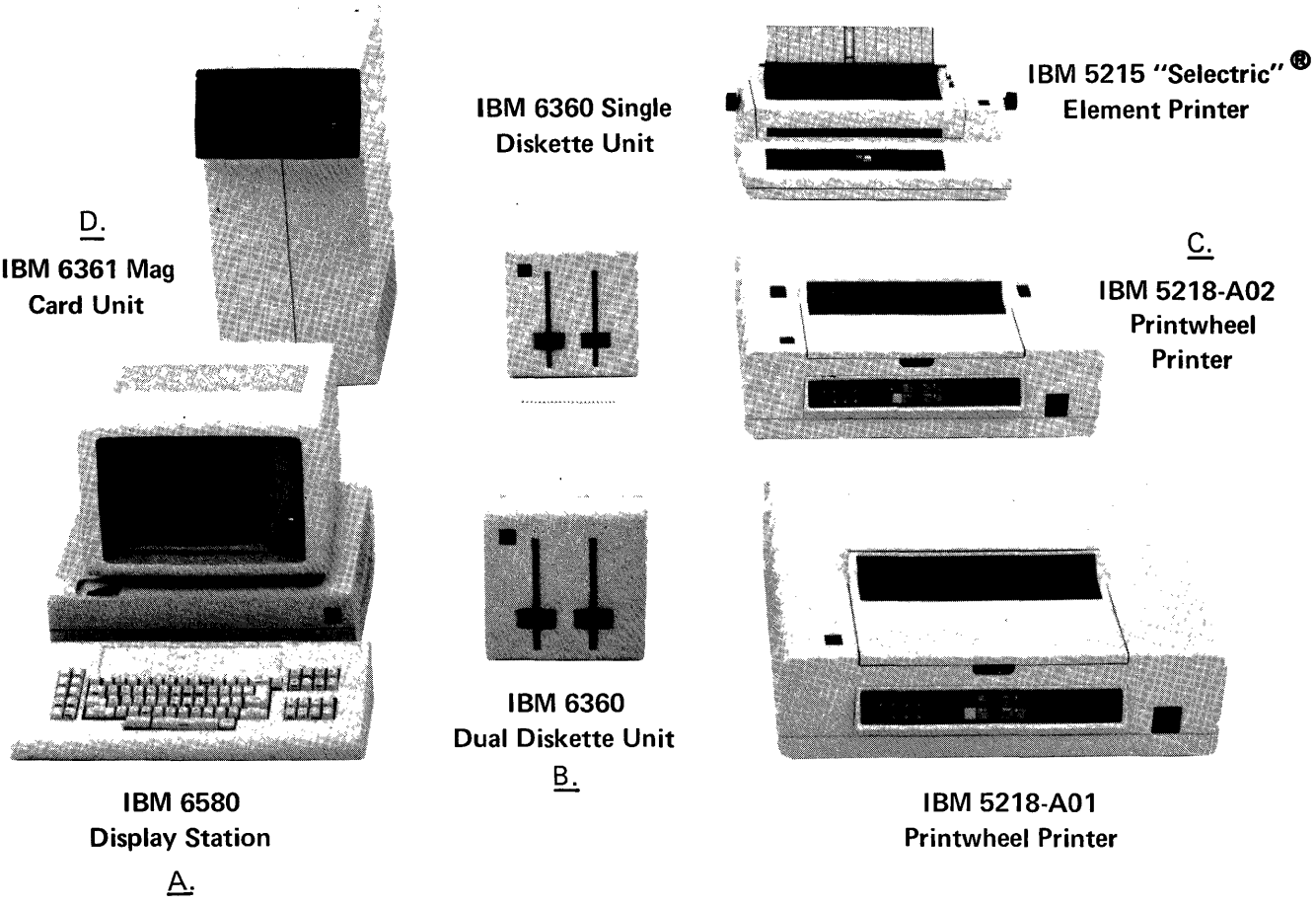

Figure 1. Displaywriter System Components

- A. IBM 6580 Display Station. The 6580 Display Station is composed of the electronics module, the display module, and keyboard module.

- B. IBM 6360 Diskette Unit. Four models of the 6360 Diskette Unit are available with the Displaywriter. The 6360-010 and the 6360-020 models are single diskette units with one usable slot for reading and recording information. The 6360-011 and 6360-022 models are dual diskette units with two usable slots.

  Together, the display station and the diskette unit form the IBM Displaywriter workstation.

  Note: The diskettes used with the 6360-010 and 6360-011 models are single-sided and provide approximately 284,000 bytes of storage. Single-sided diskettes also can be used with the 6360-020 and 6360-022 models, but dual-sided diskettes that provide approximately 985,000 bytes of storage normally are used.

- C. Printer. One of three printers can be attached to the workstation — the IBM 5215 "Selectric"® Element Printer, the IBM 5218-A01 Printwheel Printer, and the IBM 5218-A02 Printwheel Printer. Up to three workstations can share a 5218 printer.

- D. IBM 6361 Mag Card Unit. The 6361 Mag Card Unit is available for organizations that require a mag card media interface to and from IBM mag card typewriters. The Displaywriter uses this unit to record magnetic cards and to read magnetic cards created on compatible mag card office equipment.

ASYNC FACILITY OVERVIEW

The IBM Displaywriter System Asynchronous Communications Program (IBM Licensed Program 5608-SR1) enables a Displaywriter to communicate with compatible remote stations as an IBM 2741 Communications Terminal, an IBM Communicating Mag Card "Selectric"® Typewriter, or a teletypewriter similar to the Teletype[1] 33,35, or 43 Keyboard Send/Receive (KSR) models.

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

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

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[1] Trademark of the Teletype Corporation

With the ASYNC facility, 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 non-switched lines.

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

EQUIPMENT REQUIREMENTS

Besides the licensed program, the following equipment is required for asynchronous communication:

1. An external modem. The modem is attached to the Displaywriter system by a cable.

2. A communications adapter. The adapter provides an Electronics Industry Association (EIA) RS-232C compatible interface and/or an integrated modem interface. The EIA interface is required for operation with any external modem. The integrated modem interface provides all the signals necessary to drive IBM internal modems.

   Note: Two external modems can be attached to a Displaywriter if the communications adapter is in the diskette unit.

3. A communications line. The most common form of this line is a telephone line. The line can be leased from a telephone company or locally owned.

Appendix B, "Communications Hardware" has more information about the communications adapter and the modems used with the Displaywriter.

THE ASYNC DISPLAY

When an operator selects a valid communications setup from the Setup Selection menu, the display appears with the format shown in Figure 2 on page 1-6. For asynchronous communication, the display has three major areas: the Status lines (a), the Application Window (b), and the Prompt and Message lines (c).

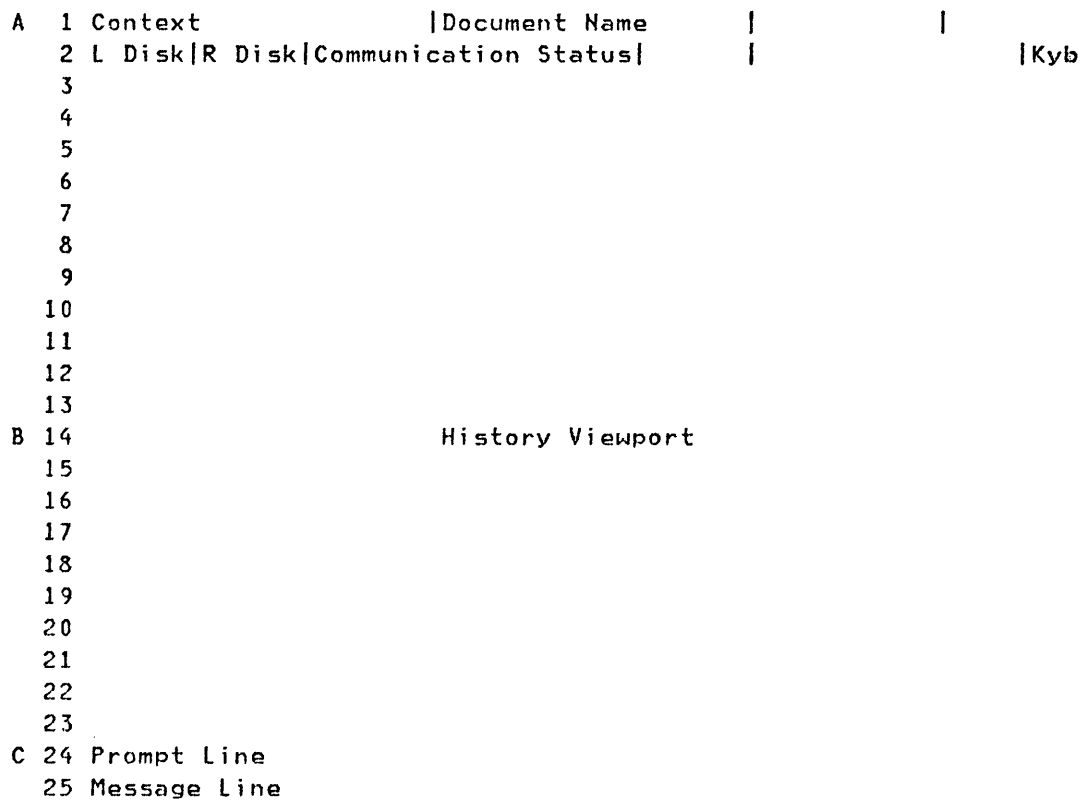


Figure 2. Display Format for Asynchronous Communication

Status Lines

First Status Line: Three fields in this line are active during an ASYNC session:

- Context — displays the current communications function
- Document Name — displays the name of the document that currently is being sent
- Audit Window — displays a description of control codes as they are cursored

Second Status Line: The Second Status line informs the operator about the name(s) of the inserted diskette(s) and the current state of the communications link. Six fields in the line can contain information:

- Left Diskette (L Disk) — displays (a) the name of the diskette mounted in a single diskette unit or (b) the name of the diskette mounted in the left slot of a dual diskette unit

- Right Diskette (R Disk) — displays the name of the diskette mounted in the right slot of a dual diskette unit. The field always is blank for a system with a single diskette unit.

- Communication Status — the Link Status and Transmission Indicator subfields of the Communication Status field give the current status of the communications link.

- Link Status — indicates the current modem and line status:

  - blank — The Data Terminal Ready (DTR) circuit is off.

  - READY — After an operator chooses a communications setup, DTR is activated and READY is displayed. A communications link with a remote station now can be established.

  - CONNECTED — Both the DTR and the Data Set Ready (DSR) circuits are up. CONNECTED appears when the link is being established or after the remote station has dropped the link.

  - ON-LINE — A remote carrier has been received, and the communications link is complete.

- Transmission Indicator — displays the system's current operating state:

  - Blank — For the TTY operating mode, the field normally is blank because TTY mode has no explicit STANDBY, SEND, or RECEIVE states.

    For the 2741 and IBM CMC operating modes, the subfield is blank when the Link Status subfield is blank or shows READY or CONNECTED.

  - STANDBY — For the 2741 and IBM CMC operating modes, ON-LINE STANDBY indicates the communications link is established, but no data is being sent or received.

  - SEND — For the 2741 and IBM CMC operating modes, ON-LINE SEND indicates the Displaywriter operator can send data over the communications line.

  - RECEIVE — For the 2741 and IBM CMC operating modes, ON-LINE RECEIVE indicates the Displaywriter can receive data over the communications line. While this message is displayed, the keyboard's inboard keys are logically locked.

  - BREAK — For TTY mode, BREAK indicates a break sequence has been received. The break sequence locks the Displaywriter keyboard. No data can be sent to the remote station, but the Displaywriter still can receive data. If the operator presses the Attention key (Attn), the keyboard unlocks, and data again can be sent.

- Page Number Field (Pg) — informs the operator which page of a stored document currently is being sent.

- Line Number Field (Ln) — used only during Document Send. The number in the field indicates how many complete lines (lines ended by a line-end code) the Displaywriter has sent from the current document page.

- Keyboard Number Field (Kyb) — displays the keyboard arrangement number of the current active keyboard.

Application Window

The Application Window is composed of the Session Header line (line 3) and the History Viewport (lines 4-21).

- Session Header Line: The Session Header line has three fields that can provide communication status information.
  - SETUP — contains the name of the active communications setup and the protocol associated with the setup
  - HISTORY STORE — indicates the current state of the History Store function
  - DOCUMENT SEND — indicates the current state of the Document Send function
- History Viewport: When data is being sent or received, the History Viewport has entries that describe the most recent communications activity. Asynchronous data is sent or received one character at a time, and each character appears in the History Viewport as soon as it is sent or received.

  During a session, sent and received data is displayed in either the Hidden Codes mode or the Display Codes mode. In Hidden Codes mode, the system default, sent or received data generally appears on the display as it does when printed from a diskette (except when proportional spacing is used). This includes displaying superscripts, subscripts, and the correct relative horizontal and vertical positions of the characters. Control codes in the text are displayed in the History Viewport and the Audit Window field only if the operator cursors the control code.

  There are no hidden codes in the Display Codes mode. In this mode, the system displays all control codes as special graphics and displaces the following text to the right when required.

  Note: In both display modes, all received data is video-reversed.

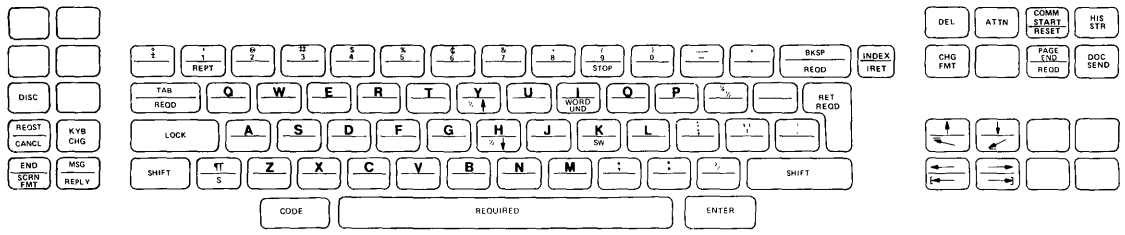
Prompt and Message Lines

During asynchronous communication, the Prompt and Message lines (C) function as if the Displaywriter is a standalone system.

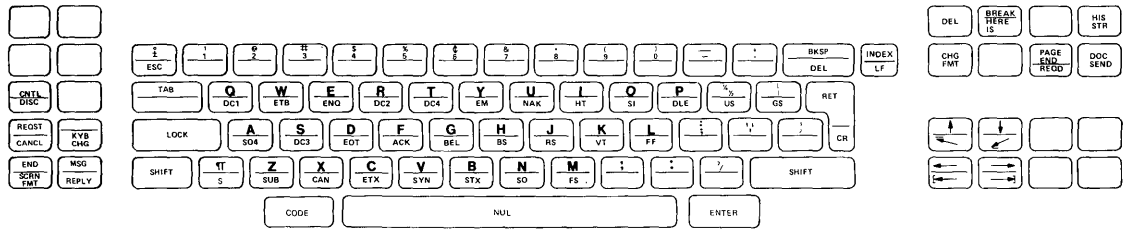
THE ASYNC KEYBOARD

For asynchronous communications, the Displaywriter keyboard has the layout shown in Figure 3. As an operator enters characters via the keyboard, the ASYNC facility displays them in the History Viewport and translates them to the appropriate line code. Characters are sent as they are keyed; editing is not allowed.

Asynchronous Communications - IBM CMC Protocol Keyboard Template



Asynchronous Communications - TTY Protocol Keyboard Template



Note: CNTL Key and Inboard Keys = ASCII Control Codes

Figure 3. Keyboards for Asynchronous Communication

- A. Graphic Keys. During a session, a Displaywriter operator can enter graphic characters at the entry point (bottom) of the Session History buffer and send them to the remote station.

- B. Text Format Control Keys. The text format control keys allow an operator to send text formatting controls such as Required Tab or Half Index Up to the remote station. The specific valid text format control keys for a session depend on the

session's operating mode (2741, TTY, or IBM CMC). Chapter 5, "Data Stream Translation Tables," lists the transmit control translates for each operating mode.

- C. Function Control Keys. The following function control keys are valid during asynchronous communication:

  - Attention (Attn) or Break — generates the Attention function for the 2741 and IBM CMC operating modes. For the TTY mode, the Break key either generates a Break signal or releases a Break state.

  - Document Send (Doc Send) — used to start and stop the sending of a document.

  - History Store — used to start and stop the storing of a Session History document on a data diskette.

  - Communications Start (Comm Start) — primarily used in the IBM CMC operating mode. When the Communication Status field is ON-LINE STANDBY (at the beginning of a session, for example), the operator presses Comm Start to place the Displaywriter in the Send state.

    The Comm Start key also is valid for the 2741 Standby state.

  - Reset — valid only in IBM CMC Send mode. Resets functions like the Coded Attention key on the IBM Communicating Mag Card Selectric Typewriter (see Chapter 3, "IBM CMC Operating Mode").

  - Change Format — used to change the line parameters of the display and the current History Store document (see "Changing the Keyboard Arrangement and the Margin and Tab Settings").

  - Page End — generates a Card Eject code for the 2741 and IBM CMC operating modes and a Form Feed code for the TTY mode.

  - Required Page End (Requird Page End) — generates a Card Eject code for the 2741 and IBM CMC operating modes and a Form Feed code for the TTY mode.

  - Here Is — used to send an Answer Back ID sequence under operator control in TTY mode.

- D. Cursor Movement Keys. Except for the Boundary Up and the Boundary Down keys, the cursor movement keys function during a session as if the Displaywriter is a standalone system:

  - Boundary Up — used to place the display cursor at the top of the Session History buffer.

  - Boundary Down — used to align the display cursor and the data entry pointer at the bottom of the Session History buffer.

- E. Workstation Control Keys. The following workstation control keys are valid during a session:

- Control — an unlabeled key used with the inboard keys to generate the ASCII control codes shown in Figure 4 on page 1-11. An operator presses Control and an inboard key simultaneously to produce a specific ASCII control code.

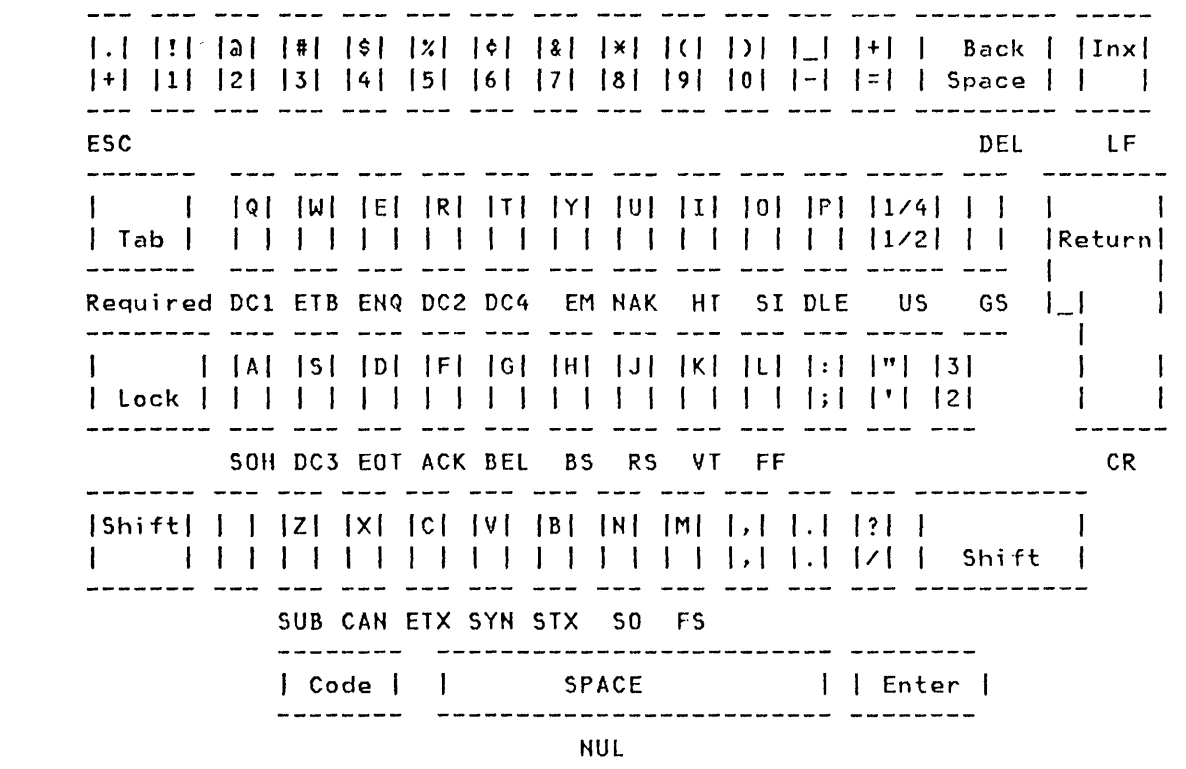


Figure 4. ASCII Control Code Keys

Control also is used when the Displaywriter operator invokes the ASYNC Trace function.

- Disconnect (Disc) — active any time the Communications Status field is not blank. Pressing Disc causes the Displaywriter to disconnect from the communications line and drop DTR. This clears the Communications Status subfield, but it does not change the current setup.

  After Disc is pressed, the Displaywriter cannot answer incoming calls, and the Displaywriter operator cannot initiate outgoing calls.

- Request — used to access the Request Tasks menu (see "Request Facility").

- Screen Format — used to access the Screen Format menu and change the display codes mode of the History Viewport.

- End — valid after Disconnect. End is used to return to the Setup Selection menu (Figure 8 on page 2-3) and end the communications task.

- Cancel (Cancl) — used to cancel functions and clear prompts.

- Keyboard Change (Keybrd Change) — used to change the current keyboard arrangement.

- Message — used to display background messages in the message queue.

- Reply — clears an "Insert Diskette" message and indicates that the diskette will not be inserted.

ASYNC Operating Modes

During a session, the Displaywriter operates in one of three modes, depending on the selected setup.

1. 2741 — enables a Displaywriter to emulate the interactive characteristics of an IBM 2741 Communications Terminal. In this mode, the Displaywriter can communicate with a host processor that supports the IBM 2741.

2. TTY — enables a Displaywriter to emulate the interactive characteristics of a teletypewriter similar to the Teletype[2] 33, 35, or 43 Keyboard Send/Receive (KSR) models. This mode can be used to communicate with: (a) a host processor that supports a character-interactive ASCII teleprinter, (b) another Displaywriter or, (c) a compatible terminal.

3. IBM CMC — enables a Displaywriter to emulate the interactive characteristics of an IBM Communicating Mag Card "Selectric"® Typewriter. When in IBM CMC mode, the Displaywriter can communicate with another Displaywriter or a compatible terminal, including the IBM CMC.

Chapter 3 describes these operating modes and the Displaywriter data stream in detail.

PROGRAMMING SUPPORT

For Displaywriter/Host communication, the ASYNC facility is supported by:

- CMS running under VM/370

- TSO running under OS/VS2

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[2] Trademark of the Teletype Corporation

- CICS/VS running under OS/VS1, OS/VS2
- VSPC running under OS/VS1 and OS/VS2
- NIO running under OS/VS1, OS/VS2, and DOS/VSE

See "Chapter 4. Programming Considerations" on page 4-1 for programming information about this support.

SUMMARY

Figure 5 on page 1-14 summarizes the main points of the Displaywriter's ASYNC facility.

	ASYNC OPERATING MODES		
	2741	IBM CMC	TTY
APPLICATIONS:			
Displaywriter/Host	X	N/A	X
Displaywriter/Office Machine	N/A	X	X
FACILITIES:			
EIA RS-232C Interface	X	X	X
Switched Lines*	X	X	X
Non-switched Lines*	X	X	X
Auto Answer Modems	X	X	X
LINE CONTROL:			
Line Speed**	134.5/300/ 1200 bps	134.5/300/ 1200 bps	110/150/200 300/1200 bps
Line Code	Correspondence	Correspondence	ASCII/7-Bit
Parity**	Odd	Odd	Even/Odd/Ignore
Reverse Interrupt	X	X	X
Terminal ID**	4 Characters	N/A	31 Chars Max.
Echoplex**	N/A	N/A	X
Inactivity Disconnect**	X	X	X
EOT Disconnect**	N/A	N/A	X
FEATURES:			
Interactive Keyboard/ Display	X	X	X
Document Transmission	X	X	X
Session History Document	X	X	X
Background Printing	X	X	X

X = supported N/A = not applicable
* = point-to-point, duplex only
** = communications setup option

Figure 5. ASYNC Facility Summary

Chapter 2. Menus and Procedures

This chapter describes for system and application programmers at a host the procedures and menus unique to the ASYNC facility. The chapter has three major topics:

- "Conducting a Communications Session" explains how a session is established and documents are sent or received.
- "Request Facility" outlines the functions that are available via the Request key.
- "Program Diskette Tasks" describes how communications setups are created or revised and system operating parameters are changed.

CONDUCTING A COMMUNICATIONS SESSION

Figure 6 shows the menu path for establishing an ASYNC session.

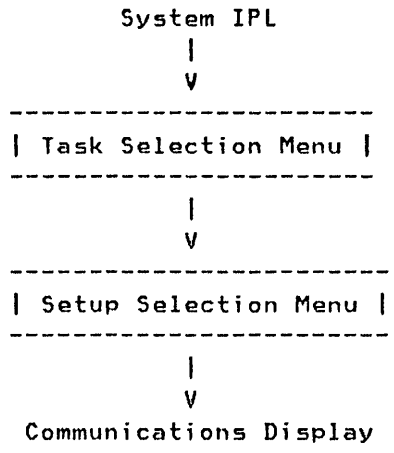

Figure 6. Menu Path for Establishing an ASYNC Session

ACCESSING THE COMMUNICATIONS FACILITY

A Displaywriter operator accesses the ASYNC facility by selecting Feature Tasks (ID e) from the Task Selection menu (Figure 7 on page 2-2).

```
|PRODSK|                                          |Kyb  1  |
                          TASK SELECTION

                ID  ITEM

                a   Typing Tasks:
                     Create, Revise or Paginate Documents
                b   Work Diskette Tasks:
                     Delete or Duplicate Documents,
                     Duplicate or Erase/Initialize (Name) Diskette,
                     Print Index of Diskette Contents, Change
                     Document or Diskette Name, Recover Documents
                c   Program Diskette Tasks:
                     Default Formats, Duplicate Setups,
                     Printer and Work Station Description,
                     Duplicate and Erase Program Diskette,
                     Feature Program Diskette Tasks
                d   Spelling Tasks
                e   Feature Tasks

Type ID letter to choose ITEM; press ENTER:_
```

Figure 7. Task Selection Menu

When (a) the operator answers all necessary prompts and loads the ASYNC feature diskette (if necessary) and (b) the system does not detect any errors, the Setup Selection menu (Figure 8 on page 2-3) appears.

SELECTING A STORED SETUP

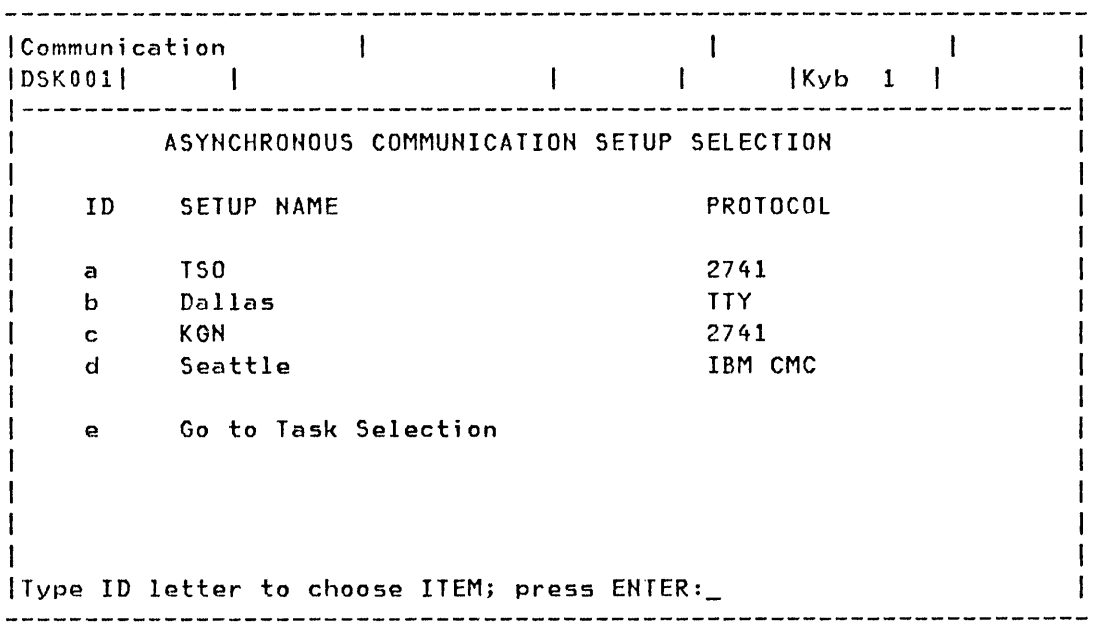

Figure 8. Sample Asynchronous Communication Setup Selection Menu

Figure 8 shows four named (used) communications setups, the maximum that can be stored on an ASYNC program diskette. Each stored setup specifies operating parameters such as protocol and code set that are associated with the setup name (see "Changing a Communications Setup").

The Setup Selection menu classifies communications setups according to protocol (2741, IBM CMC, or TTY). When an operator selects an ID for a previously defined setup, that setup's parameters are used for the communications session.

Because setups are stored on a feature program diskette by the customer, a Displaywriter operator does not need to define parameters before each session. The operator only needs to select the ID in the menu that identifies the desired communications setup.

ESTABLISHING A COMMUNICATIONS LINK

After the operator selects a communications setup, the display has the format shown in Figure 2 on page 1-6 and READY appears in the Link Status subfield.

- A communications link over a switched line is established when:

  - The Displaywriter operator makes a dial connection to the remote station

  - The Displaywriter operator manually answers an incoming call from the remote station

  - A Displaywriter modem with the Auto Answer function automatically answers an incoming call from the remote station

- A communications link over a non-switched line is established automatically. No further operator intervention is necessary after the setup is selected.

When the link is established, the Link Status subfield shows ON-LINE.

DISPLAYWRITER OPERATING MODES

During a session, the Displaywriter operates in one of three modes: (a) 2741, (b) IBM CMC, or (c) TTY. Chapter 3 describes the protocol characteristics of each of these operating modes in detail.

SENDING FROM THE KEYBOARD

The Displaywriter operator can send data directly from the keyboard if:

- The display cursor is at the bottom (the data entry point) of the Session History buffer

- The Communications Status field shows ON-LINE SEND for the 2741 and IBM CMC operating modes (ON-LINE for TTY mode)

- The DOCUMENT SEND field shows OFF

The communications display informs the operator about the active keyboard ID and the Receive Format values for margins and tabs. The keyboard specified by the keyboard ID is used by the Displaywriter to translate the data that it sends or receives into the appropriate line code. The Receive Format values for margins and tabs are used by the Displaywriter to display sent/received data in the History Viewport and to create the Session History document (if HISTORY STORE = ON).

A Displaywriter operator has the option to:

- change the keyboard arrangement and the Receive Format values for margins and tabs during a session (see "Changing the Keyboard Arrangement and the Margin and Tab Settings") or

- define and store Receive Format defaults on the ASYNC program diskette (see "Program Diskette Tasks")

SENDING A DOCUMENT FROM A DISKETTE

Documents stored on data diskettes can be sent whenever keyed data can be sent. The only exception to this is during an intervention period in IBM CMC mode (see "IBM CMC Operating Mode" in Chapter 3).

All or part of a stored document can be sent. When sending a document, however, the Displaywriter only transmits the document's formatted text. No format information or multi-byte controls are sent. For accurate document transmission, therefore, the Displaywriter operator should make sure the remote station's:

- Keyboard is compatible with the active Displaywriter keyboard/translate table
- Receive formatting controls are the same as the format defaults originally stored with the Displaywriter document

Chapter 3, "Data Stream Characteristics" describes how the Displaywriter sends a number of one-byte formatting controls that are in the text of a document.

Starting Document Send

An operator initiates Document Send via the Document Send key. Pressing this key changes the DOCUMENT SEND field from OFF to ON, and the operator is prompted for the document name and diskette name (if required).

After the operator answers the appropriate prompts, the Send Document menu (Figure 9 on page 2-6) appears. If the stored document and the Displaywriter do not specify the same keyboard ID, the message

> Keyboard ID of document is xxx. Use KYB CHG.

appears. The operator either can change the current Displaywriter keyboard ID or use it to transmit the document.

Note: If the keyboard is changed, the remote location should be notified so the appropriate changes can be made to the keyboard or translate tables at the remote location to avoid receiving invalid data.

```
|Communication        |                      |              |          |
|DSK001|      |On-Line             |        |      |Kyb  1  |          |
|-------------------------------------------------------------------------|
|                          SEND DOCUMENT                                  |
|                                                                         |
|   ID    ITEM                 YOUR       POSSIBLE                       |
|                              CHOICE     CHOICES                        |
|                                                                         |
|    a    Send From Page       0          0 = First Page,                |
|                                         1 - 9999.9.9                   |
|    b    Send From Line       1          1 - 999                        |
|    c    Send Through Page    0          0 = Last Page                  |
|                                         1 - 9999.9.9                   |
|                                                                         |
|                                                                         |
|When finished with this menu, press ENTER.                               |
|                                                                         |
|Type ID letter to choose ITEM; press ENTER:_                             |
---------------------------------------------------------------------------
```

Figure 9. Send Document Menu

Options:

- Send From Page — specifies which page of the document is the first to be sent. The default is 0, the first page.
- Send From Line — specifies which line of the Send From Page is the first to be sent. The default is 1, the first line.
- Send Through Page — specifies which page of the document is the last to be sent. The default is 0, the last page.

When the operator is finished and presses ENTER, the communications display (Figure 2 on page 1-6) appears and the Document Send function starts. The Displaywriter sends the entire document or the specified part of it one character at a time, as if the data were being keyed. The inboard keys are logically locked while the document is sent.

Stopping Document Send

The Document Send function ends when one of the following occurs:

- The entire document or the specified part of it has been sent.

- The Displaywriter operator presses the Document Send key. This key causes the the Displaywriter to stop sending data immediately. An operator normally uses this key when a line error or other malfunction occurs and it is necessary to resend a portion of the document.

- The Displaywriter operator presses the Disconnect key, the Attention key, or the Reset key (in IBM CMC mode). Each of these keys causes the Displaywriter to stop sending data immediately.

- The remote station sends a Break. Upon reception of a Break, the Displaywriter immediately terminates the Document Send function.

  Note: If the remote station intervenes at a line boundary in IBM CMC mode, the Displaywriter does not terminate the Document Send function. Instead, it suspends Document Send and receives data from the remote station. When the intervention period ends, the Displaywriter automatically resumes the sending of the document at the point of interruption.

- The communications line is lost.

- The remote carrier signal is temporarily lost. If DTR and DSR remain up, the Displaywriter automatically resumes Document Send after the signal returns.

Resuming Document Send

When the Document Send function terminates before the Send Through Page option is reached, the operator can press the Document Send key to resume it. If the document currently is available for sending, the prompt

Type document name; press ENTER:

will appear, with the name of the document already filled in.

Pressing ENTER then causes the Send Document menu to display. The Send From Page and Send From Line options will indicate where the Document Send function stopped. If the operator presses ENTER again, sending resumes at that point and continues until the original Send Through Page is processed.

THE SESSION HISTORY DOCUMENT

The Displaywriter operator has the option to store a Session History document — the data that is sent and received during a session — on a diskette. The History Store function that creates the document can be turned on and off during a session via the History Store key. This enables an operator to:

- Store all or selected portions of the communicated data. For example, the operator can elect to have HISTORY STORE = OFF when sending data and HISTORY STORE = ON when receiving data.

- Print a copy of the data whenever HISTORY STORE = OFF. When HISTORY STORE = ON, the current History Store document cannot be printed, but previous History Store documents can be.

Creating a Session History Document

Whenever the Link Status subfield shows READY, CONNECTED, or ON-LINE and HISTORY STORE = OFF, the operator can press History Store to activate the History Store function at the current cursor position. Pressing this key changes HISTORY STORE = ON, and the system prompts for the name of the History Store document.

In response to the prompt, the operator can specify either a new or an existing document:

- Naming a document not on an inserted data diskette creates a new Session History document. This document's format is based on the current Receive Format values.

- Naming a document already on an inserted data diskette appends the Session History document to the end of the existing document. When the Displaywriter appends the Session History document, it (a) starts the document on a new page and (b) inserts the current Receive Format values at the beginning of the new text.

Notes:

1. If History Store is pressed before a data link is established, a Displaywriter with a modem that has the Auto Answer function automatically begins the History Store document once the link is complete.

2. The Session History Document starts at the current cursor position.

Stopping the Session History Document

The History Store function stops when one of the following occurs:

- The Displaywriter operator uses the History Store key while HISTORY STORE = ON. The History Store document ends immediately.

- The diskette becomes full or the maximum page number (9999) is reached. In both cases, the Displaywriter continues to receive and send data, but the History Store indicator immediately changes to OFF and a message indicates why the function stopped.

- The Displaywriter operator presses the Disconnect key.

Resuming the Session History Document

To resume a Session History document during a session, the operator follows the same steps as those for creating a Session History document. The only difference is that if the last Session History document is available, its name appears after the document name prompt. The operator can press ENTER to append the new Session History to that document, or the operator can specify a different document.

CHANGING THE KEYBOARD ARRANGEMENT AND THE MARGIN AND TAB SETTINGS

During a session, the operator can change the active keyboard arrangement and the Receive Format values for margins and tabs. These changes are temporary, however. They affect the display of sent/received data and the Session History document, but system defaults that are stored on a program diskette are not altered.

Changing the Keyboard ID

The keyboard ID governs the line code translates that are used for sent and received data. To change the active keyboard ID, the operator presses the Keybrd Change key and follows the prompts for specifying a new keyboard. The new keyboard arrangement is active until the operator changes it again or the system is turned off and reIPLed. When the system is reIPLed, the base system keyboard becomes active again.

For accurate document transmission, both the sender and the receiver should specify the same keyboard ID.

Changing the Margin and Tab Settings

To change margin and tab settings during a session, the operator accesses the Communications Margins and Tabs menu (Figure 10 on page 2-10) via the Change Format key.

```
|Communication        |                     |              |          |
|DSK001|      |On-Line            |       |      |Kyb  1  |          |
|-------------------------------------------------------------------|
|a...:...1...:...2...:...3...:...4....:...5....:...6....:...7...:....8|
|                           MARGINS AND TABS                        |
|                                                                   |
| MOVE MARGINS: Use <- or -> key to move cursor to margin (<< or >>). |
|               Use SPACE bar or BKSP key to move margin.           |
|                                                                   |
|      SET TAB: Use <- or -> key to move cursor to where you want tab;|
|               press TAB.                                         |
|                                                                   |
|    CLEAR TAB: Use <- or -> key to move cursor to tab; press DEL.  |
|                                                                   |
|    MOVE TABS: Use <- or -> key to move cursor to tab.             |
|               Use SPACE bar or BKSP key to move tabs.             |
|                                                                   |
| SET ALL TABS: Use <- or -> key to move cursor to left margin (<<). |
|               Type number for spacing between tabs; press ENTER.  |
|                                                                   |
|CLEAR ALL TABS: Use <- or -> key to move cursor to left margin (<<); |
|               press DEL.                                          |
|                                                                   |
|When finished with this menu, press ENTER.                         |
---------------------------------------------------------------------
```

Figure 10. Communications Margins and Tabs Menu

The new margin and tabs settings are active until the operator changes them again or the communications task is ended. When the ASYNC program diskette is reloaded, its Receive Format defaults for margins and tabs again appear in the communications display.

DISCONNECTING THE DATA LINK AND ENDING COMMUNICATION

To terminate a session normally, the operator presses Disc (which causes the system to drop the communications link) and presses End (which causes the Setup Selection menu to appear). From the Setup Selection menu, the operator can select a setup for another session or return to the Task Selection menu.

REQUEST FACILITY

Figure 11 on page 2-11 shows the menu path for the Request facility, which an operator accesses by pressing the Request key during an ASYNC communications session.

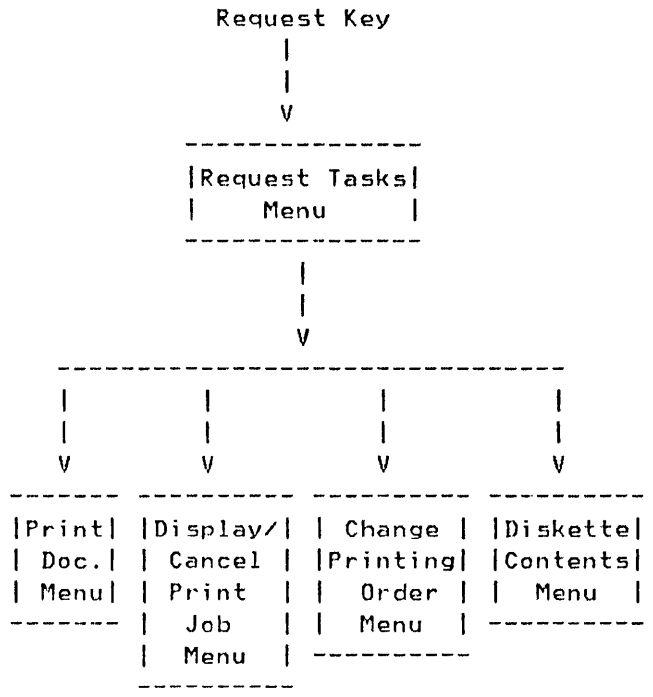

Figure 11. Menu Path for the ASYNC Request Facility

Pressing Request causes the Request Tasks menu (Figure 12 on page 2-12) to appear. Selecting some of the menu's options causes a second menu to display; selecting others immediately invokes the function.

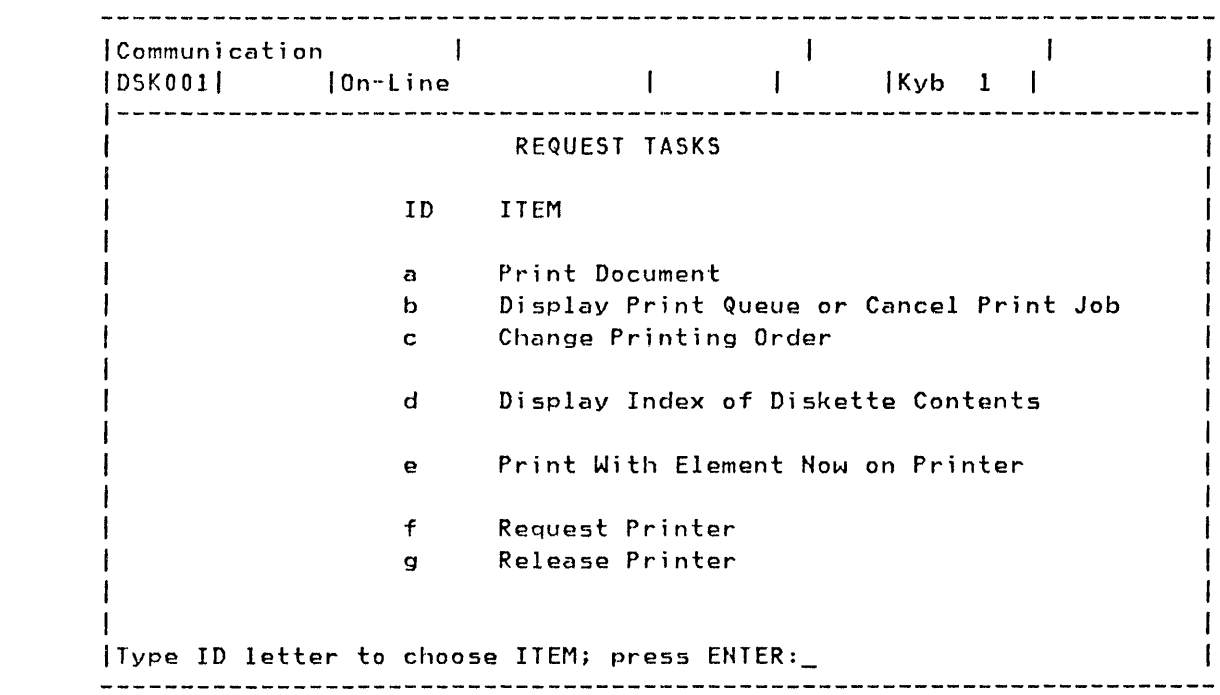

Figure 12. Request Tasks Menu for Communication

The functions available through the Request Tasks menu are not unique to the ASYNC facility. For further information, see the IBM Displaywriter System Operator Reference Guide.

PROGRAM DISKETTE TASKS

Figure 13 on page 2-14 shows the menu path an operator follows to access the ASYNC program diskette tasks. These tasks include:

- Changing the Receive Format defaults
- Duplicating the machine setup
- Creating or revising a communications setup
- Dhanging the modem and line description
- Duplicating the program diskette
- Erasing the program diskette

This section discusses the individual menus involved in these tasks that are of importance to system and application programmers at a host.

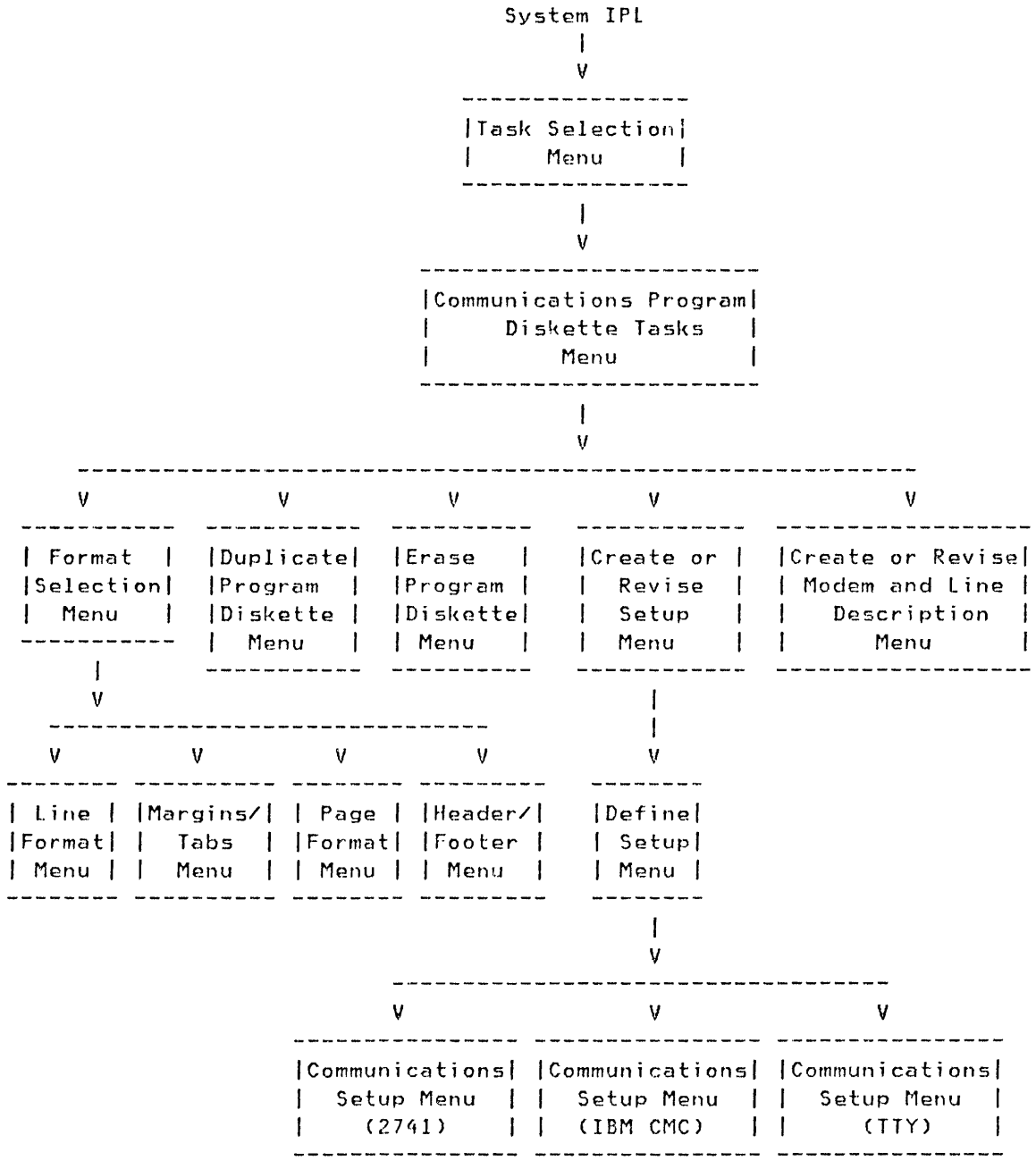

Figure 13. Menu Path for ASYNC Program Diskette Tasks

When an operator selects Program Diskette Tasks (ID c) from the Task Selection menu (Figure 7 on page 2-2), the system prompts for desired program or feature diskette. The operator should then remove the base machine diskette and load an ASYNC program diskette. After an ASYNC program diskette with the correct system maintenance level and menu language is loaded, the Asynchronous Communications Program Diskette Tasks menu (Figure 14) appears.

```
 ----------------------------------------------------------------------
|Communication        |                      |               |        |
|PRODSK|      |                    |       |      |Kyb  1  |         |
|---------------------------------------------------------------------|
|        ASYNCHRONOUS COMMUNICATIONS PROGRAM DISKETTE TASKS           |
|                                                                     |
|                     ID  ITEM                                        |
|                                                                     |
|                     a   Change Receive Format Defaults              |
|                                                                     |
|                     b   Create or Revise Communications Setup       |
|                     c   Create or Revise Modem or Line Description  |
|                                                                     |
|                     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 14. Asynchronous Communications Program Diskette Tasks Menu

Note: No background print operations are allowed concurrently with the ASYNC program diskette tasks. The Request facility also cannot be accessed during these tasks.

CHANGING THE RECEIVE FORMAT DEFAULTS

When a communications session is active, the Displaywriter uses the Receive Format defaults to display and store data that is sent or received. "Changing the Keyboard

Arrangement and the Margin and Tab Settings" explains how an operator can alter the values for margins and tabs during a session. An operator also can specify defaults on the ASYNC program diskette for line format, margins and tabs, page format, and headers and footers.

To permanently define one or more of the Receive Format defaults, an operator first must enter ID a, Change Receive Format Defaults, from the Asynchronous Communications Program Diskette Tasks menu. Selecting this option causes the Format Selection menu (Figure 15) to appear.

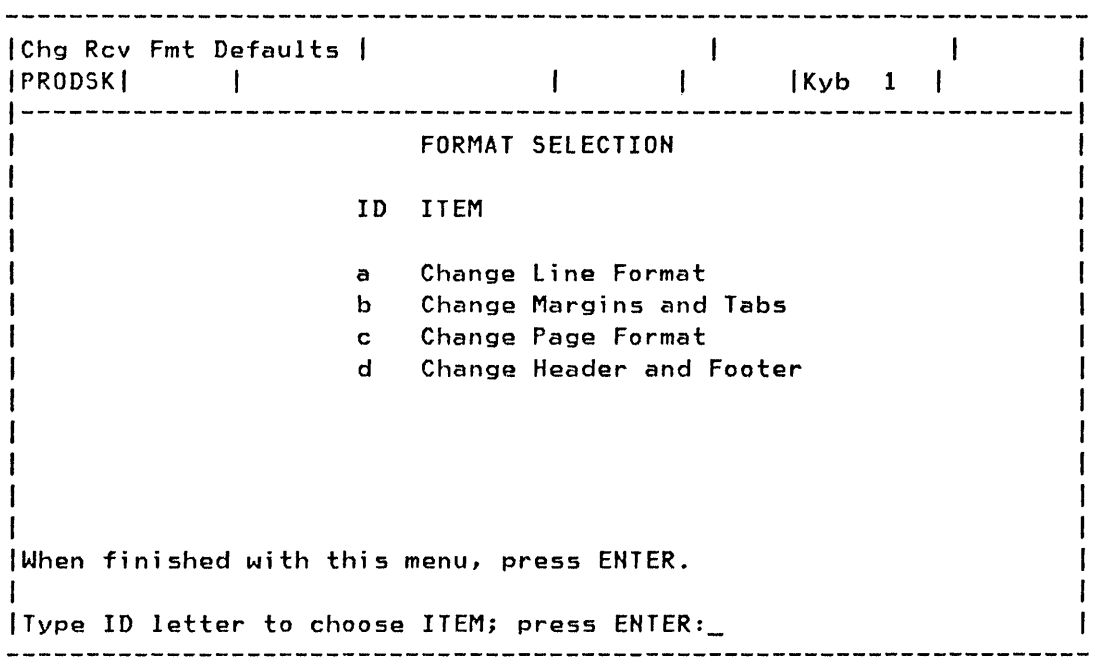

Figure 15. Format Selection Menu

When an operator selects an ID from the Format Selection menu, the system displays another menu with options for specifying the permanent format change. Each of these menus, and the steps involved in their use, is identical to the format change menu that an operator accesses when the Displaywriter is a standalone system. For further information, see the IBM Displaywriter System Operator Reference Guide.

The system uses the new Receive Format defaults the next time that the ASYNC program diskette is loaded.

CREATING OR REVISING A COMMUNICATIONS SETUP

A communications setup defines the operating characteristics (such as line speed and parity) of a communications session. A Displaywriter operator can create and store up to four setups on an ASYNC program diskette and can revise any previously defined setup.

An operator accesses the Create or Revise Setup task by entering ID b from the Communications Program Diskette Tasks menu. Selecting this option causes the Create or Revise Setup menu to appear (Figure 16).

```
-------------------------------------------------------------------
|Chg Setup           |                     |              |       |
|PRODSK|       |                   |       |      |Kyb  1  |      |
|-----------------------------------------------------------------|
|                       CREATE OR REVISE SETUP                    |
|                                                                 |
|     ID    SETUP NAME                      PROTOCOL              |
|                                                                 |
|     a     (Unused)                                              |
|     b     (Unused)                                              |
|     c     (Unused)                                              |
|     d     (Unused)                                              |
|                                                                 |
|                                                                 |
|                                                                 |
|When finished with this menu, press ENTER.                       |
|                                                                 |
|                                                                 |
|Type ID letter to choose ITEM; press ENTER:_                     |
-------------------------------------------------------------------
```

Figure 16. Create or Revise Setup Menu with No Defined Setups

Defining a Setup

Initially, the four setups on the Create or Revise Setup menu are undefined (unused). To define a setup, an operator first enters the ID of an unused setup in the Create or Revise Setup menu. This causes the Define Setup menu (Figure 17 on page 2-18) to appear.

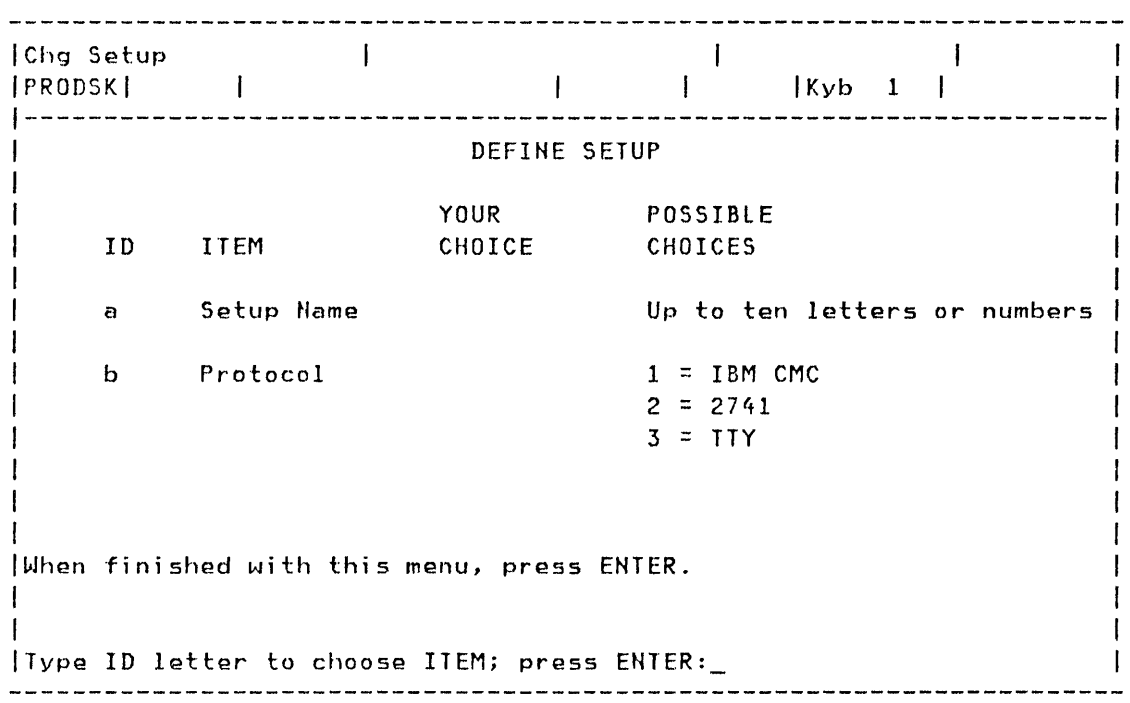

Figure 17. Define Setup Menu

The options of the Define Setup menu enable an operator to name a setup and specify its communications protocol as 2741, IBM CMC, or TTY.

Changing Defined Setups

Once a setup is defined, its name and protocol appear in the Create or Revise Setup menu. To review a specific setup or change it, the operator enters the setup's ID from the Create or Revise Setup menu. This causes the Define Setup menu to appear. Pressing ENTER in this menu then causes the Communications Setup menu for the defined setup to display.

Figure 18 on page 2-19, Figure 19 on page 2-20, and Figure 20 on page 2-21 show sample Communications Setup menus for the 2741, IBM CMC, and TTY protocols.

```
---------------------------------------------------------------------
|Chg Setup             |                     |              |       |
|PRODSK|       |                    |       |      |Kyb  1  |       |
|-------------------------------------------------------------------|
|                        COMMUNICATION SETUP                        |
|                                                                   |
|        Setup Name: DALLAS                        Protocol:  2741  |
|                                                                   |
|   ID  ITEM                     YOUR         POSSIBLE              |
|                                CHOICE       CHOICES               |
|                                                                   |
|   a   Line Speed               1            1 = 134.5    2 = 300  |
|                                             3 = 1200              |
|   b   Inactivity Disconnect    2            1 = Yes      2 = No   |
|   c   Send All Codes           2            1 = Yes      2 = No   |
|                                                                   |
|   d   Terminal ID                           Up to four characters |
|                                                                   |
|When finished with this menu, press ENTER.                         |
|                                                                   |
|Type ID letter to choose ITEM; press ENTER:_                       |
---------------------------------------------------------------------
```

Figure 18. Sample Communications Setup Menu for 2741 Protocol

2741 Protocol Options

- Line Speed — specifies the bit rate at which the Displaywriter transmits characters. The default is 1, 134.5 bps.
- Inactivity Disconnect — specifies whether the Displaywriter automatically initiates a disconnect after 30 seconds of line inactivity. The default is 2, No.
- Send All Codes — specifies whether the Displaywriter transmits all the control codes (except Switch) that normally are sent in IBM CMC mode. The default is 2, No.
- Terminal ID — identifies the Displaywriter to a host processor. The system transmits the specified ID when it receives an appropriate request from the host. The ID may be from one to four characters.

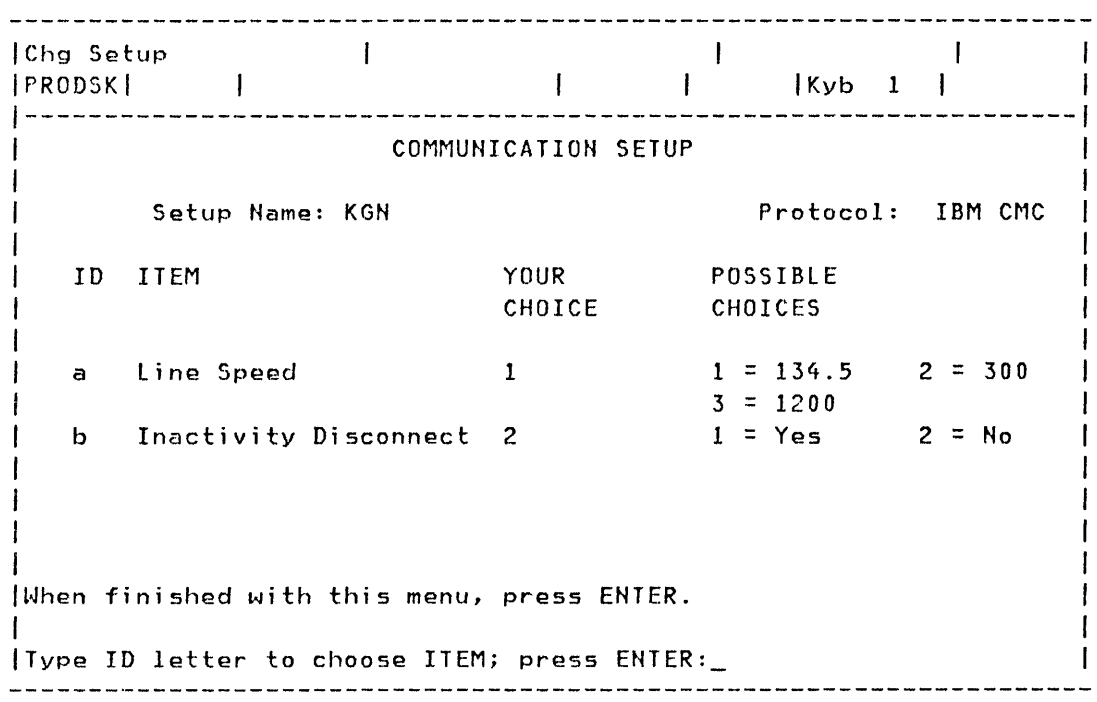

Figure 19. Sample Communications Setup Menu for IBM CMC Protocol

IBM CMC Protocol Options:

- Line Speed — specifies the bit rate at which the Displaywriter transmits characters. The default is 1, 134.5 bps.
- Inactivity Disconnect — specifies whether the Displaywriter automatically initiates a disconnect after 30 seconds of line inactivity. The default is 2, No.

```
 -------------------------------------------------------------------
|Chg Setup          |                    |              |           |
|PRODSK|      |                    |       |      |Kyb  1  |        |
|-------------------------------------------------------------------|
|                        COMMUNICATION SETUP                         |
|                                                                    |
|        Setup Name: EDB                        Protocol:  TTY      |
|                                                                    |
|   ID  ITEM                     YOUR      POSSIBLE                 |
|                                CHOICE    CHOICES                  |
|                                                                    |
|   a   Line Speed               1         1 = 110  2 = 150  3 = 200 |
|                                          4 = 300  5 = 1200        |
|   b   Inactivity Disconnect    2         1 = Yes     2 = No       |
|   c   EOT Disconnect           2         1 = Yes     2 = No       |
|   d   Echoplex                 2         1 = Yes     2 = No       |
|   e   Parity                   1         1 = Even 2 = Odd 3 = None |
|                                                                    |
|   f   Terminal ID                        Up to 31 characters      |
|   g   Automatic Answer Back    1         1 = Yes     2 = No       |
|                                                                    |
|When finished with this menu, press ENTER.                         |
|                                                                    |
|Type ID letter to choose ITEM; press ENTER:_                       |
 -------------------------------------------------------------------
```

Figure 20. Sample Communications Setup Menu for TTY Protocol

TTY Protocol Options:

- Line Speed — specifies the bit rate at which the Displaywriter transmits characters. The default is 1, 110 bps.

- Inactivity Disconnect — specifies whether the Displaywriter automatically initiates a disconnect after 30 seconds of line inactivity.

  The default is 2, No.

- EOT Disconnect — specifies whether the Displaywriter automatically initiates disconnect when it receives an EOT

  The default is 2, No.

- Echoplex — specifies whether the Displaywriter operates in echoplex mode (see Chapter 3, "Echoplex" on page 3-11).

  The default is 2, No.

- Parity — specifies which type of parity is sent and checked. For 3 = None, the Displaywriter

  - sends a mark ("1") bit in the parity field

  - ignores all received parity bits

  The default is 1, Even.

- Terminal ID — identifies the Displaywriter to a host processor. The system transmits the specified ID when:

  - it receives an appropriate request from a host,

  - the Displaywriter operator presses the local HERE IS key, or

  - upon establishment of the data link if Automatic Answer Back is specified in the active communications setup.

- Automatic Answer Back — when the Displaywriter is the called party, causes the Displaywriter to automatically transmit the Terminal ID to the host when the data link is established.

  The default is 2, No.

CREATING OR REVISING THE MODEM OR LINE DESCRIPTION

Each ASYNC program diskette has one profile that defines the modem and line used for communications sessions. A Displaywriter operator can change this profile by entering ID c from the Communications Program Diskette Tasks menu. Selecting this option causes the Modem and Line Description menu to appear Figure 21 on page 2-23.

```
|Chg Description      |                    |              |       |
|PRODSK|      |                   |       |      |Kyb  1  |       |
|-------------------------------------------------------------------|
|                    MODEM AND LINE DESCRIPTION                     |
|                                                                   |
|                                YOUR     POSSIBLE                  |
| ID   ITEM                      CHOICE   CHOICES                   |
|                                                                   |
|  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 21. Modem and Line Description Menu

Options:

- Switched Network — specifies the communications line facilities being used. The default is 1, switched network.

- CTS/RLSD (CB/CF) Option — specifies whether the modem requires the adapter to sample only the Clear to Send (CB) signal or both the Clear to Send and the Receive Line Signal Detect (CF) signals. The default is 1, Common.

- Modem Port — specifies which modem port (back panel connector) is used when this modem and line description is in effect. Port 4 = EIA interface in the electronics module; Port 4A = EIA interface in the diskette unit; and Port 4B = Internal modem/EIA adapter in the diskette unit. The default is 1, Port 4.

  The option is ignored if the EIA interface is in the electronics module.

DUPLICATING THE MACHINE SETUP

IBM distributes maintenance updates for the ASYNC facility on new feature program diskettes. After loading an ASYNC diskette with maintenance updates, an operator can use the Duplicate Machine Setup task (ID e) to copy the current system values for the:

- Document Format and Alternate Format defaults
- Communications setups
- Modem and line description

from the old ASYNC program diskette to the new program diskette. The steps to do this are the same as those used when the Displaywriter is a standalone system. For further information, see the IBM Displaywriter System Operator Reference Guide.

DUPLICATING OR ERASING AN ASYNC PROGRAM DISKETTE

The steps associated with ID f and ID g of the Communications Program Diskette Tasks menu are identical to the steps used when the Displaywriter is a standalone system. For further information, see the IBM Displaywriter System Operator Reference Guide.

Chapter 3. Data Link and Protocol Characteristics

DATA LINK CHARACTERISTICS

The Displaywriter ASYNC facility supports point-to-point, full duplex physical data links that operate from 110 to 1200 bps over switched and non-switched lines. Half duplex operation with reverse channel and multi-point (polled) lines are not supported.

DATA LINK ESTABLISHMENT

When a setup is selected from the Setup Selection menu, the Displaywriter activates the communications hardware by turning on the Data Terminal Ready (DTR) circuit. READY in the Link Status subfield of the display indicates that DTR is up.

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

- A dial connection is made to the network
- An incoming call from a remote station is answered manually
- A Displaywriter modem with Auto Answer receives an incoming call

CONNECTED replaces READY when DSR is active. ON-LINE indicates reception of a remote carrier.

For non-switched lines, DSR is always active. After a setup is selected, the communications link is established automatically as long as the modem is powered on. No further operator intervention is necessary.

In both cases, the Displaywriter establishes the communications link by sending a continuous transmit carrier to the remote station. Once it receives a remote carrier, the link is completed.

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 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 EOT Disconnect, and the remote station sends an ASCII EOT control code.

- The Displaywriter detects a remote modem disconnect.

On non-switched lines, the disconnect turns off both Data Terminal Ready and Request to Send. On switched lines, DSR also must turn off within 10 seconds.

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 will turn on DTR again to re-establish the link.

MODEM SUPPORT

For asynchronous communication, the Displaywriter supports external modems that are attached via the standard EIA RS-232C interface (see Appendix B, "Communications Hardware"). When a WE 212A modem (or equivalent) is attached to a Displaywriter, either high speed or low speed mode can be used. High speed mode always is 1200 bps, and low speed mode is 300 bps or less.

Note: See "Timeouts" on page 3-13 for a description of all timeouts that can occur during a session.

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 terminal. The data link protocols conform to the characteristics established by the IBM 2741, the IBM CMC, and the TTY KSR 33.

2741 OPERATING MODE

The 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 with correspondence code. This mode does not support word processing codes.

The 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 STX (circle D) and EOT (circle C) line control codes.

Transmission Format

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

Normally, 2741 correspondence code is a subset of IBM CMC correspondence code. But if a communications setup for 2741 mode specifies Yes for the Send All Codes option, the Displaywriter will generate the entire set of graphics and control codes (except for SWITCH) that it generates when in IBM CMC mode. Chapter 7, "Data Stream Translation Tables," lists the control codes and graphics associated with the Displaywriter's operating modes.

When sending data, the Displaywriter does not support the correspondence codes for:

TRACK LINK (TKLK)
ERROR CORRECT BACKSPACE (ECBS)
END OF TEXT (ETX)
TRACK SKIP (TKSK)

Parity

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

Line Speed

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

Error Detection

In the 2741 mode, parity always is sent and checked, 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 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 2 character-times. When the Displaywriter is in the Send Originate state, the signal causes the Displaywriter to immediately stop sending data, enter the Standby state, and wait for an STX or an EOT. Normal operation resumes when the Displaywriter receives an EOT, an STX, or the Displaywriter operator presses the Start key.

In the Receive Originate state, pressing Attn 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

As part of a communications setup, the Terminal ID is a 4-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 automatically sends an STX ID EOT sequence whenever it receives a PRE j EOT sequence from the remote station.

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

CARRIAGE RETURN (CRE)
DELETE (DEL)
END OF TRANSMISSION BLOCK (ETB)
IDLE (IDLE)

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 code for REPEAT and RESTORE is identical. When the Send All Codes option is active and the Displaywriter receives a BYPASS code, it treats a subsequent REPEAT code as RESTORE.

2741 Line Control Discipline

The line control discipline for the 2741 operating mode uses the STX and EOT control characters in the same manner as the IBM 2741:

- STX (Start of Transmission) — When sent, STX precedes a block of text. In 2741 mode, the Displaywriter automatically sends STX when the data link is first established, before each block of data that it sends, or after the reception of an EOT

  When received, STX causes the Displaywriter to switch from Standby state to Receive Originate state.

- EOT (End of Transmission) — When sent, EOT follows a block of text. The Displaywriter sends EOT automatically after transmitting a line-end code.

  When received, EOT causes the Displaywriter to switch from Receive Originate state to Standby state.

The 2741 operating mode has three states:

Send Originate

Standby

Receive Originate

Send Originate State: After sending an STX, the Displaywriter enters the Send Originate state. It remains in this state until it sends an EOT or receives a Break sequence. The EOT or Break sequence cause the Displaywriter to enter the Standby state.

The following rules apply to the Send Originate state:

- Line Turnarounds — The Displaywriter sends an EOT after each line-end character (such as a Carrier Return, a Required Carrier Return, an Index Return, or a Page End). The EOT causes a line turnaround, turns off the SEND indicator, and places the Displaywriter in the Standby state. While SEND is off, the keyboard is logically locked.

  Normally, the remote station will send STX EOT immediately back. The STX causes the Displaywriter to briefly enter the Receive Originate state. The EOT then causes the Displaywriter to send an STX (after a 50 millisecond delay) and re-enter the Send Originate state.

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

If the Displaywriter operator presses Attn during an intervention period, the Displaywriter sends a Break signal to the remote station. If the signal is honored, the remote station sends an EOT to end the intervention period.

- Line Abort — When sending data, a Displaywriter operator can press Attn to indicate that the remote station should abort the line currently being sent. Pressing Attn sends an EOT 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 an EOT (sending a line ending or aborting the line) or receives a Break sequence. In Standby, the Displaywriter waits for either an STX or an EOT. STX causes it to enter the Receive Originate state; EOT causes it to send STX 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 an STX. In this state, the Displaywriter will accept any amount of data from the remote station. No 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 an EOT, the Displaywriter re-enters 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 ms) to the remote station. If the Break is honored, the remote station sends an EOT, which causes the Displaywriter to re-enter the Send Originate state.

IBM 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 2741 operating mode is basically a subset of the IBM CMC operating mode.

Transmission Format

Identical to the 2741 operating mode.

Parity

Identical to the 2741 operating mode.

Line Speed

Identical to the 2741 operating mode.

Error Detection

Identical to the 2741 operating mode.

Break

Identical to the 2741 operating mode.

IBM CMC Line Control Discipline

Like the 2741 mode, the line control discipline of the IBM CMC operating mode uses the STX and EOT control codes:

- STX — In IBM CMC mode, the Displaywriter does not automatically send STX 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 STX before each block of data it sends and after it receives an EOT.

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

- EOT — When transmitted, EOT indicates the end of the desired text. The Displaywriter sends EOT automatically after sending a line-end code or after receiving a Break sequence.

The IBM CMC operating mode has six states:

Control

Send Originate

Standby

Receive Originate

Receive Answer

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 STX 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 Displaywriter sends STX first, the Displaywriter enters the Send Originate state. It remains in this state until it sends an EOT, receives a break sequence, or receives an EOT after the operator used the Reset key.

The following rules apply to the Send Originate state:

- Line Turnarounds — The Displaywriter sends an EOT after each line-end character (such as a Carrier Return, a Required Carrier Return, an Index Return, or a Page End). The EOT causes a line turnaround, turns off the SEND indicator, and places the Displaywriter in the Standby state. While SEND is off, the keyboard is logically locked.

  Normally, the remote station will send STX EOT immediately back. The STX causes the Displaywriter to briefly enter the Receive Originate state. After the Displaywriter receives the EOT, it delays for 50 milliseconds before sending an STX 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 EOT causes the Displaywriter to enter the Control state instead of returning to the Send Originate state.

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

  If the Displaywriter operator presses Attn during an intervention period, the Displaywriter sends a Break signal to the remote station. If the signal is honored, the remote station sends an EOT to end the intervention period.

- Line Abort — When sending data, a Displaywriter operator can press Attn to indicate that the remote station should abort the line currently being sent. Pressing Attn sends an EOT that is not preceded by a line-end code. A normal line turnaround then occurs.

- Received Break — When the Displaywriter receives a Break sequence in the Send Originate state, it immediately stops sending data, sends an EOT, and enters the Standby state.

- 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 is sent after every Index, Subscript, and Superscript.

- The number of IDLEs 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 5 characters (the default setting), two IDLEs are sent. For each additional 10 character positions (or fraction), one additional IDLE is sent after each HT.

Standby State: The Displaywriter enters the Standby state each time it sends an EOT or receives a Break sequence. In Standby, the Displaywriter waits for either an STX or an EOT. STX causes it to enter the Receive Originate state; EOT causes it to send STX 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 an STX. In this state, the Displaywriter will accept any amount of data from the remote station. No 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 an EOT, the Displaywriter re-enters 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 ms) to the remote station. If the Break is honored, the remote station sends an EOT, which causes the Displaywriter to re-enter the Send Originate state.

Receive Answer State: The Displaywriter enters the Receive Answer state each time it is in the Control state and receives an STX. Unlike the Receive Originate state, line turnaround sequences occur at each line boundary. When the Displaywriter receives the EOT that indicates a line ending, it transmits an STX and enters the Send Answer state.

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: The Displaywriter enters the Send Answer state each time it sends an STX in the Receive Answer state. Normally, the Displaywriter then automatically sends an EOT to complete a line turnaround and return to the Receive Answer state. But to keep the Displaywriter from transmitting the EOT and to send data from the keyboard, the operator can press the Attn key. Any data sent at this time cannot be interrupted by turnarounds at line endings or by received Break sequences. To complete the line turnaround and return the Displaywriter to the Receive Answer state, the operator must press Attn again.

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.

TTY OPERATING MODE

The TTY mode enables the Displaywriter to communicate with a terminal like the TTY KSR 33 that uses ASCII (7-Bit) line code or a suitably programmed host that supports TTY terminals. During a session in TTY mode, both stations can transmit data simultaneously and independently in true duplex fashion.

Transmission Format

Transmission of ASCII (7-Bit) control codes and graphics is asynchronous by character. When operating at speeds below 1200 bps a start bit (0) precedes each 8-bit character, and two stop bits follow each (one stop bit is used when operating at 1200 bps). The 8-bit characters have seven data bits and a most-significant parity bit. The Displaywriter transmits each character serially by bit, the least significant bit first.

In the TTY mode, the Displaywriter can generate all 128 ASCII graphics and control codes (see Chapter 7, "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") bit and ignore received parity bit

Line Speed

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

Time Filling Delays

In TTY mode, the Displaywriter delays after sending certain control codes to allow remote terminals to complete mechanical functions. At line speeds below 1200 bps, the

Displaywriter sends 1 DEL character after each BS (Backspace) character and 10 DEL characters after each FF (Form Feed) character.

In addition, at line speeds of 110, 150, or 200 bps, the Displaywriter sends the 3-character sequence

CR (Carrier Return) LF (Line Feed) DEL (Delete)

after each CRE (Carriage 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 code after VT (Vertical Tab) characters.

3. The Displaywriter deletes all time-filling code that it receives, including all DEL and NUL codes and all consecutive CR codes that immediately follow a CR.

Echoplex

The Communications Setup menu for TTY mode has an option for echoplex operation. In 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. Therefore, all data displayed to the operator is from the receive data stream. This enables the operator to monitor the integrity of the data sent from the Displaywriter.

Error Detection

In TTY mode, the Displaywriter sends and checks for parity, 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 deletion of characters received without a valid stop bit (framing error).

The Displaywriter operator must visually detect other types of 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 sequence that is 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 2 character-times. The signal causes the Displaywriter to immediately stop sending data. Data still can be received, however.

Normal operation resumes when the Displaywriter operator presses the Break Release key. Pressing Break 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 EOT Disconnect, and an ASCII EOT 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 second) disconnect signals depends on individual modems.

The operator can initiate a disconnect manually via the Disconnect key.

TIMEOUTS

Figure 22 on page 3-13 summarizes the timeouts that can occur at the Displaywriter during an ASYNC session.

Timeout Length	Timeout Purpose	Displaywriter Action After Timeout Expires
50 millisec.	When an EOT is received in Receive Originate State, an STX is automatically sent 50 ms later.	Send an STX (circle D).
100 millisec.	Minimum duration of sending a marking tone after sending a break.	Enable to send data, if any.
200 millisec.	Duration of sending break (space tone).	Disable sending of break.
250 millisec.	Minimum time DTR is turned off after DSR is turned off.	Turn on DTR, if enabled.
1.0 second	Minimum delay before sending data after RTS is turned on.	Enable to send data, if any.
5.0 seconds	Maximum length of time CTS stays off before DTR is turned off, disconnecting the communications link.	Turn off DTR.

Figure 22. Timeouts (1 of 2)

10.0 seconds	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-enabled.	Present message to operator.
30.0 seconds	When selected, if data is not sent or received within 30.0 seconds, DTR is turned off, disconnecting the communications link.	Turn off DTR.

Figure 23. Timeouts (2 of 2)

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 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.
- 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 that are 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 TRANSLATES

Appendix A lists the keyboards that the Displaywriter supports for communications sessions. 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 correspondence and 7-bit line codes do not have representations for certain graphics, these graphics are not preserved over the communications line.

The data processing keyboards listed in Appendix A are supported for the United States. Some international keyboards must make word-processing graphic substitutions for certain 7-bit graphics.

2741 Correspondence Line Code

Correspondence code is a 6-bit code set that has 128 possible code points because of lower case (LC) and upper case (UC) control codes. 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 succeeding code point. Lower case automatically is assumed following transmission of STX.

Correspondence line code translation for the 2741 mode involves:

- Specific control codes (Chapter 5, Figure 25 on page 5-6, and Figure 26 on page 5-8)
- Fixed codes for alphabetic graphics (Figure 27 on page 5-10).
- Variable codes for non-alphabetic graphics. These variable codes are assigned according to the character graphic set of the active keyboard ID (Figure 28 on page 5-12)

IBM CMC Correspondence Line Code

Correspondence line code translation for the IBM CMC mode is similar to that for the 2741 mode. The only major difference is in the translation of certain control codes (see Figure 25 on page 5-6 and Figure 26 on page 5-8)

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

TTY Mode 7-Bit Line Code

Line code translation for the TTY mode involves:

- Specific control codes (see Figure 25 on page 5-6 and Figure 29 on page 5-22)
- Fixed codes for alphanumeric graphics and some special graphics (see Figure 30 on page 5-24).
- Variable codes for non-alphanumeric graphics. These variable codes are assigned according to the character graphic set of the active keyboard ID (see Figure 28 on page 5-12).

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.

Chapter 4. Programming Considerations

OVERVIEW

For asynchronous communication, the Displaywriter is supported as a remote interactive terminal by the following IBM programming systems:

CMS (VM/370)

TSO (OS/VS2)

CICS/VS (OS/VS1, OS/VS2, DOS/VSE)

NTO (OS/VS1 and OS/VS2)

The Displaywriter can communicate with the above system control programs when attached in point-to-point mode as an IBM 2741 Data Communications Terminal or as a teletypewriter similar to the Teletype[3] 33, 35, or 43 Keyboard Send/Receive (KSR) models. "Attached as" means that the system expects to be communicating with an IBM 2741 or a teletypewriter, which are non-programmable ASYNC terminals.

Chapter 3 describes the data stream and protocol characteristics used by the Displaywriter.

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[3] Trademark of the Teletype Corporation

INTRODUCTION

VM/370 CMS

The Displaywriter is supported, when emulating a 2741 ASYNC terminal, by VM/370 providing VM/System Product (VM/SP), VM/Basic System Extensions (VM/BSEP), and VM/System Extension Program Product (VM/SEPP) with VM/370 Release 6 PLC4 level or higher.

CMS is a component of the IBM VM/System Product (VM/SP) that provides a comprehensive set of conversational facilities to virtual machine users.

Generation Parameters for VM/370

Before a Displaywriter can be used as a VM terminal, an RDEVICE macro must be coded for each real I/O device in the I/O configuration. The RDEVICE macro instructions describe each device, or group of devices, attached to the VM/370. Refer to the IBM Virtual Machine/System Product: Planning and System Generation Guide for further information about macro instructions.

RDEVICE Macro

```
RDEVICE ADDRESS=(050,3),DEVTYPE=3705,BASEADD=040,ADAPTER=IBM1
```

ADDRESS=(cuu cuu,nn)	Required--the real device address of the 3704/3705.
DEVTYPE=	Required--is the device type (270x, 370x, or 3705). Note: The IBM 2741 remote terminal must be coded as a 3705.
BASEADD=cuu	Required--is the native address (load address) of the 3704/3705 that controls the physical line.
ADAPTER=	Required--is the line adapter accessed by the specified real address.

3704/3705 Generation Parameters for VM/370

See "3704/3705 Generation Parameters" on page 4-14 for the 3704/3705 generation parameters to be used when attaching a Displaywriter to a host.

TSO/TCAM

The Time Sharing Option (TSO) of the Operating System/Virtual Storage, Option 2 (OS/VS2) allows you to use the facilities of a computer at a terminal.

Together with the Telecommunications Access Method (TCAM), TSO supports the Displaywriter as an IBM 2741 Communications Terminal.

Generation Parameters for TSO

In a TSO environment, a LINEGRP macro must be coded before a Displaywriter can be used as a TSO terminal. The LINEGRP macro defines a line group, which is a group of stations with similar characteristics. Refer to the Advanced Communications Function for TCAM System Programmer's Guide for further information about macro instructions.

LINEGRP Macro

```
LINEGRP DDNAME=GRPCMC,TERM=2741,LINENO=XX,UNITNO=1,DIAL=YES,
  FEATURE=(ATTN,NOBREAK),TRANTAB=CR41
```

DDNAME=	Required--specifies the names of the DD statements that define the communication lines as data sets (non-NCP stations only).
TERM=	Required--Identifies the types of stations in the line group.
LINENO=	Required--specifies the number of lines (physical device addresses) in the line group.
UNITNO=	Required--specifies the number of ACF/TCAM basic units per station buffer.
DIAL=	Required--specifies whether stations in this line group are on switched or nonswitched lines.
FEATURE=	Required--specifies the special features that the stations in this line group have (transmit or receive interrupt and Text Time-Out Suppression).
TRANTAB=	Required--identifies the translation tables to be used to translate from the station code to EBCDIC--non-NCP stations only.

3704/3705 Generation Parameters for TSO

See "3704/3705 Generation Parameters" on page 4-14 for the 3704/3705 generation parameters to be used when attaching a Displaywriter to a host.

CICS/VS BTAM

The Displaywriter is supported as a remote non-programmable ASYNC terminal by the Customer Information Control System/Virtual Storage (CICS/VS). CICS/VS is an IBM System/370 program product that controls online Data Base/Data Communication (DB/DC) applications. CICS/VS, and the applications under its control, run under any System/370 virtual storage operating system — OS/VS1 and OS/VS2 (SVS or MVS).

Together with the Basic Telecommunications Access Method (BTAM), CICS/VS supports the Displaywriter as an IBM 2741 Communications Terminal.

Generation Parameters for CICS/VS

Before a Displaywriter can be used as a CICS/VS terminal, the following DFHTCT macros must be coded to specify the appropriate (1) data set control information, (2) communication lines, and (3) terminal types for ASYNC switched and leased lines. Refer to the IBM Customer Information Control System/Virtual Storage (CICS) System Programmer's Reference Manual for information about macro instructions.

ASYNC Switched Lines

DFHTCT SDSCI Macro

```
DFHTCT TYPE=SDSCI,DSCNAME=DWS4,DDNAME=DWS4,DEVICE=2741C,ERROPT=W,
       BLKSIZE=512
```

TYPE= Required--specifies the data set control information.

DSCNAME= Required--specifies the symbolic data set control name associated with the data set control information.

DDNAME= Required--supplies the name of the data definition (DD) statement associated with a particular data set (line group).

DEVICE= Required--specifies the valid device types for this data set.

ERROPT= Required--specifies the error recovery, error recording, and on-line test options to be provided for the line group.

BLKSIZE= Required--specifies, for sequential data sets, the maximum length (in bytes) of a block.

DFHTCT Line Macro

```
AWLIN4 DFHTCT TYPE=LINE,ACCMETH=BTAM,ANSWRBK=TERMINAL,DSCNAME=DWS4,
  TRMTYPE=2741C,INAREAL=2048,FEATURE,AUTOANSR,CLASS=(ONV,HARDCOPY),
  CONVTAB=TEXTMODE,POOLADR=AW04,BTAMRLN=1,TCTUAL=44
```

TYPE= Required--specifies the data set control information.

ACCMETH= Required--specifies the access method to be used.

ANSWRBK= Required--must be indicated for switched lines to specify the terminal identification to be used.

DSCNAME= Required--specifies the data set control name for this communication line.

TRMTYPE= Required--specifies the terminal type associated with this communication line.

INAREAL= Required--specifies the message input area length.

FEATURE= Required--indicates that one or more optional features are present on a given line.

CLASS= Required--indicates the device classification associated with this communication line.

CONVTAB= Required--specifies the type of transmission code.

POOLADR= Required--must be used for switched line processing. Specifies the label assigned to the first terminal description macro associated with the particular pool of communication line.

BTAMRLN= Required--specifies the relative line number within a line group.

TCTUAL= Required--specifies the length, in bytes (0-255), of the process control information field (PCI) for all terminal entries (TCTTEs) associated with this line.

DFHTCT Terminal Macro

```
AW04 DFHTCT TYPE=TERMINAL,TRMIDNT=AW04,LASTTRM=POOL,TIOAL=512,
  TRMPRTY=1,TRMSTAT=TRANSACTION,TCTUAL=44
```

TYPE= Required--specifies the terminal for the current region.

TRMIDNT= Required--supplies a unique four character symbolic identification to each terminal.

LASTTRM= Required--indicates "host terminal" condition.

TIAOL= Required--indicates the terminal input/output area length to be passed to a transaction for non-SNA devices.

TRMPRTY= Required--Establishes the terminal priority. This decimal value (0-255) is used in establishing the overall transaction processing priority.

TRMSTAT= Required--specifies the types of activity that may occur at a given terminal.

TCTUAL= Required--specifies the length, in bytes (0-255), of the process control information field (PCI) for this terminal.

ASYNC Non-switched Lines

DFHTCT SDSCI Macro

```
DFHTCT TYPE=SDSCI,DSCNAME=DWS3,DDNAME=DWS3,DEVICE=2741C,ERROPT=W,
  BLKSIZE=256
```

TYPE=	Required--specifies the data set control information.
DSCNAME=	Required--specifies the symbolic data set control name associated with the data set control information.
DDNAME=	Required--Supplies the name of the data definition (DD) statement associated with a particular data set (line group).
DEVICE=	Required--specifies the valid device types for this data set.
ERROPT=	Required--specifies the error recovery, error recording, and on-line test options to be provided for the line group.
BLKSIZE=	Required--specifies, for sequential data sets, the maximum length (in bytes) of a block.

DFHTCT Line Macro

```
AWLIN3 DFHTCT TYPE=LINE,ACCMETH=BTAM,DSCNAME=DWS3,TRMTYPE=2741C,
  INAREAL=2048,CLASS=(CONV,HARDCOPY),CONVTAB=TEXTMODE,BTAMRLN=1,
  TCTUAL=44
```

TYPE=	Required--specifies the data set control information.
ACCMETH=	Required--specifies the access method to be used.
DSCNAME=	Required--specifies the data set control name for this communication line.
TRMTYPE=	Required--specifies the terminal type associated with this communication line.
INAREAL=	Required--specifies the length of the message input area.
CLASS=	Required--indicates the device classification associated with this communication line.
CONVTAB=	Required--specifies the type of transmission code.
BTAMRLN=	Required--specifies the relative line number within a line group.

TCTUAL= Required--specifies the length, in bytes (0-255), of the process control information field (PCI) for all terminal entries (TCTTEs) associated with this line.

DFHTCT Terminal Macro

```
AW03 DFHTCT TYPE=TERMINAL,TRMIDNT=AW03,LASTTRM=LINE,TIOAL=256,
  TRMPRTY1,TRMSTAT=TRANSACTION,TCTUAL=44
```

TYPE= Required--specifies the terminal for the current region.

TRMIDNT= Required--supplies a unique four character symbolic identification to each terminal.

LASTTRM= Required--Indicates "host terminal" condition.

TIAOL= Required--indicates the terminal input/output area length to be passed to a transaction for non-SNA devices.

TRMPRTY= Required--establishes the terminal priority. This decimal value (0-255) is used in establishing the overall transaction processing priority.

TRMSTAT= Required--specifies the types of activity that may occur at a given terminal.

TCTUAL= Required--specifies the length, in bytes (0-255), of the process control information field (PCI) for this terminal.

3704/3705 Generation Parameters for CICS/VS

See "3704/3705 Generation Parameters" on page 4-14 for the 3704/3705 generation parameters to be used when attaching a Displaywriter to a host.

NETWORK TERMINAL OPTION (NTO)

The Network Terminal Option (NTO) is an IBM program product. NTO extends the capabilities of the Advanced Communications Function Network Control Program (ACF/NCP) in a 3705 Communications Controller to allow Systems Network Architecture

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[4] Trade of the Teletype Corporation

Support (SNA) for an IBM 2741 Communications Terminal or Teletype[4] 33, 35, or 43 Keyboard Send/Receive (KSR) models. NTO provides appropriate data stream translations and protocols to make an ASYNC Displaywriter appear as an SNA 3767 to host applications.

The following IBM programming systems, and their access methods are supported by NTO:

- CICS/VS (ACF/VTAM)
- CMS (ACF/VTAM, VM/VCNA)
- TSO (ACF/VTAM)
- VSPC (ACF/VTAM)

Generation Parameters for NTO

The following example includes the real and virtual statements to define NTO resources (indicated by an *). It also includes the ACF/NCP generation statements required to define NCP to the network. See the Network Terminal Option Installation manual for further information on NTO generation statements.

Note: Use this example as a guide only. Do not code directly from this example. Your configuration will be different. For more information on installation procedures, see the ACF/NCP Installation manual.

Virtual Switched Parameters — IBM 2741

Before a Displaywriter can be used as a virtual or real switched IBM 2741 terminal, the following generation parameters must be coded.

Group Macro

```
HDVGRP1 GROUP LNCTL=SDLC,VIRTUAL=YES,DIAL=YES,MAXLU=1,
  LINEFVT=CXNFVTV,TYPE=NCP,LUFVT=(CXNFVTL,CXNFVT1,CXNFVT2),
  PUFVT=CXNFVTP
```

*LNCTL=	Required--specifies the real NTO devices as either a start-stop or BSC device.
*VIRTUAL=	Required--specifies that this line group supports NTO devices as virtual devices.
DIAL=	
MAXLU=	
*LINEFVT=	Required--specifies the name of the function vector table for the NTO lines.

TYPE=

*LUFVT= Required--specifies the name of the function vector tables for the LUs supported by NTO.

*PUFVT= Required--specifies the name of the function vector table for the PUs supported by NTO.

Line Macro

```
HDVSS02 LINE LINECB=HDVLN2
```

*LINECB= Required--provides a name for the user control block for this line.

PU Macro

```
HDVPU2 PU PUCB=HDVP2
```

*PUCB= Required-provides the name of the user control block for this PU macro.

LU Macro

```
HDVPU2 LUCB=(HDVL2,HDVL2,HDVL2)
```

*LUCB= Required--provides the name of the user control block for this LU macro.

Real Switched Parameters — IBM 2741

Group Macro

```
HDRGRP2 GROUP LNCTL=SS,DIAL=YES,TYPE=NCP,REPLYTO=NONE,TEXTTO=NONE
```

*LNCTL= Required--specifies the real NTO device as either a start-stop or BSC device.

DIAL=

TYPE=

*REPLYTO= Required--specifies the reply time-out value for the lines in this group.

*TEXTO= Required--specifies the text time-out value, in seconds, for the lines in the line group.

Line Macro

```
HDRSS02 LINE ADDRESS=0BB,SPEED=134,CODE=COR,DUPLEX=FULL,MONITOR=YES,
  ISTATUS=INACTIVE

ADDRESS=

SPEED=

CODE=
```

*DUPLEX= Required--must be specified that the real NTO line constitutes a full duplex facility.

*MONITOR= Required--specifies that the NCP is to monitor for an attention signal or a disconnect condition at the terminal.

*ISTATUS= Required--specifies if the NTO-supported line is to be initially active.

TERMINAL Macro

```
HDR2741C TERMINAL TERM=2741,CTERM=YES,FEATURE=(ATTN,BREAK),ATTN=ENABLED
```

*TERM= Required--specifies the type of station represented by this Terminal macro.

```
CTERM=

FEATURE=

ATTN=
```

Virtual Switched Parameters — TTY

Before a Displaywriter can be used as a virtual or real teletypewriter terminal, the following generation parameters must be coded:

Group Macro

```
HDVGRP1 GROUP LNCTL=SDLC,VIRTUAL=YES,DIAL=YES,MAXLU=1,LINEFVT=CXNFVTV,
  TYPE=NCP,LUFVT=(CXNFVTL,CXNFVT1,CXNFVT2),PUFVT=CXNFVTP
```

*LNCTL= Required--specifies the real NTO device as either a start-stop or BSC device.

*VIRTUAL= Required--specifies that this line group supports NTO devices as virtual devices.

```
DIAL=

MAXLU=
```

*LINEFVT= Required--specifies the name of the function vector table for the NTO lines.

TYPE=

*LUFVT= Required--specifies the name of the function vector tables for the LUs supported by NTO.

*PUFVT= Required--specifies the name of the function vector table for the PUs supported by NTO.

Line Macro

```
HDVSS06 LINE LINECB=HDVLN6
```

*LINECB= Required--provides a name for the user control block for this line.

PU Macro

```
HDVPU6 PU PUCB=HDVP6
```

*PUCB= Required--provides the name of the user control block for this PU macro.

LU Macro

```
HDVPU6 LUCB=(HDVL6,HDVL6,HDVL6)
```

*LUCB= Required--provides the name of the user control block for this LU macro.

Real Switched Parameters — TTY

Group Macro

```
HDRGRP6 GROUP LNCTL=SS,DIAL=YES,TYPE=NCP,REPLYTO=NONE,TEXTTO=NONE,
  CHAREC=(XOFF,B1)
```

*LNCTL= Required--specifies the real NTO devices as either a start-stop or BSC device.

DIAL=

TYPE=

*REPLYTO= Required--specifies the reply time-out value for the lines in this group.

*TEXTTO= Required--specifies the text time-out value, in seconds, for the lines in the line group.

CHAREC=

Line Macro

```
HDRSS06 LINE ADDRESS=0B9,SPEED=110,CODE=ASCII,DUPLEX=FULL,
  MONITOR=YES,LINESIZ=80,ISTATUS=INACTIVE
```

ADDRESS=

SPEED=

CODE=

DUPLEX=

*MONITOR= Required--specifies that the NCP is to monitor for an attention signal or a disconnect condition at the terminal.

LINESIZ=

*ISTATUS= Required--specifies if the NTO-supported line is to be initially active.

TERMINAL Macro

```
HDR3101 TERMINAL TERM=TWX,CTERM=YES,FEATURE=(ATTN,BREAK),ATTN=ENABLED
```

*TERM= Required--specifies the type of station represented by this Terminal macro.

CTERM=

FEATURE=

ATTN=

*VIRTUAL= Required--specifies that this line group supports NTO devices as virtual devices.

DIAL=

MAXLU=

*LINEFVT= Required--specifies the name of the function vector table for the NTO lines.

TYPE=

*LUFVT= Required--specifies the name of the function vector tables for the LUs supported by NTO.

*PUFVT= Required--specifies the name of the function vector table for the PUs supported by NTO.

Note: TWX must be specified as the TERM parameter.

3704/3705 Generation Parameters

When attaching a Displaywriter to a host, both a Group and a Line definition must be included in the 3705 Emulator Program (EP) configuration.

A Group macro instruction indicates the beginning of a sequence of Line macros for lines within a group. The macro mainly is used to specify whether the lines are: (a) switched or non-switched and (b) for asynchronous or or binary synchronous communication. Other operands can specify characteristics common to all lines in the group or procedural options that are applied to all lines in the group.

A Line macro represents one communication line attached to the communications controller and specifies operating parameters such as the address in the communications controller to which the line is attached and the speed of the line.

Examples of Group and Line macro instructions and explanations of the specified operands are below.

Refer to the IBM 3704 and 3705 Control Program Generation and Utilities Guide and Reference Manual for further information about these macros and the operands associated with them.

Group Macro

```
DIAL=YES,LNCTL=SS
```

DIAL=	Specifies whether the lines in the group are switched (YES) or non-switched (NO). The default is NO.
LNCTL=	Specifies whether the line group contains start-stop lines (LNCTL=SS) or BSC lines (LNCTL=BSC).

Line Macro

```
CHECK=NODCD,CLOCKING=INT,DISABLE=NO,INTPRI=0,QUIET=NO, TERM=2741,
  DUPLEX=FULL
```

CHECK=	Optional--specifies whether the controller is to use the "data carrier detect" option.
CLOCKING=	Optional--specifies the type of clocking to be used. CLOCKING=EXT means that the modem provides the clocking.
DISABLE=	Optional--specifies whether or not the modem requires a "long disable timeout" when disconnecting from the line.
INTPRI=interrupt	Optional--indicates the interrupt priority for the line, relative to other lines attached to the controller. Priority 3 is the highest; priority 0 is the lowest.
QUIET=	Optional--specifies whether or not the program is to observe a "long line quiet" (25.6 seconds) when receiving.
TERM=type	Required--specifies the type of station with which the emulation program communicates over the line.
DUPLEX=	Required--specifies that the communications line and modem constitute a full-duplex physical facility.

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Part Two. ASYNC Facility Reference

Part Two of this manual contains:

- The line code translates for ASYNC control codes and graphic characters (Chapter 5)
- Suggestions for isolating problems with the Displaywriter/host communications (Chapter 6)
- A description of the communication utilities that are available with the Displaywriter (Chapter 7)
- A list of supported keyboards for asynchronous communication (Appendix A)
- A general description of the hardware used with the ASYNC facility (Appendix B)
- Definitions of terms associated with asynchronous communication (Glossary)
- A list of related publications (Bibliography)

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Chapter 5. Data Stream Translation Tables

The acronyms used in this chapter are:

ACK	Acknowledge	NAK	Negative Acknowledge
BEL	Bell	NBS	Numeric Backspace
BS	Backspace	NL	New Line
BS(UC)	Backspace Upper Case	NSP	Numeric Space
CAN	Cancel	NUL	Null
CR	Carrier Return	PE	Form Feed
CRE	Carriage Return	POC	Program-Operator Comm.
CUn	Customer Use #	PP	Presentation Position
DCn	Device Control #	PRE	Prefix
DEL	Delete	RCR	Required Carrier Return
DLE	Data Link Escape	RES	Restore
DS	Digit Select	RFF	Required Form Feed
ECBS	Error Correct Backspace	RNL	Required New Line
EM	End of Medium	RPT	Repeat
ENQ	Enquiry	RS	Record Separator
EO	Eight Ones	RSP	Required Space
EOT	End of Transmission	SBS	Subscript
ESC	Escape	SEL	Select
ETB	End of Transmission Block	SI	Shift In
ETX	End of Text	SO	Shift Out

Figure 24. Control Code Acronyms (Part 1 of 2)

Acronyms (cont)

FF	Form Feed	SOH	Start of Heading
FMT	Format	SOS	Start of Significance
FS	Field Separator	SP	Space
GE	Graphic Escape	SPS	Superscript
GS	Group Separator	STP	Stop or Bell
HT	Horizontal Tab	STX	Start of Text
HYP	Hyphen	SUB	Substitute
IDLE	Idle	SW	Switch
IFS	Interchange File Separator	SYN	Synchronous Idle
IGS	Interchange Group Separator	TKLK	Track Link
INP	Inhibit Presentation(Bypass)	TKSK	Track Skip
INX	Index	TRN	Transparent
IRS	Interchange Record Separator	UBS	Unit Backspace
IRT	Index Return	UC	Upper Case
IT	Indent Tab	US	Unit Separator
IUS	Interchange Unit Separator	VT	Vertical Tab
LC	Lower Case	WUS	Word Underscore
LF	Line Feed or Index	#nn	

Figure 24. Control Code Acronyms (Part 2 of 2)

LINE CODE TRANSLATES

The Displaywriter's internal data stream is based on EBCDIC Multilingual, a code set that is different from the Correspondence or 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 send/receive state,
- the current Character Graphic Set ID,
- the communications protocol (TTY, 2741, or IBM CMC),
- the current internal multilingual page.

CONTROL CODES

Figure 25 on page 5-6, Transmit Control Translates, shows the EBCDIC control code points that are sent over the line in each of the three operating modes and which of those controls can be keyed from the keyboard.

Figure 26 on page 5-8, Receive Correspondence Control Translates, shows how the non-graphic code points are interpreted when they are received in IBM CMC or 2741 mode and what those code points are mapped into.

GRAPHIC CODES

Figure 27 on page 5-10, Fixed Correspondence Graphics, shows how the graphic code points are interpreted when they are received in 2741 or IBM CMC mode.

Figure 28 on page 5-12, Correspondence Line Code For Variable and Prefixed Graphics, shows the on-line hex representation of the character (upper and lowercase versions of each) plus eight additional prefixed graphics for all supported keyboards.

Figure 29 on page 5-22, Receive 7-Bit Graphics, shows the ASCII controls and how those controls are interpreted for TTY mode.

Figure 30 on page 5-24, Fixed 7-Bit Graphics, shows the ASCII on-line fixed graphics and how those graphics are interpreted for TTY mode.

Figure 31 on page 5-26, 7-Bit Line Code For Variable Graphics, shows the on-line hex representation of the character (no upper or lowercase) 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.

TRANSMIT CONTROL TRANSLATES

EBCDIC	CONTROL	KEY?	OPERATING MODE IBM CMC	2741	TTY
00	NUL	Y			NUL
01	SOH	Y			SOH
02	STX	Y			STX
03	ETX	Y			ETX
04	SELN	N			
05	HT	Y	HT	HT	HT
06	RNL	Y	RCR	RCR	CR,LF
07	DEL	Y	IDLE		DEL
08	GEN	N			
09	SPS	Y	SPS		
0A	RPT	Y	RPT		
0B	VT	Y			VT
0C	FF	Y	PE		FF
0D	CR	Y	CRE	CRE	CR
0E	SO	Y			SO
0F	SI	Y			SI
10	DLE	Y			DLE
11	DC1	Y			DC1
12	DC2	Y			DC2
13	DC3	Y			DC3
14	RES	N			
15	NL	Y	CRE	CRE	CR,LF
16	BS	Y	BS(UC)	BS(UC)	BS
17	POC	N			
18	CAN	Y			CAN
19	EM	Y			EM
1A	UBS	N	UBS		
1B	CU1	N			
1C	IFS	Y			FS
1D	IGS	Y			GS
1E	IRS	Y	CRE	CRE	RS
1F	IUS	Y			US
20	DS	N			
21	SOS	N			
22	FS	N			
23	WUS	Y	WUS		
24	INP	N			
25	LF	Y	INX	CRE	LF
26	ETB	Y			ETB

Figure 25. Transmit Control Translates (Part 1 of 2)

TRANSMIT CONTROL TRANSLATES (cont)

EBCDIC	CONTROL	KEY?	OPERATING MODE IBM CMC	2741	TTY
27	ESC	Y			ESC
28		N			
29		N			
2A	SW	Y	SW		
2B	FMT	N			
2C		N			
2D	ENQ	Y			ENQ
2E	ACK	Y			ACK
2F	STP	Y	STP		BEL
30		N			
31		N			
32	SYN	Y			SYN
33	IRT	Y	IRT	RCR	CR,LF
34	PP	N			
35	TRN	N			
36	NBS	N	NBS	BS(UC)	BS
37	EOT	Y	EOT	EOT	EOT
38	SBS	Y	SBS		
39	IT	Y	IT	IT	HT
3A	RFF	Y	PE		FF
3B	CU3	N			
3C	DC4	Y			DC4
3D	NAK	Y			NAK
3E		N			
3F	SUB	Y			SUB
40	SP	Y	SP	SP	SP
41	RSP	Y	RSP	SP	SP
60	RQD HYP	Y	RQ HYP	-	-
CA	SYL HYP	Y	-	-	-
E1	NSP	N	SP	SP	SP
42-FE	Any Invalid Graphic	Y	_	_	SUB
42-FE	Extended Graphics Preceeded by		PRE(1C)	PRE(1C)	
FF	EO	N			

Figure 25. Transmit Control Translates (Part 2 of 2)

RECEIVE CORRESPONDENCE CONTROL TRANSLATES

Correspondence Received			EBCDIC Display/Recorded	
LC	UC	Meaning	IBM CMC	2741
00		SP	SP	SP
	00	SP	SP	SP
0B		STX	**	**
0C		SPS	SPS	SPS
	0C	#25	SUB	SUB
0D		SBS	SBS	SBS
	0D	TKSK	SUB	SUB
0E		UC	**	**
	0E	UC	**	**
0F		EOT	**	**
	0F	EOT	**	**
1A		STP	STP	STP
	1A	#13	SUB	SUB
1C		#10	SUB	∂
	1C	ETX	SUB	∂
1D		INX	INX	INX
	1D	IRT	IRT	INX
1E		SW	SW	SW
	1E	#22	SUB	SUB
1F		PRE	##	##
	1F	#17	##	##
2A		HYP	R HYP	R HYP
	2A	UBS	UBS	UBS
2C		TKLK	SUB	∂∂
	2C	RPT	RPT	∂∂
2D		CRE	CRE	CRE
	2D	RCR	RCR	CRE
2E		ECBS	BS	BS
	2E	BS	BS	BS
2F		IDLE	**	**
	2F	IDLE	SUB	SUB
3A		WUS	WUS	WUS
	3A	NBS	NBS	NBS

Figure 26. Receive Correspondence Control Translates (Part 1 of 2)

RECEIVE CORRESPONDENCE CONTROL TRANSLATES (cont)

Correspondence LC	Correspondence UC	Received Meaning	EBCDIC Display/Recorded IBM CMC	EBCDIC Display/Recorded 2741
3C		RSP	RSP	RSP
	3C	PE	PE	PE
3D		HT	HT	HT
	3D	IT	IT	HT
3E		LC	**	**
	3E	LC	**	**
3F		#20	SUB	SUB
	3F	#12	SUB	SUB

Figure 26. Receive Correspondence Control Translates (Part 2 of 2)

Notes:

1. * Invalid code. Deleted from data stream.
2. ** Control code. Deleted from data stream.
3. ə BYPASS code used to invoke output suppression.
4. əə RESTORE code used to end output suppression.
5. ## Used with the following character to define extended graphics on 96-character keyboards. Deleted from data stream.

FIXED CORRESPONDENCE GRAPHICS

On-line Correspondence Representation			Internal EBCDIC
LC	UC	Graphic	Representation
0A		z	A9
	0A	Z	E9
10		t	A3
	10	T	E3
11		x	A7
	11	X	E7
12		n	95
	12	N	D5
13		u	A4
	13	U	E4
14		e	85
	14	E	C5
15		d	84
	15	D	C4
16		k	92
	16	K	D2
17		c	83
	17	C	C3
18		l	93
	18	L	D3
19		h	88
	19	H	C8
1B		b	82
	1B	B	C2
21		m	94
	21	M	D4
23		v	A5
	23	V	E5
25		r	99
	25	R	D9
26		i	89
	26	I	C9

Figure 27. Fixed Correspondence Graphics (Part 1 of 2)

FIXED CORRESPONDENCE GRAPHICS (cont)

On-line Correspondence Representation			Internal EBCDIC
LC	UC	Graphic	Representation
27		a	81
	27	A	C1
28		o	96
	28	O	D6
29		s	A2
	29	S	E2
2B		w	A6
	2B	W	E6
30		j	91
	30	J	D1
31		g	87
	31	G	C7
33		f	86
	33	F	C6
34		p	97
	34	P	D7
36		q	98
	36	Q	D8
39		y	A8
	39	Y	E8
3B		-	60
	3B	_	6D

Figure 27. Fixed Correspondence Graphics (Part 2 of 2)

	HEX POS	01		02		03		04		04*		05		05*		06		06*	
COUNTRY	KBID	l	u	l	u	l	u	l	u	l	u	l	u	l	u	l	u	l	u
USA	1	1	!	2	@	3	#	5	%	²	³	7	&	]	[	6	ç	§	¶
USA	2	1	!	2	@	3	#	5	%			7	&			6	ç		
USA	3	1	±	2	@	3	#	5	%			7	&			6	ç		
USA	4	]	[	2	@	3	#	5	%			7	&			6	ç		
USA	5	1	±	2	@	3	#	5	%			7	&			6	ç		
USA	6	]	[	2	¶	3	#	5	%			7	&			6	§		
USA	7	1	°	2	¶	3	#	5	%			7	&			6	§		
USA	8	1	°	2	¶	3	#	5	%			7	&			6	§		
USA	17	1	£	2	@	3	#	5	%			7	&			6	ç		
USA	18	1	!	2	@	3	#	5	%			7	&			6	+		
USA	19	1	±	2	@	3	#	5	%			7	&			6	ç		
PUERTO RICO	24	1	¡	2	¿	3	#	5	%			7	&			6	/		
PUERTO RICO	25	1	!	2	°	3	#	5	%	¡	£	7	&	]	[	6	/	'	"
GERMANY	26	1	;	2	"	3	=	5	&			7	)			6	(		
GERMANY	27	1	!	2	"	3	§	5	%	<	>	7	/	²	³	6	&	+	*
GERMANY-AUSTRIA	29	1	!	2	"	3	§	5	%	²	³	7	/	µ	°	6	&	+	*

* INDICATES PREFIXED GRAPHICS

| | BLANK BOXES MAPPED INTO GRAPHIC
|_ _| UNDERSCORE IN TRANSMIT AND RECEIVE.

Figure 28. Correspondence Line Code Assignments for Variable and Prefixed Graphics (Part 1 of 5)

07		07*		08		09		0B		20		22		24		32		35		37		38	
l	u	l	u	l	u	l	u	l	u	l	u	l	u	l	u	l	u	l	u	l	u	l	u
8	*	±	º	4	$	0	)	9	(	½	¼	.	.	'	"	=	+	;	:	,	,	/	?
8	*			4	$	0	)	9	(	½	¼	.	.	'	"	=	+	;	:	,	,	/	?
8	*			4	$	0	)	9	(	½	¼	.	.	'	"	=	+	;	:	,	,	/	?
8	*			4	$	0	)	9	(	!	º	.	.	'	"	=	+	;	:	,	,	/	?
8	*			4	$	0	)	9	(	!	º	.	.	'	"	=	+	;	:	,	,	/	?
8	*			4	$	0	)	9	(	!	º	.	.	'	"	=	+	;	:	,	,	/	?
8	*			4	$	0	)	9	(	]	[	.	.	'	"	=	+	;	:	,	,	/	?
8	*			4	$	0	)	9	(	½	¼	.	.	'	"	=	+	;	:	,	,	/	?
8	*			4	$	0	)	9	(	=	+	.	.	'	"	¼	=	;	:	,	,	/	?
8	£			4	$	0	)	9	(	ç	*	.	.	'	"	=	=	;	:	,	,	/	?
8	*			4	$	0	)	9	(	½	¼	.	.	'	"	=	+	;	:	,	,	/	?
8	*			4	$	0	)	9	(	´	º	.	.	;	:	=	+	ñ	Ñ	,	?	'	"
8	*	´	¨	4	$	0	)	9	(	=	+	.	.	½	¼	ñ	Ñ	;	:	,	,	¿	?
8	+			4	%	0	/	9	§	ü	Ü	.	!	ä	Ä	ö	Ö	´	`	,	?	ß	:
8	(	#	^	4	$	0	=	9	)	ü	Ü	.	:	ä	Ä	ö	Ö	´	`	,	;	ß	?
8	(	#	'	4	$	0	=	9	)	ü	Ü	.	:	ä	Ä	ö	Ö	´	`	,	,	ß	?

COUNTRY	HEX POS KBID	01 l	01 u	02 l	02 u	03 l	03 u	04 l	04 u	04* l	04* u	05 l	05 u	05* l	05* u	06 l	06 u	06* l
FRANCE	31	&	1	é	2	"	3	(	5	²	³	è	7	<	>	§	6	$
FRANCE	32	&	1	é	2	"	3	(	5			è	7			§	6	
FRANCE	33	1	!	2	"	3	§	5	%	²	³	7	/	<	>	6	+	&
FRANCE	251	&	1	é	2	"	3	(	5	²	³	è	7	<	>	§	6	$
CANADA-ENG	36	1	!	2	@	3	#	5	%			7	&			6	ç	
CANADA-ENG	37	1	!	2	@	3	#	5	%	²	³	7	&	]	[	6	ç	£
CANADA-FR	38	1	±	2	"	3	/	5	%			7	&			6	?	
CANADA-FR	39	1	!	2	@	3	#	5	%	²	³	7	&	^	^	6	ç	«
ITALY	41	&	1	"	2	'	3	ç	5	½	£	)	7	<	>	è	6	*
ITALY	46	&	1	"	2	'	3	ç	5			)	7			è	6	
NETHERLANDS	42	1	¼	2	½	3	3	5	%			7	&			6	ƒ	
NETHERLANDS	43	1	!	2	"	3	3	5	%	²	³	7	/	±	°	6	&	+
SPAIN	44	1	ç	2	¿	3	$	5	/			7	=			6	%	
SPAIN	45	1	!	2	"	3	£	5	%	|	¡	7	/	ç	½	6	&	+
SWITZERLAND-FR	48	1	$	2	"	3	*	5	&			7	)			6	(	
SWITZERLAND-FR	49	1	+	2	"	3	*	5	%	§	°	7	/	]	[	6	&	$
SWITZERLAND-GR	50																	

* INDICATES PREFIXED GRAPHICS

| | BLANK BOXES MAPPED INTO GRAPHIC
| | UNDERSCORE IN TRANSMIT AND RECEIVE.

Figure 28. Correspondence Line Code Assignments for Variable and Prefixed Graphics (Part 2 of 5)

07		07*		08		09		0B		20		22		24		32		35		37		38	
l	u	l	u	l	u	l	u	l	u	l	u	l	u	l	u	l	u	l	u	l	u	l	u
!	8	#	£	'	4	à	0	ç	9	=	+	;	.	ù	%	:	/	^	¨	,	?	)	º
!	8			'	4	à	0	ç	9	=	+	;	.	:	/	)	º	^	¨	,	?	ù	%
8	(	#	£	4	$	0	=	9	)	ù	º	.	:	à	ç	é	è	^	¨	,	;	'	?
!	8	µ	£	'	4	à	0	ç	9	=	+	;	.	ù	%	:	/	^	¨	,	?	)	º
8	*			4	$	0	)	9	(	½	¼	.	.	'	"	=	+	;	:	,	,	/	?
8	*	±	º	4	$	0	)	9	(	½	¼		.	'	"	=	+	;	:	,	,	/	?
8	¾			4	$	0	)	9	(	ç	*	.	.	;	:	½	¼	`	^	,	'	é	ç
8	*	¨	º	4	$	0	)	9	(	`	`	.	/	´	´	=	+	;	:	,	'	é	?
+	8	ì	=	(	4	é	0	à	9	§	º	;	.	ù	%	:	/	^	¨	,	?	ò	!
+	8			(	4	é	0	à	9	ì	=	;	.	:	/	ò	!	^	¨	,	?	ù	%
8	(			4	£	0	¾	9	)	+	=	.	;	´	`	/	:	^	¨	,	?	'	"
8	(	^	¨	4	£	0	=	9	)	¾	§	.	.	½	¼	:	f	´	`	,	;	'	?
8	(			4	&	0	º	9	)	´	¨	.	:	`	^	?	!	ñ	Ñ	,	;	"	'
8	(	`	^	4	$	0	=	9	)	º	ª	.	:	₧	¿	ñ	Ñ	´	¨	,	;	'	?
8	?			4	%	0	¼	9	½	'	/	.	=	à	:	è	ù	^	¨	,	+	é	ç
8	(	^	`	4	ç	0	=	9	½	è	ü	.	:	à	ä	é	ö	¨	´	,	+	'	?

COUNTRY	HEX POS KBID	01 l	01 u	02 l	02 u	03 l	03 u	04 l	04 u	04* l	04* u	05 l	05 u	05* l	05* u	06 l	06 u	06* l	06* u
SWITZERLAND-GR	51	1	+	2	"	3	*	5	%	§	°	7	/	]	[	6	&	$	£
SWEDEN-FINLAND	52	1	'	2	+	3	§	5	%			7	&			6	?	.	
SWEDEN-FINLAND	53	1	!	2	"	3	£	5	%	½	§	7	/	<	>	6	&	'	*
NORWAY	54	1	$	2	"	3	%	5	=			7	£			6	&		
NORWAY	55	1	!	2	"	3	£	5	%	½	§	7	/	<	>	6	&	'	*
DENMARK	56	1	$	2	"	3	%	5	=			7	£			6	&		
DENMARK	57	1	!	2	"	3	£	5	%	½	§	7	/	<	>	6	&	'	*
PORTUGAL	62	1	=	2	"	3	/	5	£			7	&			6	?		
PORTUGAL	63	1	!	2	"	3	£	5	%	|	§	7	/	1	¨	6	&	+	*
UNITED KINGDOM	66	1	+	2	*	3	/	5	£			7	&			6	$		
UNITED KINGDOM	67	1	!	2	"	3	£	5	%	2	3	7	'	<	>	6	&	:	*
UNITED KINGDOM	20	1	+	2	*	3	/	5	£			7	&			6	$		
UNITED KINGDOM	253	1	!	2	"	3	£	5	%	2	3	7	'	<	>	6	&	:	*
UNITED KINGDOM	254	1	+	2	*	3	/	5	£			7	&			6	$		
JAPAN	68	1	±	2	@	3	#	5	%			7	&			6	¥		
JAPAN	69	1	!	2	@	3	#	5	%	¨	¨	7	&	~	`	6	¥	ç	ß

* INDICATES PREFIXED GRAPHICS

| | BLANK BOXES MAPPED INTO GRAPHIC
|_| UNDERSCORE IN TRANSMIT AND RECEIVE.

Figure 28. Correspondence Line Code Assignments for Variable and Prefixed Graphics (Part 3 of 5)

07		07*		08		09		0B		20		22		24		32		35		37		38	
l	u	l	u	l	u	l	u	l	u	l	u	l	u	l	u	l	u	l	u	l	u	l	u
8	(	^	`	4	ç	0	=	9	½	ü	è	.	:	ä	à	ö	é	¨	´	,	;	'	?
8	(			4	=	0	/	9	½	ü	£	.	:	ä	Ä	ö	Ö	´	`	,	"	å	Å
8	(	¨	^	4	$	0	=	9	½	å	Å	.	:	ä	Ä	ö	Ö	´	`	,	;	+	?
8	(			4	?	0	/	9	½	½	+	.	:	æ	Æ	ø	Ø	¨	´	,	'	å	Å
8	(	¨	^	4	$	0	=	9	½	å	Å	.	:	æ	Æ	ø	Ø	´	`	,	;	+	?
8	(			4	?	0	/	9	½	½	+	.	:	æ	Æ	ø	Ø	¨	´	,	'	å	Å
8	(	¨	^	4	$	0	=	9	½	å	Å	.	:	æ	Æ	ø	Ø	´	`	,	;	+	?
8	'			4	§	0	)	9	(	%	+	.	:	~	^	$	º	´	`	,	;	ç	Ç
8	(	~	^	4	$	0	=	9	)	º	ª	.	:	]	[	ç	Ç	´	`	,	;	'	?
8	¾			4	@	0	)	9	(	¼	!	.	.	'	"	=	?	;	:	,	,	½	%
8	(	]	[	4	$	0	=	9	)	µ	#	.	.	@	½	±	°	;	+	,	,	/	?
8	!			4	@	0	)	9	(	]	[	.	.	'	"	=	?	;	:	,	,	½	%
8	(	]	[	4	$	0	=	9	)	µ	#	.	.	@	½	±	°	;	+	,	,	/	?
8	¾			4	@	0	)	9	(	¼	!	.	.	'	"	=	?	;	:	,	,	½	%
8	£			4	$	0	)	9	(	º	*	.	.	'	"	=	+	;	:	,	,	/	?
8	£	^	~	4	$	0	)	9	(	º	*	.	.	'	"	=	+	;	:	,	,	/	?

	HEX POS	01		02		03		04		04*		05		05*		06		06*	
COUNTRY	KBID	l	u	l	u	l	u	l	u	l	u	l	u	l	u	l	u	l	u
GREECE	74	1	+	2	"	3	%	5	£			7	/			6	?		
GREECE	75	1	!	2	"	3	£	5	£	²	³	7	/	±	º	6	&	+	*
HONG KONG	119	1	!	2	@	3	#	5	%	²	³	7	&	]	[	6	£	§	¶
SOUTH AFRICA	80	1	¼	2	½	3	£	5	%			7	&			6	ƒ		
SOUTH AFRICA	81	1	+	2	"	3	£	5	£	²	³	7	*	÷	½	6	&	˝	˜
CZECHOSLOVAKIA	82	+	1	ě	2	š	3	ř	5	²	³	ý	7	;	º	ž	6	)	(
CZECHOSLOVAKIA	83	+	1	ě	2	š	3	ř	5			ý	7			ž	6		
CZECHOSLOVAKIA	84	+	1	ě	2	š	3	ř	5			ý	7			ž	6		
CZECHOSLOVAKIA	85	+	1	ľ	2	š	3	ť	5	²	³	ý	7	;	º	ž	6	a	(
RUMANIA	86	1	1	2	"	3	=	5	+			7	)			6	(		
RUMANIA	87	1	!	2	"	3	£	5	%	²	³	7	/	ˋ	ˊ	6	&	î	Î
HUNGARY	90	1	+	2	"	3	%	5	!			7	§			6	/		
HUNGARY	91	1	!	2	"	3	§	5	%	î	Î	7	/	ű	Ú	6	+	ü	Ü
POLAND	93	1	!	2	"	3	#	5	%	º	*	7	/	<	>	6	&	ś	ć
YUGOSLAVIA	94	1	+	2	"	3	%	5	!			7	)			6	(		
YUGOSLAVIA	95	1	!	2	"	3	#	5	%	ë	Ë	7	/	c	C	6	&	+	*

* INDICATES PREFIXED GRAPHICS

| | BLANK BOXES MAPPED INTO GRAPHIC
|_ _| UNDERSCORE IN TRANSMIT AND RECEIVE.

Figure 28. Correspondence Line Code Assignments for Variable and Prefixed Graphics (Part 4 of 5)

07		07*		08		09		0B		20		22		24		32		35		37		38	
l	u	l	u	l	u	l	u	l	u	l	u	l	u	l	u	l	u	l	u	l	u	l	u
8	'			4	$	0	)	9	(	ˊ	ˊ	.	;	ˋ	ˋ	ˆ	ˆ	˛	.	,	:	¨	¨
8	(			4	$	0	=	9	)	¾	§	.	.	½	¼	:	ƒ	˛	ˋ	,	;	'	?
8	*	±	°	4	$	0	)	9	(	½	¼	.	.	'	"	=	+	;	:	,	,	/	?
8	(			4	$	0	¾	9	)	+	=	.	;	ˊ	ˋ	/	:	ˆ	¨	,	?	'	"
8	(	¨	ˆ	4	@	0	=	9	)	!	$	.	.	ŉ	'	ℓ	°	;	:	,	,	/	?
á	8	¨	'	č	4	é	0	í	9	ú	§	.	!	/	:	ů	"	ˋ	ˊ	,	?	¨	ˇ
á	8			č	4	é	0	í	9	ú	/	.	:	§	!	ů	"	ˊ	ˇ	,	?	=	%
á	8			č	4	é	0	í	9	ú	§	.	!	/	:	ů		ˋ	ˊ	,	?	¨	ˇ
á	8	n	)	č	4	é	0	í	9	ú	/	.	:	§	!	ô	"	ˊ	ˇ	,	?	=	%
8	â			4	%	0	/	9	!	ă	£	.	;	ţ	$	ş	ˆ	ˊ	ˋ	,	?	î	¨
8	(	â	Â	4	$	0	=	9	)	ă	Ă	.	:	ţ	Ţ	ş	Ş	˛	¨	,	;	+	?
8	ä			4	=	0	ó	9	:	ü	Ü	.	;	á	Á	ö	Ö	ˊó	ˊŐ	,	?	é	É
8	(	ˊő	ˊŐ	4	ˊÚ	0	=	9	)	ö	Ö	.	:	á	Á	é	É	ó	Ó	,	;	ˊú	?
8	(	ó	ź	4		0	=	9	)	ń	ż	.	:	a	e	l	L	˙	ˊ	,	;	+	?
8	&			4	/	0	=	9	*	š	Š	.	:	ć	Ć	č	Č	¨	ˊ	,	?	ž	Ž
8	(	ž	Ž	4	$	0	=	9	)	š	Š	.	:	ć	Ć	č	Č	d	D	,	;	'	?

	HEX POS	01		02		03		04		04*		05		05*		06		06*
COUNTRY	KBID	l	u	l	u	l	u	l	u	l	u	l	u	l	u	l	u	l
USA-EBCDIC	100	1	|	2	@	3	#	5	%	{	}	7	&	\	¦	6	¬	<
USA-EBCDIC	101	1	|	2	@	3	#	5	%			7	&			6	¬	
USA-ASCII	102	1	!	2	@	3	#	5	%			7	&			6	^	
USA-ASCII	103	1	!	2	@	3	#	5	%	{	}	7	&	\	¦	6	^	<

* INDICATES PREFIXED GRAPHICS

| | BLANK BOXES MAPPED INTO GRAPHIC
|_| UNDERSCORE IN TRANSMIT AND RECEIVE.

Figure 28. Correspondence Line Code Assignments for Variable and Prefixed Graphics (Part 5 of 5)

07		07*		08		09		0B		20		22		24		32		35		37		38	
l	u	l	u	l	u	l	u	l	u	l	u	l	u	l	u	l	u	l	u	l	u	l	u
8	*	`	~	4	$	0	)	9	(	¢	!	.	>	'	"	=	+	;	:	,	<	/	?
8	*			4	$	0	)	9	(	¢	!	.	.	'	"	=	+	;	:	,	,	/	?
8	*			4	$	0	)	9	(	[	]	.	>	'	"	=	+	;	:	,	<	/	?
8	*	`	~	4	$	0	)	9	(	[	]	.	.	'	"	=	+	;	:	,	,	/	?

RECEIVE 7-BIT CONTROL TRANSLATES

ASCII Received	ASCII Meaning	EBCDIC Display/Recorded
00	NUL	@
01	SOH	SOH
02	STX	STX
03	ETX	ETX
04	EOT	EOT
05	ENQ	ENQ
06	ACK	ACK
07	BEL	STP
08	BS	BS
09	HT	HT
0A	LF	LF*
0B	VT	VT
0C	FF	FF
0D	CR	CR*
0E	SO	SO
0F	SI	SI
10	DLE	DLE
11	DC1	DC1
12	DC2	DC2
13	DC3	DC3
14	DC4	DC4
15	NAK	NAK
16	SYN	SYN
17	ETB	ETB
18	CAN	CAN
19	EM	EM
1A	SUB	SUB
1B	ESC	ESC
1C	FS	IFS
1D	GS	IGS
1E	RS	IRS
1F	US	IUS
20	SP	SP
7F	DEL	@

Figure 29. Receive 7-Bit Control Translates

Notes:

1. ∂ Deleted from data stream.

2. ∂ Deleted from data stream.

3. * Received CR LF sequence converted to NL; consecutive CR's converted to single CR.

On-line ASCII Representation	Graphic	Internal EBCDIC Representation
2C	,	6B
2D	-	60
2E	.	4B
2F	/	61
30	0	F0
31	1	F1
32	2	F2
33	3	F3
34	4	F4
35	5	F5
36	6	F6
37	7	F7
38	8	F8
39	9	F9
3A	:	7A
3F	?	6F
41	A	C1
42	B	C2
43	C	C3
44	D	C4
45	E	C5
46	F	C6
47	G	C7
48	H	C8
49	I	C9
4A	J	D1
4B	K	D2
4C	L	D3
4D	M	D4
4E	N	D5
4F	O	D6
50	P	D7
51	Q	D8
52	R	D9
53	S	E2
54	T	E3
55	U	E4
56	V	E5
57	W	E6
58	X	E7
59	Y	E8
5A	Z	E9
5F	_	6D

Figure 30. Fixed 7-Bit Graphics (Part 1 of 2)

FIXED 7-BIT GRAPHICS (cont)

On-line 7-Bit Representation	Graphic	Internal EBCDIC Representation
61	a	81
62	b	82
63	c	83
64	d	84
65	e	85
66	f	86
67	g	87
68	h	88
69	i	89
6A	j	91
6B	k	92
6C	l	93
6D	m	94
6E	n	95
6F	o	96
70	p	97
71	q	98
72	r	99
73	s	A2
74	t	A3
75	u	A4
76	v	A5
77	w	A6
78	x	A7
79	y	A8
7A	z	A9

Figure 30. Fixed 7-Bit Graphics (Part 2 of 2)

COUNTRY	HEX POS KBID	2/1	2/2	2/3	2/4	2/5	2/6	2/7	2/8	2/9	2/A	2/B
USA	1	!	"	#	$	%	&	'	(	)	*	+
USA	2	!	"	#	$	%	&	'	(	)	*	+
USA	3		"	#	$	%	&	'	(	)	*	+
USA	4	!	"	#	$	%	&	'	(	)	*	+
USA	5	!	"	#	$	%	&	'	(	)	*	+
USA	6	!	"	#	$	%	&	'	(	)	*	+
USA	7		"	#	$	%	&	'	(	)	*	+
USA	8		"	#	$	%	&	'	(	)	*	+
USA	17	£	"	#	$	%	&	'	(	)	*	+
USA	18	!	"	#	$	%	&	'	(	)	*	+
USA	19		"	#	$	%	&	'	(	)	*	+
PUERTO RICO	24		"	#	$	%	&	'	(	)	*	+
PUERTO RICO	25	!	"	#	$	%	&	'	(	)	*	+
GERMANY	26	!	"			%	&		(	)		+
GERMANY	27	!	"	#	$	%	&	^	(	)	*	+
GERMANY-AUSTRIA	29	!	"	#	$	%	&	'	(	)	*	+

| | | BLANK BOXES MAPPED INTO SUBSTITUTE
| | | IN TRANSMIT AND RECEIVE.

Figure 31. 7-Bit Line Code Assignments for Variable Graphics (Part 1 of 5)

3/B	3/C	3/D	3/E	4/0	5/B	5/C	5/D	5/E	6/0	7/B	7/C	7/D	7/E	SUB	SUB
;	§	=	¶	@	[	¼	]	ç	±	2	½	3	º		
;		=		@		¼		ç			½				
;		=		@		¼		ç	±		½				
;		=		@	[		]	ç					º		
;		=		@				ç	±				º		
;	§	=	¶		[		]						º		
;	§	=	¶		[		]						º		
;	§	=	¶			¼					½		º		
;		=		@		¼		ç			=				
;		=		@	£			ç			=				
;		=		@		¼		ç	±		½				
;		=		¿		Ñ			´		ñ	¡	º		
;	½	=	¼	¿	[	Ñ	]	¨	´	£	ñ	¡	º		
;		=		§	Ä	Ö	Ü	´	`	ä	ö	ü	ß		
;	<	=	>	§	Ä	Ö	Ü	^	`	ä	ö	ü	ß	3	2
;	2	=	3	§	Ä	Ö	Ü	´	`	ä	ö	ü	ß	º	µ

COUNTRY	HEX POS KBID	2/1	2/2	2/3	2/4	2/5	2/6	2/7	2/8	2/9	2/A	2/B
FRANCE	31	!	"	#	$	%	&	'	(	)	*	+
FRANCE	32	!	"			%	&	'	(	)		+
FRANCE	33	!	"	#	$	%	&	'	(	)	*	+
FRANCE	251	!	"	μ	$	%	&	'	(	)	*	+
CANADA-ENG	36	!	"	#	$	%	&	'	(	)	*	+
CANADA-ENG	37	!	"	#	$	%	&	'	(	)	*	+
CANADA-FR	38	±	"	¾	$	%	&	'	(	)	*	
CANADA-FR	39	!	²	#	$	%	&	'	(	)	*	+
ITALY	41	!	"	£	$	%	&	'	(	)	*	+
ITALY	46	!	"			%	&	'	(	)		+
NETHERLANDS	42		"	£	$	%	&	'	(	)		+
NETHERLANDS	43	!	"	£	$	%	&	'	(	)	*	+
SPAIN	44	!	"		$	%	&	'	(	)		
SPAIN	45	!	"	₧	$	%	&	'	(	)	*	+
SWITZERLAND-FR	48		"		$	%	&	'	(	)	*	+
SWITZERLAND-FR	49	-	"	£	$	%	&	'	(	)	*	+
SWITZERLAND-GR	50		"		$	%	&	'	(	)	*	+

| | | BLANK BOXES MAPPED INTO SUBSTITUTE
| | | IN TRANSMIT AND RECEIVE.

Note:
1/ cannot be received. Underscore is sent for 1/

Figure 31. 7-Bit Line Code Assignments for Variable Graphics (Part 2 of 5)

3/B	3/C	3/D	3/E	4/0	5/B	5/C	5/D	5/E	6/0	7/B	7/C	7/D	7/E	SUB	SUB
;	<	=	>	à	º	ç	§	^	£	é	ù	è	¨	3	2
;		=		à	º	ç	§	^		é	ù	è	¨		
;	<	=	>	à	º	ç	§	^	£	é	ù	è	¨	3	2
;	<	=	>	à	º	ç	§	^	£	é	ù	è	¨	3	2
;		=		@		¼		ç			½				
;	£	=	¶	@	[	¼	]	ç	±	2	½	3	º		
;					ç	¼		^	`	é	½		ç		
;	«	=	»	@	ç	¸	´	^	`	é	º	3	¨		
;	<	=	>	§	º	ç	é	^	ù	à	ò	è	ì	¨	½
;		=				ç	é	^	ù	à	ò	è	ì	¨	
;		=		ƒ		¼	´	^	`		½		¨		¾
;	±	=	º	ƒ	§	¼	´	^	`	2	½	3	¨		¾
;	º	=		¿	ç	Ñ	´	^	`		ñ		¨		
;	º	=	ª	¿	ç	Ñ	´	^	`	½	ñ	¡	¨	£	|
	½	=	¼	ç	à	é	è	^	ù				¨		
;	§	=	º	ç	à	é	è	^	`	ä	ö	ü	¨	[	]
	§	=		ç		é		^	`	ä	ö	ü		1/	

COUNTRY	HEX POS KBID	2/1	2/2	2/3	2/4	2/5	2/6	2/7	2/8	2/9	2/A	2/B
SWITZERLAND-GR	51	´	"	£	$	%	&	'	(	)	*	+
SWEDEN-FINLAND	52		"	£		%	&	'	(	)	ü	+
SWEDEN-FINLAND	53	!	"	£	$	%	&	'	(	)	*	+
NORWAY	54		"	£	$	%	&	'	(	)		+
NORWAY	55	!	"	£	$	%	&	'	(	)	*	+
DENMARK	56	´	"	£	$	%	&	'	(	)		+
DENMARK	57	!	"	£	$	%	&	'	(	)	*	+
PORTUGAL	62		"	£	$	%	&	'	(	)		+
PORTUGAL	63	!	"	£	$	%	&	'	(	)	*	+
UNITED KINGDOM	66	!	"	£	$	%	&	'	(	)	*	+
UNITED KINGDOM	67	!	"	£	$	%	&	'	(	)	*	+
UK (LEGAL)	20	!	"	£	$	%	&	'	(	)	*	+
UNITED KINGDOM *	253	[	"	#	£	%	&	'	(	)	*	+
UNITED KINGDOM *	254	¼	"		£	%	&	'	(	)	*	+
JAPAN	68	±	"	#	$	%	&	'	(	)	*	+
JAPAN	69	!	"	#	$	%	&	'	(	)	*	+

	BLANK BOXES MAPPED INTO SUBSTITUTE
	IN TRANSMIT AND RECEIVE.

Figure 31. 7-Bit Line Code Assignments for Variable Graphics (Part 3 of 5)

3/B	3/C	3/D	3/E	4/0	5/B	5/C	5/D	5/E	6/0	7/B	7/C	7/D	7/E	SUB	SUB
;	§	=	º	ç	à	é	è	^	`	ä	ö	ü	¨	[	]
		=		§	Ä	Ö	Å		`	ä	ö	å	´		
;	<	=	>	§	Ä	Ö	Å	^	`	ä	ö	å	´	¨	½
		=		´	Æ	Ø	Å			æ	ø	å	¨		½
;	<	=	>	´	Æ	Ø	Å	^	`	æ	ø	å	¨	§	½
		=		´	Æ	Ø	Å			æ	ø	å	¨		½
;	<	=	>	´	Æ	Ø	Å	^	`	æ	ø	å	¨	§	½
;		=			§	Ç		^	`	º	ç	´	~		
;	ı	=	¨	ª	§	Ç	|	^	`	º	ç	´	~	[	]
;		=		@	¼	½	¾								
;	<	=	>	@	[	½	]	µ	±	2	#	3	º		
;		=		@	[	½	]								
;	<	=	>	@	$	½	!	µ	±	2	]	3	º		
;		=		@	$	½	!				¾				
;		=		@	£	¥	º								
;	ß	=	ç	@	£	¥	º	^	`		´	¨	~		

COUNTRY	HEX POS KBID	2/1	2/2	2/3	2/4	2/5	2/6	2/7	2/8	2/9	2/A	2/B
GREECE	74	´	"	£	$	%	ˆ	'	(	)		+
GREECE	75	!	"	£	$	%	&	'	(	)	*	+
HONG KONG	119	!	"	#	$	%	&	'	(	)	*	+
SOUTH AFRICA	80		"	£	$	%	&	'	(	)		+
SOUTH AFRICA	81	!	"	£	$	%	&	'	(	)	*	+
CZECHOSLOVAKIA	82	!	"	ř	š		ú	ˋ			ů	+
CZECHOSLOVAKIA	83	!	"	ř	š	%	ú	'	(	)	ů	+
CZECHOSLOVAKIA	84	!	"	ř	š		ú	ˋ			ů	+
CZECHOSLOVAKIA	85	!	"	ľ	š	%	ú	ň	(	)	ô	+
RUMANIA	86	!	"	£	$	%		´	(	)	ţ	+
RUMANIA	87	!	"	£	$	%	&	´	(	)	ţ	+
HUNGARY	90	!	"			%	´Ő					+
HUNGARY	91	!	"	Í	´Ú	%	´Ó	ú	(	)	Ű	+
POLAND	93	!	"	#	¤	%	&	´	(	)	*	+
YUGOSLAVIA	94	!	"			%	&	´	(	)	*	+
YUGOSLAVIA	95	!	"	#	$	%	&	'	(	)	*	+

| | BLANK BOXES MAPPED INTO SUBSTITUTE
| | IN TRANSMIT AND RECEIVE.

Figure 31. 7-Bit Line Code Assignments for Variable Graphics (Part 4 of 5)

3/B	3/C	3/D	3/E	4/0	5/B	5/C	5/D	5/E	6/0	7/B	7/C	7/D	7/E	SUB	SUB
;								^	`			¨			
;	±	=	º	ƒ	§	¼	´	^	`	2	½	3	¨		¾
;	§	=	¶	@	[	¼	]	£	±	2	½	3	º		
;		=		ƒ		¼	´	^	`		½		¨		¾
;	º	=	½	@	÷	´	ℓ	^	`	2	’n	3	¨		
	é		§	ž		í	ě	ˇ	´	ý	č	á	¨		
;	é	=	§	ž	º	í	ě	ˇ	´	ý	č	á	¨	3	2
	é		§	ž		í	ě	ˇ	´	ý	č	á	¨		
;	é	=	§	ž	º	í	ť	ˇ	´	ý	č	á	ä	3	2
;	ș	=						^	`	ă	î	â	¨		
;	ș	=	Ș	Ț	Ă	Î	Â	¸	`	ă	î	â	¨	3	2
;	ä	=	´ó	§	É	Ö	Ü	Á	ó	é	ö	ü	á		
;	ő	=	´ó	§	É	Ö	Ü	Á	ó	é	ö	ü	á	í	´ú
;	<	=	>	ę	ź	Ł	ń	ś	ą	ó	ł	ż	ć	º	·
		=	¨	Ž	Š		Ć	Č	ž	š		ć	č		
;	Ë	=	Ç	Ž	Š	Đ	Ć	Č	ž	š	đ	ć	č	ç	ë

HEX POS	2/1	2/2	2/3	2/4	2/5	2/6	2/7	2/8	2/9	2/A	2/B
COUNTRY / KBID											
YUGOSLAVIA 95	!	"	#	$	%	&	'	(	)	*	+
USA-EBCDIC 100	|	"	#	$	%	&	'	(	)	*	+
USA-ASCII 102	!	"	#	$	%	&	'	(	)	*	+
USA-ASCII 103	!	"	#	$	%	&	'	(	)	*	+

| |	BLANK BOXES MAPPED INTO SUBSTITUTE
| |	IN TRANSMIT AND RECEIVE.

Figure 31. 7-Bit Line Code Assignments for Variable Graphics (Part 5 of 5)

3/B	3/C	3/D	3/E	4/0	5/B	5/C	5/D	5/E	6/0	7/B	7/C	7/D	7/E	SUB	SUB
;	Ë	=	Ç	Ž	Š	Đ	Ć	Č	ž	š	đ	ć	č	ç	ë
;	<	=	>	@	ç		!	¬							
;	<	=	>	@	[		]	^							
;	<	=	>	@	[	\	]	^	~	{	¦	}	~		

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Chapter 6. Problem Determination Guidelines

The Displaywriter operator has a number of resources for performing problem determination at the Displaywriter. These resources include:

- System-generated messages and prompts, which often isolate procedural problems that the operator can correct without outside intervention
- The IBM Displaywriter System Communications Link Problem Determination Guide which shows the operator how to run several internal diagnostic tests (including a test of the Displaywriter modem cable)
- The Link Analysis Diskette (LAD) which contains communications diagnostic utilities for problem determination procedures in a communications environment
- IBM support personnel who can be contacted when the operator needs additional outside help

The purpose of this chapter is to help experienced personnel perform problem determination for Displaywriter/host communication. Since it is assumed host personnel are familiar with the problem determination tools available with their system, the information included here does not attempt to be host-specific or all-inclusive. Instead, the information is intended to provide a systematic, structured approach to problem determination through a general set of guidelines for symptom analysis and isolation of the symptom's cause. Using the basic structure given here, host personnel can develop a method for problem determination that fits their individual system and takes into account their system's requirements, resources, and organization.

PRELIMINARY CHECKS

When a communications problem first occurs, a number of preliminary checks can be done which may immediately isolate the cause of the problem and lead to its resolution. These preliminary checks involve analysis of: (a) error messages and (b) the system's configuration.

ERROR MESSAGES

- System Messages

  Have any messages been received either in your output data, at the host operator's console, or on the host's console log? If they have, refer to the appropriate programming guide for the meaning of the message, its cause, and the recommended response.

  Once the cause of the message has been identified, correct it (if possible) and continue with the session.

- Displaywriter Messages

  Has the Displaywriter operator reported any messages or prompts issued by the Displaywriter? If so, verify the operator has taken the action recommended in the operator's reference guide or training manual. For example, if the Displaywriter aborted a receive job because the receive data diskette became full, has the operator inserted a new diskette?

  Once the cause of the message has been identified and the Displaywriter operator has corrected it (if possible), continue with the session.

SYSTEM CONFIGURATION

- Does the problem involve a new or a modified resource?

  1. Have recent hardware changes been made? For example, has a new modem been installed at either location, or have configuration changes been made to the communications controller?

  2. Has the existing host software system been modified? For example, has a new release of a program product or program maintenance been applied?

  3. Has the application program accessed by the Displaywriter been modified?

  4. Has a new ASYNC feature program diskette been issued for the Displaywriter?

  If the answer to these or related questions is yes, does backing out the change fix the problem? If it does, (a) verify that the changes were made correctly, and (b)

review the affect that these changes have on other system resources. If it does not, continue with the next step.

- Do other non-Displaywriter terminals in the system have the same problem?

  If they do, notify the appropriate host personnel that the cause of the problem probably is a host hardware or software resource. If they do not, continue with the next step.

- Do other Displaywriters in the system have the same problem?

  If they do, continue with problem isolation. If they do not, check the hardware and software of the Displaywriter with the problem against that of a Displaywriter that operates correctly. Are there differences in:

  - Modem type or modem setup
  - Communications setup or signon procedure
  - ASYNC feature program diskette levels

  Make the necessary changes, and retry the session.

SYMPTOM ANALYSIS

If the cause of a problem remains unknown after preliminary checks are completed, symptom analysis may be helpful in discovering it and resolving the problem. The procedure for symptom analysis that is used here is chronological in nature and based on session flow. The broad, general problem symptoms which can be evident during a Displaywriter/host session are:

- No Line Established (see "No Line Established" on page 6-5)
- Line Dropped (see "Line Dropped" on page 6-7)
- Data Transmission Errors (see "Data Transmission Errors" on page 6-9)
- Incorrect Output (see "Incorrect Output" on page 6-11)

Select the general symptom that is appropriate, and read through the more specific symptoms that follow. Each specific symptom has a number of questions (checkpoints) that may isolate the cause of the problem.

Following the list of specific symptoms and their checkpoints, each general symptom has a section called "Additional Displaywriter Diagnostic Tools." This section informs host personnel of Displaywriter diagnostic utilities for communication that are provided on a separate Link Analysis Diskette. These utilities, which are described in detail in "Chapter 7. Communications Diagnostic Utilities" on page 7-1, can be used in conjunction with host system diagnostic tools and procedures. For a detailed description of the utilities available to the Displaywriter operator, see the IBM Displaywriter System Communications Link Problem Determination Guide.

Notes:

1. Although the Displaywriter operator has access to the communications diagnostic utilities, host personnel should not expect the operator to be skilled in running the utilities or in technical analysis of the data generated by the utilities. The operator's major function is to gather and report the data, not analyze it in depth.

2. Remember, the specific symptoms that follow and the questions associated with them are not meant to be host-specific or all-inclusive. Their basic purpose is to help you logically search for the cause of a problem and perhaps trigger other questions that can be asked.

NO LINE ESTABLISHED

Specific Symptoms

- No telephone answer from host (switched line).

  1. Did the Displaywriter operator dial a correct number?
  2. Is the host system powered on and available?
  3. Is there power at the host modem wall outlet?
  4. Are all cables properly connected at the host modem?
  5. Is the host modem plugged into the appropriate port?
  6. Was a host modem self test done to verify operation?
  7. Does the host modem have the auto answer function, and was auto answer enabled?
  8. Was a line defined for the Displaywriter? Usually host software requires a line definition to generate communications support.
  9. Was the line started or enabled? The host software that services the communications line (CMS, for example) must be started to enable auto answer.

- Displaywriter does not answer host.

  1. Is the Displaywriter powered on, and has the communications diskette been loaded?
  2. Does the host modem have the auto answer function, and was auto answer enabled?
  3. Did the Displaywriter operator press the Communications Start key (indicated by Ready displayed in the Status Field)?
  4. Is there power at the Displaywriter modem wall outlet?
  5. Are all cables properly connected at the Displaywriter modem?
  6. Is the switch on the Displaywriter modem cable in the operate position?
  7. Is the Displaywriter modem plugged into the port specified in the Displaywriter communications setup and is it described correctly in the Modem and Line Description?
  8. Has communications equipment been checked at the Displaywriter? Use the Displaywriter Problem Determination diskette to verify the Displaywriter

communications interface and cable. Also do the modem self test to verify local modem operation.

9. Has communications equipment been checked at the host? Verify that all cables are attached correctly and power is on. Also do the modem self test to verify modem operation.

10. Are the modem lights on indicating terminal ready?

- Line busy.

1. Did the Displaywriter operator dial a correct number?

2. Is the communications port available? Ask the host operator to inquire on the line status to see if another terminal is using the line.

3. Was the line disconnected after a previous session with the Displaywriter or another terminal? If not, have the host operator cancel, restart, or drain the line.

Additional Displaywriter Diagnostic Tools

When the Displaywriter does not answer the host, first verify that the operator has run the internal Displaywriter tests as instructed by the Displaywriter Problem Determination Guide(one of the tests checks the communications adapter interface). The Displaywriter operator already may have been directed to contact IBM support personnel to solve the problem.

If these tests have been run and the problem has not been isolated, the operator has the following utilities and can run them under host personnel instruction with reference to the IBM Displaywriter System Communications Link Problem Determination Guide.

- Control Modem Interface utility (see "Control Modem Interface" on page 7-7), used to control and display the EIA interface.

- Send Continuous Data (see "Send Continuous Data" on page 7-3) which is used to test the integrity of the line.

LINE DROPPED

Specific Symptoms

- No response from answering terminal or line dropped immediately.

  1. Did power drop, or has the modem become unplugged at either location?
  2. Are the operating parameters of the two modems compatible (strapping options, for example)?
  3. Is the host software line definition correct? Check the operands of the line definition for compatibility with line protocol, line speed, and modem characteristics.
  4. Is the appropriate level of the ASYNC feature program diskette being used?
  5. Are the selected Displaywriter communications setup and the Modem and Line Description compatible with host protocols and operating procedures?
  6. Did a timeout occur (line inactivity, for example) either at the host or at the Displaywriter?

- Line disconnect.

  1. Did power drop, or has the modem become unplugged at either location?
  2. Is the appropriate level of the ASYNC feature program diskette being used?
  3. Are the selected Displaywriter communications setup and the Modem and Line Description compatible with host line definitions, protocols, and operating procedures?
  4. Did the Displaywriter operator press the Disconnect key?
  5. Did an activity timeout occur either at the host or at the Displaywriter?

- Signon Rejected.

  1. Was the terminal previously signed on, and is it still active? Ask the host operator to inquire on the terminal status. If the terminal is active, sign off the terminal or cancel and restart the line.

  2. Are compatible keyboards in use at both locations? In general, keyboards 100, 101, 102, and 103 are used in the United States as DP keyboards.

  3. Was the signon complete, and was the syntax correct? Be sure that the signon was entered in upper case and that host system syntax requirements were followed.

  4. Was an ID or password received from the Displaywriter valid? Check the remote terminal software definitiion at the host to verify remote ID, password, and terminal characteristics.

Additional Displaywriter Diagnostic Tools

When there is no response from the Displaywriter or the line drops immediately, you can direct the operator to access the Send Continuous Data (see "Send Continuous Data" on page 7-3) or the Receive Continuous Data (see "Receive Continuous Data" on page 7-5) utilities on the Link Analysis Diskette. These utilities can be used, with complementary host programs, to exercise the link and test its integrity.

When a disconnect occurs, the Displaywriter Error History Log (see "Error Log Display" on page 7-7) may indicate why the disconnect occurred.

The Displaywriter ASYNC Trace (see "ASYNC Trace" on page 7-11) also can be used to verify ASYNC line protocol, the actual format of the data sent to the host, and mandatory disconnects.

DATA TRANSMISSION ERRORS

Specific Symptoms

- Cannot input data to the host.

  1. Was the terminal signed on successfully? Check messages received from the host after sign on, and have the host operator inquire on the terminal status. If not signed on correctly, refer to "Signon Rejected" above.

  2. Are compatible keyboards in use at both locations (see "Character Translation Problems" on page 6-12)?

  3. Are compatible modems in use at both locations?

  4. Is the host software line definition correct? Check the operands of the line definition for compatibility with line protocol, line speed, and modem characteristics.

  5. Was the application (CICS or TSO, for example) started?

  6. Is the Displaywriter in the Send state?

  7. Did the Displaywriter operator follow the proper procedure for sending a document (see "Sending a Document from a Diskette" on page 2-5).

- Cannot initiate output from host.

  - Was the terminal signed on successfully? Check messages received from the host after sign on, and have the host operator inquire on the terminal status. If not signed on correctly, refer to "Signon Rejected" above.

- Communications in wait state.

  1. Is the host busy, not ready, or is operator intervention required?

  2. Is the Displaywriter busy or not ready?

- Incomplete data received at host

  1. Did the Displaywriter abend the job because of an operator error or system failure?

  2. Did the Displaywriter abend the job because of intervention by the host? Check the ASYNC Trace for EOT codes, break characters, or mandatory disconnects.

Additional Displaywriter Diagnostic Tools

When problems with data transmission occur, the Displaywriter Error History Log (see "Error Log Display" on page 7-7) may indicate why a job aborted or a disconnect occurred.

If the ASYNC Trace mode of the communication application history was on (see "ASYNC Trace" on page 7-11), the operator also can scan data on the display for problem analysis or save the data on a diskette for printing or problem analysis later.

INCORRECT OUTPUT

Specific Symptoms

- Data received, but prints incorrectly at Displaywriter.

  1. Does the application have a programming logic error? Check the application's output data set on the host for the same formatting errors. This might indicate an application program error.

  2. Did the application abend? Check program listings or host output for error messages.

  3. Did the application format the data for a terminal type other than the one emulated by the Displaywriter?

  4. Are the Receive Format defaults of the active setup compatible with the receive job?

- Data received, but is incomplete or unintelligible.

  1. Does the application have a programming logic error? Check the application's output data set on the host for the same formatting errors. This might indicate an application program error.

  2. Is a certain transmission code not printing? If so, verify that the code is defined in the active keyboard.

  3. Are compatible keyboards in use at both locations (see "Character Translation Problems" on page 6-12)?

Additional Displaywriter Diagnostic Tools

When received data is unintelligible, the Displaywriter Send Continuous Data (see "Send Continuous Data" on page 7-3) and Receive Continuous Data (see "Receive Continuous Data" on page 7-5) utilities can be used with complementary host programs to test the integrity of the link.

If the ASYNC Trace function was on, the Displaywriter ASYNC Trace (see "ASYNC Trace" on page 7-11) can be used to review the data stream as it appears on the link. Invalid control characters received by the Displaywriter, for example, are recorded in the ASYNC display.

CHARACTER TRANSLATION PROBLEMS

In order for a graphic character to be communicated correctly, both the sending and receiving parties must use the same line-code value to represent it. The line-code value selected by the Displaywriter to represent a particular graphic character depends on the keyboard in use (see "Appendix A. Supported Keyboards" on page A-1).

If one or more graphic characters are not being communicated correctly and mis-translations are occurring, the problem may be caused by:

- The sender and receiver using different keyboards
- One side using WP assignments and the other using DP assignments

When problems in translation are discovered, the character sets used by each side and the line-code values of each character set should be examined for incompatibilities.

DISPLAYWRITER/OLTS INTERFACE

Some host operating systems offer On-Line Test Support (OLTS), which is used to verify proper on-line operation in the normal ASYNC application environment. OLTS has a number of exercisers to assist in the location of failures within the communications network.

During a session, OLTS can be accessed from the Displaywriter by sending a Request For Test (RFT) that specifies a test to be executed. To do this, the RFT should be created at the Displaywriter and stored on a data diskette or keyed online.

Any data sent to the Displaywriter as a result of the RFT is received and stored as a normal receive job. The received data can be displayed and its contents reported to personnel at the host.

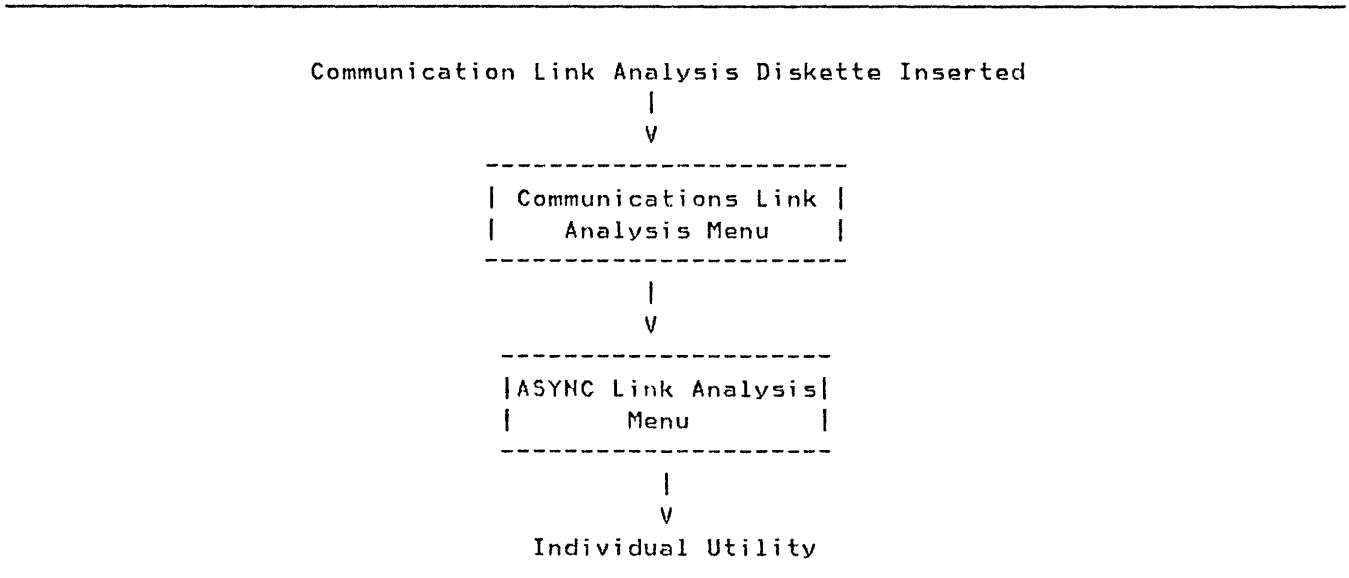
Chapter 7. Communications Diagnostic Utilities

The Displaywriter System provides the Displaywriter operator with a number of communications diagnostic utilities for problem determination in an ASYNC environment. These utilities (the ASYNC Link Analysis Utilities) enable the operator to test and exercise the modem, the communications adapter, and the link.

The ASYNC Link Analysis utilities are provided on a separate diskette (the Link Analysis Diskette). When necessary, support personnel can instruct a Displaywriter operator to load this diskette, access one or more of the utilities, and report the information that appears on the display.

- Send Continuous Data-used to continuously send known data (hex '55') down the link
- Receive Continuous Data-used to receive a continuous known data pattern, detect errors in the pattern and log the error
- Data Return to Sender-used to return all receive data back to the link
- Control Modem Interface--used to control and display the EIA interface
- Display Error Log--used to format and display the ASYNC Error Log data
- Change Link Description--used to define the ASYNC environment

Figure 32 shows how the utilities are accessed.



When the Communication Link Analysis diskette is inserted, the Communications Link Analysis menu (Figure 32) appears.

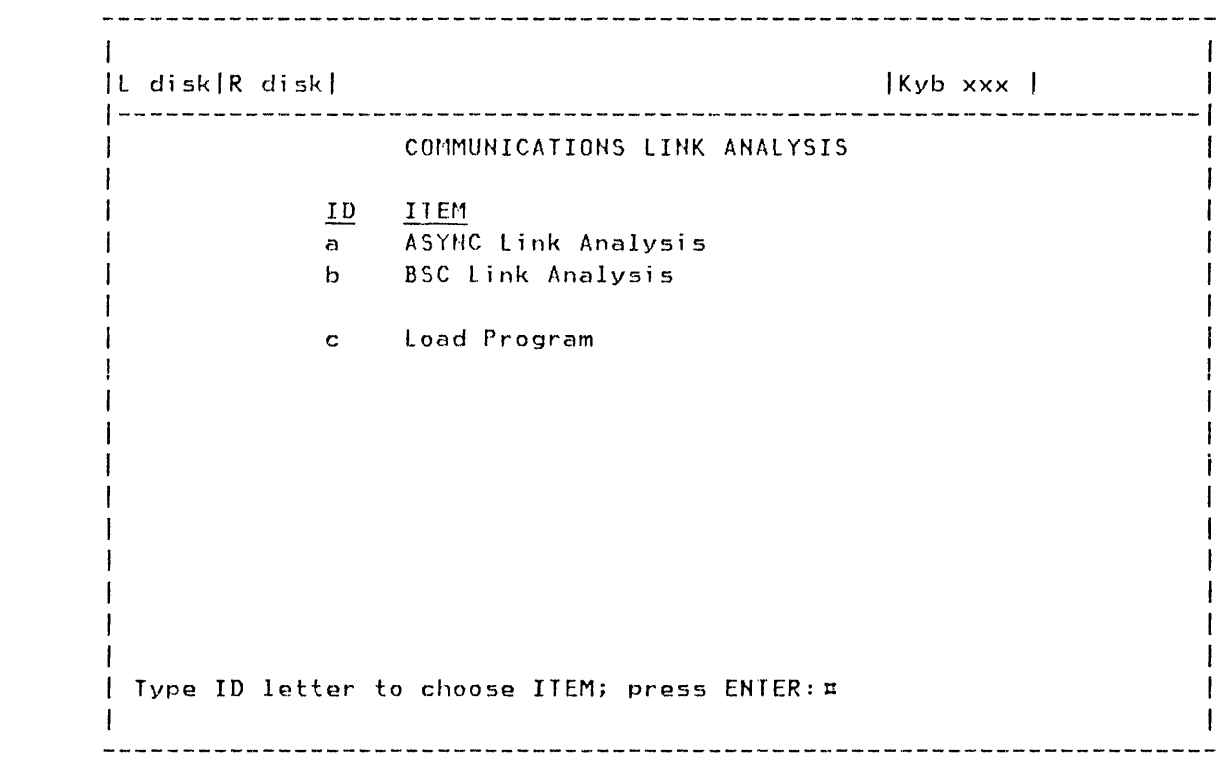


Figure 32. Communications Link Analysis Menu

Selecting ASYNC Link Analysis, ID a, from the Communications Link Analysis menu causes the ASYNC Link Analysis menu (Figure 33 on page 7-3) to appear. As Figure 33 on page 7-3 shows, a Link Description Status line (line 3) indicates:

- The code set in effect
- Line speed
- Parity
- the modem port in use

Once the ASYNC Link Analysis menu appears, an individual utility can be selected.

Note: After a link is established, an operator can press Disc to disconnect the link.

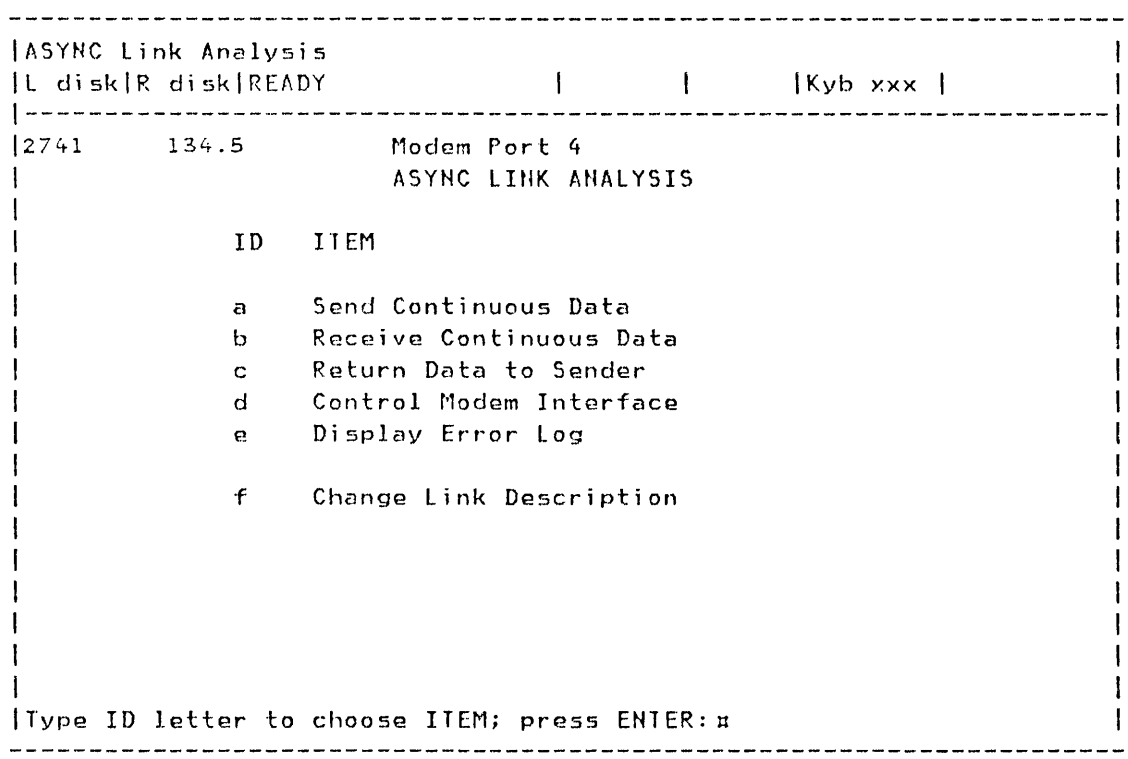


Figure 33. ASYNC Utility Selection Menu

SEND CONTINUOUS DATA

The Send Continuous Data Utility is used to test the integrity of the link by: (a) sending a continuous bit pattern (hex '55') across the link and (b) optionally checking 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)
- Remote Displaywriter or host

Selecting Send Continuous Data (ID a) from the ASYNC Link Analysis menu causes the Send Continuous Data display (Figure 34 on page 7-4) to appear.

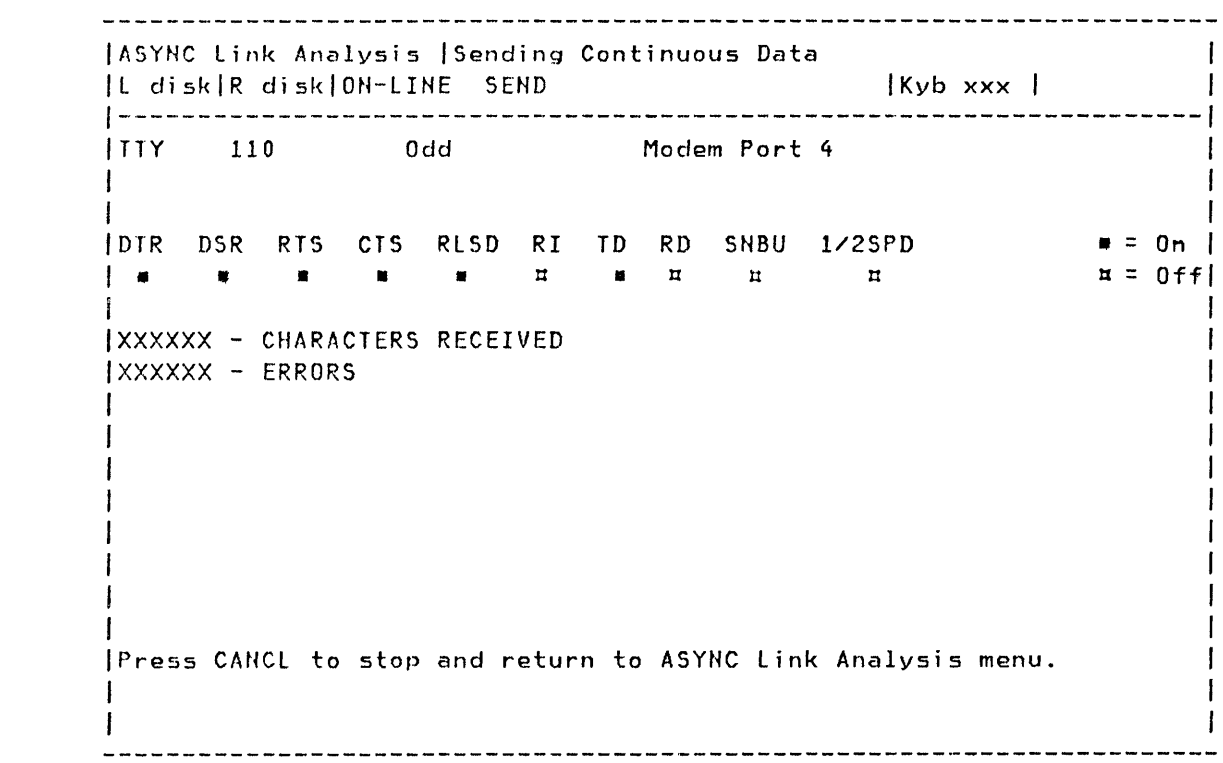


Figure 34. Send Continuous Data Display

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
 TxD = Transmit Data
 RxD = Receive Data
SNBU = Switched Network Backup
1/2SP = Halfspeed
```

If a CCITT interface is being used, all EIA terms can be replaced by CCITT numbers using the Change Link Description utility.

The display indicates: (a) the number of characters received when a wrap is possible, (b) the number of characters received that do not match the pattern when a wrap is possible, and (c) a highlighted figure of merit (test score) developed from the ratio of errors to characters received.

Note: If data is not wrapped, these fields do not apply.

RECEIVE CONTINUOUS DATA

The Receive Continuous Data utility complements the Send Continuous Data utility by:

- Receiving a continuous SYN pattern from the link
- Indicating if any errors are detected
- Wrapping the pattern

Selecting Receive Continuous Data (ID b) from the ASYNC Link Analysis menu causes the Receive Continuous Data display (Figure 35) to appear.

```
|ASYNC Link Analysis |Receiving Continuous Data                        |
|L disk|R disk|ON-LINE    RECEIVE                |Kyb xxx |           |
|-------------------------------------------------------------------|
|2741   134.5                       Modem Port 4                    |
|                                                                   |
|                                                                   |
|DTR  DSR  RTS  CTS  RLSD  RI  TI  RD  SNBU  1/2SPD          ■ = On |
| ■    ■    ■    ■    ■    ¤   ¤   ■    ¤     ¤             ¤ = Off|
|                                                                   |
|XXXXXX - CHARACTERS RECEIVED                                       |
|XXXXXX - ERRORS                                                    |
|                                                                   |
|                                                                   |
|                                                                   |
|                                                                   |
|                                                                   |
|                                                                   |
|                                                                   |
|                                                                   |
|Press CANCL to stop and return to ASYNC Link Analysis menu.        |
|                                                                   |
|                                                                   |
```

Figure 35. Receive Continuous Data Display

The Modem Interface Status lines give the state of the modem interface signal. If a CCITT interface is being used, all EIA terms can be replaced by CCITT numbers using the Change Link Description utility.

The display also indicates: (a) the total number of characters received, (b) the number of characters received that do not match the pattern, and (c) a highlighted figure of merit (test score) developed from the ratio of errors to characters received.

RETURN DATA TO SENDER

When Return Data to Sender (ID c) is selected from the ASYNC Link Analysis menu, the ASYNC Return Data to Sender menu (Figure 36) appears. The procedure for returning the data is dependent upon the protocol being used. If IBM CMC or 2741 protocols are being used the utility will return data blocks as delimited by a Circle D and Circle C. If the TTY protocol is being used the utility will return data blocks as delimited by the New Line codes.

Execution begins as soon as the utility is selected. Data received by the Displaywriter is displayed as it is received.

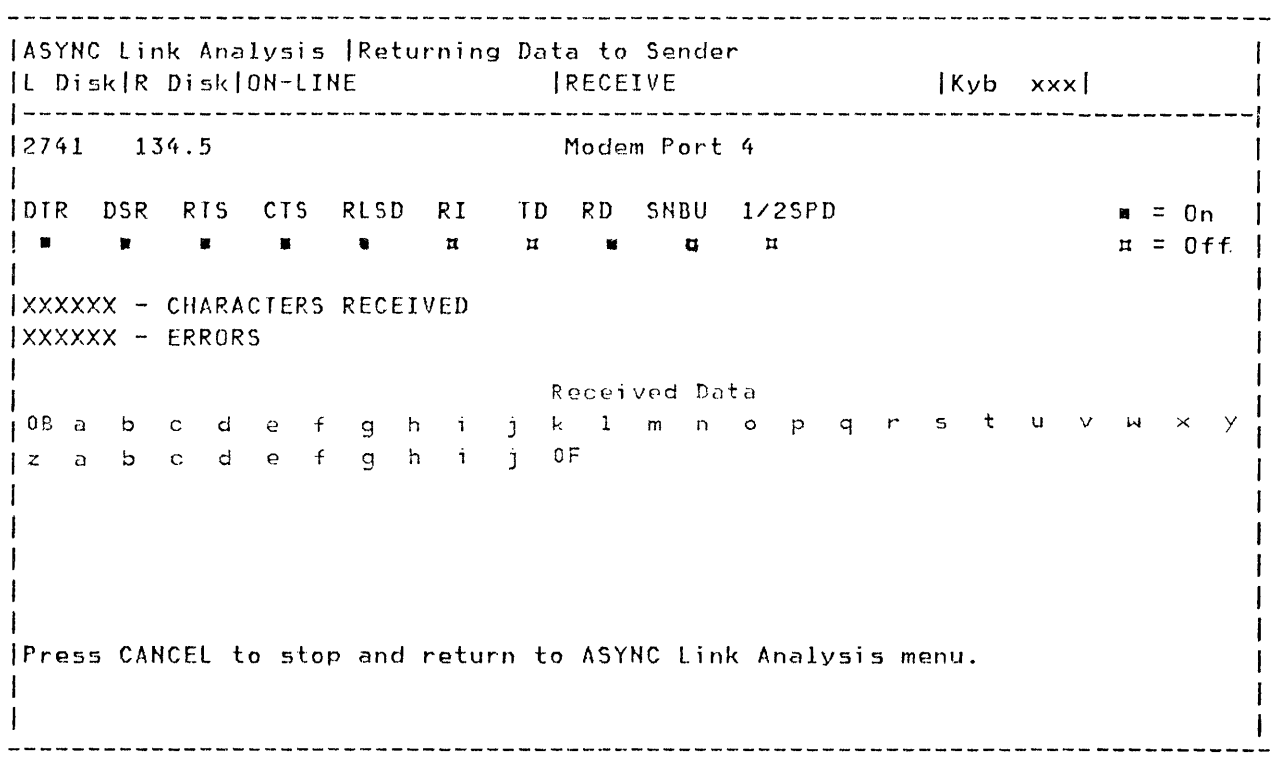


Figure 36. ASYNC Return Data to Sender Display

CONTROL MODEM INTERFACE

When Control Modem Interface (ID d) is selected from the ASYNC Link Analysis menu, the Control Modem Interface menu (Figure 37) appears. This utility, which is used to control and display the modem interface, aids in diagnosing modem problems and modem interface problems.

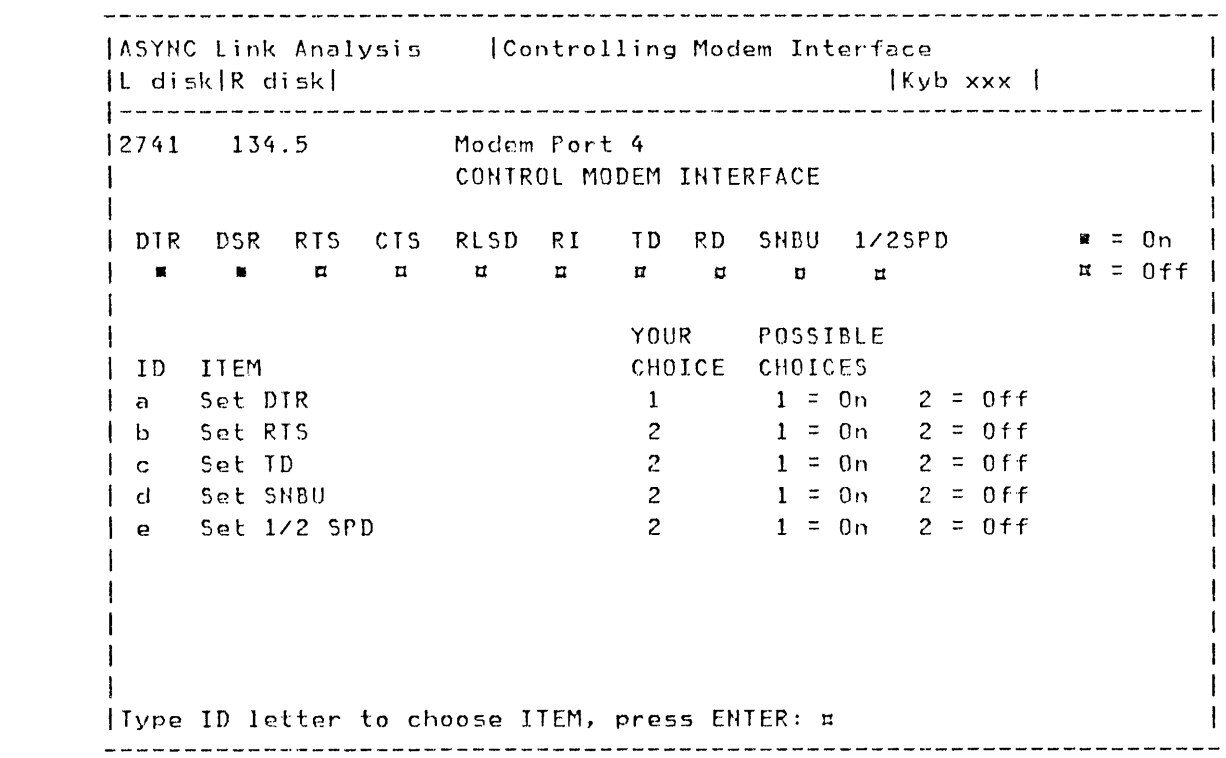


Figure 37. Control Modem Interface Menu

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

ERROR LOG DISPLAY

When Display Error Log (ID e) is selected from the ASYNC Link Analysis menu, the ASYNC Display Error Log Utility (which formats and displays the error log) is entered. After selection, the utility prompts for a Memory Record (dump) diskette.

The error log data is presented in two different sections:

1. Session Description (Figure 38)

2. Error History Log (Figure 39 on page 7-9)

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

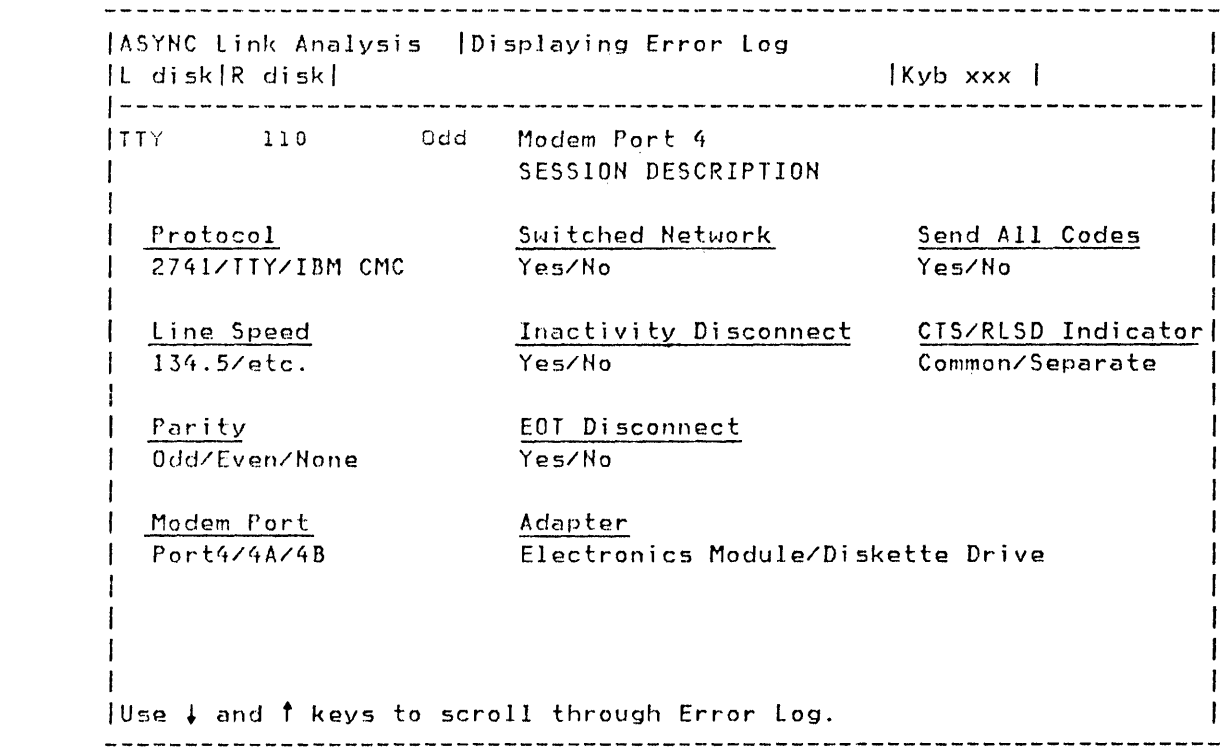


Figure 38. Sample Session Description Display

```
ASYNC Link Analysis |Displaying Error Log
L disk|R disk|                                        |Kyb xxx |

                        ERROR HISTORY LOG
                                    RI   RI
Error Type                         4/4A 4B  DTR DSR TI  RTS CTS  RLSD
Parity_____________________________2F
Parity and Framing_________________1C
Framing____________________________1D
Parity and Framing_________________2F
Framing____________________________18
Parity_____________________________2E
Overrun____________________________   Off Off On  On  Off On  On   On
DSR Dropout________________________   Off Off On  Off Off On  On   Off
Parity_____________________________3B
Framing____________________________32
DSR Dropout________________________   Off Off Off Off Off On  Off  Off
Framing____________________________18
-End of Log-

Use ↓ and ↑ keys to scroll through Error Log.
```

Figure 39. Sample Error History Log Display

As the sample 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.

CHANGE LINK DESCRIPTION

When Change Link Description (ID f) is selected from the ASYNC Link Analysis menu, the Change Link Description menu (Figure 40 on page 7-10) appears. The diagnostic diskette has an ASYNC link description for the communications environment, and this utility is used to change it temporarily or permanently.

```
ASYNC Link Analysis
L disk|R disk|READY                |        |      |Kyb xxx |
2741   134.5                        Modem Port 4
                          CHANGE LINK DESCRIPTION

                                 YOUR      POSSIBLE
ID  ITEM                         CHOICE    CHOICES

a   Protocol                     1         1 = IBM CMC  2 = 2741 3 =  TTY
b   Line Speed                   2         1 = 110  2 = 134.5  3 = 150
                                           4 = 200  5 = 300    6 = 1200
c   Parity                       1         1 = Even 2 = Odd    3 = None
d   Modem Port                   1         1 = Port 4  2 = Port 4a
                                           3 = Port 4B

e   Interface Status             1         1 = EIA   2 = CCITT

f   Store Link Description       2         1 = Yes  2 = No

When finished, press ENTER.

Type ID letter to choose ITEM, press ENTER: a
```

Figure 40. Change Link Description Menu

Options:

- 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 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 displayed as EIA or CCITT. The default is 1, Yes.
- Store Link Description — specifies whether changes made here are to be temporary or stored on the diskette. The default is 2, No.

ASYNC TRACE

The ASYNC Trace (Figure 42 on page 7-13) is a special mode of the communication application history. It provides an exact picture of the data stream as it appears on the link so that procedural errors and incompatibilities within the data stream can be diagnosed. 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 setup by pressing History Store and Control simultaneously.

ASYNC Trace Format

In 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:

  Hexadecimal

  Underscored

  Followed by a space

A list of the status information 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_' to indicate function, all error status is represented by hexadecimal 'E_' to indicate an error status, and all data lost errors are represented by a hexadecimal 'D_' to indicate a data problem.

Although not necessarily an error, a DSR dropout is indicated as an error. All error status information is followed by a status byte 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 Error History Log.

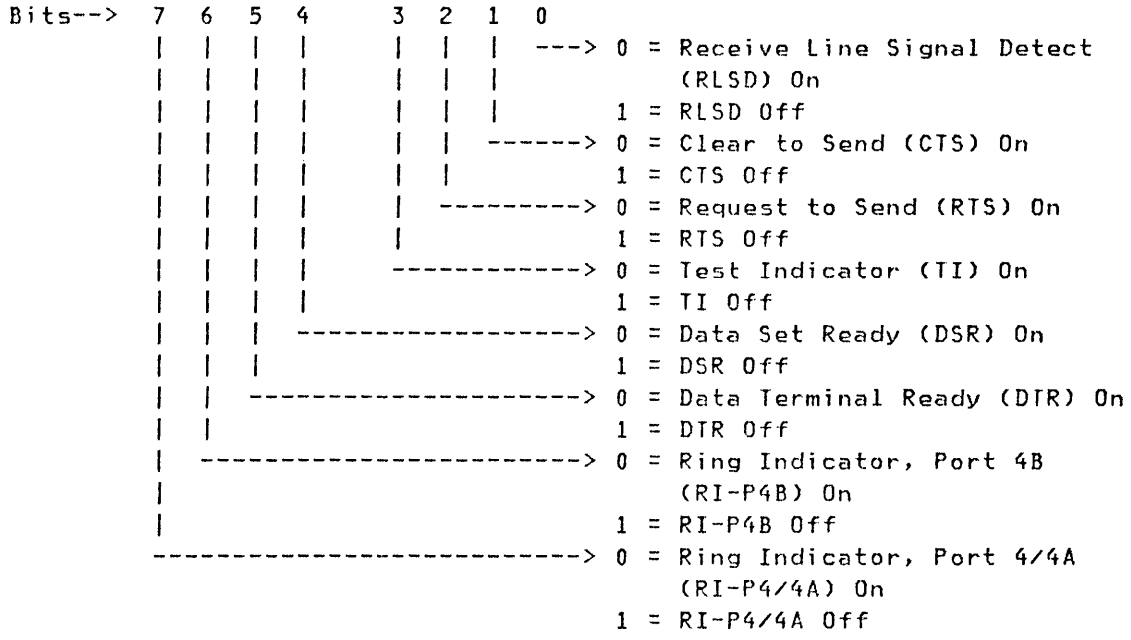


Figure 41. Error Log Hardware Status Byte

Figure 42 shows an example of 2741 ASYNC Trace output. The received data, preceded by an R in column one and a space in columns two and three, shows three errors indicated by the three underscores.

```
COMMUNICATION          |Brief                           |                 |
COMMOD|      |ACTIVE     SEND      |Pg.  1       |Ln. 34     |Kyb  122   |Pitch   12
Setup:     DIMEBOX  2741           History Store:  OFF         Document Send: OFF
R  F2 F3 F4  16 1F
S  16 1C n  7C o  w     i  s     t  h  e     t  i  m  e     f  o  r     a  1
   1     g  o  o  d     m  e  n     t  o     c  o  m  e     t  o     t  h  e
      a  i  d     o  f     1C t  h  e  i  r  5D 5D 5D 5D 5D 76 76 76 76 76 7C
      c  o  u  n  t  r  y  45 5B 5E 5E 5E 5E 5E 5E 5E 5E 5E 1F
R  16 1F
S  16 1C d  7C i  d     1C j  7C o  h  n     s  e  e     t  h  e     q  u  i
   c  k     r  e  d     f  o  x     j  u  m  p     o  v  e  r     t  h  e
   w  h  i  t  e     f  e  n  c  e  1C 70 7C 5B 5E 5E 5E 5E 5E 5E 1F
R  16 1C d  7C i  d     1C j  E1 1E o  h  n     s  e  e     t  h  e     q  u
   i  c  k     r  e  d     f  o  x     j  u  m  p     o  v  e  r     t  h  e
      w  E3 28 E1 36 t  e     f  e  n  c  e  1C 70 5B 5E 5E 5E 5E 1F
S  16 1F
R  E4 FF
```

Figure 42. Sample 2741 Trace

Figure 43 on page 7-14 shows an example of ASYNC Trace output format using TTY emulation with no parity.

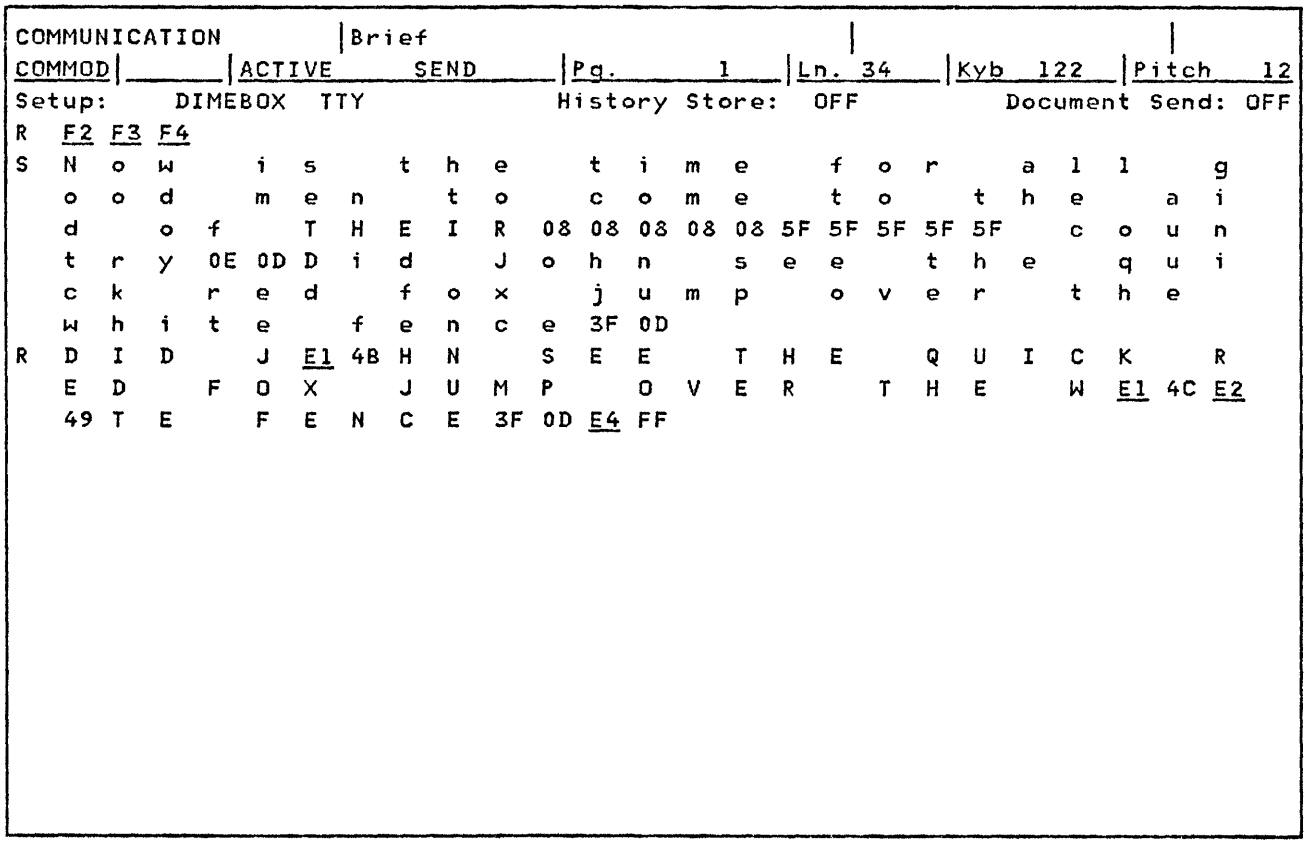


Figure 43. Sample TTY Trace

Appendix A. Supported Keyboards

The IBM Displaywriter supports the touch-typing emulation of the keyboards defined in Figure 44. This emulation results in an exact mapping of the keys from the emulated keyboards to the Displaywriter keyboard.

Notes:

1. When an 88-character keyboard is emulated, the Displaywriter treats the positions that are not used on its keyboard as invalid keys.

2. For asynchronous communication, the support for these keyboards assumes all keyboards are dead-key disconnected. Keyboards in the 124-199 range are not directly supported.

3. Only one physical/emulated keyboard can be active at one time.

	Keyboard IDs			
	Emulate Only		Engrave and Emulate	
Country (Type)	88	96	96	92
Australia/New Zealand			1	
Austria/Germany			29	
Belgium/Flemish			251	
Canada-England	36		37	
Canada-France/Britain	38		39	
Czech-Czech	82		83	
Czech-Slovak	84		85	
Denmark	56		57	
Finland/Sweden	52		53	
France/Belgium (AZ)	32	31	251	
France (Qwerty)		33	251-1	

Supported Keyboards (cont)

Country (Type)	Keyboard IDs			
	Emulate Only		Engrave and Emulate	
	88	96	96	92
Germany	26	27		
Greece (Latin)	74		75	
Hong Kong (Latin)			119	
Hungary	90		91	
Italy (S.A.)	46		41	
Japan (English)	68		69	
Netherlands	42		43	
Norway	54		55	
Poland			93	
Portugal	62		63	
Rumania	86		87	
South Africa	80		81	
Spain	44		45	
Sp. Speak/Puerto Rico	24		25	
Switzerland-Germany	50		51	
Switzerland-France	48		49	
U. K. (Legal)	20			
U. K./Israel	66		67	
U. S.	2		1	1
U. S. Dvorak			1-1	

Supported Keyboards (cont)

Country (Type)	Keyboard IDs			
	Emulate Only		Engrave and Emulate	
	88	96	96	92
U. S. (Accounting)	17,18,19			
U. S. (ASCII)	102	103		
U. S. (Correspondence)	3,4,5			
U. S. (EBCDIC)	100	101		
U. S. (Legal)	6,7,8			
Yugoslavia (Latin)	94		95	

Figure 44. Supported Keyboards

This page is left blank intentionally.

Appendix B. Communications Hardware

The communications hardware used with an IBM Displaywriter is capable of interfacing to switched or non-switched analog networks. The interface for asynchronous communication is point-to-point, full duplex. All information sent to the Displaywriter operator from the communications hardware is via the display; there are no indicator lights.

COMMUNICATIONS ADAPTER

The communications adapter used with the Displaywriter allows the Displaywriter to communicate with compatible remote stations as an IBM 2741, as teletypewriters similar to the Teletype[5] 33, 35, or 43 KSR models, the IBM Communicating Mag Card "Selectric"® Typewriter, and as IBM System/370 and 4300 processors.

For asynchronous communications, the adapter's function is selectable with respect to line speed and protocol. The adapter can operate at line speeds of 110, 134.5, 150, 200, 300, and 1200 bps in Business Machine-clocked mode and with ASYNC protocols that require 1 or 2 Stop bits.

The adapter also contains an EIA RS-232C compatible interface that provides the signal conversion for obtaining the voltage levels specified in the EIA Specification RS-232C and the CCITT Recommendation V.28. This is the standard interface for asynchronous communication. It is packaged on the communications adapter card and is connected to an external modem via a cable.

The communications adapter also detects parity, overrun, and framing errors:

- Vertical Redundancy Checking is done for ASYNC protocols. If a character is received with the wrong parity, the adapter indicates a parity error.
- If the system does not read a received character from the adapter before the next character is available, the adapter indicates an overrun condition.
- When a valid stop bit is not detected at the end of a character during asynchronous communication, the adapter indicates a framing error.

EXTERNAL MODEMS

External modems are attached to a Displaywriter Workstation via an EIA RS-232C (CCITT V.24 and V.28) interface. External modems that are compatible with this standard

---

[5] Trademark of the Teletype Corporation

interface can be attached.

When a Displaywriter system has a single external modem, the communications adapter is located in the electronics module. The external modem is attached by a cable directly to the EIA/CCITT Interface port of the communications adapter. The IBM-supplied cable is 3.8 meters (12 feet) in length.

When the communications adapter is in the Displaywriter diskette unit, the system can have two external modems attached to it. In this case, an EIA/CCIT Interface Logic Card must be used to attach the second external modem cable to the Integrated Modem Interface port of the communications adapter. The card converts the integrated modem interface signals to EIA/CCITT levels and vice versa.

Glossary

The terms in this glossary are associated with the Displaywriter's asynchronous communication facility and are defined as used in this publication. All terms marked with an asterisk (*) are from:

- The American National Dictionary for Information Processing, published by the Computer and Business Equipment Manufacturers Association. This material is reproduced from the American National Dictionary for Information Processing, copyright 1977 by the Computer and Business Equipment Manufacturers Association. Copies may be purchased from the American National Standards Institute at 1430 Broadway, New York, New York 10018.

- The ISO Vocabulary of Data Processing, developed by the International Standards Organization, Technical Committee 97, Subcommittee 1. The acronym ISO identifies these definitions.

- The IBM Data Processing Glossary, GC20-1699-5.

This glossary does not include terms that are defined in nontechnical dictionaries or have no special meaning in data processing. Some terms also may have different meanings in other contexts.

access method. A data management technique for transferring data between main storage in a central processing unit and an input/output device.

ACF/NCP/VS. Advanced Communications Function/Network Control Program/Virtual Storage. A program, generated by the user from a library of IBM-supplied modules, that controls the operation of the communication controller.

ASYNC. Asynchronous Communication (ASYNC).

***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).

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.

business machine clocking. A time base oscillator supplied by the business machine for regulating the bit rate of transmission.

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. The CCITT is an international organization that promotes the standardization and coordination of worldwide communication facilities.

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. For asynchronous communication, the Displaywriter communications link is point-to-point, full duplex, over switched or non-switched lines.

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 ASC program diskette.

Conversational Monitor System (CMS). A virtual machine operating system that provides general interactive time sharing, problem solving, and program development capabilities and operates only under the control of the VM/370 control program.

Data Communication Equipment (DCE). The common carrier's lines, devices, and facilities that interconnect data terminal equipment.

Data Set Ready (DSR). A circuit that initiates the communications link once DTR has been activated.

Data Terminal Ready (DTR). A circuit that activates the communications hardware.

DCE. Data Communication Equipment.

DSR. Data Set Ready.

DTR. Data Terminal Ready.

dead key. A function on GBG-I 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.

***EBCDIC.** Extended binary coded decimal interchange code. A coded character set consisting of 8-bit coded characters.

echoplex mode. In echoplex mode, data does not automatically appear on a display as it is sent. Instead, an image of all the data received by a remote station is returned and displayed to the sender.

EIA. Electronics Industries Association. An organization that promotes standardization and cooperation among electronic equipment industries.

EIA RS-232C Interface. The standard interface for asynchronous communication 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.

full-duplex line. A communications line with two independent data paths over which data can be transmitted in both directions simultaneously.

half-duplex line. A communications line with a single data path over which data can be transmitted in either direction (but not simultaneously).

multipoint network. A configuration in which more than two terminal installations are connected. The network may include switching facilities.

NCP. Network control program. A program generated by the user from a library of IBM-supplied program modules which controls the operation of the communication controller.

non-switched communications network. A network in which a communications line is permanently connected to a station.

OS/VS2. The IBM System/370 Operating System that supports multiprogramming with a variable number of tasks.

point-to-point. A data link that connects a single remote station to the computer; it may either be switched or non-switched.

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 IDs are validated, the session continues; if not, the session is terminated.

Session Summary. A permanent record of a session's activity.

switched communications network. A single communications facility with only one station. The station may be disconnected when the facility is not in use.

TCAM. Telecommunications Access Method. A method used to transfer data between main storage and remote or locate terminals. Application programs use either GET and PUT or READ and WRITE macro instructions to request the transfer of data, which is performed by a message control program. The message control program synchronizes the transfer, thus eliminating delays for terminal input/output operations.

Terminal ID. An identification code used by the a host to identify authorized terminals and terminal types.

TSO. Time Sharing Option. An option of MVT and OS/VS2 that provides conversational time sharing from remote terminals.

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.

Virtual Machine Facility (VM/370). A time sharing system control program that consists of: (1) a control program (CP) that manages the resources of an IBM System/370 computing system in such a way that multiple remote terminal users have a functional simulation of a computing system (a virtual machine) at their disposal, and (2) the conversational monitor system (CMS), which provides general time sharing, program development, and problem solving facilities.

38LS Internal Modem. The integrated modem used with the Displaywriter System.

5608-SR1. The IBM Displaywriter System Asynchronous Communications Program.

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Index

D

E

F

G

H

I

K

L

R

S

T

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