4690 Store System:

Programming Guide

SC30-3602-02

Note

Before using this information and the product it supports, be sure to read the general information under “Notices” on page vii.

| **Third Edition (July 1996)**

This edition applies to Version 1 Release 2 of the licensed program IBM 4690 Operating System, program number 5696-538, and to all subsequent releases and modifications until otherwise indicated in new editions. Changes are made periodically to the information herein.

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Preface

This book describes how to program the IBM 4690 Operating System and the interfaces for application programs.

Who Should Read This Book

This book is written for the programmer who uses system services or writes application programs to run on the 4690 Operating System.

How to Use This Book

The book is organized into the following parts:

- Part 1—The IBM 4690 Operating System Environment
  - Chapter 1 contains an overview of the 4690 Operating System environment and describes the system capabilities, terminal models, and problem determination aids.
  - Chapter 2 describes how you can manage your files. It provides information on naming files and subdirectories, and performing file functions.
  - Chapter 3 contains information on programming terminal input/output (I/O) devices.
  - Chapter 4 provides information on error recovery procedures and facilities. This information includes error recovery options, logging system errors, and storage retention.
  - Chapter 5 describes options you should consider when using an application with a local area network (LAN).
- Part 2—Utilities
  - Chapter 6 describes the Keyed File Utility (KFU) and provides instructions for using the utility.
  - Chapter 7 describes the input sequence tables and provides example worksheets for you to use when designing the input sequence tables.
  - Chapter 8 describes the Library Utility (LIB86). The chapter contains information on using command-line options, creating a library file, and displaying library information.
  - Chapter 9 describes the Linker and Postlink utilities. This information includes using link path variables, input file options, and command syntax.
  - Chapter 10 describes the Print Spooler Utility, which allows you to send files to one of eight queues for printing on one of eight printers.
  - Chapter 11 provides information on the Disk Surface Analysis Utility, including parameter descriptions and time-frame indicators.
  - Chapter 12 describes the Loop Status Application Utility, including formats to use to invoke the utility.
  - Chapter 13 describes the Staged IPL Utility. The chapter contains the requirements, capabilities, and application interface for using the utility.
- Part 3—Applications (Designing and Using)
  - Chapter 15 contains information for designing applications with IBM 4680 BASIC.
  - Chapter 16 contains information for designing applications with other programming languages.

- Appendixes
  - Appendix A describes the 4690 Operating System hierarchical directory structure. This appendix includes information on naming conventions for 4690 Operating System files.
  - Appendix B provides error messages for the Library, Postlink, and Linker utilities.
  - Appendix C describes character sets and the check printing application.
  - The glossary defines new, unique, and unfamiliar terms and abbreviations used in this book.
  - The index provides a quick reference to the contents of the book.

Terminal Models

The 4683/4693-*xx*1/4694 terminals are called *Mod1* terminals. Although all are called Mod1 terminals, each terminal model supports some features that other models do not support.

The 4683/4693-*xx*2 terminals are called Mod2 terminals. These terminals attach to a Mod1 terminal and depend upon that Mod1 terminal for control and communication with the store controller. Table 0-1 shows the different Mod1 and Mod2 terminals.

Table 0-1. Mod1 and Mod2 Terminals by Machine Type

4683 Terminals		4693 Terminals		4694 Terminals	
Mod1	**Mod2**	**Mod1**	**Mod2**	**Mod1**	**Mod2**
4683-P11	4683-*xx*2	4693-7*x*1	4693-*xx*2	4694-144	Not supported
4683-P21	4683-*xx*2	4693-5*x*1	4693-*xx*2		
4683-P41	4683-*xx*2	4693-4*x*1	4693-*xx*2		
4683-001	4683-*xx*2	4693-3*x*1	Not supported		
4683-A01	4683-*xx*2				
4683-421	4683-*xx*2				

Note: A 4683-*xx*2 terminal cannot attach to a 4693 Mod1 terminal. A 4693-*xx*2 terminal cannot attach to a 4683 Mod1 terminal.

The controller/terminal (for example, a 4684 or 4693-5*x*1 controller/terminal) combines the function of the store controller and point-of-sale terminal in a single product. The terminal portion of a controller/terminal is considered to be a Mod1 terminal.

Where to Find More Information

A CD-ROM is available that contains the online books that are a part of the IBM Store Systems Library Collection, SK2T-0331.

Store System Related Publications — Software

IBM 4690 Store System Library
IBM 4690 Store System: Touch Screen Support for 4690 OS Programming Guide, SGC30-3780
IBM 4690 Store System: Planning, Installation, and Configuration Guide, GC30-3600
IBM 4690 Store System: User's Guide, SC30-3597
IBM 4690 Store System: Communications Programming Reference, SC30-3582
IBM 4690 Store System: Messages Guide, SC30-3598
IBM 4680 Store System: Preparing Your Site, GA27-3692
IBM 4680 BASIC: Language Reference, SC30-3356
IBM 4680 Store System: Display Manager User's Guide, SC30-3404
IBM 4690 Store System: 4690 Terminal Services for DOS User's Guide, SC30-3688
The CAPITPGP.DOC file included with AISPO product number, 5764-091 Version 1.1 or later, the *IBM C Programming Interface for the 4690 Terminals*.

IBM 4680 and 4680-90 General Sales Application
IBM 4680-90 General Sales Application: Planning and Installation Guide, GC30-3630
IBM 4680-90 General Sales Application: Guide to Operations, SC30-3632
IBM 4680-90 General Sales Application: Programming Guide, SC30-3631
IBM 4680 General Sales Application – Price Management Feature: User's Guide, SC30-3461
IBM 4680 General Sales Application – Terminal Offline Feature: User's Guide, SC30-3499
IBM 4680-90 General Sales Application: Full Screen – Guide to Operations, SC30-3664
IBM 4680-90 General Sales Application: Master Index, GX27-3958

IBM 4680 and 4680-90 Supermarket Application
IBM 4680-90 Supermarket Application: Planning and Installation Guide, GC30-3633
IBM 4680-90 Supermarket Application: Guide to Operations, SC30-3635
IBM 4680-90 Supermarket Application: Programming Guide, SC30-3634
IBM 4680 Supermarket Application – Terminal Offline Feature: User's Guide, SC30-3512
IBM 4680 Supermarket Application – Electronic Funds Transfer Feature: User's Guide, SC30-3513
IBM 4680-4690 Supermarket Application – Electronic Funds Transfer Feature Enhancement: User's Guide, SC30-3718
IBM 4680-90 Supermarket Application: Master Index, GX27-3957

IBM 4680 Chain Drug Sales Application
IBM 4680 Chain Drug Sales Application: Planning and Installation Guide, GC30-3412
IBM 4680 Chain Drug Sales Application: Guide to Operations, SC30-3413
IBM 4680 Chain Drug Sales Application: Programming Guide, SC30-3414

IBM 4680 Store Management Application
IBM 4680 Store Management Application: Planning and Installation Guide, GC30-3483
IBM 4680 Store Management Application: Guide to Operations, SC30-3484
IBM 4680 Store Management Application: Programming Guide, SC30-3487
IBM 4680 Store Management Application – Inventory Control Feature: User's Guide, SC30-3485
IBM 4680 Store Management Application – Price Management Feature: User's Guide, SC30-3486

IBM Systems Application Architecture
IBM Systems Application Architecture: Common Programming Interface Communications Reference, SC26-4399

In-Store Processing
In-Store Processing: Application Development Guide, SC30-3534
In-Store Processing: IBM AIX – Application Development Guide, SC30-3537
In-Store Processing: IBM OS/2 Extended Edition – Application Development Guide, SC30-3538
In-Store Processing: IBM OS/400 – Application Development Guide, SC30-3535
In-Store Processing: IBM 4680 OS – Application Development Guide, SC30-3536

Store System Related Publications — Hardware

IBM 4694 Point-of-Sale Terminals
IBM 4694 Point-of-Sale Terminals: Installation and Operation Guide, SA27-4005
IBM Store Systems: Installation and Operation for Point-of-Sale Input/Output Devices, GA27-4028
IBM 4693, 4694, and 4695 Point-of-Sale Terminals: Hardware Service Manual, SY27-0337
IBM Store Systems: Hardware Service Manual for Point-of-Sale Input/Output Devices, SY27-0339
IBM Store Systems: Parts Catalog, S131-0097

IBM 4693 Point-of-Sale Terminals
IBM 4693 Point-of-Sale Terminals: Installation and Operation Guide, SA27-3978
IBM Store Systems: Installation and Operation for Point-of-Sale Input/Output Devices, GA27-4028

IBM 4693 Point-of-Sale Terminals: Setup Instructions, P/N 73G1012
IBM 4693 Point-of-Sale Terminals: Quick Reference Card, P/N 73G1022
IBM 4693, 4694, and 4695 Point-of-Sale Terminals: Maintenance and Test Summary, SX27-3919
IBM 4693, 4694, and 4695 Point-of-Sale Terminals: Hardware Service Manual, SY27-0337
IBM Store Systems: Hardware Service Manual for Point-of-Sale Input/Output Devices, SY27-0339
IBM Store Systems: Parts Catalog, S131-0097
IBM 4693 Point-of-Sale Terminals: Reference Diskette, SX27-3918
IBM 4693 Point-of-Sale Terminals: Diagnostic Diskette, SX27-3928
IBM 4693 Point-of-Sale Terminals: Support Diskette for Medialess Terminals, SX27-3929

IBM 4683/4684 Point-of-Sale Terminals
IBM 4683 Point-of-Sale Terminal: Installation Guide, SA27-3783
IBM 4684 Point-of-Sale Terminal: Installation Guide, SA27-3837
IBM 4684 Point-of-Sale Terminal: Introduction and Planning Guide, SA27-3835
IBM 4684 Store Loop Adapter/A: Installation, Testing, Problem Determination, and Technical Reference, SD21-0045
IBM 4683/4684 Point-of-Sale Terminal: Operations Guide, SA27-3704
IBM 4680 Store System and IBM 4683/4684 Point-of-Sale Terminal: Problem Determination Guide, SY27-0330
IBM 4684 Point-of-Sale Terminal: Maintenance Summary Card, SX27-3885
IBM 4680 Store System: Terminal Test Procedures Reference Summary, GX27-3779
IBM 4683/4684 Point-of-Sale Terminal: Maintenance Manual, SY27-0295
IBM Store Systems: Hardware Service Manual for Point-of-Sale Input/Output Devices , SY27-0339
IBM Store Systems: Hardware Technical Reference, SY27-0336
IBM Store Systems: Parts Catalog, S131-0097

Scanners
IBM 1520 Hand-Held Scanner User's Guide, GA27-3685
IBM 4686 Retail Point-of-Sale Scanner: Physical Planning, Installation, and Operation Guide, SA27-3854
IBM 4686 Retail Point-of-Sale Scanner: Maintenance Manual, SY27-0319
IBM 4687 Point-of-Sale Scanner Model 1: Physical Planning, Installation, and Operation Guide, SA27-3855
IBM 4687 Point-of-Sale Scanner Model 1: Maintenance Manual, SY27-0317
IBM 4687 Point-of-Sale Scanner Model 2: Physical Planning Guide, SA27-3882
IBM 4687 Point-of-Sale Scanner Model 2: Operator's Guide, SA27-3884
IBM 4687 Point-of-Sale Scanner Model 2: Maintenance Manual, SY27-0324
IBM 4696 Point-of-Sale Scanner Scale: Physical Planning, Installation, and Operation Guide, GA27-3965
IBM 4696 Point-of-Sale Scanner Scale: Maintenance Manual, SY27-0333
IBM 4696 Point-of-Sale Scanner Scale: Specification Sheet, G221-3361
IBM 4697 Point-of-Sale Scanner Model 001: Maintenance Manual, SY27-0338
IBM 4697 Point-of-Sale Scanner Model 001: Physical Planning, Installation, and Operations Guide, SY27-3990

IBM Personal Computer and IBM Personal System/2
IBM Personal System/2 – Model 50 Quick Reference and Reference Diskette, S68X-2247
IBM Personal System/2 – Model 60 Quick Reference and Reference Diskette, S68X-2213
IBM Personal System/2 – Model 70 Quick Reference and Reference Diskette, S68X-2308
IBM Personal System/2 – Model 80 Quick Reference and Reference Diskette, S68X-2284
IBM Personal System/2 – Store Loop Adapter/A – Supplements for the Hardware Maintenance Library, SK2T-0319

Cabling
A Building Planning Guide for Communication Wiring, G320-8059
IBM Cabling System Planning and Installation Guide, GA27-3361
IBM Cabling System Catalog, G570-2040
Using the IBM Cabling System with Communication Products, GA27-3620

Networks
IBM Local Area Network Support Program, IBM P/N 83X7873
IBM Token-Ring Network Introduction and Planning Guide, GA27-3677
IBM Personal System/2 Store Loop Adapter/A: Installation and Setup Instructions, SK2T-0318

General Publications

Advanced Data Communications for Stores – General Information, GH20-2188
Distributed Systems Executive – General Information, GH19-6394
Communications Manager X.25 Programming Guide, SC31-6167
IBM Disk Operating System 4.0 Command Reference, S628-0253
IBM Proprinters, SC31-3793
IBM 4680 Support for COBOL Version 2 (Softcopy provided with the product)
IBM 4680 Store System Regression Tester (Softcopy provided with the product)
IBM 4680 X.25 Application Programming Interface, GG24-3952
NetView Distribution Manager: General Information, GH19-6587
Systems Network Architecture: General Overview, GC30-3073
IBM Local Area Network Administrator's Guide, GA27-6367
DSX Preparing and Tracking Transmission Plans, SH19-6399
IBM Dictionary of Computing (New York; McGraw-Hill, Inc., 1993)
IBM Local Area Network Support Program, IBM P/N 83X7873
The Ethernet Management Guide – Keeping the Link, Second Edition (McGraw-Hill, Inc., ISBN 0-07-046320-4)

Summary of Changes

The following information has been added or modified in this edition of the manual:

- 4694
- Touch Screen Support
- Programming I/O Devices
- Full-Screen Enhanced I/O Processor
- Fiscal Printers
- Multiple File Archiver Utility

Part 1: The IBM 4690 Operating System Environment

Chapter 1. The IBM 4690 Operating System Environment

This chapter is an overview of the IBM 4690 Operating System environment. It provides the capabilities of the system and refers you to other chapters for more detailed information.

System Capabilities

The IBM 4690 Operating System is a multitasking and multiuser environment that runs in the store controller, the point-of-sale terminals, and the controller/terminals. The operating system can handle store controller communications with point-of-sale terminals, other controllers, the controller/terminal, and the host processor. The following sections briefly describe the system's capabilities.

Concurrent Operations

The following functions of the 4690 Operating System allow concurrent operations:

- The operating system allows you to run your batch and interactive programs at the same time. One program does not have to finish before another program can start.
- The operating system allows several operators to use the system at the same time. Your operators can be authorized to run one program at a time or several at a time. Operators are authorized through the *system authorization file*. See Chapter 15 for information on how to authorize users on the system.
- Multiple users on the system can run multiple interactive applications through the use of *windows*. An operator can switch from window to window, start or stop an application running on a window, or check the status of an application running on a window. Windows are possible through a window control facility. Refer to the *IBM 4690 Store System: User's Guide* for an explanation on how windows are used on the system.
- You can communicate with a host site at the same time your in-store communications are taking place.
- You can attach multiple serial devices to your store controller. The Multiple Console facility handles the management of these devices as additional system consoles.

Operator Interface

For some system functions (for example, configuration) you communicate with the system through a menu-driven interface at the store controller console. For other functions (for example, copying files) you enter commands directly into the system. You can attach auxiliary consoles to the store controller. For information on how to use system functions and auxiliary consoles, refer to the *IBM 4690 Store System: User's Guide*.

Changing the Signon Screen

You can change the signon screen displayed during signon by creating an alternate logo in the file C:\ADX_IPGM\ADXLOGOD.DAT. If this file exists during system startup, the first 10 rows of data on the signon screen are replaced with the first 10 lines of alternate logo data in this file.

ADXLOGOD.DAT should reside in the ADX_IPGM subdirectory. This file can be applied using Apply Software Maintenance (ASM). See the *IBM 4690 Store System: User's Guide* for information on the ASM utility program. When using ASM, the Advanced Data Communications Systems (ADCS) Host Command Processor (HCP) six-character name should be ?LOGOD. You maintain the contents and distribution attributes of this file.

The alternate logo can be a maximum of 10 rows with 79 columns in each row. Each row should be terminated with a carriage return and a line feed. The 4690 system editor DR EDIX automatically terminates lines with these characters.

Communications

The following list contains communications-related information:

- The communication interfaces that support Systems Network Architecture (SNA) protocols are logical unit (LU) 0 and LU 6.2 as node types 2.0 and 2.1. The line connections supported on the non-SNA interface are asynchronous (ASYNC) and Binary Synchronous Communication (BSC). The line connections supported on the SNA interface are BSC, Synchronous Data Link Control (SDLC), token ring, Ethernet, local link, and X.25. The *IBM 4690 Store System: Communications Programming Reference* explains how to use host and peer communications.
- LU 6.2 allows user-written transaction programs (TPs) on the 4690 store controller to communicate with Advanced program-to-program communications (APPC) applications on a host node (type 4 or 5) or on a peer node (type 2.1). The TP accesses the LU 6.2 communications functions by calling APPC functions. These functions are known as calls (verbs) from a set of library routines that are linked to the TP. CPI Communication is the LU 6.2 communications interface used by the 4690 Operating System. The *IBM 4690 Store System: Communications Programming Reference* explains LU 6.2 communications.
- Application-to-application communications are processed through in-memory files called *pipes*. For information on how pipes work with your applications, see Chapter 15 and Chapter 16.
- You can optionally link your store controllers together by the token ring or Ethernet and they can communicate with each other using the Multiple Controller Feature (MCF). A store controller configured as the master store controller serves as the central point of control on this type of system.
- On a system using the MCF, files are updated and distributed as you specify to other store controllers on the network. For more information, refer to the *IBM 4690 Store System: User's Guide*.

Files

This list briefly describes file security, file types, and file structures:

- The operating system provides protection for your files by limiting access to only authorized users. To control file access, you assign each user to one of three categories. See “Protecting Files” on page 2-23 for a description of these categories and their uses.
- You can specify and manage the way disk files are shared with other users. See “Sharing Files” on page 2-21 for information on allowing file access.
- You can create and manage keyed files and other files. A utility allows you to change keyed files into direct files or direct files into keyed files. See “Keyed” on page 2-4 for information about keyed files and how to change these files into direct files, or direct files into keyed files. “Creating Files” on page 2-19 explains how files are created on the system.
- The system uses a hierarchical file structure similar to the IBM Personal Computer Disk Operating System (IBM DOS).

Problem Determination Aids

The 4690 Operating System provides the following problem determination aids:

- The operating system provides several problem determination aids to help you analyze problems in your programs or on your system. One of the aids allows you to collect data about a problem, then print, display, or file the data. You can also create a diskette for documenting and analyzing a problem. Refer to the *IBM 4690 Store System: Messages Guide* for information on collecting problem analysis data.
- A system error log provides a record of system errors that occurred. You can use this data to help identify and resolve problems. For information on the system error log, see Chapter 4.

Utilities

The 4690 Operating System provides the following utilities:

- A utility is available to help you develop the input sequence table. The input sequence table lets you edit operator input from various input devices. Chapter 7 describes the input sequence table utility.
- The Apply Software Maintenance (ASM) Utility allows you to update system or user programs through a menu-driven interface. Refer to the *IBM 4690 Store System: User’s Guide* for information about this utility. The Staged IPL Utility lets you apply maintenance using ASM when one controller is up and able to run TCC Networks. See Chapter 13 for information on the Staged IPL Utility.
- Special write operations protect your data in the event of a power line disturbance. For information on recovering from power line disturbances, see Chapter 4.
- You can use the Distributed File utility to distribute files to other nodes on a multiple-controller system. Refer to the *IBM 4690 Store System: User’s Guide* for a complete description of this utility.
- A text editing facility lets you create and edit files. Refer to the *IBM 4690 Store System: User’s Guide* for information on the text editing facility.

Additional Products

The following list contains information about other products related to the IBM 4690 Operating System:

- The IBM 4690 Operating System supports an optional high-level debugging aid called the *IBM 4680 Application Debugger*. It is available by RPQ P85154.
- The IBM 4690 Operating System includes a Display Manager program that allows you to create, modify, or manage information displayed on the store controller screen. Refer to the *IBM 4680 Store System: Display Manager User's Guide* for information about this program.

Store Controller Backup

You specify the *store controller backup* during configuration. This backup automatically backs up your primary controller when activated. The function provides continuous control for your terminal operations. When you configure and prepare a store controller for backup, it can assume control of the TCC Network when the store controller for that TCC Network is not operational. For information on configuring and preparing store controller backup, refer to the *IBM 4690 Store System: User's Guide*.

The IBM 4690 Operating System also provides data backup. A multiple-controller system provides *Data Backup*, the capability for file redundancy. This capability allows store controllers to communicate with each other across the local area network (LAN). With this feature you can specify when your files are to be automatically updated and distributed. For more information on data backup with a LAN, refer to the *IBM 4690 Store System: User's Guide*.

Chapter 2. Managing Files

This chapter shows you how to handle files. It gives you information about file types and describes how to manage your files and subdirectories.

Selecting File Types

You can choose from four types of files when building the files for your store system: random, direct, keyed, and sequential. You create all files using variations of the CREATE statement and accompanying parameters.

Random

Random files have fixed record lengths. The system uses the last two bytes in each record for the carriage return and line feed characters (CR/LF). The system pads the data space between the last field of the record and the CR/LF.

Random files offer random access, which allows direct access to any record in a file. This ability makes random and direct files an ideal type for files that can be referenced by a relative record number. If you need a name or a specific number (such as a telephone number) to reference a record, use Keyed File Services. You ensure that the number of bytes occupied by the field delimiters and CR/LF do not exceed the specified record length. Figure 2-1 shows a random file composed of three records. The data is in ASCII characters.

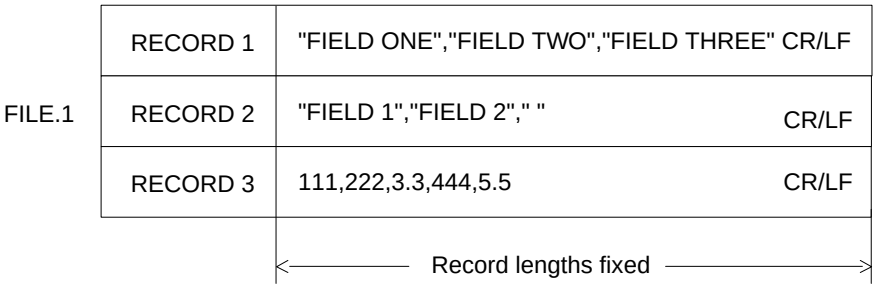


Figure 2-1. Example of a Random File

IBM 4680 BASIC locates each record of a randomly accessed file by taking the record number, subtracting 1, and then multiplying that result by the record length. The result is a byte displacement value for the record measured from the beginning of the file. Records can span sectors. You must specify the record to be accessed in each READ#, PRINT#, or WRITE# statement executed. The following BASIC program creates the random file diagrammed in Figure 2-1.

```
CREATE  "FILE.1"  RECL 40  AS 2
       A$ = "FIELD  ONE"
       B$ = "FIELD  TWO"
       C$ = "FIELD  THREE"
       D$ = "Field 1"
       E$ = "Field 2"
       F$ = ""
       G% = 111
       H% = 222
       I  = 3.3
       J% = 444
       K  = 5.5
WRITE #2,1; A$, B$, C$
WRITE #2,2; D$, E$, F$
WRITE #2,3; G%, H%, I, J%, K
CLOSE 2
END
```

The following program reads the first three fields from record 3 in FILE.1.

```
IF END #20  THEN 200
OPEN "FILE.1" RECL 40  AS 20
     READ #20,3; FIELD1%, FIELD2%, FIELD3
     PRINT FIELD1%, FIELD2%, FIELD3
200 END
```

The preceding program results in the following output.

```
111                    222                    3.3
```

For applications written for the terminal, you must use the WRITE statement to send data to a random file.

Direct

Direct files are like random files except that direct files contain no delimiting characters (quotes, commas, and CR/LF). Direct files contain no data formatting information. Because of this, you must specify a special format string when you want to access the data in a direct file. See “Performing File Functions” on page 2-18 to learn more about accessing a direct file.

The following program creates a direct file named DIRECT.DAT that consists of one 15-byte record. The variable D represents the format string used in the WRITE FORM# statement.

```
STRING  A,  D
INTEGER*2   B
REAL  C

CREATE  "DIRECT.DAT"  DIRECT  RECL 15  AS 3  LOCKED
       A = "ABC"
       B = 32767
       C = 27.35
       D = "C3, I2, R"
WRITE FORM D; #3,1; A,B,C

CLOSE 3
END
```

Figure 2-2 shows the direct file created by the preceding program. The data in the figure is in hexadecimal.

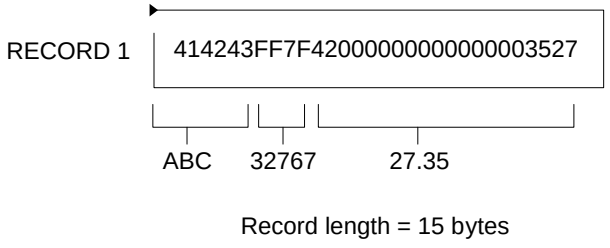


Figure 2-2. Example of a Direct File

Keyed

Keyed files are composed of fixed-length records that are accessed by using a key, which can be any combination of characters that can be used in an IBM 4680 BASIC string.

A keyed file consists of blocks that contain keyed records. A block is a 512-byte sector. Each block uses the first four bytes for chain pointers and the next 508 bytes for records. A block can contain multiple records, but records are not split across blocks. Each record contains its key and data, with the key always being first. A record can be a maximum of 508 bytes. The key can be as many bytes of the record as you need.

You should use keyed files for files accessed by a name or a number. Examples of such numbers are a Universal Product Code (UPC), a label, a telephone number, or a check authorization number. These types of names and numbers do not have any contiguous nature and are random in their occurrence. You can use numbers that have a contiguous nature to access a random or direct file.

You access keyed files by hashing the key to obtain a relative position within the file to locate the record. Keyed files do not have indexes. The more unique each key is with respect to all of the other keys used in a keyed file, the better the hashing technique works.

To access a keyed file sequentially, use the keyed file as a direct file. You can obtain information about the keyed file from the first block, which is used only for control information. The format of this first block is:

Relative Byte Offset (in Decimal)	Number of Bytes (in Decimal)	Keyed File Information
42	4	Number of blocks in keyed file
46	2	Keyed record size
48	4	Randomizing divisor
54	2	Key length
56	4	Chaining threshold

You can create keyed files directly with an IBM 4680 BASIC program, or you can use the Keyed File Utility program provided with the IBM 4690 Operating System. The utility provides an efficient two-pass method of converting a direct file into a keyed file. See “Keyed Files” on page 2-28 for an explanation of this utility.

Like direct files, keyed files use no delimiting characters. You use a format string to map the data to and from the record. Figure 2-3 shows a keyed file record with a 19-byte length. The data in the figure is in hexadecimal.

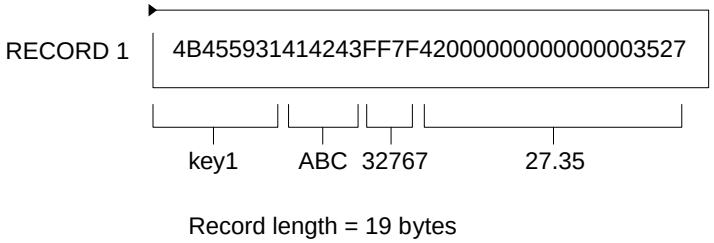


Figure 2-3. Example of a Keyed File

The following program creates the 19-byte keyed file shown in the Figure 2-3 on page 2-4. The keyed file consists of one 19-byte record.

```
STRING  A,  D,  KEY
INTEGER B
REAL  C

CREATE POSFILE  "KEYFILE.DAT" KEYED 4 , , , 200 \
  RECL 19  AS 4  LOCKED
     KEY = "key1"
       A = "ABC"
       B = 32767
       C = 27.35
       D = "C4, C3, I2, R"
WRITE FORM D; #4; KEY,A,B,C

CLOSE 4
END
```

In this program:

- The numeral 4 after the reserved word KEYED specifies a key length of 4 bytes.
- The three commas after the numeral 4 indicate that no randomizing divisor or chaining threshold value is specified; therefore, the defaults are used.
- The numeral 200 after the three commas specifies a total of 200 records in the keyed file.
- The variable D represents the format string used in the WRITE FORM# statement.

Sequential

Sequential files are composed of variable-length records accessed in a first-record-to-last-record sequence. A record in a sequential file consists of one or more fields delimited by commas between the fields. A CR/LF follows the last field. A string data field is also delimited by quotation marks. A numeric data field is converted to an ASCII representation.

A record in a sequential file can contain up to 64 KB long. Individual record lengths vary according to the size of the fields in the record. Each field occupies only the number of bytes required by the data in the field and the delimiters. Data records are written one after another and can span disk sectors.

You can open sequential files for reading or writing but not for both. You can, however, use two OPEN statements to access a sequential file, one for reading and one for writing. Each open processes the file sequentially. When you open a sequential file for reading, you start at the beginning of the file. When you open a sequential file for writing, you must specify the APPEND option in the OPEN statement. The data that you write is appended to the end of the existing file.

Although sequential files are normally accessed from beginning to end, IBM 4680 BASIC provides a way to re-establish a reference within a sequential file for reprocessing a sequential file from a saved reference. You might find this useful as a checkpoint when processing large sequential files. After re-establishing a sequential file reference, the file access is again a next-record sequence. Note that you cannot re-establish a reference when writing to a sequential file.

A special form of the WRITE command, WRITE MATRIX, enables you to write a record to a sequential file from a terminal application. The WRITE MATRIX command supports writing records longer than 512 bytes. It also supports the simultaneous writing of records from more than one terminal. WRITE MATRIX uses several file writes to place all the data in the record in the sequential file. The first write specifies some of the fields and filler data for the remainder of the record. After the first write, the record contains the fields that fit into 512 bytes, and the remainder of the fields are empty (the record is filled with commas

and a terminating CR/LF). The other writes fill the remainder of the fields in increments of 512 or fewer bytes. The entire record is locked until all of the writes are finished. The record is unlocked if the connection between the store controller and the terminal is lost. The system writes a WRITE MATRIX record this way to keep an application from reading the record until it is complete. It also allows an application to determine whether the record has been completed or not. Records placed in a sequential file by WRITE MATRIX are not guaranteed to be in the sequence in which they occur.

You should use sequential files for data that is collected in a serial manner. Examples are the sales data collected in the terminal that is associated with each sales transaction, a listing of events as they occur, and data to be saved in a file to be printed later.

Figure 2-4 shows a sequential file composed of three records. The data in the figure is in hexadecimal.

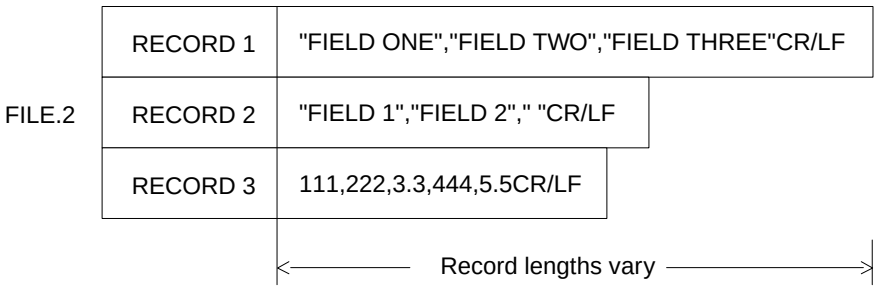


Figure 2-4. Example of a Sequential File

The third field in RECORD 2 is a null string. Commas and quotation marks serve as delimiters but may also appear in a field as long as they are imbedded within quotation marks. The only exception is that a quotation mark followed by a comma must serve as a string delimiter. The following program creates the sequential file diagrammed in Figure 2-4.

```
CREATE  "FILE.2"  AS 2
       A$ = "FIELD ZERO, ONE"
       B$ = "FIELD TWO"
       C$ = "FIELD THREE"
       D$ = "Field 1"
       E$ = "Field 2"
       F$ = ""
       G% = 111
       H% = 222
       I  = 3.3
       J% = 444
       K  = 5.5
WRITE #2; A$, B$, C$
WRITE #2; D$, E$, F$
WRITE #2; G%, H%, I, J%, K
CLOSE 2
END
```

The three WRITE# statements correspond to the three records, and each variable corresponds to a field.

When you access sequential files, each field is read one at a time from the first to the last. The READ# statement considers a field complete when it encounters a comma or CR/LF for numeric fields, and a quotation mark followed by a comma or carriage return for string fields.

The following program reads the fields in FILE.2 sequentially and prints them on the display device, one field for each line.

```
IF END #19  THEN 100
OPEN "FILE.2" AS 19
     FOR I% = 1 TO 11
       READ #19; FIELDS$
       PRINT FIELDS$
     NEXT I%
100 END
```

The data type should match the variable type on a field-by-field basis.

The preceding program results in the following output:

```
FIELD ONE
FIELD TWO
FIELD THREE
Field 1
Field 2

111
222
3.3
444
5.5
```

Note: Applications written for the terminal can send data to a sequential file using the WRITE MATRIX statement only.

Naming Files and Subdirectories

A complete name for a file contains the name of the file, the disk or diskette drive that contains the file, the subdirectory path for the file, and the node name if you have MCF and want to access a file on another store controller. Some of the information in the file name is optional. If it is not present, the system either treats it as blanks or substitutes default values. Generally, you should specify values rather than rely on defaults.

The general format for a complete file name is:

*nodename::**drivename:**subdirectory**filename.extension*

where:

nodename The name used to identify a store controller on the network. You can use this name to access files on a different store controller on the LAN. The *nodename* must be followed by two colons (::). See “Using Node Names to Access Files” on page 2-18 for more information.

drivename The name for the disk or diskette drive. A is for the first diskette drive. B is for the second diskette drive. C is for the first fixed disk drive. D is for the second fixed disk drive. The *drivename* must be followed by one colon (:).

subdirectory The names of the subdirectories in the path for this file. See Appendix A for determining the use of these names. Subdirectory names can contain one to eight characters and are delimited by backslashes. You can specify multiple subdirectory names. If you do not specify a subdirectory name, the system uses the root directory. The IBM 4690 Operating System generally uses the first level of the subdirectory and not the root.

filename The actual name of the file. The file name can contain one to eight characters.

extension The extension of the file name. You use the extension as an additional set of characters to uniquely define a file. The extension can contain one to three characters and is separated by a period from the file name.

In an application program, you should use a *logical name* to represent the complete file name. The logical name is easier to use and allows the file to be placed on the desired drive without changing the application program. See "Using Logical Names" on page 2-11 for information on logical names.

Rules for Naming Subdirectories and Files

The general rules for naming subdirectories and files are:

1. Do not start a subdirectory or file name with ADX. The prefix ADX is reserved for the IBM 4690 Operating System files.
2. Avoid using a name for a file that matches a name of an IBM 4690 Operating System command.
3. Characters allowed in subdirectories, file names, and extensions are:
   - Uppercase A–Z
   - 0–9
   - Special characters @ # ( ) { }

   Note: Do not use these special characters in the first, fourth, fifth, or eighth position of a file name because these conflict with Host Command Processor (HCP) and input sequence table build file names.
4. The following characters are not allowed in subdirectories, file names, and extensions:

   ? * : . $ & _ ; , [ ] ! + = < > " - / \ |
5. In terminal applications, you can use a maximum of 24 characters in a statement for a file name, including its extension. This maximum includes a mandatory node name (for example, R::) of three characters prior to all file names.
6. In the store controller, you can use a maximum of 127 characters in a statement for a file name, including its extension.
7. File names with a .BSX extension are symbol files for programs with the same file name.
8. The file extension .$$$ represents a temporary file that the data distribution application (DDA) uses when distributing an entire file across the LAN (MCF Network).

   For example, when distributing the file ABC.DAT to a remote node, the application creates a new version named ABC.$$$. The application deletes the ABC.DAT copy and renames the temporary file (ABC.$$$) to ABC.DAT.
9. The file extension .C0 is a temporary input file to the Keyed File Utility.
10. All ADX*xxxxx* names are not files or subdirectories. Some ADX file names represent functions, pipes, processes, or node names. For example:

ADXFILES	Function for a forced close
ADXLNDAP	Pipe indicating that a store controller is the acting master
ADXLND1L	LAN distribute per update process
ADXLXCCN::	LAN node name for store controller CC
ADXLXAAN::	LAN node name for acting master store controller
11. All 4690 files are found in directories. Some files are placed in the root directory, but most are located in subdirectories that are one level below the root directory.

12. 4690 Operating System subdirectory names have the following general form:

    ADX_*yzzz*

    Where:

    y = Intended user of the subdirectory:

    I = IBM applications
    S = Operating system
    K = Store Systems Regression Tester
    U = User

    zzz = Contents of the subdirectory:

    PGM = Active programs and associated data
    DT1 = Data files
    DT4 = Data files
    MNT = Maintenance modules
    BUL = Backup level of maintenance modules

13. The following subdirectories do not follow the 4690 Operating System naming conventions:

    ADX_APGM User subdirectory that allows application data files to be system-mirrored files
    ADX_BSX Subdirectory for .BSX symbol files that are not currently being used
    ADX_IOSS 4690 Operating System print spooler data files and control blocks

Use these rules for file names and extensions.

Part of determining how to name a file is knowing the intended use of the file and the subdirectory containing the file. Generally, files are either programs or data. Some data files are really a logical extension of programs such as files that contain messages, screen definitions, or personalization values. Other data files contain data that is referred to or modified as a result of the sales activity.

Table 2-1 describes the naming rules for the various types of files and subdirectories.

Table 2-1 (Page 1 of 2). Naming Files on the IBM 4690 Operating System

Subdirectory	File Name	Extension
ADX_IPGM ADX_IMNT ADX_IBUL	• Must be 8 characters. • First 3 characters must be the same as defined in configuration and cannot be ADX. • Last character must be D, F, L, O, S, V, or W. See Table 2-2 on page 2-10. • Any of the valid name characters, but do not use special characters in the 5th character position.	Must be 3 characters and must be determined according to the file use table based on the last character of the file name (see Table 2-2 on page 2-10).
ADX_IDT1	• Must be 8 characters. • First 3 characters must be the same as the files in ADX_IPGM. • Other 5 characters can be any of the valid name characters.	• Should be DAT. • Exception might be files that are only referred to by the application and HCP using logical file name (LFN).
ADX_IDT4	• Must be 8 characters. • First 3 characters must be the same as the files in ADX_IPGM. • Other 5 characters can be any of the valid name characters.	• Should be DAT. • Exception might be files that are only referred to by the application and HCP using LFN.

Table 2-1 (Page 2 of 2). Naming Files on the IBM 4690 Operating System

Subdirectory	File Name	Extension
ADX_SPGM ADX_SMNT ADX_SBUL ADX_SDT1	These subdirectories are for use only by the IBM 4690 Operating System and must not contain any application files.	
ADX_UPGM ADX_UMNT ADX_UBUL See *note* below.	Must be 4 characters.	Must be 3 characters and must be determined according to the file use table (see Table 2-2 on page 2-10). The last character of the file name is not used to determine the extension for these subdirectories.
ADX_UDT1 See *note* below.	Must be 4 characters.	Must be 3 characters according to what type of translation should be done by HCP when exchanging this file with the host: **ASC** = ASCII to EBCDIC **BIN** = No translation **XLT** = User translation

Note: To be exchanged with the host processor through HCP, names in the ADX_UPGM, ADX_UMNT, ADX_UBUL, and ADX_UDT1 subdirectories must follow these guidelines. If the files in these subdirectories are used only for local use, such as for program development, follow the general file naming rules. When local files need to be exchanged with the host, you can rename them according to the renaming rules for these subdirectories.

Table 2-2 (Page 1 of 2). File Use Table

File Name Character	Extension	Intended File Use
A	A86	Assembler source code
B	BAS	4690 source code
C	C	C source code
D	DAT	Product control files
E		Reserved; do not use
F	DAT	Messages, input sequence tables, and similar files
G		Reserved; do not use
H	H	C source code include files
I		Reserved; do not use
J	J86	4690 source code include files
K	L86	Library files
L	286	4690-executable file
M	MAP	Linkage editor map file
MF	DAT	Data files (messages)
N	INP	Linkage editor input file
O	OBJ	Relocatable object file
P	LST	Language translator listing file
Q	LIS	4690 interlisting file
R	LIN	4690 line number file

Table 2-2 (Page 2 of 2). File Use Table

File Name Character	Extension	Intended File Use
S	DAT	Display Manager screen files
T	SYM	Linkage editor symbol table file
U	BSX	Symbols file
V	OVR	4690-executable overlay file
W	SRL	Shareable runtime libraries
X	XRF	Cross-reference file
Y	SYS	4690 non-relocatable file
Z	BAT	Batch files

For example, the LOAD ALL TERMINALS function uses these files:

ADXCS20L.286 The executable module or program
ADXCS3AS.DAT The Display Manager screens for running the utility interactively
ADXCS3MF.DAT The message file used by the utility

Using Logical Names

A *logical name* is a way to abbreviate a file name. You can use logical names to represent either the entire file name (LFN type) or the drive and subdirectory path of the file name (LDSN type). You can use LFN, which represents the logical file name as the entire file name. You can use LDSN, which represents the logical drive and subdirectory name, as the drive and subdirectory path part of the file name. Table 2-3 illustrates the use of these terms:

Table 2-3. LDSN and LFN Terms

Type	General Form for Using This Type	Example of a Name Using This Type
LDSN	LDSN:*filename.extension*	ADX_IDT1:EALABCDE.DAT
LFN	LFN	C:\ADX_IDT1\EALPQRST

The operating system provides LDSN forms of logical names for all of the supported subdirectories. Table 2-4 lists the LDSNs.

Table 2-4 (Page 1 of 2). System-Provided LDSN Format

LDSN	for DRIVE: \SUBDIRECTORY\
ADX_SPGM:	C:\ADX_SPGM\
ADX_SMNT:	C:\ADX_SMNT\
ADX_SBUL:	C:\ADX_SBUL\
ADX_SDT1:	C:\ADX_SDT1\
ADX_IPGM:	C:\ADX_IPGM\
ADX_IMNT:	C:\ADX_IMNT\
ADX_IBUL:	C:\ADX_IBUL\
ADX_IDT1:	C:\ADX_IDT1\
ADX_IDT4:	C:\ADX_IDT4\

Table 2-4 (Page 2 of 2). System-Provided LDSN Format

LDSN	for DRIVE: \SUBDIRECTORY\
ADX_UPGM:	C:\ADX_UPGM\
ADX_UMNT:	C:\ADX_UMNT\
ADX_UBUL:	C:\ADX_UBUL\
ADX_UDT1:	C:\ADX_UDT1\

Defining Logical File Names

You can create, display, or modify logical file names during the configuration process. Configuration screens allow you to define three types of logical file names:

- System files
- Application files
- User files

Note: You must not use the same name for any type of communications line or SNA link that you use for any system, application, or user logical file name.

System Logical File Names: System logical file names are reserved names used for operating system files and subdirectories. The ADXDA*xy*F.DAT file (where *xy* is the store controller ID) in the ADX_SPGM subdirectory contains the system logical file names.

Using the configuration screens, you can change the disk drive name defined in the LFN forms of these system files. You cannot change the LDSN forms of the system logical names and you cannot add new system logical names.

Application Logical File Names: An IBM licensed program or another program defines application logical file names. The ADXDC*xy*F.DAT file (where *xy* is the store controller ID) in the ADX_SPGM subdirectory contains the application logical file name.

Use the configuration screens to change the disk drive name specified in the LFN form of the application logical names. You cannot change the LDSN forms of the application logical names and you cannot add new application logical names.

Defining User Logical File Names: You can completely define user logical file names through configuration. You can define these file names as any allowed logical names that are not reserved by the operating system or an IBM licensed program. You can define either LFN or LDSN types of user logical names. The ADXDE*xy*F.DAT file (where *xy* is the store controller ID) in the ADX_SPGM subdirectory contains the user logical file names.

You can define logical names whenever you choose, but the changes do not become effective until you activate them. To activate logical names, use the Supplemental Diskettes.

| To have more displayable characters available on your store controller applications, define the logical
| name *disp4680* to any value. Setting a value causes 4690 OS to use the 4680 Controller Video Display
| Character set. Refer to the *IBM 4680 Basic Language Reference* for a description of the 4680 and 4690
| Controller Video Display Character Sets.

Logical File Names on a LAN (MCF Network) System

Logical file names make accessing files on other store controllers on the LAN (MCF Network) easier by letting you abbreviate lengthy file names. The system expands your abbreviated file name to the full file name when accessing the file.

For example, MYITEMS is a logical name used by your sales application for an item record file. The system expands this name to its full file name, ADXLXAAN::C:\ADX_IDT1\MYITEMS.DAT, when another node references MYITEMS. (Refer to the *IBM 4690 Store System: User's Guide* for a discussion of nodes and node IDs.) In this example, the expanded name gets the version of the MYITEMS.DAT file that is on the master store controller (ADXLXAAN::), on the C drive (C:), in the ADX_IDT1 subdirectory (\ADX_IDT1\).

You can use a logical name to refer to a unique node, a unique subdirectory, or to a file. For example, ADX_IPGM: is a logical name for the subdirectory C:\ADX_IPGM\. Likewise, the logical name ADX_IPGM:MYMOD.286 refers to a module whose full file name is C:\ADX_IPGM\MYMOD.286.

More than one logical name can refer to the same file. For example, if you define both ABC and DEF as logical names for C:\ADX_UPGM\YOURMOD.286, any reference to ABC or DEF translates to the same file name.

You could then define ABCD to be the logical name for the file ADXLXCCN::C:\ADX_UPGM\YOURMOD.286, and ABCDE to be the logical name for the file ADXLXAAN::C:\ADX_UPGM\YOURMOD.286. A reference to ABC or DEF would look for YOURMOD.286 only on the local controller. A reference to ABCD would look for the file only on the store controller node with the ID of CC. A reference to ABCDE would look for the file on the acting master store controller (ADXLXAAN::) wherever it is and whatever its ID is. If there was no acting master at that time, the system returns a file error message.

Every distributed file must have a logical name defined in the application logical names file or the user logical names file. The format of the logical name in the Logical Names File is:

For a compound file:

`ADXLXAAN::`*`drive\subdirectory\filename.extension`*

Logical name format for a mirrored file:

`ADXLXACN::`*`drive\subdirectory\filename.extension`*

Note: The system allows only one level of a subdirectory in a logical name expansion.

You can access prime versions of compound or mirrored files to read, write, delete, or rename files. However, you can only read an image version. You cannot access image versions of distributed files that are distribute at close. If you try to write, delete, rename or lock an image version of a distributed file, you will receive an error message.

Logical Names Table

The operating system uses a single table of logical names for its files, store controller node names, subdirectories, and for most I/O devices such as printers and displays. A default logical names table is supplied with the operating system at installation. The system adds application and user logical names from the application and the user logical names files to the system table at IPL. (See "Using Logical Names" on page 2-11 for information on application and user logical names files.)

These application files can be unique for each store controller so the logical names table can also be unique for each store controller. The files used in the building of the logical names table are:

ADXDA*xy***F.DAT** Operating system logical names file (initially the system default table)
ADXDC*xy***F.DAT** Application logical names file
ADXDE*xy***F.DAT** User logical names file

Note: *xy* is the node ID.

Building a Logical Names Table: The operating system builds a logical names table at IPL time by combining the operating system, application, and user logical file names.

The operating system uses these steps to create the table:

1. The system starts with the default operating system logical names file.
2. The system adds any new names from the application logical names file.
3. If any of the application logical file names duplicate an operating system logical file name, the operating system logical file name is overlaid with the application logical file name.
4. The system uses the user logical names file to add new names or overlay existing names.

Because the user logical names file is the last to be scanned, it has precedence over both the application and operating system logical names files.

Displaying the Logical Names Table: To display the logical names table, from the SYSTEM MAIN MENU, select the Command Mode option by typing **7** and press **Enter**. In the root directory, type **DEFINE -S -N** (S for system, N for logical names table) and the system displays the logical names tables. To display the logical names table one screen at a time, you can use the MORE parameter. For example:

```
C:>define -s -n |more
```

Changing the Logical Names Table: You can change application logical names using the DEFINE command. However, it is recommended that these names not be changed. Refer to the *IBM 4690 Store System: User's Guide* for a description of the DEFINE command.

You cannot change application logical names through the configuration process. You can change the disk drive identification for some of these names to provide disk space and better performance.

You can define user logical names during store controller configuration. Use these names to override application logical names if desired.

Accessing Distributed Files in Store Controller and Terminal Applications

This section shows how to access distributed files from terminal nodes using logical names. The section uses an example to show how to define the file in the user logical names table and how to distribute the file to other nodes.

The example shows how a terminal user program can access a user-defined distributed file called MYFILE.DAT. The file is a compound file that is Distribute Per Update. The system distributes a compound file to all store controllers. The example shows how to put the prime version of the file on drive D of the master store controller in the ADX_IDT4: directory.

In the example, the user program reads the local image version of the file, which reduces response time and improves performance. To update the file, the user program opens the prime version of the file on the master store controller.

Setting up the file on the LAN (MCF Network) and opening the file in the user program is a three-part process. This process consists of defining the file, creating it, and accessing it through the user program.

Step 1. Define the File: Define the file MYFILE.DAT in the user logical names tables. You must define the file in the logical names file on each eligible store controller. (Refer to the *IBM 4690 Store System: Planning, Installation, and Configuration Guide* for information on worksheets and designating eligible LAN store controllers.)

When the file is defined in the user logical names tables, the table will have two entries placed in it for the MYFILE.DAT user file as follows:

```
1     $YFILE = D:\ADX_IDT4\MYFILE.DAT   ! Local version
2     MYFILE = ADXLXxxN::$YFILE   ! Prime version
```

where the actual node ID of the current acting master store controller replaces *xx*.

The first entry gives the path to the local image version of the file for each store controller (for example, on drive D in the ADX_IDT4 subdirectory, with the file name of MYFILE.DAT). Open this file when you want to access the local version of the distributed file. Your application can only read this version.

The second entry gives the path to the prime version of MYFILE on the master store controller (ADXLXxxN::). Open this file when you want to update the prime version of the distributed file.

When the prime version of MYFILE.DAT is updated or deleted, DDA updates the local image versions on the other nodes using the LFN $YFILE. Since each eligible store controller on the LAN has its own definition of $YFILE, the drive and subdirectory of the local image versions may be different from the path of the local version on the master store controller.

Note: When updating any distributed file named MYFILE.DAT using the LDSN or complete file name formats, DDA will continue to use the LFN $YFILE on the other nodes if LFN MYFILE is defined on the master store controller. If the LFN $YFILE is not defined on the other nodes, DDA will assume $YFILE is the expanded full file name and place the updates in the file C:\$YFILE on the other store controllers.

Attention: Undesirable operations may be performed on the image versions if two or more files named MYFILE.DAT exist in separate directories on the master store controller.

To define the file in the logical names file, perform the following steps at the master store controller. You must repeat these steps for each eligible store controller on the LAN.

1. On the SYSTEM MAIN MENU screen, type **4** and press **Enter**.
2. When the INSTALLATION AND UPDATE AIDS screen appears, type **1** and press **Enter**.
3. On the CONFIGURATION screen, type **2** and press **Enter**. When prompted “Are you configuring for a LAN system?”, type **Y**.
4. When the CONTROLLER CONFIGURATION screen appears, press **Enter**.
5. At the next configuration screen, select a store controller by moving the highlighted cursor to the appropriate node ID and press **Enter**. You must return to this screen to select an ID for each eligible store controller.
6. When the next CONTROLLER CONFIGURATION screen appears, use the **Tab** key to move the cursor next to User Logical File Names. Type **X** and press **Enter**.
7. When the USER LOGICAL FILE NAMES screen appears, type **1** and press **Enter**.
8. On the same screen in the file name window, enter the user logical name to be used to access this file. (The sample problem uses MYFILE as the logical name.) Press **Enter**.

9. On the DEFINE LOGICAL FILE NAMES screen, type in the expanded name to define the logical name for the distributed user file, and press **Enter**. The sample problem uses `ADXLXAAN::D:\\ADX_IDT4\MYFILE.DAT`.

   The node name ADXLXAAN:: defines this file to be on the master store controller. The D:\\ defines it on drive D and the double backslash ensures that drive D is accessed while operating in any subdirectory. The remaining portion of the node name, ADX_IDT4\MYFILE.DAT, is the standard subdirectory/filename.extension naming convention.

10. Press **F3** to go back through the configuration screens until you return to the CONTROLLER CONFIGURATION screen. On this screen, select another controller node ID.
11. Repeat steps 5 through 10 until you have defined the user logical name MYFILE on all store controllers on your network.
12. Press **F3** again to back out of the configuration process until you get to the CONFIGURATION screen. On this screen, type **5**, and press **Enter**.
13. On the next screen, type **2** (Controller Configurations) and press **Enter** to activate the changes just made.
14. After you have verified, distributed, and activated the changes, you must IPL the controllers. To do this, press the **SysRq** key, then type **C** to select controller functions. On the next screen, type **2** (Controller functions) again and press **Enter**. On the next screen, type **9** (Load Controller Storage) and press **Enter**.

    In the highlighted box that appears, type an asterisk (*) to IPL all store controllers. Answer **Y** to the prompt about stopping background programs.

    If you do not want background programs stopped now, press **F3** to process, and wait until all background processing is finished before continuing. Before the next steps can be completed, the controllers **must** be IPLed. You can choose the time to do that.

Step 2. Create the File: Create the file MYFILE.DAT in one of the following ways:

- Create a user-written program that creates a POS file statement. For example, if you are using an IBM 4680 BASIC program, include a CREATE POSFILE statement. Be sure the statement includes the parameters COMPOUND and PERUPDATE to give the file the correct attributes.
- At the master store controller from the host specifying either CREATE or CLOD (Create and Load) using ADCS. Be sure you specify the correct attributes on the CREATE or CLOD statements (that is, SHARE=NO, VOL=3) to get the correct distribution attributes.
- Use another supported means instead of ADCS to send HCP commands to create the file.
- Use the 4690 Operating System COPY command to copy the file from a diskette to the fixed disk. You can create the version on the diskette as a distributed file and then the proper attributes are transferred during the copy process. If you copy a nondistributed version, use the Distributed File Utility (DFU) to define the file as distributed after you copy it. Refer to the *IBM 4690 Store System: User's Guide* for more information about the DFU.

  The file is distributed to the proper store controllers by the DDA. Refer to the *IBM 4690 Store System: User's Guide* for more information.

Step 3. Access the File from the User Program: The user program uses the MYFILE user logical name to open the prime version of MYFILE.DAT on the master store controller for a READ or READ-WRITE.

The program uses the $YFILE file to open the local version of the file on the store controller that is supporting the TCC Network that the terminal is on.

You can open the local file only for READ, because an application cannot update an image version of a file. If you create the file with a file attribute of distribute at close, the application cannot open $YFILE because an application cannot read a file with the distribute at close attribute.

Using File Names in Store Controller Applications

In store controller applications, the IBM 4680 BASIC statements that use file names are OPEN, CREATE, RENAME, SIZE, and CHAIN. For all statements except the CHAIN statement, use any of the following formats:

LFN
LDSN:filename.extension
drivename:\subdirectory\...\filename.extension

The LFN allows you to place the referenced file on any drive without modifying the application. You should define the LFN to be a complete file name with the subdirectory being ADX_IDT1. (There should be an ADX_IDT1 subdirectory on each drive.) If you use the LDSN format, you should define the LDSN as a drive and subdirectory path. You can use the complete file name format for cases that are not supported by the LFN or LDSN format, such as a special testing environment.

When you are using the CHAIN statement, use a file name and extension with a drive and subdirectory, or use the LDSN for the drive and subdirectory. Whichever format you use, you must specify the drive and subdirectory. The possible formats are:

LDSN:filename.extension
drivename:\subdirectory\...\filename.extension

Using File Names in Terminal Applications

In terminal applications, the IBM 4680 BASIC statements that use file names are OPEN, CREATE, RENAME, LOAD, SIZE, and CHAIN. Each of these statements requires that the node name R:: precede the file name.

When using the OPEN, CREATE, RENAME, or LOAD statements, use the LFN format for the file name. This allows you to place the referenced file on any disk drive without modifying the application. You should define the logical file name to be a complete file name with the subdirectory being ADX_IDT1. (There should be an ADX_IDT1 subdirectory on each disk drive.) An example of a file name using this format is:

```
R::EALABCDE
```

Note: The LFN represents all of the file name *except* the R:: node name. The terminal application can access any drive except the diskette drives for OPEN, CREATE, or RENAME. CHAIN and LOAD can access any drive.

The IBM 4690 Operating System converts logical file names to their fully qualified names that you defined in configuration.

When using the CHAIN statement, use a file name and extension without a drive or subdirectory because the IBM 4690 Operating System automatically uses the ADX_IPGM subdirectory. An example of a file name using this format is:

```
R::EALPQRSL.286
```

Using Node Names to Access Files

To access a file on another store controller, an application must use a file specification that includes the node name when opening a file. (Refer to the *IBM 4690 Store System: User's Guide* for a discussion of nodes and node IDs.) If file specification does not include the node name, the request tries to locate the file on the local store controller.

The complete file specification should follow the format:

nodename::*pathname**filespec*

Every node name has the form ADXLX*xy*N:: where *xy* is the store controller ID. Note that you end node names with a double colon. Use a single colon to indicate physical devices on the same controller, such as C:, D:, LPT1:, COM1:, and so on. Use the double colon to indicate different nodes on the network.

R:: is required in a terminal application when addressing an external (any controller) file. For example, when opening the XYZ file on the file server, the terminal application refers to this file as R::XYZ, where the XYZ logical name might be defined in the logical names table as ADXLXACN::C:\ADX_IDT1\EAL__XYZ.DAT. ADXLXACN is the system name for the file server.

In addition to the unique node name, some store controllers also have a *logical* node name. These store controllers are the master, alternate master, file server, and alternate file server. The logical node name provides a quick means of identifying the most important store controllers on your system. The logical node name is updated whenever the acting master or file server changes.

The following list shows how the operating system names the logical nodes on your system:

Store Controller	**Logical Node Name**
Acting master	ADXLXAAN::
Acting alternate master	ADXLXABN::
Acting file server	ADXLXACN::
Acting alternate file server	ADXLXADN::

You can access files using either the unique node name or the logical node name.

Logging Distribution Errors

The system enters errors that are made when updating copies of distributed files in the Distribution Exception Log. Refer to the *IBM 4690 Store System: User's Guide* for information about this log.

Performing File Functions

IBM 4680 BASIC provides statements to perform such file functions as creating, deleting, and using data files. These statements help you manage data files within your applications. Both terminal and store controller applications can use these statements.

You can also perform file functions using commands in Command Mode. Refer to the *IBM 4690 Store System: User's Guide* for an explanation of these commands.

Note: The term disk is used throughout the remainder of this section to indicate both a fixed disk and a diskette.

Creating Files

You can create files using either the text editor or IBM 4680 BASIC statements. For information on creating files with the text editor, refer to the *IBM 4690 Store System: User's Guide*.

Warning: Creating a file using a 4680 BASIC statement establishes a new file on a disk. If you create a file with a name that already exists, the system erases the existing file before the new file is created.

Use the CREATE statement to create sequential, random, and direct files. You can execute this statement in both terminal and store controller applications. If the disk does not have the space required for the file, the CREATE statement fails.

Use the CREATE POSFILE KEYED statement to create keyed files. You can execute this statement only in the store controller. Once you create a keyed file, you cannot increase its size. To increase the keyed file, you must rebuild it. See "Keyed Files" on page 2-28 for an explanation of rebuilding files.

On a LAN (MCF Network) system, use the CREATE POSFILE statement to create files. You must specify a distribution mode and a file type for files created with this statement. For information on distribution modes and file types, refer to the *IBM 4690 Store System: User's Guide*.

Space Allocation: When you create a file, the operating system keeps track of the available disk space in the File Allocation Table (FAT). As your application creates, deletes, or expands files, the system updates the available space in the table. When you create a random or direct file, the system allocates only one cluster on the disk. This space is not initialized. If the space must be initialized to use the file, your application should write all of the initial records. You can increase the size of a random or direct file by writing records past the end of the created file.

When you create a keyed file, the system allocates disk space for the requested number of records; it also initializes the space to binary zeros.

When you create a sequential file, the system allocates only one cluster on the disk. The space allocated is not initialized. The size of a sequential file is increased as your application writes data to the file.

File Access Rights: When you create a file, the operating system assigns the user ID, group ID, and access rights of the executing application to the file. The operating system places this information in the directory entry of the file. See "Protecting Files" on page 2-23 for information on user ID, group ID, and access rights. You cannot change this information with a 4680 BASIC application after the file is created. To change the access rights, use the FSET command in Command Mode.

You set up the user ID and group ID for applications executed in Command Mode in the system authorization file. Applications started as primary or secondary from the SYSTEM MAIN MENU are always assigned user ID=1 and group ID=2. See "System Authorization" on page 15-8 for more information.

The system starts an IBM 4680 BASIC application with access rights that allow READ, WRITE, and DELETE access for owners and requesters for group or world rights. Use the ACCESS statement to modify the access rights.

Creating a file also performs the same function as opening a file. See "Accessing Files" on page 2-20 for a description of these functions.

Deleting Files

IBM 4680 BASIC provides a DELETE statement for deleting a file from the disk. To delete a file, the application must have the file open and have DELETE access rights for the file. To ensure that the file is deleted, the file must not be opened by another application. You can ensure that your application is the only user by opening the file as LOCKED. See “Sharing Files” on page 2-21 for information on the LOCKED option.

Accessing Files

Your application gains access to a file on a disk by using the OPEN statement. Both the terminal and the store controller can use this statement.

The values on the OPEN statement determine how the application opens the file. You normally open a file according to the way it was created. For example, you open a direct file by specifying direct with the OPEN statement. You can, however, open files differently. To sequentially read all the records in a keyed file, you can open the file in direct mode by specifying direct with the OPEN statement and specifying a record length of 512. When an OPEN statement specifies keyed, the IBM 4680 BASIC runtime library checks that you created the file as a keyed file.

The OPEN statement requests access for the file functions that the application will perform. This statement can request access to perform read, write, or delete functions. These access rights define the allowed operations for owners, group users, and world users. The IBM 4690 Operating System checks the file’s access rights against the requested functions when the application uses the OPEN statement. If the kind of functions requested are not allowed for your application, the OPEN statement fails. You should specify only the needed functions to avoid OPEN statement failures. For terminal applications, OPEN statements that request only the read function are more efficient than OPEN statements requesting the write function. See “Protecting Files” on page 2-23 for more information on file access rights.

The OPEN statement also specifies the type of file sharing that the executing application is requesting. The type specified remains in effect for as long as the file is open. See “Sharing Files” on page 2-21 for information on file sharing types. If the OPEN statement requests a file sharing value that conflicts with current file opens, the OPEN statement fails.

If your application is opening a sequential file to write, use the APPEND reserved word. APPEND causes data written to the file to be added at the end of the file. The WRITE statement can only add data to a sequential file. If you want to remove the data in a sequential file, you must delete the entire file or create the file again.

For keyed, random, and direct files, do not specify the BUFF and BUFFSIZE reserved words. For these file types, the 4680 BASIC runtime buffer size is equal to the value of the RECL reserved word. The IBM 4690 Operating System provides file record level data integrity for file writes of 512 or fewer bytes only.

For sequential files, the RECL reserved word is not valid, and the BUFF and BUFFSIZE reserved words determine the 4680 BASIC runtime buffer size. If you specify BUFFSIZE, the system ignores BUFF, and the buffer size is equal to the value specified with BUFFSIZE. If you do not specify BUFFSIZE, the buffer size is equal to the value specified for BUFF multiplied by 128 bytes.

You should select the sequential file buffer size according to your intended use of the file. When you are reading a sequential file, the 4680 BASIC runtime library requests file reads in increments of the buffer size. When you are writing to a sequential file with a WRITE# statement, the 4680 BASIC runtime library uses the buffer to request a file write. If you open the sequential file as LOCKED, the IBM 4680 BASIC runtime library places as much data as fits into the buffer, independent of record size, before requesting a

file write. If you open the sequential file as other than LOCKED, then IBM 4680 BASIC runtime library requests a file write for each application WRITE statement.

The IBM 4690 Operating System provides file record level integrity only for file writes of 512 or fewer bytes. To prevent record fragmenting when using a LOCKED sequential file, force a file write in increments of complete records by using the TCLOSE statement.

The 4680 BASIC runtime buffer used for file I/O is allocated from your application heap. Each file has its own buffer allocated.

Terminal applications can use a PRIORITY reserved word on the OPEN and CREATE statements. The PRIORITY reserved word causes the READ or WRITE requests for this file to have a higher priority for disk service at the store controller than a file not opened with the PRIORITY reserved word. Use this function only for files that are accessed in the critical response time paths in your terminal application.

Ending Access to Files

Use the CLOSE statement in the store controller and the terminal when your application has no further use for a file.

Because the store controller and terminal can lose communications with each other, the IBM 4690 Operating System provides a periodic check of the terminals. A terminal can stop communicating with the store controller when a TCC Network is broken or disconnected, when the terminal is powered-OFF, or when you have defective terminal hardware or software. Periodically, the operating system in the store controller exchanges a message with the operating system in the terminal to determine that each terminal with open files is still communicating. If a terminal does not respond, the IBM 4690 Operating System in the store controller executes a close function for the files that are opened by that terminal. The close function also releases any outstanding record locks for that terminal. If the terminal returns to operation without having to IPL, the operating system in the terminal reopens the files for that terminal.

Sharing Files

The IBM 4690 Operating System and IBM 4680 BASIC provide facilities for specifying and managing the way several applications share a disk file. Your application can request READ and WRITE access to a file. In addition, when your application accesses a file it can request that the system restrict the READ and WRITE access for other applications.

File security attributes control whether an application can access a specified file. This access is based on the access rights of the specified file and the type of access requested by the application. See “Protecting Files” on page 2-23 for information on file security. File sharing controls how many applications access one file.

A terminal application cannot access a keyed file in direct mode if another terminal is currently accessing the file as a keyed file. The terminal application trying to access the file in direct mode receives errors from the store controller file system as a result. The terminal application accessing the file in keyed mode must close the file before access to the file in direct mode functions correctly.

On the OPEN and CREATE statements, you can specify how you want your application to share a file. You can use three different values on these statements to specify the three types of sharing. The sharing type is in effect as long as your application has the file open.

The following list describes the sharing values and their meaning:

Option	Description
LOCKED	Requests access to this file as the only application to use this file. The request is not allowed if another application has this file open. If the request is allowed, no other application can open this file for any kind of access.
READONLY	Requests access to this file that allows all other applications to have only READ access to this file. The request is not allowed: • If another application has this file open as LOCKED • If another application has this file open as READONLY or UNLOCKED and has WRITE access If this request is allowed, another application cannot open this file as: • LOCKED • READONLY and request WRITE access • UNLOCKED and request WRITE access
UNLOCKED	Requests access to this file, which allows all other applications to have both READ and WRITE access to this file. This is the least restrictive access type and you should use this type whenever possible. The request is not allowed: • If another application has this file open as LOCKED • If another application has this file open as READONLY and this request specifies WRITE access If this request is allowed, another application cannot open this file as: • LOCKED • READONLY if this request specified WRITE access

When your application opens a file as LOCKED or READONLY, it does not need to provide for sharing write access with other applications.

When your application opens a file as UNLOCKED, it should lock records that it intends to modify. This serializes all the changes to a record of a random, direct, or keyed file. You can use sequential files UNLOCKED without the application use of record locking because the system appends each record write to the end of the file.

In a store controller application, you can lock and unlock records for random and direct files by using the LOCK and UNLOCK functions or the AUTOLOCK and AUTOUNLOCK reserved words on the READ and WRITE statements. The preferred way is the AUTOLOCK and AUTOUNLOCK. In a terminal application you can use only the AUTOLOCK and AUTOUNLOCK.

If your application opens the same file many times, you should include only one LOCK or READ AUTOLOCK at a time for the file.

For keyed files, you can use only the AUTOLOCK and AUTOUNLOCK in both the store controller and the terminal applications.

If you have many applications that lock a record in more than one file, use the same sequence of locking in each application. This prevents applications from deadlocking by having some records locked that another application is trying to lock.

An application is not allowed to lock more than five records for each keyed file at the same time.

The system might reject a request to lock a record because another application has already locked the record. When this occurs, the application should wait and try the record lock again; if the application has an operator interface, it should notify the operator that the record is temporarily not available.

Locking a record in a keyed file actually locks all of the records in the file sector containing that record. Therefore, you should avoid application designs that would require high-performance use of keyed file record locks by two or more applications.

Copying Files

You can use the COPY command in Command Mode to copy a file. The COPY command creates a new file with the name you specify. Because the COPY command is creating a new file, the new file has the user ID and group ID assigned to the COPY command when it began. The access rights for the new file are the same as the access rights of the original file. The user requesting the COPY command must have READ access rights to the original file. If a file with the new name already exists, the user needs DELETE access to that file so that COPY can delete that file.

Renaming Files

You can rename a file with the IBM 4680 BASIC RENAME function or you can use the RENAME command in Command Mode. Both methods change the name of the file and leave the user ID, group ID, and access rights unchanged. The requester of the RENAME must have either WRITE or DELETE access rights.

Protecting Files

The IBM 4690 Operating System and IBM 4680 BASIC provide facilities to limit file access to only authorized users. The facilities provide for controlling READ, WRITE, DELETE, and EXECUTE access to a file for three categories of users. The categories of user are owner, group, and world. The system bases file security functions on how the user ID and group ID of the requesting application match the user ID and group ID of the requested file.

The system assigns an application a user ID and group ID when the application starts. The system assigns the IDs for an operator interactive application in the store controller according to the system authorization file. This includes Command Mode commands. For your background application, the user ID is one and the group ID is two. For operating system background applications, the user ID and group ID are either one, one and zero, or zero. The terminal 4680 BASIC application IDs are always treated as a user ID of one and a group ID of two.

You assign a file a user ID, group ID, and access rights when you create the file. This section explains the access rights. The section “File Access Rights” on page 2-19 contains information on how you assign access rights to the file.

The system performs file security checking when a file is opened. The first part of security checking compares the user ID and group ID of the requesting application and the user ID and group ID of the requested file. Based on this comparison, the requesting application falls into one of three categories: owner, group, or world.

- For the requesting application to become an owner, the user ID of that application must be equal to the user ID of the file, and the group ID of the requesting application must be equal to the group ID of the file.

```
Group = Group --
              ---- OWNER access
User  = User  --
```

- For the requesting application to become a group requester, the group ID of the requesting application must be equal to the group ID of the file without the user ID of the requesting application being equal to the user ID of the file.

```
Group = Group --
              ----- GROUP access
User ≠ User --
```

- For the requesting application to become a world requester, the group ID of the requesting application must not be equal to the group ID of the file.

```
Group ≠ Group --
               ----- WORLD access
User  =  User  --
```

When a requesting application has a user ID of zero and a group ID of zero, the system bypasses the file security checking.

The second part of security checking compares the type of access requested by the application with the type of access allowed for this file. A 4680 BASIC application can request READ, WRITE, and DELETE access on the OPEN statement. A 4680 BASIC application requests EXECUTE access to a file by attempting to chain to that file. The access rights for each file define whether this file can be accessed to read, write, delete, or execute for each category of user. Owner, group, and world user access rights are independent and do not have to provide diminishing levels of access. For example, the access rights of the operating system data files allow an owner to read, write, delete, and execute; a group user to read and execute; and a world user to read and execute. For a 4680 BASIC application to be allowed access to a file, all of the access types requested on the OPEN statement must be allowed for the application's requester category. If any of the access types for the file are not allowed, the OPEN request fails.

To rename a file, a requesting application must have either WRITE or DELETE access rights.

Protecting Subdirectories

Subdirectories can contain multiple files and can be protected in similar ways to individual files. You assign a user ID, group ID, and access rights to each subdirectory when you create it. You assign the subdirectory the user ID and the group ID of the creating application. The creating application can be the MKDIR command or a 4680 BASIC application.

The MKDIR command sets the access rights as READ, WRITE, DELETE, and EXECUTE for the owner, nothing for the group user, and nothing for the world user. You can change the access rights with the FSET command.

When a 4680 BASIC application uses the MKDIR command to create a subdirectory, the access rights are set according to the ACCESS statement. The EXECUTE access is always set for the owner and is set for the group user and the world user if any other access right is set for that user.

The access rights for a subdirectory have a different meaning than they do for a file:

Access Right	Description
READ	Allows the use of SIZE and DIR commands for files in the subdirectory
WRITE	Allows the use of CREATE, DELETE, and RENAME commands for files in the subdirectory
EXECUTE	Allows a program to open files in the subdirectory
DELETE	Allows the use of the FSET command in Command Mode for files in the subdirectory

The access rights and restrictions described for subdirectories do not apply to the root directory.

Enabling and Disabling File and Subdirectory Security

Each disk can have a disk label. The disk label contains the volume name for the disk, the user ID, the group ID of the label's creator, access rights for the label, and mode flags. The mode flags control the enabling and disabling of security for files and subdirectories for the entire disk. When you enable security, you control application access to files and subdirectories. When you disable security, all applications have full READ, WRITE, EXECUTE, and DELETE access to all files and subdirectories on the disk.

You use the DISKSET command to create a disk label. Refer to the *IBM 4690 Store System: User's Guide* for information on how to use DISKSET. You can also use DISKSET to enable and disable file security for a disk if you have WRITE or DELETE access rights to the disk label.

The installation process for the IBM 4690 Operating System creates the disk label for the fixed disks with a user ID of zero, a group ID of zero, and security enabled. File security on the fixed disks provides protection of the system files from applications and protection of the application files from other applications.

Reading a File Record

You read the data from a disk file record into BASIC variables with the READ#, READ# LINE, READ FORM#, and READ MATRIX statements. The READ# statement specifies the file to read by the I/O session number, the variables to assign the data to, the format for mapping the data record into the variables, and whether to lock the record from use by other applications. Refer to the *IBM 4680 BASIC: Language Reference* for a description of the format string items used with the READ FORM# statement.

You read sequential file records with the READ#, READ# LINE, and READ MATRIX statements. The READ# LINE statement assigns all of the data in the current record to a single variable, and the READ# statement assigns the individual fields of the record to the individual variables specified on the READ# statement. You can also use the READ FORM# statement for sequential files, but it is less practical because the records in sequential files usually vary in length.

The READ MATRIX statement, which is used only for sequential files, allows one-dimensional string arrays to be read from disk efficiently. READ MATRIX reads a sequential file record and parses the record into an array.

You can read random file records with the same statements as sequential files. The READ FORM# statement is less practical for random file records because the fields of a random file can vary in length.

Keyed and direct file records can be read only with the READ FORM# statement. The format string items are necessary because there are no field or record delimiters within the data record.

The reads of a sequential file normally proceed from the first record of the file to the last record of the file. By using the PTRRTN function, you can save the relative position of a record within a sequential file so that you can use it to reread from that position in the file. You use the POINT statement to re-establish the saved relative position. You cannot issue a WRITE# statement after a POINT.

The reads of a keyed, direct, and random file are for records at any position in the file. For direct and random files, the record number determines the relative position in the file when it is multiplied by the record length. For keyed files, the key is transformed into a relative sector within the keyed file and that sector and any sectors chained to that sector are scanned for the record. See “Keyed Files” on page 2-28 for more information about sectors.

Writing a File Record

You write the data to a disk file record from IBM 4680 BASIC variables with the WRITE#, WRITE FORM# (described as part of WRITE#), and WRITE MATRIX statements. You can also use the PRINT USING# statement in the store controller to write data to a disk record. The WRITE statements are the recommended statements. The WRITE statement specifies the file to write by the I/O session number, the variables to get the data from, the format to map the data from the variables into the record data, and whether to unlock the record for use by other applications. Refer to the *IBM 4680 BASIC: Language Reference* for a description of the format string items used with the WRITE FORM#.

The IBM 4690 Operating System provides record integrity support to ensure that a record is written to the file correctly. The record integrity support is dependent on a record being no more than 512 bytes. The only exception to this is the WRITE MATRIX statement, which can write records larger than 512 bytes. Both terminal and store controller applications can use the WRITE MATRIX statement.

A store controller application writes sequential file records with the WRITE# statement. The WRITE# statement assigns the individual variables of the statement to the fields in the record. String expressions are placed into the record with a starting quotation mark and ending quotation mark followed by a comma. Numeric expressions are placed into the record after being converted to their ASCII representation and are followed by a comma. The last expression in the record is followed by a CR/LF instead of a comma. The WRITE FORM# statement can also be used in a store controller application to write a sequential record, but it is not very convenient because the application must provide all of the sequential file record delimiters.

When using a WRITE# statement to write a shared sequential file, the BUFFSIZE value in the 4680 BASIC OPEN statement should be as large as the largest record that you are going to write to that file. This value should take into consideration the quotes enclosing the fields and the two bytes for the CR/LF. Failure to do this could cause the record being written to be split if another application writes to that file at the same time.

A terminal application writes sequential file records with the WRITE MATRIX statement. The WRITE MATRIX statement assigns the string array elements to the fields in the record in the same way that a WRITE# statement assigns strings to a field.

The records written to a sequential file by a WRITE MATRIX statement might not be in the same chronological sequence in which they were requested. Any application reading a sequential file should provide for this sequence.

You can write random file records with the WRITE# statement. The variables are mapped to the fields within a data record the same as sequential files, except that a comma is placed after the last field and the records are padded to fill the record size. You can use the WRITE FORM# statement to write a random record, but it is not very convenient because the application must provide all of the random file record delimiters.

You can write keyed and direct file records only with the WRITE FORM# statement. The format string items are necessary because there are no field or record delimiters recorded with the data.

The writes to a sequential file proceed from the first record of the file to the last record of the file. By using the PTRRTN function, you can save the relative position of a record within a sequential file to use at a later time to read from that position in the file. You cannot use PTRRTN to write for files that are opened, UNLOCKED. Use the POINT statement to re-establish the saved relative position. You can also use a POINT statement to truncate a sequential file to zero size if the file is opened LOCKED or READONLY. See the description of the POINT statement.

The writes of a keyed, direct, and random file are for records at any position in the file. For direct and random files, the record number determines the relative position in the file when it is multiplied by the record length. For keyed files, the key is transformed into a relative sector within the keyed file and that sector and any sectors chained to that sector are scanned for the record. If the record cannot be found in those sectors, it is added to the file. See “Keyed Files” on page 2-28 for more information about sectors.

Ensuring Data Integrity across Power Line Disturbances

The IBM 4690 Operating System saves the data in NVRAM. If a power line disturbance (PLD) occurs during a disk write and prevents the completion of the disk write, the system uses the saved data to complete the disk write when the power is restored.

PLD Protection for Writing One Record: All file type writes of 512 bytes or less and the WRITE MATRIX are protected by this feature. There are no reserved words on the 4680 BASIC statements to invoke or disable PLD support. The PLD recovery routine writes the entire record independent of whether the record spans disk sectors.

Any disk write that is queued in the store controller and has not been started prior to the PLD is lost when a PLD occurs. Because the terminal memory is battery-powered, a terminal program can make the WRITE request again after the power is restored.

PLD Protection for Writing Two Records: You can use the HOLD reserved word on a WRITE statement in the store controller to PLD protect a pair of record writes issued by the same application. The HOLD function ensures that either both of the records are written or that both of the records are not written with respect to the occurrence of a PLD. You can use the HOLD function only for records of 512 bytes or less for random, direct, and keyed files.

You should use this function when an application needs to ensure that modifications are made to two files. For example, getting a current total from one file and updating a running total in another file requires that the current total be written to zero and that the running total be written to the sum of the two totals. You can also use the HOLD function to control the modification of more than two files by using a status file for one of the files.

When an application requests a write with a HOLD, the IBM 4690 Operating System actually queues the request in the store controller memory and informs the requesting application that the write is complete. When the same application requests a second write with a HOLD, the system saves both of the write requests and then performs both writes. If a PLD prevents the writes from completing, it completes the writes when the power is restored.

Because the writes with HOLD are queued in the store controller memory, you can use the HOLD function in concurrently executing applications that are sharing files. Before updating a record, your application must do a read with autolock for the record. The write with HOLD must AUTOUNLOCK the record. When the first write with HOLD is issued, it is queued and that means that the AUTOUNLOCK is not executed until the write is executed. Your application should follow the locking guidelines in “Sharing Files” on

page 2-21 to prevent deadlocks. It should also minimize the time that records are being locked when using the HOLD function.

WRITE HOLD provides PLD protection only if both files being written reside on the same store controller.

The WRITE HOLD function ensures that either both or neither of the disk requests occurs if a PLD occurs. However, if other types of failures prevent the disk requests from occurring, the second WRITE HOLD indicates the failure. Because the return code cannot distinguish, the failure indicated on the second WRITE HOLD might be for the first or second disk operation. You should look at the error results as appropriate for either disk request.

Design Considerations for File Performance

When your applications use files, the functions they perform are synchronous operations. Your applications should begin any necessary I/O functions, which are asynchronous, before they begin file functions. For example, in the terminal, printing should be started first.

In your terminal applications, any file function that issues a WRITE statement forces the data to be written to the media.

In store controller applications, all file functions force the data to be written to the media. The one exception is a sequential file opened in LOCKED mode.

In your store controller applications, use as few file functions as possible that cause store controller files to be locked. This is recommended because as the number of terminals for each store controller increases, the number of locks on files increases. Each terminal program might have to wait for the LOCK request to be granted.

In general, your applications should minimize the number of file requests they make. For example, if you need two data fields from the same record, read the file once and save the second field until you need it.

Keyed Files

Two alternate hashing algorithms are provided to improve performance in large files having more than 40K records and a randomizing divisor greater than 6000, and where ASCII keys are required. See “Hashing Algorithms” on page 6-10 for more information about these algorithms.

You can improve the performance of keyed files in your system by following some basic guidelines:

- Ensure that all of your keyed files contain an adequate amount of free space.

  In keyed files of more than 1000 records, at least 25% of the space should be free. If the record length is greater than 169, then only one or two records will fit into one sector or 508 bytes. Allow up to 50% of free space for these files to reduce chaining of these files. When you create a keyed file, the Keyed File Utility allows you to check the amount of free space by giving you the packing factor. The packing factor gives you the percentage of records occupied.

- Eliminate long chains in a keyed file.

  The system checks chain lengths against the chaining threshold. When chains greater than the threshold are reached, the system logs a message in the system error log. Use the Keyed File Utility to determine and to reduce the chain lengths. Reduce chain lengths by allocating more space, changing the hashing algorithm, or changing the randomizing divisor. See “Hashing Algorithms” on page 6-10 for more information.

- When the system is writing or reading a record from a keyed file, it processes the record to find out to which block in the file the record belongs. The system should need to access the file only once to find the correct record. If many overflow chains are present, the system might need more than one read from the file. By ensuring that the records are evenly distributed throughout a keyed file, you can reduce the number of disk accesses needed to get to a particular record.
- Keyed file performance improves when the file is placed on the disk in 10 or fewer contiguous extensions. Use the CHKDSK command to determine the number of contiguous extensions of a file. Refer to the *IBM 4690 Store System: User's Guide* for information on the CHKDSK command.

Chapter 3. Programming Terminal I/O Devices

This chapter shows how to program terminal I/O devices. It provides general information as well as specific information about each device. Each device has a section containing information on:

- Device characteristics
- How to access the device
- How to end access to the device
- Specific programming information about the device
- A code example for the device to perform a basic task, such as printing lines

4690 controls each device through a device driver. Various input and output statements are used to communicate with each device driver. This chapter uses IBM 4680 BASIC to explain the methods for communicating with each device driver. For syntax and further information on these statements, refer to the *IBM 4680 BASIC Language Reference*.

Terminal I/O devices can also be programmed using the C language. For syntax and more information refer to the CAPITPGP.DOC file included with AISPO product number, 5764-081, Version 1.1 or later, the IBM C Programming Interface for 4690 Terminals.

2x20 Displays

This section describes all the displays that fall into the 2x20 (2 rows x 20 columns) category and provides guidelines for using these displays.

The following are 2x20 displays:

- Alphanumeric
- Operator
- 40-character Liquid Crystal Display (LCD)
- 40-character Vacuum Fluorescent Display II (VFD II)
- Two-sided VFD II

Two different 4690 drivers provide 2x20 display support for a terminal. The alphanumeric display is handled by the alphanumeric display driver and all of the other 2x20 displays are handled by the operator display driver.

Characteristics

- Up to three of these displays can be attached to a terminal.

  To support three 2x20 displays, you must configure one as ANDISPLAY, the second as ANDISPLAY2, and the third as ANDISPLAY3 in the Terminal Device Group for your terminal.

  There are some restrictions when configuring these displays. Refer to the *4690 Store System: Planning, Installation, and Configuration Guide* for the valid combinations of 2x20 displays that can be configured.

- 2x20 display format (2 rows by 20 columns)
- Display character sets representing different code pages

  There are some differences in the character sets for each of the 2x20 displays.

  Refer to the *IBM 4680 BASIC Language Reference* . for a description of the available display character sets.

  The alphanumeric display is unique because you can customize its display character set. See “Customizing the Alphanumeric Display Character Set” on page 3-7 for more information.

  The other displays have a fixed set of characters contained within the electronics of the display. The characters that can be displayed are determined by the country selected during installation.

Functions Your Application Performs

Your application can perform the following functions with the 2x20 displays:

- Select which display to use.
- Write characters to any character location.
- Read characters from any character location.
- Clear the display.
- Determine whether the driver handling your 2x20 display is the alphanumeric or operator display driver.

If the 2x20 display is configured as the system display in the terminal device group for your terminal:

- Your application shares the display with the I/O Processor.

  The I/O processor uses the display to display keyboard data that is specified as display-as-keyed and to display operator prompts. Your input sequence table specifies the starting character location and

length of these display fields. Your application should be designed to coordinate its display data with your input sequence table.

- Other system functions use the 2x20 display but with a separate display buffer

If the 2x20 display is not configured as the system display, then the only system use of the 2x20 display is to display progress indicators during IPL.

Accessing the Display

Use the OPEN statement to gain access to the display.

Use the CLOSE statement to end your application's use of the display. The CLOSE statement does not clear the display.

Clearing the Display

Use the CLEARS statement to clear the display. The CLEARS statement writes a space character to each character location and sets the current character location to (1,1).

Writing Characters to the Display

Use the WRITE statement to display characters on the display.

Before writing data to the display, you can set the current character location.

After the WRITE statement completes, the current character location is set to the next character location after the last character location that was written to.

Current Character Location: A character location is defined as a row and column coordinate (row,column).

The current character location is the (row,column) of the next character to be written or read.

You use the LOCATE statement to change the current character location.

Valid row values are 1 and 2 (top to bottom). Valid column values are from 1 to 20 (Left to right).

Character Wrapping: If the number of characters you write is greater than the number of character locations remaining on the current row, the characters are written on the next row. If the current row is the last row of the display, then the characters are written to row 1. The characters will continue to wrap until all of the characters are written.

2x20 Display Character Sets: The display character set determines what is displayed on the display for each character written by your application. There are some differences in the character sets for each of the 2x20 displays.

Refer to the *IBM 4680 BASIC Language Reference* for a description of the available display character sets.

Customizing the Alphanumeric Display Character Set: You can customize your alphanumeric display character set using the Alphanumeric Display Character Set option in the configuration for your terminal.

Each character location in the character set contains a 5 x 12 dot matrix, which is used to form the

character. You can redefine any character location except 'blank'. Most of the default characters are defined using 5 x 9 dots of the 5 x 12 matrix. You can define no more than 36 dots on the matrix for any given character. The display has a blank space between character locations and between the two rows. You should consider these blank spaces if you use multiple character locations to produce a graphic display.

Refer to the *4690 Store System: Planning, Installation and Configuration Guide* for more information on customizing the alphanumeric display character set.

Determining Display information

You use the GETLONG function to determine the following information about the 2x20 display:

- Current character location (row and column)
- Whether the driver handling your 2x20 display is the alphanumeric or the operator display

Reading from the Display

Use the READ statement to read the characters that have been written to your application's display buffer.

Before reading from the display, you can set the current character location. This is the row and column where you want to start reading from the display. See "Current Character Location" on page 3-7 for more information. The length of the data variable specified on the READ FORM # statement determines the number of character locations read from the display. If the length requested exceeds the remaining character locations on a row, wrapping is done as described in "Character Wrapping" on page 3-7.

After the READ FORM # is complete, the current character location is set to the next character location after the last character that was read.

Programming Hints for 2x20 Displays

An application written for a 2x20 display will run on any other display in the 2x20 family with the following considerations:

- Differences in display character sets

  Refer to the *IBM 4680 BASIC Language Reference* for a description of each of the character sets.

Example

This example contains code for operating a 2x20 display. The program writes text to each line of the display and clears the display.

```
%ENVIRON T

! Declare a two-byte integer.
INTEGER*2 DISPLAY

! 20-character message for line 1.
LINE.ONE$ = "ROW ONE SAMPLE      "

! Message for line two.
LINE.TWO$ = "ROW TWO SAMPLE      "
ON ERROR GOTO ERR.HNDLR

! Open the display.
DISPLAY = 1
OPEN "ANDISPLAY:" AS DISPLAY

! Clear the display.
CLEARS DISPLAY

! Write a greeting.
WRITE #DISPLAY; " 2x20 DISPLAY SAMPLE"

! Pause.
WAIT;2000

! Clear the greeting.
CLEARS DISPLAY

! Display the string.
WRITE FORM "C20";#DISPLAY; LINE.ONE$

! Pause.
WAIT;2000

! Set character location (2,1) and display the second line
LOCATE #DISPLAY ;2,1
WRITE #DISPLAY; LINE.TWO$

! Pause.
WAIT;2000

! Clear the display then write sample ending message
CLEARS DISPLAY
WRITE #DISPLAY; "END OF 2x20 SAMPLE"
CLOSE DISPLAY
STOP

ERR.HNDLR:
! Prevent recursion.
ON ERROR GOTO END.PROG
! Determine error type
! and perform appropriate
! recovery and resume steps.
```

```
END.PROG:
STOP
END
```

Shopper Display

This section describes characteristics of the shopper display and provides guidelines for using this display.

Characteristics

The shopper display has the following characteristics:

- You can attach one of these displays (SDISPLAY:) to a terminal
- 1x8 display format with six guidance lights
- Fixed display character set

Functions Your Application Performs

Your application can perform the following functions with the shopper display:

- Write characters to the display and display guidance lights.
- Clear the display.
- Read data from the display.
- Get guidance light information from the display

Because the shopper display cannot be configured as the system display in the terminal device group for your terminal, your application has exclusive use of the shopper display. The only system use of the shopper display is to display IPL progress indicators during IPL.

Accessing the Shopper Display

Use the OPEN statement to gain access to the shopper display device driver.

Use the CLOSE statement to end your application's use of the shopper display driver. The CLOSE statement does not clear the characters from the shopper display.

Clearing the Shopper Display

Use the CLEARS statement to clear the display. The CLEARS statement writes a space character to each of the character locations.

Writing Characters to the Shopper Display

The WRITE statement allows you to write to all or part of the shopper display and guidance lights. The specified number of characters are written right-adjusted to the display, padded on the left with blanks. Guidance lights data, established by the most recently issued PUTLONG statement, is simultaneously displayed.

Shopper Display Character Set: The display character set determines what is displayed on the display for each character written by your application. The shopper display character set includes the numerals and a limited number of alphabetic and special characters.

Each character location contains seven bar-segments used to form the character. Some locations also contain a comma or decimal point segments. The bar-segment pattern for each character is defined within the shopper display electronics. You cannot modify this character set.

Refer to the *IBM 4680 BASIC Language Reference* for the definition of the shopper display character set.

Setting the Guidance Lights on the Display

Use the PUTLONG statement to set up the guidance lights on the shopper display. The guidance lights are arranged in two columns of three lights each. The six low-order bits of the byte control the guidance lights. Bit 5 controls the upper-left light, bit 4 controls the middle-left light, bit 3 controls the lower-left light, bit 2 controls the upper-right light, and so on.

Reading from the Display

Use the READ statement to read the characters that are specified in your application display buffer.

Determining Shopper Display Status

Use the GETLONG statement to get the current status of the guidance lights from the shopper display.

Example

This example contains code operating the shopper display.

```
%ENVIRON T
INTEGER*4 LIGHTS
DISPLAY1=1
DISPLAY2=2
ON ERROR GOTO ENDPROG
! Open video display.
OPEN "VDISPLAY:" AS DISPLAY2
CLEARS DISPLAY2
WRITE FORM "C20"; #DISPLAY2; "video is open"
WAIT;500
! Open shopper display.
OPEN "SDISPLAY:" AS DISPLAY1
WRITE FORM "C20"; #DISPLAY2; "shopper is open"
WAIT;500
! Clear shopper display.
CLEARS DISPLAY1
WAIT;500
! Set pointer data.
LIGHTS = 00000001h
PUTLONG DISPLAY1,LIGHTS
! Write data.
WRITE FORM "C6"; #DISPLAY1;"111.11"
WAIT;500
! Set pointer data.
LIGHTS = 00000002h
PUTLONG DISPLAY1,LIGHTS
```

```
! write data
WRITE FORM "C10"; #DISPLAY1;"22,222,222"
WAIT;500
! set pointer data
LIGHTS = 00000004h
PUTLONG DISPLAY1,LIGHTS
! Write data.
WRITE FORM  C6"; #DISPLAY1;"333.33"
WAIT;500
! Set pointer data.
LIGHTS = 00000008h
PUTLONG DISPLAY1,LIGHTS
! Write data.
WRITE FORM "C6"; #DISPLAY1;"444.44"
WAIT;500
! Set pointer data.
LIGHTS = 00000010h
PUTLONG DISPLAY1,LIGHTS
! Write data.
WRITE FORM "C8"; #DISPLAY1;"5,555,55"
WAIT;500
! Set pointer data.
LIGHTS = 00000020h
PUTLONG DISPLAY1,LIGHTS
! Write data.
WRITE FORM "C12"; #DISPLAY1;"66.666.66"
! Clear displays.
CLEARS DISPLAY1
CLEARS DISPLAY2
WRITE FORM "C30"; #DISPLAY2;" SHOPPER CLEARED - END TEST "
STOP
ENDPROG:
! Display error messages and perform appropriate recovery
! and resume steps.
STOP
END
```

Video Display

This section describes the video display and provides guidelines for using this display.

Two different 4690 drivers provide video display support for the terminals.

When the video display is connected using a Feature A expansion card (4683 terminal only), the Feature A video driver is used. When the video display is connected to the video port or to a VGA (Video Graphics Array) adapter, the VGA video driver is used.

Although the application programming interface (API) to these drivers is the same, there are some restrictions when using the Feature A attribute with the VGA video driver. There are extensions to the API for the VGA video driver that overcome these restrictions as well as providing additional function. See “VGA Video Driver” on page 3-14 for more information.

Note: These extensions are available with 4690 OS maintenance level 9620 or higher.

Use ADXSERVE to determine whether your video display is a Feature A or VGA. See “ADXSERVE (Requesting an Application Service)” on page 15-17 for more information. See the “Example” on page 3-20 for an example of how to use this application service.

Characteristics

The video display has the following characteristics for each of the video display drivers:

Feature A video driver

- You can attach up to two video displays

  To support two displays you must configure one of the video displays as VDISPLAY and the other as VDISPLAY2 in the Terminal Device Group for your terminal.

- Programmable video display format

  The video display can have one of four video display formats.

  You configure the default video display format in the Terminal Device Group for your terminal.

  The following table shows the 4 video display formats that are available:

Table 3-1. Feature A Video Display Format Types

Video Display Format	Number of Rows	Number of Columns	Restrictions
25 x 80	25	80	12 and 9 inch displays only
16 x 60	16	60	12 and 9 inch displays only
12 x 40	12	40	None
6 x 20	6	20	5 inch display only

- Video character sets representing different code pages

  Refer to the *IBM 4680 BASIC Language Reference* for a description of the available Feature A video display character sets.

- A cursor in the form of a blinking line can appear at the bottom of any character location on the video display.

- You can select any of eight attribute specifications for every character location on the display:
  - Reverse Video
  - Blink
  - Blank
  - Intensify
  - Underline
  - Red
  - Blue
  - Green

  Note: If reverse video is selected the foreground color (the character) is black and the color and intensify bits apply to the background color. If reverse video is not selected then the background color is black, and the color and intensify bits apply to the foreground color.

  Refer to the *IBM 4680 BASIC Language Reference* . for a list of the colors available using the combinations of color bits and the intensify bit.

VGA Video Driver

- You can attach only one video display

  You configure this video display as either VDISPLAY or VDISPLAY2 in the Terminal Device Group for your terminal.

  Note: In a controller/terminal the video display is VDISPLAY.

- Programmable video display format

  The video can have one of four video display formats.

  You configure the default video display format in the Terminal Device Group for your terminal.

  The following table shows the 4 video display formats that are available:

Table 3-2. Video Display Format Types

Video Display Format	Number of Rows	Number of Columns	Restrictions
25 x 80	25	80	None
16 x 60	16	60	This is a 16 row x 60 column character window centered on a 16 row x 80 column character screen. Character positions 1-10 and 61-80 are blank and are not accessible by your application. Accessing character location (1,1) is actually character position (11,1). VGA supports only 40 or 80 columns while in character mode.
16 x 80	16	80	This video display format is available only through the API. It cannot be configured as the default video display format in the Terminal Device Group for your terminal.
12 x 40	12	40	None

- Video character sets representing different code pages

  There are differences between the VGA and Feature A video character sets.

  Refer to the *IBM 4680 BASIC Language Reference* for a description of the available video display character sets.

- A cursor in the form of a blinking line can appear at the bottom of any character location on the video display.

Note: See restrictions for the 16x60 video display format in Table 3-2.

- You can use the Feature A attribute or with VGA video extensions you can use the VGA attribute

Feature A Attribute: The Feature A attribute is the same as described in "Feature A video driver" on page 3-13 with the following restrictions:

- No underline support

  The underline bit is ignored.

- No background intensified colors supported

  The intensify bit is ignored when the reverse video bit is set to 1

VGA attribute: If using the VGA attribute, the following attribute specifications are provided:

- Red, green, blue and intensify for foreground color
- Red, green, and blue for background color
- Underline for monochrome displays
- Choice of blinking or intensify for background color

Refer to the *IBM 4680 BASIC Language Reference* for a list of the colors and underlining available using the combinations of color bits and the intensify bit.

Functions Your Application Performs

Your application can perform the following functions with the video display:

- Control the video display format.
- Determine the video display format.
- Determine whether the attached video display is monochrome or color.
- Write characters and attributes to any character location.
- Write characters to any character location without changing the attributes.
- Write attributes to any character location without changing the characters.
- Read characters from any character location.
- Read attributes from any character location.
- Control the type of attribute for each character location (VGA extension)
- Control the attribute for each character location.
- Determine the type of attribute for the current character attribute (VGA extension)
- Determine the current character attribute
- Control whether underlining is enabled on monochrome displays (VGA extension)
- Determine whether underlining is enabled on monochrome displays (VGA extension)
- Control whether blinking or background intensified colors are enabled (VGA extension)
- Determine whether blinking or background intensified colors are enabled (VGA extension)
- Control current character location
- Control whether the cursor is visible at a current character location
- Clear the video display.

If the video display is configured as the system display in the terminal device group for your terminal:

- Your application shares its video display buffer with the I/O Processor

  The I/O processor uses your applications video display buffer to display keyboard data that is specified as display-as-keyed and to display operator prompts. Your input sequence table specifies the starting character location and length of these display fields. Your application should be designed to coordinate its video display data with your input sequence table.

- Other system functions use the video display but with a separate video display buffer

If the video display is not configured as the system display, then the only system use of the video display is to display IPL progress indicators during IPL.

Accessing the Video Display

Use the OPEN statement to gain access to the video display device driver. OPEN sets the current character location to row 1, column 1 (1,1).

You use the GETLONG function to determine the default video display format and whether the attached video display is color or monochrome.

Use the CLOSE statement to end your application's use of the video display driver. The CLOSE statement does not clear the video display.

Clearing the Video Display

Use the CLEARS statement to clear the video display. The CLEARS statement writes a space character with the default attribute (Feature A 0xE0) to each character location and sets the current character location to (1,1).

Changing the Video Display Format

The video display format sets the size and number of character locations on the video display. For example, a 12 x 40 video display format defines a video display that has 12 horizontal lines (rows) with 40 characters (columns) in each line.

Use byte MM in the PUTLONG statement to change the video display format. The Feature A video driver uses three bits and the VGA video driver uses four bits to specify a change in the video display format.

If none of the video display format bits are set in the PUTLONG statement, then the video display format does not change. If you set one of the bits to 1, the video display changes to the video display format specified by that bit.

If more than one of the video display format bits is set to 1, an error is returned to your application and the video display format does not change. If you select the current video display format, success is returned to your application, but the video display format does not change.

The video display is cleared and the current character location is set to (1,1) when the video display format is changed.

Special Considerations for a Feature A Video Driver: If you select a video display format that is not valid for the video display type that is configured, an error is returned to your application and the video display format is not changed.

If you select a video display format that is larger than the default video display format, the driver must allocate additional memory. If memory is not available to satisfy this request, an error is returned to your application and the video display format is not changed. For this reason, it is recommended that you configure the default video display format for the largest video display format that your application uses. This prevents the need to allocate additional memory when your application changes the video display format.

Writing to the Video Display

Use the WRITE statement to display characters and/or attributes on the video display. The default mode of writing characters to the video display automatically changes the attribute associated with each character written to the current character attribute.

Use byte CC in the PUTLONG statement to change the way characters are written to the video display. To write characters without having the attribute updated see “Writing Characters Without Changing Attributes” on page 3-18. To write attributes without having the character updated see “Writing Attributes Without Changing Characters” on page 3-18.

Before writing data to the video display, you can set the current character location and the current character attribute. After the WRITE statement is complete, the current character location is set to the first character location after the last character location written.

Current Character Attribute: The default current character attribute is the Feature A attribute 0xE0.

You can change the current character attribute by using byte AA of the PUTLONG statement. If using video extensions, you can also use byte VV to select that byte AA contains a VGA attribute, whether blinking or background intensified colors are enabled and whether underlining is enabled for monochrome video displays.

This attribute is used by the video display driver for all default mode writes performed by your application until your application changes it with another PUTLONG statement.

If the current character attribute is a Feature A attribute, then it does not effect the attribute of characters written by the I/O processor.

The I/O Processor full screen function supports only the Feature A attribute. If the current character attribute is a VGA attribute, then the following must be considered:

- If a blinking Feature A attribute is chosen in your input sequence table and your application has enabled intensified background colors, then the input sequence table attribute will display with its background color intensified rather than blinking.
- If a blue Feature A attribute is chosen in your input sequence table and your application has enabled underlining, then the input sequence table attribute will display underlined if the video display is monochrome.

Current Character Location: A character location is defined as a row and column coordinate (row,column). Each character location contains a character and an attribute. The default current character location is (1,1).

Use the LOCATE statement to change the current character location. This is the row and column where you want to start writing characters on the video display.

The current video display format determines the valid row and column values for each character location. Valid values range from one to the maximum row and column for the current video display format.

The location of the cursor is the same as the current character location. You also use the LOCATE statement to control whether or not the cursor is visible. The current character location does not affect the location of characters written by the I/O processor.

Character Location Wrapping: If the number of characters or attributes you write is greater than the number of character locations remaining on the current row of the video display, the characters or attributes are written on the next row. If the current row is the last row, then the characters or attributes are written to row 1. The characters or attributes continue to wrap around until all of the characters or attributes are written.

Video Display Character Set: The video display character set determines what is displayed on the video display for each character written by your application. Each video display driver has its own set of video character sets for the different code pages supported. Differences exist between the video display character sets used by the Feature A and VGA video drivers.

Refer to the *IBM 4680 BASIC Language Reference* for a description of each of the video character sets.

Writing Characters Without Changing Attributes: Use byte CC in the PUTLONG statement to change the write mode to write characters without changing the attribute.

If you select to have characters written without changing the attribute, then the current character attribute is not used on all subsequent WRITE statements until your application changes the write mode with another PUTLONG statement. The attribute remains the same as it was before the character was written.

See the “Example” on page 3-20 where this mode of writing characters is used to restore a screen.

Writing Attributes Without Changing Characters: Use byte CC in the PUTLONG statement to change the write mode to write attributes without changing the character. Also use byte VV in the PUTLONG statement to change the current character attribute type.

If you select to have attributes written without changing the character, then the data variable is interpreted as attribute data on all subsequent WRITE statements until your application changes the write mode with another PUTLONG statement.

Although the current character attribute is not used, the type of the current character attribute is used to determine whether the data variable contains Feature A or VGA attributes.

See the “Example” on page 3-20 where this mode of writing attributes is used to restore a screen.

Determining Video Display Information

You use the GETLONG function to determine the following information about the video display:

- Current character attribute
- Current character attribute type (VGA extension)
- Current character location (row and column)
- Whether the cursor is visible
- Current video display format
- Whether the attached video display is monochrome or color
- Whether underlining is enabled (VGA extension)
- Whether blinking or background intensified colors are enabled (VGA extension)

Reading from the Video Display

Use the READ FORM # statement to read the characters or attributes that have been written by your application and the I/O Processor. The default mode of reading from the video display is to read the characters that have been written.

Use byte CC in the PUTLONG statement to change the read mode. To read attributes instead of characters see “Reading Attributes from the Video Display” on page 3-19.

Before reading from the video display, you can set the current character location. This is the row and column where you want to start reading from the video display. See “Current Character Location” on page 3-17 for details.

The length of the data variable specified on the READ FORM # statement determines the number of character locations read from the video display. If the length requested exceeds the remaining character locations on a row, wrapping is done as described in “Character Location Wrapping” on page 3-18

After the READ FORM # statement is complete, the current character location is set to the first character location after the last character location that was read.

See the “Example” on page 3-20 where this mode of reading characters is used to save a screen.

Reading Attributes from the Video Display: Use byte CC in the PUTLONG statement to change the read mode to read attributes from the video display. Also use byte VV in the PUTLONG statement to change the current character attribute type.

If you select to read attributes, then all subsequent READ FORM # statements will return attributes until your application changes the read mode with another PUTLONG statement. The type of the current character attribute is used to determine whether the attributes being returned are Feature A or VGA attributes.

See the “Example” on page 3-20 where this mode of reading attributes is used to save a screen.

Special Considerations When Using VGA Video Driver and Feature A Attributes: Feature A attributes read from the video display are not guaranteed to match the attributes originally written. This is because the VGA video driver must map the Feature A attribute internally to a VGA attribute, and there are some characteristics of the Feature A attribute that are not supported. See “Feature A Attribute” on page 3-15 for more information

However, rewriting these previously read attributes produces the same original result.

Running a 2x20 Display Application on the Video Display

An application written for a 2x20 display runs on a video display with the following considerations:

- The application must change the OPEN statement to access VDISPLAY or VDISPLAY2
- Character location wrapping is different

  On 2x20 displays wrapping occurs to the next row when 20 character locations are exceeded. On video displays it is dependent on the current video display format.

  For example, a write to the alphanumeric display of 40 characters starting at character location (1,1) appears as two lines on the alphanumeric display. The same write to the video display appears as one line.
- Display character sets are different

Refer to the *IBM 4680 BASIC Language Reference* for a description of the display character sets.

- GETLONG returns different information

  Only the CC (current column) and RR (current row) bytes of the GETLONG are consistent between the video and 2x20 displays.

Example

The following example contains a BASIC application for the video display. This example writes to the video display using Feature A attributes, writes to the video display using VGA attributes, saves the screen, clears the video display, then restores the saved screen.

```
%ENVIRON T

INTEGER*4 PUTLDATA
INTEGER*2 VDISP, VGADRIVER
STRING TSTATUS, CHARS, FAATTRS, VGAATTRS

! ADXSERVE subroutine
SUB ADXSERVE (RET,FUNC,PARM1,PARM2) EXTERNAL
INTEGER*4 RET
INTEGER*2 FUNC,PARM1
STRING PARM2
END SUB

! Establish an error routine.
ON ERROR GOTO ERROR1

! Open the video display.
VDISP = 2
OPEN "VDISPLAY:" AS VDISP

! Change video display format to 25x80, and grey Feature A attribute
PUTLDATA = 000800E0H
PUTLONG VDISP, PUTLDATA

! Display Feature A attribute examples title line
WRITE #VDISP; "Following are examples of Feature A attributes:"

! Set character location to (3,1), set green blinking Feature A attribute
! and display test line
LOCATE #VDISP; 3,1,OFF
PUTLDATA = 00000082H
PUTLONG VDISP, PUTLDATA
WRITE #VDISP; "Green blinking characters on black background"

! Set character location to (4,1), set red reverse Feature A attribute
!  and display test line
LOCATE #VDISP; 4,1,OFF
PUTLDATA = 00000021H
PUTLONG VDISP, PUTLDATA
WRITE #VDISP; "Black characters on red background"

! Set character location to (5,1), set blue Feature A attribute
!  and display test line
LOCATE #VDISP; 5,1,OFF
PUTLDATA = 00000040H
```

```
|  PUTLONG VDISP, PUTLDATA
|  WRITE #VDISP; "Blue characters on black background"

|  ! Set character location to (6,1), set magenta Feature A attribute
|  !  and display test line
|  LOCATE #VDISP; 6,1,OFF
|  PUTLDATA = 00000060H
|  PUTLONG VDISP, PUTLDATA
|  WRITE #VDISP; "Magenta characters on black background"

|  ! Set character location to (7,1), set magenta intensified Feature A attribute
|  !  and display test line
|  LOCATE #VDISP; 7,1,OFF
|  PUTLDATA = 00000068H
|  PUTLONG VDISP, PUTLDATA
|  WRITE #VDISP; "Light magenta characters on black background"

|  ! Set character location to (8,1), set white underlined Feature A attribute
|  !  and display test line
|  ! Note: Will not be underlined on VGA video display
|  LOCATE #VDISP; 8,1,OFF
|  PUTLDATA = 000000F0H
|  PUTLONG VDISP, PUTLDATA
|  WRITE #VDISP; "White underlined characters on black background"

|  ! If have a VGA video display then display test lines for some VGA attributes
|  VGADRIVER = 0
|  CALL ADXSERVE(RET,4,0,TSTATUS)
|  IF (RET = 0) AND (MID$(TSTATUS,48,1) = "1") THEN \
|  BEGIN

|    ! Set we have a VGA video driver
|    VGADRIVER = 1

|    ! Set character location (10,1), set grey VGA attribute
|    !  and display VGA attribute examples title line
|    LOCATE #VDISP; 10,1,OFF
|    PUTLDATA = 01000007H
|    PUTLONG VDISP, PUTLDATA
|    WRITE FORM "C80"; #VDISP; "Following are examples of VGA attributes:"

|    ! Set character location (12,1), set green foreground and black
|    !  background VGA attribute and display test line
|    LOCATE #VDISP; 12,1,OFF
|    PUTLDATA = 01000002H
|    PUTLONG VDISP, PUTLDATA
|    WRITE FORM "C80"; #VDISP; "Green characters on a black background"

|    ! Set green foreground and brown
|    !  background VGA attribute and display test line
|    PUTLDATA = 01000062H
|    PUTLONG VDISP, PUTLDATA
|    WRITE FORM "C80"; #VDISP; "Green characters on a brown background"

|    ! Set cyan foreground and red background
|    !  VGA attribute and display test line
|    PUTLDATA = 01000043H
|    PUTLONG VDISP, PUTLDATA
```

```
|    WRITE FORM "C80"; #VDISP; "Cyan characters on a red background"

|    ! Set blue foreground, grey background,
|    !  blinking VGA attribute and display test line
|    PUTLDATA = 010000F1H
|    PUTLONG VDISP, PUTLDATA
|    WRITE FORM "C80"; #VDISP; "Blue blinking characters on grey background"

|    ! Set magenta background, white foregound
|    !  VGA attribute and display test line
|    PUTLDATA = 0100005FH
|    PUTLONG VDISP, PUTLDATA
|    WRITE FORM "C80"; #VDISP; "White characters on magenta background"

|    ! Set red foreground, green background
|    !  VGA attribute and display test line
|    PUTLDATA = 01000024H
|    PUTLONG VDISP, PUTLDATA
|    WRITE FORM "C80"; #VDISP; "Red characters on green background"

|    ! Announce about to enable background intensified colors
|    WRITE FORM "C80"; #VDISP; "About to enable background intensified colors"
|    ! Wait 5 seconds
|    WAIT; 5000

|    ! Set character location to (18,1), set light red foreground,
|    !  yellow background VGA attribute, enable intensify background colors
|    !  and display test lines
|    LOCATE #VDISP; 18,1,OFF
|    PUTLDATA = 050000ECH
|    PUTLONG VDISP, PUTLDATA
|    WRITE FORM "C80"; #VDISP; "Background intensified colors enabled and blinking disabled"
|    WRITE FORM "C80"; #VDISP; " for entire screen - light red characters on yellow background"

|    ! Announce about to enable underlining
|    WRITE FORM "C80"; #VDISP; "About to enable underlining"

|    ! Wait 5 seconds
|    WAIT; 5000

|    ! Set character location to (20,1), set light blue foreground, grey background
|    ! VGA attribute, enable intensify background colors and underlining
|    ! and display test lines
|    ! Note: Will be light blue characters without underlining on color display
|    LOCATE #VDISP; 20,1,OFF
|    PUTLDATA = 07000079H
|    PUTLONG VDISP, PUTLDATA
|    WRITE FORM "C80"; #VDISP; "Underlining enabled for entire screen -"
|    WRITE FORM "C80"; #VDISP; " white underlined characters on grey background"

|    ! Announce about to disable underlining and background intensified colors
|    WRITE FORM "C80"; #VDISP; "About to disable underlining and background intensified colors"

|    ! Wait 5 seconds
|    WAIT; 5000

|    ! Set character location to (22,1), set light magenta foreground,
|    !  blue background VGA attribute, disable intensify background colors
```

```
|    !  and underlining and display test lines
|    LOCATE #VDISP; 22,1,OFF
|    PUTLDATA = 0100001DH
|    PUTLONG VDISP, PUTLDATA
|    WRITE FORM "C80"; #VDISP; "Background intensified colors disabled, blinking enabled,     "
|    WRITE FORM "C80"; #VDISP; " and underlining disabled for entire screen - "
|    WRITE FORM "C80"; #VDISP; " light magenta characters on blue background"

|  ENDIF

|  ! Set grey Feature A attribute
|  !  and display about to clear the screen
|  LOCATE #VDISP; 25,1,OFF
|  PUTLDATA = 000000E0H
|  PUTLONG VDISP, PUTLDATA
|  WRITE FORM "C80"; #VDISP; "Now let's clear the screen"

|  !*********************************************************************
|  ! Save the screen for restoring later
|  !*********************************************************************

|  !  Read characters from video display
|  LOCATE #VDISP; 1,1,OFF
|  READ FORM "C2000"; #VDISP; CHARS

|  ! Set read mode to read Feature A attributes, set character location
|  !  to (1,1) and read the attributes
|  PUTLDATA = 000002E0H
|  PUTLONG VDISP, PUTLDATA
|  LOCATE #VDISP; 1,1,OFF
|  READ FORM "C720"; #VDISP; FAATTRS

|  ! If have a VGA driver then save VGA attributes
|  IF (VGADRIVER = 1) THEN \
|  BEGIN
|    !  Set read mode to read VGA attributes then read
|    PUTLDATA = 01000207H
|    PUTLONG VDISP, PUTLDATA
|    LOCATE #VDISP; 10,1,OFF
|    READ FORM "C1200"; #VDISP; VGAATTRS
|  ENDIF

|  ! Wait 5 seconds then clear
|  WAIT; 5000
|  CLEARS VDISP

|  !*********************************************************************
|  ! Restore the screen
|  !*********************************************************************

|  LOCATE #VDISP; 1,1,OFF
|  WRITE FORM "C80"; #VDISP; "Now let's restore the screen"

|  !  Wait 3 seconds
|  WAIT; 3000

|  !  Set write mode to write Feature A attributes then write them
|  PUTLDATA = 000008E0H
```

```
| PUTLONG VDISP, PUTLDATA
| LOCATE #VDISP; 1,1,OFF
| WRITE FORM "C720"; #VDISP; FAATTRS

| ! If have a VGA driver then restore VGA attributes
| IF (VGADRIVER = 1) THEN \
| BEGIN

|   !  Set write mode to write VGA attributes then write them
|   PUTLDATA = 01000807H
|   PUTLONG VDISP, PUTLDATA
|   LOCATE #VDISP; 10,1,OFF
|   WRITE FORM "C1200"; #VDISP; VGAATTRS
| ENDIF

| !  Wait 2 seconds
| WAIT; 2000

| !  Set write mode to write characters without updating attribute,
| !   set grey Feature A attribute
| PUTLDATA = 000004E0H
| PUTLONG VDISP, PUTLDATA
| LOCATE #VDISP; 1,1,OFF
| WRITE FORM "C2000"; #VDISP; CHARS

| !  Wait 2 seconds
| WAIT; 2000

| ! Set character location to (25,1) and display test end line
| LOCATE #VDISP; 25,1,OFF
| WRITE FORM "C80"; #VDISP; "End of Video display sample program                    "

| CLOSE VDISP
| STOP

| ERROR1:
| ! Prevent recursion.
| ON ERROR GOTO END.PROG
| ! Determine error type and perform appropriate recovery
| ! and resume steps.
| END.PROG:
| STOP
| END
```

Using Feature A Video Driver Command Stacking to Improve Performance

You can use command stacking to further improve system performance when using video displays with the Feature A video driver.

The VGA video driver does not support command stacking. Command stacking selection on the PUTLONG statement is ignored by the VGA video driver. However, this method requires minor changes to your application programs.

Command stacking reduces the system overhead that is associated with sending the application program's WRITE, LOCATE, and PUTLONG statements. Command stacking combines or packages a number of

| these statements into a single video adapter command. Using this packaging or stacking technique, you
| can send a group of application statements to the video adapter with no more overhead than a single
| command.

| In some cases, the video driver automatically combines the statements sent from an application program
| before sending the statements to the video adapter. However, you can gain better video performance by
| using the application program to signal the video driver when it is safe to combine application statements.
| The application program can use bit 0 of byte CC of the PUTLONG statement to convey this information
| to the driver.

| An application program must set bit 0 of byte CC to 1 to allow the driver to begin stacking application
| statements. The driver continues to stack application statements for maximum performance until bit 0 of
| byte CC is reset to zero.

| The video driver determines the amount of information that can be combined into one video adapter
| command. When bit 0 is set to 1, the video driver continues to combine application statements until the
| maximum adapter command size is reached. When this maximum size is reached, the video driver sends
| the command to the adapter and combines subsequent application statements in a second adapter
| command. This process continues independently of the application program. If you reset bit 0 from 1 to
| 0, the video driver sends all application statements in the video command buffer to the adapter. If bit 0 is
| not reset, the driver continues to wait for additional application program statements until the maximum
| adapter command size is reached.

| When bit 0 is set to 1, it signals the driver to begin combining application statements. Bit 0 must be
| maintained as 1 on subsequent statements until the application issues a PUTLONG that resets bit 0 to
| zero. See the “Example Program Using Command Stacking” for additional information.

| **Restrictions Using Command Stacking:** You can use command stacking only with other
| application WRITE statements of a similar type. For example, commands to write characters while
| updating attributes can be stacked only with other commands that write characters while updating
| attributes, write character only commands with other write character only commands, and write attribute
| only commands with other write attribute only commands. Switching from writing only attributes to writing
| only characters causes the system to flush the stack buffer. Therefore, when writing both characters and
| attributes, it is more efficient to set the attributes using a PUTLONG command (leaving bits 2 and 3 of
| byte CC 0) and then issue a WRITE command to send the character data, rather than sending separate
| write attribute and write character commands.

| Any data the I/O processor sends to the video driver results in the command stacking buffer being cleared
| and the data sent to the screen. Examples of data written by the I/O processor include displaying
| keyboard input using the display-as-keyed feature of the input sequence table, and displaying operator
| prompt messages defined in the input sequence table. Since information displayed this way is considered
| to be immediately required by the user, the video driver forces it to the screen automatically instead of
| waiting for the application to flush the command stacking buffer.

| **Example Program Using Command Stacking:** The following example shows an application
| program that uses command stacking. The program displays a box on the screen with a calendar
| included inside the box. This program shows how to turn on command stacking and how to leave the
| stacking bit turned on until a group of statements have been issued. Command stacking is optional, but
| might result in faster screen response when using the video display.

| The source code following shows how to use the PUTLONG command to stack or combine all of the
| program statements required to display the calendar. Bit 1 of byte CC in the PUTLONG statement is set
| to 1 before any of the WRITE statements are issued. This same bit is maintained as 1 during all of the

PUTLONG commands used to change the screen attributes. After all of the WRITE statements have been issued, a final PUTLONG command clears the video buffer, thus sending the data to the screen.

Example Program Source Code

```
!    ************** Command Stacking Program Example *****************
!
!    This program displays the December 1995 calendar on the
!    4683 video display.  It utilizes the command stacking
!    feature of the Feature A video driver to ensure the best screen
!    response is attained.
!
!    ***************************************************************

%ENVIRON T

! Establish an error routine.
ON ERROR GOTO ERROR1
OPEN "VDISPLAY:" AS 2    ! Open video display driver
CLEARS 2                 ! Clear display before displaying the calendar

! Change video display format to 25x80, and set grey attribute
PUTLONG 2, 000800E0H

! Start command stacking, bit zero byte CC = 1
PUTLONG 2, 000001E0H

! *********  Form the box that surrounds the calendar
  LOCATE #2; 2, 4, OFF
  WRITE FORM "C31"; #2; CHR$(6)+STRING$(29, CHR$(12))+CHR$(7)
  FOR II = 3 To 13
    LOCATE #2; II, 4, OFF
    WRITE FORM "C31"; #2; CHR$(25) + STRING$(29, CHR$(32)) + CHR$(24)
  NEXT II

  LOCATE #2; 14, 4, OFF
  WRITE FORM "C31"; #2; CHR$(4) + STRING$(29, CHR$(12)) + CHR$(5)

!******** Write the Month and Year using the intensify and underscore attribute
  PUTLONG 2, 000001F8H     ! Change to intensify and underscore, leaving stack bit on
  LOCATE #2; 4, 13, OFF
  WRITE #2; "DECEMBER 1995"
!******** Write days of the week in highlighted attribute
  PUTLONG 2, 000001E8H     ! Change to highlighted, leaving stack bit on
  LOCATE #2; 6, 6, OFF
  WRITE #2; "SUN MON TUE WED THU FRI SAT"

!******** Write the days of the month using a normal attribute
  PUTLONG 2, 000001E0H     ! Change to normal, leaving stack bit on
  LOCATE #2; 8, 28, OFF
  WRITE  #2; "1   2"
  LOCATE #2; 9, 8, OFF
  WRITE  #2; "3  4  5  6  7  8  9"
  LOCATE #2; 10, 7, OFF
  WRITE  #2; "10  11  12  13  14  15  16"
  LOCATE #2; 11, 7, OFF
  WRITE  #2; "17  18  19  20  21  22  23"
  LOCATE #2; 12, 7, OFF
```

```
|    WRITE  #2; "24  25  26  27  28  29  30"
|    LOCATE #2; 13, 7, OFF
|    WRITE  #2; "31"

|  !******** Make the day of the month blink for emphasis and also intensify
|    PUTLONG 2, 000001EAH      ! Change to blinking and intensified, leaving stack bit on
|    LOCATE #2; 9, 11, OFF
|    WRITE #2; "4"

|    PUTLONG 2, 000000E0H      ! Flush video buffer - force data to screen

|    CLOSE 2
|    STOP

|  ERROR1:
|  ! Prevent recursion.
|  ON ERROR GOTO END.PROG
|  ! Determine error type and perform appropriate recovery
|  ! and resume steps.
|  END.PROG:
|  STOP
|  END
```

Cash Drawer Driver

This section describes the cash drawer driver and provides guidelines for using it.

Characteristics

The cash drawer has the following characteristics:

- Each terminal supports a maximum of two cash drawers or one cash drawer and one alarm.
- You can attach an external alarm using a set of relay contacts. Your application program controls whether the contacts are open or closed. The cash drawers are numbered 1 and 2. You must connect the alarm in place of cash drawer number 2.
- To open a cash drawer, your application must send a pulse of a minimum duration to the cash drawer to cause it to open. If you use an IBM cash drawer, the pulse time is 80 ms. If you use a non-IBM cash drawer, you might need other pulse times. You request these pulse times during configuration. The cash drawer driver supports pulse times from 1 ms to 1048 ms; the default is 80 ms.

Functions Your Application Performs

An application program can perform the following functions with the cash drawer or alarm:

- Open a cash drawer.
- Turn an alarm on or off.
- Obtain cash drawer or alarm status.

Accessing the Cash Drawer or Alarm

Use the OPEN statement to gain access to the cash drawer driver.

Use the CLOSE statement to end your application's use of the cash drawer driver.

Controlling a Cash Drawer or Alarm

Use the WRITE FORM statement to control a cash drawer or the alarm. With a single WRITE FORM statement you can perform one of the following operations:

- Open cash drawer 1.
- Open cash drawer 2.
- Turn the alarm on.
- Turn the alarm off.

Obtaining Cash Drawer or Alarm Status

Use the GETLONG statement to determine the status of the cash drawers and alarm. Cash drawer status provides the following information:

- Cash drawer 1 open
- Cash drawer 1 closed
- Cash drawer 1 not connected
- Cash drawer 2 open or alarm on
- Cash drawer 2 closed or alarm off
- Cash drawer 2 or alarm not connected
- No cash drawer or alarm connected

When you issue a WRITE FORM statement to open a cash drawer, the cash drawer sensor (part of the cash drawer assembly) detects the status change. Following a WRITE FORM to open a cash drawer, give the drawer time to open before requesting a cash drawer status.

Example

This example contains code for operating a cash drawer. This program writes a message to the display, opens the cash drawer, writes another message, and then waits for the operator to close the drawer.

```
%ENVIRON T
! Declare work integers.
INTEGER*4  I4,S4
INTEGER*1  DRAWER.ONE
! Constant to open drawer 1.
DRAWER.ONE = 1
ON ERROR GOTO ERR.HNDLR
! Open the display as #2.
OPEN "ANDISPLAY:" AS 2
CLEARS 2
! Open cash drawer driver as #1.
OPEN "CDRAWER:" AS 1
WRITE #2;"CASHDRAWER DRIVER OPEN"
WAIT;2000
START.DRAWER.CONTROL:
CLEARS 2
WRITE #2; "OPEN DRAWER 1"
WAIT;2000
! Open cash drawer number 1.
WRITE FORM "I1";#1;DRAWER.ONE
DRAWER.OPEN:
! Loop while the drawer is open.
CLEARS 2
WRITE #2; "CLOSE DRAWER"
```

```
WAIT;1000
! Get the status.
I4 = GETLONG(1)
!Shift status.
S4 = SHIFT(I4,8)
! Turn off all but status.
STAT% = S4 and 000000FFH
!Return until cash drawer is closed.
IF STAT% <> 0 THEN GOTO DRAWER.OPEN \
ELSE\
! End the execution.
CLEARS 2
WRITE #2; "end of sample"
WAIT;1000
CLOSE 1
CLOSE 2
STOP
ERR.HNDLR:
! Prevent recursion.
ON ERROR GOTO END.PROG
! Determine error type
! and perform appropriate
! recovery and resume steps.
END.PROG:
STOP
END
```

Coin Dispenser Driver

This section describes the coin dispenser driver and provides guidelines for using it.

Characteristics

The coin dispenser has the following characteristics:

- Each 4683 terminal supports a maximum of two feature expansion cards. You can attach a non-IBM coin dispenser to one of these feature expansion cards.
- Your application should specify the amount of money to be dispensed as a four-digit integer. This number represents the number of monetary units to be dispensed (cents, for example). The definition of the term *monetary unit* depends on the country in which the coin dispenser is designed to operate.
- The 4690 Operating System supports the coin dispenser and feature expansion cards only on 4683 terminals.

Accessing the Coin Dispenser

Use the OPEN statement to gain access to the coin dispenser driver.

Use the CLOSE statement to end communication with the coin dispenser driver.

Dispensing Coins

To dispense coins, issue a WRITE FORM statement. You can specify the number of monetary units to be dispensed as a variable or a constant in the WRITE FORM statement. If an error occurs, control passes to the ON ASYNC ERROR subprogram. Your application should allow the coin dispenser enough time between writes to complete coin dispensing.

Example

This example program runs through one time, dispenses 47 cents, and then stops.

```
%ENVIRON T
! Declare variables.
INTEGER*4 hx%,sx%
INTEGER*2 COIN%,ANDSP%
SUB ASYNC.ERR(RFLAG,OVER)
INTEGER*2 RFLAG
STRING OVER
RFLAG = 0
OVER = ""
hx% = ERRN
ERRFX$ = ""
FOR s% = 28 TO 0 STEP -4
  sx% = SHIFT(hx%,s%)
  THE.SUM% = sx% AND 000fh
  IF THE.SUM% > 9 THEN    \
     THE.SUM%=THE.SUM%+55 \
  ELSE                    \
     THE.SUM%=THE.SUM%+48
  A$=CHR$(THE.SUM%)
  ERRFX$ = ERRFX$ + A$
NEXT s%
CLEARS ANDSP%
WRITE  #ANDSP%;"ERR=",ERR,"   ERRL=",ERRL
LOCATE #ANDSP%;2,1
WRITE  #ANDSP%;"ERRF=",ERRF%," ERRN=",ERRFX$
WAIT ;15000
RESUME
END SUB
ON ERROR GOTO ERRORA
! Set ON ERROR routine.
ON ASYNC ERROR CALL ASYNC.ERR
! Set ON ASYNC ERROR routine.
COIN% = 3
! Initialize session numbers.
ANDSP% = 1
OPEN "ANDISPLAY:" as ANDSP%
! Open alphanumeric display.
CLEARS ANDSP%
! Clear alphanumeric display.
WRITE #ANDSP% ; "SAMPLE COIN PROG"
! Indicate start of application.
WAIT;5000
! Wait 5 seconds.
OPEN "COIN:" AS COIN%
! Open coin dispenser.
LOCATE #ANDSP% ; 2,1
```

```
! Locate to 2nd line of display.
WRITE #ANDSP% ; "COIN DISPENSER OPEN"
WAIT;5000
AMOUNT% = 47
! Load amount to be dispensed.
CLEARS ANDSP%
! Clear display
WRITE FORM "C8 PIC(####) C8" ;#ANDSP% ; "WRITING ",AMOUNT%," CENTS."
WRITE FORM "I4" ; #COIN% ; AMOUNT%
! Dispense coins command.
WAIT;5000
! Wait 5 seconds.
LOCATE #ANDSP% ; 2,1
WRITE #ANDSP% ; "END OF SAMPLE"
STOP
ERRORA:
! Error assembly routine.
hx% = ERRN
ERRFX$ = ""
FOR s% = 28 TO 0 STEP -4
  sx% = shift(hx%,s%)
  THE.SUM% = sx% AND 000fh
  IF THE.SUM% > 9 THEN    \
     THE.SUM%=THE.SUM%+55 \
  ELSE                    \
     THE.SUM%=THE.SUM%+48
  A$=CHR$(THE.SUM%)
  ERRFX$ = ERRFX$ + A$
NEXT s%
CLEARS ANDSP%
WRITE  #ANDSP%;"ERR=",ERR,"   ERRL=",ERRL
LOCATE #ANDSP%;2,1
WRITE  #ANDSP%;"ERRF=",ERRF%," ERRN=",ERRFX$
WAIT;15000
RESUME
END
```

I/O Processor

This section describes the I/O processor and provides guidelines for using it.

Characteristics

The I/O processor and the input sequence tables work together to allow the accumulation and validation of operator input from the keyboard, optical character reader (OCR) or bar code reader, magnetic wand, or scanner. This accumulation and validation can occur simultaneously with your application. When the operator enters specified amounts of input, you can have the input forwarded to your application for further processing. The input from the various devices can be formatted so that your application receives only one format regardless of the source device.

The accumulation and validation of operator input at the I/O processor level allows rapid response to operator input. For example, during point-of-sale checkout, the operator can enter item information that the I/O processor processes while your application finishes a previous item by performing a price lookup.

The I/O processor is a driver that processes operator input according to the input sequence tables. You must build the input sequence tables according to the requirements of your application. See Chapter 7 for more information. You must load the input sequence tables into terminal memory before using the I/O processor.

Input Devices on Your System

The system device driver for the I/O processor is named IOPROC: Your application accesses the following input devices via the I/O Processor driver.

Keyboard
Magnetic wand (4683 only)
Scanner
Optical Character Reader (OCR)

These devices are all optional attachments for the IBM Point of Sale Terminals. For information on attaching and configuring them refer to the section on Terminal Configuration Keywords in the *4690 Store System: Planning, Installation, and Configuration Guide.*

I/O Processor Functions

The I/O processor and input sequence tables provide the following general capabilities:

- Display messages to prompt the operator for input.
- Validate operator input sequences.
- Edit, modulo-check, and convert data.
- Display data as entered.
- Map input into buffers.
- Issue error tones and display messages for valid input.
- Allow automatic end-of-field sequences.
- Queue input to the application for processing.
- Allow **CLEAR** key processing without application action required.

If the terminal has a primary display configured that is larger than 2x20, a set of Enhanced I/O Processor functions can be used. These are known as the Enhanced Full-Screen I/O Processor functions as shown in the following list:

- Customization of Message Display.
- Three Display Attributes Per Field.
- Large Input Sequences.
- Header Field Extensions.
- Upper Case Display-As-Keyed.
- Additional Tab Keys Definition.
- WRITE Statement.
- PUTLONG Statement.
- Double-Quote Substitution.

Input Sequence Tables

The input sequence tables consist of three tables:

- Input state table
- Label format table
- Modulo check table

The input state table is always required to allow operator input from the keyboard, OCR, magnetic wand, or scanner. The label format table and modulo check table are optional depending on your application requirements.

The input sequence tables are used by the I/O processor to determine what operator input is allowed and how to process it.

Definitions and Concepts: The following terms are used to describe the I/O processor and input sequence tables:

A *state* is a condition of the terminal for which there is a set of allowed inputs. A state is identified by an ID (1 through 300). The state is set by an application program, and the terminal can move from one state to another state based on operator input occurring in a state.

A *function code* is a value from 61 to 255 that delimits an input data field. For keyed input, a function code corresponds to a non-data key (such as “enter” or “total”). The function code values for keys are defined in the keyboard layout in Terminal Configuration. For example, the **Enter** key is assigned a function code of 95 (function codes can be reassigned during configuration). You can associate numeric or alphanumeric data with a function code. Data is concatenated to function codes in the messages passed from the I/O Processor to the application. It is possible to have a function code without any accompanying data.

A function code can result from other than a physical key being pressed. For example, an option is available to pass numeric values entered without a function key to an application. This is called the automatic end-of-field option. You can specify a function code to be associated with this data.

Function codes can represent fields on labels. The data from labels is formatted into fields consisting of function codes and data. This allows the application to handle input from scanners and readers with the same processing as used for keyed input.

A *motor function code* is a function code that causes all of the accumulated data and function codes entered since the beginning of the input sequence to be queued to the application. A motor function code is also called a *motor key*.

An *input sequence* is a series of one or more operator inputs that initially starts in a state that allows an operator to begin input. The input sequence ends in a motor function code or error specified to be given to the application. The input sequence can contain up to 10 function codes with their associated data if the Enhanced Full-Screen support is not being used, or up to 127 function codes with their data if the Enhanced Full-Screen support is being used.

Input State Table: The input state table is required to allow and process operator input from the keyboard, OCR reader, magnetic wand, or scanner. The input state table consists of information common to all states and information defined specifically for each state.

Note: Where you can define an action in the following descriptions, you can specify a message to be displayed and whether to remain in the current state, go to another state, or lock (disallow) input.

Information Common to All States

The following information is common to all states:

- Data editing information to use when display-as-keyed is used for numeric data. Display-as-keyed means the numeric keys appear on the display as they are entered. You can define the thousands separator character, decimal point character, and the number of decimal digits to use to format the

field on the display after the complete field is entered. Use of display-as-keyed is specified in the function code information. The position to use on the display is specified in the state information.

- A function code (key) to clear a system busy condition and a message to display when a system busy condition occurs. The system busy condition occurs when all buffers available to hold input sequences are full and queued to the application. This condition can occur when the operator enters information faster than the application can process it. If you define a function code to clear a system busy condition, the operator must press this key before any other operator input is allowed. This is useful if you want the operator to slow down the input and verify that all items entered were processed.
- Whether a double entry of the **Clear** key should return the terminal to the state that is defined as the beginning of the current input sequence. Refer to the information for each state for the specification of a beginning state.
- Tone type and duration to sound for errors based on device source (keyboard, OCR reader, magnetic wand, and scanner).
- Function codes that are valid in all states. You can define a function code to be valid in all states and also valid in one or more specific states. In this case, the definition of the function code in a specific state takes precedence when in that state.
- If you have an alphanumeric or ANPOS keyboard, a field passed to the application can be a function code and zero or more numeric digits, or it can be a function code and zero or more alphanumeric characters.
- Whether Enhanced Full-Screen mode is being used.
- Double-Quote Substitution character (Enhanced Full-Screen mode only). Within an input sequence, fields are enclosed in double quotes and delimited by commas. Alphanumeric and ANPOS keyboards have a double-quote character that would conflict with the double-quote used to enclose data passed from the I/O Processor to the application. To prevent such a conflict a character must be defined to be used as a substitute for double-quotes within fields. This enables the application and the I/O Processor to distinguish between the two classes of double-quotes. The substitution is in the input sequence that is passed to or from the application; it is not apparent to the operator. Substitution occurs for both the function code and the data within the field. The value selected for the substitution byte should be different than any function code and any keyable value.
- Additional Tab Keys Definition (Enhanced Full-Screen mode only) You may define any configurable key as an additional tab forward or tab backward key. The definition is in effect for all states. This technique also allows you to define tab keys on keyboards that don't have any tab keys, such as the 50-key keyboard.

Information for Each State: For each state, you can specify the following:

- State ID and name. The state ID must be a value from 1 to 300. State names are used only in the utility used to build the input sequence table. State IDs are used by the I/O processor and passed to an application.
- Valid function codes.
- Whether this state begins an input sequence. This is related to the double **Clear** key usage definition in the common information.

  Note: When the double **Clear** key usage is selected in the common information, and the terminal operator presses **Clear** twice consecutively, the application is notified.

  Notification means that the input fields entered up to this point are queued to the application.
- Allowed input devices in the state.

- Whether data should display-as-keyed and whether to edit the data (editing information is in the common information section). Display-as-keyed is defined in both state and function code definitions. If a function code has not yet been received in a state, the state definition determines the display-as-keyed properties until a function code is received.
- A message to be displayed when the terminal enters this state.
- Whether to support automatic end-of-field in this state. If supported, you can also specify the number of data keys defined to cause end-of-field and the function code to be associated with this field.
- The action to take for function codes entered but not defined in this state.
- Whether to allow data to be keyed and assigned to a function code that will be keyed following other function codes. You can do this one of two ways. You can indicate “Data not allowed” or “Data follows function code” for the function code key that will be pressed following the data. You can also indicate “Assign saved data” for the function code to which the data is to be assigned.
- Whether or not the state is a full-screen state. A non-full-screen is restricted to the top left 2x20 area of the display for display-as-keyed data and messages defined in the state table. A full-screen state does not have this restriction.
- Where to display the data on the display, if the state is not a full-screen state. If the state is a full-screen state, the locations for displaying data are specified in the function code definitions (display-as-keyed locations) and in the common information section (message locations).
- Whether data is displayed in normal or reverse order (non-full-screen states only).

Information for Each Function Code: For each function code allowed in a state and for each function code common to all states, you can define the following:

- Function code value (61 through 255).
- Whether this function code is a motor function code. A motor function code causes the application to be notified.
- Whether this function code is a **Clear** key.
- Whether to notify the application if an error is detected in the data associated with this function code.
- The action to take if no error is detected in the data entered.
- Whether data is allowed, required, or optional, and the action to take if this data requirement is not met.
- Whether data associated with this function code precedes or follows entry of the function code.
- Whether to assign saved data to this function code. This option is used in conjunction with the state option to allow saving of such data. Saved data is data that was entered but could not be assigned to the function code immediately preceding or following the data (if the state option is in effect). This option is useful if a desired input sequence contains several function codes, and a particular function code is entered separately from its associated data.
- Whether data should display-as-keyed and whether to edit the data (editing information is in the common part of the table).
- Minimum and maximum number of data digits (0 through 64) allowed and action to take if minimum and maximum requirements are not met.
- Whether to check the value of the data entered using a defined range (0 through 99999999) and the action to take if the range check is not met.
- Whether to modulo-check the data entered using the name of a modulo-check definition in the modulo check table (see “Modulo Check Table” on page 3-37), and the action to take if the modulo check fails.

- The relative variable position in the read buffer of the field occupied by this function code and associated data. You can allow up to 10 function codes during an input sequence, if Enhanced Full-Screen mode is not being used, or up to 127 if Enhanced Full-Screen mode is being used. The relative position defines the order of placement for a function code and its associated data in the input sequence buffer that will be queued to your application.
- Which other positions are mutually exclusive with this function code's relative position in the buffer. If any of the positions specified are already filled during this input sequence when the function code is entered, an error is assumed. You also can define the action to take if the mutual exclusive check is not met.
- Whether the manager's key must be turned on to enter this function code and the action to take if the manager's key requirement is not met.
- Whether to assign previously saved data to this function code.
- For full-screen states, additional information is in each function code:
  - Location on the display
  - Display attribute byte
  - Whether data is displayed in normal or reverse order.
  - The data type (numeric, alphabetic, or alphanumeric).
  - Field order

    This option specifies the order in which the fields of a state are accessed. The first field is accessed when the state is entered, tab forward accesses the next field, and tab backward accesses the previous field.

  - **Automatic Tab**

    This option specifies whether the cursor automatically moves to the next field when a field is full of data. If this option is not selected, the cursor remains in the current field and can be moved backward for reentry of previously keyed data.

  - **Upper Case Display-As-Keyed (Enhanced Full-Screen mode only)**

    An additional option in the function code definitions of full-screen states allows you to flag the field as an upper-case-only field. For an input field thus defined, the I/O Processor will convert any lower-case character keyed to upper-case. The data appears as upper-case on the video display and in the input sequence passed to the application.

  - **Three Display Attributes per Field (Enhanced Full-Screen mode only)**

    You may specify 3 attributes per input field. They are: The attribute in effect when the input field is current; the attribute in effect when the input field is non-current and non-empty; and the attribute in effect when the input field is non-current and empty. The reason for a 2nd non-current field attribute is to enable highlighting of required fields via the 'non-current and empty' attribute.

Note: When a full-screen state is entered, the display's cursor is placed in the position defined for the state's first data-entry field. The other data-entry fields of the state are accessed by the tab forward and tab backward keys.

The values of function codes assigned to the data-entry fields can be assigned according to the convenience of the application—their purpose is to identify the field to the application; they are not necessarily a value assigned to a key position. The non-data-entry function codes of the state (such as an **Enter** key) provide a recommended and relatively simple means to control routing previously entered fields to the application or transfer to another state, although you can define the function codes assigned to the data-entry fields to accomplish this.

Label Format Table: The label format table defines the information required to process OCR labels, magnetic ticket labels, and bar code labels (UPC, EAN, CODE39, Interleaved Two of Five [ITF]). This table is divided into information common to all label formats and information about specific label types.

Information Common to All Label Formats

- Function code required for keying bar code labels.
- Function code (key) required to indicate modulus 11 when keying a label.
- Predominant label type (UPC or EAN). Specify the label type if you have both UPC and EAN labels, and the operator is allowed to bypass leading zeros when keying one of the label types. Leading zeros are not required in the predominant label type.
- Whether to convert UPC-E label format to UPC-A label format.
- Display message for errors detected while keying labels.

OCR Label Format

- Format identifier
- Number of subfields in the format
- Length of each subfield (specific or variable)
- Function code to assign to each subfield

Magnetic Ticket Label Format

- Format identifier
- Number of fields in this format
- Length of each field
- Function code to be assigned to each field
- Whether each field is numeric or alphanumeric
- Order in which fields are to be processed

Bar Code Label Format

- Format identifier
- Specific label type (UPC-A, UPC-E, UPC-A+2, UPC-A+5, UPC-E+2, UPC-E+5, UPC-D1, UPC-D2, UPC-D3, UPC-D4, UPC-D5, EAN-13, EAN-8, EAN-13+2, EAN-13+5, EAN-8+2, EAN-8+5, CODE39, CODE93, CODE128, ITF)
- Number of fields in this format
- Length of each field
- Function code to assign to each field

Modulo Check Table: The modulo check table allows you to define the characteristics of a modulo check to be performed on key-entered or scanner-entered data fields. You can define as many different modulo-check definitions as required. When you build a modulo-check definition, you assign an eight-character name to each definition. You request modulo checking of a field by referencing the name of the modulo-check definition in the input state table. The modulo check table is defined by the following information:

- Name of the definition. The name referenced by the input state table.
- Algorithm type. IBM, USER, or UPC/EAN price field.
- Formula. Product Add or Product Digit Add.
- Modulus. The divisor value to use in calculating the modulo.
- Weights. Default or User-defined.
- User-defined weights. The weight assigned to each digit in the field to be checked.

All fields are not required for each algorithm. You can define as many different modulo check tables as required.

User-Defined Modulo-Check Algorithm

If you choose a user-defined modulo-check algorithm, you must choose either the Product Add or Product Digit Add formula. The Product Add formula assumes that the sum of the product of each field digit and its assigned weight, divided by the modulus factor, results in a zero remainder.

For example, if the field being modulo checked is:

```
1 2 3 4 5 4
```

where the last digit (4) is the check digit and the weights are:

```
4,3,6,6,2,2
```

and the modulus value is 5, the sum of the products becomes: .

```
(1x4)+(2x3)+(3x6)+(4x6)+(5x2)+(4x2)

= 4+6+18+24+10+8

= 70
```

Then 70 divided by 5 equals 14, which has a zero remainder, and the field passes the modulo check.

The Product Digit Add is the same as the Product Add format, except that after all digit weight products have been formed, the sum of all of the digits in the products, rather than the sum of the products is calculated. As in the preceding example, the sum divided by the modulus value must result in a zero remainder to pass the modulo check.

For example, if the field to be checked is:

```
1 2 3 4 5 2
```

where the last digit (2) is the check digit and the weights are:

```
4,3,6,6,2,2
```

and the modulus value is 5, the products resulting are:

```
1x4=4, 2x3=6, 3x6=18, 4x6=24, 5x2=10, 2x2=4
```

and the sum of the resulting products are:

```
=4+6+1+8+2+4+1+0+4

=30
```

Then 30 divided by 5 equals 6, which has a zero remainder, and the field passes the modulo check.

IBM Modulo-Check Algorithm

The IBM modulo-check algorithm uses a modulus value of 10, the Product Digit Add format, and a series of weights, beginning with 1 for the least significant digit and alternating in a 1,2,1,2,1,2,... series.

The maximum length of a field to be modulo checked is 64 digits including the check digit. The check digit must be the last digit.

UPC/EAN Modulo-Check Algorithm

The UPC/EAN modulo-check algorithm is used for checking price fields on the bar code labels. The UPC/EAN modulo-check algorithm multiplies each digit of the field to be checked by its assigned weight. The 10's position value of each product is then added to that product if the transform sign is plus; or subtracted from that product if the transform sign is minus. If no transform sign is specified, the product is left unchanged. The unit's position value of each transformed product is added to the check value accumulation. After the check value accumulation is complete, it is divided by the modulus. If there is no remainder from the division, the check is complete with no error.

For example, if the field to be checked is:

```
4 2 5 0 9 9
```

where the first digit (4) is the check digit, and the defined weights are:

```
+7,-2,2,+3,-6,+4
```

and the modulus value is 11, the products values are:

```
4x7 = 28
2x2 =  4
5x2 = 10
0x3 =  0
9x6 = 54
9x4 = 36
```

The transformed products are:

```
28+2 = 30
4-0  =  4
10   = 10
0+0  =  0
54-5 = 49
36+3 = 39
```

The accumulated check value is:

```
0+4+0+0+9+9 = 22
```

Then 22 divided by 11 equals 2, which has a zero remainder, and the field passes the modulo check.

Functions Your Application Performs

An application program can perform the following functions with the I/O processor:

- Load the input sequence tables.
- Wait for accumulated input.
- Read accumulated operator input.
- Allow or disallow operator input.
- Obtain status.
- Preload input sequence data via WRITE Statement (Enhanced Full-Screen only)

Loading the Input Sequence Tables: Before you obtain access to the I/O processor, you must load the input sequence tables into memory using a LOAD statement. The input state table is required, and the label format table and modulo-check table are optional.

Accessing the I/O Processor: Use the OPEN statement to gain access to the I/O processor driver, specifying the parameters for the maximum buffer size and the maximum number of buffers the driver can use to queue input sequences to the application. The buffer size must be large enough to contain the largest input sequence that can be generated according to the input state table. See "Receiving Data" on page 3-41 for the format of the input sequence data.

Use the CLOSE statement to end communication with the I/O processor. The CLOSE function locks the I/O processor and discards any data available.

Preparing to Receive Data from the I/O Processor: The I/O processor can be locked or unlocked. In the locked state, data cannot be read. In the unlocked state, data can be read. Following an OPEN statement, the I/O processor is unlocked and in state ID number 1. You should always build your input state table so that state 1 is a valid state and is the initial state you expect the terminal to be in, following an OPEN statement issued to the I/O processor.

Overview of Operator Input Flow: Following an OPEN statement, the I/O processor is unlocked and state 1 is set. The operator can then enter data. The following steps describe the flow of operator input through the I/O processor and to the application:

1. Operator input consists of data (optional) and function codes. Input from the keyboard consists of data keys and function keys. Label input from readers and scanners generates data and function codes separated into fields according to the label format table.
2. The I/O processor gets one of the buffers allocated for operator input sequences.
3. The I/O processor receives the data and function codes and processes them according to the definition of the state and function code in the input state table. The input sequence tables tell the I/O processor where to place the input fields in the driver buffer.
4. As you enter function codes, different state IDs can be set according to the action defined in the input state table. Each different state can alter the allowed input sequence. Each function code can also alter the allowed input sequence by defining mutually exclusive function codes.
5. When you enter a function code that is a motor function code, the system queues the buffer that holds the current input sequence information to the application.
6. The motor function code indicates if input can continue. If the action of the motor function code is to remain in the current state or set a new state, operator input remains unlocked, and input can continue. If the action is to lock the I/O processor, input cannot occur until the application unlocks the I/O processor.
7. The application can wait for operator input, read the input sequence buffer, and unlock the I/O processor as described in the following sections.

Waiting for Received Data: You can use a WAIT statement to wait for data to be available from the I/O processor. In many cases you need to wait for data from multiple sources such as the I/O processor and the magnetic stripe reader (MSR). The WAIT statement allows you to wait for input from multiple devices. The system uses a timer to monitor the length of time that it has not received data. When valid data is available from the I/O processor, the system runs the statement following the WAIT. When you are waiting on feedback from multiple devices, use the EVENT% statement to determine if the I/O processor is the device responding to the WAIT.

If an error occurs during a WAIT (such as keyboard offline), the system gives control to your ON ERROR routine. Errors that occur in the input sequence, which you defined to be passed to your application, do not cause entry to the ON ERROR routine. The system passes these errors to you in the input sequence buffer queued to your application.

Receiving Data: An input sequence buffer consists of a header field followed by up to 10 function code/data fields. ASCII quotation marks enclose each field, and ASCII commas separate each field. The header field is 14 bytes long if the Enhanced Full-Screen functions are not being used or 26 bytes long if the Enhanced functions are being used. The header field contains the following information:

- State ID that began the input sequence
- Current state ID
- Input device source (last contributing device if input was from multiple devices)
- Manager's key status
- Keyed label status
- Last function code received
- Error associated with the last function code
- Tab order of the last active input field (Enhanced Full-Screen mode only)
- Cursor Position (Enhanced Full-Screen mode only)
- Number of input fields in the sequence (Enhanced Full-Screen mode only)

Note: If you specify the double CLEAR usage in the common information, the state ID that began the input sequence is the last state specified as one that begins an input sequence for which the application issued an UNLOCKDEV. Otherwise, the state ID that began the input sequence is the last state for which the application issued an UNLOCKDEV. Thus, if you specify double CLEAR usage, the application can issue UNLOCKDEVs (to states that do not begin an input sequence), following its initial UNLOCKDEV for the sequence, and the state ID for the UNLOCKDEV is preserved.

Each function code/data field consists of the function code followed by any data associated with that function code. Refer to the *IBM 4680 BASIC: Language Reference* for the details of the header field.

You can issue either a READ or a READ LINE statement to receive an input sequence queued to the application.

The READ statement reads each field into the string variables named on your READ statement. You must specify 11 string variables if you are not using the Enhanced Full-Screen functions. The READ statement reads the header field into the first variable, and reads the function code/data fields into the variable corresponding to the relative position you specified for the function code in the input state table. Relative positions 1 through 10 correspond to variables 2 through 11 because the header occupies the first variable. The READ statement removes the double quotes around each field and the comma between each field before placing the fields into your string variables.

If you issue a READ LINE statement, the statement places all fields in the input sequence in your string variable. The header field is first followed by 10 function code/data fields. Enclose each field in double quotes and separate them with a comma. Your application must parse the input sequence into separate fields as required.

Allowing and Disallowing Operator Input: The UNLOCKDEV statement unlocks the I/O processor. When the I/O processor is unlocked, it can receive the keyboard, reader, and scanner input as specified for the current state of the terminal. You can also specify a state ID to be set and a PRIORITY parameter. The I/O processor has two queues for operator input: a normal queue and a priority queue. You control which queue the operator input is placed in by setting the active queue to either the normal or priority queue. An UNLOCKDEV statement without the PRIORITY parameter sets the normal queue, and UNLOCKDEV with PRIORITY sets the priority queue. One use for the priority queue is when operator input is queued and an error is detected. You might want to receive new input from the operator before reading the queued input. In this case, you could set the priority queue and communicate with the operator. You could then return to the normal queue with an UNLOCKDEV statement to read the queued input and continue normal processing.

The LOCKDEV statement locks the I/O processor. When locked, the I/O processor rejects all keyboard, reader, and scanner input. If you specify the PURGE parameter on an LOCKDEV statement, all data queued to your application is discarded. The data is discarded from the currently active queue.

The PUTLONG statement can be used in place of UNLOCKDEV when additional function not provided by UNLOCKDEV is needed. This allows a particular field within a state to be made the current field. PUTLONG is typically used in conjunction with the WRITE statement.

Determining Status of the I/O Processor: Use the GETLONG statement to determine the following I/O processor status:

- I/O processor locked or unlocked
- Normal or priority queue
- If PURGE was specified on the last LOCKDEV statement executed

Preloading Input Sequence Data: An application can use the WRITE Statement (Enhanced Full-Screen mode only) to preload input sequence data. This is useful when an application reads an input sequence, detects an error, and needs the operator to correct the error. The I/O Processor places the input sequence into its internal input sequence buffer, which is where complete, validated fields are assembled into an input sequence. The I/O Processor assumes that data in the buffer is valid.

Data written to the I/O Processor must be of the same form as data read from the I/O Processor. In particular, the you must be sure to precede default data with the field's function code.

The WRITE statement also helps the application perform error recovery. For example, if the application detects something wrong with the data in one of the fields of a received input sequence, the following produces a look and feel similar to the I/O Processor's recovery of data validation errors.

- 1. Clear the field in error from the received input sequence.
- 2. Beep.
- 3. Display an operator guidance message.
- 4. Write the problem field's data to the video display using current field attributes.
- 5. LOCATE the cursor appropriately.
- 6. WRITE the input sequence back to the I/O Processor.
- 7. PUTLONG to the I/O Processor (described below). The argument to PUTLONG should specify:
- - The state to unlock to.
- - That input fields are not to be initialized.
- - That the field in error is to be current.

(If I/O Processor style error correction is not desired, steps 1, 4, and 5 are not required, and step 7 should allow initialization of input fields.)

From the operators point of view, this is what occurs (if all steps are implemented):

- 1. Data is keyed into several fields on the video display, then a motor key is pressed.
- 2. The terminal beeps.
- 3. A message is displayed indicating a problem with one of the fields.
- 4. The field in error is current, and is displaying residual keyed data.
- 5. The operator enters the correct data. The first key pressed causes the residual data to be cleared from the display and the newly keyed data to appear in its place. This is the same way that the operator corrects errors detected via the I/O Processor's data validation.

  Note that all of the fields that were not in error are still displayed and they do not need to be re-keyed. The operator may tab to them and edit them as usual.
- 6. The operator presses a motor key, and the corrected input sequence is queued to the application.

WRITE Processing: Input sequences written to the I/O Processor must be of the same form as input sequences read from the I/O Processor. A write to the I/O Processor always causes the I/O Processor to lock and any residual data in the input sequence buffer to be cleared.

The I/O Processors input sequence buffer has fixed size slots for each relative position possible with the loaded input state table. Each slot is of the size required to hold the function code and data of the longest input field defined for that relative position anywhere in the input state table. An application may write any length data up to the slot length.

If an application attempts to write field data that is too long for a slot, the data is truncated to the slot length. It is possible to write field data of a length greater than the input field length of the current state.

An application may write fewer fields to the I/O Processor than an input sequence for the loaded input sequence table would dictate. In this case, the I/O Processor fills its input sequence buffer with as many fields as were provided. Any remaining slots are left empty.

An application may write more fields to the I/O Processor than an input sequence for the loaded input sequence table would dictate. In this case, the I/O Processor fills its input sequence buffer as usual and ignores the extra data.

The application is required to provide a status field (the first field) in a write to the I/O Processor. Although required, the data in this status field is not actually used by the I/O Processor. Any string, even a null string, can be specified.

Coding the WRITE Statement: The following 4680 BASIC code fragments illustrate how to write input sequences to the I/O Processor:

```
Example 1:
!
! This is how to WRITE an input sequence that
! was read via READ LINE.
! The format string "PIC(&)" is required to prevent
! BASIC from surrounding the input sequence with an
! additional pair of double-quotes.
!
STRING INPUT.SEQUENCE$
INTEGER*2 IOP%
IOP% = 20
READ#IOP;LINE INPUT.SEQUENCE$
.
.
WRITE FORM "PIC(&)";#IOP%;INPUT.SEQUENCE$

Example 2:
!
! This is how to WRITE an input sequence that
! was read via READ.
!
STRING STATUS$,A$,B$,C$,D$,E$,F$,G$,H$,I$,J$
INTEGER*2 IOP%
IOP% = 20
READ#IOP%;STATUS$,A$,B$,C$,D$,E$,F$,G$,H$,I$,J$
.
.
WRITE#IOP%;STATUS$,A$,B$,C$,D$,E$,F$,G$,H$,I$,J$
```

Non-Full-Screen Example: The code shown here writes a message to the display, loads an input sequence table, waits for scanner input, checks the input, and writes it in readable form to the display.

```
! This routine requires that an input sequence table be created.
! In this example the table is loaded from the fixed disk in drive C.
! The table should have at least one function code, which is a motor
! function code.
! The relative position should be 3, 2, or 1 for this routine to
! display the input.
%ENVIRON T
! Declare integers.
INTEGER*2 DISPLAY
INTEGER*2 OPERIN
DISPLAY = 1
OPERIN = 2
ON ERROR GOTO ERR.HNDLR
! Open the display.
OPEN "ANDISPLAY:" AS DISPLAY
! Write a greeting.
CLEARS DISPLAY
WRITE #DISPLAY; "I/O PROCESSOR SAMPLE"
WAIT;2000
! Open the I/O processor and load an
! Input sequence table.
LOAD "ISTBL=R::C:UUUU@SMP.DAT, FMTTBL=
R::C.UUUU@LBL.DAT,MODTBL=R::C:UUUU@MOD.DAT"
OPEN "IOPROC:" AS OPERIN BUFFSIZE 70
! Prompting is displayed by the I/O processor
! as specified in the input sequence table.
KBWAIT:

! Wait for input.
WAIT;5000
! You would normally test
! for a timeout condition.
! Read the available input data.
READ #OPERIN; IOPDATA$,B$,C$,D$,E$,F$,G$,H$,I$,J$,K$
! Display 14 status bytes.
CLEARS DISPLAY
WAIT;2000
WRITE #DISPLAY;"IOP=", IOPDATA$
WAIT;2000
! Check byte 14 for I/O processor flagged edit condition.
! Return for reentry by user if error in data.
IF MID$(IOPDATA$,14,1) <> " " THEN GOTO KBWAIT
! Display three of the relative variables.
CLEARS DISPLAY
WRITE #DISPLAY;"B=", B$
WAIT;2000
CLEARS DISPLAY
WRITE #DISPLAY;"C=", C$

WAIT;2000
CLEARS DISPLAY
WRITE #DISPLAY;"D=", D$
WAIT;2000
CLEARS DISPLAY
WRITE #DISPLAY; "END OF SAMPLE"
CLOSE DISPLAY, OPERIN
```

```
! STOP
ERR.HNDLR:
! Prevent recursion.
ON ERROR GOTO END.PROG
! Determine error type
! and perform appropriate
! recovery and resume steps.
END.PROG:
STOP
END
```

Additional I/O Processor Features

Data Editing Data input fields are considered to be one-dimensional arrays up to 80 characters long. They can start on one row and continue on the following rows, but in terms of data entry and cursor movement, only left and right movement is allowed. When the last position of a row is reached, the next position is the first position of the next row. The position that precedes the first position of a row is the last position of the previous row. For cursor movement keys, the cursor wraps from the last position of a field to the first position. For data entry keys, wraparound does not occur—the cursor remains at the last position of a field when the field is full and automatic tab is not in effect. Entry of more data results in an error tone.

- Data keys

  The data keys insert characters and move the cursor to the right within the current field. The **space bar** is considered a data key that inserts a blank.

  If the field is displayed in reverse order of entry, the cursor stays in the same position, data is inserted in that position, and previously entered data moves to the left.

- **Backspace** key

  The **Backspace** key moves the cursor to the left and sets the moved-from position to null if no data follows it, or to blank if data follows it. The cursor stops at the first position of the field.

  If the field is displayed in reverse order of entry, the cursor stays in the same position and the data to the left of that position, if any, is shifted to the right to remove the data previously at the cursor position. If there is no data located to the left of the cursor position, the data at the cursor position becomes null.

- Cursor right key

  The cursor right key moves the cursor to the right if there is previously entered data to the right. If there is no previously entered data to the right, or if the end of the field is reached, wraparound to the first position of the field occurs.

  If the field is displayed in reverse order of entry, wraparound occurs to the position preceding the leftmost character previously entered. You can enter data regardless of the cursor position. If the cursor has been moved from the rightmost position, data is inserted at the cursor position. Data to the right of that cursor position is not shifted. Any data at or to the left of that cursor position is shifted left.

- Cursor left key

  The cursor left key moves the cursor to the left if it is not at the beginning of the field. If it reaches the beginning of the field, wraparound occurs to the rightmost position in the field that contains previously entered data. If there is no previously entered data, the cursor remains at the first position of the field.

  If the field is displayed in reverse order of entry, wraparound occurs from the leftmost position containing previously entered data to the rightmost position of the field.

- **Insert** key

  The **Insert** key is a toggle. Data keys following the **Insert** key (until it is pressed again) are inserted into the field at the cursor position, the cursor moves to the right, and data to the right of the cursor's previous position is moved to the right.

  If the field is displayed in reverse order of entry, the Insert key has no effect—data to the left of the cursor is moved to the left as data is inserted at the cursor position.

- **Delete** key

  The **Delete** key causes the data at the cursor position to be deleted. All data to the right of the cursor is moved to the left to occupy the vacated position. The cursor remains in the same position.

  If the field appears in reverse order of entry, data to the left of the cursor is moved to the right to occupy the vacated position.

Note: The cursor up, cursor down, PgUp, PgDn, **Home**, and **End** keys are processed as any other configurable function keys.

Customization of Message Display (Enhanced Full-Screen mode only): The I/O Processor writes data to the display in three general categories: state prompt messages, error messages, and display-as-keyed data. If the enhanced full-screen support is not selected, this data is always written to the top left 2x20 area of the video display. If the enhanced full-screen support is selected and the state definition specifies that the display fields are defined in the function code definitions, the data written by the I/O Processor may be customized in the following ways:

- Location

  You specify the row and column of the upper left character of the message area. In the case of a bordered message, this would be the location of the top left corner character.

- Width of display area

  You may specify the width of the display area. If a border was specified (see below), this width includes the 2 positions occupied by the left and right border characters. The specified display width may be narrower or wider than the actual message. If it is narrower, then the message text is clipped to the display width (if bordered, it is clipped to within the borders). If the display width is specified as being wider than the message, then the unwritten area of the display width is written with blanks.

- Border

  You may specify that a border surrounds the message. You specify the border characters as eight hex values for the eight parts of the border: top left corner, top, top right corner, left, right, bottom left corner, bottom, bottom right corner.

- Attributes (colors, blink, etc.)

  You may specify a hex attribute byte to be used for the message area. This byte must be defined in the Feature A attribute format of the video driver. See the video section in the *4680 Basic Language Reference* for a description of the Feature A attribute format.

- Single or Double Line Formatting

  You may specify whether the message text is to be displayed in a 2x20 format or a single line format. Although messages are no longer necessarily displayed in a 2x20 format, the method of defining this data remains unchanged. That is, the IST Build Utility presents you with a 2x20 box in which to specify the message text.

  If the single line format is selected, the I/O Processor concatenates the line-1 text and the line-2 text such that there is exactly one blank between the last non-blank character preceding column 20 and the first non-blank character at or after column 20. This is so that messages formatted for 2x20 display appear correctly without requiring redefinition.

- Centering

  You may specify that the message text is to be centered within the defined display area. The centering option is ignored for display-as-keyed messages and 2x20 formatted messages.

  Note: Customization information is specified in the Common Information section of the State Table. There is one specification for prompt messages, one specification for error messages, and one specification for display-as- keyed data associated with non-full-screen states (for full-screen states, there are separate display-as-keyed specifications for each field in each full-screen state). The prompt and error message specifications are in effect for all states. The display-as-keyed specification is in effect for all non-full-screen states.

  The I/O Processor does not save and restore the areas of the screen to which it writes data. It is the application's responsibility to clear any undesirable residual data from the screen. The I/O Processor writes to the display according to information in the State Table. The State Table part of the application and the executable part of the application should be developed to work in harmony with each other.

  If the display-as-keyed area is a 2x20 box at the top left of the display with default attributes and with no border, no change to this area occurs until the operator starts keying in a non-full-screen state (no change from the behavior when enhanced full-screen support is not used). If the display-as-keyed area is anything other than the default 2x20 box, it is initialized when an unlock to a non-full-screen state occurs (the same behavior as fields of a full-screen state). This implementation allows you to add full-screen function to an application that was previously non-full-screen and preserve the behavior of parts of the application that were not changed, but improve the behavior of parts that are changed.

  Of concern to the application programmer is the fact that all unwritten positions of the defined display area are written with blanks in order for their attributes to be visible. If the display-as-keyed area and the prompt area are both configured to occupy the same 2x20 area on the screen, the display-as-keyed area will overlay the prompt.

  As an example, consider implementing a 2x30 area to be used for both prompts and display-as-keyed data. You could configure the prompt messages as single-line, 30 characters wide, originating at row 1 column 1, and the display-as-keyed messages as single line, 30 characters wide, originating at row 2 column 1. The display-as-keyed area no longer interferes with the prompt area. Note that for this case, the asterisks defining the location of keyed data must not be placed beyond column 10 of the 2nd line, as this is offset 30 into the defined display area. Any data that spills out of the defined display area is clipped (not displayed).

An Example: Implementing a Shared Message Line: Assume that you are using a 16x60 display, and that you want to use the bottom line of the video for both application and I/O Processor messages. Using the IST Build Utility, define the error messages location and attributes as follows:

- Display at row 16, column 1.
- Format for single line display.
- The display area is 60 characters wide.
- The text is to be centered within the display area.

When the I/O Processor detects an error, it displays the message text on the defined message line. There is a problem here, however. The error message is not cleared from the message line after the error condition has been corrected. The solution is to define a blank message to be displayed when a function code is received without error. Use the IST Build utility to define this message for each function code definition (it is necessary to type spaces over the underscores to create a blank message). The function code for an input field is received when a tab or motor key is pressed. This is a reasonable time to clear the message.

The application is free to write to the same message line. To prevent the I/O Processor from writing to the message line at the same time as the application, the application should ensure that the I/O Processor is locked. The application does a PUTLONG to the video display to set the color, then a LOCATE to row 16 column 1, then a WRITE to the video. Since the operator does not need to be aware of the source of the message, the application and the I/O Processor form a more integrated solution than that which is possible without using the enhanced full-screen support.

Large Input Sequences (Enhanced Full-Screen mode only): When the enhanced full-screen support is not selected, the maximum number of input fields per state is limited to 10 (not including the status field). The maximum has been raised to 127 when enhanced full-screen support is selected. Relative positions 1 through 127 may be defined. The actual number of relative positions that are received by an application on a read of the I/O Processor depends on the highest relative position defined for any state in the input sequence table. If the highest number defined is 10 or less, then there will be 10 relative positions in the input sequence (not including the status field). Otherwise, the number of relative positions in the input sequence will be equal to the highest relative position defined for any state. This is the number of relative positions that an application will receive for EACH read of the I/O Processor, regardless of which state is current. Specifying too few or too many variables on a READ FORM statement is an error. For this reason, READ LINE is now the recommended method of reading from the I/O Processor. The 3-character ASCII representation of the number of relative positions contained in the input sequence is available in the status field. See *Status Field Extensions* below for details. The buffer size specified in the BASIC OPEN statement previously limited the input sequence buffer size to 200 bytes. This limit has been removed. There is no artificial limit imposed on the buffer size.

EXAMPLE 1: An input sequence table defines 3 states. State 1 defines function codes with relative positions 1,2,3,4, and 5. State 2 defines function codes with relative positions 1,6, and 9. State 3 defines function codes with relative positions 3 and 4.

On each read of the I/O Processor, regardless of which state is current, the I/O Processor will provide an input sequence containing 10 relative positions (not including the status field).

EXAMPLE 2: An input sequence table defines 3 states. State 1 defines function codes with relative positions 1,2,3,4, and 5. State 2 defines function codes with relative positions 1,6, and 9. State 3 defines function codes with relative positions 9,10,11,12 and 13.

On each read of the I/O Processor, regardless of which state is current, the I/O Processor will provide an input sequence containing 13 relative positions (not including the status field).

Magnetic Stripe Reader Driver

This section describes the single-, dual-, and three-track magnetic stripe reader drivers and provides guidelines for using them.

Characteristics of the Single-Track Magnetic Stripe Reader

The single-track MSR has the following characteristics:

- The single-track MSR attaches to the top of the keyboard and connects to the keyboard by a cable.

- The MSR can read data encoded on a card (credit card or badge) as the card is passed through a slot in the reader. The single-track MSR reads track 2 data as specified in the following standards:
  - "The American National Standards Institute (ANSI) Specifications for Magnetic-Stripe Encoding for Credit Cards", ANSI X4.16-1983
  - "The American National Standards Institute (ANSI) Specifications for Credit Cards", ANSI X4.13-1983.
- The data available to your application consists of the account number field, a separator character, and a discretionary data field. The account number can be a maximum of 19 characters. The discretionary data field can be up to 36 characters. The total number of characters occupied by the account number field, the separator character, and the discretionary data field cannot exceed 37.

Characteristics of the Dual-Track Magnetic Stripe Reader

The dual-track MSR has the following characteristics:

- The dual-track MSR attaches to the top of the keyboard or connects directly to slot 5B on the back of the base unit.
- There are two models available: one reads tracks 1 and 2 data and the other reads tracks 2 and 3 data.
- The returned data consists of a buffer of 144 bytes. The first 37 bytes of data from track 2 are in the same format as the single-track MSR (the 37 bytes are padded with X'00' characters if needed). The data from track 2 is followed by a one-byte field containing the length of the actual data in the first 37 bytes (or X'FF' to indicate an error on track 2). Following that field is a one-byte field with the length of the data from track 1 or 3 (or X'FF' for error) followed by 105 bytes of data from track 1 or 3 (the 105 bytes are padded with X'00' if needed).
- When receiving data, the dual-track MSR formats track 1 data as alphanumeric using only the lower 6 bits of each byte. The maximum number of data characters on track 1 is 80 characters. Track 3 data is numeric only and has the same format as track 2 binary coded decimal (BCD). The maximum number of data characters on track 3 is 105 characters.

X'FF' in either length field is the same as return code 80A5000B for the track with the error. The 80A5000B code is returned if both tracks contain read errors. If an error is encountered on track 2, and track 1 or 3 is valid, the track 2 data starts with 1 byte of X'00' followed by the separator X'0D' then padded with X'00' to 37 bytes.

Characteristics of the Three-Track Magnetic Stripe Reader

The three-track MSR has the following characteristics:

The three-track MSR can read all or any combination of the three tracks.

- Track 1 data is alphanumeric. The driver returns a maximum of 98 data characters from track 1.
- Track 2 data is numeric only. The driver returns a maximum of 46 data characters from track 2. However, if operating in single- or dual-track mode, the maximum number of data characters returned is 37.
- Track 3 data is numeric only. The driver returns a maximum of 139 data characters from track 3.

Data Formats and Error Reporting

The data formats for the various MSR devices supported by the three-track MSR are:

- Single-track MSR

  Single-track MSRs support reading data from track 2 only. The return code from the READ statement provides the actual number of bytes read. See Format 01 in Figure 3-1 on page 3-51.

If an error occurs, the first byte of the returned buffer contains a X'00', followed by the separator character X'0D'. The remainder of the buffer is padded with X'00'

- Dual-track MSR
  - Dual-track MSRs read data from track 2 and either track 1 or track 3. The data is returned in a single buffer. The return code of the READ statement provides the size of the buffer. See Format 02 in Figure 3-1 on page 3-51.
  - The dual-track MSR driver supports single-track emulation. The single-track MSR description applies when operating in this mode.
  - The length field of each track contains the actual number of characters read from that track. If a read error occurs on either track, but not both, the length field for the track on which the error occurred has a value of X'FF', and the buffer is padded with X'00'. If a read error occurs on both tracks, the return code from the READ statement is 80A5000B, and the entire buffer is padded with X'00'. Refer to the *IBM 4690 Store System: Messages Guide* for a description of the 80A5000B return code.
- Three-track MSR

  Three-track MSRs read data from all tracks.

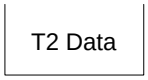
  If the device is configured for single-track emulation (track 2 only), or as a dual-track device (tracks 1 and 2 or tracks 2 and 3), the amount and format of the data is identical to that previously described.

  The three-track device provides additional individual track capacities and capabilities. The various formats are described in Figure 3-1 on page 3-51.

  Error reporting is done the same as with the dual-track MSR. If one or more, but not all, configured tracks report a read error, the length field for each track in error has a value of X'FF', and the buffer for each track is padded with X'00'. If a read error occurs on all configured tracks, the return code from the READ statement is 80A5000B, and the entire buffer is padded with X'00'. Refer to the *IBM 4690 Store System: Messages Guide* for a description of the 80A5000B return code.

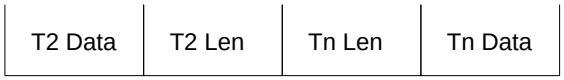
Format of the Data in the Applications Buffer

Format 01 - Single-track - Track 2 data returned



37 bytes maximum

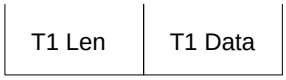
Format 02 - Multi-track - Track 2 data and Track 1 or 3 data returned



37 bytes 1 byte 1 byte n bytes

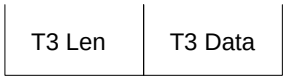
n = Track 1 or 3 (98 or 139 respectively)

Format 04 - Single-track - Track 1 data returned



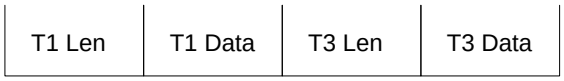
1 byte 98 bytes

Format 08 - Single-track - Track 3 data returned



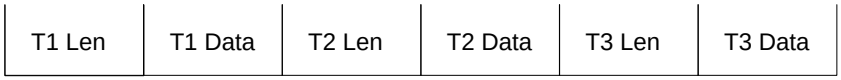
1 byte 139 bytes

Format 10 - Multi-track - Tracks 1 and 3 data returned



1 byte 98 bytes 1 byte 139 bytes

Format 20 - Multi-track - All tracks data returned



1 byte 98 bytes 1 byte 46 bytes 1 byte 139 bytes

Tn = track number

Figure 3-1. Multi-Track Reader Data Formats

Table 3-3 shows the applicable formats of returned data as a function of MSR configuration.

Table 3-3. Applicable Formats of Returned Data

Device Type	Configuration		Format
	Number of Tracks	Which Tracks	
Dual-Track	1	2	01
Dual-Track	2	1 and 2	02
Dual-Track	2	2 and 3	02
Three-Track	1	1	04
Three-Track	1	2	01
Three-Track	1	3	08
Three-Track	2	1 and 2	02
Three-Track	2	2 and 3	02
Three-Track	2	1 and 3	10
Three-Track	3	1, 2, and 3	20

Restrictions of Single- and Multi-Track MSRs

Only one is allowed per terminal. Mod1 and Mod2 terminal pairs cannot have different types of MSRs attached.

Functions Your Application Performs

Your application program can perform the following functions with the MSR:

- Allow or disallow data to be read from a card.
- Wait until data is available.
- Read card data.
- Determine data-allowed or data-disallowed status.
- Determine format of the data returned by the MSR.

Accessing the MSR

Use the OPEN statement to gain access to the MSR driver.

The CLOSE statement ends communication with the MSR. CLOSE locks the MSR and discards any data available.

Preparing to Receive Data from the MSR

The MSR can be in two states, *locked* and *unlocked*. In the locked state, data cannot be read. In the unlocked state, data can be read. Initially the MSR is in the locked state. You must issue an UNLOCKDEV statement to put the MSR in the unlocked state. After being read by the MSR, data is available but not passed to the application until a READ LINE statement is executed. If your application issues an UNLOCKDEV statement when the MSR has data available, the data is discarded.

The MSR changes from unlocked to locked when one of the following occurs:

- Valid data is read from a card.
- Your application issues a LOCKDEV statement.
- Your application ends communication with the MSR by a CLOSE statement.

Issue the UNLOCKDEV statement each time you prepare to read data from the MSR.

Waiting for Received Data

Your application should issue a WAIT statement to wait for data available from the MSR. The WAIT statement allows the application to wait for input from multiple devices. These devices include a timer to indicate that no input was received during a specific time. When valid data is available from the MSR, the statement following the WAIT is executed. Following the WAIT, use the EVENT% function to determine if data is available to be read from the MSR. If an error occurs during a WAIT, control is given to your ON ERROR routine.

Receiving Data

Issue a READ LINE statement to receive data from the MSR. READ LINE is a synchronous operation. If valid data is available from the MSR, the READ LINE is completed, and the variable specified on the READ LINE statement contains the data. If an error occurs, control is given to the ON ERROR routine.

The driver validates the buffer size passed to it. If the buffer size is insufficient to handle all potential data for the active configuration, the driver returns 80A50004. Refer to the *IBM 4690 Store System: Messages Guide* for a detailed description of the 80A50004 return code.

After good data is received, the MSR is locked.

Data Characteristics Common to all MSRs

The data characters in the application's buffer are in BCD format. Only the characters 0 through 9 and a separator character can appear in the buffer. Zero is 00H, nine is 09H, and the separator is 0DH.

Parity checking and other data used by the hardware are not passed to the application. The return code from the READ LINE statement contains the amount of data returned.

The characteristics specific to single-track or multi-track MSRs are:

- Single-track MSRs

  The total number of bytes returned to the application cannot exceed 37.

- Multi-track MSRs
  - The maximum number of data characters on track 1 is 102.
  - The maximum number of data characters available to the application from track 2 is increased to 46 when operating a three-track device in specific configurations (see Figure 3-1 on page 3-51).
  - The maximum number of data characters on track 3 is 103 for a dual-track device and 139 for a three-track device.

Disallowing MSR Data

Issue the LOCKDEV statement to prevent the MSR from receiving card data. If data is already available when you issue the LOCKDEV statement, the data is discarded.

Determining Status of the MSR

Use the GETLONG statement to make the following determinations:

- The state of the MSR – Locked or Unlocked
- Which of tracks 1 or 3 is connected for a dual-track MSR
- The format of the returned data for a three-track MSR

Integer Format for Single-Track MSR Driver: The integer represents information in the form *RRRRRRLL*. *RR, RR, RR*, and *LL* represent one of the four bytes. The *RRRRRR* bytes are reserved for system use.

The *LL* bytes represent the following state information:

LL **=** 0 if the MSR is unlocked.
LL **=** 1 if the MSR is locked.

Integer Format for Dual-Track MSR Driver: The integer represents information in the form of *RRSSRRLL*, where *RR, SS, RR*, and *LL* each represent one of the four bytes. The only difference between the single and dual-track data is *SS*, which represents the status information. The *RR* bytes are reserved for system use.

The *LL* byte represents the following state information:

LL **=** 0 if the MSR is unlocked.
LL **=** 1 if the MSR is locked.

Integer Format for Three-Track MSR Driver: The integer represents information in the form *RRSSFFLL*, where *RR, SS, FF*, and *LL* each represent one of the four bytes. The *RR* bytes is reserved for system use.

The *LL* byte represents the following state information:

LL **=** 0 if the MSR is unlocked.
LL **=** 1 if the MSR is locked.

The *SS* byte represents the following status information:

Bit 0 = 0 RESERVED
Bit 1 = 0 RESERVED
Bit 2 = 1 Track 1 Enabled
Bit 3 = 1 Track 2 Enabled
Bit 4 = 1 Track 3 Enabled
Bit 5 = 1 EC Level Response
Bit 6 = 0 RESERVED
Bit 7 = 0 RESERVED

The *FF* byte represents the following formatting information:

Bit 0 = 1 Format 01
Bit 1 = 1 Format 03
Bit 2 = 1 Format 04
Bit 3 = 1 Format 08
Bit 4 = 1 Format 10
Bit 5 = 1 Format 20
Bit 6 = 0 RESERVED
Bit 7 = 0 Dual-Track Device
Bit 7 = 1 Three-Track Device

Single-Track MSR Example

This example reads data from a card passed through the MSR. The data is converted and displayed. The example processes three card reads before ending.

```
%ENVIRON T
! Declare integers.
INTEGER*2 DISPLAY
INTEGER*2 MSREADER
! Convert data to display characters.
FUNCTION CONVERT.TO.HEX$(THE.SUM%)
 IF THE.SUM% > 9 THEN \
 THE.SUM%=THE.SUM%+55\
 ELSE                \
 THE.SUM%=THE.SUM%+48
 CONVERT.TO.HEX$=CHR$(THE.SUM%)
 EXIT FUNCTION
END FUNCTION

DISPLAY = 1
MSREADER = 2
ON ERROR GOTO ERR.HNDLR
! Open the display.
OPEN "ANDISPLAY:" AS DISPLAY
! Write a greeting and wait 2 seconds.
CLEARS DISPLAY
WRITE #DISPLAY; "MS READER SAMPLE"
WAIT;2000
! Open the magnetic stripe reader driver.
OPEN "MSR:"  AS MSREADER
! Loop and read three cards.
FOR I% = 1 to 3
 UNLOCKDEV MSREADER
! Display instructions.

 CLEARS DISPLAY
 WRITE #DISPLAY;"PASS A CARD THROUGH"
 MSRWAIT:
! Wait for input 5 seconds.
 WAIT MSREADER;5000
! You would normally test for
! a timeout condition.
! Read the available input data.
 READ #MSREADER; LINE MSRDATA$
! Convert the input to characters that can be displayed
```

```
 DISPL.DATA$ = " "
! Loop through the input data and convert
! each character.
 FOR J% = 1 to LEN(MSRDATA$)
  A$=MID$(MSRDATA$,J%,1)
  THE.SUM% = ASC(A$)
  A$=CONVERT.TO.HEX$(THE.SUM%)
  DISPL.DATA$ = DISPL.DATA$ + A$
 NEXT J%
! Display input data and wait 2 seconds.
 CLEARS DISPLAY
 WRITE #DISPLAY;DISPL.DATA$
 WAIT;2000
NEXT I%
CLEARS DISPLAY
WRITE #DISPLAY; "END OF SAMPLE"
CLOSE DISPLAY,MSREADER
STOP

ERR.HNDLR:
! Prevent recursion.
ON ERROR GOTO END.PROG
! Determine error type and perform appropriate
! recovery and resume steps.
END.PROG:
STOP
END
```

Dual-Track MSR Example

This example reads data from a card passed through the MSR. The data is converted and displayed. The example processes three card reads before ending.

```
%ENVIRON T
! Declare variables.
INTEGER*2 DISPLAY
INTEGER*2 MSR2.READER
STRING    MSR2.DATA
STRING    MSR2.DATA.TRACK2
STRING    MSR2.DATA.TRACK13
INTEGER*2 L1,L2
DISPLAY=1
MSR2.READER=2
ON ERROR GOTO ERR.HNDLR
! Open the display.
OPEN "ANDISPLAY:" AS DISPLAY
! Write greeting and wait 2 seconds.
CLEARS DISPLAY
WRITE #DISPLAY; "MSR2 SAMPLE"
WAIT;2000
! Open the MSR driver.
OPEN "MSR:" AS MSR2.READER
! Loop and read 3 cards.
FOR I%=1 TO 3
 UNLOCKDEV MSR2.READER
! Display instructions.
 CLEARS DISPLAY
 WRITE #DISPLAY; "PASS A CARD THROUGH ",I%
```

```
 MSRWAIT:
! Wait for 5 seconds.
 WAIT MSR2.READER;5000
! You would normally test for a timeout condition.
! Read the available input data.
READ #MSR2.READER; LINE MSRDATA$
! Get the length of the track 2 data (255 indicates error).
L1=ASC(MID$(MSRDATA$,38,1))
! Get the length of the track 1 or 3 data (255 indicates error).
L2=ASC(MID$(MSRDATA$,39,1))
! Process track 2 data.
IF L1 = 255 THEN \
  BEGIN
! Display error message.
    CLEARS DISPLAY
    WRITE #DISPLAY; "TRACK 2 ERROR"
    WAIT;3000
    ENDIF \
ELSE \
  BEGIN \
    MSR2.DATA.TRACK2 = MID$(MSRDATA$,1,L1)
! Here you would convert the input to
! characters and display it.
  ENDIF
! Process track 1/3 data.
IF L2 = 255 THEN \
  BEGIN
! Display error message.
    CLEARS DISPLAY
    WRITE #DISPLAY; "TRACK 1/3 ERROR"
    WAIT;3000
    ENDIF \
ELSE \
  BEGIN \
    MSR2.DATA.TRACK13 = MID$(MSRDATA$,40,L2)
! Here you would convert the input to
! characters and display it.
  ENDIF
NEXT I%
CLEARS DISPLAY
WRITE #DISPLAY; "END OF SAMPLE"
CLOSE MSR2.READER,DISPLAY
STOP
ERR.HNDLR:
! Prevent recursion.
ON ERROR GOTO ERR.EXIT
! Determine error type and
! perform appropriate recovery
! and resume steps.
ERR.EXIT:

STOP
END
```

Three-Track MSR Example

The following example reads data from a card passed through the MSR. The data is converted and displayed. The example processes three cards before ending.

```
%ENVIRON T
! Declare variables.
INTEGER*2 DISPLAY
INTEGER*2 MSR2.READER
INTEGER*2 L1, L2, L3
INTEGER*4 CONFIG,MSRTYPE,MSRFMT,MSRSTA
STRING    MSRDATA$,MSRDATA1$,MSRDATA2$,MSRDATA3$,DISPLINE$
STRING    MSRSTA$
DISPLAY=1
MSR2.READER=2
ON ERROR GOTO PROGERR
! Open the display.
OPEN "ANDISPLAY:" AS DISPLAY
! Write greeting and wait 2 seconds.
CLEARS DISPLAY
DISPLINE$="MSR3 SAMPLE"
WRITE #DISPLAY; DISPLINE$
WAIT;2000
! Open the MSR driver.
OPEN "MSR:" AS MSR
! Get device information.
CONFIG=GETLONG(MSR)
! Isolate device type.
MSRTYPE=CONFIG AND 00008000H
MSRTYPE=SHIFT(MSRTYPE,8)
! Here you would determine if operating with a dual-track
! or 3-track device.
! Isolate data format.
MSRFMT=CONFIG AND 00007F00h
MSRFMT=SHIFT(MSRFMT,8)
! Here you would determine the format of the data
! to be received.
! Isolate status.
MSRSTA=CONFIG AND 00FF0000H
MSRSTA=SHIFT(MSRSTA,16)
! Here you would determine the status of the device.
! Loop and read three cards.
FOR I%=1 TO 3
 UNLOCKDEV MSR
 CLEARS DISPLAY
 DISPLINE$= "PASS A CARD THROUGH",I%
 WRITE #DISPLAY; DISPLINE$
 MSRWAIT:
! Wait for 5 seconds.
 WAIT MSR;5000
! You would normally test for a timeout condition.
! Read the available input data.
READ #MSR; LINE MSRDATA$
! Get the length of the data on each track - this example
! assumes all three tracks are configured
L1=ASC(MID$(MSRDATA$,1,1))
L2=ASC(MID$(MSRDATA$,100,1))
L3=ASC(MID$(MSRDATA$,147,1))
```

```
! Process track 1 data.
IF L1 = 255 THEN \
  BEGIN
! Display track error message.
    CLEARS DISPLAY
    DISPLINE$= "TRACK 1 ERROR"
    WRITE #DISPLAY; DISPLINE$
    ENDIF \
ELSE \
  BEGIN \
    MSRDATA1$ = MID$(MSRDATA$,2,L1)
! Here you would convert the input to
! displayable characters and display it.
  ENDIF
! Process track 2 data.
IF L2 = 255 THEN \
  BEGIN
! Display track error message.
    CLEARS DISPLAY
    DISPLINE$= "TRACK 2 ERROR"
    WRITE #DISPLAY; DISPLINE$
    ENDIF \
ELSE \
  BEGIN \
    MSRDATA1$ = MID$(MSRDATA$,101,L2)
! Here you would convert the input to
! displayable characters and display it.
  ENDIF
! Process track 3 data.
IF L3 = 255 THEN -
  BEGIN
! Display track error message.
    CLEARS DISPLAY
    DISPLINE$= "TRACK 3 ERROR"
    WRITE #DISPLAY;DISPLINE$
    ENDIF \
ELSE \
  BEGIN \
    MSRDATA1$ = MID$(MSRDATA$,148,L3)
! Here you would convert the input to
! displayable characters and display it.
  ENDIF
NEXT I%
CLEARS DISPLAY
DISPLINE$= "END OF SAMPLE"
WRITE #DISPLAY; DISPLINE$
CLOSE MSR
STOP
PROGERR:
! Prevent recursion.
ON ERROR GOTO ERR.EXIT
! Determine error type and
! perform appropriate recovery
! and resume steps.
ERR.EXIT:

STOP
END
```

Printer Driver Model 2

This section describes the model 2 printer driver and provides information on accessing and using it.

Characteristics

The printer is composed of a single bidirectional print head and two stations that provide three logical stations. The first station is called the customer receipt/document insert (CR/DI) station; the second is called the summary journal (SJ) station.

You can use the CR/DI station to print on a customer receipt or an inserted document. When a document is used, it is positioned between the customer receipt and the print head. You cannot use the CR/DI station to print on the customer receipt tape and a document at the same time.

At each station, the print head can print 38 characters on a line. It prints each character on a 7 x 8 dot matrix. Three columns of dots to the right of each character are reserved for spacing. The print line for each station measures 380 dots across.

One line feed advances the paper 11 vertical dots. A printed line becomes visible to the operator at either station after the printed line is advanced eight line feeds.

Printing one line takes approximately 0.5 seconds. One line feed takes approximately 0.075 seconds in the CR/DI station and up to 0.158 seconds in the SJ station.

The operating system supports logo printing, character printing, and check printing. This facility allows you to print any dot in the middle 300 dots of a 380-dot line at the CR/DI station. Logos cannot be printed at the SJ station. Partial line feeds are available for the CR/DI station. Each partial line feed advances the line by one dot. You can print logos taller than 8 dots by using partial line feeds to print adjoining logo patterns.

A default dot matrix is supplied for many of the available 256 code points. You can redefine the dot matrix configuration for most characters. You cannot define horizontally adjacent dots. The system prints undefined characters as a single dot. Refer to the *IBM 4680 BASIC: Language Reference* for the definition of the default character set.

Functions Your Application Performs

Your application program can perform the following functions with the printer:

- Write characters to any station.
- Write all-points-addressable data to the CR/DI station.
- Control document insertion and sensing.
- Obtain status.
- Wait for outstanding print lines to print.

Accessing the Printer

Use the OPEN statement to gain access to the printer device driver. The name for each print station is:

CR: Customer receipt station
SJ: Summary journal station
DI: Document insert station

Note: The colon is part of the name, and you must open each station before it will print.

The CLOSE statement ends communication with a printer station. You must issue a CLOSE statement for each print station to which your application has issued an OPEN.

Preparing a Line To Print

You can specify the data to be printed on a line in one or more expressions. Each expression can be a string or of numeric type. The format string on the WRITE FORM statement defines how these expressions are formatted for a print line. Refer to the *IBM 4680 BASIC: Language Reference* for a description of a format string.

Printing a Line of Text at the Printer

Use the WRITE FORM statement to print one line in the CR/DI or SJ station. An I/O session number, specified in the OPEN statement, indicates which printer station to use. Specify line feed information in the format string.

The printer driver prints the line asynchronously to execution of your application. You can issue multiple WRITE FORM statements to queue more than one print line to the printer driver. If you attempt to queue more than five statements, your application must wait until buffer space becomes available in the queue. Each print line must contain 38 bytes of data. The system performs line feeds after the data is printed. To line feed before printing a line, execute a WRITE FORM specifying the number of line feeds required with data of all blanks. If the data in a print line is all blanks, the system moves the print head only if necessary to return the head to home position. Home position is between the CR/DI and SJ stations.

Controlling the Document Insert Station

Use the PUTLONG statement to control the DI station options. The following bit values refer to byte MM, which contains the DI control bits.

Bit 4 controls whether manual or automatic document insertion mode is selected. If manual mode is selected (bit 4=0), the document is inserted from the side of the DI station, manually aligned, and the station manually closed using a printer button. Keyboard input can be used to let the application know that the document is ready for printing. If automatic mode is selected (bit 4=1), the document is inserted from the front until the document is stopped by the gate. When printing is started at the DI station, the station closes and performs the print operation. The difference between manual and automatic mode as viewed from the application program is that the printer driver closes the station in automatic mode when printing is started at the DI station. In manual mode, the operator must close the station.

If a document is pulled from the top of the DI station, the station can be left closed without a document inserted. You can open the station by using the printer open and close button, or by using the CR/DI station line feed button. Your application can also issue a WRITE FORM to the CR station.

Bit 5 controls whether the application is notified if a document is removed and replaced between print lines at the DI station. If a document is not in the DI station when a print at the DI station is being performed,

your application receives an error notification that the document is missing. If your application needs notification on document removal (bit 5=0), the driver remembers that the document was removed. The driver remembers this even if the document was removed while no print operation was being done. After removal, on the next print at the DI station, the application receives an error stating the document is not inserted. This error occurs even if the document was replaced before the print operation. The error notification allows your application to take action on this condition. This action could be to void the transaction or to log the occurrence. The status is reset from document-inserted to not-inserted when either the error is passed to the application or when a print is done at the CR station.

Bits 6 and 7 control options for use of a document while printing at the CR station. Documents can be inserted from the front or side of the DI station. If the document is inserted from the side, it can be aligned to reach above the print head path so that any printing at the CR station is printed on the document because it is physically in front of the CR paper. If the document is inserted from the front, it stops when the gate is reached, and printing at the CR station is done on the CR paper (not the document). If the document is inserted from the front before a DI print, the document is ready for printing without having to prompt the operator to insert the document. The printer controls the use of a document during CR printing as follows:

- If bit 6=0 and bit 7=0, a document cannot be inserted if printing is done at the CR station. A print to the CR station results in an error if a document is inserted.
- Bit 6=0 and bit 7=1 is not a valid combination. If a PUTLONG is issued with this combination, the PUTLONG results in an error.
- If bit 6=1 and bit 7=0, a document can be inserted even if a print is issued to the CR station. No error results because a document is inserted.
- If bit 6=1 and bit 7=1, a document must be placed in the DI station when printing at the CR station. If a print to the CR station is issued and a document is not inserted, an error results stating that a document is missing. This option is normally used to ensure that a document is inserted before printing on the CR receipt tape. The document can be printed after the CR receipt is printed.

When your application issues a PUTLONG statement, the options specified affect all WRITE FORM statements issued after the PUTLONG. The new PUTLONG options do not affect queued print operations resulting from WRITE FORM statements that were issued before the PUTLONG.

Determining the Printer Status

Use the GETLONG function to determine printer status information. This function returns the current settings of the DI control bits set by PUTLONG and printer status information. The status information includes:

- Printer status (reset or not reset)
- Paper status for SJ station (low or paper jam or not low and no paper jam)
- Document insertion status (inserted or not inserted)
- DI station status (open or closed)
- Printer head status (at home or not home)
- Printer cover status (open or closed)

Printing Checks

Checks are inserted vertically and the characters printed sideways. Check printing can be done only at the DI station of a Model 2 printer. The check must conform to the United Kingdom Association for Payment Clearing Services (APACS) standard, or all of the data to be printed on the check must fit into the area between the 84th print position to the right of the left margin and the 156th print position to the left of the right margin. (A total of 380 print positions are available.) To print an APACS check, the check is inserted with the amount field at the top.

Check printing is useful because the customer does not have to write out the check. A blank check is handed to the cashier by the customer. The cashier inserts the check into the document insert station, and the printer types the date, amount, and payee. Then the customer signs the check.

Formatting the Data

Your application can detect if a Model 2 printer is attached by checking bit 3 of GETLONG byte SS. If bit 3 is 1, the printer supports check printing. To use check printing, the application issues a PUTLONG to any of the printer stations with bit 3 of byte MM set to one. This instructs the printer driver to interpret the next WRITE LOGO to the DI station as a check printing command. The WRITE LOGO statement is used to print checks.

The format of the data array specified on the WRITE LOGO statement is similar to normal WRITE LOGO data. The printing field is variable in size and smaller than the 300 dot print field of a normal WRITE LOGO statement. The first three array elements contain some control information. The application can give more than one line of check data to the driver on one WRITE LOGO. This function allows the printer driver to print the check faster. The maximum amount of check data must fit into the 381 array elements used by the WRITE LOGO statement. The check data passed to the driver with the WRITE LOGO statement is in slice form, which means that each byte represents a column of eight dots on the paper. The data on a normal WRITE LOGO statement is also in slice form. The application is responsible for translation of character data to slice data and the rotation of the data for vertical printing. The system sends the data to the printer horizontally.

The printer has a total of 380 print positions: there are 190 called *primary* and 190 called *secondary*. The even-numbered print positions are primary beginning at zero, and the odd-numbered positions are secondary. The first byte in the buffer is the number of primary print positions between the home position and the first right position of the data to be printed.

Note: When counting print positions, begin counting from right to left. The lowest number is the print position closest to home. The highest number is the print position closest to the margin.

Check data can be printed only from primary position 78 to primary position 148. Use caution in changing the value of this byte. If one WRITE LOGO contains a different value in this byte than the previous WRITE LOGO for the same check, the printer moves the print head to home before printing the new data with the new offset. Check printing can slow if small changes are frequently made to this byte. Performance is improved if the application does not revert to the previous offset. However, increasing the value in this byte decreases the area where the print head is moved, which can improve performance.

The following control information must be contained in the first three array elements (bytes 1, 2, and 3):

- Byte 1 plus the dividend of byte 2 divided by 2 equals the number of primary print positions taken up by the print line. Byte 1 divided by 2 is less than or equal to 148.
- Byte 2 in the buffer equals the length of the data (that is, the number of bytes of data for one line of the check data). Byte 2 cannot be less than 50 bytes and should be an even integer.
- Byte 3 equals the number of lines buffered in the WRITE LOGO buffer. The buffer that passes to the printer driver on a WRITE LOGO always has 380 bytes for print data. One line of check data is always less than 377 bytes. Byte 3 should always be less than or equal to 377 when it is divided by the value of byte 2 and rounded to the nearest integer.

  Note: To reduce processing time, the application can pass multiple check print lines to the driver simultaneously.

Character Sets

Character sets are used to print the check data. Byte 381 contains the number of dots to advance the paper after each line is printed. If the 5 x 8 dot character set is being used, the byte should be set to 6. If the 8 x 8 dot character set is being used, the byte should be set to 9. Characters cannot be split across print lines. You should move the print head to the home position after the check is printed to ensure that the check printed correctly. There are two ways to code the application to move the print head:

- Perform a TCLOSE after the last line of the check is printed.
- On the last WRITE LOGO, set the high-order bit of byte 381 to ON. The driver looks at the high-order bit of byte 381. On the last printed line of the WRITE LOGO, the driver commands the printer to return the print head to the home position.

  This procedure is faster than a TCLOSE because a TCLOSE forces the application to wait until all queued prints have completed the procedure.

Problem Determination

To perform problem determination, an ASYNC error with the error number 80900524 results from one of the following conditions:

- The first three bytes of the data in the WRITE LOGO buffer do not conform.
- There are adjacent wire-fires in the print data.
- The printer does not support check printing.

Your application can determine the cause of the error by checking bit 3 of byte SS. The return code is ERRN=80900524H.

Your application must verify that no adjacent wire-fires are in check data. For example, if bytes 34 and 35 are part of the same print pass, ANDing the two should give you zero.

Warning: Adjacent wire-fires can result in the destruction of the print head. If the design of the character-to-slice translation table is correct, the application should not have to check for adjacent wire-fires.

Programming Considerations

The following procedures are not checked by the printer driver. They should be performed by the application.

- After any document insert line feed commands, a blank APACS print should be done before printing the check. Otherwise line feeding is incomplete after the first print pass.
- The value in the low-order four bits of byte 381 of the logo buffer should not be greater than 9.
- One pass of the print head must be used to print one, and only one, column of characters. If columns of characters are split between print passes, print quality is not readable.

Example

See Appendix C for an example application using check printing.

Logo Printing

Logo printing can be done only at the CR/DI station. Use the WRITE LOGO statement for printing logos.

The WRITE LOGO statement prints all-points-addressable data at the CR/DI station. The dots to be printed are specified in an array with this statement. The number of elements in the array must be a multiple of 381. Each set of 381 bytes has 380 bytes of logo print data followed by one byte that contains the number of dots that the paper is advanced after printing. Only the first 300 bytes of the 380 bytes of print data can be printed. These bytes are printed in the center 300-dot columns of the line. The system ignores the last 80 bytes of print data. Each byte controls the printing of one 8-dot column. The first byte in the array corresponds to the leftmost print position. Bit zero of each byte corresponds to the topmost dot of each dot column. If a bit=1, the corresponding dot is printed.

Only one WRITE LOGO statement can be queued. If a WRITE LOGO is issued before the previous logo print ends, execution is suspended until the previous logo print is complete. The system passes errors to the ON ASYNC ERROR subprogram. The error can be bypassed or the entire logo can be reprinted. Requests for retries of logo prints should not be made.

Determining When Printing is Complete

If you have print lines queued and want them printed before continuing application execution, use the TCLOSE statement. This statement causes your application to suspend execution until all outstanding print lines have been printed at all printer stations or until an error is detected. If an error is detected during the completion of any queued prints, the system gives control to the ON ASYNC ERROR subprogram. When the TCLOSE is complete, the print queue is empty and the print head returns to the home position.

Performance Considerations

There is a margin to the left of the CR/DI station and a margin to the right of the SJ station. When printing is done at a station, the print head first moves from the home position to the station margin or from the margin to the home position depending on where the head was left from the previous print. If the print head is in the margin of one station and the next print request is for the other station, the print head must move back to the home position before it reaches the station at which the print is requested. In such a case the print head travels across one station without printing.

To maximize performance, your application can print so that print head travel time is minimized. Your application should start with the head in the home position (following TCLOSE) and print an even number of times at one station before printing at the other station. In some cases your application prints the same data at both the CR/DI station and the SJ station. In such cases, you should alternate which station is printed at first (CR, SJ, SJ, CR, CR, SJ, and so on). This results in an even number of prints at one station before moving to the other.

For logo printing, the print head must travel across the print line either two or four times. Only two passes are required if you compose the logo by using every other column of dots. You should use either all odd dot columns or all even dot columns.

Example

This example contains code for operating a printer. The program writes messages to the display, sets up the synchronous and asynchronous error handlers, and prints lines at the CR and DI stations.

```
%ENVIRON T
! Declare integers.
INTEGER*2 DISPLAY.NUMA
INTEGER*4 REQ%,STAT%
! Async error handling subprogram.
SUB ASYNCSUB(RFLAG,OVER)
INTEGER*2 RFLAG
STRING    OVER
! Set up synchronous error handler
! for async subprogram.
ON ERROR GOTO SERROR
! See the error recovery example
! for the ON ASYNC ERROR CALL
! statement in the IBM 4680 BASIC
! Language Reference.
EXIT SUB
END SUB

Start execution.
! The alphanumeric display is opened for display of prompt.
DISPLAY = 4
OPEN "ANDISPLAY:" AS DISPLAY
CLEARS DISPLAY

WRITE #DISPLAY; "PRINTER SAMPLE"
WAIT;2000
! Branch around called routines.
GOTO START.OF.PRINTS
! Open the print station designated in the variables.
FUNCTION PRINTER
 OPEN STATIONS$ AS NUMA
 CLEARS DISPLAY
 WRITE #DISPLAY; "OPEN PRINTER  ", STATIONS$
 EXIT FUNCTION
END FUNCTION
! TCLOSEs to clear all the print requests,
! then display and close the print station.
FUNCTION CLOSEA
 TCLOSE NUMA
 CLEARS DISPLAY
 WRITE #4; "CLOSE = ", NUMA
 CLOSE NUMA
 EXIT FUNCTION
END FUNCTION
! Start printing.
START.OF.PRINTS:
! Set up the asynchronous error handler
! and the synchronous error handler.
ON ASYNC ERROR CALL ASYNCSUB
ON ERROR GOTO ERR.HNDLR
! Print and space at the customer receipt station.
```

```
CR.PRINTER:
 NUMA = 3
 STATION$ = "CR:"
CALL PRINTER
WRITE FORM "C38 A1";#NUMA; "PRINT CASH RECEIPT AND SPACE 1 AFTER "
WRITE FORM "C38 A2";#NUMA; "PRINT CASH RECEIPT AND SPACE 2 AFTER "
WRITE FORM "C38 A3";#NUMA; "PRINT CASH RECEIPT AND SPACE 3 AFTER "
WRITE FORM "C38 A4";#NUMA; "PRINT CASH RECEIPT AND SPACE 4 AFTER "
WRITE FORM "C38 A5";#NUMA; "PRINT CASH RECEIPT AND SPACE 5 AFTER "
CALL CLOSEA
! Print and space at the document insert station.
DI.PRINTER:
  NUMA = 2
  STATIONS$ = "DI:"
  CALL PRINTER
REQ% = 00000H
! Set manual document insert.
! Requires operator to press Close button.
PUTLONG NUMA , REQ%
INSERT.DOC:
CLEARS DISPLAY
WRITE #DISPLAY; "INSERT DOCUMENT"
! Test for document present.
REQ% = GETLONG (NUMA)
STAT% = REQ% AND 00000030H

IF STAT% <> 00000010H THEN GO TO INSERT.DOC
   WRITE FORM "C38 A1";#NUMA; "PRINT ON DOCUMENT AND SPACE 1 AFTER "
   WRITE FORM "C38 A2";#NUMA; "PRINT ON DOCUMENT AND SPACE 2 AFTER "
   WRITE FORM "C38 A3";#NUMA; "PRINT ON DOCUMENT AND SPACE 3 AFTER "
   WRITE FORM "C38 A4";#NUMA; "PRINT ON DOCUMENT AND SPACE 5 AFTER "
  CALL CLOSEA
CLEARS DISPLAY
WRITE #DISPLAY; "END OF PRINT SAMPLE"
CLOSE DISPLAY
GOTO END.PROG
ERR.HNDLR:
! Prevent recursion.
ON ERROR GOTO END.PROG
! Determine error type and perform appropriate
! recovery and resume steps.
END.PROG:
STOP
END
```

Printer Driver Model 3 or 4

This section describes the model 3 and 4 printer drivers and provides guidelines for using them.

Characteristics

The Model 3 or 4 printer is a two-station impact printer that provides three functions. It provides a CR function in one station, an SJ function in a second station, and a DI function in the same CR and SJ stations. The CR function provides a hard copy of the transaction. It also can function as a general output device to provide data to the operator. The SJ function records data on every transaction for an audit trail or performs any other printing function that the user program dictates. The DI function allows

insertion of a form, document, or check directly into the printer from the front or from the top. Use this function to print a variety of forms such as store charge account forms, or to print or endorse checks. The printer mechanism is a 9-wire dot matrix, bidirectional, all-points-addressable, high-speed device. The number 9 print wire can be used for an underscore or descenders.

The CR and SJ stations each print up to 38 characters at 15 characters per inch (CPI). The DI station prints up to 86 characters at 15 CPI. Other fonts are stored in the printer that include 12 CPI, and 7.5 CPI. The 7.5 CPI characters also can be printed double high. Lowercase characters can be printed in addition to normal characters. Double strike is available in all stations for emphasis, but at a reduced rate because of unidirectional printing.

The default line spacing for the CR, SJ, and DI stations is six lines per inch. The line spacing for each station can be changed by the PUTLONG statement and the current line spacing is returned by the GETLONG function. Refer to the *IBM 4680 BASIC: Language Reference* for additional information on the PUTLONG and GETLONG functions.

The application program can specify how the printer driver is to interpret the line feed specification (A value) of the WRITE statement. The application can advance the paper in the various stations in increments of full lines or motor steps. (There are 9 motor steps per line at a line spacing of 8 lines per inch and there are 12 motor steps per line at a line spacing of 6 lines per inch.) If PUTLONG and GETLONG bit 4 of byte LL is zero, the driver interprets the A value of the WRITE statement as a full line feed. If bit 4 of byte LL is 1, the driver interprets the A value in motor steps. For compatibility with current applications, the driver defaults to interpreting the WRITE A value in full line feeds.

Logo printing is supported in the printer code, but at approximately half the speed because of unidirectional printing. Double high fonts are also printed at a lower speed. (Single-line logos print at full speed.) However, the driver code does not support logo printing in the SJ station. See “Logo Printing” on page 3-78 for additional information.

While printing in the normal mode, the print speed is up to 250 lines per minute, depending on the application.

Compatibility with Applications Written for the Model 1 and 2 Printers

The Model 3 or 4 printer is compatible with applications written for the Model 1 and 2 printers, but some minor changes to existing applications will be necessary due to printer hardware differences. The following list identifies the application changes required for compatibility with the Model 3 or 4 printer:

- The number of line spaces to advance the paper at the end of a transaction must be increased from 8 to 10 lines. See “Receipt Paper Cutter” on page 3-76 for more information.
- A receipt paper cutter command must be issued after advancing the paper at the end of a transaction. See “Receipt Paper Cutter” on page 3-76 for more information.
- Two new printer driver return codes must be added to the application asynchronous error routine. See “Journal Buffering When Printing on Documents” on page 3-74, “Preventing Unnecessary Reprints” on page 3-76, and also refer to the *IBM 4690 Messages Guide* for more information.

Depending on how the application program has been designed to position documents, the following changes might also be required:

- The number of line spaces a document is advanced after being inserted in the document station might need to be changed. See “Manual or Automatic Document Insertion” on page 3-72 for more information.
- A document eject command might be required to remove a document from the document station. See “Document Eject Command” on page 3-75 for more information.
- It is recommended that the print head be moved to the center home position before inserting a document. If the application was not originally designed to do so, this change might be required. See “Positioning the Print Head” on page 3-75 for more information.

If a single application program is used with both the Model 3 and 4 printers and the existing Model 1 and Model 2 printers, the application program needs to determine which printer is being used and execute the preceding changes only for the Model 3 or 4 printer. See “Determining the Printer Status” on page 3-76 for more information.

If you are not familiar with 4680 BASIC or the methods used to interface to these printers, refer to the *IBM 4680 BASIC: Language Reference*.

Functions Your Application Performs

Your application program can perform the following functions with the printer:

- Write characters to any station using four different character fonts.
- Write characters to any station using emphasized print.
- Write all-points-addressable data to the CR and DI stations.
- Sense documents and control document positioning.
- Change line spacing in all stations.
- Execute a cut of the receipt station paper.
- Obtain the printer status and printer type.

Accessing the Printer

Use the OPEN statement to gain access to the printer device driver. The name for each print station is:

CR: Customer receipt station
SJ: Summary journal station
DI: Document insert station

Note: The colon is part of the name, and you must open each station before it will print.

Use the CLOSE statement to end communication with a printer station. You must issue a CLOSE statement for each print station to which your application has issued an OPEN.

Preparing a Line to Print

You can specify the data to be printed on a line in one or more expressions. Each expression can be a string or of numeric type. The format string on the WRITE FORM statement defines how these expressions are formatted for a print line. Refer to the *IBM 4680 BASIC: Language Reference* for a description of a format string.

Printing a Line of Text at the Printer

Use the WRITE FORM statement to print one line in the CR, DI, or SJ stations. An I/O session number, specified in the OPEN statement, indicates which printer station to use. Specify line feed information in the format string.

The printer driver prints the line asynchronously to execution of your application. You can issue multiple WRITE FORM statements to queue more than one print line to the printer driver. When the printer driver queue becomes full, your application must wait until buffer space becomes available in the queue. The system performs line feeds after the data is printed. To line feed before printing a line, issue a WRITE FORM specifying the number of line feeds required with data of all blanks. If the data in a print line is all blanks, the system moves the print head only if necessary to return the head to a home position. The home position is between the CR and SJ stations and to the left of the CR station.

Emphasized Printing: Emphasized, or double strike printing, is available in all printer stations at a speed that is one-third the normal printing speed. In emphasized print mode, the line is printed once, the print head is returned to the starting position, and the line is printed a second time. Therefore, every line of print requires three passes of the print head.

Emphasized printing is primarily intended to be used when printing on thick multiple-part forms. A second strike of the print head wires on most forms results in the copies having darker, more easily readable print. An application program puts the printer in emphasized mode by imbedding control characters at the beginning of the print data sent by the WRITE statement. Table 3-4 shows the character sequences for emphasized printing. Emphasized mode must be used for the entire line and remains in effect for only one line. Emphasized printing is available with all printer fonts.

Table 3-4. Model 3 or 4 Printer—Emphasized Print Definition Characters

Description	Control Character Designator	Comments
Start Emphasized Print	CHR$(27), CHR$(69)	Results in one-third print speed

Emphasized Printing Programming Example: The following example illustrates the method used to print a line using emphasized printing:

```
OPEN "CR:" as 5                          ! REM Open Printer Receipt Station
ESTART$ = CHR$(27) + CHR$(69)            ! REM Start Flag - Emphasized Printing

LINE$ = ESTART$ +"  Welcome to BROOKS Department Store  "
WRITE FORM "C40 A2"; #5; LINE$           ! REM Print Welcome line on Receipt
                                         ! REM and space 2 lines.
WRITE FORM "C38 A1"; #5; "  January 29, 1995        10:10 a.m.  "
```

Output of Example Program

```
|    Welcome to BROOKS Department Store       |
|                                             |
|January 29, 1995                 10:10 a.m. |
```

Font Specification: The pitch of the default font for the Model 3 or 4 printer is 15 CPI. You can specify a font change by imbedding a control character, followed by a character designating the font type desired, in the data field sent to the printer by the WRITE statement. (For example, CHR$(27), CHR$(58) results in a 12 CPI font.)

After receiving the character sequence denoting a font change, the printer continues to print in that font until the end of the line is reached or until another font change character sequence is found. At the end of the line, the printer resets to the default font of 15 CPI.

Only 15 CPI and 7.5 CPI fonts can be mixed in one WRITE statement. However, single high and double high characters cannot be mixed in one WRITE statement. If different pitch characters must be printed on the same line, the application can print the line using two WRITE statements with no line feed between the two statements. This technique requires two passes to print one line.

The application program should ensure that the number of characters specified in a WRITE statement for a given font can be printed on the station being used. The printer driver returns an illegal data error (ERR=ID; ERRN = X'80900524') if the line width exceeds the width of the station.

Table 3-5 shows the maximum number of printable characters for each font type and station type. The table also shows the fonts supported by the Model 3 or 4 printer and the control characters used to designate the fonts. Each font control character pair inserted in the WRITE data field increases the size of the field by two bytes. To account for the larger data field size, the 4680 BASIC runtime subroutines support data fields greater than 38 characters. However, the Model 1 and Model 2 printer drivers return an error if more than 38 characters are used.

Table 3-5. Model 3 or 4 Printer Font Definition Characters

Font Description	Control Character Designator	Maximum Characters Per Line	Comments
15 CPI	CHR$(27),CHR$(59)	38 CR, SJ; 86 DI	Default Font
12 CPI	CHR$(27),CHR$(58)	30 CR, SJ; 68 DI	
7.5 CPI	CHR$(27),CHR$(14)	19 CR, SJ; 43 DI	15 CPI Double Wide Font
7.5 CPI Double High	CHR$(27),CHR$(23)	19 CR, SJ; 43 DI	Double High, Double Wide

Font Change Programming Example: The following example illustrates the method used to change fonts with the Model 3 or 4 printer:

```
OPEN "CR:" as 5                          ! REM Open Printer Receipt Station
FONT15$ = CHR$(27) + CHR$(59)            ! REM 15 char/inch Control String
FONT75$ = CHR$(27) + CHR$(14)            ! REM 7.5 char/inch Control String

LINE$ = "  Welcome to " + FONT75$ + "BROOKS" + FONT15$ + " Dept. Store "
WRITE FORM "C36 A1"; #5; LINE$           ! REM Print Welcome line on Receipt
```

Output of Example Program

```
  Welcome to B R O O K S Dept. Store
```

In the preceding example, the 7.5 CPI pitch characters used for the word BROOKS take twice the space of characters printed at 15 CPI (the highlighted characters in the example are used to simulate a double-wide font). This extra width results in only 32 data characters filling the 38 character-wide receipt paper. It is important when mixing fonts in a single line of print that the line width of the individual printer station not be exceeded.

Controlling the Document Insert Station

The document station on the Model 3 or 4 printer covers both the CR and SJ stations (on the Model 2 printer, only the CR station is blocked when a document is being printed). The document sensors are positioned at the far right of the DI station, so the document must be aligned to a fixed guide located at the right edge of the SJ station. For additional information about positioning forms, refer to the *IBM 4683/4684 Point of Sale Terminal: Operations Guide*, the *IBM 4680 Store System: Preparing Your Site*, and the *IBM Store Systems: Installation and Operation Guide for Point-of-Sale Input/Output Devices*.

Note: The fixed guide is provided for alignment similar to the Model 1 and 2 printers. For wider documents, the document is inserted over the top of the guide and aligned against the right wall of the DI station.

When your application issues a PUTLONG statement, the options specified affect all WRITE FORM statements issued after the PUTLONG. The new PUTLONG options do not affect queued print operations resulting from WRITE FORM statements that were issued before the PUTLONG. Refer to the *IBM 4680 BASIC: Language Reference* for additional information on the PUTLONG statement.

Top or Front Loaded Documents: Documents can be inserted from the top or the front on the Model 3 or 4 printer. A sensor is activated as the operator inserts the document to the positive stop feed rollers and a light emitting diode (LED) on the front of the printer lights when the sensor is activated.

An application can use the GETLONG function to determine the presence of a document. Bit 0 of byte SS is 1 when a document has been inserted in the top document station or the top of the form has been detected for a document inserted in the front document station. Bit 4 of byte SS is 1 when a document has been inserted in the front document station or the bottom of form has been detected for a document loaded in the top document station. Both top and bottom document sensors must be activated before printing can begin at the document station.

An application can use the two document sensors to sense how a document was inserted. Based on this determination, the application can order the print lines accordingly, for example, either printing the lines in reverse order for top-inserted forms or standard order for forms inserted from the front.

Manual or Automatic Document Insertion: GETLONG or PUTLONG byte MM, bit 4, controls whether manual or automatic document insertion mode is used. If manual mode is selected, the document is inserted to the feed rollers, and the station is activated using the document station ready button on the front of the printer. Pressing the printer document station ready button causes the document to be fed into the printer until the first printable position is in the print field. If the operator wants to start printing in a position other than the top of form, the operator can use the printer line feed buttons to further position the document, or the application can advance the document.

If automatic mode is selected (bit 4=1), the document is again inserted to the feed rollers, but the station is automatically activated and the document is automatically positioned to the first print position when the first WRITE statement is sent to the document station. The application can advance the document additional spaces before printing the first line by issuing a WRITE statement with the desired line feed information. The difference between manual and automatic mode as viewed from the application program is that the printer driver gets the station ready in automatic mode when printing is started at the document station. In manual mode, the operator must get the station ready by pressing the document station ready button.

Documents inserted from the top block the CR and SJ stations when the form is stopped against the feed rollers. The operator must not insert a form from the top until printing at the CR station has completed. An error is returned if a WRITE statement is issued to the CR station when a document is in place.

Documents inserted from the front will not block the CR or SJ stations until manually fed into the station using the document ready button or automatically from a WRITE statement to the document station.

Since users can insert documents from either the top or the front of the Model 3 or 4 printer, designing an application to accommodate both insertion methods is not trivial. Mistakes could be made even if a message is displayed prompting you on the method of insertion. To compensate for user error and to make the process of designing applications easier for the programmer, the printer is designed to automatically interpret the intended insertion direction and automatically correct for user errors.

The document will be automatically registered at the top-of-form if an application program is designed for automatic front insertion of documents. The following is an example of an application program that is designed for automatic front insertion of documents:

- The document motor direction is front-to-top (bit 1 of PUTLONG byte MM is zero).
- The automatic insert bit is 1 (bit 4 of byte MM).
- The document is inserted from the front.

If, however, you insert the document from the top, the printer automatically advances the document through the printer until the document is registered at the top-of-form. The advantage to this method is that even though the application was designed for front insertion, the result of inserting the document from the top is exactly the same as inserting from the front.

The operation of the opposite insertion method is also automatic. If an application is designed for automatic top document insertion and you place the document in the front opening, the printer automatically advances the form through the printer, registering the document at the bottom-of-form.

This feature of the printer should allow for more efficient application programs and improved usability.

Removing and Replacing a Document: Bit 5 of byte MM controls whether the application is notified if a document is removed and replaced between print lines at the DI station. If a document is not in the DI station when a print at the DI station is being performed, your application receives an error notification that the document is missing. If your application needs notification on document removal (bit 5=0), the driver remembers that the document was removed. The driver remembers this even if the document was removed while no print operation was being done. After removal, on the next print at the DI station, the application receives an error stating the document is not inserted. This error occurs even if the document was replaced before the print operation. The error notification allows your application to take action on this condition. Such action could be to void the transaction or to log the occurrence. The status is reset from document-inserted to not-inserted when either the error is passed to the application or when a print occurs at the CR station.

Document Options: Bits 6 and 7 control options for use of a document while printing at the CR station. These options can be used only with documents inserted from the front of the DI station. If the document is inserted from the front, it stops when the rollers are reached, and printing at the CR station is done on the CR paper (not the document). If the document is inserted from the front before a DI print, the document is ready for printing without having to prompt the operator to insert the document. The printer controls the use of a document during CR printing as follows:

- If bit 6=0 and bit 7=0, a document cannot be inserted if printing is done at the CR station. A print to the CR station results in an error if a document is inserted.
- Bit 6=0 and bit 7=1 is not a valid combination. If a PUTLONG is issued with this combination, the PUTLONG results in an error.
- If bit 6=1 and bit 7=0, a document can be inserted even if a print is issued to the CR station. No error results because a document is inserted.
- If bit 6=1 and bit 7=1, a document must be placed in the DI station when printing at the CR station. If a print to the CR station is issued and a document is not inserted, an error results stating that a

document is missing. This option is normally used to ensure that a document is inserted before printing on the CR receipt tape. The document can be printed after the CR receipt is printed.

Journal Buffering When Printing on Documents: The SJ station of the Model 3 or 4 printer is blocked when a document is being printed. Therefore, simultaneous printing on the DI and SJ stations is not possible. To minimize the impact to the application program, the printer driver buffers all data written to the SJ station when a document is being printed.

Note: Buffering of the journal data is not required when printing on the CR.

The default method of journal buffering is transparent to the application and is activated from the document sensors. The driver buffers all data sent to the SJ station after a form has been detected by the top document sensor and prints the data following the removal of the document.

The application program can control when the buffered journal data is printed by setting bit 2 of byte LL in the PUTLONG statement. When this bit is zero, the buffered journal data is printed after the document has been removed. If bit 2 is 1, the buffered data is held until this bit is reset to zero. This method of controlling the print execution of the buffered journal data can be advantageous when a transaction requires more than one document (for example, the driver continues to buffer the data until all of the documents have been printed). Immediately after resetting bit 2 from 1 to zero, the printer driver begins printing the journal data. Therefore, the application should ensure that the user has completely removed the document from the printer before resetting this bit to zero.

Use terminal configuration to specify the maximum number of journal lines the driver buffers. The driver reads the configuration data and allocates the memory required to store the number of lines specified. The driver holds this memory in reserve at all times to ensure it is available when required.

Note: For planning purposes, 64 bytes of memory are reserved for each line specified in configuration. This value includes 38 bytes for data and 26 bytes for line feed and other control information.

If more lines are sent to the SJ station than specified during configuration, the driver logs error message W354. The application program receives a return code, ERRN=8090052F ERR=BO, in response to WRITE statements to the SJ station after the journal buffer is exceeded. If the application receives this return code, it should eject the document and display a message indicating the journal buffer was exceeded. When the document is ejected, the data is printed (assuming bit 2 of byte LL is zero), and the journal buffer is cleared. An application program can issue a GETLONG command to determine the status of the journal buffer. If bit 0 of byte LL is zero, the journal buffer is empty. After clearing the buffer, a message can be displayed prompting the operator to reinsert the document and complete the transaction. No data is lost if the document is ejected when this error is first received. Retries are not allowed in response to the journal buffer overflow return code.

As a visual indicator that the buffer was exceeded, a line of asterisks with an error message number is also printed on the journal station following the printed data. This message alerts store personnel that an error occurred and that the journal buffer size must be increased using the configuration utility. Figure 3-2 is an example of how the journal station appears after the buffer has been exceeded.

```
        1  LAYAWAY     0182  0001 110
LAYAWAY OPENED ON              2/05/95
ACCOUNT 5384
1                      MDS 1     25.00
8                      MDS 1     50.00
5                      MDS 1     30.00
4                      MDS 2      5.00
**************** W354 ****************
```

Figure 3-2. Exceeding the Journal Buffer Example

Reinserting Documents for Printing: Some transactions require that a document be inserted into the printer many times for printing at a different location each time (for example, documenting exception conditions or for voiding transactions). These documents can be positioned for printing using the automatic method described in “Manual or Automatic Document Insertion” on page 3-72, or they can be positioned using a manual method for the Model 3 or 4 printer. The following steps are required for reinserting a document using the manual method:

1. Insert the document to the feed rollers and press the printer line advance button until the desired print location is positioned just above the printer cover.
2. Press the document station ready button to reverse feed the document into the printer. The document is now correctly positioned for printing and the application can issue WRITE statements to the DI station.

This feature makes the Model 3 or 4 printer compatible with existing application programs that require documents to be inserted from the side and manually positioned for printing.

Document Eject Command: The document station of the Model 3 or 4 printer holds documents tightly in place, preventing manual repositioning. This method allows for more accurate positioning when advancing a document under program control, but it also prevents an operator from pulling a document out of the printer after printing has completed.

For fast removal of documents after printing, use the document eject command. Issuing this command results in the document being fed rapidly out of the printer until it is free from the document feed rollers. The document eject command is initiated by sending the control character sequence “CHR$(27), CHR$(12)” in a WRITE statement to the DI station. The direction the document is advanced out of the printer is controlled by the document line feed setting specified by PUTLONG or GETLONG byte MM, bit 1. The TCLOSE command ensures that the document eject is completed before the application is able to issue another printer command, and it is recommended that this command be used after the document eject command.

Positioning the Print Head: Before inserting documents, the print head should be moved to the center home position. Inserting documents is easier if the print head is at the center home position. To center the print head at the home position, the application should issue a TCLOSE command before inserting the document.

Note: Some forms might insert more easily with the print head positioned at the far left sensor position. Testing your application with the various print head locations is highly recommended.

Reversible Document Station Motor: The default document motor direction is the same as that used to feed the receipt paper during printing (bottom-to-top). The direction of the document motor is changed by the PUTLONG statement. The current setting of the document motor is found by using the GETLONG function. Refer to the *IBM 4680 BASIC: Language Reference* to determine the appropriate bit mapping.

Document Station Character Line Lengths: For maximum performance, the Model 3 or 4 printer driver checks the length of the data sent to the document station to determine how far the print head should travel. If 38 characters or less are written to the document station, the print head travels only half the width of the station. The data is printed right-justified over the journal station. If more than 38 characters are printed, the print head travels the entire width of the document station. Using the larger character fonts, some blanks can be truncated to meet the 38-character limit. If this occurs, increase the length of the data string to greater than 38 characters to force the print head to travel the entire distance.

Determining the Printer Status

Use the GETLONG statement to determine printer status information. This statement returns the current settings of the DI control bits set by the PUTLONG statement and other printer status information. The status information includes:

- Printer type (Model 2, Model 3, or Model 4)
- Paper status for the SJ station (out-of-paper or paper jam)
- Document insertion status (present or not present, top or front insert)
- DI station status (document ready or not ready)
- Document station line feed direction (bottom-to-top or top-to-bottom)
- Line spacing mode for any station (6 lines per inch or 8 lines per inch)
- Line spacing setting (line feeds or motor steps)
- Journal buffer status (holding buffered data or not holding buffered data)
- Current LOGO setting (300 or 380 slices to be printed)
- Printer head status (at center or left home or not at center or left home)
- Printer cover status (open or closed)

Refer to the *IBM 4680 BASIC: Language Reference* for additional information.

Preventing Unnecessary Reprints

The following return code indicates that the printer cover of the Model 3 or 4 printer has been opened:

```
ERRN = 8090052D        ERR = D0
```

The printer driver issues this return code whenever the printer cover has been opened and the outstanding print line completed successfully. No retries are required by the application in response to this return code, but the application may display an informational message indicating the printer cover is open.

Note: If printing is in progress when the cover is opened, the line in progress completes. However, no additional printing can occur until the cover has been closed.

Receipt Paper Cutter

A receipt paper cutter is provided on all Model 3 and 4 printers and the application interface provides control characters for executing a partial cut of the paper. Since the tear bar on the Model 3 or 4 printer is intended only for occasional use (for example, when tearing off the excess paper after paper loading), every application must be changed to use the cutter at all times.

Table 3-6 shows the characters that have been defined to initiate a partial cut.

Table 3-6. Model 3 or 4 Printer—Receipt Paper Cutter Control Characters

Description	Control Characters	Comments
Partial Cut	CHR$(27), CHR$(80)	Must be only characters in WRITE statement

The cutter control characters must be included in a WRITE statement following the last line before the cut. These characters must be the only characters included in the WRITE statement. No line advance occurs as part of the cutter command, and therefore, the A value in the WRITE FORM statement is ignored on a cutter command.

The application must advance the paper at the end of the transaction so that the last line clears the cutter. Ten line feeds are needed to clear the tear bar when the receipt station line spacing is set to 6 lines per inch. Twelve line feeds are required when the line spacing is set to 8 lines per inch.

Receipt Paper Cutter Example: The following example illustrates the method used to issue a paper cut command.

```
OPEN "CR:" as 5
WRITE FORM "C38 A10"; #5; "THIS IS LAST LINE OF THE TRANSACTION "
WRITE FORM "2C1 A0"; #5; CHR$(27), CHR$(80)      ! REM Issue cut command
                                                 ! REM 'A' line advance value ignored
```

Printer Home Sensors

The Model 3 or 4 printer has two home sensors: one located between the CR and SJ stations, and the other located to the left of the CR station. Bit 6 of byte SS of the GETLONG indicates when the print head is at the center home sensor. This is the same for the Model 1 and Model 2 printers. The information for the left sensor of Model 3 or 4 printers is made available to an application using bit 3 of byte MM.

Left Home Command

A control character sequence is available to move the print head to the left home sensor (left of the receipt station). To move the print head to the far left, issue a WRITE statement that includes a left home control character sequence. The left home character sequence is CHR$(27), CHR$(76) or CHR$(27), “L”. No other data characters can be included in a WRITE statement that includes the left home control characters.

Printing Checks

Checks can be printed in normal mode (horizontally) in the document station of the Model 3 or 4 printer. Therefore, the Model 2 check printing feature is not supported on the Model 3 or 4 printer. For additional information on the Model 2 check printing feature, see “Printing Checks” on page 3-62.

A check printing utility is available from IBM for users of IBM application programs (for example, General Sales Application or Supermarket) and also for users not using an IBM-supplied application. For additional information, contact your IBM marketing representative.

Logo Printing

You can print logos only at the CR and DI stations. Use the WRITE LOGO statement for printing logos.

The WRITE LOGO statement prints all-points-addressable data at the CR and DI stations. The dots to be printed are specified in an array with this statement. The number of elements in the array must be a multiple of 381. Each set of 381 bytes has 380 bytes of logo print data followed by one byte that contains the number of dots that the paper is advanced after printing. Each byte controls the printing of one 8-dot column. The first byte in the array corresponds to the leftmost print position. Bit zero of each byte corresponds to the topmost dot of each dot column. If a bit=1, the corresponding dot is printed. Due to hardware limitations, only the first 300 bytes of the 380 bytes of print data can be printed with the Model 1 and 2 printers.

No hardware restriction exists with the Model 3 or 4 printer to limit the width of logo printing to 300 slices. However, to maintain compatibility with current 4680 or 4690 application programs, the Model 3 or 4 printer drivers default to the current logo width of 300 columns. To use the full 380-column width of the receipt or document station, set bit 1 of byte LL of the PUTLONG statement to 1. Use the GETLONG statement to determine the current bit value.

There is no provision in the Model 3 or 4 printer drivers for logo printing across the entire width of the 86-character wide document station. Therefore, the maximum logo width in either the receipt or document station is 380 slices.

Only one WRITE LOGO statement can be queued. If a WRITE LOGO is issued before the previous logo print ends, execution is suspended until the previous logo print is complete. The system passes errors to the ON ASYNC ERROR subprogram. The error can be bypassed or the entire logo can be reprinted. Requests for retries of logo prints should not be made.

Determining When Printing is Complete

If you have print lines queued and want them printed before continuing application execution, use the TCLOSE statement. This statement causes your application to suspend execution until all outstanding print lines have been printed at the CR or DI stations or until an error is detected. If an error is detected during the completion of any queued prints, the system gives control to the ON ASYNC ERROR subprogram. When the TCLOSE is complete, the print queue is empty and the print head returns to the home position.

Performance Considerations

There is a margin to the left of the CR station and a margin to the right of the SJ station. When printing is done at a station, the print head first moves from the home position to the station margin or from the margin to the home position depending on where the head was left from the previous print. If the print head is in the margin of one station and the next print request is for the other station, the print head must move back to the home position before it reaches the station at which the print is requested. In such a case, the print head travels across one station without printing.

To maximize performance, your application can print so that print head travel time is minimized. Your application should start with the head in the home position (following TCLOSE) and print an even number of times at one station before printing at the other station. In some cases your application prints the same data at both the CR station and the SJ station. In such cases, you should alternate which station is printed at first (CR, SJ, SJ, CR, CR, SJ, and so on). This results in an even number of prints at one station before moving to the other.

For logo printing, the print head must travel across the print line either one or three times. Only one pass is required if you compose the logo by using every other column of dots. To maximize performance, you should use either all odd dot columns or all even dot columns.

Magnetic Ink Character Recognition Support for Printers Model 3 and 4

The Magnetic Ink Character Recognition (MICR) feature lets you read the account number and other information from the check. You do this by placing the document into the document insert (DI) station of a 4680 model 3R printer, or a 4690 model 4R printer that is equipped with the appropriate hardware.

Note: For your application to access the parsing routines described in this section, you must define the logical name ADXMICRF in the system logical names as ADX_IDT1:ADXMICRF.DAT.

MICR Data Format

The MICR hardware returns an ASCII string of up to 65 bytes that may include the following:

```
0-9                     ASCII 0-9     (30H  - 39H)
Transit Character       ASCII T       (54H)
On Us Character         ASCII A       (41H)
Dash                    ASCII -       (2DH)
Unreadable Character    ASCII ?       (3FH)
Amount Character        ASCII $       (24H)
blank                   ASCII blank   (20H)
```

Using the MICR Reader

You must place checks face down in the far right of the MICR reader for the MICR line to be read properly. You must place the check in the DI station and make the DI station ready prior to the MICR read command being sent to the device (prior to the WAIT to the DI station or the READ LINE from the DI station). See the *IBM Store Systems: Installation and Operation Guide for Point-of-Sale Input/Output Devices* for complete information about how to use the MICR reader.

Note

You can perform printing (franking) on the back of a check when you insert it in the far right of the DI station. However, only the last 20 characters of the narrow document print command can be printed on the check while in that position.

From the time that the check is inserted in the far right position and the MICR command is sent, until the check is removed from the printer, all DI print commands must be DI narrow print with the first 18 characters buffered with blanks. The application is responsible for ensuring that this restriction is followed. No checking will be done by the printer driver.

Determining If a MICR Is Installed

The MICR present bit is 0X04 of the GETLONG MM byte.

Reading from the MICR

There are two ways to do a MICR read:

- Issue a READ LINE to the DI station.

  ```
  READ # PRTDI%; LINE MICRDATA$
  ```

  This causes the application to wait until the MICR read has completed, or an error has occurred before the application regains control.

- Issue a WAIT to the DI station. When the WAIT completes, issue a READ LINE to obtain the MICR data.

  ```
  WAIT PRTDI%;2000 ! wait 2 for MICR or 2 seconds

  ! save the completed event
  SAVE.EVENT = EVENT%

  ! if the MICR event completed
  IF SAVE.EVENT = PRTDI% THEN BEGIN
     READ # PRTDI%; LINE MICRDATA$
     ENDIF
  ```

As with any other WAIT statement, when the first event being waited on completes, all others will be cancelled. For example, if a DI wait and a timer wait are initiated and the timer event completes, the DI

wait will be canceled and no data will be available for a READ LINE at that time. If a READ LINE is issued when the DI event was canceled, the MICR read command will again be passed to the hardware. The application will not regain control until it completes.

After the application obtains the MICR data, it can use the optional MICR data parsing routines described in this section or can parse the data using proprietary routines. The printer driver returns the data as passed by the hardware and performs no manipulation on the data.

Understanding MICR Errors: Any error encountered on either the WAIT for the printer or the READ LINE to the printer will trigger the ON ERROR statement currently in effect. Only errors on printer WRITE statements will trigger the ON ASYNC ERROR in effect.

Any of the defined printer driver errors may be encountered during MICR actions. Printer driver return codes can be determined by checking the first two bytes of the four byte return code for 8090nnnnH, where nnnn is the unique portion of the return code, and the 8090 signifies that the error is from the printer driver. The following table contains the most common MICR errors.

Table 3-7. Common MICR Errors

4 Byte Return Code	Description
80900002H	No MICR present
80900528H	No document present in DI
80900521H	Head movement error

Understanding MICR Parsing Routines

The MICR parsing routines provided by the system provide a terminal application with the ability to extract the following fields from the MICR line read from a check:

- Transit or routing number
- Account number
- Check sequence number

The MICR function is included by adding the following line to your link input file:

```
ADXMICRK.L86[S],     (for medium memory model)

or

ADXMICRB.L86[S],     (for big memory model)
```

To use the MICR parsing function, your application must first initialize the parsing table. Use the following functions to perform the initialization:

```
FUNCTION MICRINIT EXTERNAL
INTEGER*4 MICRINIT
END FUNCTION
```

The function reads the MICR parsing table from the ADXMICRF file using session number 64. The function returns 0 if initialization was OK. If the initialization was not OK, it returns the ERRN value of any error encountered.

After initialization you can parse MICR information read from a check using the following subprogram:

```
SUB MICRPARS(RC,MICRLine$,MICRTransit$,MICRAccount$, \
             MICRSequence$)  EXTERNAL
  INTEGER*1 RC          !* MICR PARSING   OK = -1,
                        !*          NO MATCH = 0
  STRING MICRLine$      !* MICR line read from check
  STRING MICRTransit$   !* Transit number extracted
  STRING MICRAccount$   !* Account number extracted
  STRING MICRSequence$  !* Check Sequence number
                        !*  extracted
END SUB
```

Fiscal Printer Support

The fiscal printer executes fiscal commands in accordance with the tax laws of the particular country supported. Every fiscal command starts with X'1B66' (ESC∧f in ASCII) that is unique to fiscal commands.

Applications written for the standard Model 3 printer are compatible with the Fiscal Printer Model 3A and Model 3F. Logo commands cannot be printed by the fiscal printer, but no error occurs if a logo print command is executed. Refer to the *IBM Fiscal Printer Software Supplement* for your specific country, for a detailed description of the fiscal commands.

Application Programming for the 4690 OS Fiscal System

The command used to print lines on both the customer receipt and summary journal stations is the IBM 4680 BASIC WRITE FORM command. This command remains unchanged for any existing print option application. Application programs issue fiscal commands using the WRITE FORM command. These commands provide the capability to release sales slips, daily closing vouchers, and fiscal documents. Fiscal vouchers are printed on the customer receipt station and then duplicated on the summary journal print station. The non-fiscal print command is used to provide a line feed or eject at the print stations.

The application opens the document insert station when issuing fiscal commands. Opening the document insert station allows 115 bytes of data to be sent with the fiscal commands. Opening the customer receipt or summary journal station only allows 75 bytes of data and may not be enough for some fiscal commands.

Note: The IBM 4680 BASIC WRITE LOGO command and special characters are not supported by the 4680 Fiscal System.

Error Handling and Recovery Procedures: For user programming errors, see the *IBM 4680 BASIC: Language Reference* for details regarding error reporting procedures and user actions. For functional hardware errors, see the *IBM Fiscal Printer Hardware Supplement* for your specific country.

Lines reprinted by the fiscal unit (when applicable) are identified by the number sign (#).

Read Commands

The following two sections describe the extensions to the 4680 BASIC GETLONG and PUTLONG statements for the Model 3 printer. See *IBM 4680 BASIC: Language Reference*, for more information on the other statements used to communicate with the 4683 printer drivers.

GETLONG Function: Use the GETLONG function to get status information from the impact printer driver.

The statement format is: i4 = GETLONG ---(number)---

i4 = A 4-byte integer that represents the driver status. The integer represents information in the form RRLLMMSS, where RR, LL, MM, and SS each represent one of the four bytes.

number = The same 2-byte integer variable or constant assigned to any one of the printer stations in the OPEN statement.

Note: The changes made to support the Model 3 printer have been marked with an asterisk (*).

Byte RR is reserved for system use:

bit 0 (X'01') = Reserved – This bit is used by the 4680 BASIC runtime subroutines and varies in value. It should be ignored by all application programs.
bit 1 = 0 Reserved
bit 2 = 0 Reserved
bit 3 = 0 Reserved
bit 4 = 0 Reserved
bit 5 = 0 Reserved
bit 6 = 0 Reserved
bit 7 = 0 Reserved

Byte LL represents status information:

* bit 0 (X'01') = Journal buffer is empty
= 1 Journal buffer contains data to be printed
* bit 1 = 0 Print only first 300 slices of LOGO data
= 1 Print full 380 slices of LOGO data
* bit 2 = 0 Print buffered journal data
= 1 Hold buffered journal data
* bit 3 = 1 Reserved for future optional paper cutter. Value set to 1.
* bit 4 = 0 WRITE FORM statement line feed specification (A value) represents line feeds (default)
= 1 WRITE FORM statement line feed specification (A value) represents motor steps
* bit 5 = 0 6 lines/inch line spacing mode in the customer receipt station (default)
= 1 8 lines/inch line spacing mode in the customer receipt station
* bit 6 = 0 6 lines/inch line spacing mode in the summary journal station (default)
= 1 8 lines/inch line spacing mode in the summary journal station
* bit 7 = 0 6 lines/inch line spacing mode in the document insert station (default)
= 1 8 lines/inch line spacing mode in the document insert station

Byte MM represents mode information:

* bit 0 = 0 Model 1 or Model 2 printer installed
= 1 Model 3 printer installed.
* bit 1 = 0 Document line feed is in normal mode, bottom-to-top (default)
= 1 Document line feed is in reverse mode, top-to-bottom
* bit 2 = 0 Reserved

| * bit 3 = 0 Print head not at left position sensor
| = 1 Print head at left position sensor
| * bit 4 = 0 Manual document insert (Documents can only be inserted from the top or front.)
| = 1 Automatic document insert. Documents can be inserted from the top or front. The printer closes the document feed rollers on the document when the first print line on the document insert station is issued. The document must cover the sensor.
| * bit 5 = 0 Document cannot be removed and replaced between print lines on the document insert station. If you remove a document between print lines, an error occurs.
| = 1 Document can be removed and replaced between print lines on the document insert station.
| * bit 6 = 0 Document cannot be placed in the document insert station during printing on the customer receipt station. If you insert a document while printing on the customer receipt station, an error occurs.
| = 1 Document can be placed in the document insert station during printing on the customer receipt station.
| * bit 7 = 0 Document sensing not required by the document insert station for printing on the customer receipt station.
| = 1 Document sensing required by the document insert station for printing on the customer receipt station. Or, the document must be sensed during customer receipt station printing.

| Byte SS represents status information as follows:

| * bit 0 (X'01') = 0 Document not present in top document station
| = 1 Document present in top document station
| bit 1 = 0 Reserved
| = 1 Paper error at the summary journal station (check bit 2 for more information)
| bit 2 = 0 No paper error
| = 1 Paper error at the summary journal station (for example, out-of-paper or paper jammed)
| bit 3 = 0 Reserved for Model 2 printer check printing feature
| * bit 4 = 0 Document not present in front document station
| = 1 Document present in front document station
| bit 5 = 0 Document insert station ready
| = 1 Document insert station not ready
| bit 6 = 0 Print head not at center home position
| = 1 Print head at center home position
| bit 7 = 0 Printer cover closed
| = 1 Printer cover open

| **PUTLONG Function:** Use the PUTLONG function to make changes to the customer receipt, summary journal, and document insert station mode.

| The statement format is: i4 = PUTLONG ---(number)---

| number = the same 2-byte integer variable or constant assigned to any one of the printer stations in the OPEN statement.

| i4 = a 4-byte integer that represents the driver status. The integer represents information in the form RRRRLLMM, where RR, RR, LL, and MM each represent one of the four bytes. The first two bytes are reserved for system use.

| **Note:** The changes made to support the Model 3 printer have been marked with an asterisk (*).

| Byte LL represents mode information:

| bit 0 (X' 01') = 0 Reserved
| * bit 1 = 0 Print only first 300 slices of LOGO data
| = 1 Print full 380 slices of LOGO data

| * bit 2 = 0 Print buffered journal data
| = 1 Hold buffered journal data
| bit 3   = Reserved
| * bit 4 = 0 WRITE FORM statement line feed specification (A value) represents line feeds
| = 1 WRITE FORM statement line feed specification (A value) represents motor steps
| * bit 5 = 0 6 lines/inch line spacing mode in the customer receipt station
| = 1 8 lines/inch line spacing mode in the customer receipt station
| * bit 6 = 0 6 lines/inch line spacing mode in the summary journal station
| = 1 8 lines/inch line spacing mode in the summary journal station
| * bit 7 = 0 6 lines/inch line spacing mode in the document insert station
| = 1 8 lines/inch line spacing mode in the document insert station

| **Notes:**

| 1. The function provided by bit 1 is not supported by the Model 3A fiscal printer.
| 2. The function provided by bit 6 is not supported by the Model 3A fiscal printer.
| 3. The function provided by bits 5 and 7 is not supported by the Model 3A fiscal printer in fiscal mode.

| Byte MM represents mode information as follows:

| bit 0   (X'01') = 0 Reserved
| * bit 1 = 0 Document line feed is in normal mode, bottom-to-top (default)
| * bit 1 = 1 Document line feed is in reverse mode, top-to-bottom
| bit 2   = 0 Reserved
| * bit 3 = 0 Reserved
| bit 4   = 0 Manual document insert
| bit 4   = 1 Automatic document insert
| bit 5   = 0 Document cannot be removed and replaced between print lines on the DI:
| bit 5   = 1 Document can be removed and replaced between print lines on the DI:
| bit 6   = 0 Document cannot be placed in DI: during printing on CR:
| bit 6   = 1 Document can be placed in DI: during printing on CR:
| bit 7   = 0 Document sensing not required by DI: for printing on CR:
| bit 7   = 1 Document sensing required by DI: for printing on CR:

| **Note:** The functions provided by bits 4, 5, 6, and 7 are not supported by the Model 3A fiscal printer.

| **Reading from the Model 3 Fiscal Printer:** The CBASIC language does not permit reading from the printer. This function is provided by a library routine in the file ADXFISRL.286 (for medium memory models) or ADXFISBL.286 (for big memory models), that must be linked with applications using the fiscal printer.

| The function is called FISREAD and has the following definition:

```
| SUB FISREAD(FISRC,FISERR,FISDATA) EXTERNAL
| INTEGER*4 FISRC
| INTEGER*2 FISERR
| STRING FISDATA
| END SUB
```

| FISRC is a 4-byte return code from the printer driver.

| FISERR is a 2-byte error code with the following possible values:

| 0 = no error
| –1 = error on open
| –2 = error on read

FISDATA is a string variable with the format:

- Bytes 0 – 3 are the first 4 bytes of printer status
- Bytes 4 – 5 are reserved for service personnel
- Byte 6 is a read flag
  - X'0' indicates this data has not been read by the application before. This is the first time data is read from the buffer, and the status matches the read data.
  - X'1' indicates the data has been read by the application previously. This occurs if no fiscal read commands (X'DA' or X'DB') were processed by the printer since the last FISREAD command was issued. This data has been read from the buffer previously and the status matches the read data.
  - X'2' indicates this is the first time data is read from the buffer, but the status bytes have been updated after the read data was received.
  - X'3' indicates this data has been read from the buffer previously, but the status bytes have been updated after the read data was received.
- Byte 7 is the Microcode EC (engineering change) level.
- Bytes 8 – 9 contain the length of the fiscal read response. These two bytes are in INTEGER*2 format.
- Bytes 10 – 265 contain the response to the fiscal read command.

Using the FISREAD call: To read the printer data, the following sequence should be used:

1. Write the FISCAL READ command (X'DA' or X'DB') to the printer with a WRITE statement.
2. Issue a TCLOSE to the printer to flush the print buffer.
3. Call the FISREAD routine to retrieve the fiscal data into the application buffer.
4. Check the FISERR value for an error indication.
5. For an error, obtain the return code from the FISRC variable, or if no error, extract the needed data from the FISDATA string variable.

An example of a CBASIC FISREAD call is:

```
CALL FISREAD(FISRC,FISERR,FISDATA)
```

Scale Driver

This section describes the scale driver and provides guidelines for using it.

Characteristics

- One scale can be attached to a terminal and can be one of the following:
  - Non-IBM scale attached to Feature Expansion Card B or C (4683 only)
  - Integrated scanner/scale attached to a terminal socket

Refer to the *4690 Store System: Planning, Installation, and Configuration Guide* for the terminal sockets that support a scanner/scale on your terminal

- You can select to have either English or Metric weight

  English - weight returned is:

  maximum of four digits
  hundredths of pounds

  Metric - weight returned is::

  maximum of five digits
  thousandths of kilograms

Accessing the Scale

Use the OPEN statement to gain access to the scale driver.

Use the CLOSE statement to end communication with the scale driver.

Receiving Data

Issue a READ FORM statement to receive data from the scale. If valid data is available, the variable specified in the READ FORM statement contains the weight. If an error occurs, control passes to the ON ERROR routine.

Example

To run the following example, put a weight on the scale. The program reads the scale, displays the weight one time, and then stops.

```
%ENVIRON T
! Declare variables.
INTEGER*4 hx%,sx%,WEIGHT%
INTEGER*2 SCALE%,ANDSP%
ON ERROR GOTO ERRORA
! Indicate "ON ERROR" label.
ANDSP% = 1
! Set alphanumeric display session number to 1.
SCALE% = 2
! Set scale session number to 2.
OPEN "ANDISPLAY:" as ANDSP%
! Open alphanumeric display.
CLEARS ANDSP%
! Clear alphanumeric display.
```

```
WRITE  #ANDSP% ; "SAMPLE SCALE PROG"
WAIT;5000
! Wait 5 seconds so display can be read.
CLEARS ANDSP%
! Clear alphanumeric display.
OPEN "SCALE:" AS SCALE%
! Open the scale.
WRITE #ANDSP% ; "SCALE OPEN"
! Indicate the scale was opened.
WAIT;5000
! Wait 5 seconds so display can be read.
CLEARS ANDSP%
! Clear display.

WRITE #ANDSP% ; "READ THE SCALE NOW!"
READ FORM "I4" ; #SCALE% ; WEIGHT%
WRITE FORM "C10 PIC(####)" ; #ANDSP% ; " WEIGHT = ",WEIGHT%
WAIT;6000
! Wait 6 seconds so weight can be read.
LOCATE #ANDSP% ; 2,1
! Locate to second line.
CLOSE SCALE%
! Close scale.
WRITE #ANDSP% ; "SCALE IS CLOSED"
WAIT ; 5000
! Wait 5 seconds so message can be read.
STOP
ERRORA:
ERROR ASSEMBLY ROUTINE
hx% = ERRN
ERRFX$ = ""
for s% = 28 to zero STEP -4
   sx% = shift(hx%,s%)
   THE.SUM% = sx% AND 000fh
IF THE.SUM% > 9 THEN    \
   THE.SUM%=THE.SUM%+55 \
ELSE                    \
   THE.SUM%=THE.SUM%+48
   A$=CHR$(THE.SUM%)
   ERRFX$ = ERRFX$ + A$

NEXT s%
CLEARS ANDSP%
WRITE #ANDSP%;"ERR=",ERR,"   ERRL=",ERRL
LOCATE #ANDSP%;2,1
WRITE #ANDSP%;"ERRF=",ERRF%," ERRN=",ERRFX$
WAIT ;15000
RESUME
END
```

Serial I/O Communications Driver

This section describes the serial I/O communications driver and provides guidelines for using it.

Characteristics

The serial I/O communications driver has the following characteristics:

- Each IBM 4683 Point of Sale Terminal supports a maximum of two feature expansion cards. Each of these can contain two ports to attach serial communication I/O devices. One port can attach an I/O device that is compatible with an Electronics Industries Association (EIA) RS232C interface and the other port can attach an I/O device compatible with an EIA RS232C interface or an asynchronous 20-milliampere current-loop interface.
- Each port can be used in either a half-duplex or full-duplex mode.
- The terminal serial I/O port functions as Data Communications Equipment (DCE) and the serial communication device functions as Data Terminal Equipment (DTE) in terms of RS232C interface.
- 4684 terminals support serial ports COM1 and COM8 on the native serial ports and the ports on the dual asynchronous adapter. 4693 terminals support serial ports COM1 and COM2 on the native serial ports and COM1 through COM8 on the Dual Async adapter. 4694 terminals and 4683-4x1 terminal upgrades support serial ports COM1 through COM2 on the native serial ports. These serial I/O ports function as DTEs, and the serial communication device functions as DCEs as related to an RS232C interface.

  To attach a device to the serial I/O port, you need the interface requirements of the particular device and the EIA RS232C or asynchronous current-loop interface requirements. Current loop is supported on 4683 terminals.

  Commands allow you to communicate with the device. Your application has responsibility for any protocol requirements such as checkpointing, pacing, positive or negative response, or error recovery.

Functions Your Application Performs

An application program can perform the following functions with the device attached to the serial I/O port (depending on the capability of the device):

- Transmit data to the device
- Receive data from the device
- Set communication parameters
- Obtain status

Accessing the Serial I/O Port

Use the OPEN SERIAL statement to gain access to the serial I/O driver. Specify the following parameters on the OPEN SERIAL statement:

- Serial I/O port to open (1 through 4).
- Transmit or receive speed (110, 300, 1200, 2400, 4800, 9600, or 19200 bits per second).
- Parity (even, odd, or none).
- Number of data bits per character (5 through 8).

  If the bits-per-character is less than eight, the significant bits are placed in the rightmost bits of each byte in the application buffer on a READ, and taken from the rightmost bits on a WRITE.
- Number of stop bits (1, 1.5, or 2).
- Maximum application buffer size (1 through 247).

You determine how to set these parameters by the interface requirements of the device attached to the serial I/O port. The maximum application buffer size is the maximum number of bytes that you will transmit or receive from the device on a single write or read operation.

Once you have issued the OPEN SERIAL to a port, you cannot change any of the parameters associated with the OPEN SERIAL unless you issue a CLOSE to delete your I/O session and then issue another OPEN SERIAL with different parameters.

Use the CLOSE statement to end your application's use of the serial I/O port.

Overview of Receiving Data

Your application must enable receive mode on the serial I/O feature expansion to allow data to be received. You should also set an appropriate intercharacter timeout value. An intercharacter timer is started (using this value as the upper limit) each time a character is received. As data characters are received, they are placed in a 247-byte driver buffer.

Data in the driver buffer becomes available to your application when any of the following conditions occur:

- Data has been received and the timer expires before the next character is received.
- The driver buffer is full.
- Data has been received and an error or special event is detected (see “Waiting for Received Data” for a list of the errors or events).

The normal condition that causes data to be available to your application should be the expiration of the intercharacter timer. This value must be compatible with the device sending the data so that the timer expires before 247 bytes are received. If the driver buffer is filled, data is lost if more data is received before the application reads the driver buffer data.

If your device can send multiple blocks of data without a response from your application, you should read the driver buffer promptly following the availability of data. If data becomes available because the timer expired, and new data characters are received before the application performs a read operation, the new characters are added to the driver buffer data. This could result in a buffer overrun condition if the driver buffer data is not read promptly.

If data has been received and an error is detected, the error is not reported until the application reads the data already received. The error is reported the next time the application performs a wait or read operation. Any data received following the error is discarded until the application is notified of the error.

If the driver buffer is empty and an error occurs, the application is notified of the error on the next wait or read operation. Any data received before the application is notified of the error is discarded. Note that data detected to be in error is never passed to the application; only the error status is passed.

Preparing to Receive Data from the Device

Issue a PUTLONG to set up the following parameters in preparation for receiving data from the device:

- Intercharacter timeout value. Choose a value compatible with your device. The default value is 100 milliseconds.
- Enable receive (byte CC, bit 2=1).
- For a 4683 terminal feature expansion card I/O port, condition Data Set Ready (DSR) (byte CC, bit 1) and Clear To Send (CTS) (byte CC, bit 5) according to the requirements of your device.
- For a 4683 terminal feature expansion card I/O port, Data Terminal Ready (DTR) must be active to receive data (byte CC, bit 6). Choose this parameter according to the requirements of your device.
- For an I/O port not on a feature expansion card, condition DTR (byte CC, bit 1) and Request To Send (RTS) (byte CC, bit 5) according to the requirements of your device.
- For an I/O port not on a feature expansion card, DSR must be active to receive data (byte CC, bit 6). Choose this parameter according to the requirements of your device.

Waiting for Received Data

Your application should issue a WAIT statement to wait for data from the device. In most cases you need to wait for data from multiple sources such as the serial device and the I/O processor. The WAIT statement allows you to wait for input from multiple devices including a timer to indicate no input received during a specific time. When good data is available from the device, the statement following the WAIT is executed. When you wait on multiple devices, use the EVENT% statement to determine if the serial device was the device satisfying the WAIT. If an error occurs during a WAIT, control is given to your ON ERROR routine.

Any of the following conditions causes a WAIT to be satisfied by the serial I/O driver:

- The intercharacter timer expires.
- The 247-byte system buffer is full.
- One of the following errors or events occurs:
  - A framing error is detected. A framing error results when the asynchronous character stop bit is not detected at the proper time during reception of a character.
  - A parity error is detected. Feature Expansion hardware error is detected.
  - A break is received from the device.
  - For a 4683 feature expansion card I/O port, DTR is inactive when DTR monitoring is requested with a PUTLONG, and not configured as a current TCC Network.
  - For an I/O port not on a feature expansion card, DSR is inactive when DSR monitoring is requested with a PUTLONG.

Receiving Data from the Device

Issue READ LINE to receive data from the device. READ LINE is a synchronous operation. If good data is available from the device, the READ LINE is completed and the data is placed in your string variable specified on the READ LINE statement. You can use the LEN function to check the number of bytes received. If an error occurred, control is given to the ON ERROR routine.

Determining Serial I/O Port Status

The GETLONG statement returns the current settings of the control parameters that can be set with PUTLONG. GETLONG also returns status information related to the device and the serial I/O port. The status information contains the following information for a 4683 feature card serial port:

- Data available
- Data lost
- DTR status (at the time GETLONG is executed)
- RTS status (at the time GETLONG is executed)
- Parity error
- Framing error
- Break received
- Transmit buffer empty

The status information contains the following information for 4684 and 4693 ports (both native and on Dual Async adapters), 4694, and 4683-421 terminal upgrade native serial ports.

- Data available
- Data lost
- DSR status (at the time GETLONG is executed)
- CTS status (at the time GETLONG is executed)
- Transmit buffer empty

Preparing to Transmit Data to the Device

For a 4683 feature expansion card I/O port, issue a PUTLONG to condition DSR, CTS, and to set the option that causes the driver to wait or not wait for DTR on transmit (byte CC, bit zero). These settings must be according to the requirements of your device.

For an I/O port not on a feature expansion card, issue a PUTLONG to condition DTR, RTS, and to set the option that causes the driver to wait or not wait for DSR on transmit (byte CC, bit zero). These settings must be according to the requirements of your device.

Transmitting Data to the Device

Issue a WRITE statement to transmit data from your application to the device. A WRITE is an asynchronous operation. The serial I/O driver has one transmit buffer. If all previous write operations are complete when you issue a WRITE statement, the driver fills its transmit buffer and returns control to the statement following the WRITE command. If a previous write operation is not complete when you issue a WRITE, execution of your application is suspended until the previous write operation ends. You can see if a write operation is complete by checking the transmit buffer empty bit in the status returned on a GETLONG statement.

A write operation is complete when any of the following conditions occur:

- All data specified on a WRITE has been sent to the device.
- For a 4683 feature expansion card I/O port, DTR goes inactive for at least 30 seconds and wait for DTR active was set with a PUTLONG statement (byte CC, bit zero=1), and not configured as a current TCC Network.
- A serial I/O feature expansion hardware error has been detected.
- For a 4683 feature expansion card I/O port, RTS goes inactive for at least 30 seconds and not configured as a current TCC Network.
- For an I/O port not on a feature expansion card, DSR goes inactive for at least 30 seconds and wait for DSR active was set with a PUTLONG statement (byte CC, bit zero=1).

- For an I/O port not on a feature expansion card, CTS goes inactive for at least 30 seconds.

If an error is detected on a write operation, control is given to your ON ASYNC ERROR routine.

Sending a Break to the Device

You can send a break to the device that is attached to an I/O port by specifying *send break* on a PUTLONG statement (byte CC, bit 3=1). You do not have to reset the bit. Each time you issue a PUTLONG statement with the send break bit set, the driver sends a break to the device. The serial I/O feature expansion causes a break by generating 10 consecutive framing errors.

Simultaneous Receive and Transmit

Your application can perform receive and transmit operations simultaneously by issuing a WRITE, which is executed asynchronously, and then a WAIT to wait for received data.

Example

This sample program uses the serial I/O interface to print the following 59-byte character set in a rippled pattern on a serial printer or video display using the RS232-EIA port.

"ABCDEFGHIJKLMNOPQRSTUVWXYZ0123456789&*:;""'@?,.$=!><()-%+#/ "

Make the following assumptions:

1. Port 2 = RS232 EIA INTERFACE
2. 9600 BPS Baud Rate
3. ASYNC DATA FORMAT
   - NO PARITY
   - 8 BIT CODE WITH 1 STOP BIT.

```
%ENVIRON T                              !! INDICATE TERMINAL
INTEGER*4 hx%,sx%                       !! DECLARE VARIABLES
INTEGER*2 ANDSP%,EIAP%
ANDSP% = 1                              !! INIT I/O SESSIONS
EIAP% = 12

SUB ASYNC.ERR(RFLAG,OVER)
INTEGER*2 RFLAG
STRING OVER
RFLAG = 0
OVER = ""
hx% = errn
errfx$ = ""
for s% = 28 to 0 step -4
  sx% = shift(hx%,s%)
  the.sum% = sx% and 000fh
  IF THE.SUM% > 9 THEN    \
     THE.SUM%=THE.SUM%+55 \
  ELSE                    \
     THE.SUM%=THE.SUM%+48
  A$=CHR$(THE.SUM%)
  errfx$ = errfx$ + A$
next s%
clears ANDSP%
```

```
write  #ANDSP%;"err=",err,"   errl=",errl
locate #ANDSP%;2,1
write  #ANDSP%;"errf=",errf%," errn=",errfx$
wait ;15000
resume
END SUB

ON ERROR GOTO ERRORA                      !! SET "ON ERROR"
ON ASYNC ERROR CALL ASYNC.ERR             !! SET "ON ASYNC ERROR"
OPEN "ANDISPLAY:" AS ANDSP%               !! OPEN AN DISPLAY
CLEARS ANDSP%
WRITE #ANDSP% ; "SERIAL I/O SAMPLE "
WAIT ; 5000                               !! WAIT 5 SECONDS
! --------------
! ENABLE PORT 2 (RS232 EIA INTERFACE) AS I/O SESSION 12
! --------------
OPEN SERIAL 2,9600,"N",8,1 AS EIAP% BUFFSIZE 80
LOCATE #ANDSP% ; 2,1                      !! LOCATE TO SEC LINE
WRITE #ANDSP% ; "SER I/O PORT 2 OPEN"
! --------------
! CONSTANT FOR 59 CHAR. RIPPLE PATTERN CHARACTER SET
! --------------
BUF1$="ABCDEFGHIJKLMNOPQRSTUVWXYZ0123456789&*:;'""@?,.$=!><()-%+#/ "
BUF2$ = "ABCDEFGHIJKLMNOPQRST"
B1$ = BUF1$ + BUF1$ + BUF2$  !!! 59 + 59 + 20 FOR RIPPLE 80 CHARS
I% = 1                       !!! VARIABLE FOR RIPPLE COUNTER
WRITE #ANDSP% ; "START RIPPLE PRINT"

EXERCISE:
FOR I% = 1 TO 20
  C1$ = MID$(B1$,I%,80)                   !!! MSG DATA-RIPLE PATRN
  WRITE # EIAP%; C1$                      !!! SEND 1 MSG EACH PASS
NEXT I%
CLOSE EIAP%                               !! CLOSE SERIAL I/O
WRITE #ANDSP% ; "END OF SAMPLE"
CLOSE ANDSP%                              !! CLOSE AN DISPLAY
STOP                                      !! STOP PROGRAM
ERRORA:
!!ERROR ASSEMBLY ROUTINE!!
hx% = errn
errfx$ = ""

for s% = 28 to 0 step -4
    sx% = shift(hx%,s%)
    the.sum% = sx% and 000fh
  IF THE.SUM% > 9 THEN    \
    THE.SUM%=THE.SUM%+55 \
  ELSE                     \
    THE.SUM%=THE.SUM%+48
  A$=CHR$(THE.SUM%)
  errfx$ = errfx$ + A$
next s%
clears  ANDSP%
write  #ANDSP%;"err=",err,"   errl=",errl
locate #ANDSP%;2,1
write  #ANDSP%;"errf=",errf%," errn=",errfx$
wait ;15000
resume
```

```
end
```

Tone Driver

This section describes the tone driver and provides guidelines for using it.

Characteristics

The tone driver has the following characteristics:

- The tone is an output device that provides audible feedback at the terminals.
- Your application controls the occurrence, frequency, and duration of tones.
- The operator can set the volume of the tones to be high or low by keying input to the terminal system functions. The *IBM 4690 Store System: User's Guide* explains how to set the tone volume.

Functions Your Application Performs

Your application program can perform the following functions with the tone:

- Specify the tone frequency and duration.
- Turn the tone on or off on request.

Accessing the Tone

Use the OPEN statement to gain access to the tone device driver.

Use the CLOSE statement to end your application's use of the tone device driver.

Generating a Tone

Use the WRITE FORM statement to generate a tone. You must specify the frequency of the tone as either low, medium, or high. You must also choose to either generate a tone of a specified duration or control the tone through individual WRITE FORM statements. If you specify a tone duration, the tone driver turns the tone on, waits the specified duration, and turns the tone off. If you do not specify the duration, you must turn the tone on or off with separate WRITE FORM statements. You can set the volume of the tone by specifying HI or LOW as the duration on a WRITE FORM statement.

When you issue a WRITE FORM statement, the request is queued to the tone driver. Control proceeds to the statement following the WRITE FORM unless an error occurs. The driver allows a maximum of one tone request being sounded and two queued requests; it discards any others. If you request the tone ON (duration not specified), your next tone request must be a tone OFF request. Any tone requests other than tone OFF are discarded.

The terminal tone volume can be controlled by using the WRITE FORM statement with HI or LOW as the duration. To set the volume to high, specify HI as the duration. Specify LOW for low volume. In either case, you must also include a valid frequency. A WRITE FORM with a HI or LOW does not produce any tone, but sets the volume for future tone requests. The tone volume remains in effect until the next HI or LOW is specified or until system function 6 is entered from the keyboard to toggle the tone volume.

When the driver processes a tone request, it ensures that at least 0.2 seconds elapse between completion of the request and processing another one. This pause ensures that queued tone requests do not sound like a single tone.

The I/O processor can also generate tones. You can specify in the input state table that a tone should result from certain input sequences. The I/O processor issues the tone when these input sequences occur.

Example

This example writes a message to the display, runs a test of the tone device, and then writes another message to the display.

```
%ENVIRON T
!  Declare a two-byte integer.
INTEGER*2   DISPLAY
INTEGER*2   TONE
DISPLAY =  1
TONE = 2
ON ERROR GOTO ERR.HNDLR
! Open the display.
OPEN "ANDISPLAY:" AS DISPLAY
CLEARS DISPLAY
WRITE #DISPLAY; "START TONE TEST"
WAIT  ; 2000
OPEN  "TONE:" AS TONE
CLEARS DISPLAY
WRITE #DISPLAY;  "TONE"
WAIT ;2000
WRITE FORM "C4,C3"; #TONE; "0750", "020"
WAIT; 250
WRITE FORM "C4,C3"; #TONE; "1000", "020"
WAIT; 250
WRITE FORM "C4,C3"; #TONE; "1800", "020"
WAIT; 250
CLOSE TONE
CLEARS DISPLAY
WRITE #DISPLAY;  "END TONE SAMPLE"
CLOSE DISPLAY
STOP

ERR.HNDLR:
! Prevent recursion.
ON ERROR GOTO END.PROG
! Determine error type
! and perform appropriate
! recovery and resume steps.
END.PROG:
STOP
END
```

Totals Retention Driver

This section describes the totals retention driver and provides guidelines for using it.

Characteristics

The totals retention driver has the following characteristics:

- 1024 bytes are available for your application to store data that needs to be saved if the 4683 terminal loses power for a prolonged period. 16 KB are available for your application with a 4693/4694.
- Your application can use the totals retention storage area like it does for either a direct file or a sequential file. The following functions are available:
  - Direct Mode
    - Write data to a specified address.
    - Read data to a specified address.
  - Sequential Mode
    - Write data.
    - Read data.
    - Specify offset for next read or write.
    - Get offset of last record read or written.
- For direct or sequential mode access, four bytes consisting of length and cyclic redundancy check (CRC) information are added to each record written. You must include this overhead when calculating record addresses or space requirements. The overhead bytes are not passed to your application when you read a record.

  For sequential mode, there is an additional overhead of four bytes for an end-of-file (EOF) marker. This marker is appended to the end of a record on a write. If the offset is not changed, the previous EOF marker is overlaid by each sequential record write.

  The maximum record size that your application can write is 60 bytes in direct mode and 56 bytes in sequential mode for a 4683 terminal, or 1020 bytes in direct mode and 1016 bytes in sequential mode for a 4693/4694 terminal. The totals retention driver automatically adds the required overhead bytes to your records.

  The application address space for totals retention is 1 through 1024 for a 4683 terminal, or 1 to 16384 for a 4693-xxx and 4694 terminal. Your application has the responsibility to determine the record start and length in direct mode.

Accessing the Totals Retention Driver

Use the OPEN statement to gain access to the totals retention driver.

The CLOSE statement ends communication with the totals retention driver.

Accessing Totals Retention in Direct Mode

Direct mode is specified when you use the READ FORM or WRITE FORM statement. You must always specify the address (1 through 1020 for 4683, 1 through 16380 for 4693/4694) of the record to be read or written. You cannot specify direct mode access to start at addresses greater than 1020 for the 4683 terminals or 16380 for the 4693 and 4694 terminals because of the overhead requirements. There is no EOF marker added on a direct mode write.

Reading Data in Direct Mode

To read a record in direct mode, issue a READ FORM statement specifying the totals retention address of the start of the record. The data (without the overhead bytes) is placed in the variables specified on your READ FORM statement. If there is an error in the data read, control passes to your ON ERROR routine. If the error returned is offline, there is no data put into the specified variable.

Writing Data in Direct Mode

To write a record in direct mode, issue a WRITE FORM statement specifying the starting address (1 through 1020 for 4683, 1 through 16380 for 4693/4694) of the record. The number of bytes in your record must be 1 through 60 (4683 terminals), or 1 through 1020 (4693/4694 terminals). If an error is detected on the WRITE FORM, control passes to your ON ERROR routine.

Accessing Totals Retention in Sequential Mode

Sequential mode is specified when you use the READ LINE, WRITE, or POINT statements or the PTRRTN function. For sequential mode, the totals retention driver maintains a pointer to the next record to read or be written and a pointer to the beginning of the last record that was read or written. After an OPEN statement is executed, both pointers point to address one.

Specifying the Address in Sequential Mode

When you read or write records in sequential mode, the totals retention driver uses the next record pointer to determine the starting address of the read or write. Following a successful read or write, the next record pointer and last record pointer are updated. Issue a POINT statement when you want to prepare to read or write a record other than the next sequential record. The address on the POINT statement must be between 1 and 1020 (4683 terminals) or 1 and 16380 (4693/4694 terminals) for a READ LINE. The address on the POINT statement must be between 1 and 1016 (4683 terminals) or 1 and 16376 (4693/4694 terminals) for a WRITE.

If you want to access the last record read or written, use the PTRRTN function to return the address of the last record accessed. This address can be used on a POINT statement to prepare to reread or rewrite the last record accessed.

Reading Data in Sequential Mode

Issue a READ LINE statement to read a record in sequential mode. The next record pointer contains the starting address for the read. Following the read, the record data is placed in the string variable specified on the READ LINE statement. If an EOF marker is detected or an error occurs, control passes to your ON ERROR routine.

Writing Data in Sequential Mode

Issue a WRITE statement to write a record in sequential mode. The next record pointer contains the starting address for the write. Following a successful write, the next record pointer and last record pointer are updated and an EOF marker is written.

When you write records sequentially by letting the next record pointer indicate the address, the previous EOF marker is overwritten and replaced by the new record and new EOF marker. If you use the POINT statement to change the address of the next write, it is possible to create multiple EOF markers in Totals Retention storage.

Example

The following example contains code written to communicate with a totals retention driver. This example writes a message to the display, runs a test of the totals retention driver by writing data to it and then reading data from it. It then compares the data that it stored with the original data, writing messages about the results of the comparison to the display.

```
%ENVIRON T
! Totals Retention sample.
! Define the variables.
INTEGER*2 HARDTOT, DISPLAY,I1,I2
INTEGER*2 J1,J2,OFFSET
INTEGER*4 I3,I4,J3,J4,TIME
REAL R1,R2
STRING DATA1$,DATA2$,RDMFMT$
! Set up the error handler.
ON ERROR GOTO ERROR1
! Open the totals retention driver and
! the AN display for messages.
HARDTOT = 1
DISPLAY = 2
TIME = 5000
OPEN "ANDISPLAY:" AS DISPLAY
OPEN "TOTRET:" AS HARDTOT BUFFSIZE 1020
CLEARS DISPLAY
WRITE #DISPLAY; "START OF TOTALS RETENTION SAMPLE"
WAIT ; TIME
! Initialize the variables.
OFFSET = 1
R1 = 100.3
I1 = 1
I2 = 2
DATA1$ = "ABCDEFGHIJKLMNOPQRSTUVWXYZ7890"
I3 = 35
I4 = 36
RDMFMT$ = "R 2I2 C30 2I4"
! Write the data in the totals retention area of storage.
WRITE FORM RDMFMT$;#HARDTOT,OFFSET;R1,I1,I2,DATA1$,I3,I4
CLEARS DISPLAY
WRITE #DISPLAY; "WRITE COMPLETE
WAIT ;TIME

! Then read the data back, and compare with the original
! data.  This portion of the example could be executed
! after a power-down situation to demonstrate totals
! retention.
RDMREAD:
READ FORM RDMFMT$;#HARDTOT,OFFSET;R2,J1,J2,DATA2$,J3,J4
! Compare the data read with original data.
CLEARS DISPLAY
IF R1 = R2 THEN \
   WRITE # DISPLAY; "REAL DATA COMPARES OK"\
ELSE \
   WRITE # DISPLAY; "REAL DATA DOESN'T COMPARE OK  "
WAIT ; TIME
CLEARS DISPLAY
IF I1 = J1 THEN \
```

```
   WRITE # DISPLAY;"INTEGER DATA COMPARES OK  -1     " \
ELSE \
   WRITE # DISPLAY; "INTEGER DATA DOESN'T COMPARE OK -1    "\
WAIT ; TIME
CLEARS DISPLAY
IF I2 = J2 THEN \
   WRITE # DISPLAY; "INTEGER DATA COMPARES OK  -2     " \
ELSE \
WRITE # DISPLAY ;"INTEGER DATA DOESN'T COMPARE OK -2"
WAIT ; TIME
CLEARS DISPLAY
IF I3 = J3 THEN \
   WRITE # DISPLAY;"INTEGER DATA COMPARES OK  -3     " \
ELSE\
   WRITE # DISPLAY;"INTEGER DATA DOESN'T COMPARE OK -3"
WAIT ; TIME
CLEARS DISPLAY
IF I4 = J4 THEN \
   WRITE # DISPLAY;"INTEGER DATA COMPARES OK  -4     " \
ELSE \
   WRITE # DISPLAY;"INTEGER DATA DOESN'T COMPARE OK -4"
WAIT ; TIME
CLEARS DISPLAY
IF DATA1$ = DATA2$ THEN \
   WRITE # DISPLAY;"CHARACTER DATA COMPARES OK         " \
ELSE \
   WRITE # DISPLAY:"CHARACTER DATA DOESN'T COMPARE OK  "
WAIT ; TIME
CLEANUP:
CLOSE HARDTOT
CLEARS DISPLAY
WRITE # DISPLAY;"END OF TOTALS RETENTION SAMPLE    "
CLOSE DISPLAY
STOP

ERROR1:
! Prevent recursion.
ON ERROR GOTO ERROR2
! Determine error type and perform appropriate recovery
! and resume steps.
ERROR2:
STOP
END
```

Chapter 4. Using Error Recovery Procedures and Facilities

Error Recovery Options

The IBM 4690 Operating System provides procedures and facilities that help you recover from error situations or from situations that could result in the loss of data. These procedures are either:

- Automatic functions of the IBM 4690 Operating System
- Enabled during configuration
- Included in your applications

The 4690 Operating System provides several means for recovering from errors:

- IBM 4680 BASIC functions and statements
- A facility for logging system errors or events
- Special write operations that help save your data during a power line disturbance
- A storage retention function on your terminal that protects data during a power outage

Error Functions and Statements

Several IBM 4680 BASIC functions and statements help you process and recover from errors associated with your application. These include the ON ERROR, ON ASYNC ERROR CALL, IF END#, and RESUME statement, and the ERR, ERRL, ERRF%, and ERRN functions. Refer to the *IBM 4680 BASIC: Language Reference* for additional information on each of these statements and functions.

ON ERROR Statement

The ON ERROR statement specifies a label in control when an error associated with a synchronous operation occurs. This statement should be the first executable (nondeclarative) statement in your main application. All operations that your program generates are synchronous operations except for writing data to the terminal printer, using the serial I/O driver, and writing data to a host communication session or link.

Your ON ERROR routine can contain any valid IBM 4680 BASIC statement or function. The first statement in your ON ERROR routine should be a test to see if you have run out of memory (ERR=OM). If you get this error, do not attempt to initialize or increase the size of a string or an array. This would result in another OM error and your program would end up in an infinite loop.

Your application can have multiple ON ERROR statements. However, one ON ERROR routine is in effect at any one time. If your application consists of multiple functions and subprograms, each of these can contain its own ON ERROR routine. When you enter the function or subprogram and an ON ERROR statement is executed, the runtime library remembers the previous ON ERROR routine that was in effect. When you exit the function or subprogram, the runtime library restores the ON ERROR routine to the label it had before entering the procedure.

The ON ERROR routines in the terminal should check to determine if the terminal experiencing the I/O error is powered-OFF. The applications for the Mod1 and Mod2 terminals both execute when the Mod1 terminal is powered-ON. Because Mod2 might be powered-OFF while the Mod1 terminal application is still running, the ON ERROR routine should always check whether the I/O error was caused by the powered-OFF terminal. You should use the ADXSERVE function for the application status to determine whether the terminal is powered-ON or powered-OFF. ADXSERVE always indicates that the Mod1 terminal is powered-ON. See “ADXSERVE (Requesting an Application Service)” on page 15-17 for more information on the ADXSERVE function.

When you have determined the type and source of the error, you must issue a RESUME statement to recover from the error.

| When a runtime error occurs during an I/O operation, that I/O session number should not be closed in the
| ON ERROR code. Closing it before resuming from the error leaves runtime data pertaining to that session
| number in an indeterminate state. If a file, pipe, device or communication link must be closed because of
| an error, the ON ERROR code should set a flag to be checked in the mainline code where the I/O session
| can be safely closed.

ON ASYNC ERROR CALL Statement

The ON ASYNC ERROR CALL statement specifies a subprogram where control is given when an error associated with an asynchronous operation occurs. This statement should be the second executable (nondeclarative) statement in your main application if it contains any asynchronous operations. Asynchronous operations are writing data to the terminal printer, using the serial I/O driver, and writing data to a host communication session or link.

Your ON ASYNC ERROR CALL subprogram can contain most valid IBM 4680 BASIC statements and functions. This subprogram must have its own ON ERROR routine, local to this subprogram, to handle any synchronous errors that occur when executing this recovery path.

Your application can have multiple ON ASYNC ERROR CALL statements. Only one ON ASYNC ERROR CALL subprogram is in effect at any one time, however. If your application consists of multiple functions and subprograms, each of these can contain its own ON ASYNC ERROR CALL subprogram. When you enter the function or subprogram and an ON ASYNC ERROR CALL statement is executed, the runtime library remembers the previous ON ASYNC ERROR CALL subprogram that was in effect. When you exit the function or subprogram, the runtime library restores the ON ASYNC ERROR CALL subprogram to the label it had prior to entering the procedure.

The ON ASYNC ERROR CALL subprograms in the terminal should check to determine whether the terminal experiencing the I/O error is powered-OFF. See “ON ERROR Statement” on page 4-2 for information on using the power on or off indication.

Refer to the *IBM 4680 BASIC: Language Reference* for information regarding the definition of the subprogram and returning control to the application where the error occurred.

IF END# Statement

The IF END# statement specifies a label where control is given when a file-not-found, end-of-file, or disk-full error occurs for a specified sequential, random, or direct file. For a keyed file, the label gets control when a file-not-found or record-not-found error occurs.

An IF END# statement, unlike the ON ERROR and ON ASYNC ERROR CALL statements, is associated with only one file. You can have only one IF END# statement active for each file; but you can have several files active, each with its own IF END# statement.

Your IF END# routine can contain any valid IBM 4680 BASIC statement or function.

When you have taken some corrective action in your IF END# routine, you must issue a GOTO statement to return to some point in your application.

RESUME Statement

The RESUME statement allows some type of recovery from all synchronous errors. The recovery options available depend on the type of error that occurred. There are two types of errors: I/O errors and non-I/O errors. The options available for recovery from an I/O error are RESUME, RESUME RETRY, and RESUME label. The only option available for non-I/O errors, which are usually logic errors, is RESUME label.

| **Note:** The RESUME statement may only be executed within an ON ERROR routine. Do not place the
| RESUME statement in a subprogram, function, or subroutine which is called by the ON ERROR
| routine.

RESUME: Execution of a RESUME statement causes the failing I/O statement to be bypassed. This ignores a noncritical I/O instruction that caused an error and continues execution at the next sequential instruction.

RESUME RETRY: Execution of a RESUME RETRY statement causes the failing I/O statement to be executed again. The application must keep track of the number of times the statement is executed to avoid an infinite loop if there is a hard I/O failure.

RESUME label: Execution of a RESUME label statement causes the failing statement to be bypassed and control to be given to a specified point in the application. You might want to designate several key recovery points in your application where control should be given in case of a logic error or some other unrecoverable error. This way you will be able to branch to one of several recovery points in your application, depending on how far you have gotten through your program when the error occurs. You can also call an application service to take a system dump so that debugging data is available. Do not RESUME to a label that identifies a subroutine.

ERR Function

The ERR function returns a two-character string containing the error message of the last runtime error that occurred. If no error has occurred when ERR function executes, it returns a null string. To identify and get an explanation of the two-byte error code, refer to the *IBM 4680 BASIC: Language Reference*.

ERRL Function

Use the ERRL function when debugging your application. It returns the line number at which the error occurred. If no error has occurred when this function executes, it returns a zero.

ERRF% Function

The ERRF% function returns the I/O session number associated with the most recent I/O error.

ERRN Function

The ERRN function returns a four-byte error code associated with I/O and operating system errors. This error code can help isolate the specific cause of an error when multiple conditions exist that could generate a single error code.

Logging System Errors

The IBM 4690 Operating System handles error recovery through retry operations and event or error logging. If the operating system detects an error, it usually retries the operation automatically. It continues system operation unless data integrity is endangered. Events and errors that take place on the system are recorded in a system log.

System Log

The operating system provides an event and error logging function that gives you a record of events surrounding a system error. You can use the data collected by this function to help resolve problems that you identify after a logged event or error takes place.

The data collected by the event or error logging function is stored in a set of files called the *system log*.

This system log consists of six files in which the new entries replace the old entries. The six files in the system log are:

- Store Controller Hardware Errors
- Terminal Hardware Errors
- Terminal Events
- Store Controller Events
- System Events
- Application Events

Placing system log data into these files helps isolate serious log entries (for example, a broken terminal printer) from entries resulting from expected occurrences (for example, a terminal recovering from a power line disturbance). The system uses the following guidelines for selecting a file for a particular event or error:

File	Use
Store Controller Hardware Errors	Used for faults that can be corrected by hardware repair at the store controller.
Terminal Hardware Errors	Used for faults that can be corrected by hardware repair at the terminal.
Terminal Events	Used for recording errors or events in terminals.
Store Controller Events	Used for recording errors or events in the controller.
System Events	Used for a wide variety of normal events (for example, initial program loads (IPLs), PLD recoveries), program-induced faults (for example, program checks), logical environment faults (for example, missing data sets), or certain operator-induced events (for example, choosing a system application).
Application Events	Used for events generated by application programs. The application can execute in either the terminals or store controller.

System Messages

Your operating system uses *system messages* to communicate exception conditions. These messages result from internal conditions that the operating system detects and logs as events or errors in the system log. In addition, system messages can result from your application calls to ADXERROR to accomplish desired application event logging.

System messages give information about errors and tell you the action needed to correct such errors. The messages consist of an identifier and descriptive text.

System Messages at the Store Controller: The main operator interface program handles system message requests in the store controller. This program receives requests, formats and writes system log entries, manages the six system log files, and based on severity code, adds messages to the SYSTEM MESSAGE DISPLAY screen.

The general format for messages displayed at the store controller is:

```
mm/dd hh:mm cc ttt s annn xxxxxxxxxxxxxxxxxxxxxxxx
                         xxxxxxxxxxxxxxxxxxxxxxxx
```

where:

mm/dd hh:mm is the log entry time stamp.
cc is the controller identifier.
ttt is the terminal number.

s is the severity code for the event or error.
annn xxx...xxxxx is the message text.

For more specific information about the content and use of system messages, refer to the *IBM 4690 Store System: Messages Guide*.

Severity Codes: You can specify which messages you want displayed on the SYSTEM MESSAGE DISPLAY screen through the use of *severity codes*. Depending on the severity code you set, messages at or below a certain severity level are shown as they are logged.

Severity codes are assigned to system message entries. Use these codes to indicate the impact of certain events or errors on a store's operation. For information on the severity codes, refer to the *IBM 4690 Store System: Messages Guide*.

For information on setting the system message display level, refer to the *IBM 4690 Store System: User's Guide*.

Severity Codes at the Terminal: System messages displayed at the terminal consist of a system message identifier and text and pertain only to problems the terminal operator needs to know about for recovery. These messages originate only from conditions detected by the operating system.

Terminal Services, an interface program for terminal software, provides logging and system message support for the terminal. Events or errors in each terminal component are reported to Terminal Services by specifying a message number, a group character, a request type, and any error or event parameters. When Terminal Services receives error or event data, it sends the data to the store controller, and the data can be displayed if desired. If a terminal has more than one display, the Terminal Services messages will be displayed on the system display. Depending on the request type specified, the message is displayed immediately or delayed. Delayed messages can be viewed only by entering key sequences that display the message. For information on system message display operations at the terminal, refer to the *IBM 4690 Store System: User's Guide*.

The format of the terminal message depends on the type of display attached to the terminal. For information on terminal message format, refer to the *IBM 4690 Store System: Messages Guide*.

Audible Alarm

The 4690 Operating System provides a function to sound an audible alarm at the store controller when system messages are logged. This alarm alerts operators to situations that might require immediate action to keep store operations running smoothly.

You can activate the alarm for a specified length of time, deactivate the alarm, and report the status of the alarm. The functions can be used locally or remotely from a host processor.

You can select a report on the SYSTEM MESSAGE AUDIBLE ALARM FUNCTIONS screen to indicate the status of the audible alarm at each controller. The report includes the store controller ID (if it is activated), the length of time the alarm is set to sound, and informs you if the alarm is activated. The message numbers can be displayed, printed, or written to a file.

Setting the Audible Alarm Function

The audible alarm function consists of four parts:

- Building the list of messages to sound the alarm
- Reporting the list of messages to sound the alarm
- Activating the function
- Deactivating the function

To set the audible Alarm, select the Installation and Update Aids option from the SYSTEM MAIN MENU. Then select the System Message Audible Alarm option on the INSTALLATION AND UPDATE AIDS screen.

To build a list of messages to sound the alarm, type **1** from the SYSTEM MESSAGE AUDIBLE ALARM FUNCTIONS screen. A table appears where you can enter message numbers. After determining which messages you want to activate the audible alarm, enter the message numbers in the table on the screen. If you have more message numbers than will fit on one screen, press the **PgDn** key. Another screen will appear that will allow you to enter numbers. You can enter up to 100 message numbers. After you have entered the desired message numbers, press the **Enter** key to save the numbers.

Note: The message numbers you select apply for all store controllers on a LAN (MCF Network).

To report the list of messages selected, select **2** from the SYSTEM MESSAGE AUDIBLE ALARM FUNCTIONS screen. You can direct the report output to the screen, the printer, or to a file by placing a value of 1, 2, or 3 in the Destination of Output field on the screen. If you select to direct the report output to a file, the report is placed in ADX_SDT1:ADXCS1RF.DAT.

Message numbers are four character spaces in length. The first space is a character (A, B, C, D, T, U, W, X, Y, or Z). The next three spaces are numbers from 000 to 999. Refer to the *IBM 4690 Store System: Messages Guide* for an explanation of these messages.

Setting the Audible Alarm Function through RCP: The audible alarm function can also be set using the Remote Command Processor (RCP). Refer to the *IBM 4690 Store System: Communications Programming Reference* for more information on the Remote Command Processor.

You cannot perform the Build Audible Alarm Message File function through RCP. You must build the audible alarm message file at your central site 4690 store controller. The file containing the messages that sound the alarm is ADX_SDT1:ADXCS1AF.DAT. After building the file at your central site 4690 store controller, you must send this file to your central site host processor. You can then transmit the file to each remote 4690 store controller. The RCP commands allow you to perform the report, activate, and deactivate functions directly.

For information on command formats using RCP, refer to the *IBM 4690 Store System: Communications Programming Reference.*

Activating the Audible Alarm Function

Option 3 on the SYSTEM MESSAGE AUDIBLE ALARM FUNCTIONS screen allows you to activate the audible alarm function. Unless you activate the function, the alarm will not sound for the chosen messages. If you want the alarm to sound on more than one store controller in your 4690 LAN (MCF Network) but not on all of the controllers, you can use the activate function as many times as you have store controllers to activate by changing the node ID.

You can limit the length of time the alarm will sound when a chosen message is logged. In the Alarm time limit in seconds field, you can enter an asterisk (*****) indicating that the alarm will sound continuously until

the operator views the messages on the SYSTEM MESSAGE DISPLAY screen. You can also enter a numeric value from 0 to 99 in this field. If a numeric value is entered, the alarm will sound for that number of seconds.

The message will be highlighted on the SYSTEM MESSAGE DISPLAY screen even if the alarm has finished sounding.

In the Alarm Based on System Message Level field, you can indicate which of the two ways a message alarm can be sounded. This option is important because a message can be logged with different severity levels at different times. When enabling the audible alarm function, you should decide under which of the following two conditions the alarm is to be sounded:

1. The first condition is by message number only. This means the alarm will be sounded only if the logged message number matches a message number that you selected.
2. The second condition is by message number and message severity. This means that the alarm will be sounded only if:
   - The logged message matches a message number that you selected and,
   - The message has a severity level equal to or higher than the current system message level setting (1 is the highest severity and 5 is the lowest severity).

The severity of a message is an indicator of the severity of the event. Messages with severity 1 indicate that a serious error has occurred and some action is required. Messages with severity 5 indicate something of interest has happened, but requires no action on the part of the operator. See “Severity Codes” on page 4-6 for more information on setting the System Message Display Level and also refer to the *IBM 4690 Store System: User's Guide*.

Using the Audible Alarm

When the alarm sounds, the operator must press **Sysreq** and **M** on the store controller keyboard to view the SYSTEM MESSAGE DISPLAY screen. The message causing the alarm is highlighted on the SYSTEM MESSAGE DISPLAY screen. Pressing the **Sysreq** and **M** keys will stop the alarm. The duration of the alarm is determined by either of the following:

- The length of time that the user specifies
- The store controller operator views the SYSTEM MESSAGE DISPLAY screen by pressing the **Sysreq** and **M** keys.

If you are operating a 4690 system with the Multiple Controller Feature on a LAN, you can request that the report be generated for all store controllers on the LAN or a specific store controller. You can request this by placing an asterisk (*****) or a two-character store controller ID in the ID of controller field on the screen.

The operator should follow the operating procedures provided by store personnel for each of the messages that are highlighted. You can enable or disable this function at any time.

Deactivating the Audible Alarm Function

You can deactivate the audible alarm function by selecting option 4 on the SYSTEM MESSAGE AUDIBLE ALARM FUNCTIONS screen. Deactivating the function prevents the alarm from sounding and prevents the messages from being highlighted on the SYSTEM MESSAGE DISPLAY screen.

Distribution Exception Log

On a LAN (MCF Network), all unsuccessful requests made to other nodes are entered in the Distribution Exception Log. For more information on this log, which exists on both the master and file server nodes, refer to the *IBM 4690 Store System: User's Guide*.

Power Line Disturbance Recovery

A PLD is an interruption in the AC power to the store. The duration of the PLD determines the effect on the operation of the store controller and the terminal. Some PLDs are short enough that there is no effect; others cause the unit to stop operation.

When a PLD causes the store controller to shut down, the store controller re-IPLs after power is restored. When a PLD causes the Mod1 or Mod2 terminals to stop, the storage retention function supplies power to the memory of the terminal.

Store Controller PLD Recovery

The IBM 4690 Operating System provides four levels of PLD recovery for the disk functions. The levels are for a sector, the File Allocation Table, a single record, and a record pair. See "Performing File Functions" on page 2-18 for a description of the single record and record pair PLD recovery facilities.

The file PLD recovery facility uses a battery-powered NVRAM to save the data to recover the file functions interrupted by a PLD.

Sector level recovery saves the sector of data to be written to the disk for each disk write. The saved data contains the original data on the sector and the new data. If a PLD prevents a sector from being written, the sector is written as part of the store controller IPL.

File Allocation Table recovery keeps track of whether copy 1 or copy 2 of the File Allocation Table is being updated. The copies are updated serially. If a PLD occurs during the update of either copy of the File Allocation Table, the system copies the unaffected copy to the affected copy as part of the store controller IPL.

You should write your store controller applications so that they can be restarted after a PLD. File updates should be done so that they can always be restarted or the updates should have checkpoints.

Terminal PLD Recovery

Terminal PLD recovery is dependent on the storage retention function. If the PLD does not last longer than the batteries provide power to the terminal memory, the terminal application restarts where it stopped. Your application needs to have I/O device error recovery procedures, because any I/O function interrupted by the PLD will indicate a failure or a timeout error. The other functions of the application should not be affected by the PLD. The IBM 4690 Operating System restores the data on the displays after a PLD. Because the terminal application is ready to start when the power is restored and the store controller is IPLed, the terminal application may want to allow the terminal operator to wait for the store controller to become available instead of continuing without the store controller. See "Storage Retention" on page 4-10 for details on the storage retention function.

Storage Retention

The storage retention function provides battery power to the memory in the 4683 or 4693 Mod1 terminals. The battery powers only the memory; it does not power the processor or any of the I/O devices.

The battery retains the power to the memory. The actual length of time depends on the amount of memory, the size of the battery, and the battery charge. If the power outage lasts longer than the battery can power the memory, the original contents of memory and function in process are lost and the terminal re-IPLs when the power is restored.

You can enable and disable the storage retention function from the system screens, a store controller application, a terminal application, or a terminal keyboard.

If the terminal operating system or application is in a code loop, powering-OFF the device and then powering-ON with storage retention enabled will only return to the looping condition. Refer to the system request functions in the *IBM 4690 Store System: User's Guide* for information on getting out of the loop.

| **Note:** The 4694 Point-of-Sale Terminal does not support storage retention.

Terminal Power ON/OFF

This section describes the power ON/OFF functions for the Mod1 and Mod2 terminals.

Terminal Power ON/OFF for the Mod1 Terminal with Storage Retention Enabled

If power remains at the wall plug for the Mod1 terminal, powering OFF the terminal interrupts power to all of the terminal functions except the memory. The power-OFF is treated as a PLD by the operating system. As long as power remains at the wall plug, memory is retained and the storage retention batteries are recharging. If the power is interrupted at the wall plug while the storage retention feature is enabled, the battery powers the memory until power is restored or until the battery discharges.

When the terminal is powered-ON and the memory is still retained, the application is restarted by the same process used in a PLD recovery.

Terminal Power ON/OFF for the Mod2 Terminal

The power-OFF switch on the Mod2 terminal interrupts power to all the Mod2 terminal functions. It does not affect the memory in the Mod1 terminal that is used for the Mod2 terminal. If the Mod1 memory is retained switching the Mod2 power OFF and ON appears to the Mod2 terminal as a PLD recovery situation. On a 4684 controller/terminal, the power-OFF switch does not interrupt power to the 4683 Mod2 terminal functions, but the Mod2 will not work. For the 4693 terminals, if the Mod1 is turned off, the Mod2 will automatically power down in about 7 seconds.

Disk and File Error Recovery

Your application's ON ERROR routine must provide error recovery for the disk functions. Your application can also use the IF END# statement.

Several types of errors can occur when a disk I/O statement is executed. Some of the errors indicate that your program has attempted a function that is not valid; others indicate that there is a problem with the

operation of the disk or a problem with a particular file on the disk. Only those errors that are associated with the disk and files are described in this section.

Your error handling routines should be different for the terminal and the store controller. For example, in some situations you might want to design the terminal application to function in a stand-alone mode when access to the store controller is lost.

You can use the IF END# statement to detect end-of-file, missing records in keyed files, missing files, and disk-full situations. Refer to the *IBM 4680 BASIC: Language Reference* for the details of using the IF END# statement. Your application can either use a different IF END# routine for reads, writes, and so on, or must set a variable to indicate to the IF END# routine the file function attempted.

All other disk and file errors cause the ON ERROR routine to be given control. If an IF END# statement is not used, the IF END# types of errors also cause the ON ERROR statement to be given control. IF END# statements are defined on a unique file basis and an ON ERROR statement is applicable to all disk and file errors.

When errors detected on a READ statement cause the application to execute the ON ERROR routine, all of the variables specified on the failing READ statement are set to zero or null when a RESUME statement is executed.

Table 4-1 shows errors that can occur for some or all of the disk 4680 BASIC statements. Only the most likely errors needing application recovery code are listed. Most of the errors not listed in this section could be treated as your application would treat other program defects. You should review all of the possible disk and file errors by referring to the *IBM 4680 BASIC: Language Reference*.

Table 4-1 shows errors that apply to both the store controller and the terminal. The *xx* values indicate values that you need not pay attention to.

Table 4-1. Errors on the store controller and terminal

Error Code	Description	Action
EF 0000001C	No IF END statement and attempt to read past end of sequential file	Type 12
EF 0000001C	No IF END statement and no record found for keyed, random, direct	Type 16
DW 00000018	No IF END statement and there is no disk or directory space to write another record	Type 20
ME 0000003C	No IF END statement and there is no disk or directory space to create a file	Type 20
xx 80xx4001	Cannot open file due to access rights	Type 10
NR 80xx4007	Bad FNUM	Type 24
xx 80xx4010	File not found	Type 14
xx 80xx400C	Cannot access file due to current use	Type 11
xx 80xx400D	Not enough memory	Type 17
xx 80xx4301	Media change occurred	Type 15
OM 80F30000	Insufficient memory	Type 17
KF 80F306C6	Chain in keyed file is not valid	Type 13
EF 80F306C8	Record not found in keyed file	Type 13
DW 80F306CE	Keyed file is full	Type 13

Table 4-2. Errors unique to the terminal

Error Code	Description	Action
XS 0000042C	AUTOUNLOCK of a WRITE statement failed for a random or direct file	Type 22
XT 0000042E	AUTOLOCK of a READ statement failed for a random or direct file	Type 23
OM 80F10000	Insufficient memory	Type 18
TO 80F10681	Terminal offline	Type 21
TF 80F206A1	No files opened	Type 19
TF 80F206A2	No read-only files opened	Type 19
TF 80F206A3	Temporarily cannot process this file request	Type 19
TF 80F206A4	No more files opened	Type 19

The following list describes the type of action for your application. For all of the following, your application should report the error to the operator or log the error for later analysis. Avoid redundant logging.

Action Type **Explanation**

10 Your application is requesting access rights that cannot be satisfied. This is probably a file security problem. Your application should report that the user is trying to access a file for a function that is not authorized.

11 Your application is requesting access to a file and it is in conflict with the current usage of the file.

12 Record specified by application was beyond the current end-of-file.

13 The keyed file has a problem that requires user attention.

14 The file does not exist as defined by the name.

15 The user changed the diskette. Prompt the user to restore the original media and continue.

16 The record specified for a READ does not exist.

17 There is insufficient dynamically allocatable memory in the store controller to perform the requested function.

18 There is insufficient dynamically allocatable memory in the terminal to perform the requested function.

19 The terminals are attempting to open more files than defined by configuration.

20 The disk drive is full and requires user attention to free disk space.

21 No files are available in the store controller. The application should execute in offline mode if possible. When the store controller is available, the system will open the files again. The application should not assume that previous file functions were successful. For example, the application should repeat a READ AUTOLOCK instead of using the results of a previous READ AUTOLOCK prior to executing a WRITE AUTOUNLOCK.

22 This could be a program defect; the program is trying to unlock a record that it does not have locked. It could also occur if the terminal temporarily loses communication with the store controller. The application should repeat the READ with AUTOLOCK and WRITE with AUTOUNLOCK sequence for this record.

23 The file record is already locked. Your application should wait and retry. If the condition persists, notify the user that this record cannot be accessed.

24 The file is no longer able to be accessed because of a bad FNUM. The file should be closed and then reopened again by the application. Caution should be taken so that the application only tries to reopen the file a selected number of times so that a suspend condition does not occur due to looping.

Error Recovery for I/O Devices

Many error conditions can occur when you use terminal I/O devices. Some errors indicate that your program has attempted a function that is not valid; others indicate that there is a problem with the device.

Application Responses

The type of response your application makes to an error condition depends on the type of error that occurred. Depending on the type of error, your application must perform one of the following:

Request operator intervention. Your application asks the operator to take corrective action by putting a message on a device other than the failing one. For example, if the error is caused by a paper jam, the application could write a message to the display requesting that the operator clear the jam. The application could then wait for the operator to signal (usually by a keyboard entry) that corrective action has been taken.

Retry the operation. Your application requests that the failing I/O operation be retried. If the error caused entry to the ON ERROR routine, the retry is done by a RESUME with the RETRY parameter. For a terminal printer error, the retry occurs when you set the retry flag parameter on (set to -1) in the ON ASYNC ERROR subprogram and then exit the subprogram.

Bypass the operation. Your application requests that the failing I/O operation not be retried. If the error caused entry to the ON ERROR routine, the bypass is done by a RESUME without the RETRY parameter or a RESUME with a label specified. If the error caused entry to the ON ASYNC ERROR subprogram, the bypass is done when you exit the subprogram with the retry flag parameter off (set to 0).

Refer to the *IBM 4690 Store System: Messages Guide* for error codes for I/O devices.

Chapter 5. User Application Considerations with a LAN (MCF Network)

Using TCLOSE to Close Application Data Files

Because applications open and close application data files, you should be aware of each file's distribution attributes when programming the updating and closing of files.

If the file mode attribute is Distribute At Close, and the application requires that a snap-shot of the file be taken periodically so that the image version closely matches the prime version, you should be very cautious about how often TCLOSE is used. You should be especially cautious if the file is large because TCLOSE can take considerable time distributing a large file over the LAN (MCF Network). Refer to the *IBM 4680 BASIC: Language Reference* manual for a discussion of the TCLOSE instruction.

While TCLOSE permits more frequent distribution of the file without requiring both a close and an open, it could also have a significant performance impact on the system because of the resulting network traffic.

Note: A checkout application has priority over the distribution function and therefore should not be affected. In contrast, the performance of a sales support program could be degraded. Depending on file size and system utilization, file distribution could take several minutes.

Application Read Restrictions

An application should read only the prime version of a file having a file mode of Distribute At Close.

The reason for this restriction is important. Unless a TCLOSE had just completed, an application reading an image version of a file distributed at close could possibly receive obsolete data.

The importance of this restriction is seen in the case of an accounting totals file. This file, which is updated continually by a sales support application and distributed at close, needs the most current data, which is contained in the prime version.

In contrast, an application can read the image version of a per update file. If an application had to read the prime version of a per update file such as an item record file, then all price lookup data from 4690 store controllers would have to go across the LAN (MCF Network) and back. This could cause a performance problem.

Spool Files on a LAN (MCF Network) System

If a terminal application writes to a prime version of a file that is on a 4690 store controller other than the one it is attached to, the record is sent on the store loop or token ring to the 4690 store controller, then over the LAN (MCF Network) to the other 4690 store controller.

If the remote 4690 store controller with the prime version of the file is disabled, the terminal application, with one exception, will receive a write error because the record cannot be delivered over the LAN (MCF Network) to the disabled 4690 store controller.

The one exception is if the terminal application issues a WRITE MATRIX. WRITE MATRIX is a 4680 BASIC language instruction that permits terminal applications to write string arrays to sequential files. Refer to the *IBM 4680 BASIC: Language Reference* manual for details on the WRITE MATRIX instruction. Instead of generating a write error, the WRITE MATRIX record is saved in a spool file created on the 4690 store controller that supports the terminal. These saved records are sent (despooled) to the intended file's prime version later, when the disabled 4690 store controller is returned to service.

This process is called WRITE MATRIX spooling, and is described by the example below, using a two-controller LAN system, with the master version of the transaction log on the master or file server. The Alternate Master or Alternate File Server supports the TCC Network, and terminals on the network are using a sales application that is issuing a WRITE MATRIX at the end of each transaction.

If the master or file server becomes disabled, the Multiple Controller Feature on the alternate master or alternate file server will create a sequential spool file, ADXFSSSF.SPL, when it receives its first WRITE MATRIX from a terminal application.

As the alternate file server receives a normal WRITE MATRIX from each terminal on the network, it discards the WRITE MATRIX record, and a message is sent to the terminal telling it to send the record again as a different type of WRITE MATRIX record. This new WRITE MATRIX is the same as the original but has a 26-byte header containing the file name of the original target file. This header information is used later in despooling to send each record to the correct file.

The new WRITE MATRIX, with the header, is sent by the terminal applications addressed to the spool file now instead of the original file. The operating system receives the new WRITE MATRIX record and logs it to the spool file. Thus, the sequential spool file grows with each WRITE MATRIX.

When the file server is enabled again, the operating system determines that the file server is back up, and can now start logging directly to the prime version of the target file again. As each terminal sends in the next WRITE MATRIX, the header is stripped off, and the record is sent to the prime version on the file server. A message is sent to the terminal to begin sending each WRITE MATRIX to the master version of the target file.

In the meantime, DDA starts despooling the spool file starting with the first record. The despooled records are sent to the master version of the target file. Both the terminal application and DDA may be writing records to the same file. This means that the spooled records will be intermixed with new records written by the terminals.

When the DDA comes to the end of the sequential spool file, it closes the file and starts issuing requests every two minutes to erase the spool file. Each erase command will fail until all opens to the spool file have been closed. From the beginning, the system has counted the number of terminals that have been writing to the spool file, and decrements the count each time the system redirects a new terminal to the target file. When all terminals have been notified (the count goes to zero), the spool file is closed. At this point there are no opens to the spool file, DDA's erase command works, and the spool file disappears.

Erasing the Spool File

To erase the spool file, all the terminals that wrote to the spool file are redirected to the target file. This redirection can only occur if each of those terminals continues to send in WRITE MATRIXes. If a terminal is inactive, or is turned off, the system will not be able to reduce its spooling terminal count to zero and therefore, it will not close the spool file. Consequently, the spool file cannot be erased by DDA. In this case, the spool file, even though it has been processed and is not being used, may not be erased right away.

Note: Leaving the spool file on disk does not cause problems. It does, however, require disk space.

Forcing the Spool File to be Erased

One way to erase the spool file after all the transactions have been despooled, but before the system program's terminal count has gone to zero, is to IPL the 4690 store controller that has the spool file. To the system program, the spool file is closed, and DDA is able to erase the file. There is no direct indication of this condition, however.

Using Drive D for the Spool File

Normally, the spool file is created automatically on the root directory of drive C. The user can choose to have the spool file created at the root of drive D. This choice is made by using the User Logical Name table during configuration. The user logical file name should define ADXFSSSF to be D: ADXFSSSF.SPL. By creating a user logical file name that points to the drive D, the system will write there rather than the default drive C. Note that when you define the D:ADXFSSSF.SPL file, you receive a warning that you are defining an ADX file name and the system queries you. The answer should be Y for yes.

Effects of Activating the Alternate File Server on Despooling

DDA tracks the log whether it is despooled to the file server's prime version of the target file, or the (new) prime version on the alternate file server that is made acting file server. The only difference for the system is that the records are despooled over the LAN (MCF Network) to the configured file server, or are despooled locally (on the same 4690 store controller) to the alternate but acting file server. If the alternate file server is made the acting file server, WRITE MATRIXes are now logged to the new prime version in the acting file server. The attempt to distribute the new records to the disabled file server will be logged in the exception log as part of normal DDA activities for mirrored files. When the file server returns, DDA will distribute the new records to the file server according to the exception log record entries to synchronize the mirrored files on both 4690 store controllers.

Reactivating the Configured File Server

Before reactivating the file server, the acting file server has to be deactivated. For the period of time it takes to activate the configured file server, there will be no acting file server. The system will restart the spooling process. The WRITE MATRIX records are written to the spool file until the configured file server is activated. Then DDA can distribute the spooled records over the LAN (MCF Network) to the desired target file on the configured file server.

Record Sizes

The maximum TCC Network buffer size for sending WRITE MATRIX data to the 4690 store controller from the terminal application is 508 bytes. If the WRITE MATRIX data block is greater than 508 bytes, the block is divided into as many buffers as needed to comply with the 508-byte limit.

If the data received from the TCC Network by the 4690 store controller needs to be distributed to another 4690 store controller, and the total WRITE MATRIX data consists of more than one 508 buffer, a header count byte in the first buffer indicates this. A message tells the receiving 4690 store controller to expect the required number of buffers. When the whole WRITE MATRIX (consisting of more than one buffer) distribution is completed over the LAN (MCF Network), the sending 4690 store controller sends an unlock indicator as part of the last message to indicate that the data distribution is complete.

If a WRITE MATRIX sent by the terminal is less than 508 bytes, there will only be one message sent per distribution. If the WRITE MATRIX length is over 508 bytes, then the number of LAN messages is the absolute value of (1 + *n*/508) where *n* is the size of the data block.

Thus the overhead of distributing a 509-byte data block (one over the limit) in terms of LAN messages required, is 2 to 1 for the 508 data block.

Using the Application Program Interface (OS/2)

The application program interface between a 4690 store controller and an Operating System/2* (OS/2*) PC allows file operations to be performed across the LAN using common application program statements. Application programs can be written to create, open, read, and write to files between two nodes on the LAN; thus providing a means of automating repeated file tasks.

To access a file on an OS/2 remote node, a 4690 application program must specify the remote node name. The complete file specification should follow this format:

```
nodename::path:filename.ext
```

The OS/2 computer name (the name designated during installation) should replace the *nodename*, and the shared file resource name should be used in the *path* position.

OS/2 application programs reference files on a 4690 store controller using the device name from the NET USE command. Before invoking an OS/2 application that opens or creates files on a 4690 store controller, the NET USE command should have been issued.

For a C-language program written to copy the General Sales Application transaction summary log from a 4690 store controller to an OS/2 machine, see “Example of a C/2 C-Language Program” on page 5-5. It shows that only standard C-language commands and library functions were used to perform the copy process.

The “Example of a 4680 BASIC Program” on page 5-8 also shows how to copy files between the 4690 Operating System and OS/2. The program prompts the user for the source and destination file names prior to invoking the program statements that result in the file being copied. As noted in the program comments, this particular program is limited to copying files no larger than 32,767 bytes. This size restriction can be eliminated by using a more complex program that calculates the size of the file and determines an appropriate record size.

Example of a C/2 C-Language Program

Note: The statements enclosed in a /* */ are comments about the program.

```
/* This test program is designed to copy the                          */
/* transaction log "EALTRANS" from 4690 to OS/2.                      */
/* Prior to executing this program, virtual device E:                 */
/* must be defined by a NET USE statement as the                      */
/* the ADX_SDT1 subdirectory of the 4690 store controller.            */
/* This program can be compiled using the IBM C/2 compiler            */
/* that is used with OS/2.                                            */


#include <stdio.h>

main()

{
   FILE *FP1, *FP2;
   long length;
   char buf[512];

/* Open the transaction log as a read-only, binary file at 4690       */
   if ((FP1 = fopen("e:ealtrans.dat","rb")) == NULL) {
       perror("open of ealtrans.dat failed");
       abort();
       }

/* Create a read/write binary file on the OS/2 machine.               */
   if ((FP2 = fopen("trans.dat", "wb")) == NULL) {
       perror("open of transact.log failed");
       abort();
       }

/* Copy the transaction summary log to the OS/2 file in blocks        */
/* of 512 bytes.                                                      */
   while ((length = fread(buf, 1, 512, FP1)) != 0)
        fwrite(buf, 1, length, FP2);

/* Close the files and end the program.                               */
   if (fclose(FP1) != 0)
       perror("fclose of ealtrans.dat failed");
   if (fclose(FP2) != 0)
       perror("fclose of transact.log failed");

}  /* End */
```

Using the Application Program Interface (DOS)

The application program interface between 4690 Operating System and DOS allows file operations to be performed across the LAN using common application program statements. Application programs can be written to create, open, read, and write to files between two nodes on the LAN to provide a way to automate repeated file tasks.

To access a file on a remote DOS node, a 4690 application program must use a file specification that includes the node name of the remote computer. The complete file specification should follow this format:

nodename::path:filename.ext

The DOS computer name (the name designated by the NET START command) should be substituted for the *nodename*, and the shared resource short name should be used in the *path* position.

DOS application programs reference files on a 4690 store controller using the device name from the NET USE command. Before invoking a DOS application that opens or creates files on a 4690 store controller, the NET USE command must have been issued.

See “Example of a DOS C-language Program” on page 5-7 for an example of a C-language program written to copy the General Sales Application transaction summary log from a 4690 store controller to a DOS PC. It shows that only standard C-language commands and library functions were used to perform the copy process.

“Example of a 4680 BASIC Program” on page 5-8 includes a 4680 BASIC program used to copy files between the two operating systems. The program prompts the user for the source and destination file names prior to invoking the program statements that result in the file being copied. As noted in the program comments, this particular program is limited to copying files no larger than 32,767 bytes. This size restriction can be eliminated by using a more complex program that calculates the size of the file and determines an appropriate record size.

Example of a DOS C-language Program

```
/* This test program is designed to copy a transaction log            */
/* "EALTRANS" from the 4690 to DOS.  Prior to invoking the             */
/* program, virtual device E: must be defined by a NET USE             */
/* statement as the ADX_SDT1 subdirectory of the 4690 store            */
/* controller.  This program was compiled using the                    */
/* MetaWare High C compiler for use with DOS.                          */

#include <stdio.h>
#include <stdlib.h>


void main()

{
   FILE *FP1, *FP2;
   int length;
   char buf[512];

/* Open the transaction log as a read-only, binary file                */
/* at the 4690 store controller.                                       */
   if ((FP1 = fopen("e:ealtrans.dat", "rb")) == NULL) {
       perror("open of ealtrans.dat failed");
       abort();
       }

/* Create a read/write, binary file on the DOS machine.                */
   if ((FP2 = fopen("transact.log", "wb")) == NULL) {
       perror("open of transact.log failed");
       abort();
       }

/* Copy the transaction summary log to the DOS file in                 */
/* blocks of 512 bytes                                                 */
   while ((length = fread(buf, 1, 512, FP1)) != 0)
       fwrite(buf, 1, length, FP2);

/* Close the files and end the program.                                */
   if (fclose(FP1) != 0)
       perror("close of ealtrans.dat failed");
   if (fclose(FP2) != 0)
       perror("close of transact.log failed");

}  /* END */
```

Example of a 4680 BASIC Program

This BASIC program copies files between two nodes on the LAN. The program prompts the user for the source and destination file names before invoking the program statements that result in the file being copied. As noted in the program comments, this particular program is limited to copying files no larger than 32,767 bytes. This size restriction can be eliminated by using a more complex program that calculates the size of the file and determines an appropriate record size.

```
REM   This program allows 4690, DOS, or OS/2 on the LAN to copy
REM   files of up to 32,767 bytes, to itself or other 4690, DOS, or OS/2
REM   on the LAN.
REM
REM   Provide the sending and receiving store controllers netnames,
REM   directories, and filenames when prompted.
REM
REM   For example: Sending Controller     DOMAIN::CDISK:FILE1
REM                Receiving Controller   ADXLXCCN::C:NEWFILE1
REM
REM   The previous example would cause FILE1 from the C
REM   disk subdirectory of the store controller, DOMAIN1,
REM   to be copied to the store controller, ADXLXCCN.
REM   When FILE1 is placed in the root directory, it
REM   is renamed as NEWFILE1.
REM
REM
      integer*4 fsize%,rnum%
      on error goto 1000
100   CLEARS
      print " *****  4690 - OS/2 - DOS Connectivity Test Program ***** "
      print "  "
      print "     TO EXIT THIS PROGRAM JUST PRESS THE ENTER KEY  "
      print "  WHEN PROMPTED FOR THE SENDING OR RECEIVING CONTROLLERS"
      print " "
      input "  ENTER THE SENDING CONTROLLER NAME AND PATH "; sender$
      print "  "
      If sender$ = " " then goto 2000          !  EXIT THE PROGRAM
      input "  ENTER THE RECEIVING CONTROLLER NAME AND PATH "; receiver$
      print "  "
      print "  "
      If receiver$ = " " then goto 2000        !  EXIT THE PROGRAM
      print "  "
      ios1% = 1          !  ESTABLISH I/O SESSION NUMBER FOR SENDER
      ios2% = 2          !  ESTABLISH I/O SESSION NUMBER FOR RECEIVER
      rnum% = 1
      fsize% = size(sender$)       !  DETERMINE THE SIZE OF THE FILE
      if fsize%  >32767 then 1500  !  EXIT PROGRAM IF FILE IS GREATER THAN MAX
      if fsize%  > 0 then 250      !  FILE IS VALID KEEP PROCESSING
      print "THIS PROGRAM COPIES FILES WITH A SIZE RANGE OF 1 - 32767 BYTES "
      print "THE FILE YOU SPECIFIED TO BE COPIED IS EMPTY "
      goto 2000                    !  EXIT PROGRAM BECAUSE INPUT FILE IS EMPTY

250   print "  THERE ARE"; fsize%; "BYTES IN THE INPUT FILE "
      numchars$ = "c"+str$(fsize%)  !  CONVERT SIZE TO CHARACTER FOR READ/WRITE
      open sender$  recl fsize% as ios1%     !  OPEN INPUT FILE
      openin% = 1                            !  SUCCESSFUL OPEN INDICATOR
      create receiver$ recl fsize% as ios2%  !  CREATE A NEW OUTPUT FILE
      openout% = 1                           !  SUCCESSFUL OPEN INDICATOR
      read form numchars$; #ios1%,rnum%; data1$   !  READ THE DATA FROM SENDER
```

```
      write form numchars$ ;#ios2%,rnum%; data1$  !  WRITE THE DATA TO RECEIVER
      print " "
      print "  COPY COMPLETE  "
      close ios1%                 !  CLOSE INPUT FILE
      close ios2%                 !  CLOSE OUTPUT FILE
      wait;5000                   !  PAUSE
      goto 100                    !  GO BACK TO THE BEGINNING
1000  print " AN ERROR HAS OCCURRED "
      print " CHECK THE DATA YOU INPUT FOR THE SENDER/RECEIVER"
      wait;5000                   !  PAUSE SO THAT MESSAGE CAN BE READ
      if openin% <= 0 then 1200   !  DETERMINE IF INPUT FILE HAD BEEN OPENED
      close ios1%                 !  CLOSE INPUT FILE
      if openout% <= 0 then 1200  !  DETERMINE IF OUTPUT FILE HAD BEEN OPENED
      close ios2%                 !  CLOSE OUTPUT FILE
1200  resume 100                  !  GO BACK TO THE BEGINNING
1500  print " "
      print "FILES > 32767 BYTES CANNOT BE PROCESSED BY THIS PROGRAM"
      print "THE SIZE OF THE FILE YOU SPECIFIED IS "; FSIZE%; "BYTES"
2000  Print " "
      Print " "
      Print "*******     THE PROGRAM IS CANCELED      *******"
      stop
      end
```

Part 2: Utilities

Chapter 6. Using the Keyed File Utility

The IBM 4690 Operating System provides a Keyed File Utility (KFU) to allow you to create and manage keyed files. You can start the utility from the SYSTEM MAIN MENU screen, from Command Mode, or from the host processor.

When you start the KFU from the SYSTEM MAIN MENU, you are using it in an operator-interactive mode. When you start the utility from a batch file, you provide the necessary input on the command statement that starts the utility. When you start the utility from the host processor, you provide the necessary input through Host Command Processor (HCP) commands. Refer to the *IBM 4690 Store System: Communications Programming Reference* for information on using the KFU from the host processor.

To learn more about the characteristics of keyed files, see “Internal Processes of Keyed Files” on page 6-12.

Accessing the Keyed File Utility

The KFU is accessed using menu screens. From the SYSTEM MAIN MENU, choose File Utilities. When the FILE UTILITIES screen appears, select the Keyed File Utilities option. When you select it, the ORGANIZE KEYED FILES screen appears.

This screen, and the ones that follow it, guide you in creating keyed files or checking the performance of existing keyed files. You can also create keyed files from a BASIC application program using the CREATE POSFILE statement.

Using the Keyed File Utility from the Host

The following steps explain how to invoke KFU from the host:

1. Use the ADCS CREATE command.
2. You can create an ADXCSKPF.DAT file at the host, send it to the 4690, and start KFU as a background program from the host. The KFU looks for the ADXCSKPF.DAT file, uses it to get the required parameters, and performs the operation you specified.

   These steps are:

   a. Create the ADXCSKPF.DAT file at the host. Each record in the file is a separate KFU command. Each record should have the parameters *a* through *m* starting with *a*. Do not include the ADXCSK0L command at the beginning of each record.

   b. Be sure the logical names table on the 4690 includes the logical name for ADXCSKPF.

   c. Send the ADXCSKPF.DAT file to the store controller.

   d. Start KFU as a background program on the 4690 from the host. Refer to the *IBM 4690 Store System: Communications Programming Reference* for more information.

   e. The KFU puts “X*X*X*X ” in place of each record in the ADXCSKPF.DAT file that completes successfully. If a record does not complete successfully, the record remains untouched. By pulling this file back to the host at the end of the job, you can determine the completion status. You can resend this file with the completion status records to retry the records that did not complete successfully because KFU ignores the records containing “X*X*X*X ”.

      If a record in the ADXCSKPF.DAT file is less than eight characters long, KFU writes only a left substring of “X*X*X*X ” at the successful completion of the record. The length of the substring is the length of the record. For example, the function to cancel a checkpoint needs only one parameter (the character 8). KFU writes X in place of 8 to indicate the successful completion of the function.

Creating a Keyed File

An existing direct file is used as input to create a keyed file. Before creating the keyed file, you must determine values for the following variable parameters:

- Size of the keyed file

  The size of a keyed file does not change. When you create a keyed file, specify more than the actual number of records you intend to place in the file. If you anticipate that the actual number of records in the file will increase, specify your best guess for the maximum number of records the file will ever hold. After you have determined the maximum number of records for the file, increase the number by 25% to allow for adequate chaining space.

- Hashing algorithm

  See “Hashing Algorithms” on page 6-10.

- Randomizing divisor

  Selection of an efficient randomizing divisor is important in minimizing the number of chained records in a keyed file. Chained records require more disk read operations for retrieval than do home records. Therefore, minimizing chained records maximizes performance when accessing the file by key.

  Before selecting a randomizing divisor, calculate the number of blocks in the file as follows:

  ```
  Records per block = 508 / record size
  Total blocks = total records / records per block
  ```

  The randomizing divisor must be less than the total blocks in the file by one or more. In general, prime numbers are best. A good randomizing divisor might be the highest prime number that is less than the number of blocks in the keyed file. The efficiency of a randomizing divisor can be tested by requesting the Chaining Statistics from a Direct File option on the KEYED FILE MANAGEMENT screen. You can specify a randomizing divisor and hashing algorithm to be analyzed. The direct file is scanned to report the chaining, distribution, and packing. A chained record percentage greater than 10% is normally considered too inefficient.

When you have selected your file size, randomizing divisor, and hashing algorithm, request the Create Keyed File option on the KEYED FILE MANAGEMENT screen. You are prompted to enter all of the variables needed to create the keyed file. The KFU begins writing records to the keyed file.

The KFU builds the keyed file in three phases:

1. The utility writes the home records to the keyed file, and places the channel records in a work file.
2. The utility sorts the work file.
3. The utility writes chained records to the keyed file.

Information messages appear on your screen as the keyed file is being created. The system displays the current phase and a count of the records that the utility has written to the keyed file. Checkpoints are taken by the KFU at 20-minute intervals. When creation of the keyed file is complete, the utility asks if you would like to erase the input file. If you do not need the input file for any other purpose, erase it.

If the keyed file creation process is interrupted, you can restart the process from the last checkpoint. When you start the KFU after creation of a keyed file has been interrupted, the CHECKPOINT RESTART menu appears. You can restart creation of the keyed file or cancel the checkpoint.

Creating a Direct File

The KFU enables you to create a direct file using a keyed file as input. You specify this option on the KEYED FILE MANAGEMENT screen and fill in the name of the keyed file to be used as input. When the utility creates a direct file from a keyed file, it reverses the process described previously. It creates a direct file of the records found in the keyed file by reading the file sequentially and writing the records to a direct file as it reads them.

Reporting Keyed File Statistics

The KFU can display statistics on each keyed file created. These statistics include the number of reads, writes, deletes, opens, and closes done on files. They also include information on the number of sectors and chains the file contains. You can examine these statistics and reset them to zero as required.

Creating an Empty Keyed File

The KFU can create an empty file. Terminal and store controller applications can add records to an empty file as needed.

Chaining Statistics from a Direct File

The KFU can test the efficiency of randomizing divisors and hashing algorithms before you create a keyed file. The direct file is scanned to report the percentage of chained records and the distribution.

Rebuilding a Keyed File

The KFU allows you to rebuild a keyed file. You need to recreate a keyed file if you want to change its options. To do this, first convert the keyed file to a direct file by selecting the Create a Direct File option on the KEYED FILE MANAGEMENT screen.

After you convert your file, you can access it and make the desired changes. Then recreate the keyed file using the Create a Keyed File option with the direct file as the input.

Using the Keyed File Utility in a Batch File

If you have several keyed files to create, you can set up a batch file to invoke the KFU for each file to be created.

Use the batch file method to create keyed files by doing the following:

- Create a keyed file from a direct file.
- Create a direct file from a keyed file.
- Create an empty file.
- Produce statistics for a keyed file.
- Report chaining statistics from a direct file.
- Restart from a checkpoint.
- Restart from the last checkpoint if the checkpoint exists for the specified keyed file. If a checkpoint does not exist for the specified keyed file, delete the checkpoint and create the specified keyed file from a direct file.

- Cancel the checkpoint and erase the checkpoint records.
- Cancel the checkpoint and create a keyed file from a direct file.

The KFU does not modify the batch file as a result of executing it.

Keyed File Utility Input Parameters

The following is a list of all of the parameters that can be submitted to the KFU from a command line or the ADXCSKPF file. The identifying characters, *a* to *p*, are referenced by error messages issued by the KFU when errors are detected in the batch file parameters.

a Function request:

1 Create a keyed file from a direct file.
2 Create a direct file from a keyed file.
3 Report keyed file statistics.
4 Create an empty keyed file.
5 Report chaining statistics from a direct file.
6 Restart from a checkpoint.
7 Restart from the last checkpoint if the checkpoint exists for the specified keyed file. If a checkpoint does not exist for the specified keyed file, delete the checkpoint and create the specified keyed file from a direct file.
8 Cancel the checkpoint and erase the checkpoint records.
9 Cancel the checkpoint and create a keyed file.

b Report output device:

2 Printer output
3 File output

c Disposition of input file after processing is finished:

N Do not erase the input file.
Y Erase the input file.

d Disposition of an existing version of the output file:

N Do not erase an existing version of the output file.
Y Erase an existing version of the output file.

e Name of input file (up to 35 characters).

f Name of output file (up to 35 characters).

g Record length of input file (range 1 to 508).

h Record length of output file (range 1 to 508).

i Length of key (<= record length).

j Number of records to be allocated on disk. (This should be the maximum number of records anticipated plus a minimum of 25%.)

k Randomizing divisor. If *k* = 0 is entered, a system generated randomizing divisor is used.

l Chaining threshold.

m File attributes:

1 Local
2 Mirrored at update
3 Mirrored at close
4 Compound at update
5 Compound at close

n Hashing algorithm. (This optional parameter can be used to override any hashing algorithm specified using logical names. It can be 0, 1, or 2. See “Hashing Algorithms” on page 6-10.)

o Maximum in memory table buffers. (This optional parameter can be used to limit the number of 32K buffers that can be allocated to create a large file or report chaining statistics.)

p Minimum in memory table buffers. (This optional parameter can be used to specify the minimum number of 32K buffers to be allocated to create a file or report chaining statistics.)

Note: Parameters *n*, *o*, and *p* are optional. They are positional parameters. If one is specified, all of the preceding parameters must be specified.

Creating a Keyed File from a Direct File

Use the following command line in the batch file:

Format

ADXCSK0L *a b c d e f g h i j k l m n o p*

where:

a Function request. Valid values are:

1 Create a keyed file from a direct file.
7 Restart from the last checkpoint if the checkpoint exists for the specified keyed file. If a checkpoint does not exist for the specified keyed file, delete the checkpoint, and create the specified keyed from a direct file.
9 Cancel the checkpoint and create a keyed file.

b Report output device:

2 Printer output
3 File output

c Disposition of direct file after processing is finished:

N Do not erase the input file.
Y Erase the input file.

d Disposition of an existing version of the keyed file:

N Do not erase an existing version of the keyed file.
Y Erase an existing version of the keyed file.

e Name of direct file (up to 35 characters).

f Name of keyed file (up to 35 characters).

g Record length of a direct file (range of 1 to 508).

h Record length of keyed file (range of 1 to 508).

i Length of key (<= record length).

j Number of records to be allocated on disk. (This should be the maximum number of records anticipated plus a minimum of 25%.)

k Randomizing divisor. If *k* = 0 is entered, a system generated randomizing divisor is used.

l Chaining threshold.

m File attributes:

1 Local
2 Mirrored at update
3 Mirrored at close
4 Compound at update
5 Compound at close

n Hashing algorithm. (This optional parameter can be used to override any hashing algorithm specified using logical names. It can be 0, 1, or 2. See “Hashing Algorithms” on page 6-10.)

o Maximum in memory table buffers. (This optional parameter can be used to limit the number of 32K buffers that can be allocated.)

p Minimum in memory table buffers. (This optional parameter can be used to specify the minimum number of 32K buffers to be allocated.)

Note: Parameters *n*, *o*, and *p* are optional. They are positional parameters. If one is specified, all of the preceding parameters must be specified.

F1 is not accepted if the checkpoint file exists.

Creating a Direct File from a Keyed File

Use the following command line in the batch file:

Format

ADXCSK0L 2 *b c d e f m*

where:

b Report output device:

2 Printer output
3 File output

c Disposition of keyed file after processing is finished:

N Do not erase keyed file when finished.
Y Erase keyed file when finished.

d Disposition of an existing version of the direct file:

N Do not erase an existing version of the direct file.
Y Erase an existing version of the direct file.

e Name of keyed file (up to 35 characters).

f Name of direct file (up to 35 characters).

m File attributes:

1 Local
2 Mirrored at update
3 Mirrored at close
4 Compound at update
5 Compound at close

Creating an Empty File (Batch Method)

Use the following command line in the batch file:

Format

ADXCSK0L 4 *b c d e f g h i j k l m n*

where:

b Report output device:

2 Printer output
3 File output

c Y or N (used only as a placeholder).

d Disposition of an existing version of the keyed file:

N Do not erase an existing version of the keyed file.
Y Erase an existing version of the keyed file.

e Dummy name (used only as a placeholder).

f Name of keyed file (up to 35 characters).

g Record length (used only as a placeholder).

h Record length of keyed file (range of 1 to 508).

i Length of key (<= record length).

j Number of records to be allocated on disk.

k Randomizing divisor. If *k*=0, a system generated randomizing divisor is used.

l Chaining threshold.

m File attributes:

1 Local
2 Mirrored at update
3 Mirrored at close
4 Compound at update
5 Compound at close

n Hashing algorithm. (This optional parameter can be used to override any hashing algorithm specified using logical names. It can be 0, 1, or 2. See “Hashing Algorithms” on page 6-10.)

Reporting Keyed File Statistics

Use the following command line in the batch file:

Format

ADXCSK0L 3 *b c d e*

where:

b Report output device:

2 Printer output
3 File output

c Y (not used)

d Disposition of statistics after producing the report:

N Do not clear statistics after producing report.
Y Clear statistics after producing report.

e Name of keyed file (up to 35 characters).

Reporting Chaining Statistics from a Direct File

Use the following command line in the batch file:

Format

ADXCSK0L 5 *b c g i j k [n] [o] [p]*

where:

Note: Parameters *n*, *o*, and *p* are optional. They are positional parameters. If one is specified, all of the preceding parameters must be specified.

b Report output device:

2 Printer output
3 File output

c Name of direct file (up to 35 characters).

g Record length of keyed file (1 to 508).

i Length of key (<= record length).

j Number of records to be allocated in the keyed file.

k Randomizing divisor. If *k*=0, a system generated randomizing divisor is used.

n Hashing algorithm. (Must be 0, 1, or 2. See “Hashing Algorithms” on page 6-10.)

o Maximum in memory table buffers. (This optional parameter can be used to limit the number of 32K buffers that can be allocated.)

p Minimum in memory table buffers. (This optional parameter can be used to specify the minimum number of 32K buffers to be allocated.)

Restarting from a Checkpoint

Use the following command line in the batch file:

Format

ADXCSK0L 6

Canceling (Erasing) a Checkpoint

Use the following command line in the batch file:

Format

ADXCSK0L 8

Keyed File Utility Working Files

The following list shows the logical names of working files created or updated by the KFU:

ADXCSKPF Parameter file created at the host
ADXCSKOF Report file
ADXCSKTF Temporary file used when the input file has the same name as the output file
ADXCSKCP Checkpoint file
ADXCSKCK Temporary checkpoint file
ADXCSKST Sector table file
ADXCSKSS Copy of the sector table file used for checkpoint restart
ADXCSKCF Temporary report work file
ADXCSKWF Work file for chained records
ADXCSKAF Work file for sort
ADXCSKBF Work file for sort

Hashing Algorithms

The IBM 4690 Operating System provides a default hashing algorithm for all keyed files: the IBM Folding algorithm. It also provides the Exclusive OR (XOR) rotation hashing algorithm and the polynomial hashing algorithm for use on large keyed files. Using the XOR rotation hashing algorithm or the polynomial hashing algorithm on large keyed files results in fewer chained records and improved performance in file build and file access.

The polynomial hashing algorithm improves record distribution when keys contain repeated numeric patterns. A key that has ASCII characters is an example of a key with repeated numeric patterns.

Hashing algorithms other than the default should be chosen for files having more than 40K records and a randomizing divisor greater than 6000. An item record file is an example of a file whose performance might be improved through use of a hashing algorithm other than the default.

Warning: The XOR rotation hashing algorithm and the polynomial hashing algorithm cannot be used on the Item Movement File of the 4680 or 4680-4690 Supermarket Application.

You can select the hashing algorithm when a keyed file is created and specified through logical names. The logical names are entered using the User Logical File Names option on the CONTROLLER CONFIGURATION screen. You must define the logical name at the store controller (master store controller or file server) where the file is created. Perform the following steps:

Note: If you are using the IBM Folding hashing algorithm, you do not need to perform this procedure.

1. From the SYSTEM MAIN MENU, select the Installation and Update Aids option.

   The INSTALLATION AND UPDATE AIDS screen appears.

2. Select Change Configuration.

   The CHANGE CONFIGURATION screen appears.

3. Select Controller Configuration, and then select User Logical File Names.

4. Define the logical name for the file. The logical name is the file name with an H appended, for example, EALITEMRH for the file EALITEMR.DAT. The name is the same as it appears in the disk directory but without the file extension.

   The User Logical File Names screen is displayed. Select the Define a Logical File Name option, and type the logical name (the file name with the H appended). The Define Logical File Names screen appears. Enter either **0**, **1**, or **2** on this screen to define the desired hashing algorithm for use with the file:

   0 IBM Folding algorithm
   1 Exclusive OR (XOR) rotation hashing algorithm
   2 Polynomial hashing algorithm

   For example, to select the XOR rotation hashing algorithm for file EALITEMR.DAT, the logical name EALITEMRH = 1.

   When the system creates a file, it searches the logical names table in the following order:

   - File name with H appended
   - If the above file name is not found, it searches the system default hashing algorithm name ADXHASH.
   - If neither logical file name is found, the system selects the default hashing algorithm.

5. After defining the logical name, return to the CONTROLLER CONFIGURATION screen and select the Activate Configuration option.

6. When you activate the configuration, IPL the store controller to load the new definitions. You can verify the definitions as described in “Verifying Definitions” on page 6-12.

7. If the logical name shows the correct hashing algorithm, create the keyed file. Use either a 4680 BASIC program or the KFU.

Note: If you use the KFU to create the keyed file, you can override the hashing algorithm selection made using logical names.

Specifying Algorithms for Files

If you want to know which algorithm has been specified for a particular file, use the following procedure:

1. On the SYSTEM MAIN MENU, select the File Utilities option.
2. When the next screen appears, select the Keyed File Utilities option.
3. When the next screen appears, select the Performance Statistics of a Keyed File option.

This function of the KFU produces a report that includes the hashing algorithm specified for the particular file.

If you want to change the hashing algorithm on a keyed file, use the KFU to create a direct file from the keyed file. Then erase the keyed file. Create the keyed file from the direct file by specifying the desired hashing algorithm.

You can define the system default hashing algorithm using the logical name ADXHASH. If you define logical name ADXHASH as 1, all keyed files created use the XOR rotation hashing algorithm. If you define the logical name ADXHASH as 2, all keyed files created use the polynomial hashing algorithm. The KFU has an optional parameter to override the system default when creating a keyed file from a direct file.

Verifying Definitions

To verify new definitions that have been activated, select the Command Mode option from the SYSTEM MAIN MENU. When the prompt appears, enter **DEFINE -S-N** *logical name*. The system searches the logical names table for the logical name that you entered.

Internal Processes of Keyed Files

This section contains additional information on the internal processes of keyed files. It explains the algorithms used in keyed files to randomize record keys. It explains how the record chaining is used. This section also contains a layout of the control fields in the first block of a keyed file.

IBM Folding Algorithm: The IBM Folding algorithm randomizes the distribution of keyed records in the data set. Randomizing transforms record keys into expected block addresses relative to the start of the data set. The procedure is divided into two distinct parts: *key folding* and *randomizing*.

Key Folding: Folding is a logical accumulation of the bytes of the key into two accumulation bytes; these bytes are initialized to zero. Alternate key bytes are folded into accumulators with the Exclusive OR (XOR), starting with the low-order key byte into the low-order accumulator and the next byte of the key into the high-order accumulator. This process continues, working through the key from low-order to high-order (right to left), until the key is entirely processed. The result is a two-byte value derived from the entire key. See Figure 6-1 on page 6-13 for more information.

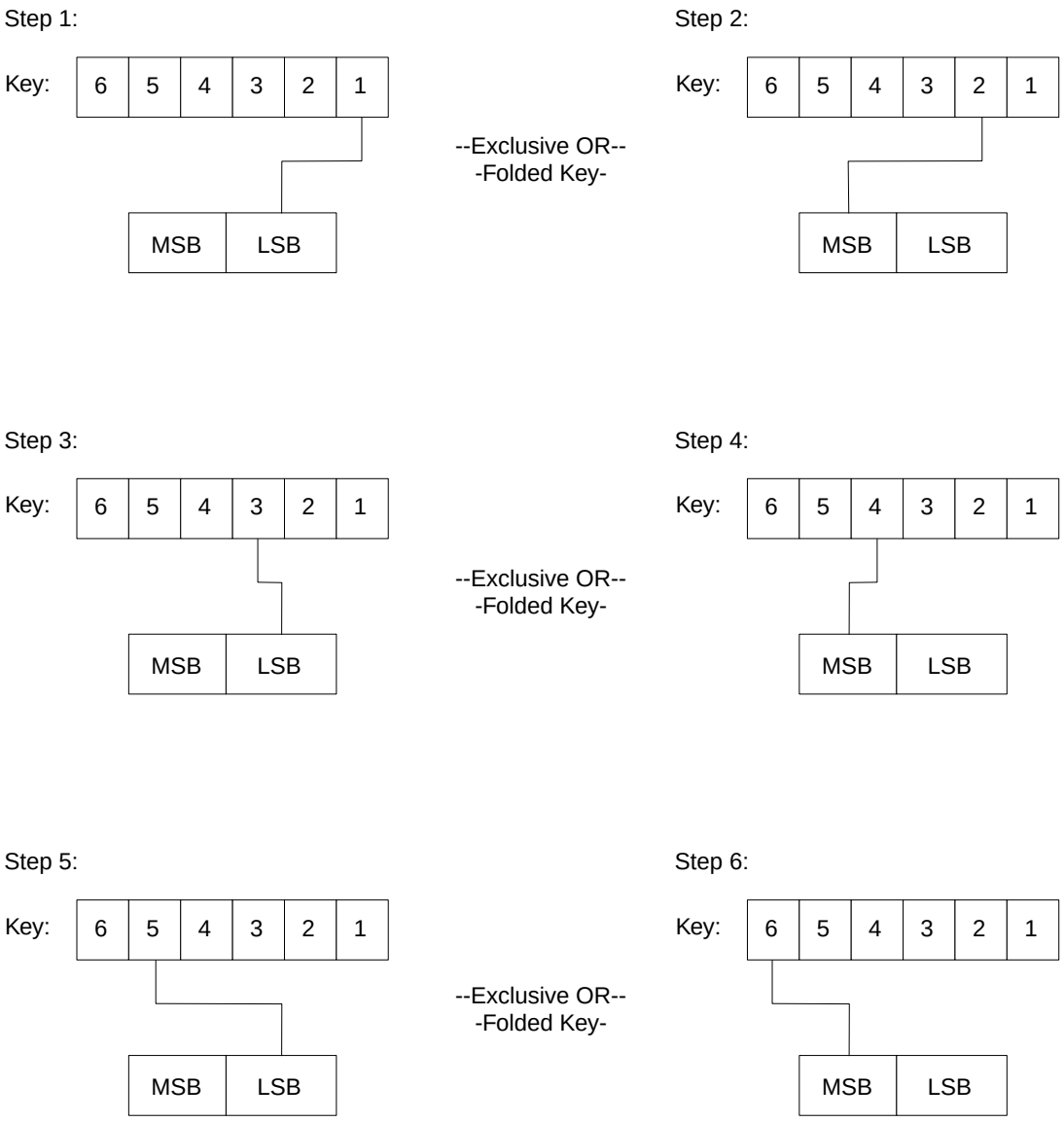


Figure 6-1. IBM Folding Algorithm

Notes:

1. MSB denotes the most significant byte.
2. LSB denotes the least significant byte.

Randomizing: A randomizing divisor divides the folded key. The divisor must be less than the number of blocks allocated for the keyed data set. The remainder from the division is the expected relative block number. The choice of the randomizing divisor and record keys affects the distribution of records in the data set. You must choose these variables so that the data set contains a uniform distribution of records. While no records randomize greater than the randomizing divisor, these blocks are used for overflow records if any additional blocks are needed and available.

Randomization is performed by dividing the two-byte folded key (MSBLSB) by the randomizing divisor. The resulting remainder is the relative block number in the keyed file that contains the keyed logical record or an overflow chain pointer to the block containing the record. If the remainder is equal to zero, the relative block number is equal to the randomizing divisor.

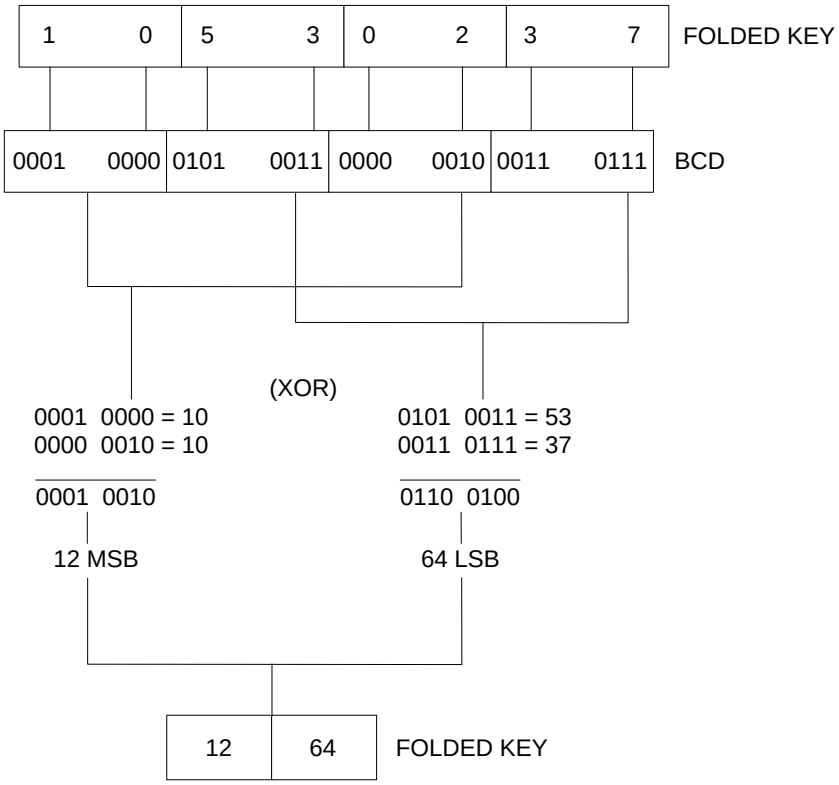
The XOR Rotation Hashing Algorithm: The XOR rotation hashing algorithm expands the length of the folded key produced by the key folding step of the IBM folding algorithm. It also rotates the bits in a random way to produce less record chaining. The algorithm performs the following operations:

1. Calculates the number of bit positions of rotation to be done after folding (a number from 0 to 15).
   a. Adds each digit (or half-byte) to a sum as the key is scanned from right to left during folding. Prior to this addition, the sum is multiplied by 10. This effectively reverses the digits of a packed decimal key and converts to binary. To prevent a 32-bit overflow, the conversion is ended if the sum reaches 214,748,364. During the scan, the summing process does not begin until a nonzero byte is encountered. The sum does not include null bytes that are right-justified in the key.
   b. Divides the resulting sum by 31 (a prime number). The remainder is halved to produce the bit rotation count from 0 to 15.
2. Rotates the bits in the folded key the number of positions calculated in Step 1. The bits are rotated to the left. Bits shifted out of the high-order position move to the low-order position.
3. Combines the rotated folded key with the original folded key to form a 32-bit number. The rotated folded key becomes the high-order word of the 32-bit number. The original folded key becomes the low-order word of the 32-bit number.
4. Rotates the bits in the 32-bit number to the left the number of positions calculated in Step 2.
5. Zeroes the high-order bit of the 32-bit number to prevent a negative result.
6. Divides the 32-bit number by the randomizing divisor. The remainder becomes the relative block number of the record.

Example of the XOR Rotation Hashing Algorithm: Assume a 4-byte key of eight packed decimal digits shown here.

10	53	02	37

The randomizing divisor is 49997.



Note:

BCD denotes "binary code decimal"
MSB denotes "most significant byte"
LSB denotes "least significant byte"
XOR denotes "Exclusive OR" explained below:

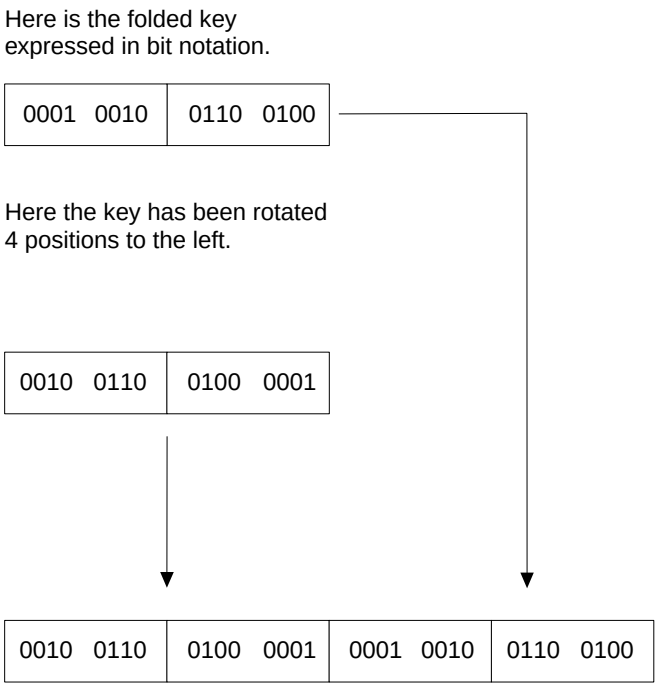
Bit 1	Bit 2	Result
0	0	0
0	1	1
1	0	1
1	1	0

The IBM folding algorithm (see Figure 6-1 on page 6-13) is performed to produce this folded key.

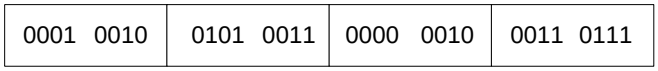
12	64

As it computes the folded key, the algorithm calculates the bit rotation count as follows:

1. Converts the digits to binary in reverse order and divides by 31. 73203501 / 31 = 2361403 with a remainder of 8.
2. Halves the remainder to produce the bit rotation count. 8 / 2 = 4.



The rotated key is concatenated with the original folded key
to form the 32-bit number shown above.
The 32-bit number is rotated 4 positions to the left.



The hexadecimal representation of the result is 64112642.
The binary value is 1,678,845,506.
The 32-bit number is divided by the randomizing divisor divisor, 49997, giving
33578 with a remainder of 46240.

The home block of the key is remainder, 46240.

Polynomial Hashing Algorithm: The polynomial hashing algorithm uses the same technique that generates the Frame Check Sequenced (FCS) field for SDLC transmission frame. This algorithm is for users who choose to generate the FCS without using the Hashing Utility, KFU.

The algorithm performs the following steps:

1. Generate a 16-bit FCS number from the key of a record.
2. Reverse the key byte by byte.
3. Generate another 16-bit FCS number from the reversed key.
4. Concatenate the 16-bit numbers from Step 1 and Step 3 to make a 32-bit number. The high-order 16 bits are from Step 3 and the low-order 16 bits are from Step 1.
5. Turn off the high-order bit of the 32-bit number from Step 4.
6. Divide this 32-bit number by the randomizing divisor. The remainder becomes the relative block of the record.

The following example illustrates the polynomial hashing algorithm. You can use the following application to generate a keyed file without using the KFU.

Use the same 4-byte key used in the XOR rotation hashing algorithm example, 10530237. Assume the randomizing divisor is 49997.

Key	16-Bit FCS Number	Hexadecimal Equivalent	Bit Notation
10530237	9588	2574	0010 0101 0111 0100

Reversed Key	16-Bit FCS Number	Hexadecimal Equivalent	Bit Notation
37025310	48043	BBAB	1011 1011 1010 1011

Concatenation of these two numbers equals:
1011 1011 1010 1011 0010 0101 0111 0100

When you turn off the high-order bit, the number equals:
0011 1011 1010 1011 0010 0101 0111 0100

The hexadecimal representation of the result equals:
3BAB2574

The decimal value equals:
1,001,071,988

Divide the decimal value (1,001,071,988) by the randomizing divisor (49997) giving:
20022 Remainder = 32054

The home block of the key (10530237) equals:
Remainder = 32054 Hexadecimal Value = 7D36

Example C-language Program: This example program is written in *C* language. It is used to generate a 16-bit FCS number.

```
unsigned short crcgen (data, length)
char *data;       /* address of the key */
int length;       /* key length         */
{
unsigned char crcbyte1, crcbyte2, r1;
   char *ptr;
   int i;
   union byte_to_word
     {
        char bytes[2];
        unsigned short   ret;
     }  return_val;

   ptr = data;
   crcbyte1 = 0xFF
   crcbyte2 = 0xFF

   for (i=0; i<length; i++)
     {
       r1 = *ptr++ ^ crcbyte2;
       r1 = (r1 << 4) ^ r1;
       crcbyte2 = (r1 << 4) | (r1 >> 4);
       crcbyte2 = (crcbyte2 & 0x0F ) ^ crcbyte1;
       crcbyte1 = r1;
       r1 = (r1 << 3) | (r1 >> 5);
       crcbyte2 = crcbyte2 ^ (r1 & 0xF8);
```

```
        crcbyte1 = crcbyte1 ^ (r1 & 0x07);
    }

  return_val.bytes[0] = ~crcbyte2;
  return_val.bytes[1] = ~crcbyte1;
  return(return_val.ret);
}
```

The following table shows the output from the example program when used with the input data shown. The I/O is two bytes and hexadecimal form.

Input	Output
1234	DEC1
1111	8206
4143	2066

Record Chaining: Each block has two chain pointers, each two bytes long. One pointer points forward, the other, backward. The system uses these pointers to chain together records that overflow one block into another. The next block that the overflow data is put into cannot be the next sequential sector on the disk. By chaining them together using pointers, the system knows which home block the data is related to.

The block the overflow data is related to is called a *home block*. If the system tries to add a record to a home block that is already full of records, it checks to see if an overflow chain exists for that block. If one does, the system checks it for available space. If the system finds the available space, it adds the record to the block with the available space. If there is no available space in that overflow chain, the system locates another block without overflow records, and adds this block to the end of that block's overflow chain.

If no overflow chain exists for the original home block, the system creates one. It scans the keyed file for a block with sufficient room for the record. The block cannot already contain other overflow records. The record is added to this block; this block is added to the record's home block overflow chain.

Note: Overflow chains **will not** contain overflow records from more than one home block.

When creating a keyed file, the system sets a value for a number called the *chaining threshold*. The system logs a message in the system log when adding records and an overflow chain is encountered that is longer than the threshold value. This message indicates that either the keyed data storage is getting too full or that the file is poorly randomized.

Figure 6-2 through Figure 6-5 on page 6-20 illustrate space management with and without overflow chains.

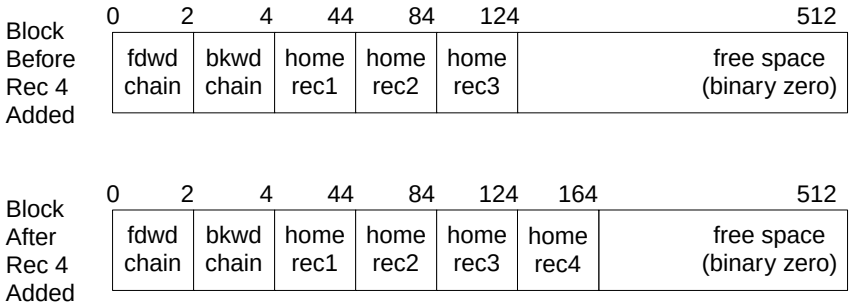


Figure 6-2. Example of Home Record Add without Overflow Present

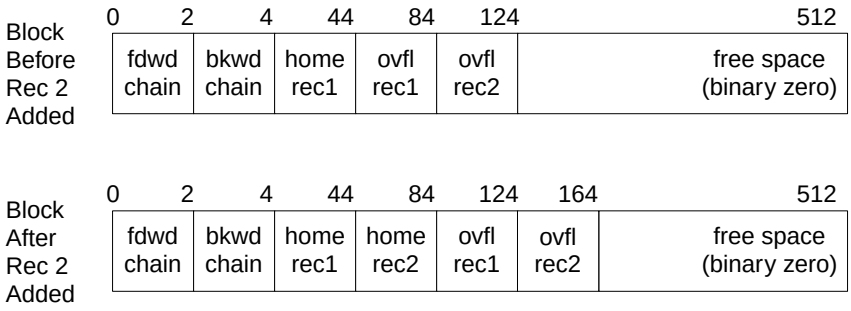
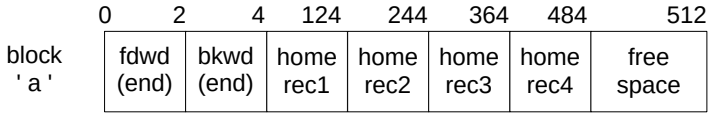


Figure 6-3. Example of Home Record Add with Overflow Present

Data set before record five added to block 'a'.



Data set after overflow block allocated and record five added. Record five becomes the first overflow chain for block 'a'.

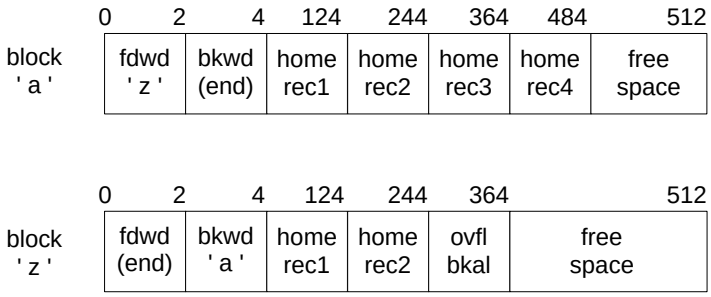
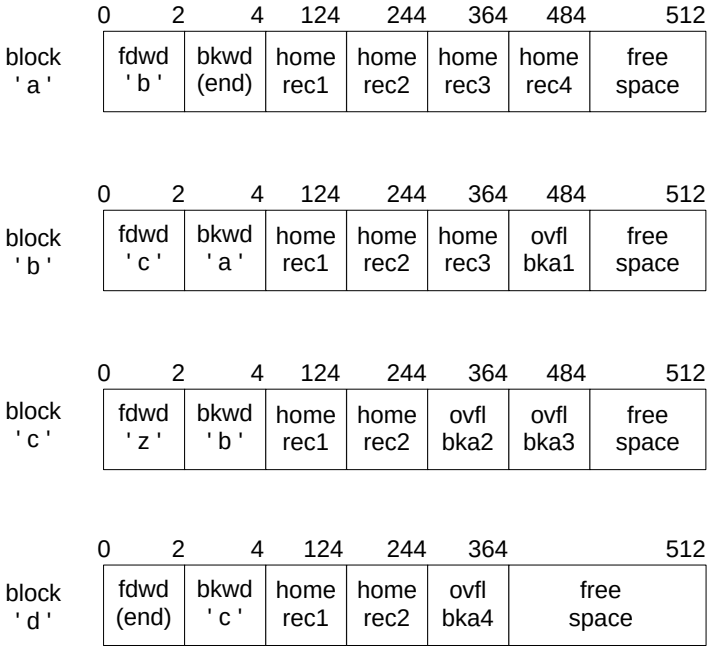


Figure 6-4. Example of Adding a Record to a Full Home Block Creating Overflow Chain

Note: The same process is performed if the last block in the overflow chain is full. Space is found in another block not containing any overflow records, and this block is added to the current overflow chain.

Data set before record three added to block 'c'



Data set after record three added to block 'c'

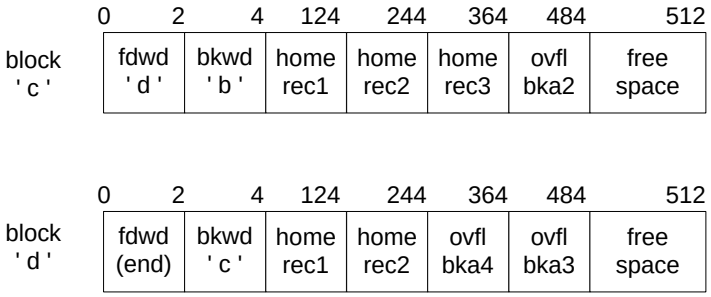


Figure 6-5. Example of Home Record Add with Overflow Expulsion

Notice that blocks 'a' and 'b' remain unchanged from their original positions.

Keyed File Control Record: The Keyed File Control Block (KFCB) is located in sector zero of a keyed file. When creating a keyed file, initialize the entire sector (512 bytes) to zero and then initialize the appropriate fields.

All fields marked with an asterisk (*) should be initialized (zero might be valid for some of these fields). All binary fields are in 80286 convention (for example, decimal 512 would be B'0002').

Do not use any of the reserved fields.

Offset	Length	Description
* 0	12	Reserved
12	18	File name (ASCII with binary zero padded)

The following table contains keyed file creation time stamp:

Offset	Length	Description
* 30	2	Year the file was created (binary)
* 32	1	Month the file was created (binary)
* 33	1	Day the file was created (binary)
* 34	4	Time the file was created in milliseconds after midnight (binary)
* 38	2	Time zone (may be left zero)

The following table contains keyed file parameters:

Offset	Length	Description
* 40	2	Block size (must be 512, B'0002')
* 42	4	Number of blocks in the file
* 46	2	Keyed record size (cannot exceed block size)
* 48	4	Randomizing divisor
* 52	2	Key offset (must be zero)
* 54	2	Key length (cannot exceed record size)
* 56	4	Chaining threshold

The following table contains keyed file statistics:

Offset	Length	Description
60	4	Longest chain encountered
64	4	Total failed requests (including key not found)
68	4	Total reads (not for update)
72	4	Total reads for update
76	4	Total writes to add records
80	4	Total writes to update records
84	4	Total release requests
88	4	Total delete requests
92	4	Total reads or writes of records chained 1 deep
96	4	Total reads or writes of records chained 2 deep

Offset	Length	Description
100	4	Total reads or writes of records chained 3 deep
104	4	Total reads or writes of records chained > 3 deep
108	4	Total file opens
112	4	Total file closes without release
116	4	Total file closes with release
120	10	Time stamp when statistics were cleared (format the same as the create time stamp above)
130	30	Reserved

The following table contains miscellaneous information:

Offset	Length	Description
* 160	9	File valid string (if valid = FSFACADX)
169	10	Reserved
* 179	1	Hashing algorithm (binary 0,1, or 2)
* 180	2	Chain pointer type used for the file (binary 0 or 1). If 0, chain pointers are absolute block numbers. If 1, chain pointers are relative offsets from the home block. The range is + or - 32767. A chain pointer to the home block is - 32768.
182	266	Reserved
448	60	For use by user applications
* 508	4	User identification (This should be “USER” or another identification of how the file was created. This field is binary zeros if created by IBM.)

Chapter 7. Using the Input Sequence Table Build Utility

| This chapter is your guide to using the Input Sequence Table Build Utility for building and maintaining your
| application's input sequence tables. The tables' concepts and definitions are described in Chapter 3 on
| page 3-1 in the I/O Processor section. You should review that section if you are not familiar with input
| sequence tables. This utility has extensive help screens, that are a valuable resource for learning about
| the input sequence tables.

| Input Sequence Tables

| The input sequence tables consist of three tables:

- | Input state table
- | Label format table
- | Modulo check table

| The input state table is always required to allow operator input from the keyboard, OCR, magnetic wand,
| or scanner. The label format table and modulo check table are optional depending on your application
| requirements.

| The input sequence tables are used by the I/O processor to determine what operator input is allowed and
| how to process it.

Using the Input State Table Utility

The Input Sequence Table Utility is a menu-driven program that allows you to add (build), erase, copy, change, activate, or rename any of these tables. You can also display, print, or file a formatted report for a table.

Tables Maintained by the Utility

In addition to the three input sequence tables, the utility maintains a symbol table associated with each of the input sequence tables. The utility automatically names and updates the symbol tables as you name and update the input sequence table.

The utility also maintains a working table for each table you have changed but not activated. This function allows your application to use the input sequence table unchanged while you change the working tables. The utility automatically names and updates the working tables as you update the input sequence table.

When you use the utility options to manage your input sequence table, the utility also manages any associated symbol and working files. For this reason, you should always use the utility options to manage your tables rather than using other programs that are not aware of the additional tables.

Running the Input Sequence Table Utility

To run the Input Sequence Table Utility, use the store controller system screens. Using these screens, you can add, display, erase, copy, print, change, or rename any of these tables. There is also an option that allows you to file (instead of printing) the report produced by a display or print option. To work on any other table, select the desired table on the INPUT SEQUENCE TABLE UTILITY screen.

Input Sequence Table Utility on a LAN (MCF Network) System

On a LAN (MCF Network) system, you can run the Input Sequence Table Utility on any store controller. The utility creates only local files (nondistributed files). You must use the Distribution File Utility to distribute the results of the Input Sequence Table Utility.

When you use the Copy option from the INPUT SEQUENCE TABLE screen to copy a table, the new table will be a local file regardless of the attributes of the source file.

If file security is enabled on your system, you cannot change an input sequence table in the ADX_IPGM subdirectory. The Input Sequence Table Utility executes as user ID = 1 and group ID = 3, and can therefore only create files in the ADX_UPGM subdirectory or in the root. While this is important to protecting your files, it can be inconvenient when updating a table in the ADX_IPGM subdirectory. To overcome this temporary inconvenience, you can copy input sequence table files produced by the utility from the ADX_IPGM subdirectory to the ADX_UPGM subdirectory by using the Copy option on the INPUT SEQUENCE TABLE screen.

Use the following method to update a table in the ADX_IPGM subdirectory:

1. Run the Input Sequence Table Utility as described in “Running the Input Sequence Table Utility.”
2. Copy the table from the ADX_IPGM subdirectory to the ADX_UPGM subdirectory using the input sequence table Copy option.
3. Make the desired changes using the Change option.
4. Activate the changes using the Input Sequence Table Utility.
5. Use the ASM Utility to update the table to the ADX_IPGM subdirectory. For information on this utility, refer to the *IBM 4690 Store System: User’s Guide*.

Input Sequence Table Utility Options

The following options can be used for any of the three input sequence tables:

Display a table: The display option displays a formatted report of a table. For the input state table you can request a report for part of the table.

Print a table: The print option prints a formatted report of a table. For the input state table you can request a report for part of the table.

File the report of a table: The file option writes a formatted report of a table to a file name you choose. For the input state table you can request a report for part of the table. The name for this file must be in the root or in ADX_UPGM. You are responsible for erasing the report file.

Erase a table: When you erase a table, the system erases the named table and any associated symbol and working tables. The system asks you for a confirmation of your option choice before erasing the table.

Copy a table: This option copies a table and associated symbol and working tables.

Rename a table: This option changes the name of a table and associated symbol and working tables. Before renaming a table, make sure that you will not execute any applications that refer to the table by its old name.

Change a table: This option allows you to change an existing table and still use the unchanged table. When you change a table, the utility allows you to change the working table if one already exists. If there is no working table, one is created by making a copy of the table. You make changes to the working table while your applications continue to use the original one.

You can change a portion of a table, leave the utility, and return to work on it later. The utility maintains your changes in the working table. The utility will not make the changed table active until you request the option to activate a table.

Activate a table: This option allows you to replace the currently active table with the associated working table. When you activate the working table, the utility erases the currently active table and associated symbol table and renames the working table and working symbol table to the names of the original tables. The utility cannot erase a file in ADX_IPGM due to file security.

Add a new table: This option allows you to build a new table. Because of references between tables, the input sequence table should be created in the following order:

1. Label format table
2. Modulo check table
3. Input state table

Table Naming Conventions

The table names are also the file names of the tables. When naming your tables, use the following naming conventions. Also see “Naming Files and Subdirectories” on page 2-7. Use a file name that places files in the root or in ADX_UPGM.

xxxa@*bbb*.DAT

where:

xxx = Three characters of your choice. If you are defining additional tables for the IBM licensed products, use UUU.
a = A character of your choice.
@ = The fifth character of each file name.
bbb = Three characters of your choice. These characters are optional.

The utility automatically names symbol and working tables. The symbol table name is created by replacing the @ character with the $ character. The working table names are created by replacing the @ character with a character and replacing the $ character with a character.

Notes on Using the Utility

When you run the Input Sequence Tables Utility, it should be the only utility or application being executed due to the utility storage requirements.

When you are adding states or function codes and you name a next state, the named state must have already been defined or you will receive an error message. To bypass the error, you can temporarily call the next state CURRENT or LOCK. You can then change to the correct state name after the state has been added.

You should assign state IDs sequentially starting with 1. Allowing gaps in ID assignments causes additional storage to be used.

Once a state ID is assigned, you cannot change the ID. You can change only the state symbolic name.

When you are entering messages to be displayed, there is a difference between spacing with the **space bar** and moving the cursor. When you use the **space bar**, a blank is displayed in that position. When you move the cursor, nothing will be displayed for that position (unless you previously entered something).

When you choose to add to a table, default values appear in the screen input fields. When you add a state, you can request another state be used as a model. This model state is used for default values. When you add function codes to a state or common state information, the previous function code you added for the state or common state is used to set up default values.

The maximum size of any table is 64 KB. You can use the directory function of the operating system to determine the size of your tables.

Chapter 8. Using the LIB86 Library Utility

This chapter tells you how to use the LIB86 Library Utility. It includes information on creating library files, appending an existing library, and replacing or deleting library modules.

A library file consists of one or more object modules. To increase the speed of the linking process, a library file contains an index. The index contains all the public functions and subprograms that are in each module, enabling LINK86 to determine which routines in the library are required to create the program. LIB86 is a library utility that enables you to create and modify your own library files.

| The following files are on the 4690 Optional Diskettes:

| LIB86.286 is the 4690 OS library utility.

| LIB86.EXE is the DOS or OS/2 library utility.

LIB86 is a versatile library manager for developing library files to use with LINK86. LIB86 can:

- Create a library file from a group of object files
- Append modules to an existing library file
- Replace modules in an existing library file
- Delete modules from an existing library file
- Select specific modules from a library file
- Display library information

LIB86 generates library files according to instructions you specify in the command line. Input files can have a file extension of OBJ or L86. LIB86 assumes an input file has an OBJ file extension if you do not specify a different file extension. To conclude processing, LIB86 displays the total number of modules processed and the use factor. The use factor is a decimal percentage value specifying the amount of memory LIB86 uses.

The command line starts LIB86 and specifies the input files to be processed.

A LIB86 command line uses the following general format:

```
A:>LIB86 filespec=filespec {[options]} {,filespec}
```

LIB86 checks for errors and displays literal error messages. The error messages are described in “LIB86 Error Messages” on page B-1.

Using LIB86 Command-Line Options

LIB86 has 14 command-line options. You specify the options (enclosed in brackets) in a LIB86 command line. Table 8-1 lists the LIB86 command-line options, an option abbreviation, and a brief description of each option.

Table 8-1. LIB86 Command-Line Options

Option	Abbr	Purpose
DELETE	D	Delete a module from a library file.
Echo	D	Echos contents of the INP file on the console.
EXTERNALS	E	Show external symbols in a library file.
INPUT	I	Read commands from input file.
MAP	MA	Create a module map.
MODULES	MO	Show modules in a library file.
NOALPHA	N	Show modules in order of occurrence.
PUBLICS	P	Show public symbols in a library file.
REPLACE	R	Replace a module in a library file.
SEGMENTS	SEG	Show segments in a module.
SELECT	SEL	Select a module from a library file.
XREF	X	Create a cross-reference file.
$O		Specify input file location.
$X		Specify .XRF file destination.
$M		Specify .MAP file destination.

You can specify either the option or its abbreviation in a command line. The remainder of this chapter explains the use of command-line options.

LIB86 can process any number of files. The length of a command line can be a maximum of 128 characters. When you must use a command line that exceeds 128 characters, you can shorten file names, or place the command line in a file and use the INPUT option.

You can create command-line files with an INP file extension using a text editor. Enter the new library name before an equal sign and list each input file, with options, after the equal sign, the same way you do in a command line. Do not include the characters LIB86 in the file. You can place tab characters, carriage returns, and line feeds anywhere in a command line file.

The following example shows the beginning of a command-line file named LIBRARY1.INP:

```
LIBRARY1 = SUBTOT [XREF], ADD2, SUB45, MULT, DIV2,
           NET1, NET2, NET3,
           TOTAL, GROSS1, GROSS2, GROSS3,
           CHART1, CHART2, CHART3,
            .
            .
            .
```

To use the command-line file and start LIB86, specify the INP file as follows:

```
A:>LIB86 LIBRARY1 [INPUT]
```

Note: LIB86 assumes an INP file extension if you are using the INPUT option.

The preceding example specifies the INPUT option, instructing LIB86 to read the remainder of the command line from the LIBRARY1.INP disk file.

Creating a Library File

The following example creates a library named TEST.L86 from the input files ONE.OBJ, TWO.OBJ, and THREE.OBJ. You do not have to specify the L86 file extension for the library name. LIB86 assumes a file extension of OBJ for input files unless you specify a different file extension. OBJ files contain only one module.

```
A:>LIB86 TEST=ONE,TWO,THREE
```

You can create one large library file from several smaller library files.

The following example creates a large library file named TESTLIB.L86 from the input files LIB1.L86 and LIB2.L86. L86 files contain more than one module.

```
A:>LIB86 TESTLIB=LIB1.L86,LIB2.L86
```

You can combine OBJ and L86 files in one command line to create a library, as shown in the following example:

```
A:>LIB86 MATHLIB=MULT,DIVIDE.L86
```

The preceding example creates a library file named MATHLIB.L86 from the input files MULT.OBJ and DIVIDE.L86.

Appending an Existing Library

To add a module to an existing library, specify the existing library file name on both sides of the equal sign. Then, list the input files you want to append. Include the L86 file extension for the library file name on the right side of the equal sign.

The following example appends the files ONE.OBJ and LIB1.L86 to the existing library file TESTLIB.L86:

```
A:>LIB86 TESTLIB=TESTLIB.L86,ONE,LIB1.L86
```

You can rename an appended library file, as shown in the following example:

```
A:>LIB86 NEWTEST=TESTLIB.L86,ONE,LIB1.L86
```

The preceding example appends the files ONE.OBJ and LIB1.L86 to the existing library TESTLIB.L86, creating a new library file named NEWTEST.L86.

Replacing Library Modules

Use the REPLACE option to replace a module in an existing library file.

The following command line replaces the module ONE with the file NEWONE.OBJ in the library file TESTLIB.L86.

Note: See the correct use of brackets in the command line.

```
A:>LIB86 TESTLIB=TESTLIB.L86 [REPLACE [ONE=NEWONE]]
```

If you want to replace a module but maintain the same module name, specify the name only once after the REPLACE option.

The following example replaces the module ONE with a new ONE.OBJ file in the library TESTLIB.L86, and renames the library NEWLIB.L86:

```
A:>LIB86 NEWLIB=TESTLIB.L86 [REPLACE [ONE]]
```

You can replace several modules with one command line. Separate the REPLACE option specifications with commas, as shown in the following example:

```
A:>LIB86 NEWLIB=TESTLIB.L86 [REPLACE [ONE=NEW1, TWO=NEW2]]
```

You cannot use the command-line options DELETE and SELECT with REPLACE in the same command line.

LIB86 displays an error message if it cannot find a specified module in the library file.

Deleting Library Modules

Use the DELETE option to delete modules from an existing library file as shown in the following example. Module TWO is deleted from the library file TESTLIB.L86:

```
A:>LIB86 TESTLIB=TESTLIB.L86 [DELETE [TWO]]
```

You can delete several modules with one command line. Separate modules after the option DELETE with commas.

The following example deletes three modules to create a new library named NEWLIB.L86:

```
A:>LIB86 NEWLIB=TESTLIB.L86 [DELETE [ONE, TWO, FIVE]]
```

You can delete a group of contiguous library modules using a hyphen, as shown in the following example:

```
A:>LIB86 NEWLIB=TESTLIB.L86 [DELETE [ONE - FIVE]]
```

The preceding command line deletes all modules from module ONE through module FIVE.

You cannot use the command-line options REPLACE and SELECT with the DELETE option in one command line.

LIB86 displays an error message if it cannot find a specified module in a library file.

Selecting Modules

Use the SELECT option to select specific modules from an existing library to create a new library.

The following example creates a new library named NEWLIB.L86 that consists of three modules selected from OLDLIB.L86:

```
A:>LIB86 NEWLIB=OLDLIB.L86 [SELECT [TWO, FOUR, FIVE]]
```

You can select a group of contiguous library modules using a hyphen, as shown in the following example. A new library is created that consists of five modules selected from an existing library, assuming modules ONE, TWO, THREE, FOUR, and FIVE are contiguous in the library file.

```
A:>LIB86 NEWLIB=OLDLIB.L86 [SELECT [ONE - FIVE]]
```

You cannot use the command-line options DELETE and REPLACE with the SELECT option in the same command line.

LIB86 displays an error message if it cannot find a specified module in a library file.

Displaying Library Information

LIB86 can produce listing files of two types: a cross-reference file and a library module map. A cross-reference file contains an alphabetized list of all public, external, and segment name symbols a library file. Following each symbol is a list of all modules that contain the symbol. LIB86 marks the module or modules that define the symbol with a pound (#) sign. LIB86 encloses segment names in slashes (//). For example, the segment CODE would appear as /CODE/.

Use the XREF option to create a cross-reference listing for a specified library file.

The following example creates a cross-reference file named TESTLIB.XRF for the TESTLIB.L86 library file:

```
A:>LIB86 TESTLIB.L86 [XREF]
```

A module map contains an alphabetized list of all modules in a library file. Following each module name is a list of all segments in the module and the length of each segment. A module map also includes a list of all public and external symbols specified in the module.

Use the MAP option to create a module map for a specified library file.

The following example creates a module map named TESTLIB.MAP for the TESTLIB.L86 library file:

```
A:>LIB86 TESTLIB.L86 [MAP]
```

Usually, LIB86 alphabetizes the names of modules in a module map listing. Use the NOALPHA option to produce a module map that lists module names in order of occurrence, as shown in the following example:

```
A:>LIB86 TESTLIB.L86 [MAP, NOALPHA]
```

You can use LIB86 to create partial library information maps using the MODULES, SEGMENTS, PUBLICS, and EXTERNALS options. You can use the four options in any combination.

The following example creates a module map that contains only public and external symbols:

```
A:>LIB86 TESTLIB.L86 [PUBLICS, EXTERNALS]
```

You can combine the SELECT option with any of the options previously described to generate partial library information maps, as shown in the following examples:

```
A:>LIB86 TESTLIB.L86 [XREF, [SELECT [ONE, + TWO, THREE]]]
A:>LIB86 MATHLIB.L86 [MAP, NOALPHA, SELECT [MULT, + DIVIDE]]
A:>LIB86 LIBRARY1.L86 [MODULES, SEGMENTS, SELECT + [ONE - FIVE]]
```

Accessing Files in Other Directories

| LIB86 assumes that all files specified on a command line (or INP file) are in the default directory. You can
| access files in other directories in several ways. These options are listed in their order of precedence:

1. A fully specified path name can be included with each L86 or OBJ file name. The following example shows how to specify locations of L86 or OBJ files that are not contained in the default directory:

   | ```
   | A:>LIB86 C:\LIBA\NEW1=LIB1.L86,C:OBJ1\ONE,C:\OBJ2\TWO
   ```

   In this case, a new library, NEW1.L86, will be created in the C:\LIBA directory. The components of the new library will be LIB1.L86 (default directory), ONE.OBJ (C:\OBJ1 directory), and TWO.OBJ (C:\OBJ2 directory).

2. Options $M, $O, and $X can be used on the command line (or in an INP file). These options override the default directory. They must be specified as follows:

   - $O*filespec* specifies input OBJ or L86 file location.
   - $X*filespec* specifies output XRF file destination.
   - $M*filespec* specifies output MAP file destination.

   The $O option remains in effect as the library utility processes a command line from left to right, until it encounters another $O. This feature is useful when you create a library from groups of files in different directories.

   The following command causes a MAP file to be placed in C:\MAPS, an XRF file to be placed in C:\XREFS, and looks for OBJ files only in the C:\OBJS subdirectory.

   ```
   A:>LIB86 TEST.L86[X,MA,$XC:\MAPS,$MC:\XREFS,$OC:\OBJS]
   ```

   Note: The $O option is selectively ignored if a fully specified file name is used for any OBJ, INP, or L86 input file.

| 3. LIB86 recognizes 4690 logical file names, but does not supply the .OBJ file extension when an
| extension is not specified.

4. A search path can be set up to look for OBJ, L86, or INP files if they are not found in the default directory. Environment variable, LIB86PATH, should be set (or defined) in the current DOS, OS/2, or 4680 session before running the LIB86 utility.

   If you want the library utility to search for OBJ, INP, or L86 components first in the C:\NEWCODE, then in the C:\OLDCODE directories, establish that search path by issuing the following command:

   OS/2 or DOS:

   ```
   A:>SET LIB86PATH=C:\NEWCODE;C:\OLDCODE
   ```

   4680:

   ```
   A:>DEFINE LIB86PATH=C:\NEWCODE;C:\OLDCODE
   ```

   When the library utility is subsequently run, OBJ, INP, and L86 files will be searched for along this path if they are not found in the default directory.

   Note: This option is selectively overridden if either option 1 or option 2 is specified for specific input files.
   ```

Chapter 9. Using the Linker Utility and the POSTLINK Utility

Introduction to the Linker Utility

The linker utility, LINK86, is a linkage editor that combines relocatable object files into a load module that runs on the IBM 4690 Operating System. Any IBM 4690-compatible compiler or assembler can produce the object files. See Table 9-2 on page 9-5 for a summary of command-file option parameters.

The linker is available to run in a DOS, OS/2, or 4690 Operating System environment. The file LINK86.286 runs in the 4690 Operating System environment. LINK86.EXE runs in either a DOS (Version 3.3 or higher) or OS/2 (Version 1.2 or higher) environment. The linker utility is shipped in the 4690 Optional Programs diskette.

LINK86 accepts the following types of files as input:

Object (OBJ) file
: A language source file that has been translated by the compiler or assembler into a machine-readable object code.

Library (L86) file
: An indexed library of commonly used object modules. The library utility LIB86 generates library files.

Input (INP) file
: A file that contains file names and options, the same as a command line you enter from the keyboard.

LINK86 creates the following types of files:

Executable Load Module (286) file
: Contains a memory image of a program and runs directly under the operating system.

Overlay (OVR) file
: Contains information that is loaded into memory when it is needed by the program.

Symbol Table (SYM) file
: Contains a list of symbols from the object files and their offsets.

Line Number (LIN) file
: Contains a list of code offsets of program source lines. This file is created only when the compiler puts line number information into the object files being linked.

Map (MAP) file
: Contains segment information about the load module.

| **Debug Information (DBG) file**
| : Contains information used by the 4690 application debugger.

During processing, LINK86 displays unresolved symbols. An unresolved symbol is declared to be external in one or more modules, but is not publicly defined in any module.

| When processing is complete, LINK86 displays the size of each section of the load module. See Figure 9-1 on page 9-3.

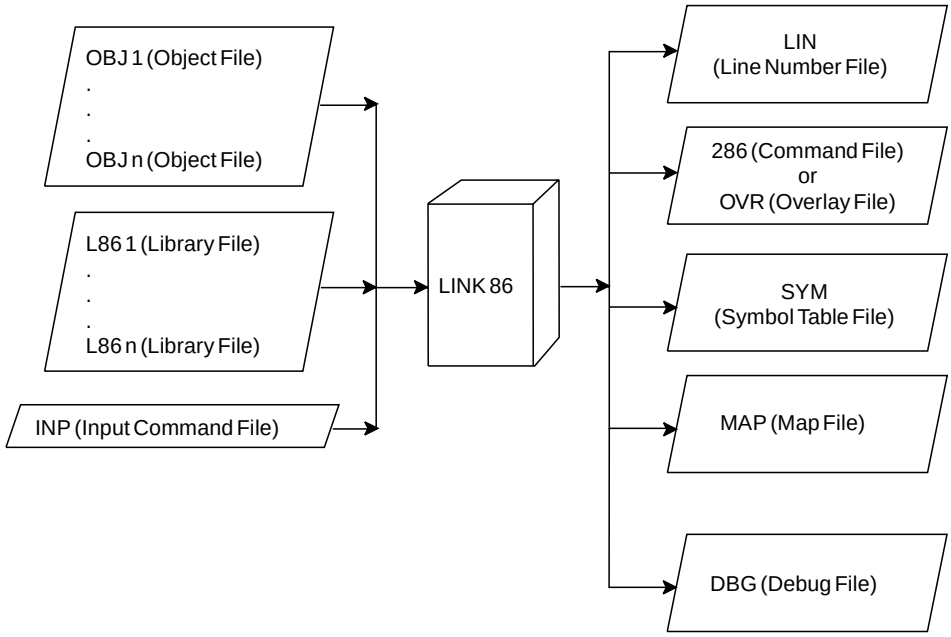


Figure 9-1. LINK86 Operation

LINK86 Command Syntax

You invoke LINK86 with the following command format:

LINK86 [*filespec* =] *filespec1* [*,filespec2,...,filespecn*]

filespec is a file specification, consisting of an optional path specification and a file name with optional file extension. If you enter a file name to the left of the equal sign, LINK86 creates output files with that file name and the appropriate file extensions.

For example, using the files PARTA, PARTB, and PARTC, the following command creates MYFILE.286:

```
A:>LINK86 MYFILE = PARTA,PARTB,PARTC
```

Note: The files PARTA, PARTB, and PARTC can be a combination of object files and library files. If no file extension is specified, the linker assumes a file extension of OBJ.

If you do not specify an output file name, LINK86 creates the output files using the first file name in the command line.

For example, the following command creates the file PARTA.286:

```
A:>LINK86 PARTA,PARTB,PARTC
```

Note: If you specify a library file in your link command, do not enter the library file as the first file in the command line.

You can also instruct LINK86 to read its command line from a file, thus making it possible to store long or commonly used link commands on disk:

```
A:>LINK86  LINKFIL[I]
```

Additional linker options are discussed later in this chapter.

Linking With Shared Runtime Libraries

LINK86 supports store controller-shared runtime libraries. Shared runtime libraries (SRTLs) allow multiple users to share a single copy of library code at runtime. It is not necessary for each user to store library code in their load module. When libraries are shared, only references to the library code are linked with a user's object files.

| No extra steps are required when linking BASIC object files with SRTL files. Do not specify the runtime
| libraries SB286L.L86 or SB286TVL.L86. They are automatically requested by the compiler.

Note: See "SHARED and NOSHARED Options" on page 9-8 for information on linking with shared runtime libraries.

LINK86 Command Options

When you invoke LINK86, you can specify command options that control the link operation. Command options are in one of three categories, depending on the type of file affected.

Command options in the first category affect the contents of the command file and apply to the entire link operation. Command options in the second category affect the SYM and MAP files. These options turn on and off as LINK86 processes the command line from left to right. Command options in the third category affect the library and input files and apply to one file in the command line.

When you specify command options, enclose them in square brackets following the file name.

A command option is specified using the following command format:

```
A:>LINK86 file[option]
```

For example, to specify the command option MAP for the file TEST1 and the NOLOCALS option for the file TEST2, enter the following:

```
A:>LINK86 TEST1[MAP],TEST2[NOLOCALS]
```

You can use spaces to improve the readability of the command line, and you can put more than one option in square brackets by separating them with commas.

The following example specifies that the MAP and NOLOCALS options be used for the TEST1 file and the option LOCALS for the TEST2 file:

```
A:>LINK86 TEST1 [MAP, NOLOCALS], TEST2 [LOCALS]
```

Table 9-1 (Page 1 of 2). LINK86 Command Options and abbreviations

Option	Abbreviation	Meaning
CODE	C	Controls contents of CODE section of load module.
DATA	D	Controls contents of DATA section of load module.
EXTRA	E	Controls contents of EXTRA section of load module.

Table 9-1 (Page 2 of 2). LINK86 Command Options and abbreviations

Option	Abbreviation	Meaning
STACK	ST	Controls contents of STACK section of load module.
LIBSYMS	LI	Include symbols from library files in SYM file.
NOLIBSYMS **	NOLI	Do not include symbols from library files in SYM file.
LOCALS **	LO	Include local symbols in SYM file.
NOLOCALS	NOLO	Do not include local symbols in SYM file.
NOSYMS	NOSY	Inhibits generation of a SYM file.
LINES **	LIN	Create LIN file with line number information.
NOLINES	NOLIN	Do not create LIN file.
NOSEARCH	NOSE	Link all library modules whether referenced or not.
MAP	M	Create a MAP file.
SEARCH **	S	Search library and only link referenced modules.
SHARED	SH	Force an SRTL to be treated as shared.
NOSHARED	NOSH	Force an SRTL to be treated as a normal unshared library.
CODESHARED	CODESH	Designates that this load module's code can be shared by multiple processes. After a load module is linked CODESHARED, the load module must be POSTLINKed using the POSTLINK Utility.
INPUT	I	Read command line from disk file.
ECHO	ECHO	Echo contents of INP file to the screen.
DBI	DBI	Create a DBG file that contains debug information.

Note: ** = Default Value

Command-File Options

The options described in this section affect the contents of the command file created by LINK86. Table 9-2 lists the command-file option parameters.

Table 9-2. Command-File Option Parameters

Parameter	Abbreviation	Meaning
GROUP	G	Groups to be included in load module section
SEGMENT	S	Segments to be included in load module section
ADDITIONAL	AD	Additional memory allocation for the load module section
MAXIMUM	M	Maximum memory allocation for load module section

CODE/DATA/STACK/EXTRA: A load module consists of a 128-byte header record ordinarily followed by four sections. The sections are called CODE, DATA, STACK, and EXTRA. Each of the sections correspond to a LINK86 command option of the same name. The header contains the length of each section of the load module and its minimum and maximum memory requirements. The operating system uses the header to load the file.

GROUP and SEGMENT

The GROUP and SEGMENT parameters each contain a list of groups or segments that you want LINK86 to put into a specified section of the load module.

For example, the following command instructs LINK86 to put the segments CODE1, CODE2, and all the segments in group XYZ into the CODE section of the file TEST.286:

```
A:>LINK86 TEST [CODE [SEGMENT [CODE1, CODE2], BGROUP [XYZ]]]
```

ADDITIONAL and MAXIMUM

The ADDITIONAL and MAXIMUM parameters tell LINK86 the values to put in the load module header. These parameters override the default values that LINK86 uses.

Each parameter is a hexadecimal number enclosed in square brackets.

The ADDITIONAL parameter specifies the amount of additional memory, in paragraphs, required by the specified section of the load module.

Note: A paragraph is 16 (X'10') bytes.

The MAXIMUM parameter specifies the maximum amount of memory needed by the section of the load module. The program loader attempts to allocate as much of the requested maximum as possible.

In the following example, the command creates the file TEST.286:

```
A:>LINK86 TEST [DATA [ADD [100], MAX[FFF]]]
```

The TEST.286 file header contains the following information:

- The DATA section requires at least X'100' paragraphs in addition to the data in the load module.
- The DATA section can use up to X'FFF' paragraphs of memory.

SYM File Options

The following command options affect the contents of the SYM file that LINK86 creates:

- NOSYMS
- LOCALS
- NOLOCALS
- LIBSYMS
- NOLIBSYMS

These options must appear in the command line after the specific file or files to which they apply. When you specify one of these options, it remains in effect until you specify another option. Therefore, if a command line or input file (INP) contains two options, the leftmost option affects all of the listed files until the next option is encountered. The next option affects all remaining files specified on the command line or input file.

NOSYMS: The NOSYMS option prevents the generation of a SYM file. In this case, all other SYM file options are ignored.

LOCALS and NOLOCALS: The LOCALS option directs LINK86 to include local symbols in the SYM file if they are in the object files being linked. The NOLOCALS option instructs LINK86 to ignore local symbols in the object files. The default is LOCALS.

For example, the following command creates a SYM file containing local symbols from TEST2.OBJ and TEST3.OBJ, but not from TEST1.OBJ:

```
A:>LINK86 TEST1 [NOLOCALS], TEST2 [LOCALS], TEST3
```

LIBSYMS and NOLIBSYMS: The LIBSYMS option instructs LINK86 to include in the SYM file symbols from a library searched during the link operation. The NOLIBSYMS option instructs LINK86 not to include library symbols in the SYM file. A library search usually involves the runtime subroutine library of a high-level language such as IBM 4680 BASIC. Because the symbols in such a library are usually of no interest to the programmer, the default is NOLIBSYMS.

The following example disables library symbol generation for ADXADMBL.L86:

```
A:>LINK86 TEST,ADXACRCL.L86,ADXADMBL.L86 [NOLI]
```

LIN File Options

The IBM 4680 BASIC compiler provides an option that puts line numbers into object files. If line numbers are present in the object file, LINK86 can create a file containing line numbers and their code offsets.

The LINES and NOLINES options specify whether or not LINK86 creates a LIN file.

The LINES option, which is active by default, instructs LINK86 to create a LIN file, if possible. If no line information is present in the object file, LINK86 does not create the LIN file. The NOLINES option instructs LINK86 not to create a LIN file, even if line numbers are present in the object file:

```
A:>LINK86 TEST [NOLIN]
```

MAP File Options

The MAP option instructs LINK86 to create a MAP file containing information about segments in the load module.

The amount of information that LINK86 puts into the MAP file is controlled by the following optional parameters:

OBJMAP	NOOBJMAP
L86MAP	NOL86MAP
ALL	NOCOMMON

The optional parameters are enclosed in brackets following the MAP option. The OBJMAP parameter directs LINK86 to put segment information about OBJ files in the MAP file. The NOOBJMAP parameter suppresses this information. The L86MAP parameter instructs LINK86 to put segment information from L86 files into the MAP file. The NOL86MAP parameter suppresses this information. The ALL parameter instructs LINK86 to put all the information into the MAP file. The NOCOMMON parameter suppresses all common segments from the MAP file.

When you instruct LINK86 to create a MAP file, you can change the parameters to the MAP option at different points in the command line. For example, the following command directs LINK86 to create a map file containing segment information from FINANCE.OBJ and SCREEN.L86:

```
A:>LINK86 FINANCE [MAP[ALL]],SCREEN.L86,GRAPH.L86 [MAP[NOL86MAP]]
```

Notes:

1. Segment information for GRAPH.L86 is suppressed by the NOL86MAP option.
2. If you specify the MAP option with no parameters, LINK86 uses OBJMAP and NOL86MAP as defaults.

L86 File Options

The following command options determine how the library files are used by LINK86:

- SEARCH
- NOSEARCH
- SHARED
- NOSHARED

SEARCH and NOSEARCH Options: The SEARCH option instructs LINK86 to search the preceding library, and include in the load module only those modules that satisfy external references from other modules. Because SEARCH is the default value, using it as a value is redundant. The NOSEARCH option instructs the linker to include in the load module all modules whether an external reference is satisfied or not.

Note: LINK86 searches L86 files automatically.

The NOSHARE option must be specified for each module to be linked.

For example, the following command creates the file TEST1.286 by combining the object files TEST1.OBJ, TEST2.OBJ, and modules from MATH.L86 that are referenced in TEST1.OBJ or TEST2.OBJ:

```
A:>LINK86 TEST1, TEST2, MATH.L86
```

The modules in the library file do not have to be in any special order. LINK86 makes multiple passes through the library index when attempting to resolve references from other modules.

SHARED and NOSHARED Options: The SHARED and NOSHARED options determine whether a library file is to be used as an SRTL. When a runtime library is NOSHARED, both the code and the data from that library are linked with the object files. When a runtime library is SHARED, only the data from that library is linked with the object files, and a single copy of the library code resides in a special load module called an executable shared runtime library (XSRTL). The code stored in an XSRTL file can be accessed by any file linked as a user of the SRTL.

When an SRTL is created, it is given an attribute that determines whether the library is to be treated as a SHARED or a NOSHARED option.

The store controller runtime library for IBM 4680 BASIC (SB286L.L86) was created with the SHARED attribute.

If an SRTL has a default attribute of SHARED, you can force LINK86 to treat it as a normal library by specifying the NOSHARED option. This forces the referenced SRTL routines to be resident in the user's code file, and the loader does not have to perform a load-time resolution of external references.

As an example of the NOSHARED option, the following command format causes LINK86 to treat the shareable runtime library as an unshared library:

```
A:>LINK86 MYPROG=MAIN,PART1,PART2[NOSHARED]
```

CODESHARED: Normally a load module created by the linker has a bit set in the header that identifies to the loader that only one process can use the code segments at one time. By specifying the CODESHARED option, you can force the loader to use the same copy of the module's code segments for multiple processes.

Note: A load module that has been linked with the CODESHARED option must be POSTLINKed using the POSTLINK Utility before the 4690 Operating System will allow it to run.

If you are executing the same application program in both the Model 1 and Model 2 terminals, you should use this option because it saves a significant amount of storage. If your application uses the Display Manager* product, you must *NOT* use this option because the Display Manager's code is not shareable.

INPUT File Options

The INPUT and ECHO command options determine how LINK86 uses the input file.

The INPUT option instructs LINK86 to obtain further command-line input from the file. Other files can appear in the command line, but the input file must be the last file name on the command line. When LINK86 encounters the INPUT option, it stops scanning the command line entered from the keyboard.

Note: You cannot nest command input files. A command input file cannot contain the INPUT option.

The input file consists of file names and options the same as a command line entered from the keyboard. An input file can contain up to 4096 characters, including spaces but excluding comments. Comment delimiters recognized by LINK86 are **;** and *** ***. When LINK86 encounters either of these delimiters in an input file, the remaining characters on that line are ignored. Use comments as often as you like to make the input file easier to understand and maintain.

In the following example, the file TEST.INP might include the lines:

```
;This is a comment
MEMTEST=TEST1,TEST2,TEST3,
IOLIB.L86[S],MATH.L86[S], **This is another comment
TEST4,TEST5[LOCALS]
```

To direct LINK86 to use this file for input, enter the following command format:

```
A:>LINK86 TEST.INP [INPUT]
```

If no file extension is specified for an input file, LINK86 assumes INP.

The ECHO option causes LINK86 to display the contents of the INP file on the display:

```
A:>LINK86 TEST [ECHO,I]
```

Input/Output Option

The $ option controls the source and destination devices under LINK86. The general form of the $ option is:

$*tpathname*

Note: *t* is a file type, and *pathname* is a fully specified path or a drive letter followed by a colon.

File Types: LINK86 recognizes the following seven file types:

```
C -  Load Module (286 or OVR)
D -  Debug Information File (DBG)
L -  Library File (L86)
M -  Map File (MAP)
N -  Line Number File (LIN)
O -  Object File (OBJ or L86)
S -  Symbol File (SYM)
```

The value of a $ option remains in effect until LINK86 encounters a countermanding option as it processes the command line from left to right. For example, the following command will link TEST1.OBJ and TEST2.OBJ files from subdirectory C:\OBJ1 with the TEST3.OBJ file in subdirectory C:\OBJ2:

```
C:>LINK86 TEST.286=TEST1 [$OC:\OBJ1],TEST2,TEST3[ $OC:\OBJ2]
```

$C (Command) Option:

The $C option uses the following format:

$C*pathname*

LINK86 usually creates the load module in the same subdirectory as the first object file in the command line. The $C option instructs LINK86 to place the load module in the specified directory. The $C option also applies to OVR files when you use LINK86 to create overlays.

```
A:>LINK86 TEST [$CC:\286S]
```

$D (Debug Information) Option:

The $D option uses the following format:

$D*pathname*

LINK86 normally creates the DBG file in the default directory. The $D option instructs LINK86 to place the DBG file in the directory you specified with the pathname.

```
A:>LINK86 TEST [$D:\DBGS]
```

$L (Library) Option:

The $L option uses the following format:

$L*pathname*

LINK86 searches the default directory for runtime subroutine libraries that are linked automatically. The $L option instructs LINK86 to search the specified *pathname* for the runtime subroutine libraries.

```
A:>LINK86 TEST [$LC:\LIBS]
```

$M (Map) Option:

The $M option uses the following format:

$M*pathname*

LINK86 normally creates the MAP file in the default directory. The $M option instructs LINK86 to place the MAP file in the specified directory.

```
A:>LINK86 TEST [$MC:\MAPS]
```

$N (Line Number) Option:

The $N option uses the following format:

$N*pathname*

LINK86 normally creates the LIN file in the same subdirectory as the load module. The $L option directs the linker to place the LIN file in the directory specified by the *pathname* that follows the $N option:

```
A:>LINK86 TEST [$NC:\LINS]
```

$O (Object) Option: The $O option uses the following format:

```
$O pathname
```

LINK86 searches for the OBJ or L86 files that you specify in the command line on the default drive, unless such files have drive prefixes. The $O option allows you to specify the drive location of multiple OBJ or L86 files without adding a path name prefix to each file name.

In the following example, the command instructs LINK86 that all the object files except the last one are located in subdirectory D:\OBJS.

```
A:>LINK86 P [$OD:\OBJS],Q,R,S,T,U.L86,B:V
```

Note: This does not apply to libraries that are linked automatically. See the $L option.

$S (Symbol) Option: The $S option uses the following format:

```
$S pathname
```

LINK86 normally creates the symbol file in the same subdirectory as the load module. The $S option directs LINK86 to place this file in the subdirectory specified by the *pathname* that follows the $S option.

```
A:>LINK86 TEST [$SC:\SYMS]
```

DBINFO Option: The DBINFO option instructs LINK86 to create a DBG file containing necessary information for the 4680/4690 Application Debugger. If you are combining several OBJ and/or L86 modules, specify the DBI option on the first OBJ file listed on the command line or in the INP file.

Refer to the *IBM 4680-4690 Application Debugger User's Guide* for additional information about compiling and linking an application to prepare it for debugging.

```
A:>LINK86 TEST ffDBI"
```

Use of Link Path Variables to Search Other Directories

Sometimes you might want to search a particular path to find OBJ, L86, or INP files. If a file is not found in the first directory, the search continues to other directories in the specified path. Using this method, you can make modifications to a base set of OBJ files and keep the modified OBJ files in a separate directory or series of directories.

Using the LNK86PATH environment variable, you can define the search order so the linker looks first in the changed files directory and, if not found, then looks in the base directory.

The LNK86PATH environment variable is defined using the SET command (DOS or OS/2) or the DEFINE command (4690). This variable must be set at least once before running the linker utility, and it must be set during the same session.

Under DOS or OS/2, use the following command:

```
A:>SET LNK86PATH=path1;path2;path3;<....;pathn>
```

where *pathn* represents the directories that you intend to search for files to be read by the linker.

Under 4690 Operating System, use the following command:

```
A:>DEFINE LNK86PATH=path1;path2;path3 <.... pathn>
```

intend to search for files to be read by the linker.

How Various Search Priorities Relate

The following search order is used when linking with files in remote directories:

1. A path name specified as part of a file name on the command line or in an INP file. If the file is not found, the search is abandoned.
2. The $ directives $O and $L. If an OBJ, INP, or L86 file is not found in the specified directory, the search is abandoned.
3. The default directory.
4. The path specified by the environment variable LNK86PATH.

Use of ERRORLEVEL Test

When running the LINK86 program from a batch file, the results of the link can be tested for errors. If the link step is successful, an ERRORLEVEL value of zero is returned. To test for an error, use the batch file statement “IF ERRORLEVEL 1....”

The following is an example within a batch file:

```
LINK86 TEST
IF ERRORLEVEL 1 ECHO  We have a problem >> RESULTS
```

In the above example, if the link of the TEST file fails the message “We have a problem” is written to the file RESULTS.

Overlays

Overlays are supported only in the store controller. This section describes how LINK86 creates programs with separate files called overlays. Each overlay file is a separate program module that is loaded into memory when it is needed by the program. By loading only those program modules that are needed at a particular time, the amount of memory used by the program is kept to a minimum; however, you must link your application with the runtime library using the NOSHARED option.

As an example, many application programs are menu-driven, with the user selecting the functions to perform. Because the program’s modules are separate and invoked sequentially, they need not reside in memory simultaneously. Using overlays, each function on the menu can be a separate subprogram that is stored on disk, and loaded only when required. When one function is completed, control returns to the menu portion of the program. You then select the next function.

Figure 9-2 shows the concept of using large program overlays. Assume that a menu-driven application program consists of three separate user-selectable functions. If each function requires 30K of memory, and the menu portion requires 10K, then the total memory required for the program is 100K (without overlays). However, if the three functions are designed as overlays (separate overlays), the program requires only 40K, because all three functions share the same locations in memory.

Note: The POSTLINK Utility must not be used on overlay files or the root module of an overlay file.

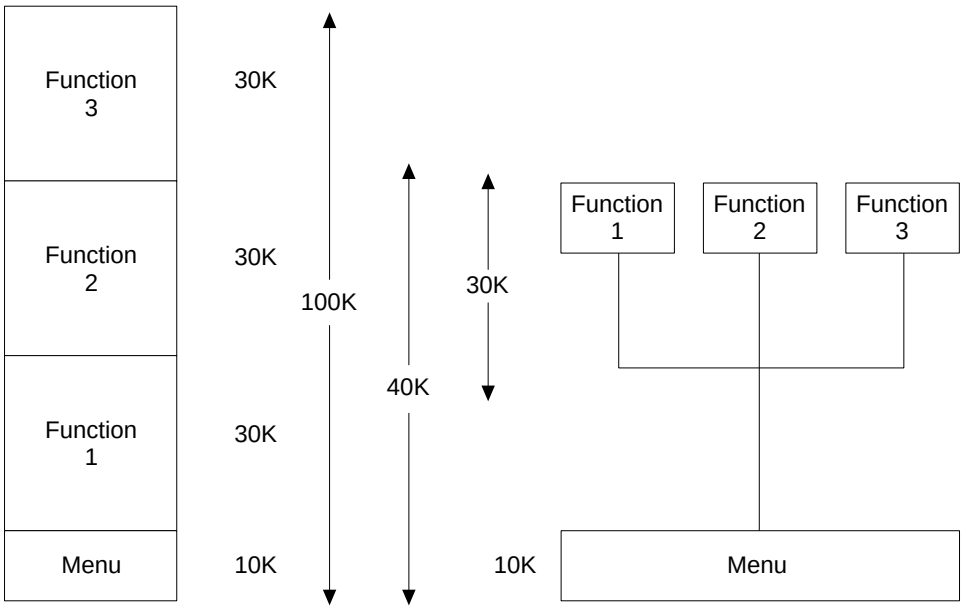


Figure 9-2. Using Overlays in a Large Program

You can also create nested overlays in the form of a tree structure. Figure 9-3 shows a tree structure overlay.

The top of the highest overlay determines the total amount of memory required. In Figure 9-3, the highest overlay is SUB4. This overlay requires substantially less memory than would be required if all the functions and subfunctions were to reside in memory simultaneously.

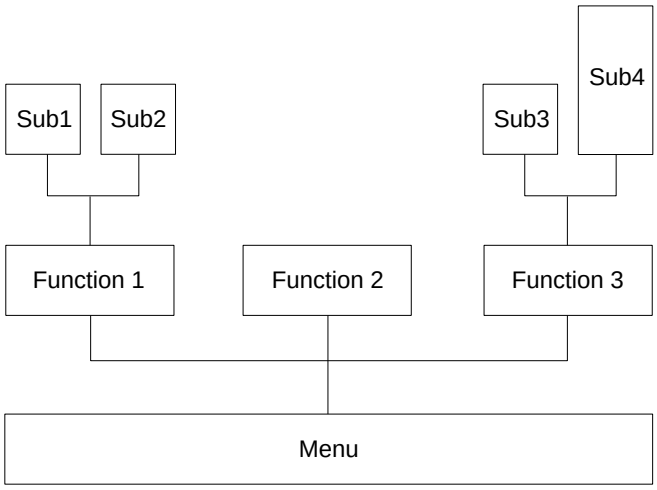


Figure 9-3. Tree Structure of Overlays

Overlay Command Line Syntax

You specify overlays in the LINK86 command line by enclosing each overlay specification in parentheses.

You can specify an overlay in one of the following formats, where ROOT.OBJ is the object file that calls the overlays:

```
A:>LINK86 ROOT (OVERLAY1)
A:>LINK86 ROOT (OVERLAY1,PART2,PART3)
A:>LINK86 ROOT (OVERLAY1=PART1,PART2,PART3)
```

- The first form produces the files ROOT.286 and OVERLAY1.OVR from ROOT.OBJ and OVERLAY1.OBJ.
- The second form produces the files ROOT.286 and OVERLAY1.OVR from ROOT.OBJ, OVERLAY1.OBJ, PART2.OBJ, and PART3.OBJ.
- The third form produces the files ROOT.286 and OVERLAY1.OVR from ROOT.OBJ, PART1.OBJ, PART2.OBJ, and PART3.OBJ.

On the command line, a left parenthesis indicates the start of a new overlay specification and the end of the previous overlay specification. You can use spaces to improve readability, and commas can separate parts of a single overlay. However, do not use commas to separate the overlay specifications from the root module or from each other.

In the following example, the command line is not valid:

```
A:>LINK86 ROOT(OVERLAY1),MOREROOT
```

The correct command line is:

```
A:>LINK86 ROOT,MOREROOT(OVERLAY1)
```

To nest overlays, you must specify them in the command line with nested parentheses.

In the following example, the command line creates the overlay system shown in Figure 9-3:

```
A:>LINK86 MENU(FUNC1(SUB1)(SUB2))(FUNC2)(FUNC3(SUB3)(SUB4))
```

When linking files to be overlayed along with files not to be overlayed, the files to be overlayed are specified last. When you create the file ROOT.286 from the files ROOT.OBJ, PARTA.OBJ, and PARTB.OBJ, to link OVER1.OBJ and OVER2.OBJ as overlays, enter the following command line:

```
A:>LINK86 ROOT,PARTA,PARTB(OVER1, OVER2)
```

The POSTLINK Utility

The POSTLINK Utility is a postprocessor program that converts a LINK86 load module into a module that can be loaded faster and use memory more efficiently in a multitasking environment. Using POSTLINK is mandatory for all load modules that have been linked with the CODESHARED option.

When POSTLINK is invoked, a temporary file called FILENAME.PST is created. When POSTLINK has completed converting the LINK86 load module into a new load module, the temporary file is erased.

Notes:

1. The POSTLINK Utility must not be used on overlay files or the root module of an overlay file.
2. A Postlinked load module that contains large unreferenced object modules can cause unpredictable results when loaded on a 4683 point-of-sale terminal.

Invoking the POSTLINK Utility

You invoke the POSTLINK Utility with the following command line format:

```
POSTLINK filespec
```

filespec is a file specification of a load module consisting of an optional path specification and a filename with an extension.

The output file has the same filespec as the input file.

```
A:>POSTLINK C:\LOADMODS\TEST.286
```

Use of ERRORLEVEL Test

When running the POSTLINK Utility from a batch file, the POSTLINK operation can be tested for errors. If POSTLINK is successful, an ERRORLEVEL value of zero is returned. To test for an error, use the batch file statement IF ERRORLEVEL 1...

The following is an example within a batch file:

```
POSTLINK TEST.286
IF ERRORLEVEL 1 ECHO  We have a problem >> RESULTS
```

In the above example, if the POSTLINK is unsuccessful the message “We have a problem” is written to the file RESULTS.

Chapter 10. Using the Print Spooler Utility

The IBM 4690 Operating System has a Print Spooler Facility that allows you to send your files to one of eight queues for printing on one of eight printers. This spooling facility can be shared by concurrently executing applications.

System configuration allows a maximum of eight printers to be defined. Printers are assigned numbers (PRN1: through PRN8:) at configuration time. An application program uses this number to gain access to a particular printer. An application can gain access to the printer assigned to the console the application is running on by using the printer name PRN:.

One of the printers (PRN1: through PRN8:) can also be defined as the system printer. Any application can access the system printer using PRN0:.

Note: By using the application service ADXSERVE, applications can determine the printer assigned to the console it is running on.

Your application must open the printer in UNLOCKED mode. This mode allows multiple applications to use the printer. The printer must be closed before printing can be scheduled. You can use either CLOSE or TCLOSE. CLOSE releases the application from all control of the file; TCLOSE allows limited control.

If your application uses TCLOSE, the application can receive job or printer status information. The TCLOSE is performed when the application completes sending data to the print spooler. The file is then scheduled for print. The print spooler allows only reading of a job's status. If the application decides some action needs to be taken, it can issue special commands to perform the action on a print job or queue. See "Using Special Commands" on page 10-3 for more information on these special commands.

The job status is obtained by the application performing a read after a TCLOSE. The spooler returns job and queue status as detailed in the next section. Special commands are issued by performing a WRITE FORM with a string of characters representing the desired command.

Obtaining Job Status after a TCLOSE

To obtain a job's status, your application must perform a read with a buffer capable of holding at least 16 characters. The spooler places the job's status in the buffer.

The first seven characters in the buffer correspond to specific events.

If any of these seven characters is occupied by a space, that particular event did not occur since the last read was performed. An event that has occurred since the last read is marked by an asterisk. The characters indicate the following events:

- Character 0

  Job completed. The job has been entirely despooled to the printer and removed from the system.
- Character 1

  Job canceled. The job was removed from the system before it could be printed. The user either canceled that particular job or an authorized user purged an entire print queue.

- Character 2

  Printer held. A hold command has been issued, and no jobs are currently being despooled from that particular queue. When an activate command is issued, the job currently at the top of the queue will start over.
- Character 3

  Printer error. The printer has detected an error in printing. This does not include errors such as out-of-paper, powered-OFF, and so on.
- Character 4

  Out-of-Paper. The printer has run out of paper and is currently waiting.
- Character 5

  Printer timeout. The printer has taken too long to give the “go ahead” signal.
- Character 6

  Printer powered-OFF. The printer lost power. This event is serious because it involves a loss of data.

The last nine characters are used as follows:

- Character 7

  Indicates the printer the job was queued for. This value is a number 1 through 8. If the job is being held (not the queue), this character is an asterisk.
- Characters 8 through 10

  Indicate the job’s current position for printing. ‘000’ indicates the job is currently being despooled to the printer.
- Characters 11 through 13

  Indicate the job’s current job ID.
- Characters 14 and 15

  Are carriage return and line feed characters, which indicate the end of the record.

The only error that is returned from a read is an implementation error. (This type of error is defined in “Error Return Codes for the Print Spooler” on page 10-5.) This error is returned if a read is attempted and the job has not been closed using TCLOSE.

Issuing a Command to the Print Spooler

Following a TCLOSE, an application can issue a special command that will affect a job or a queue. Special commands are issued by writing all necessary data to perform the action.

The format for these special commands is the following (number in parentheses is the number of characters for that variable):

command(2),*jobid*(3),*source*(1),*destination*(1),*node*(8),

where:

command =

PJ = Move priority job to top of queue.
TJ = Transfer job to another queue.
CJ = Cancel the job.
HJ = Hold the job.
AJ = Activate the job.
HQ = Hold the queue.
AQ = Activate the queue.
LQ = Load the queue following an IPL.
TQ = Transfer a queue.
RQ = Resume a queue after previous transfer.
CQ = Cancel a queue.

jobid = The three-character variable indicates the job to be affected (commands ending with a J). Default job is the job corresponding to this OPEN.

source = The one-character variable indicating the queue to be affected (commands ending with a Q). Valid values are 1 to 8. Default queue is the one corresponding to this OPEN.

destination = The queue to receive jobs (commands TJ and TQ). Valid values are 1 to 8. This variable has no default.

node = Eight-character variable used for commands TJ and TQ. If the destination printer is across the network, this variable supplies the node name.

All parameters are optional depending on the command and whether or not a default exists. A delimiting comma must replace each parameter not entered. For example, if an application wanted to terminate one of its own jobs, the following command would terminate job 001 corresponding to the I/O session number used:

```
CJ,001,,,
```

The following command transfers all current and future files for PRN1: to PRN3:.

```
TQ,,1,3,,
```

The following command results in job 073 being transferred to the PRN5: printer at node DD (if such a printer exists).

```
TJ,073,,5,ADXLXDDN
```

This command cancels all jobs currently queued (and not being held) for PRN4:.

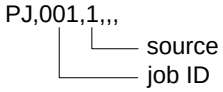
```
CQ,,4,,,
```

Using Special Commands

The following nine special commands are available to applications that have performed a TCLOSE:

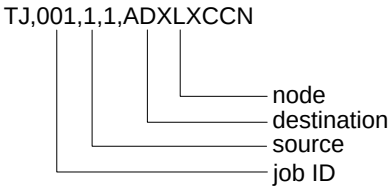
- PJ (Move priority job to top of queue)

  An application can perform this operation on a job that is currently queued (but not being held). This command moves the job to the position immediately following the current job in whatever queue it is residing. If the job is currently printing or will be the next to print, the operation completes successfully. Possible errors returned from this operation include Job Does Not Exist and Queue Full.



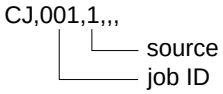
- TJ (Transfer job to another queue)

  An application can perform this operation on any job that has been scheduled to print, regardless of whether it is currently queued or being held. The command moves the job from wherever it is to the destination printer specified and queues it for that printer. Therefore a job could be moved from one queue to another or activated with this command. The destination printer might be across the network as long as a proper node and printer are specified. Network moves are done by writing the job's file across the network. Non-network moves are done by simply moving the job's record from one queue to another. Network moves, therefore, take more time to complete than a non-network move.



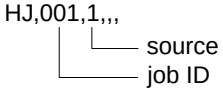
- CJ (Cancel a job)

  This operation may be carried out on any job scheduled to print, regardless of whether it is currently queued or being held. The job entry will be deleted from the appropriate queue and the job's file will be erased. No recovery is possible.



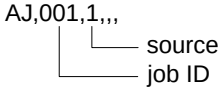
- HJ (Hold a job)

  Any job which is currently queued may be placed on hold. If an attempt is made to place an already held job on hold, a successful return code is received. Jobs placed on hold will be held indefinitely. However, a limit of 32 held jobs exists. Any attempt to hold more than this will receive a queue full error.



- AJ (Activate a job)

  This command can be used on any held job. It will be activated in the queue from which it was held. If an alternate queue is desired, then the move command should be used.

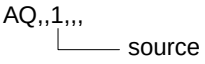


- HQ (Hold the queue)

  To hold all jobs scheduled to print, issue the HQ command. This command places the queue on hold indefinitely.

- AQ (Activate a held queue)

  This command allows a held print queue to resume printing the jobs.



- LQ (Load a queue)

This command is used only in the special instance where an IPL has occurred. If the spooler detects unfinished jobs in a queue after an IPL, it enters recovery mode. In this mode, no affected queues are restarted until a load queue command is given. However, a queue is automatically restarted after an IPL if it is sent a new job to queue.

```
LQ,,1,,,
      └──── source
```

Note: Only an authorized user with an access of Group 2 - User 1 or higher can perform the following commands (transfer, resume, and cancel queue).

- TQ (Transfer a queue)

  When a printer needs to be taken offline, it is possible to transfer all of its jobs to an alternate printer. This alternate printer must be within the system or within the network. Transfers within the system are checked for situations where, for example, PRN2: is redirected to PRN1: and PRN1: is redirected to PRN2:. Transfers across the network are not checked, and it is the user's responsibility to prevent a loop. All transfers remain active.

```
TQ,,1,1,ADXLXCCN
   │ │ │       │
   │ │ │       └──── node
   │ │ └──────────── destination
   │ └────────────── source
```

- RQ (Resume a queue)

  After a printer has been transferred, you can place it back online using this command.

  To ensure that the WRITE FORM statement goes to the correct print spooler driver, open the device SPRN1: on the controller that the application is running. Otherwise, if your PRN1: is transferred to another controller your WRITE FORM might receive an implement error (80894009).

```
RQ,,1,,,
      └──── source
```

- CQ (Cancel all the jobs in a queue)

  Use this command if you need to cancel all of the jobs scheduled to print on a particular printer. All jobs currently queued for the specified printer are removed from the queue and their corresponding files deleted. Jobs that have been held from this queue will not be affected.

```
CQ,,1,,,
      └──── source
```

Error Return Codes for the Print Spooler

If a write of a special command is attempted before a TCLOSE has been performed, no error is returned. The command is treated like print data and is spooled with all other data.

If a proper special command is written to the spooler following a TCLOSE, the following error return codes are possible:

- JOB HELD (80890006)

  For a PJ command, this means the job is not in a queue and needs to be activated first. For an HJ command, it means that because of a system failure, the held job has no printer associated with it and to be activated, a transfer command needs to be used.
- NOJOB (80890002)

  The job ID specified is not currently in use in the system (the job was finished or canceled).
- LOOP (80890003)

The requested redirection would result in a loop because of previous transfers.

- QUEUEFULL (80890004)

  The requested action could not be completed because of a full queue.
- AUTHORIZE (80890005)

  The requested action is not possible because the requestor is not operating under a group-user that allows such actions.
- IMPLEMENT (80894009)

  A command is either missing a required parameter, contains a parameter that is not valid, or was issued by an unauthorized user.

In addition, any errors that might result from trying to open a printer can also be returned (when performing a network move or a network redirection.)

When an error occurs, the print spooler handles each of the printer errors in the same way. If any other action is desired, you must initiate it.

When the spooler detects an error, it sets up a timer lasting 30 seconds. Upon completion of the timer, the spooler resumes where it left off and continues trying to send data to the printer. For the timeout error, the print drivers handle the time. Therefore, the spooler does not start a timer; it continues trying to send data.

The type of reaction to these errors should depend on how serious a situation is considered to be. While timeout and paper out do not cause the loss of data and might not be a serious error, a printer error can cause the loss of data, which can be serious.

If an application detects these errors, a reasonable response would be to print a message for you indicating something is wrong. If the error involves certain data loss, it would even be reasonable to issue a command to hold the queue. A hold causes the current job to be restarted from the beginning when the queue is activated thus ensuring it is printed in its entirety.

However, if the printer is connected through serial interface, many (possibly all, depending on the interface and communication scheme) of the errors are detectable only as timeout errors. Therefore, there would be no way to distinguish between the errors.

Note: If the same application is to perform both reads and writes of a special command after TCLOSE, the reads and writes must be performed under different I/O session numbers.

Chapter 11. Using the Disk Surface Analysis Utility

Introduction to the Disk Surface Analysis Utility

The Disk Surface Analysis Utility is designed to minimize the disruption to the store while recovering from disk surface failures. Previously, the procedure used for recovering from fixed disk surface failure involved manually formatting or replacing the fixed disk. The 4690 Operating System and other data would have to be reloaded on the new fixed disk.

Using the Disk Surface Analysis Utility allows you to recover from surface failures by replacing only the data affected by the surface failure. You do not need to replace or format the fixed disk. If host communications are available, an operator can perform the disk surface analysis remotely at the host site.

The IPL Command Processor provides the capability to execute a sequence of commands during the store controller IPL. The IPL Command Processor is necessary to start the Disk Surface Analysis Utility from the host.

IPL Command Processor

The IPL Command Processor executes commands at three separate times in the IPL sequence. The commands are located in the command file ADXILI0F.DAT, in the subdirectory ADX_SDT1. You must create the command file. Each command must have a time frame indicator to specify when the processor should invoke the command. This is necessary because certain commands can be performed only at specified times during the IPL sequence.

Table 11-1. Using Time Frame Indicators

Time Frame Indicator	Description
1	Commands that the IPL Command Processor processes early in the IPL sequence occur before the creation of the operator console facility (OCF) error logging process. Commands executed at this point can gain exclusive access to the disk. LAN (MCF Network) and error logging (ADXERROR) services are not available.
2	Commands that the IPL Command Processor processes in the middle of the IPL sequence occur after the installation of the LAN drivers and before the installation of Data Distribution. Primitive LAN services are available, but Data Distribution is not active to prevent operations on image files. File updates are not distributed. Image versions of distributed files can be updated, renamed, and erased. The operating system does not resolve discrepancies automatically. Prime versions of distributed files can be updated, renamed, and erased, although these changes are not performed on the corresponding image files. Disk repair procedures require changes to the image file, but the changes can cause damage if not used carefully. The user is responsible for the results of all file updates made during time frame 2. Only files that are defective and have been repaired by the Disk Surface Analysis Utility should be modified during time frame 2. Error logging services (ADXERROR) are not available during time frame 2.
3	Commands that the IPL Command Processor processes late in the IPL sequence occur after most drivers and services have been initialized. However, ADXSERVE, ADXSTART, and ADXERROR are not available. At each of the three time frames, the IPL Command Processor executes the commands for that phase in the order that they appear in the command file. The only control structure provided by the IPL Command Processor is the Exit On Error option (-x). If a command that has been prefaced by the Exit on Error option ends in an error, the IPL Command Processor executes no other commands for the remainder of the IPL sequence. An error is a non-zero return code. Each command appears on the screen as it is being executed. Output on the display for each command is redirected to a temporary RAM disk work file. This allows the command to have exclusive access to the disk. The work file is copied to the output file (ADXNS*xx*F.DAT) in subdirectory ADX_SDT1. The *xx* represents the node ID. If the output file already exists, the work file is appended to the existing output file. Each command name and return code is saved and logged when the OCF logging function becomes active. After the last command in the command file has been processed, the local output file is appended to ADXNS*xx*F.DAT in subdirectory ADX_SDT1 on the Acting Master Controller. The local output file is deleted when the Master store controller receives a copy of the output file.

The IPL Command Processor assumes that each command in the command file is the name of a .286 file and executes it directly. Therefore, you cannot specify shell commands, such as ERASE, directly in the command file. To execute shell commands from the command file, you must specify command.286 with the command specified as an argument. The -c option must be present between “command” and the argument.

For example:

```
-3 command -c erase junk.dat
```

The above command erases the file JUNK.DAT. The return code for an internal command is not logged because the shell actually executes it. The return code that is logged represents the return code from the execution of command.286. The following is a list of shell commands:

ASSIGN DVRUNIT
DEFINE DVRUNLK
ERASE MKDIR
DVRLINK RMDIR
DVRLOAD SECURITY

For more information on these commands, refer to the *4690 Store System: User’s Guide*.

To allow Data Distribution to update the command file in place on the disk, the attributes must be a compound, Distribute Per Update. Each command in the command file may be prefaced by a node identifier which allows each store controller on a LAN (MCF Network) to be customized. Each command must be on a separate line and ended by ASCII carriage return and line feed characters.

There are three options that may precede the command. Each option should begin with the switch character (-). The options are:

1. The Exit On Error option: -x
2. A time frame indicator: -1, -2, or -3. The default indicator is -3.
3. A node indicator: -nXX. XX is the two-character node ID. The default is the local node ID.

Note: Each command must be entered on one line. The commands must not be split between lines.

Example of a Command File

In the example that follows, the first four commands are executed on controller DD only. USERAP1 and USERAP2 are executed on all store controllers.

```
-nDD -1 chkdsk   c:
-nDD -1 adxcsw0l c: -f
-nDD -2 rename   c:\adx_spgm\adxrt1sl.286 c:\adx_sdt1\adxrt1sl.bad
-nDD -2 copy     c:\adx_sdt1\adxxxxx1.286 c:\adx_spgm\adxrt1sl.286
-3 c:\adx_upgm\userap1
-3 c:\adx_upgm\userap2
```

Note: If a command fails to terminate, you can abruptly end the command and the IPL Command Processor by pressing the **F1** key while the command is displayed. The IPL completes. However, when you press the **F1** key, no other IPL Command Processor commands are processed during the IPL. The message recorded in the System Log indicates that you ended the command by pressing the **F1** key.

Disk Surface Analysis Utility

The Disk Surface Analysis Utility performs a surface analysis on a fixed disk. The utility can also relocate files away from areas containing surface defects on the fixed disk. The defective surface areas are marked in the file allocation table to prevent future access to these areas. If the defective area is allocated to a file, some data is lost. To replace the damaged file, you must copy the data from another source.

For each defective surface area, ADXCSW0L reports the file name or subdirectory name that is allocated in the defective disk space. Unallocated areas with surface defects are also reported.

You can use the following formats to invoke the Disk Surface Analysis Utility. These formats are explained in “Command Formats for ADXCSW0L” on page 11-4.

- ADXCSW0L drive:
- ADXCSW0L drive:\filename.filetype
- ADXCSW0L drive: -parameters
- ADXCSW0L drive:\filename.filetype -parameters

Subdirectories are reported as being defective, but are not fixed. Information appears that includes the defective cluster number, the subdirectory name, and a brief message indicating that the correction has not been performed.

After invoking a Disk Surface Analysis Utility command, two sections of information appear. The first section displays the defective cluster information. The information can be a sector number specified by a user or reported by the utility. The surface analysis information includes the following:

- Defective cluster number
- The status of the disk space
  - Allocated
  - Unallocated
- Cylinder head sector address
- Relative sector number
- Error code (returned during the read-verify of the sector)

Note: When the sector parameter (-R) is specified, the information appears regardless of the error code. See “Parameter Descriptions for ADXCSW0L” on page 11-4 for more information on the sector parameter.

The second part of the report lists the file names that are relocated. The following information is displayed:

- New cluster number that contains the recovered data
- The defective cluster number that was replaced
- The name of the file
- The offset and size of the data area that was defective

You can invoke the Disk Surface Analysis Utility without the -F parameter to report the current defects and changes that have been made.

Parameter Descriptions for ADXCSW0L

Descriptions of the parameters provided with the ADXCSW0L routine are listed below.

-R Allows you to specify a defective sector on a fixed disk. It is referred to as the sector parameter. This parameter must be followed by a decimal or hexadecimal (prefixed by 0X) number, which represents a relative sector number. The first sector on a fixed disk is the relative sector number 0. ADXCSW0L assumes that the disk sector that is specified by the -R parameter is defective. The cluster corresponding to the specified sector is marked defective in the file allocation table. The data is copied to a new area on the disk when the -F parameter is specified.

Note: If you do not know if the sector is defective, invoke the utility without the -F parameter. All information about the sector is printed. The data remains in place.

-F Allows you to make repairs. If you do not specify this parameter, the information is listed, but not corrected. Unallocated areas with surface defects are marked defective in the file allocation table. Each cluster that is allocated to a file that contains defective sectors is remapped to another cluster. The former cluster is marked defective in the file allocation table. The data is read into the new cluster, and the sectors that cannot be read are replaced with fill data. The default fill character is 0x2E.

Note: The file allocation table and the root directory cannot be remapped. Errors within these areas can be reported, but cannot be corrected.

-C Allows you to specify the fill character to replace the unreadable sectors in a file. The -C parameter can override the default fill character.

Command Formats for ADXCSW0L

ADXCSW0L *drive*: performs a surface analysis of the entire disk drive. All surface defects that are not flagged in the FAT are reported, and the information on the repaired files is displayed. If the -F parameter was specified, the default character `X'2E'` is used when the data is recovered from the defective area of the fixed disk.

Note: If the -F parameter is not specified, a message is displayed on the screen that indicates defects are reported but not corrected.

Example 1: The following command scans the entire C: drive. Surface defects are listed but not corrected. The output report is listed below the command.

```
C>ADXCSW0L C:
    Surface defects are reported but not fixed.

    Attempting to recover C:

    ****************************
    ****   Surface Defects  ****
    ****************************

    Cluster Number:            0032
    Status:                    Allocated
    Cylinder:                  4
    Head:                      1
    Sector:                    8
    Relative Sector Number:    16c
    Error Code:                86210004

    ****************************
    ****   Files Repaired   ****
    ****************************

    Cluster Number:           0033
    Replaces Cluster Number:   0032
    File Name:                C:\TEST1.DAT
    Lost Data Offset:         Lost Data Size:
    3500                      0200
```

ADXCSW0L *drive:\filename.filetype* performs a surface analysis on the disk space occupied by the specified file. If an error is located, the defect is reported. The fill character defaults to X'2E'.

Note: The correction is made if the -F parameter is specified.

Example 2: The following command recovers the file TEST2.DAT on the D: drive. Surface defects are reported but not corrected. The output report is listed below the command.

```
C>ADXCSW0L D:\TEST2.DAT
    Surface defects are reported but not fixed.

    Attempting to recover D:\TEST2.DAT

    ****************************
    ****   Surface Defects  ****
    ****************************

    Cluster Number:            0946
    Status:                    Allocated
    Cylinder:                  071
    Head:                      03
    Sector:                    06
    Relative Sector Number:    25BD
    Error Code:                86210004
```

```
    ***************************
    ****   Files Repaired   ****
    ***************************

    Cluster Number:            0033
    Replaces Cluster Number:   0946
    File Name:                 C:\TEST2.DAT
    Lost Data Offset:          Lost Data Size
    3500                             0200
```

ADXCSW0L *drive: -parameters* allows any combination of the parameters. However, a sector number cannot be specified when a file name is specified.

Example 3: In this example, the command uses the sector parameter, the fill character parameter, and the -F parameter. The specified sector parameter is assumed to be defective. All of the data on the defective sector is relocated. The specified fill character is used in the reallocated disk space. All changes are written to the disk because the -F parameter is issued. The output report is listed after the command.

```
C>ADXCSW0L D: -R0x25D1 -C0x3D -F
    Attempting to recover D:

    With specified sector number 25D1.

    Information on specified bad sector:
    Cluster Number:              094B
    Status:                      Allocated
    Cylinder:                    071
    Head:                        04
    Sector:                      09
    Relative Sector Number:      25D1
    Error Code:                  86210004

    ***************************
    ****   Files Repaired   ****
    ***************************
    Cluster Number:            0950
    Replaces Bad Customer:     094B
    File Name:                 TEST3.DAT
    Lost Data Offset:          Lost Data Sizes
    1800                             200
```

ADXCSW0L *drive:\filespec -parameters* performs a surface analysis on a specified file name to be specified along with the parameters. However, only the fill character and the fix parameters are allowed with the file name. The sector parameter -R is not allowed. A message appears if the -R is included in the command.

Example 4: The following command recovers the file TEST4.DAT on the D: drive. The -F and -C parameters allow the surface defect areas to be corrected and filled with the fill character 0x4A. The output report is listed below the command.

```
ADXCSW0L D:\TEST4.DAT -C0x4A -F
    Attempting to recover D:\TEST4.DAT
```

```
**************************
****  Surface Defects  ****
**************************

Cluster Number:           0947
Status:                   Allocated
Cylinder:                 071
Head:                     03
Sector:                   09
Relative Sector Number:   25C0
Error Code:               86210004

**************************
****   Files Repaired   ****
**************************

Cluster Number:           0046
Replaces Cluster Number:  0947
File Name:                C:\TEST4.DAT
Lost Data Offset:         Lost Data Sizes
2600                            0200
```

Using the Disk Surface Analysis Utility to Recover Data

Use the Disk Surface Analysis Utility to locate surface defects and to mark them defective in the FAT. Data may be moved if necessary. This process prevents future access to the defective areas on the fixed disk. If the defective area is within a file, some data is lost. Replace the damaged file by copying the file from another source.

The store controller might dump, or a power line disturbance might occur during an IPL. The command file should be organized so that problems are not caused by running the same command multiple times. For more information on command files, see “Example of a Command File” on page 11-3.

To ensure that the command file executes only one time, place an ERASE command at the end of the command file. Perform the erase at time frame 3 to distribute the request.

If you use RCP to re-IPL, and you configure it to start at each IPL as a background application, the IPL Command Processor command file ADXILI0F.DAT should contain a time frame 3 command to erase the RCP selection file ADXCSHCF.DAT. The ERASE command prevents a store controller IPL loop.

If a surface defect prevents the IPL of a store controller, or if host communications cannot be established, the Disk Surface Analysis Utility can be invoked from the supplemental diskettes. You can use the disk rebuild function to obtain specific replacement files from another store controller on the LAN (MCF Network). In a non-LAN environment, you must obtain the replacement files from a diskette or tape.

The following steps explain how to use the Disk Surface Analysis Utility for disk recovery.

Note: You can omit steps 1 through 3—which contain the initial disk analysis command, re-IPL, and report sequence—if you know a particular file is damaged (for example, an error message has been logged on a file).

1. Transfer the command file containing the ADXCSW0L command from the host. The command requests that the Disk Surface Analysis Utility be started on the store controller's fixed disk.
2. IPL the store controller manually or by using the RCP re-IPL command. Refer to the *IBM 4690 Store System: Communications Programming Reference* for more information.
3. The store controller generates the utility's output report, and the host retrieves it. The report indicates fixed disk areas that are defective.
4. Send a new command file to the store controller containing the following commands:
   - Disk Surface Analysis Utility command using the -F parameter.
   - ERASE or RENAME command of files containing surface defects. You can use the RENAME command to save a copy of the file that contains unreadable data replaced by fill characters.
   - COPY command for each file with surface defects from any store controller on the LAN. If the store controller is not on a LAN, the file can be transmitted from the host.
5. IPL the store controller and the repairs are performed.
6. The store controller generates a second output report at the store controller, and the host retrieves it to verify the changes.
7. Send a default (empty) command file to the store.

Note: To ensure that a command file can be transmitted to the store after a surface defect appears, you can send a default command file containing zeros or blanks equaling the maximum number of commands that you need. Use the HCP LOAD FILE command or the RCMS SEND command to overwrite the existing file with the new command file.

Using the Time Frame Indicators

As part of the disk recovery procedure, you must execute some commands within a specified time frame. The time frame default is -3. For example:

CHKDSK	-1
ADXCSW0L	-1
RENAME	-2
COPY	-2
COMMAND -c ERASE	-2

RENAME and COPY are executed within time frame -2, so the operation is not distributed. If a RENAME, COPY, or ERASE in the command file is to be distributed, the command should be preceded by -3.

You should use time frame -1 only for executing CHKDSK and the Disk Surface Analysis Utility. Use time frame -2 only for renaming, erasing, or copying to files that have been repaired by the Disk Surface Analysis Utility.

Case Examples of Disk Recovery

This section describes some example scenarios and disk recovery procedures. In an actual situation, multiple files can be affected, a situation which would require you to develop a recovery procedure. However, in these examples, only one file is affected by a surface defect.

Non-LAN (MCF Network), Defect in .286 File

Symptom: A user in a non-LAN environment cannot execute the Format Dump Data Utility (ADXCSL0L.286).

The following messages were logged:

- A W754 B4/S004/E021 with RC=80210004 or RC=8021000D
- A W754 B4/S004/E018 with the file name: ADXCSL0L.286

Action:

1. Create the following command file at the host site and transmit it to the store as ADX_SDT1:ADXILI0F.DAT

   ```
   -1 adxcsw0l c:
   ```

2. Execute the following RCP command to re-IPL the store controller:

   ```
   adxcs20l N 13
   ```

3. Retrieve ADX_SDT1:ADXNSCCF.DAT (assumes store controller node is CC) from the store. Verify that the only file with a surface defect is ADXCSL0L.286.
4. Transmit a new copy of ADXCSL0L.286 to subdirectory ADX_SMNT.
5. Create the following command file at the host site and transmit it to the store as ADX_SDT1:ADXILI0F.DAT

   ```
   -x -1 adxcsw0l c: -f
   command -c erase ADX_SPGM:ADXCSL0L.286
   rename ADX_SMNT:ADXCSL0L.286 ADX_SPGM:ADXCSL0L.286
   ```

6. Execute the following RCP command to re-IPL the store controller:

   ```
   adxcs20l N 13
   ```

7. Retrieve ADX_SDT1:ADXNSCCF.DAT (assumes store controller node is CC) from the store. Verify that recovery was successful.
8. Transmit a copy of ADX_SDT1:ADXIIL0F.DAT, which contains no commands to the store.
9. Delete ADX_SDT1:ADXNSCCF.DAT.
10. If a different version of ADXCSL0L.286 was in the ADX_SMNT subdirectory prior to this recovery procedure, re-transmit that version to the store.

LAN (MCF Network), Defect in .286 File on Master Controller

Symptom: A user in a two-controller LAN store environment cannot execute the Format Dump Data Utility (ADXCSL0L.286) on the master store controller. The master is node CC and the alternate master is node DD.

The following return codes are logged:

- A W754 B4/S004/E021 with RC=80210004 or RC=8021000D
- A W754 B4/S004/E018 with file name: ADXCSL0L.286

Action:

1. Create the following command file at the host site and transmit it to the store as ADX_SDT1:ADXILI0F.DAT

   ```
   -1 -nCC adxcsw0l c:
   ```

2. Execute the following RCP command on the master store controller to re-IPL:

   ```
   adxcs20l N 13
   ```

3. Retrieve ADX_SDT1:ADXNSCCF.DAT from the store. Verify that the only file with a surface defect is ADXCSL0L.286.
4. Create the following command file at the host site and transmit it to the store as ADX_SDT1:ADXILI0F.DAT

   ```
   -ncc -x -1 adxcsw0l c: -f
   -ncc -2 copy adxlxddn::adx_spgm:adxcsL0L.286      gadx_sp m:adxcsL0L.286
   ```

5. Execute the following RCP command on the master store controller to re-IPL.

   ```
   adxcs20l N 13
   ```

6. Retrieve ADX_SDT1:ADXNSCCF.DAT from the store. Verify that recovery was successful.
7. Transmit a copy of ADX_SDT1:ADXILI0F.DAT that contains no commands to the store.
8. Delete ADX_SDT1:ADXNSCFF.DAT.

LAN (MCF Network), Defect in .286 File on Alternate Master Controller

Symptom:

A user in a two-controller LAN environment cannot execute the Format Dump Data Utility (ADXCSL0L.286) on the alternate master. The master is node CC and the alternate master is node DD.

The following return codes are logged:

- A W754 B4/S004/E021 with RC=80210004 or RC=8021000D
- A W754 B4/S004/E018 with file name: ADXCSL0L.286

Action:

1. Create the following command file at the host site and transmit it to the store as ADX_SDT1:ADXILI0F.DAT

   ```
   -1 -ndd adxcsw0l c:
   ```

2. Execute the following RCP command to re-IPL the alternate master.

   ```
   dd::adxcs20l N 13
   ```

3. Retrieve ADX_SDT1:ADXNSDDF.DAT from the store. Verify that the only file with a surface defect is ADXCSL0L.286.
4. Create the following command file at the host site and transmit it to the store as ADX_SDT1:ADXILI0F.DAT

   ```
   -ndd -x -1 adxcsw0l c: -f
   -ndd -2 copy adxlxccn::adx_spgm:adxcsL0L.286      gadx_sp m:adxcsL0L.286
   ```

5. Execute the following RCP command to re-IPL the alternate master.

   ```
   dd::adxcs20l N 13
   ```

6. Retrieve ADX_SDT1:ADXNSDDF.DAT from the store. Verify that recovery was successful.
7. Transmit a copy of ADX_SDT1:ADXILI0F.DAT that contains no commands to the store.
8. Delete ADX_DST1:ADXNSDDF.DAT.

Non-LAN (MCF Network), Defect in Unallocated Space

Symptom: A user in a non-LAN environment cannot transmit a file from the host to the store. The problem could be caused by an unallocated area of the disk that contains a surface defect. Assume that the store controller node is CC.

The following return codes are logged:

- W754 B4/S004/E021 with RC=80210004 or RC=8021000D
- W754 B4/S004/E018 with the name of the file being transmitted

Action:

1. Create the following command file at the host site and transmit it to the store as ADX_SDT1:ADXILI0F.DAT

   ```
   -1 adxcsw0l c: -f
   ```

2. Execute the following RCP command to re-IPL the store controller:

   ```
   adxcs20l N 13
   ```

3. Retrieve ADX_SDT1:ADXNSCFF.DAT from the store. Verify that recovery was successful. The error is associated with an allocated cluster of the transmitted file.
4. Transmit a copy of ADX_SDT1:ADXILI0F.DAT that contains no commands to the store.
5. Delete ADX_SDT1:ADXNSCCF.DAT.
6. Retransmit the original file to the store.

LAN (MCF Network), Defect in Unallocated Space on Master Controller

Symptom: A user in a two-controller LAN environment was unable to transmit a file from the host to the store. The symptom may be caused by an allocated area of the disk that contains a surface defect. The master is node CC and the alternate master is node DD.

The following return codes are received:

- A W754 B4/S004/E021 with RC=80210004 or RC=8021000D
- A W754 B4/S004/E018 with the name of the file being transmitted

Action:

1. Create the following command file at the host site and transmit it to the store as ADX_SDT1:ADXILI0F.DAT

   ```
   -1 -ncc adxcsw0l c: -f
   ```

2. Execute the following RCP command on the master to re-IPL it:

   ```
   adxcs20l N 13
   ```

3. Retrieve ADX_SDT1:ADXNSCCF.DAT from the store. Verify that the recovery was successful. The error is associated with an allocated cluster of the transmitted file.
4. Transmit a copy of ADX_SDT1:ADXILI0F.DAT that contains no commands to the store.
5. Delete ADX_SDT1:ADXNSCCF.DAT.
6. Retransmit the original file to the store.

LAN (MCF Network), Defect in Unallocated Space on Alternate Master Controller

Symptom: A two-controller LAN store environment cannot transmit a file from the host to the store. A Distribution Exception Log entry was logged for the file being transmitted at node DD. The master is node CC and the alternate master is node DD.

Message W754 B4/S004/E021 with RC=80210004 or RC=8021000D was logged at node DD.

Action:

1. Create the following command file at the host site and transmit it to the store as ADX_SDT1:ADXILI0F.DAT

   ```
   -1 -ndd adxcsw0l c: -f
   ```

2. Execute the following RCP command to re-IPL the alternate master:

   ```
   dd::adxcs20l N 13
   ```

3. Retrieve ADX_SDT1:ADXNSDDF.DAT from the store. Verify that the recovery was successful. The file that was transmitted from the host is reconciled during the IPL of the alternate master.
4. Transmit a copy of ADX_SDT1:ADXILI0F.DAT that contains no commands to the store.
5. Delete ADX_SDT1:ADXNSDDF.DAT.

Non-LAN (MCF Network), Defect in Item Record File

Symptom: The user is in a non-LAN environment. The item record file on the D: drive contains a defect.

The following errors were logged:

- W754 B4/S004/E021 with RC=80210004 or RC=8021000D
- W754 B4/S004/E018 with file name EALITEMR.DAT

Action:

1. Create the following command file at the host site and transmit it to the store as ADX_SDT1:ADXILI0F.DAT

   ```
   -1 adxcsw0l d:
   ```

2. Execute the following RCP command to re-IPL the store controller:

   ```
   adxcs20l N 13
   ```

3. Retrieve ADX_SDT1:ADXNSCCF.DAT (assumes store controller node is CC) from the store. Verify that the only file with a surface defect is EALITEMR.DAT.
4. Create the following command file at the host site and transmit it to the store as ADX_SDT1:ADXILI0F.DAT

   ```
   -1 adxcsw0l d: -f -c0
   ```

   Note: A fill character of binary 0 is recommended for use when recovering a keyed file.

5. Execute the following RCP command to re-IPL the store controller:

   ```
   adxcs20l N 13
   ```

6. Retrieve ADX_SDT1:ADXNSCCF.DAT (assumes store controller node is CC) from the store. Verify that recovery was successful.
7. Transmit a copy of ADX_SDT1:ADXILI0F.DAT that contains no commands to the store.

8. Delete ADX_SDT1:ADXNSCCF.DAT.
9. Use existing procedures to reload the item record file. Until this is done, attempts to access items that were present in the damaged section of the item record file fails.

LAN (MCF Network), Defect in Item Record File on Master Controller

Symptom: In a two-controller LAN environment, the master is node CC and the alternate master is node DD. The item record file is on the D: drive, which does not contain enough free space on the D: drive for a second copy of it.

The following return codes were logged against the item record file on the master:

- W754 B4/S004/E021 with RC=80210004 or RC=8021000D
- W754 B4/S004/E018 with file name: EALITEMR.DAT

Action:

1. Create the following command file at the host site and transmit it to the store as ADX_SDT1:ADXILI0F.DAT

   ```
   -ncc -1 adxcsw0l d:
   ```

2. Execute the following RCP command on the master to re-IPL it:

   ```
   adxcs20l N 13
   ```

3. Retrieve ADX_SDT1:ADXNSCCF.DAT from the store. Verify that the only file with a surface defect is EALITEMR.DAT.
4. Create the following command file at the host site and transmit it to the store as ADX_SDT1:ADXILI0F.DAT.

   ```
   -1 -ncc -x adxcsw0l d: -f -c0
   -2 -ncc command -c erase d:adx_idt1\ealitemr.dat
   -2 -ncc copy adxlxddn::d:\adx_idt1\ealitemr.dat       &d:\adx us.idt1\ealitemr.dat
   ```

5. Execute the following RCP command on the master to re-IPL it:

   ```
   adxcs20l N 13
   ```

6. Retrieve ADX_SDT1:ADXNSCCF.DAT from the store. Verify that recovery was successful.
7. Transmit a copy of ADX_SDT1:ADXILI0F.DAT that contains no commands to the store.
8. Delete ADX_SDT1:ADXNSCCF.DAT.

LAN (MCF Network), Defect in Item Record File on Alternate Master

Symptom: On a two-controller LAN store environment, W754 errors are periodically logged against the item record file on the alternate master. The master is node CC and the alternate master is node DD. The item record file is on the D: drive, and there is not sufficient free space on the D: drive for a second copy of it.

These return codes were logged:

- W754 B4/S004/E021 with RC=80210004 or RC=8021000D
- W754 B4/S004/E018 with file name: EALITEMR.DAT

Action:

1. Create the following command file at the host site and transmit it to the store as ADX_SDT1:ADXILI0F.DAT

```
-ndd -1 adxcsw0l d:
```

2. Execute the following RCP command to re-IPL the alternate master.

```
dd::adxcs20l N 13
```

3. Retrieve ADX_SDT1:ADXNSDDF.DAT from the store. Verify that the only file with a surface defect is EALITEMR.DAT.
4. Create the following command file at the host site and transmit it to the store as ADX_SDT1:ADXILI0F.DAT.

```
-1 -ndd -x adxcsw0l d: -f -c0
-2 -ndd command -c erase d:adx_idt1\ealitemr.dat
-2 -ndd copy adxlxccn::d:\adx_idt1\ealitemr.dat       &d:\adx us.idt1\ealitemr.dat
```

5. Execute the following RCP command to re-IPL the alternate master:

```
dd::adxcs20l N 13
```

6. Retrieve ADx_SDT1:ADXNSDDF.DAT from the store. Verify that the recovery was successful.
7. Transmit a copy of ADX_SDT1:ADXILI0F.DAT that contains no commands to the store.
8. Delete ADX_SDT1:ADXNSDDF.DAT.

Non-LAN (MCF Network), Defect Near End of TLOG

Symptom: This example is a variation of a previous example. In a non-LAN store environment, unallocated space is causing errors. The difference is that this problem occurs as the terminals attempt to write to the end of the transaction log.

The following errors were logged as the terminals attempt to write to the transaction log:

- W754 B4/S004/E021 with RC=80210004 or RC=8021000D
- W754 B4/S004/E018 with file name: EALTRANS.DAT

Action:

1. Create the following command file at the host site and transmit it to the store as ADX_SDT1:ADXILI0F.DAT

```
-1 adxcsw0l c: -f
```

2. Execute the following RCP command to re-IPL the store controller:

```
adxcs20l N 13
```

3. Retrieve ADX_SDT1:ADXNSCCF.DAT from the store. Verify that recovery was successful.
4. Transmit a copy of ADX_SDT1:ADXILI0F.DAT that contains no commands to the store.
5. Delete ADX_SDT1:ADXNSCCF.DAT.

LAN (MCF Network), Defect Near End of TLOG on File Server

Symptom: A store in a two-controller LAN environment cannot write data to the end of the transaction log because of a defect in unallocated space. The file server/master is CC and the alternate file server/alternate master is DD.

The following errors are logged as the terminals attempt to write to the transaction log:

- W754 B4/S004/E021 with RC=80210004 or RC=8021000D
- W754 B4/S004/E018 with file name: EALTRANS.DAT

Action:

1. Create the following command file at the host site and transmit it to the store as ADX_SDT1:ADXILI0F.DAT

   ```
   -1 -ncc adxcsw0l c: -f
   ```

2. Execute the following RCP command to re-IPL the file server:

   ```
   adxcs20l N 13
   ```

3. Retrieve ADX_SDT1:ADXNSCCF.DAT from the store. Verify that recovery was successful.
4. Transmit a copy of ADX_SDT1:ADXILI0F.DAT that contains no commands to the store.
5. Delete ADX_SDT1:ADXNSCCF.DAT.

LAN (MCF Network), Defect Near End of TLOG on Alternate File Server

Symptom: In a two-controller LAN environment, the file server node is CC and the alternate file server is DD. The Distribution Exception Log for the file server contains an entry for the transaction log.

The following errors were logged by the alternate file server:

- W754 B4/S004/E021 with RC=80210004 or RC=8021000D
- W754 B4/S004/E018 with file name: EALTRANS.DAT

Action:

1. Create the following command file at the host site and transmit it to the store as ADX_DST1:ADXILI0F.DAT

   ```
   -1 -ndd adxcsw0l c: -f
   ```

2. Execute the following RCP command to re-IPL the alternate file server:

   ```
   dd::adxcs20l N 13
   ```

3. Retrieve ADX_SDT1:ADXNSDDF.DAT from the store. Verify that the recovery was successful. Reconciliation should update the alternate file server with a current copy of the transaction log.
4. Transmit a copy of ADX_SDT1:ADXILI0F.DAT that contains no commands to the store.
5. Delete ADX_SDT1:ADXNSDDF.DAT.

Chapter 12. Using the Loop Status Application Utility

The Loop Status Application Utility provides the current status for all configured loop adapters on a 4690 Operating System.

The application initially displays status for the first primary or backup loop adapter found. If no primary or backup loop adapter is found, status for the first loop adapter appears in the controller running the Loop Status Application.

The application views each controller as having two loop adapters. If a loop adapter is not physically present, or is present but not configured, the application reports the adapter's configuration as "Not Used."

The following information is displayed for each loop adapter:

- The number of configured loop adapters on the system
- The controller ID and loop adapter number
- The terminal number that was last used to select this loop adapter
- The loop adapter configuration; for example, primary, backup, or not used
- For primary loops, whether Auto-Resume is configured
- The loop adapter status; for example, controlling loop, receiving backup, backup allowed, backup prevented, providing backup, or inactive
- The date, time, and terminal number for the last beacon received
- The last three system messages for this loop adapter

Use one of the following formats to invoke the Loop Status Application Utility:

Format:

ADXLAS0L

The default interval is 30 seconds.

Format:

ADXLAS0L -R*nnn*

where:

nnn = the number of seconds between automatic refreshes. Specifying a zero-seconds interval disables automatic refresh. The default interval is 30 seconds.

Format:

ADXLAS0L -*p*

where:

p = The number of seconds between refreshes of the report. The default interval is 30 seconds.

You can select loop adapters for status display by performing the following steps:

1. Press the **PgDn** key to view the next adapter.
2. Press the **PgUp** key to view the previous adapter.
3. Enter the controller ID and loop adapter number of the desired adapter.
4. Enter the terminal number of an active terminal.

Loop adapter status is checked at regular intervals and the status screen is automatically updated. You can also request the current status at any time by pressing the Refresh key (**F9**).

HELP information is available at any time by pressing the Help key (**F1**).

The following is an example of a LOOP STATUS screen:

```
                      L O O P   S T A T U S               Loop 3 of 4

 Controller/Loop:  CC/1             Configured:   Primary, Auto Resume

 Select Terminal:  016                  Status:   Controlling Loop

 Last Beacon:  09/09 12:06 Terminal 028

 ***************  System Messages for this Store Loop Adapter  ****************

  09/09 10:26 CC      2 W772 OPEN LOOP - BEACONING
                         B4/S008/E040
  09/09 10:26 CC      2 W761 LOOP IS OPERATIONAL
                         B5/S008/E039
  09/09 12:06 CC      2 W760 OPEN LOOP - TERMINAL 028 IS BEACONING
                         B4/S008/E036
 ****************************  End of Messages  (Newest)  ******************

 To select a loop:   Press Page Down for next loop  -OR-
                     Enter Controller/Loop number   -OR-
                     Enter Select Terminal

F1 HELP   F2   F3 QUIT   F4   F5   F6   F7   F8   F9 Refresh   F10
```

Chapter 13. Using the Staged IPL Utility

Requirements

This utility is useful only if you enable the Multiple Controller Feature and configure the controllers to allow backup. By only IPLing one controller at a time, the terminals automatically switch to an active controller. On most systems, the order can be chosen so that the terminals end up on their primary controller. Automatic resume may be necessary in some topographies, especially those that have two TCC adapters on different controllers that back each other up. See “Recommended Use” on page 13-5 for more information.

Capabilities

This section describes the capabilities of the Staged IPL Utility.

TCC Network Considerations

The main benefit of the Staged IPL Utility is that at least one controller is available at all times to run the terminals, provided that store controller backup is allowed. During utility execution, the terminals can switch controllers up to four times; each switch can cause an interruption of checkout lasting 6 to 10 seconds.

Applications Only

The Staged IPL utility can cause a dump IPL code loop if used for activating either the 4690 Operating System or LAN (MCF Network) because there is a brief time when both controllers are up and running different software levels of code. For this reason, the Staged IPL utility does not permit activation of either 4690 Operating System or LAN with the staged IPL.

Incompatible Software Levels

The same exposure of incompatible software levels exists for applications. You must test each application maintenance package on a test system using the Staged IPL Utility with a long wait time to assess the compatibility of the software levels. If there are changes in the file formats or message formats, you must consider what effect these would have during the brief time that both controllers are up and running different software levels of code.

If your test reveals that an incompatibility problem could result from running the LAN (MCF Network) at different software levels on each controller, you can minimize this exposure by taking the following precautions:

- Make the master store controller and file server the last node to IPL. Thus, the files that are open by the terminals continue to use the older level files until the terminals are ready to load. This arrangement prevents an incompatibility problem when terminal code has a corequisite change to controller code or data files.
- IPL the terminals immediately after they come on line with a controller that has activated the new maintenance, but only if an IPL of the terminals is necessary to load new terminal code. Use the TL parameter on the ADXCST0L command, not the disable terminal IPL function of the ADXSERVE command. If the terminals must be loaded, the TL parameter is recommended under any circumstances. If terminal code has a corequisite change to controller code or data files, avoid the disable terminal IPL function of the ADXSERVE command so that old terminal code does not try to interface with new controller code. If there is no corequisite change with controller code or data files, the disable terminal IPL function is recommended while cashiers are signed on. (See “Loading Terminal Storage” on page 13-7.)
- Minimize the wait time between controller IPLs so that the controllers do not have much time to communicate with each other. This prevents an incompatibility problem when controller code has a corequisite change to code or data files on another controller. However, this option is undesirable because of the time required for all of the background applications and runtimes to load. It may be necessary to set the wait time to zero seconds if the software levels are found to be incompatible. If you do so, any terminal request to the controller will take more time than usual because the request must compete with the loading of background applications and runtimes.

Note: These steps are unnecessary for most maintenance; they are only precautions you should follow when the software might be incompatible. Even then, it may not be necessary to follow all these suggestions. Use those that provide the most safety with the least inconvenience.

Application Interface

This section describes the application interfaces that you can use with the Staged IPL Utility.

Apply Software Maintenance

Before running the Apply Software Maintenance (ASM) Utility, run ADXCST0L with the NI RCP parameter to build the activation file, ADX_SPGM:ADXCSTAF.DAT. This file instructs the IPL code to activate maintenance upon the next IPL, but this procedure does not IPL the controllers. You can then IPL the controllers manually or use this utility to IPL each controller individually.

A dump or a power outage after you select NI and before the Staged IPL Utility runs can cause ASM to run prematurely during the IPL. That should not cause any problem except for a longer than normal IPL, which would cause terminals to be offline for a longer than normal period. You can minimize this window by running the Staged IPL Utility immediately after running ADXCST0L with the NI parameter.

The activation file created by running ADXCST0L with the “NI” parameter will always be erased by the Staged IPL Utility or by the IPL portion of Apply Software Maintenance. If the Staged IPL Utility does not complete successfully and must be restarted, you must also restart ADXCST0L.

RCP Command

The Staged IPL Utility is an RCP command named ADXCS50L, which is placed in the RCP command file, usually immediately following the ADXCST0L command.

Format:

ADXCS50L *i w t n n n...*

where:

i = The RCP status file reset indicator:

Y = Reset RCP status file before the command executes.
N = Do not reset RCP status file.

Note: Normally, this indicator is N because it usually runs after ADXCST0L. Also, you would not want to erase resulting messages from ADXCST0L.

w = Wait time. This indicator is the number of seconds to wait after the remote node comes up. The node is considered up by this utility after the IBM logo is first displayed on the controller, and the background applications have begun to load and start. The wait time should usually be the estimated amount of time it takes to load and start the background applications. The value must be between 0 and 2147483 (about 24 days). The value must not have a decimal point, comma, or minus sign.

t = Timeout value. This indicator is the number of minutes to wait for the remote node to come up. If the node does not come up within the number of minutes specified, this utility ends with an error message and attempts to cancel maintenance on the controllers that have already successfully

activated maintenance. The value must be between 10 and 35791 (about 24 days). The value must not have a decimal point, comma, or minus sign.

n = Node ID. The node IDs are sets of two-character designations for the controllers to be IPLed. The controllers are IPLed in the order of the node IDs specified with this command. If the controller on which this utility runs is on the list, it must be last. Otherwise, the IPL ends this utility and the subsequent nodes are not be IPLed.

Examples:

```
ADXCS50L N 300 120 DD CC
```

This example does not reset the RCP status file. It requests that controller DD be IPLed first. After controller DD comes up, wait 300 seconds (5 minutes) for the background applications to finish loading and then IPL controller CC. If DD does not come up within 120 minutes, do not IPL CC.

```
DD::ADXCS50L N 0 180 CC DD
```

This example does not reset the RCP status file. It requests that this utility be run on controller DD so that you can IPL controller CC first. After CC comes up, immediately IPL controller DD. If CC does not come up within 180 minutes, do not IPL DD.

Error Recovery

If any error is detected while IPLing the controllers, this utility does not IPL the remaining controllers. If a controller has already IPLed before the error is detected, this utility attempts to cancel the maintenance from all controllers that have successfully activated maintenance. To cancel maintenance, the activation must have been in test mode, and the controller must have come back up. If the error was a timeout waiting for a controller to IPL, the maintenance of that controller cannot be canceled, leaving the controllers at different software levels.

Some examples of errors that can stop the IPL sequence after controllers have already started IPLing are:

- A timeout waiting for the controller to complete the IPL. The timeout value is specified as a parameter.
- An error while activating maintenance during the IPL. The return code of the activation process is kept in a temporary file, ADX_SDT1:ADXCS5TF.DAT. This error is rare and would be accompanied by a W638 message in the System Event Log. If a W638 is logged, the activation of maintenance has failed and remains in the same state as before the attempt to activate maintenance. The new maintenance might be in the ADX?SMNT? subdirectory, depending on when the error occurred.
- The request to IPL could not be communicated to a remote controller for a reason other than not being active on the LAN (MCF Network).
- One of the controllers that has come up with the new software has dumped.

All progress and error messages are logged in the RCP status file on the acting master controller. If messages cannot be written to the acting master, which happens if it is not the last controller to IPL, messages are written to the local controller. Before this utility terminates, the messages are transferred to the acting master. If this transfer fails, the messages must be gathered from both the acting master and the local controller.

Recommended Use

This section provides some recommendations for using the Staged IPL Utility.

Test Mode: Activation of maintenance should be in test mode. This mode allows automatic cancelation of maintenance if anything goes wrong. If disk space is a concern, the maintenance can be accepted after the RCP status file has been checked to verify the successful completion of the IPLs. An acceptance of maintenance in test mode does not require an IPL of the controllers. If the RCP status file indicates that the controllers are now at different software levels, you must run an appropriate ADXCST0L command to direct the controllers to start running the same level of software.

Wait Time: Before using this utility in a live store, you should apply the maintenance to a test system using this utility with a very long wait time. Observe how well the system runs with the controllers at different software levels.

If the new software is highly compatible with the old software, the wait time should be about 300 seconds. This gives the applications time to load and open all of the necessary files. Some systems might take longer to load applications, depending on the number and complexity of the applications to be loaded. If the wait time expires before all of the applications are loaded, any terminal request to the controller will take longer than usual because the request must compete with the loading of background applications and runtimes.

If testing reveals an incompatibility problem with running the old and new software on another controller, the wait time should be zero.

Timeout Value: Set the timeout value long enough so that it expires only when a controller has taken too long to come up. If the timeout does expire, this utility attempts to cancel the maintenance that has already been successfully applied to other controllers. Make sure that you allow time for exception log processing, for an IPL to activate configuration changes, and for other contingencies; 120 minutes should be adequate for most systems. Set the timeout value short enough so that all controllers are back up and operating at the same software level in time for the busiest part of the day.

Examples: Assume that you have a four-controller LAN requiring 100 minutes per controller to activate maintenance through an IPL, reconcile the exception log, and load the background applications. Assume that the timeout value chosen is 120 minutes and that the third controller does not come up within that time. The total elapsed time for the first two controllers to IPL is 200 minutes, plus 120 minutes for the third controller to timeout, and 200 minutes to cancel maintenance on the first two controllers. This time totals 520 minutes. Calculate the worst case situation for your system, and choose the timeout value accordingly.

Where to Run this Staged IPL Utility: You can run this utility on any controller by putting the controller ID in front of the command. The controller running ADXCS50L must be IPLed last. Otherwise, this utility will end when the controller running it is IPLed.

Examples:

```
DD::ADXCS50L N 0 120 CC DD
```

This command causes the Staged IPL Utility, ADXCS50L, to run on the controller DD.

```
AA::ADXCS50L N 0 120 CC DD
```

This command causes the Staged IPL Utility, ADXCS50L, to run on the acting master. If DD is not the acting master store controller, the utility ends with the message:

```
CONTROLLER DD MUST BE LAST IN THE LIST OF CONTROLLERS TO IPL
```

IPL Order: You should IPL the primary controller before the backup controller. When the backup controller is IPLed, the primary controller will resume. Otherwise, you must provide some means for the resume operation, for example, configure automatic resume, resume manually, or IPL the backup controller.

Example:

If CC is the primary store controller and DD is the backup store controller, the command should be:

```
DD::ADXCS50L N 0 120 CC DD
```

If CC is running one TCC Network and DD is running another, and they are backing each other up, you should activate automatic resume.

You should IPL the acting master last. Because the RCP status file is opened on the acting master, messages to be written while the acting master is down must be saved in the local RCP status file and written to the acting master RCP status file after it comes back up. This should not be a problem unless there are errors trying to open files and or moving the messages.

If there are two controllers and they back up each other, no sequence will result in both controllers returning to their primary node (backup or primary) unless the resume is automatic or manual.

Load Terminals: If you apply maintenance that must be loaded in the terminal to make it active, you must load terminal storage in all terminals. You should use the TL parameter of ADXCST0L to accomplish this. The terminals do not reload until the TCC Networks switch to a controller that has been IPLed to apply the new maintenance. Also, you should disable loading of terminal storage whenever a cashier is signed on. See “Loading Terminal Storage” on page 13-7 for more information about disabling loading of terminal storage.

Other methods exist to load the terminals, but they all require a separate action that must be invoked after the controllers have come back up. You can invoke one of the following after checking the RCP status file for errors:

- Use the ADXCS20L N 11 RCP command.
- Select the Load Terminal Storage option from the STORE CONTROL FUNCTIONS menu accessed using the **SysReq** key.
- Power off half of the terminals at a time so that there are always some terminals online. This only works if memory retention is disabled.

User Applications that IPL the Controller: If you have an application that runs whenever there is an IPL or that detects an IPL, ensure that the actions taken by that application do not cause the controller to IPL or otherwise interfere with the IPLing of the controllers. Do not manually or otherwise IPL any controller while this utility is running. Allow this utility to perform all IPLs until it has finished.

Ideal System: The following summarizes the requirements presented in this chapter:

- Run ADXCST0L first with the NI RCP parameter.
- Put the controller on which this utility is running last on the list.

The following list summarizes the recommendations presented in this chapter:

- IPL the controller acting as primary before the controller configured to support backup.
- If the terminals need to be loaded, use the TL parameter of ADXCST0L.
- Use a wait time of 300 seconds.
- Use a timeout value of 120 minutes.
- IPL the acting master last.
- ADXCST0L should activate the software in test mode.

An example of an ideal system is:

```
CC is the acting master and file server.
DD is the alternate master and alternate file server.
CC is the backup store controller.
DD is the primary store controller.
Allow backup is active.
Automatic resume can be active or inactive in this example.
```

The command file should be:

```
AA::ADXCST0L Y 1G TL NI
AA::ADXCS50L N 300 120 DD CC
```

Note: If CC is not the acting master, this utility ends with the message:

```
CONTROLLER CC MUST BE LAST IN THE LIST OF CONTROLLERS TO IPL
```

Loading Terminal Storage

Terminals must be loaded to make terminal application changes active. However, loading terminals while operators are running customer checkout would defeat much of the usefulness of this utility. Therefore, the following two exit steps are recommended to significantly reduce terminal downtime.

ADXSERVE (function 54) disables the loading of terminals. If this ADXSERVE call was made in the user exit for operator signon, and enabled (function 53) again in the user exit for operator signoff, the load all terminals request would only load terminals that were signed off. When the remaining terminals sign off, each then reloads. All terminals will eventually load, but not while the operator is running customer checkout. To use this recommendation, the old terminal code must be compatible with the new controller code.

Enable Terminal IPL

This function enables terminals to reload. If terminals were to be reloaded earlier but could not because you had disabled IPL, making this call causes the terminals to reload.

Note: This function does not prevent a terminal from dumping or reloading as a result of a request to load a specific terminal.

For the enable terminal IPL parameters, see “Using the Enable IPL Function” on page 15-28.

Disable Terminal IPL

This function prevents the automatic reload that can occur when a terminal comes online, and it allows the terminal application to use effectively the terminal RAM disk support for temporarily logging data. In most cases, when the controller comes back online, the terminal application transfers the logged data to the controller.

For the disable terminal IPL parameters, see “Using the Disable Terminal IPL Function” on page 15-29.

Messages

The following table explains the messages which can appear when you use this utility.

Table 13-1 (Page 1 of 3). Staged IPL Utility Messages

Message	Description
Request is only valid on a LAN (MCF Network) system.	The Multiple Controller Feature is not active.
ADXCST0L has not completed successfully.	The Apply Software Maintenance activation file, ADX_SPGM:ADXCSTAF.DAT, does not exist. Either ASM was not run beforehand, or ASM had an error that was logged in the RCP status file.
Request is not allowed while activating OS or LAN (MCF Network).	The Apply Software Maintenance activation file, ADX_SPGM:ADXCSTAF.DAT, indicates that either the Operating System or the Multiple Controller Feature was chosen to apply maintenance using the staged IPL. This situation is not allowed because there will be a brief time when the controllers are up and running at different software levels. In many cases, this would cause a communication problem between the controllers. Results would be unpredictable.
The wait time must be numeric characters.	The wait time cannot contain periods, commas, minus signs, letters, or any characters other than 0 through 9.
The wait time must not exceed 2147483 seconds.	The largest number allowed is 2147483.
The timeout value must be numeric characters.	The timeout value cannot contain periods, commas, minus signs, letters, or any characters other than 0 through 9.
The timeout value must not exceed 35791 minutes.	The largest number allowed is 35791.
Node names must have a length of two characters.	The node name lists must be of the form “CC DD”. There should not be commas separating the parameters.

Table 13-1 (Page 2 of 3). Staged IPL Utility Messages

Message	Description
Controller *xx* must be last in the list of controllers to IPL.	The controller that is running this utility must be last in the list. To run on another controller, add the node ID to the front of the command, as in the following example: `DD::ADXCS50L N 0 120 CC DD`
Controller *xx* is not active on the LAN (MCF Network).	The controller indicated is not able to receive commands using the Multiple Controller Feature.
Status of controller *xx* could not be verified.	An ADXSERVE command issued to the remote node to test the ability of the controller to communicate failed.
Controller *xx* could not be IPLed.	An attempt to IPL the remote node failed. Either the request returned a negative return code, or the controller remained up after acknowledging the request. If no failing return code was returned from the request, the user-specified timeout value was used to prevent a long wait for the controller to go down.
Controller *xx* has IPLed.	The remote controller has successfully received the command to IPL. If an error is detected, this utility will not try to IPL the remaining controllers. Use this message to determine which controllers were IPLed before the failure occurred.
Controller *xx* became inactive after IPL.	The remote controller IPLed, then came up to at least the point when background applications are started. After the specified wait time, a query of the node returned an error indicating that the controller is not active on the LAN (MCF Network).
Controller *xx* is not configured.	The remote controller has not been defined by configuration.
Controller *xx* did not come up within *nn* minutes.	The remote controller has not come up within the number of minutes you specified as the timeout parameter.
None of the remaining controllers will be IPLed.	Because of an error reported previously, the IPL sequence was ended before all controllers were IPLed.
None of the controllers have been IPLed.	Because of an error reported previously, the IPL sequence was ended before any controllers were IPLed.
Return Code is 8*xxx*4*xxx*.	Refer to the *4690 Store System: Messages Guide* for further information on interpreting the error.
ADXSERVE Return Code is -1*xxx*.	See “ADXSERVE (Requesting an Application Service)” on page 15-17 to interpret the error.
Create of temporary work file on node *xx* failed.	The temporary file, ADX_SDT1:ADXCS5TF.DAT, could not be created on the remote node. This utility creates the file so that the IPL portion of ASM can put the return code in it. Use this file to verify that ASM ran properly during the IPL.
xx is not a valid node ID.	The node ID is not two uppercase letters.
Insufficient number of parameters.	You must supply at least four parameters for this function to work. See the section about the format of the command.
Controller *xx* cannot be listed more than once.	The node ID was the same as another node ID previously listed in the parameter list. If it is not listed twice, it is the same as another logical drive that points to the same controller.
Activation of maintenance on controller %c%c failed.	The IPL portion of ASM that moves files failed. A W638 message should be in the System Event Log. Maintenance will be canceled automatically if possible.
See the W638 message in the System Event Log.	The IPL portion of ASM that moves files failed. A W638 message should be in the System Event Log. Maintenance will be canceled automatically if possible.

Table 13-1 (Page 3 of 3). Staged IPL Utility Messages

Message	Description
Cancel failed because activation was not test mode.	At least one controller was IPLed to activate maintenance. When a problem prevented the remaining controllers from activating maintenance, the cancel attempt failed because the activation was not test mode.
The controllers are now at different maintenance levels.	Some of the controllers were successfully IPLed to activate maintenance, but a problem occurred that prohibits the remaining controllers from activating maintenance. It was not possible to cancel maintenance.
The reset parameter must be a Y or N.	The first parameter must be a Y or N.
Attempting to cancel maintenance on controller *xx*.	At least one controller was IPLed to activate maintenance, but a problem prevented the remaining controllers from activating maintenance. The utility now attempts to change the activation file command from test to cancel and IPL the controllers that have already activated maintenance in test mode.
Attempt to cancel maintenance on controller *xx* failed.	At least one controller was IPLed to activate maintenance, but when a problem prevented the remaining controllers from activating maintenance, the cancel attempt failed.
The timeout value must be at least 10 minutes.	The timeout value must be at least long enough to allow time for the controller to IPL and activate maintenance.
The failing parameter is *xx*.	The error message previously reported points to the indicated parameter.
Remove diskette from drive A: on node *xx*.	A diskette is in the A: drive of one of the controllers, and is preventing the successful activation of maintenance. Remove the diskette, and restart both ADXCST0L and ADXCS50L.

ASM History File

If a failure occurs after a controller has already successfully applied maintenance and the activation was test mode, the utility attempts to cancel the maintenance from the controllers that have already activated maintenance. This action logs an entry in the ASM history file, because this is an Apply Software Maintenance action. If the cancel action is initiated from this utility, a B is recorded in the action field. This B value is a new indicator for the action field and is not documented in this manual.

Chapter 14. Using the Multiple File Archiver Utility

ADXNSXZL is a multiple file archiver with built-in compression and decompression. It provides a simple and convenient means of copying large files onto a diskette as efficiently as possible. It is not compatible with the 46x0 Compress/Decompress utility and is intended only for command line use.

This utility is built into the installation and migration tools used by 4690 OS and is also used by the Apply Software Maintenance procedures to minimize the number of diskettes that maintenance requires. Other uses might include archiving a subdirectory before replacing some files for testing purposes. To receive a helpful reminder of the command line options, you may start the application as follows to receive minimal documentation.

Format:

```
ADXNSXZL
```

Compressing, Combining, and Archiving Files

To create a combine file, you must specify a name for the combine file and which file (or files) you wish to be included. Additional files may be added later.

Format:

```
ADXNSXZL C TEST.DAT ADXCSLCF.DAT
```

This example creates a file called TEST.DAT which contains a compressed version of the 4690 dump file ADXCSLCF.DAT.

Efficiency of compression varies greatly depending upon the contents and the size of the file to be compressed. Large dump files compress very well. In contrast, there is negligible compression on small text files. It is possible that the resulting combine file is actually larger than the original uncompressed files. However, in general, ADXNSXZL recognizes if a file is unlikely to benefit from compression, and in this case, simply adds the file to the combine file without attempting to compress it. In particular, ADXNSXZL never tries to compress files that are smaller than 2K bytes in size. This provides some optimization of speed versus compression.

Alternatively, if you wanted to compress all the files in ADX_UPGM: you could use the following command:

Format:

```
ADXNSXZL C MYFILES.DAT ADX_UPGM:**
```

The resulting combine file, MYFILES.DAT, contains all the files in ADX_UPGM and the original files are left untouched.

When called with the C parameter to create a combine file, ADXNSXZL first checks for the existence of the combine file. If it already exists, an error is reported.

If you wish to add files to an already existing combine file, you must use the A parameter.

Format:

```
ADXNSXZL A MYFILES.DAT C:\TEST.LOG
```

This example adds a compressed version of the file C:\TEST.LOG to the existing combine file MYFILES.DAT. If the combine file is missing, an error is reported and no action is taken.

Wildcards may also be used with the A parameter to add files to an existing combine file.

Format:

```
ADXNSXZL A MYFILES.DAT ADX_UDT1:*.DAT
```

This example adds all files with an extension of DAT in the subdirectory ADX_UDT1 to the existing combine file MYFILES.DAT without affecting the original files in ADX_UDT1.

Mapping the Combine File

To determine which files are contained within a given combine file, it is necessary to map the combine file, using the M parameter.

Format:

```
ADXNSXZL M TEST.DAT
```

This example lists the contents of the combine file TEST.DAT and reports the original sizes, time stamps, and other information. The following is an example of the output:

Format:

```
ADXNSSLG.DAT   468663    1   4-05-1995  15:23  [61%]  ■■■
```

This example shows that the combine file only contains one compressed file, ADXNSSLG.DAT, that had an original size of 468663 bytes, a distribution attribute of 1 (local file), and a time stamp of 3:23 PM on the 5th of April 1995. It also lists to what extent the file was compressed as 61% (the compressed version of ADXNSSLG.DAT was 61% of the original size).

The final symbols (■■■■) reflect whether the compressed version of the file is split across several combine files. If the size option for add and compress is not used, this will always show three solid blocks, indicating that the compressed version of the file is contained completely within this combine file.

Through the use of the size option, at times a compressed file will not fit completely within a single combine file, then other symbols are shown in this space, as follows:

- ■■■ compressed file is contained completely within this combining file
- ■■• only the beginning of the compressed file is included
- •■• only a middle portion of the compressed file is included
- ••■ only the end of the compressed file is included

If the complete file is not included within the combine file, you will need to look in other combine files to find the remaining portions of the compressed file before you will be able to split out the original files.

Splitting Files Out of a Combine File

To restore files to their original format from a combine file, you must use the split parameter.

Format:

```
ADXNSXZL S TEST.DAT ADX_UPGM:
```

This restores all the files compressed in TEST.DAT to the subdirectory ADX_UPGM:.

Alternatively, you can request individual files to be split out of the combine file by adding the filename as an optional parameter.

Format:

```
ADXNSXZL S TEST.DAT ADX_UPGM: AMCTESTF.DAT
```

This restores just the file AMCTESTF.DAT from the combine file TEST.DAT into the subdirectory ADX_UPGM:.

The subdirectory is not an optional parameter. If you wish to restore files into the current subdirectory, then use the following format:

Format:

```
ADXNSXZL S TEST.DAT .\
```

This relies upon the fact that '.' is the current directory. Also, the subdirectory must have a colon (':') or a back slash ('\') at the end of its name. The following is an example of an error:

Incorrect Format:

```
ADXNSXZL S TEST.DAT C:\ADX_UPGM       (missing trailing back slash)
```

This reports errors for each of the files it attempts to split out of the combine file. Because it tries to create the target file by adding the filename to the directory name as given, it results in an attempt to create files such as C:\ADX_UGPMAMCTESTF.DAT, which is a filename that is not valid.

To correct the last invocation, a back slash should be appended as follows:

Correct Format:

```
ADXNSXZL S TEST.DAT C:\ADX_UPGM\      (notice trailing back slash)
```

Splitting a Given List of Files from a Combine File

As well as splitting all files or a specific file out of a combine file, it is possible to split a chosen list of files. This relies upon the L (list) parameter supported by ADXNSXZL:

Format:

```
ADXNSXZL L TEST.DAT ADX_UPGM: FILES.LST
```

This restores all the files listed in FILES.LST from the combine file TEST.DAT into the subdirectory ADX_UPGM:. FILES.LST should be a list of filenames, with one file per line, followed by a carriage return line feed. This can be created with a text editor.

Log Files

If ADXNSXZL is being used as part of another process, perhaps being called from a BATCH file, then it may be useful to have any messages generated logged to a file rather than displayed to the screen. This can be accomplished by using the optional log file parameter on the split and list commands.

Format:

```
ADXNSXZL S TEST.DAT .\ (C:\ADXNSXZL.LOG
```

This splits all the files contained in the TEST.DAT combine file into the current directory and reports all messages to ADXNSXZL.LOG in the root directory of the C: drive.

Return Codes

ADXNSXZL displays messages and progress indicators for most of the common functions provided. However, for functions involving split combine files, it often relies upon return codes to report progress and errors.

These return codes are not visible when calling ADXNSXZL directly from the command line. They can be detected through the use of IF ERRORLEVEL when ADXNSXZL is invoked from a BATCH file.

The return codes are:

0 Good
1 Incorrect parameters
2 File is not valid or is corrupted.
3 Combine file is corrupted.
4 Filename/directory is not valid.
5 Unable to allocate storage.
6 File already exists.
7 Combine file is not valid.
8 Out of disk space.
9 Temp file is not valid.
10 List file is not valid.
11 Log file is not valid.
99 New combine file is required.

Part 3: Applications (Designing and Using)

Chapter 15. Designing Applications with IBM 4680 BASIC

The IBM 4690 Operating System is a protected-mode operating system. This means that an application can only access code and data areas that are part of that application. Also, because of file security capabilities, the application can only access files that it has created or been designated to access. Memory requirements vary depending on your application's objectives and design. You can make an application a single module or split it into several load modules and chain from one to the other.

Refer to the *IBM 4680 BASIC: Language Reference* for the character set, variable types, commands, and syntax rules. You can use a text editor to write your IBM 4680 BASIC applications.

The IBM 4690 Operating System limits access to files and operating system functions. Each file and function is assigned security attributes that limit its use according to the authorization level of the user. The system maintains a system authorization file, ADXCSOUF.DAT, that defines these authorization levels. For more information on the system authorization file and file protection, see "System Authorization" on page 15-8 and "Protecting Files" on page 2-23.

For additional information on how to use the functions of your system, refer to the *IBM 4690 Store System: User's Guide*.

Types of Applications

The store controller operating system supports two types of applications: interactive and background. An *interactive* application uses the store controller keyboard and display or auxiliary console to directly communicate with the operator. A *background* application communicates directly with the operator through the BACKGROUND APPLICATION CONTROL screen. This screen is a background application control screen used for communication between the operator and background applications.

Using a window, you can run several interactive applications at the same time. Each application runs until it either finishes or operator input is required. When input is required, the application waits for further input before continuing.

Interactive Applications

Interactive applications fall into two categories: primary and secondary. The *primary application* is the main application that runs in your store's normal operating environment. *Secondary applications* are applications that are selected from the SECONDARY APPLICATION menu. This menu is reached by choosing the second option on the SYSTEM MAIN MENU.

Each interactive application is assigned a *window*. Windows enable each application to execute as if it had actual control of the screen and keyboard. The *IBM 4690 Store System: User's Guide* explains windows.

Background Applications

Background applications are non-interactive store controller applications. Some background applications start or stop running when the system is IPLed or when the acting master store controller or acting file server is changed on a LAN (MCF Network) system. The operator or the host must start other applications that do not start automatically.

There are two kinds of background applications: permanent and temporary. You define *permanent* background applications when designing your store's configuration. You define the name of the background application, the parameters passed to it, the text, and whether it begins at IPL by using the configuration screens.

Temporary background applications are started from the host site or from your application using the ADXSTART interface (see "ADXSTART" on page 15-6). HCP, if begun from the host site, runs as a temporary background application. The operator can remove temporary applications if they are not active by pressing the **Clear** key while viewing the BACKGROUND APPLICATION CONTROL screen.

You can determine the status of your background applications by displaying the BACKGROUND APPLICATION CONTROL screen and specifying the application name. This screen gives you the status of the executing background application, the parameters passed to it, and any message sent by the background application to the operator. Refer to the *IBM 4690 Store System: User's Guide* for information on BACKGROUND APPLICATION CONTROL.

Your applications update the BACKGROUND APPLICATION CONTROL status screen by writing messages to it periodically. Use a function called Display Background Application Status to write these status messages. This function is described in "Using Application Services" on page 15-17.

Application Size

The IBM 4690 Operating System has several size restrictions on memory and disk space that your programs must meet. The restrictions are different for the terminal and the store controller.

When planning your applications, you should know how much disk space is available to you. The IBM 4690 Operating System keeps track of the amount of space already used and the amount available on your disk. You can determine this information by using the CHKDSK or DIR commands.

The CHKDSK command has options through which you can get a report of how much total disk space you have, how much of it contains files, how much space is still available, and how much space, if any, is considered defective.

The DIR command gives you a listing of the files on your disk, how much space they occupy, and how much space remains available. For more information on these commands, refer to the *IBM 4690 Store System: User's Guide*.

Memory Models

IBM BASIC supports three different memory models: large (for store controllers) and big and medium (for terminals). With large or big memory models, your application can have more than 64 KB of code and more than 64 KB of *heap* data (see "Data Size" on page 15-4). Big memory models allow up to one 64 KB segment of *static* data, while large memory models allow multiple 64 KB segments of static data. Medium memory models require that all *stack*, static, and heap data reside within one 64 KB segment.

Use the compiler directive %ENVIRON to specify whether your application is to execute in the store controller or in the terminal. For more details on memory models, refer to the memory allocation chapter in the *IBM 4680 BASIC: Language Reference*.

Code Size

Each IBM 4680 BASIC program module that you compile produces an object module (OBJ file). An object module contains a code segment and a data segment.

Each code segment can have a maximum of 64 KB. When you compile a program module, the compiler lists the number of bytes required for the code segment. When you link your program modules together to form a load module, the link editor lists the code size (which is the total number of bytes for all of the code segments of the modules).

The maximum code size supported by the link editor is one million bytes. If your code size exceeds the amount of memory you have available, you may consider chaining from one load module to another to decrease the memory required by each load module. See "Chaining Applications" on page 15-30 for more information on chaining.

Each code segment requires a code segment name. You can use a maximum of 200 code segment names in a load module for the terminal. The IBM 4680 BASIC compiler uses up to five of these code segment names for each load module. Each object module uses one code segment name. Therefore, you can have up to 195 object modules per load module plus five code segment names used by the compiler for a terminal application. There is no limit to the number of object modules in a load module for an application in the store controller.

Data Size

The total data area for a load module is composed of three elements: static data, heap data, and stack data.

The terminal medium memory model default data size is almost 64 KB. If you want to change the value of the terminal data size, use the DATA[MAX[]] option on the LINK86 command. The maximum data area size is almost 64 KB. To define the maximum data area size, use the DATA[MAX[FFF]] option.

The terminal big memory model and store controller default data area size is the sum of the initial 8 KB heap plus the load module static data plus the stack. The data area size changes dynamically with the size of the heap.

The *static data* area is used to hold your integer and real variable data for your code modules. It also contains a pointer for each string variable and a pointer for each array definition. In addition, it contains these same types of data for the shared runtime library, common variables, and overlay variables.

When you compile a program module, the compiler lists the number of bytes of static data required. When you link your program modules together to form a load module, the link editor lists the static data size, which is the total number of bytes of static data for all of the program modules. The maximum static data area for a medium model terminal load module is 64 KB minus the stack and minus the heap. The maximum static data area for a big memory model terminal load module is 64 KB. The maximum static data area for a store controller load module is one million bytes.

For medium memory models (terminals only), there is one data area whose size can be no larger than 64 KB minus 16 bytes. (This is the default.) This area contains the stack (2K), the static data, and the heap data. Big memory models allow up to 64 KB of static data. Large memory models allow multiple 64 KB of static data— up to 1 MB. Both large and big memory models allow up to 64 KB of stack space.

The *heap data* area is where variable length items are kept. These items include all string variables, array elements, application file and device buffers, and other runtime subroutine library data. In the terminal, the size of the heap is determined by the number of bytes remaining in the data area after the stack and the static data are allocated. In the store controller, and in the terminal big memory model, the size of the heap is determined dynamically. The program requests heap space as needed.

You can determine the amount of available heap space from the application. The FRE function indicates the total number of bytes available everywhere in the heap, and the MFRE function indicates the largest number of contiguous bytes available anywhere in the heap.

The *stack data* area is used to pass parameters from one function or subprogram to another. It is also used by the runtime subroutine library procedures to pass internal data. The stack also contains the caller's return address.

The size of the stack is determined when the application load module is loaded. The loader must be able
| to obtain the minimum stack size request, which is 128 bytes for the terminal medium memory model,
| 1024 bytes for the terminal big memory model, and 2560 bytes for the store controller, or the application

load does not succeed. The loader obtains as much memory as possible for the stack, up to the maximum size requested.

| The runtime stack in the BASIC terminal medium memory model occupies the first 2 Kb of the data
| segment. This stack size is fixed and cannot be changed.

| The maximum stack size for big and large memory model applications is 64 Kb. Check the LINK86 output
| messages for the default maximum stack size defined. You may change this with the LINK86
| STACK[MAX[]] option. In order to leave more space for dynamic data (the heap), the stack should be no
| larger than is necessary for the application to run correctly. Refer to Chapter 9 for more information on
| STACK and other link options.

File Size

Depending on your needs, you can decide to keep the current default size of system files or change the size. Changing file size can help you manage your storage more efficiently. The *IBM 4690 Store System: User's Guide* tells you how to change file size when performing controller configuration.

You do not have to change system file sizes. When the system is IPLed, the operating system checks the size of your store controller dump file. If the store controller system dump file size is not large enough, file size is automatically increased. The terminal dump file size is not automatically adjusted.

Application Priorities

The IBM 4690 Operating System runs all controller foreground applications and all terminal applications at priority 5. Background controller applications can run at any priority between 1 (high priority) and 9 (low priority). For most systems, background applications should be run at priority 5, which is the same priority as any foreground applications. Applications are scheduled to run as follows:

- If several applications are running at the same priority, then the 4690 Operating System uses the *time-slice method*. The time-slice method maintains a queue of application requests and allows each application to process for a certain time period and interrupts execution, so the next application may process.
- The 4690 Operating System allows the application with the highest priority to execute until one of the following conditions is met:
  - The application has completed execution.
  - The application must wait for access to a resource such as a file.
  - Another application with a higher priority is executed.

File Access Priorities in Terminal Applications

You can specify priorities for file access in a terminal application using the reserve word, PRIORITY. PRIORITY is a reserved word that is valid only in terminal applications. You can specify it with the OPEN or CREATE statements.

When you specify PRIORITY, the operations of that file are performed before requests from other terminal files. For example, if you create a file using PRIORITY, reading from and writing to that file takes priority over other pending terminal file requests without PRIORITY.

Note: All terminal file requests have a higher priority than store controller file requests.

Starting a Background Application

This section describes functions that can start background applications. These functions are contained in the runtime library ADXACRCL.L86.

ADXSTART

This function starts a background application using the 4690 Operating System.

This function is declared as follows:

```
FUNCTION ADXSTART (NAME$,PARM$,MESS$) EXTERNAL
INTEGER*2 ADXSTART
STRING NAME$,PARM$,MESS$
END FUNCTION
```

where:

NAME$ = Name of background application to be started (without R::) (maximum length = 21 bytes)
PARM$ = Parameters for the background application (maximum length = 46 bytes)
MESS$ = Initial message to be displayed on the background status screen (maximum length = 46 bytes)

The function is invoked as:

```
return.small=ADXSTART (pname$,iparm$,imess$)
```

This function returns a zero if a command was issued to start the application. Table 15-1 shows return codes and their descriptions.

Table 15-1. ADXSTART Return Codes

Return Code	Description
0	Function completed successfully.
-1000	Function code (for example, first parameter) is not valid.
-1001	Buffer address or length not valid.
-1170	Application name missing or not valid.
-1171	All background application list entries in use.
-1172	Maximum number of background applications already active.
-1175	Invalid parameter.
-1176	Internal error (unable to open driver).

ADXPSTAR

This function starts a background application at a specified priority. To better understand ADXPSTAR and its priority, you should become acquainted with how the 4690 Operating System schedules applications.

Every application has a priority ranging from 1 (highest) to 9 (lowest) with 5 being the default. If several applications are running at the same priority, the operating system uses a time-slice method to service them. Each application is allowed to run for a certain period and stop, so that the next application may run. The 4690 Operating System allows the application with the highest priority to execute until one of the following conditions occur:

- The application is complete.
- An application with a higher priority becomes scheduled to run and is executed.
- The application is forced to wait for an external event to end.

For example, if a system is running three applications, one at priority 2 and two at priority 5, then the application at priority 2 executes until it has completed or is forced to wait. If an application at priority 1 is submitted, then the application at priority 2 is preempted. The priority 5 applications would begin execution on a time-slice basis after the higher priority applications had completed execution or entered wait states.

Use the ADXPSTAR function carefully. As the 4690 Operating System allows the highest priority application to execute until it ends or is preempted, it is possible that a high-priority application could cause your system to neglect all lower priority applications. This occurs if the high-priority application takes a long time to either complete or experiences few wait states.

The ADXPSTAR function allows you only to set the priority of the background applications. All previous applications and any applications initiated by the host, whether background or previous applications, run at the default priority 5.

The function is declared as follows:

```
FUNCTION ADXPSTAR (NAME$,PARM$,MESS$,PRIORITY) EXTERNAL
INTEGER*2 ADXPSTAR,PRIORITY
STRING NAME$,PARM$,MESS$
END FUNCTION
```

where:

NAME$ = Name of background application to be started (maximum length = 21 bytes)
PARM$ = Parameters for the background application (maximum length = 46 bytes)
MESS$ = Initial message to be displayed on the background status screen (maximum length = 46 bytes)
PRIORITY = Priority of the background application (value from 1 to 9; default=5)

The function is invoked as:

```
return.small=ADXPSTAR (pname$,iparm$,imess$,iprior)
```

This function returns a zero if a command was issued to start the application. Table 15-2 on page 15-8 shows return codes and their descriptions.

Table 15-2. ADXSTAR Return Codes

Return Code	Description
0	Function completed successfully.
-1001	Buffer address or length not valid.
-1170	Application name missing or not valid.
-1171	All background application list entries in use.
-1172	Maximum number of background applications already active.
-1175	Invalid parameter.
-1176	Internal error (unable to open driver).
-1177	Priority given is out of range.

System Authorization

To ensure system and data security, the IBM 4690 Operating System requires that each operator using the system be authorized. This authorization is granted through a *system authorization file* named ADXCSOUF.DAT. It contains *operator authorization records*. Each operator using the system must have a record in this file. This record contains the operator identifier (ID), password, group ID, and user ID and specifies which system request keys and menu options the operator ID can use.

When an operator signs onto the store controller console, the system verifies the operator ID and password entered with the ID and password in the system authorization file. If both are valid, the operator is allowed to use those system functions specified for the ID by the operator authorization record.

The system authorization file is placed on your system during installation. The ADXCSOUF.DAT file resides in subdirectory ADX_IDT1 and has the same file protection as your other application files.

The operating system does not provide operator authorization for terminal signon. The IBM 4680 or 4690 applications provide this function. If you write your own application, it must provide this function if it is needed.

ADXAUTH

For your operators to sign on and use the system, you must create and maintain authorization records for each one. To add, change, or delete an operator authorization record, your application program must use the function ADXAUTH. The application program using this function should be an interactive application. You can also use this function in a background application, but only with functions that do not require screens to be used (functions 3, 8, 9, and 10). This function can be used only in the store controller and is only in ADXACRCL.L86.

The user ID and group ID for each operator can be set with ADXAUTH. Operators needing access to files in command mode should be assigned according to:

Files in Subdirectories	User ID	Group ID
ADX_I*xxx*	1	2
ADX_U*xxx*	1	3

xxx can be any subdirectory name beginning with ADX_I or ADX_U.

Software development functions should be performed in the ADX_U*xxx* subdirectories.

The following example shows how to declare the ADXAUTH function:

```
FUNCTION ADXAUTH (FUNC, OPID$,OPPW$,OPID2$)  EXTERNAL
STRING       OPID$,OPPW$,OPID2$
INTEGER*2      ADXAUTH,FUNC
END  FUNCTION
```

where:

FUNC = The action to be taken.
OPID$ = The operator ID on which an action is to be taken.
OPPW$ = The password for the ID.
*OPID2$* = The current operator ID or the template ID depending on the requested function. For FUNC parameter 10, OPID2$ indicates two IDs separated by a colon. The first is the template, and the second is the OPID whose authorization must not be exceeded.

The following example shows how to invoke the ADXAUTH function:

```
AUTH.RET=ADXAUTH (func.code,operator,password,operid2)
```

AUTH.RET is a 2-byte integer variable that receives the return code from the function.

Note: The operating system does not restrict access to your primary and secondary applications. If security is required for these applications, you must provide it in the application. The current operator ID is the only parameter passed to these applications and can be used as part of an application authorization function if required.

FUNC Parameter for Operator Authorization: The FUNC parameter tells you what action can be taken. The functions you can choose are:

1 = Change an operator authorization record.
2 = Add an operator authorization record.
3 = Delete an operator authorization record.
8 = Change password only.
9 = Make operator ID have the same authorization as the operator ID specified by OPID2$. If OPID2$ does not exist, a new ID is created.
10 = This function is the same as FUNC 9 except OPID2$ contains a template ID and a second ID whose authorization must not be exceeded.

If you choose the ADD or CHANGE functions, the system displays several screens from which you select the system functions the operator can use. The current operator (OPID2$) can select for another ID (OPID$) only those functions for which the current operator ID is authorized.

Note: You must have at least one ID on your system that is authorized for all system functions.

The current operator ID making a change to a record cannot be the same as the operator ID being changed.

If you try to change an authorization record that does not exist, you receive error code 1010, and your request is handled as an add function. The system creates a record having default authorization. The initial default authorization for the add function makes no system functions available. The operator would be allowed only to sign on and select primary and secondary applications.

If you try to add a record for an operator ID that already exists, you receive error code -1010, and your request is handled as a change function.

If you try to delete an authorization record that does not exist, you receive error code -1010.

The make function allows you to use an operator ID as a template for other IDs. You can create or change other IDs without having to select each system function from the screens. The new or changed IDs have the same authorization as the template ID. However, for FUNC 10, the new ID does not have greater authorization than the ID whose authorization must not be exceeded.

If the template ID you specify for the make function does not exist, error code -1011 is returned and default authorization is used as the template. A new ID having default authorization is created.

Table 15-3 shows the FUNC parameter return codes and their descriptions.

Table 15-3. FUNC Parameter for Operator Authorization Return Codes

Return Code	Description
0	Function completed successfully.
-1000	Unknown function code.
-1001	File not found.
-1002	Error reading or writing the disk.
-1003	OPID$ not specified.
-1004	No password specified.
-1005	No OPID2$ (only when two OPIDs required).
-1010	One of these conditions exists: • Add function was handled as change because ID already existed. • Change function was handled as an add because ID was not found. • Delete requested for ID that was not found.
-1011	Function handled as requested using default authorization because OPID2$ was not found.
-1020	Memory could not be allocated to process authorization.

OPID$ Parameter—Operator ID: This parameter indicates the operator ID to add, change, or delete. The OPID$ parameter should be a string containing up to nine ASCII alphanumeric characters. There should be no leading blanks. Leading blanks and zeros are considered part of the operator ID. Trailing blanks are ignored.

OPPW$ Parameter—Operator Password: This parameter is the password for functions 1, 2, 8, 9, and 10. The OPPW$ parameter should be a string containing up to eight ASCII alphanumeric characters. This parameter should not contain leading blanks. Leading blanks and zeros are considered part of the password. Trailing blanks are ignored.

OPID2$ Parameter: For FUNC parameters 1 and 2, the OPID2$ parameter should be a previously defined operator ID. For FUNC parameter 9, this parameter indicates the operator ID to be used to set the authorization for the ID specified by OPID$. The OPID2$ parameter should be a string containing up to nine ASCII alphanumeric characters without any leading blanks. Leading zeros are considered part of the operator ID. Trailing blanks are ignored. For FUNC parameter 10, OPID2$ contains two IDs separated by a colon. The first is the template ID, and the second ID is the ID whose authorization must not be exceeded (this can be the currently signed on ID). Both IDs should be strings containing up to nine alphanumeric characters.

For example:

```
"1234" + ":" + "4567"
```

For other FUNC parameters, this parameter is ignored.

Password Encryption

The IBM 4690 Operating System uses one-way encrypted passwords. The system encrypts passwords before storing them in the system authorization file. When an operator signs on, the password entered is encrypted and the encryption code is compared to the encrypted password code in the operator's authorization record. If the two codes match, the operator is allowed to sign on. If your application files contain passwords, your applications should encrypt the passwords. You can use the following subprogram to encrypt an eight-character ASCII password:

```
SUB ADXCRYPT (RETCODE, PWIN$, PWOUT$) EXTERNAL
STRING      PWIN$,PWOUT$
INTEGER*2   RETCODE
END SUB
```

where:

RETCODE = Contains the return code from the call.
PWIN$ = Contains the password to be encrypted.
PWOUT$ = Receives the encrypted value.

The PWIN$ parameter should be a string containing up to eight ASCII alphanumeric characters with no leading blanks. Leading zeros are considered part of the password. If this parameter is missing, error code -1100 is returned.

The PWOUT$ parameter returns an eight-character string containing ASCII characters that represent decimal digits.

You can use this subprogram in both the store controller and the terminal. It is in ADXACRCL.L86, ADXUCLTL.L86, and ADXUCRTL.L86.

Communicating between Applications

Your applications can communicate with each other in two ways. They can write information to and read information from a file, or they can use *pipes*. Pipes are file-like structures in memory used for communicating between applications. Exchanging data using pipes is much faster than with disk files.

Use pipes to communicate data that can be recreated by the application writing the data; if there is a power line disturbance the store controller is IPLed, and the contents of the pipe are lost. Use disk files for data that cannot be recreated.

Pipes are used in the following types of application communication:

- Between applications at the store controller
- Between applications from one terminal to another terminal or the store controller
- Between applications from one node to another node on a multiple store controller system

A pipe is an area of memory that is like a sequential file. Your application creates a pipe by using the CREATE command and specifying a pipe name. A pipe name has the same characteristics as a file name. The identifier pi: must precede the pipe name and no extension (*xxx*) is allowed.

More than one program can write to a pipe, but only one reads data from it. Because pipes are used this way, two pipes must be used to communicate both ways between applications.

Pipes have security restrictions similar to those used for files. The application creating the pipe owns it, and the system saves the user and group ID of the creator. The system creates and opens the pipe in read-write mode unless your application specifies otherwise.

A pipe is temporary. When the last application that has access to a pipe closes that pipe, the pipe is deleted. If a program using a pipe is terminated by the operating system (not a normal application termination), the operating system automatically closes the pipe. Refer to the *IBM 4680 BASIC: Language Reference* for more detailed information on pipes.

A pipe may be created with a zero-length buffer size for use as a simple semaphore. A READ operation of a semaphore pipe obtains the semaphore and a WRITE releases it. If another process has obtained the pipe previously, the READing process waits until a WRITE to that pipe has been performed. Write operations, on the other hand, never wait; even if the pipe was released previously, the call returns without an error. To create a semaphore pipe in a BASIC application, omit the BUFFSIZE parameter and specify BUFF as 0 in the CREATE statement.

Pipe Routing Services

Pipe Routing Services is a facility of the IBM 4690 Operating System that enables applications to exchange data with applications in other store controllers or terminals by using pipes.

To exchange data with other store controllers or terminals, you must use the pipes created through Pipe Routing Services.

Identify these pipes using pipe IDs. A pipe ID is a letter between A and Z. Make each ID in a store controller or terminal unique. Each store controller or terminal can have up to 26 IDs (A to Z). If you have several applications running in a store controller at once, each must use a different pipe ID.

One of three runtime libraries (one for the controller and two for the terminal) contain these functions, depending on whether you are requesting services for the store controller or the terminal.

| The large memory model controller library is ADXACRCL.L86.
| The medium memory model terminal library is ADXUCRTL.L86.
| The big memory model terminal library is ADXUCLTL.L86.

The system has separate functions for the terminals and the store controllers. The function names are as follows:

```
PRSxyyy
```

where:

x = T for functions used in the terminal
x = C for functions used in the store controller
yyy = CRT for the create pipe function
= WRT for the write function
= INT for the initialization function

To prepare for receiving data through a Controller Pipe Routing Services pipe, call this function:

```
FUNCTION PRSxCRT (IONUM,SIZE%,PIPEID) EXTERNAL
INTEGER*2 PRSxCRT
INTEGER*2 IONUM,SIZE%
STRING    PIPEID
END FUNCTION
```

where:

IONUM An I/O session number used for normal opens and creates. Use the same number for waits and reads that follow.

SIZE The number of bytes to allocate for the pipe size. Maximum pipe size for pipes created by terminal applications is 240 bytes. If you inadvertently define a size larger than the maximum allowed, the pipe size is limited but no error message appears. The maximum pipe size for pipes created by a controller application is 65,536 bytes.

PIPEID A character between A and Z. (Lowercase is forced to uppercase before it is used by this function.)

Table 15-4 shows the two-byte integers the PRSxCRT function returns.

Table 15-4. Function PRSxCRT Two-Byte Integers

Integer	Description
0	Good completion
-1000	Invalid pipe ID
-1001	Pipe already exists

Note: Your calling program should have an ON ERROR routine to handle normal pipe creation runtime errors.

Before reading data from a Pipe Routing Services pipe, your application should use the WAIT statement to obtain notification that there is data in the pipe.

Note: If a terminal application issues a WAIT for a Pipe Routing Services pipe, you should be aware that the terminal sends a message to the controller by way of the TCC Network. This message tells the controller that the terminal is waiting for data to become available in the pipe. If the WAIT ends because the timeout interval specified on the WAIT is exhausted, the terminal sends another message to the controller by way of the TCC Network. This message tells the controller that the terminal is no longer waiting for data in that pipe. Repeatedly issuing WAITs for Pipe Routing Services pipes with short timeout intervals in the terminal results in a large number of TCC Network messages being sent to the controller. This additional volume of TCC Network messages can have an adverse impact on the controller's response time to terminal requests. Therefore, short timeout intervals on the WAIT should be used only if absolutely necessary. In no case should the timeout interval be less than 100 milliseconds, as this much time is required to send the WAIT message to the controller and to receive a response back from the controller. When the WAIT statement finishes for the pipe, the application should use the READ FORM# statement to read the data from the pipe. The READ FORM# statement should specify the number of bytes to read according to the type of message written to the Pipe Routing Services pipe. You can use fixed-length or variable-length message types.

For fixed-length message types, the number of bytes read from the pipe must be the same as the number of bytes written to the pipe. Fixed-length messages require that the application writing to the pipe and the application reading from the pipe always use the same number of bytes in their messages.

For variable-length message types, the number of bytes read from the pipe must be less than or equal to the number of bytes written to the pipe.

A variable-length message consists of two parts. The first part is fixed-length and indicates whether there is a second part and the size of the second part. The application writing the variable-length message writes both parts of the message together as one message. The application reading the variable-length message reads the first part of the message by reading a fixed-length message. From the first part of the message the application determines the number of bytes to read for the second part.

| The following conditions can result in errors being returned to a terminal application for a READ FORM# statement. Refer to the *IBM 4690 Store System: Messages Guide* for error information.

- If a READ FORM# specifies more bytes for a message than are actually in the Pipe Routing Services pipe, the system purges all of the data in the Pipe Routing Services pipe.
- If the program issues a WAIT and is notified that data is in the Pipe Routing Services pipe, it is possible for the data to become unavailable before the program can issue the READ FORM#. This can occur if the program that wrote the data into the Pipe Routing Services pipe is ended before the READ FORM# is issued.
- If a program attempts to read a message of more than 120 bytes, an error is returned. Pipe Routing Services pipe messages can contain a maximum of 120 bytes.

Sending data to other terminals or store controllers is a two-part process. First, your application must initialize the writing service. Use the function shown here to perform this initialization.

```
FUNCTION PRSxINT EXTERNAL
INTEGER*4 PRSxINT
END FUNCTION

INTEGER*4 PRSNUM

PRSNUM=PRSxINT
```

This function returns a four-byte integer. Your application must save this integer for use when writing. You should call the initialization function only one time for each load of the application.

If your controller application calls the PRSCINT function, and if your controller application uses the CHAIN statement to transfer control to another controller application, your application should call the PRSCCLS function before chaining:

```
FUNCTION PRSCCLS EXTERNAL
INTEGER*1 PRSCCLS
END FUNCTION

CALL PRSCCLS
```

PRSCCLS releases the resource obtained by the PRSCINT function and makes it available to other programs. If you omit this call to PRSCCLS, eventually this resource could be depleted. PRSCCLS does not return a return code.

After initialization, you can write to another store controller or terminal. Do this using the following function:

```
FUNCTION PRSxWRT (PRSNUM,DEST,BUFFER) EXTERNAL
INTEGER*4 PRSxWRT
INTEGER*4 PRSNUM
STRING    DEST, BUFFER
END FUNCTION
```

where:

PRSNUM = Contains the value returned by the initialization function.

BUFFER = Contains the data to be sent. The maximum length of data that controller applications may write to controller pipes or terminal pipes is 120 bytes. The maximum length of data that a terminal application may write to a terminal pipe is also 120 bytes. The maximum length of data that a terminal application may write to a controller pipe is 512 bytes.

DEST = Contains the destination address. This is four characters of the form *aaaw*.

The *aaa* indicates the terminal or store controller to which to send. For terminals, *aaa* is the terminal number in ASCII. For store controllers, it consists of 0*xy* where *x* and *y* are characters between C and Z. Thus, for the store controller, *aaa* can range from 0CC to 0ZZ. There are also two special values of *aaa* for store controllers: 0AA and 0BB. Use 0AA when the destination is the master store controller. Use 0BB when the destination is the controller to which the terminal is attached. You can think of these destinations as logical destinations. The destination is associated with the machine performing the function rather than the physical machine that is assigned the address. Where necessary, the operating system switches a destination to another machine when a configuration change occurs that affects the destinations. For example, the system switches destinations when one store controller takes over another store controller's TCC Network. Pipe Routing Services perform the translations of 0AA and 0BB so that your application does not have to actually know the real store controller addresses.

The *w* part of the destination address indicates which pipe to write to in the specified store controller or terminal. It is a pipe ID. It should be one of the pipe IDs used by an application in the destination terminal or controller to create a Pipe Routing Services pipe.

Note: If a terminal application is writing to a pipe created by another terminal, both terminals must be located on the same controller. A terminal application cannot write a message across the LAN to a terminal located on a different controller.

Table 15-5 shows the 4-byte integers that are returned by the PRSxWRT function.

Table 15-5. Function PRSxWRT Four-Byte Integers

Integer	Description
0	Good completion.
-1	Destination pipe is full or does not have enough space available to hold the data being written.
-1010	Invalid destination specified.
-1011	Destination not found.
-1012	Error on write to destination.
-1013	Data length greater than the maximum allowed length.

Additionally, you may choose to use the conditional pipe write. This write is identical in every way to the normal PRSxWRT pipe write with one additional function. If the destination pipe is full or does not have enough room left to contain the entire message being written, the write will not wait for room to become available. Instead, the application is given control immediately with a -1 return code. At this point, the application can make a decision to either discard the data being written or to retry the write at a later time. The intended use for the conditional pipe write is for situations where it is undesirable for an application to wait for extended periods of time. To use the conditional pipe write, use the following function:

```
FUNCTION PRSxWRC (PRSNUM,DEST,BUFFER) EXTERNAL
INTEGER*4 PRSxWRC
INTEGER*4 PRSNUM
STRING    DEST, BUFFER
END FUNCTION
```

where:

PRSNUM = Contains the value returned by the initialization function.

BUFFER = Contains the data to be sent. The maximum length of data that controller applications may write to controller pipes or terminal pipes is 120 bytes. The maximum length of data that a terminal application may write to a terminal pipe is also 120 bytes. The maximum length of data that a terminal application may write to a controller pipe is 512 bytes.

DEST = Contains the destination address. This is four characters of the form *aaaw*.

The *aaa* indicates the terminal or store controller to which to send. For terminals, *aaa* is the terminal number in ASCII. For store controllers, it consists of 0*xy* where *x* and *y* are characters between C and Z. Thus, for the store controller, *aaa* can range from 0CC to 0ZZ. There are also two special values of *aaa* for store controllers: 0AA and 0BB. Use 0AA when the destination is the master store controller. Use 0BB when the destination is the controller to which the terminal is attached. You can think of these destinations as logical destinations. The destination is associated with the machine performing the function rather than the physical machine that is assigned the address. Where necessary, the operating system switches a destination to another machine when a configuration change occurs that affects the destinations. For example, the system switches destinations when one store controller takes over another store controller's TCC Network. Pipe Routing Services perform the translations of 0AA and 0BB so that your application does not have to actually know the real store controller IDs.

The *w* part of the destination address indicates which pipe to write to in the specified store controller or terminal. It is a pipe ID. It should be one of the pipe IDs used by an application in the destination terminal or controller to create a Pipe Routing Services pipe.

Note: If a terminal application is writing to a pipe created by another terminal, both terminals must be located on the same controller. A terminal application cannot write a message across the LAN to a terminal located on a different controller.

Table 15-6. PRSCWRC Function Four-Byte Integers

Integer	Description
0	Good completion.
-1	The destination pipe is full or does not have enough space available to hold the data being written.
-1010	Invalid destination specified.
-1011	Destination not found.
-1012	Error on write to destination.
-1013	Data length greater than the maximum allowed length.

Using Application Services

Application Services is a group of operating system services that are available to store controller and terminal applications for performing various tasks. Some of these services can be used by both store controller and terminal applications.

Store Controller and Terminal Application Services

This section lists routines that are available to applications at the store controller and the terminal. The function code and parameters for each function are listed, along with an explanation of the function.

ADXSERVE (Requesting an Application Service): Both store controller and terminal applications use a routine called ADXSERVE to request Application Services.

ADXSERVE is located in the following libraries:

- ADXACRCL.L86 for store controller applications
- ADXUCLTL.L86 for big memory model terminal applications
- ADXUCRTL.L86 for medium memory model terminal applications

The routine must be declared as follows:

```
SUB ADXSERVE (RET,FUNC,PARM1,PARM2) EXTERNAL
INTEGER*4 RET
INTEGER*2 FUNC,PARM1
STRING    PARM2
END SUB
```

Invoke the routine using this request:

```
CALL ADXSERVE(RET,FUNC,PARM1,PARM2)
```

where:

RET = Is the return code. It is zero if the operation was successful, or negative if the operation failed. Return code values are listed below.
FUNC = Specifies which ADXSERVE service is to be called.
PARM1 = Varies according to the function. See the following function descriptions.
PARM2 = Varies according to the function that is called.

Note: If your controller application calls ADXSERVE, it should also call ADXSERCL (see “ADXSERCL (Closing an Application Service)” on page 15-39) prior to chaining to another application in order to free system resources.

Table 15-7. ADXSERVE Return Codes

Return Code	Description
-1000	Invalid function code.
-1001	Buffer or length invalid. (Returned when FUNC=25, 26, or 27)
-1002	Invalid terminal number supplied.
-1003	System unable to obtain a flag.
-1015	Cannot send power-OFF message to remote controller because of non-LAN system. (Returned when FUNC=5)
-1016	Machine to be powered-OFF is not 4690 family or controller/terminal environment. (Returned when FUNC=5)
-1017	Invalid date/time specified in ADXSERVE call. (Returned when FUNC=5)
-1018	Invalid controller ID specified in ADXSERVE call or not active controller. (Returned when FUNC=5)
-1019	Request issued on LAN system controller that is not the master store controller.
-1020	ABIOS driver open failed. (Returned when FUNC=5)
-1021	ABIOS driver call failed either because of a system problem or invalid time. (Returned when FUNC=5)
-1022	User logical name not defined/unknown request.
-1023	Programmable Power request is pending. Either Programmable Power has been disabled or an application has set the 'No-IPL' flag in a MOD1 or MOD2. (Returned when FUNC=5)*
-1080	Command blocked by system control function from the screen and keyboard. (Returned when FUNC=2 or 3)
-1081	Terminal failed to respond.
-1100	Requestor not an interactive application. (Returned when FUNC=25 or 27)
-1101	Requestor not a background application.
-1212	Programmable power command issued for non-469*x* family or controller/terminal.

Note:

You receive an incorrect FUNC message if a store controller-only function is called in the terminal application.

* When programmable power is subsequently enabled, the pending power-OFF command will be issued if the power-ON time has not passed, or if the power-ON time is 999.

Dump System Storage: The Dump System Storage function causes all of the storage in the machine at which the request is made to be dumped to a disk file. Both the application and operating system storage are dumped.

The Dump System Storage function uses the following parameters:

FUNC = 1
PARM1 = Unused; the value is ignored.
PARM2 = Unused; the value is ignored.

Enable Terminal Storage Retention: This function enables storage retention on terminals. If this function is called in a non multiple-controller LAN (MCF Network), all the terminals on that TCC Network are enabled. If this function is called in a terminal, only that terminal's storage retention is enabled. If this function is called only from the acting master store controller in a multiple-controller LAN (MCF Network), all terminals on that network are enabled.

If the function is called in the terminal, the effect is temporary. The condition established in the controller overrides the temporary terminal condition. Whenever the terminals receive updates from the controller, terminal online updates occur when terminal-to-controller communications are interrupted or when system functions are used that require sending new status to a terminal.

The Enable Terminal Storage Retention function uses the following parameters:

FUNC = 2
PARM1 = Unused; the value is ignored.
PARM2 = Unused; the value is ignored.

Disable Terminal Storage Retention: This function disables storage retention on terminals. If this function is called in a non multiple-controller LAN (MCF Network), all the terminals on that TCC Network are disabled. If this function is called in a terminal, only that terminal's storage retention is disabled. If this function is called from only the acting master store controller in a multiple-controller LAN (MCF Network), all terminals on that network are disabled.

If the function is called in the terminal, the effect is temporary. See "Enable Terminal Storage Retention" on page 15-18.

The Disable Terminal Storage Retention function uses the following parameters:

FUNC = 3
PARM1 = Unused; the value is ignored.
PARM2 = Unused; the value is ignored.

Get Application Status Information: This function gathers status information and places it in the string variable you specify with PARM2. The information returns in ASCII data format. Use the MID$ statement to extract selected fields from PARM2. MID$ references the offset in the PARM2 string from the left which ensures that your program works properly if PARM2 size is extended.

The Get Application Status Information function uses the following parameters:

FUNC = 4
PARM1 = Unused; the value is ignored.
PARM2 = Specify a string variable.

Table 15-8 shows the data for the store controller application status.

Table 15-8 (Page 1 of 2). Store Controller Application Status

Offset	Length	Description
0	4	Store number
4	1	Date format: 1 = m/d/y 2 = d/m/y 3 = m.d.y 4 = d.m.y
5	1	Time format: 1 = h:m:s 2 = h.m.s
6	1	Monetary format: 1 = period convention (1,234,970.06) 2 = comma convention (1.234.970,06) 3 = French convention (1 234 970 06)

Table 15-8 (Page 2 of 2). Store Controller Application Status

Offset	Length	Description
7	1	Display type 0 = unknown display (for example CMOS information is invalid) 1 = monochrome display 2 = color display
8	3	Number of terminals configured (001 through 999)
11	4	Store controller ID 00CC through 00ZZ for this store controller
15	2	Reserved
17	2	Controller ID for the master is 00 if not found; otherwise CC through ZZ.
19	3	Printer lines per page 001 through 999
22	1	Number of digits after decimal point 0 or 2
23	1	This controller on an active LAN System = 1; else = 0.
24	2	Acting ID is a 2-byte ASCII field: • Controller is on LAN = 1 • Master = 16 • Alternate master = 8 • File server = 4 • Alternate file server = 2 • Or a combination of these (add the values) (for example, alternate master and alternate file server = 11; • Master and file server = 21 • Controller is not on LAN = 00
26	1	Printer associated with console (1 through 8)
27	1	Assigned console (0 through 8)
28	1	LAN Type: 0 = LAN not installed 1 = Token Ring 2 = Ethernet
29	51	Reserved

Table 15-9 shows the data for the terminal application status.

Table 15-9 (Page 1 of 3). Terminal Application Status

Offset	Length	Description
0	4	Store number
4	1	Date format: 1 = m/d/y 2 = d/m/y 3 = m/d/y 4 = d/m/y
5	1	Time format: 1 = h:m:s 2 = h:m:s
6	1	Monetary format: 1 = period convention (1,234,970.06) 2 = comma convention (1.234.970,06)

Table 15-9 (Page 2 of 3). Terminal Application Status

Offset	Length	Description
7	3	Terminal number (001 through 999)
10	1	Terminal online/offline 0 = offline 1 = online
11	1	Storage Retention 0 = disabled 1 = enabled
12	24	Default Application Name • device name - 8 character maximum (:) • file name - 8 character maximum (.) • file extension - 3 character maximum
36	1	Number of digits after decimal point 0 or 2
37	1	Terminal powered ON/OFF 0 = on 1 = off - Always on for Mod1; may be on or off for Mod2.
39	1	Backup (loop) 1 = Loop in backup 0 = Not in backup
40	1	System Display 1 = Display named ANDISPLAY is the system display 2 = Display named ANDISPLAY2 is the system display 3 = Display named VDISPLAY is the system display 4 = Display named VDISPLAY2 is the system display 5 = Display named ANDISPLAY3 is the system display
41		0 = Mod1 1 = Mod2
42	3	Partner terminal address
45	2	Current store controller ID
47	1	Video Display Adapter 0 = 4683 Video display feature A 1 = VGA
48	1	Application Environment 0 = Running in a terminal 1 = Running in a controller/terminal
49	2	Hard Totals NVRAM Size 01 = 1 KB Hard Totals (4683) 16 = 16 KB Hard Totals (4693/4694)
51	1	Terminal Type 1 (4693) 2 (4694) 3 (4683) 4 (4684)
52	1	Supporting Operating System 1 (4690 OS) 2 (4690 Terminal Services for DOS)

Table 15-9 (Page 3 of 3). Terminal Application Status

Offset	Length	Description
53	27	Reserved

Programmable Power: Programmable power allows terminal or controller applications to issue program calls to enable or disable the programmable power feature, and to issue program calls to power OFF a terminal or controller.

When the application calls the power-OFF function, it will specify the day and time that the power is to be turned back on. The time must be specified in the international format. A 0000 or 2400 will be accepted as midnight. The day of month is also specified and must meet either of the following criteria:

- If the day and time are prior to the current day and time, the day must be valid for the next calendar month.
- If the day and time are after the current day and time, the day must fall within the current month.

Note: Using 999 for the time will indicate that a power down is to be done without enabling a power-ON time.

The maximum time that a controller or terminal can be programmed to wait before powering-ON is one month plus or minus a few minutes due to clock variances.

Power OFF a Remote Controller: This function is used to power OFF a remote LAN (MCF Network) controller. This function can be invoked on a controller from any supported family (personal computer, 4684, or 469x). The controller on which this function is invoked must be the master controller in a LAN system. The remote controller being powered-OFF must be in the 469x family to have the programmable power feature. The day, hours, and minutes in the PARM2 string are the power-ON time.

This function uses the following parameters:

FUNC = 5
PARM1 = 1
PARM2 = *DDHHMMCC*
DD = is the day of month (01 - 31)
HH = The hours (00 - 24)
MM = The minutes (00 - 59)
CC = The controller ID (CC through ZZ)

Power OFF a Remote Terminal: This function is used to power OFF a remote terminal. The terminal can be store loop attached or token ring attached. This function can be invoked on a controller from any supported family (personal computer, 4684, or 469x). The controller on which this function is invoked must be the master controller if on a LAN (MCF Network) system, or from the stand-alone controller running either the store loop or token ring for terminals. The remote terminal being powered-OFF must be in the 469x family to have the programmable power feature. The day, hours, and minutes in the PARM2 string are the power-ON time.

This function uses the following parameters:

FUNC = 5
PARM1 = 2
PARM2 = DDHHMMTTT
DD = The day of month (01 - 31)
HH = The hours (00 - 24)
MM = The minutes (00 - 59)
TTT = The terminal number (001 - 999)

Disable Controller Programmable Power: This function is used to disable programmable power on the local controller. This function must be invoked on the controller on which programmable power is to be disabled. The controller on which this function is invoked must be in the 469*x* family to have the programmable power feature.

This function uses the following variables:

FUNC = 5
PARM1 = 3
PARM2 = Unused; the value is ignored.

Enable Controller Programmable Power: This function is used to enable programmable power on the local controller. This function must be invoked on the controller on which programmable power is to be enabled. The controller on which this function is invoked must be in the 469x family to have the programmable power feature.

This function uses the following parameters:

FUNC = 5
PARM1 = 4
PARM2 = Unused; the value is ignored.

Power OFF a Local Machine (Controller or Terminal): This function is used to power OFF a local machine. The machine may be a controller or terminal, provided that the controller or terminal is in the 469x family. This function should be invoked on the machine that is to be powered-OFF. The day, hours, and minutes in the PARM2 string are the power-ON time.

This function uses the following parameters:

FUNC = 5
PARM1 = 5
PARM2 = DDHHMM
DD = The day of month (01 - 31)
HH = The hours (00 - 24)
MM = The minutes (00 - 59)

Display Application Status Message: Interactive applications use this function to display status on the SYSTEM WINDOW CONTROL Screen. Applications started in Command Mode cannot use this function.

This function displays the specified text on the WINDOW CONTROL screen. It puts the message in the description field of the window for the application using this function.

The message is available any time you swap to the WINDOW CONTROL screen. It is displayed until the application ends. This message function provides one place where you can look to see the status of all active applications.

This function uses the following parameters:

FUNC = 25
PARM1 = Unused; the value is ignored.
PARM2 = Specify a string containing the message. This should not be modified.

Display Background Application Status Message: The following function gives status for background applications only. Applications started in Command Mode cannot use this function.

This function displays the specified text on the BACKGROUND APPLICATION CONTROL screen. It puts the message in the message field of the requesting background application. The message is available any time you swap to the BACKGROUND APPLICATION CONTROL screen. It is displayed until the application ends. This message function provides one place where you can look to see the status of all active background applications.

This function uses the following parameters:

FUNC = 26
PARM1 = Unused; the value is ignored.
PARM2 = Specify a string containing the message; this should not be modified.

Stop Application with Message: Interactive applications use this function to display status on the SYSTEM WINDOW CONTROL screen. Applications started in Command Mode cannot use this function. The primary purpose of this function is to handle initialization problems preventing the application from operating. It should not be used once the application has displayed its first screen.

After this function stops the application, it displays the message text that you have specified. It displays this text on the message line of the system screen used to start the requesting application.

This function uses the following parameters:

FUNC = 27
PARM1 = Unused; the value is ignored.
PARM2 = Use to pass a string containing the message; this should not be modified.

The message is displayed only if this function is requested by the current owner of the physical screen.

Get Disk Free Space: This function returns the amount of free space on the specified remote or local drive.

This function uses the following parameters:

FUNC = 28
PARM1 = Unused; the value is ignored.
PARM2 = Specify a node name (if non-local) and the drive or a logical name for the node or drive.

Get Configured Controllers on the Network: This function returns the IDs of all the store controllers on the network. Each ID is two bytes long. Store controller IDs range from CC through ZZ. A store controller ID of 00 indicates the end of the list.

This function uses the following parameters:

FUNC = 29
PARM1 = Unused; the value is ignored.
PARM2 = Specify a string variable.

Get the Controller ID for a Specified Terminal: This function returns the store controller ID for a terminal you specify.

The data returned is a negative return code, a numeric value for the store controller ID representing the ASCII values CC through ZZ or X'0' if the terminal was not defined.

Note: This function returns a controller ID CC through ZZ only if the function was issued at the master store controller or if the terminal is local to the controller issuing the function.

This function uses the following parameters:

RET = Always modified.
FUNC = 30
PARM1 = Number of the terminal for which the ID is requested.
PARM2 = Unused.

Convert ASCII Characters to EBCDIC Characters: This function converts ASCII characters in a string to EBCDIC characters.

This function uses the following parameters:

FUNC = 31
PARM1 = Unused; the value is ignored.
PARM2 = Specify a string of ASCII characters to be converted to EBCDIC; this string is modified to EBCDIC characters.

Convert EBCDIC Characters to ASCII Characters: This function converts EBCDIC characters in a string to ASCII characters.

This function uses the following parameters:

FUNC = 32
PARM1 = Unused; the value is ignored.
PARM2 = Specify a string of EBCDIC characters to be converted to ASCII; this string is modified to ASCII characters.

Terminal Dump Preservation: This function prevents terminal dumps from being written to the terminal dump file until the dump currently in the file can be copied to a diskette. This function is enabled by creating a user logical name ADXTDUMP.

The terminal dump preservation function automatically sets a flag whenever a terminal dump occurs. The preservation flag is reset after the dump is successfully copied to a diskette using the Create Problem Analysis Diskette function. The preservation flag is also reset when the Create Problem Analysis Diskette encounters an incomplete terminal dump and the user chooses to bypass copying the terminal dump to a diskette. While the flag is set, terminal dump requests will be rejected so that the dump currently in the terminal dump file will not be overwritten.

This function uses the following parameters:

FUNC = 33
PARM1 = Specify one of the following:
0 To turn off the terminal dump preservation flag
1 To turn on the terminal dump preservation flag
2 To query whether the terminal dump preservation flag is ON or OFF
PARM2 = Unused; the value is ignored.

Get Loop Message: This function gets the three most recent system messages for the store loop or token-ring adapter specified in PARM2. PARM2 is a string consisting of node (for example, CD), TCC Network (1 or 2), and three TCC Network messages.

The node and the TCC Network must be the first three characters of the string when the ADXSERVE function is called. When the ADXSERVE function returns, the three most recent messages will follow the node and TCC Network in the string. If no messages exist for the specified node and TCC Network, blanks will be returned for the messages. The oldest message will be put in the buffer first. Each message is 133 characters long.

This function uses the following parameters:

FUNC = 34
PARM1 = Unused; the value is ignored.
PARM2 = Specify a string containing node and TCC Network.

Get Loop Status: This function returns the configuration and current status of the two loop adapters. Data is returned in RET in the form *WWXXYYZZ* (hex) where:

ZZ = The 1st adapter configuration
YY = The 1st adapter status
XX = The 2nd adapter configuration
WW = The 2nd adapter status

The configuration is defined as:

00 = Not used
01 = Primary
02 = Secondary
04 = 2400 bps loop
80 = Auto-resume of Primary Loop Control

The status is defined as:

03 = Standby
04 = Controlling
05 = Prevented

This function uses the following parameters:

FUNC = 35
PARM1 = Unused; the value is ignored.
PARM2 = Unused; the value is ignored.

Get All Active Controllers on the Network: This function returns the IDs of all the active store controllers on the network. Each ID is two bytes long. A store controller ID of 00 indicates the end of the list.

This function uses the following parameters:

FUNC = 36
PARM1 = Unused; the value is ignored.
PARM2 = Specify a string variable.

Get Controller ID and Loop ID for a Specified Terminal: The data returned in RET is two bytes for the Loop ID followed by the two bytes for the controller ID. A `X'01'` is returned if the terminal number cannot be found.

Note: The RET is valid only if this function is issued at the master store controller.

This function uses the following parameters:

FUNC = 37
PARM1 = Terminal number.
PARM2 = Unused; a string variable.

Get the Controller Machine Model and Type: This function retrieves the machine model and type and places the 3-byte hexadecimal values to the left in the RET parameter. The 3-byte hexadecimal values will be returned in PARM2 if PARM2 is specified. Use the MID$ statement to extract the individual bytes from PARM2. The MID$ statement references, from the left, the offset in the PARM2 string.

This function uses the following parameters:

RET = INTEGER*4 with the 3 most-significant bytes containing the machine model and type. The least-significant byte is always zero. Identical to the contents of PARM2.
FUNC = 38
PARM1 = Unused, the value is ignored.
PARM2 = 3 hexadecimal values left-justified machine model and type. For example, for a 4693-541, the values returned are:
X'F8'
X'3E'
X'00'.

Check the Master or File Server Exception Log: This function returns whether or not there are any entries in the exception log.

This function uses the following parameters:

RET = One of the following values:
0 = No entries in the exception log
1 = Entries exist in the exception log
8xxxxxxx = Error code indicating why the status of the exception log cannot be obtained.
FUNC = 39
PARM1 Specify one of the following values:
1 = Check the Master exception log
2 = Check the File Server exception log
PARM2 = Unused

Set Terminal Sleep Mode Inactive Timeout: This function allows an application running in a store controller to set the Terminal Sleep Mode Inactive Timeout. When you enable Terminal Storage Retention, you set this value to determine how many minutes a terminal will remain idle before being powered-down.

Note: This function is supported only on the store controller. In order for the sleep mode inactive timeout to take effect, you must invoke this function before enabling the Terminal Storage Retention. You may also specify the terminal sleep mode inactive timeout by selecting the Enable Terminal Storage Retention option on the TERMINAL FUNCTIONS screen. The default for the terminal sleep mode inactive timeout is 30 minutes.

This function uses the following parameters:

FUNC = 41
PARM1 = Terminal Sleep Mode Timeout value. Valid values are 0 through 255. You can use a 0 value to disable the terminal sleep mode.

PARM2 = Unused; a string variable.

Enable/Disable IPL: Terminals are able to run offline from the controller. The primary reason to run offline is if there is a problem with the controller.

In many cases, maintenance is applied to the controller to correct the problem. One of the modules that may be applied to the controller as maintenance is the terminal operating system (ADXRT1SL.286). The controller and terminal interact to ensure the terminal is running the latest terminal operating system. The latest is the terminal operating system file currently being used on the controller. The controller is IPLed to apply maintenance. If the terminal is not running the same level of the operating system that exists in ADX_SPGM on the controller, the terminal is IPLed to load the latest terminal operating system.

When the terminals run offline, the application can write the transaction data to the terminal RAM disk. This allows the terminals to run offline while a controller problem is being addressed. The terminals eventually communicate with the controller and transfer all saved transactions in terminal RAM disk to normal transaction files in the controller. If the terminal is IPLed prior to the completion of the saved transaction movement to the controller, the saved transactions are lost.

Enable/Disable IPL allows an application program that is processing in a terminal to temporarily prevent automatic reloading of the terminal. Automatic terminal reload can occur when the terminal is offline and returns online or when an operator requests the Load Terminal Storage Function with an "*" specified as the terminal number. Automatic terminal reloads can also occur when ADXCS20L is invoked with the Load All Terminals function code.

Application programs should use the Disable IPL function when the terminal application recognizes that it is offline and begins to save data on the RAM disk. When the terminal application recognizes it is online with the controller, the saved data can be transferred to the controller. After all data has been transferred to the controller, the terminal application can use the Enable IPL function to allow any possible IPL.

The requests to enable and disable the IPL of the terminal for the Mod1 and the Mod2 are handled independently. If a Disable Terminal IPL was outstanding on both terminals and one terminal's application issued an "Enable Terminal IPL" request, an IPL is not possible for the Mod1 and the Mod2 pair. Both terminals must have the IPL enabled before an IPL can occur.

| ***Load Specific Terminal:*** This function allows an application running in a store controller to load a
| specific terminal.

| This function uses the following parameters:

| *FUNC* = 42
| *PARM1* = Terminal Number
| *PARM2* = Unused; a string variable

Using the Enable IPL Function: This function enables the terminals to IPL. If terminals were IPLed earlier, but could not because the user had disabled the IPL, requesting this function would cause the terminals to IPL.

To enable terminal IPL, use the following parameters:

FUNC = 53
PARM1 = Unused; the value is ignored.
PARM2 = Unused; the value is ignored.

This function is also used to enable programmable power. It allows the terminal to accept power-OFF commands. If a previous power-OFF command had been issued while programmable power had been

disabled, and the power-ON time had not yet passed, this function would cause the terminal to power down.

Using the Disable Terminal IPL Function: This function prevents the automatic reload which may occur when a terminal comes online. This function allows the terminal application to effectively use the terminal RAM disk support for temporarily logging data. In most cases, when the controller returns online, the terminal application transfers the saved transaction files to the controller.

To disable terminal IPL, use the following parameters:

FUNC = 54
PARM1 = Unused; the value is ignored.
PARM2 = Unused; the value is ignored.

This function is also used to disable programmable power. It allows the terminal application to block or delay a power down command.

ADXERROR (Application Event Logging): Your application can use a routine called ADXERROR to make entries in the system log and optionally display system messages. The routine should be declared as follows:

```
FUNCTION ADXERROR (TERM,MSGGRP,MSGNUM,SEVERITY,EVENT,UNIQUE) EXTERNAL
INTEGER*2 TERM,MSGNUM,ADXERROR
INTEGER*1 SEVERITY,MSGGRP,EVENT
STRING    UNIQUE
END FUNCTION
```

Invoke the routine using this request:

```
i%=ADXERROR(....)
```

The function always returns zero and uses the following parameters:

TERM The parameter is the terminal number. This information comes from the GET APPLICATION STATUS INFORMATION application service request in the terminal. If the application calling this routine resides in the store controller, the TERM parameter should be zero.

MSGGRP The (message group) parameter is a one-byte integer that contains the ASCII equivalent of the message group character. The message group is unique for each product and should be in the range of J to S.

MSGNUM The message number, if any. The message number should be zero if no message is to be displayed. The system takes this number and converts it to three printable decimal digits, which it appends to the message group to form the message identifier. The message identifier is used to scan the Application Message file. Your application must provide this file for the system message display.

SEVERITY A number ranging from 1 to 5 that is used to indicate the importance of each message. The system uses the field as a message level indicator. The most important messages have a 1 in this field. The operator can request a message level from 1 to 5, and only messages whose severity number is less than or equal to the current message level appears.

EVENT A one-byte integer whose value is completely determined by the application. It can be used to indicate why the request is being made.

For store controller application events 64 to 79, decimal, and terminal application events 64 to 81, decimal, the system uses the log data to generate Network Problem Determination Alert (NPDA) messages. For a description of NPDA support, refer to the *IBM 4690 Store System: Communications Programming Reference*.

UNIQUE A string of up to 10 bytes of data. This data is included in the log entry made as a result of this request. If the data is longer than 10 bytes, the system uses the first 10 bytes. If it is shorter, the system pads the entry with blanks.

Note: The system automatically includes the application name in the log entry.

Application Message Logging: The system references a message display file that your application can provide for messages. This file is called ADXCSOZF.DAT and must be in subdirectory ADX_IPGM:.

This message file contains fixed length records, so entries must follow this format:

```
cXXX_sssssssss
```

where:

c = 1-character message group passed through parameter MSGGRP to application services.
XXX = 3-digit message number passed through parameter MSGNUM to application services.
_ = Blank space.
sssssssss = Message text explaining the message. This text must fill 106 character spaces. If the message text is not that long, pad it with blanks.

Note: The 106-character message is displayed as two lines of 53 characters, so be careful of word breaks in your message text.

The system uses the first four characters (*cXXX*) of the message to scan the message file for a match. If it finds one, the system displays the message identifier and accompanying text on the SYSTEM MESSAGE DISPLAY screen.

Chaining Applications

Chaining means to transfer control from a currently executing application program directly to another application program. Before the CHAIN statement is issued, any Display Manager files must be closed using the CLSDIS command. Failure to do this results in a loss of system resources needed to open files. Chaining can be performed in one of two ways: chaining to a directly executable module or chaining to an overlay. Directly executable modules have a file extension of 286. Overlays have a file extension of OVR.

Refer to the *IBM 4680 BASIC: Language Reference* for more information on chaining.

Chaining to Overlays

Chaining to overlays is supported only in the store controller.

You can share data with an overlay by using common variables. You cannot pass parameters to an overlay with the CHAIN statement. Applications using overlays are made up of a root section and overlay sections.

The root section should define all the public functions and subprograms that overlays need to use. This allows the overlays to share a single definition of the function or subprogram instead of each overlay having its own copy of the function or subprogram. You can chain from the root to an overlay and from one overlay to another. You cannot chain from an overlay to the root.

When you chain to an overlay, execution begins at the first executable statement in the program. If you use overlays, you must link edit your application with its own copy of the runtime subroutine library, because a shared copy of the runtime library does not support overlays.

Chaining to Directly Executable Modules

Chaining to directly executable modules is supported in both the store controller and the terminal.

You can share data by passing parameters to the modules in the CHAIN statement. When a directly executable module is chained to, execution begins at the first executable statement in the program. Directly executable modules can use a shared copy of the runtime subroutine library.

RAM Disk Files

The 4690 Operating System also supports another type of in-memory file called *RAM disks*. A RAM disk is a section of memory set aside for use as a high-speed disk storage device. RAM disks improve performance by reducing the amount of time it takes to load frequently-used programs and by redirecting existing application access to files in memory rather than to a hardware disk. RAM disk files can be used for both the store controller and the point-of-sale terminal.

The IBM 4690 Operating System allows you to optionally install up to four virtual disks in the controller's RAM memory and up to two virtual disks in the terminal's RAM memory. Virtual disks can be automatically installed at IPL if your system is configured for RAM disk memory.

The controller's optional disks are named disk devices T:, U:, V:, and W:. Terminal applications can access only disk T:. Controller applications can access all disks.

The terminal's optional disks are named disk devices X: and Y:. Terminal applications can access these disks, but controller applications cannot.

Considerations for Installing RAM Disks

RAM disk installation is specified during the configuration process. You can specify the RAM disk size in increments of 32K bytes and the number of directory entries in increments of 16.

Note: Terminal RAM disk is created using the RAM disk information found in the Mod1 terminal device group record only. Mod2 terminal device group records are erased when creating terminal RAM disks.

Some characteristics of RAM disks are fixed and cannot be redefined by the user. These characteristics include:

Sector size 512 bytes
Cluster size 512 bytes
Track size 8 sectors

The maximum disk size is dependent on the terminal memory size, space available, and number of files. Disk memory is allocated in increments of 32 KB. Directory space is allocated in increments of 16 files. FAT space is calculated based on the number of sectors.

Accessing RAM Disk Files from Controller Applications

In controller applications, all operating system file commands can be executed for RAM disk files, and your IBM 4680 BASIC applications can OPEN, CLOSE, TCLOSE, READ#, or WRITE# to RAM disk files.

Data on the RAM disks is lost during a power outage. Therefore, you should set checkpoints during processing for copying the data from the RAM disk to the hardware disk. The distribution characteristics of RAM disks are similar to those of diskettes: files are not distributed. However, options of ADXCOPYF allow preservation of distribution attributes so that distribution occurs when the files are copied to the fixed

disk. For information on how to copy files from the RAM disk, refer to the section on “ADXCOPYF (Copying RAM Disk Files)” on page 15-32.

Accessing Controller RAM Disk Files from Terminal Applications

Your terminal application can use all IBM 4680 BASIC statements, which are used for the controller’s fixed disks or diskettes, to access RAM disk T: RAM disk U:, V:, and W: cannot be accessed. In addition, use ADXCOPYF to copy files in the controller, regardless of which disk contains them.

Accessing Terminal RAM Disk Files from Terminal Applications

Your terminal application can access the controller RAM disk with the same IBM 4680 BASIC statements that it uses to access hard disks and diskettes on the controller. Terminal applications cannot use BASIC statements to access controller RAM disks U:, V:, and W:. Your application can call ADXCOPYF to copy files between the controller and terminal, regardless of which disk contains the files.

ADXCOPYF (Copying RAM Disk Files): The subprogram is designed specifically for RAM disk files, but can be used on any files when the target file is on the same controller as the source file. This subprogram is not supported for copying files across the LAN (MCF Network).

Warning: If ADXCOPYF fails, the target file is deleted, because partial data might have been written. Therefore, if ADXCOPYF fails while copying to a file which already exists, that file is erased.

When you specify a filename for this routine you must specify the exact filename that you want to copy. You must also specify the exact source and target filenames. Do **not** use global (or wildcard) filename characters. The ADXCOPYF subroutine is in the system runtime library: ADXACRCL.L86 for store controller applications, ADXUCRTL.L86 for terminal medium memory model applications, and ADXUCLTL.L86 for terminal big memory model applications.

ADXCOPYF issued from a terminal will always attempt to transmit to all terminals requesting a file at the same time.

Your 4680 BASIC application should include a declaration similar to the following:

```
SUB ADXCOPYF (RETC,INFILE,OUTFILE,OPT0,OPT1) EXTERNAL
  INTEGER*4 RETC
  STRING    INFILE,OUTFILE
  INTEGER*2 OPT0,OPT1
END SUB
```

The function is invoked as follows:

```
CALL ADXCOPYF (retc,infile,outfile,opt0,opt1)
```

Where:

retc = A 4-byte integer return code.

infile = A string containing the file name to be copied from (source file).

Note: For the terminal ADXCOPYF, the total length of a controller input file name must be less than 25 characters. You can use a logical name to avoid this restriction. See “Using Logical Names” on page 2-11 for more information.

outfile = A string containing the filename to be copied to (target file).

opt0 = A 2-byte integer indicating whether or not copy operation should be performed:

0 = File is copied whether or not the output file already exists.
1 = Error message (-2008) is returned if the file already exists and the file is not copied.

opt1 = A 2-byte integer used to indicate distribution on a LAN (MCF Network) system (only for 4680 Version 2):

0 = Keep the distribution on the output file the same as on the input file.
1 = If the output file exists, keep the same distribution.
2 = Make the output file local.

Table 15-10 shows the ADXCOPYF defined return codes and their descriptions:

Table 15-10. ADXCOPYF Return Codes

Return Code	Description
0	Successful copy
Error codes for open on input file	
-2001	An incorrect file name on the input file
-2002	File in use on the input file
-2003	Input file not found
-2004	Ownership differences
-2005	Incorrect device for input file
Error codes for open on output file	
-2006	Invalid file name on the output file
-2007	File in use on the output file
-2008	File already exists and user-specified not to delete
-2009	Incorrect device for output file
Error codes for reading the input file	
-2011	Error reading the input file
Error codes for writing to the output file	
-2016	Hardware error writing to the output file
-2017	Insufficient space for the output file
-2018	Unable to allocate Read/Write buffer for copy
Error code for closing the input file	
-2021	Error closing the input file
Error code for closing the output file	
-2026	Error closing the output file
Error code for renaming the temporary file	
-2031	Rename error

Store Controller Application Services

| This section contains routines that are available only to applications on the store controller. These
| routines are in runtime library ADXACRCL.L86.

ADXFILES (Canceling the Shared Use of a File): ADXFILES cancel the shared use of a file such as the transaction log. Without the use of ADXFILES, a shared file cannot be renamed or deleted because it is in use by more than one user.

Some of the conditions that can cause file sharing problems are incomplete transactions, terminal hardware failures, incomplete controller functions, and software failures. ADXFILES provides the following functions to manage the canceling of shared file usage:

- Restricting a file for exclusive use
- Unrestricting a file that was restricted
- Determining despool status

Your 4680 BASIC application should include a declaration similar to the following:

```
SUB ADXFILES (RET,FUNC,PARM1,PARM2) EXTERNAL
INTEGER*4 RET
INTEGER*2 FUNC, PARM1
STRING    PARM2
END SUB
```

ADXFILES Restrict: ADXFILES restrict forces the exclusive use of a single file. This function is intended to be used only for store closing procedures and should not be used as a general purpose function.

ADXFILES restrict function causes all applications currently using that file to lose their access to that file until they have closed and reopened the file. When an application attempts to use a file that has been restricted, the file request is rejected and a new return code is returned. In the controller the return code is 80F306F0 and the associated ERR code in BASIC is *I. In the terminal, the first terminal access to a restricted file receives a 80F306F0 and subsequent accesses (by the same or other terminals) receive a 80004007 (bad file number). Both of these return codes in the terminal have an associated ERR code of *I. When an application has a file open and receives either of these return codes for a file request, it should close and reopen that file.

- Purpose:

  To restrict the use of a file by all other applications. The restrict applies to applications on all controllers and all terminals. To restrict the use of a mirrored or compound file you restrict the prime version of the file on the file server or master respectively. You cannot use restrict for a distribute-on-close type file. After a file is restricted:

  – It cannot be opened by any application.
  – An application that is using a file that is restricted by another application must close and reopen a file to use the file again.

- Restrictions:

  – Only one ADXFILES to restrict a file can be active at a time.
  – To restrict a file on a file server or a master the controller application executing the restrict must be connected to the active file server or master.
  – To restrict a mirrored file or compound file an application must restrict the prime version of the file.
  – A distribute-on-close type file cannot be restricted.

- Location of usage:

  – Any application on any controller.
  – It cannot be used by a terminal application.

- Calling sequence:

  `CALL ADXFILES (`*`ret,func,parm1,parm2`*`)`

where:

RET = 4-byte integer that indicates the status of the restrict function

hi lo
xx xx yy yy = Indicates how the file was being used when the restrict was executed:

xxxx = Number of other controller applications that were using this file when it was restricted.

yyyy = Number of controllers where terminal applications were using this file when it was restricted.

0000 = No other application has the file open.

80 F3 06 F4 = Application attempted to restrict a file while another restrict is active.
80 F3 06 F5 = Application attempted to restrict a distribute-on-close file.
80 F3 06 F6 = Application attempted to restrict the file on the wrong node.
8x xx xx xx = Any other operating system error return code.
-1201 = Invalid function code used for the FUNC values defined for ADXFILES.
-1202 = PARM1 is not defined.
-1203 = PARM2 is not defined.
-1204 = PARM2 is not a valid file name.
-1205 = Force Close support is not installed.

FUNC = 1 (This is the restrict function code for ADXFILES.)

PARM1 = Unused; the value is ignored.

PARM2 = String containing the file name of the file to be restricted. The name may be a logical name or a fully-qualified file name. To reference a mirrored or compound file use the generic node names for the file server and the master:

- for file server use ADXLXACN::
- for master use ADXLXAAN::

Note: When an application attempts to use a file that has been restricted, you receive either an 80F306F0 or an 80004007 (in BASIC, ERR code = *I). The error recovery should not be done in the ON ERROR code. The ON ERROR code should indicate that an error has occurred and the file should be closed and reopened. The indication should be made to the code that uses the file. The reopen should provide a delay and retry mechanism because the file remains restricted until it is unrestricted by the application.

For example, you can declare a global variable in the program. If the ERR code is *I and ERRN is either 80F306F0 or 80004007, set a special value to the global variable in the ON ERROR routine to indicate that the file has been restricted by another application. Then RESUME to the statement following the failing statement. The program can then check for the special value in the global variable set in the ON ERROR routine. If the value is set, perform the error recovery.

ADXFILES Unrestrict: ADXFILES unrestrict stops the effect of the ADXFILES restrict. The unrestrict is requested for the same file name that was used for the restrict even if the file was renamed while it was restricted. After the unrestrict is executed that file name may be used by all applications again.

- Purpose:

  To unrestrict the use of a file that had been previously restricted. To unrestrict the use of a Mirrored or Compound file, unrestrict the prime version of the file on the File Server or Master respectively. After a file is unrestricted:

  - The file name can be used to open files according to the normal guidelines.
  - An application that lost access to a file due to restrict must issue a CLOSE followed by an OPEN after the unrestrict is issued to gain access to the file again.

- Prerequisites:

  The application executing the unrestrict ADXFILES must have executed the restrict ADXFILES.

- Restrictions:

  If an application is unrestricting a file on a file server or a master, the controller executing the application must be connected to the active file server or master.

- Location of usage:

  – Any application on any controller.
  – It cannot be used by a terminal application.

- Calling sequence:

  ```
  CALL ADXFILES (RET,FUNC,PARM1,PARM2)
  ```

  RET = 4-byte integer that identifies the unrestrict status.

hi lo	
00 00 00 00	= Unrestrict is successful.
80 F3 06 F2	= Application attempted to do an unrestrict without doing a restrict.
80 F3 06 F3	= Application attempted to unrestrict a file that it did not have restricted.
8x xx xx xx	= Any other OS error return code.
-1201	= Invalid function code.
-1202	= PARM1 is not defined.
-1203	= PARM2 is not defined.
-1204	= PARM2 is not a valid file name.
-1205	= Force Close support is not installed.

  When an unsuccessful unrestrict is executed because of a LAN failure (80 60 *xx xx*), the application should wait 30 seconds and retry the unrestrict. This should be repeated for a total of 7 executions of unrestrict.

  FUNC = 2 (This is the unrestrict function code for ADXFILES.)

  PARM1 = Unused; the value is ignored.

  PARM2 = String containing the file name of the file to be restricted. The name can be a logical name or a fully qualified file name. To reference a mirrored or compound file use the generic node names for the file server and the master store controller:

  – For file server use ADXLXACN::
  – For master use ADXLXAAN::

ADXFILES Despool: ADXFILES despool determines how many total bytes of data remain in all the spool files and how many controllers have spool files. By using this function the applications can determine that the store personnel should be notified that a store closing must be delayed and can give the store personnel an idea of the length of the delay.

- Purpose:

  This function determines the status of the operating system despooling of files. This function determines how many bytes of data are yet to be despooled and how many controllers have data in their spool files to be despooled. The values determined by this function are probably different than the sizes of the spool files because the size of the spool files are not set to zero until all the data has been despooled from them.

- Prerequisites:

  None currently identified.

- Restrictions:

  This function can only determine despool status for controllers that are currently in session with this controller on the LAN.

- Location of Usage:
  - Any application on any controller.
  - It cannot be used by a terminal application.

- Calling sequence:

  ```
  CALL ADXFILES (RET,FUNC,PARM1,PARM2)
  ```

  RET = 4-byte integer that specifies the despool status.

  hi lo

  0w xx yy yy = where:

  w = Status of LAN communications.

  0 = Means all controllers are communicating with this controller.

  8 = Means one or more controllers are not communicating with this controller.

  xx = Number of communicating controllers with data to despool.

  yyyy = Total number of bytes (in 1000s) of data to be despooled by controllers communicating.

  00 00 00 00 = The system supports LAN and there is no despooling to do or the system does not support LAN.

  8x xx xx xx = Any operating system error return code.

  -1201 = Invalid function code.

  -1202 = PARM1 is not defined.

  -1205 = System supports LAN but Force Close support is not installed.

  FUNC = 3 (This is the despool function code for ADXFILES.)

  PARM1 = Unused; the value is ignored.

  PARM2 = Unused; the value is ignored.

ADXCSEOL (Store Closed Query Application): ADXCSEOL is a 4690 Operating System application that determines if the store has been closed to allow end of day processing to begin.

For example, you may want to start the end of day processing in every store in your IBM 4690 Store System network. Before starting this processing you must be sure that each store is closed. *Closed* means you are no longer processing transactions. To determine if all the stores are closed, invoke ADXCSEOL in each store using the NetView* DM INITIATECLIST command. The code returned to NetView DM from the 4690 controller may indicate the store is still processing sales transactions. In this case the NetView DM plan which starts the end of day processing bypasses the store.

The ADXCSEOL application is written in IBM 4680 BASIC and allows for a user exit. The user exit determines the status of the store. If a zero (0) is returned to the main program, the store is closed. If the

store is open, the return code is a negative one (-1). The return value is defined as INTEGER*4. ADXCSEOL returns the code to the operating system.

A user exit is required because determination of the store being closed differs for each sales application product. The name of the user exit must be ADXCSEUR. You must link your user exit with the base application to form ADXCSEOL. The default user exit returns a store closed status of -1 which is open.

The purpose of this user exit routine is to enable you to write code in 4680 BASIC to accomplish any processing that you want. For example, printing reports or saving critical data files.

The subroutine should terminate with a recognizable return code that is returned to the host.

A user exit subroutine is available for the IBM General Sales Application. It queries the store status field in the terminal status file and return a code of zero (closed) or negative one (open). For other sales applications, a user exit is not available.

ADXEXIT (Set the ERRORLEVEL VALUE): ADXEXIT can be used in a BASIC application to set the ERRORLEVEL value that can be tested in a BAT file. This value provides a way for a BAT program to test the results of a BASIC program that it has invoked.

Calling ADXEXIT terminates the calling program and sets a 2-byte integer that is used to set the ERRORLEVEL value for a BAT file. To call ADXEXIT in a BASIC program, you must first define it as follows:

```
SUB ADXEXIT (PARM1) EXTERNAL
INTEGER*2 PARM1
END SUB
```

To call ADXEXIT, your code should be similar to the following:

```
ERRORLEVEL = 20
CALL ADXEXIT (ERRORLEVEL)
```

The allowed values for the 2-byte integer are 0 to 32,767.

In addition, the BASIC program calling ADXEXIT must be linked with the ADXACRCL.L86 file containing ADXEXIT.

To test the value of errorlevel in a BAT file, test in descending order as in the following example:

```
IF ERRORLEVEL 500 GOTO T500
IF ERRORLEVEL 20  GOTO T20
IF ERRORLEVEL 19  GOTO T19
IF ERRORLEVEL 1   GOTO T1
   (this statement would be executed if ERRORLEVEL is 0)
:T500
    (this statement would be executed if ERRORLEVEL is 500 or more)
:T20
    (this statement would be executed if ERRORLEVEL is 20 to 499)
:T19
    (this statement would be executed if ERRORLEVEL is 19)
:T1
     (this statement would be executed if ERRORLEVEL is 1 to 18)
```

This section lists functions available only to applications running at the store controller. Use the ADXSERVE request call for these functions.

ADXSERCL (Closing an Application Service): This subprogram is used by controller applications to close ADXSERVE. The ADXSERCL subprogram is to be used only before chaining from an application that invoked ADXSERVE. If ADXSERVE was not invoked, ADXSERCL does not affect the operating system.

ADXSERCL allows applications that chain to deallocate system resources. These resources are allocated the first time the application uses ADXSERVE. It is not necessary to close ADXSERVE each time it is used. If an ADXSERCL is used after each execution of ADXSERVE, system performance is impaired.

Warning: If you have invoked ADXSERVE and you are not chaining applications, ADXSERCL must not be used.

The ADXSERCL routine for store controller applications is written in IBM 4680 BASIC. The application should include the following declaration statement:

```
SUB ADXSERCL EXTERNAL
END SUB
```

The subprogram is invoked as follows:

```
    Call ADXSERCL
```

Terminal Application Services

This section lists routines that are available only to applications at the terminal.

ADXDIR (Listing Terminal RAM Disk Files): Terminal applications use the ADXDIR subprogram to list the files in RAM disks X: and Y: and the amount of free space on the disks. This subprogram displays the same type of information about terminal RAM disks that the DIR command displays about controller disks. The ADXDIR subprogram is in the system runtime subroutine library ADXUCRTL.L86 for medium memory model terminal applications and ADXUCLTL.L86 for big memory model terminal applications.

The 4680 BASIC terminal application must contain a routine similar to the following:

```
SUB ADXDIR (RETC,DISKID,OUTINFO,FILEINDX) EXTERNAL
INTEGER*4 RETC
STRING  DISKID,OUTINFO
INTEGER*2 OPTION
END SUB
```

The SUBPROGRAM is called as follows:

CALL ADXDIR *(retcode,disk,direntry,opt)*

where:

retcode = 4-byte integer return code.

disk = String containing the disk ID (X: or Y:) and optionally continuing with a file name with or without global file name characters (*).

direntry = String that contains information for one directory entry on return to the caller.

opt = Option indicating whether the first or next directory entry is desired. An integer value of 0 indicates first and 1 indicates next.

The ADXDIR subprogram is typically called within a loop in the application, such that each repetition of the loop passes the information for a directory entry. The *opt* parameter should indicate the first entry on the first repetition of the loop, and it should indicate the next entry on the following repetition. When the application is executing such a loop, the ADXDIR subprogram passes information for each file on the RAM disk in the *direntry* string as the loop progresses. As the loop is executed and file information is passed in the *direntry* string, the application can display it, collect it, or send it to an application in the controller, for example. When information for all existing files has been passed, the *retcode* indicates this condition and the application can terminate the loop.

Table 15-11. Successful ADXDIR Return Codes that do not imply error conditions.

Return Code	Description
0	Indicates successful passing of file information
1	Indicates no more files on the disk

Table 15-12. ADXDIR Error Return Codes that imply error conditions.

Return Code	Description
3001	Indicates the disk ID is not X: or Y:
3002	Indicates the requested X: or Y: disk is not configured.

The *direntry* string is formatted as follows on return from ADXDIR:

If the return code is 0:

file name –8 characters
blank –1 character
file extension –3 characters
blank –1 character
file size –7 characters
blank –1 character
date –8 characters
blank –1 character
time –6 characters

blank	–1 character
number of files	–3 characters
blank	–1 character
number of free bytes	–7 characters
blank	–1 character

If the return code is 1, the *direntry* string contains the number of files and the number of free bytes in the positions indicated above, but all other positions contain blanks.

Extended Memory Management for the IBM Point of Sale Terminal: Extended memory management is an alternative to terminal RAM disk. It is typically used when the terminal does not have enough memory for the RAM disk, but the application needs more memory for data than its 64K data segment. Extended memory management is a library of subroutines that is linked with the terminal application. There are two sets of libraries available that contain these subroutines: ADXMEM0L.L86 and ADXMEM1L.L86 are used when linking an application that was compiled using the 4680 CBASIC medium memory model compiler; ADXMEL0L.L86 and ADXMEL1L.L86 are used when linking an application that was compiled using the 4680/90 CBASIC big memory model.

ADXMEM0L.L86 and ADXMEL0L.L86 libraries contain subroutines that allow the application to allocate, free, read, write, and search the memory. ADXMEM1L.L86 and ADXMEL1L.L86 libraries contain subroutines that allow the application to insert and delete keyed records in memory. Applications in the Mod1 and Mod2 terminals can share a section of memory while using any of these routines.

The subroutines are linked by adding the appropriate library to your link input file.

Notes:

1. If you are a *medium* memory model user: If you use only extended memory management routines contained in the ADXMEM0L.L86 library, you do not need to link with the ADXMEM1L.L86 library. If you use any routines contained in the ADXMEM1L.L86 library, you must also link with the ADXMEM0L.L86 library. Also, the ADXMEM1L.L86 library must precede the ADXMEM0L.L86 library in the link order to avoid link errors.
2. If you are a *big* memory model user: If you use only extended memory management routines contained in the ADXMEL0L.L86 library, you do not need to link with the ADXMEL1L.L86 library. If you use any routines contained in the ADXMEL1L.L86 library, you must also link with the ADXMEL0L.L86 library. Also, the ADXMEL1L.L86 library must precede the ADXMEL0L.L86 library in the link order to avoid link errors.

The following table describes each subroutine and defines its library name.

Subroutine	Description	Medium Memory Model Library Name	Big Memory Model Library Name
GETMEM	Allocate a memory file	ADXMEM0L.L86	ADXMEL0L.L86
OPENMEM	Gain access to a shared memory file	ADXMEM0L.L86	ADXMEL0L.L86
MEMSYN	Gain mutually exclusive access to shared memory	ADXMEM0L.L86	ADXMEL0L.L86
MEMUNSYN	Release mutually exclusive access to shared memory	ADXMEM0L.L86	ADXMEL0L.L86
FREEMEM	Free a memory file	ADXMEM0L.L86	ADXMEL0L.L86
AVAILMEM	Query available free memory	ADXMEM0L.L86	ADXMEL0L.L86
MEMWRITE	Write data to a memory file	ADXMEM0L.L86	ADXMEL0L.L86

Subroutine	Description	Medium Memory Model Library Name	Big Memory Model Library Name
MEMREAD	Read data from a memory file	ADXMEM0L.L86	ADXMEL0L.L86
MEMSRCHB	Binary search for matching field	ADXMEM0L.L86	ADXMEL0L.L86
MEMSRCHS	Sequential search for matching field	ADXMEM0L.L86	ADXMEL0L.L86
MEMWRKEY	Insert keyed records into a memory file sequenced in ascending order by key	ADXMEM1L.L86	ADXMEL1L.L86
MEMDLKEY	Delete keyed records from a memory file sequenced in ascending order by key	ADXMEM1L.L86	ADXMEL1L.L86
MEMCLEAR	Clear a memory file	ADXMEM1L.L86	ADXMEL1L.L86

Using Extended Memory Management: A section of memory that is managed by these subroutines is called an *in-memory file*. An in-memory file is not the same as a RAM disk file. In-memory files have much less overhead than RAM disk files. In-memory files are intended for terminals that have 1 MB of memory. Normally these terminals do not contain enough memory for RAM disk use.

The subroutines can be divided into five different categories, according to their functions.

1. The first category contains subroutines that are used to access or to release access to memory. GETMEM is used to allocate a section of memory of a size specified by the application. GETMEM has an option to allocate a section of memory that can be shared by other applications. If another application needs to access an in-memory file that was allocated in this way, it issues an OPENMEM call. It can then access the in-memory file just as if it had allocated it by issuing GETMEM. FREEMEM is used to release access to an in-memory file. In the case of shared in-memory files, the memory is released when the last application issues the FREEMEM against the in-memory file.

2. The second category contains subroutines which read and write the memory. These subroutines function the same whether or not the in-memory file is shared. The simplest subroutines are MEMREAD and MEMWRITE.

   MEMSRCHS is a routine that is used for a sequential search of an in-memory file for a particular key. MEMSRCHB is used for a binary search. MEMSRCHB should be used for doing searches only if the in-memory file is sequenced by a key in ascending order; otherwise MEMSRCHS should be used. The MEMWRKEY subroutine is used to build a key sequenced memory file. A binary search is faster than a sequential search, but a binary search does not work if the data is not sorted.

   Using the MEMSRCHS and MEMSRCHB subroutines, the caller passes a search argument, search argument length, and the offset into the in-memory file records of the key. The search argument is compared with the key. If they match, the search completes successfully.

3. The third category of subroutines is used by applications to synchronize access to shared in-memory files. If an application temporarily needs exclusive access to a shared memory file, it should call MEMSYN before beginning the access. After it is finished with the access it should call MEMUNSYN.

   Following is an explanation of how MEMSYN and MEMUNSYN are used. There are two applications: application A and application B. They share an in-memory file. The in-memory file contains a counter that is incremented at the end of every transaction, so that it contains the total number of transactions that have occurred on the Mod1 and Mod2 pair. At the end of each transaction, the application must read in the counter using MEMREAD, increment it, and write it back using MEMWRITE.

If the applications are not using MEMSYN and MEMUNSYN, the following happens: application A finishes a transaction. It reads in the counter using MEMREAD. Application A is preempted by application B, which is also finish a transaction and read in the counter. Application B increments the counter and writes it back using MEMWRITE. Application A runs again. It increments its copy of the counter and write it back. At that point, the counter is less than it should be because the applications are not guaranteed exclusive access. However, if each of the applications had called MEMSYN before calling MEMREAD; and called MEMUNSYN after calling MEMWRITE, this problem would not have happened.

If an application calls MEMSYN and then another application calls MEMSYN using the same in-memory file number, execution of the second application is suspended until the first application calls MEMUNSYN.

Note: When a shared in-memory file is created, the GETMEM subroutine performs a MEMSYN. Until the application that performed the GETMEM calls MEMUNSYN, the execution of any application performing a MEMSYN is suspended.

4. The fourth category is the subroutine AVAILMEM. AVAILMEM is called to find out how much free memory is in the system.

   Each of the calls (excluding AVAILMEM) provides an in-memory file number. When the GETMEM or the OPENMEM is performed, the subroutines associate that in-memory file number with a section of memory until the FREEMEM is done.

   One application may not have more than one in-memory file with the same in-memory file number. If two applications use the same in-memory file number for non-shared in-memory files, the in-memory file number refers to a different section of memory for each application.

   If an application allocates a shared in-memory file, the other application accesses that shared in-memory file by issuing an OPENMEM with the same in-memory file number as was used by the application that called GETMEM.

5. The fifth category contains the subroutines, MEMWRKEY and MEMDLKEY. MEMWRKEY and MEMDLKEY are used to insert and delete keyed records in an in-memory file. MEMWRKEY and MEMDLKEY do not work if the in-memory file is not sorted in ascending order by key. Creating a file using MEMWRKEY automatically sorts the in-memory file in ascending order by key.

   Using MEMWRKEY, the in-memory file is searched for a record. If a record with the same key is found, MEMWRKEY overlays the old record. If the record that was found does not have the same key, then the MEMWRKEY creates space for the new record by moving up each record with a greater key. An argument is passed to MEMWRKEY that indicates the length of the key, and the size of the data including the key.

   Using MEMDLKEY, the in-memory file is searched for a record. If the record is found the keyed record is deleted and all records with a greater key are shifted down by one record. If MEMDLKEY does not find the specified record, an error message indicating the record was not found is returned to the application.

   MEMCLEAR can be used to delete all records from the in-memory file. The entire memory space is filled with `X'0xFF'` and the internal record counter is reset to zero.

   Note: When using MEMWRKEY and MEMDLKEY, the key must start with the first byte of the record. If MEMWRKEY, MEMDLKEY, or MEMCLEAR are being used on a shared in-memory file, the application should call MEMSYN before calling MEMWRKEY, MEMDLKEY, or MEMCLEAR followed by calling MEMUNSYN.

Defining Extended Memory Management Subroutines: The following section contains an explanation of the subroutines that are supported by extended memory management.

Note: The following explains the parentheses within the parameter list:

- *I* passes input data to the memory manager subroutine.
- *O* passes output data from the memory manager subroutine.
- *I/O* passes input data to and output data from the memory manager subroutine in the same parameter.

Warning: Before reading data from a memory file, a string of data must be allocated in IBM 4680 BASIC. The memory manager does not allocate or increase the size of the receiving string.

The subroutines by entry point are:

GETMEM Allocates a memory file

- Call Parameters:

  (O) INTEGER*4 return value receive area
  (O) INTEGER*4 record count or system error receive area
  (I) INTEGER*2 memory file number
  (I) INTEGER*4 count of memory records to allocate
  (I) INTEGER*2 memory record size
  (I) INTEGER*2 shared memory flag

  0 = not shared
  1 = shared

- Return Value:

  – Zero if file is successfully created
  – Negative return code on error

Notes:

1. GETMEM performs a MEMSYN when creating a shared in-memory file. MEMUNSYN should be called after GETMEM to allow the next function which issues a MEMSYN to obtain exclusive access to the in-memory file. If MEMUNSYN is not called after GETMEM, the next function to issue a MEMSYN is suspended until a MEMUNSYN is issued.
2. The memory file number is set by the 4680 BASIC program. The size of the in-memory file that is allocated is obtained by multiplying the record count by the record size. Shared in-memory files are limited in size to 64 Kb minus 12 bytes. A record count is returned to the caller to indicate the number of records that were allocated. Non-shared files can be as large as the available memory in the terminal.

OPENMEM Gains access to a shared memory file

- Call Parameters:

  (O) INTEGER*4 return value receive area
  (O) INTEGER*4 record count or system error receive area
  (I) INTEGER*2 memory file number
  (I) INTEGER*2 memory file record size

- Return Value:

  – Zero if file is successfully created
  – Negative return code on error

Note: The record size specified on the OPENMEM should be the same as the record size specified on the GETMEM. However, no automatic checking is done for this. A record count that is returned to the caller indicates the size of the in-memory file.

MEMSYN Gains mutually exclusive access to shared memory

- Call Parameters:

  (O) INTEGER*4 return value
  (O) INTEGER*4 system error receive area
  (I) INTEGER*2 memory file number

- Return Value:

  – Zero if file is successfully created
  – Negative return code on error

Note: An error results if this call is issued using a file number for a non-shared in-memory file.

MEMUNSYN Releases mutually exclusive access to shared memory

- Call Parameters:

  (O) INTEGER*4 return value
  (O) INTEGER*4 system error receive area
  (I) INTEGER*2 memory file number

- Return Value:

  – Zero if file is successfully created
  – Negative return code on error

Note: An error results if this call is issued using a file number for a non-shared in-memory file.

FREEMEM Frees a memory file

- Call Parameters:

  (O) INTEGER*4 return value receiving area
  (O) INTEGER*4 system error code receiving area
  (I) INTEGER*2 memory file number

- Return Value:

  – Zero if successful
  – Negative return code on error

AVAILMEM Queries available free memory

- Call Parameters:

  (O) INTEGER*4 return value receiving area
  (O) INTEGER*4 system error code receiving area

- Return Value:

  – Amount of free memory available in bytes

MEMWRITE Writes data to a memory file

- Call Parameters:

  (O) INTEGER*4 return value receiving area
  (O) INTEGER*4 system error code receiving area
  (I) INTEGER*2 memory file number
  (I) STRING data to be written
  (I) INTEGER*4 target memory record number
  (I) INTEGER*2 offset into target record
  (I) INTEGER*2 length of data (0 defaults to record size)

- Return Value:

- Zero if successful
- Negative on error

MEMREAD Reads data from a memory file

- Call Parameters:

  (O) INTEGER*4 return value receiving area
  (O) INTEGER*4 system error code receiving area
  (I) INTEGER*2 memory file number
  (O) STRING receiving string for the data
  (I) INTEGER*4 target memory record number
  (I) INTEGER*2 offset into target record
  (I) INTEGER*2 length of data (0 defaults to record size)

- Return Value:

  - Zero if successful
  - Negative on error

Note: Before calling MEMREAD, allocate a string that is large enough to receive the data.

MEMSRCHB Conducts binary search for matching field

- Call Parameters:

  (O) INTEGER*4 return value receiving area
  (O) INTEGER*4 system error code receiving area
  (I) INTEGER*2 memory file number
  (I/O) STRING search argument
  (I) INTEGER*2 length of search argument
  (I) INTEGER*2 offset into target record of field, offset of 0 is valid
  (I) INTEGER*2 length of return data

  If 0, no data is returned. If greater than 0, data is returned to the search argument.
  (I) INTEGER*4 offset of return data field in record, offset of 0 is valid

- Return Value:

  - Zero if successful
  - Negative on error

Note: The file must be sorted in ascending order to use the binary search. If the file is partially filled with records, it should be initialized with records of hexadecimal X'FF'' to ensure ascending order. If data is to be returned, allocate the argument string large enough to receive the data.

MEMSRCHS Performs sequential search for matching field

- Call Parameters:

  (O) INTEGER*4 return value receiving area
  (O) INTEGER*4 system error code receiving area
  (I) INTEGER*2 memory file number
  (I/O) STRING search argument
  (I) INTEGER*2 length of search argument
  (I) INTEGER*2 offset into target record of field, offset of 0 is valid
  (I) INTEGER*2 length of return data

  If 0, no data is returned. If greater than 0, data is returned to the search argument.
  (I) INTEGER*4 offset of return data field in record, offset of 0 is valid

- Return Value:
  - Zero if successful
  - Negative on error

Note: If data is to be returned, allocate the argument string large enough to receive the data.

MEMWRKEY Inserts data to a memory file in ascending order by key

- Call Parameters:

  (O) INTEGER*4 return value receiving area
  (O) INTEGER*4 system error code receiving area
  (I) INTEGER*2 memory file number
  (I) STRING data to be written
  (I) INTEGER*2 length of key
  (I) INTEGER*2 length of data (0 defaults to record size)

- Return Value:
  - Zero if successful
  - Negative on error

Notes:

1. When using MEMWRKEY, the key must start with the first byte of the record.
2. If MEMWRKEY is being used on a shared in-memory file, the application should call MEMSYN before calling MEMWRKEY followed by calling MEMUNSYN.

MEMDLKEY Deletes data from a memory file sequenced in ascending order by key

- Call Parameters:

  (O) INTEGER*4 return value receiving area
  (O) INTEGER*4 system error code receiving area
  (I) INTEGER*2 memory file number
  (I) STRING key of record to be deleted
  (I) INTEGER*2 length of key

- Return Value:
  - Zero if successful
  - Negative on error

Notes:

1. When using MEMDLKEY, the key must start with the first byte of the record.
2. If MEMDLKEY is being used on a shared in-memory file, the application should call MEMSYN before calling MEMDLKEY followed by calling MEMUNSYN.

MEMCLEAR Clears a memory file

- Call Parameters:

  (O) INTEGER*4 return value receiving area
  (O) INTEGER*4 system error code receiving area
  (I) INTEGER*2 memory file number

  Note: If MEMCLEAR is being used on a shared in-memory file, the application should call MEMSYN before calling MEMCLEAR followed by calling MEMUNSYN.

Example Subroutine Declarations using IBM 4680 BASIC: The following examples explain how to format an IBM 4680 BASIC declaration.

```
SUB GETMEM (RETCODE,SYSRET,FILEID,KOUNT,RECSIZE,SHFLAG) EXTERNAL
    INTEGER*4 RETCODE, SYSRET, KOUNT
    INTEGER*2 FILEID, RECSIZE, SHFLAG
END SUB

SUB OPENMEM (RETCODE,SYSRET,FILEID,RECSIZE) EXTERNAL
    INTEGER*4 RETCODE, SYSRET
    INTEGER*2 FILEID, RECSIZE
END SUB

SUB MEMSYN (RETCODE,SYSRET,FILEID) EXTERNAL
    INTEGER*4 RETCODE, SYSRET
    INTEGER*2 FILEID
END SUB

SUB MEMUNSYN (RETCODE,SYSRET,FILEID) EXTERNAL
    INTEGER*4 RETCODE, SYSRET
    INTEGER*2 FILEID
END SUB

SUB FREEMEM (RETCODE,SYSRET,FILEID) EXTERNAL
    INTEGER*4 RETCODE, SYSRET
    INTEGER*2 FILEID
END SUB

SUB AVAILMEM (KOUNT,SYSRET) EXTERNAL
    INTEGER*4 KOUNT, SYSRET
END SUB

SUB MEMWRITE (RETCODE,SYSRET,FILEID,INDATA$,\
                      RECNUM,OFFSET,LENGTH) EXTERNAL
  INTEGER*4 RETCODE, SYSRET, RECNUM
  INTEGER*2 FILEID, OFFSET, LENGTH
  STRING    INDATA$
END SUB

SUB MEMREAD (RETCODE,SYSRET,FILEID,INDATA$,\
                        RECNUM,OFFSET,LENGTH) EXTERNAL
    INTEGER*4 RETCODE, SYSRET, RECNUM
    INTEGER*2 FILEID, OFFSET, LENGTH
    STRING    INDATA$
END SUB

SUB MEMSRCHB (RETCODE,SYSRET,FILEID,INDATA$,\
              SLENGTH,TOFFSET,RLENGTH,ROFFSET) EXTERNAL
   INTEGER*4 RETCODE, SYSRET
   INTEGER*2 FILEID, SLENGTH, TOFFSET, RLENGTH, ROFFSET
   STRING    INDATA$
END SUB

SUB MEMSRCHS (RETCODE,SYSRET,FILEID,INDATA$,\
              SLENGTH,TOFFSET,RLENGTH,ROFFSET) EXTERNAL
   INTEGER*4 RETCODE, SYSRET
   INTEGER*2 FILEID, SLENGTH, TOFFSET, RLENGTH, ROFFSET
   STRING    INDATA$
END SUB

SUB MEMWRKEY (RETCODE, SYSRET, FILEID, INDATA$,\
```

```
              KLENGTH, LENGTH) EXTERNAL
    INTEGER*4 RETCODE, SYSRET
    INTEGER*2 FILEID, KLENGTH, LENGTH
    STRING    INDATA$
END SUB

SUB MEMDLKEY (RETCODE, SYSRET, FILEID, KEY$,\
             KLENGTH) EXTERNAL
    INTEGER*4 RETCODE, SYSRET
    INTEGER*2 FILEID, KLENGTH
    STRING    KEY$
END SUB

SUB MEMCLEAR (RETCODE, SYSRET, FILEID) EXTERNAL
    INTEGER*4 RETCODE, SYSRET
    INTEGER*2 FILEID
END SUB
```

Table 15-13. Function Return Codes

Return Code	Description
-1009	Attempted to allocate more than 64 files
-1011	Out of memory; cannot continue
-1013	Attempted to allocate the same file ID twice
-1014	File not found, or attempted to use MEMSYN or MEMUNSYN on a non-shared file
-1015	Record position outside of the file
-1016	Search record not found
-1017	Data length not valid (greater than 512 bytes), negative length, or empty string passed as parameter to subroutine
-1019	Receiving string not large enough
-1020	Requested shared memory greater than 65,524 bytes in length
-1021	Null string parameter detected

Chapter 16. Designing Applications with Other Languages

This chapter contains coding guidelines and restrictions that you should consider when you are writing a program in a language other than IBM 4680 BASIC to run under the IBM 4690 Operating System. It contains specific information about programming applications in C language and COBOL.

The interfaces described in this chapter provide access to many parts of the 4690 Operating System. This chapter explains how to use these interfaces.

4690 Operating System Interfaces for C and COBOL

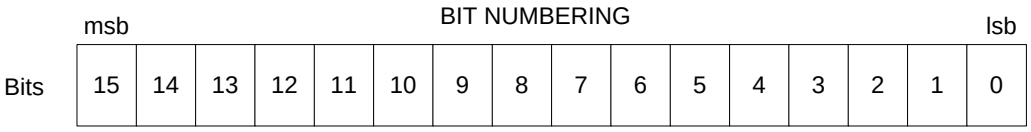
The 4690 Operating System interfaces described in this chapter provide access to various 4690 features for applications written in C language or COBOL.

| The functions described in this chapter can be used only with IBM 4690 store controller applications.
| However, with the IBM C Programming Interface for 4690 terminals, C applications can be written for a
| 4690 Terminal. See the CAPITPGP.DOC included with the IBM C Programming Interface for 4690
| Terminals product for more information.

These functions are written in C language and can be used by applications written in C language and COBOL. The functions were compiled using a memory model that generates 32-bit addresses. The memory model permits multiple code and data segments. To use these functions, link with ADXAPACL.L86 located on the optional diskette. Use the search option to link only the required code with the application and not the entire library. These functions were written in MetaWare High C.**. Any application that is not written in High C also must link with ADXAPABL.L86.

| The parameters are assumed to be passed with the first parameter being pushed last on the stack. The first parameter for most functions is a four-byte return code. A negative return code indicates an error code. Any nonsystem error codes that may be returned by these functions are listed with the function descriptions. System error codes are returned as four-byte hexadecimal values. Refer to the *IBM 4690 Store System: Messages Guide* for a complete list of system error codes. The conversion function can be used to convert the four-byte hexadecimal bytes to eight printable ASCII characters.

The bit numbering scheme numbers the bits right to left with the least significant bit (lsb) being bit zero and the most significant bit (msb), being bit 15. The following is an example of numbering for a two-byte word.



Using the C Language Interface

Applications written in C language can be written in Metaware High C or an equivalent C language. The functions in this chapter were tested with Metaware High C code. The test code was compiled using the big memory model. The big memory model allows multiple code and data segments of up to 64K bytes each and creates 32-bit addresses. An application using these functions must be compiled in the same manner.

The assumed sizes of the basic data types used are:

char = 1 byte
int = 2 bytes
long = 4 bytes

Using the COBOL Language Interfaces

Applications written in COBOL can be written in COBOL/2* or an equivalent COBOL language. The functions described here were tested with COBOL/2 code. The test code was compiled using the huge memory model and the following compiler directives:

- /NOIBMCOMP
- /LITLINK
- /VSC2
- /OS(FLEXOS)**

An application using these functions must be compiled in the same manner. The HUGE memory model produces 32-bit addresses and *far calls*. It allows literal names if the compiler directive */LITLINK* is used. The directive */NOIBMCOMP* causes the compiler to store data in one byte binary fields. The directive */LITLINK* causes the compiler to create external references to the literal names of the functions in this chapter. The directive */VSC2* allows the use of the BY VALUE in the CALL statement. If the application is written in COBOL/2, the directive */OS(FLEXOS)* is needed for compatibility with the LINK86 command. If the directive OS(FLEXOS) is not recognized, a later level of COBOL/2 is required. COBOL/2 references FAR_DATA in the OBJ files and OS(FLEXOS) removes it. If CBLINK.BAT is used to link files, the message “FAR_DATA NOT FOUND” will be generated and the resulting 286 file will not execute properly. To avoid this problem, edit the file MF_LNK.INP that is used by CBLINK.BAT and remove “,class[FAR_DATA,DATA]” from the data statement. Or you can use LINK86 with an INP file that does not contain FAR_DATA.

For applications using these functions, the usage type, COMP-5, is assumed for numeric variables. This usage indicates that the value which can be stored for a numeric variable is not limited to the number of decimal digits specified in the picture clause. The value can be the largest binary number that can be stored in the indicated space.

The convention for byte length of COBOL numeric variables is:

PIC 9(2) = 1 byte
PIC 9(4) = 2 bytes
PIC 9(8) = 4 bytes

In this chapter, some of the descriptions about how to call each function contain a variable that is listed as USAGE IS POINTER. The address of this pointer is coded BY VALUE in the CALL statement. These variables are specified in this manner to allow variation in applications and programming styles. The following is an example of how the variables may be defined in a program:

```
01  KFBUFF.
    03  KF-KEY   PIC  9(8)    USAGE IS COMP-5.
    03  KF-DAT   PIC  X(46)   USAGE IS DISPLAY.
77  BUFFADR                  USAGE IS POINTER.
PROCEDURE DIVISION.
SET BUFFADR TO ADDRESS OF KFBUFF.
CALL ... ... USING BY VALUE BUFFADR.
```

Disk File Management

Disk media on the 4690 Operating System contain the following:

File names Every file created on a disk must have a name to identify the file. The 4690 Operating System forces all file names to uppercase on the media.

File record size
When a file is created, the record size must be specified. A record size of zero is equivalent to a record size of one byte. If a record size of zero or one is specified, the IBM 4690 Operating System will not perform record boundary checks when a READ or WRITE is requested.

File Access

Access to files is initiated using a CREATE or an OPEN operation. Use a CREATE to open a new file. Use an OPEN to gain access to an existing file. For both operations, a file name will be specified and a four-byte file number will be returned. The file number is then used for all subsequent operations on that file. When the file is closed the file number is deleted. If the file is reopened, a new number is assigned.

The DELETE statement removes a file from the disk directory. Files to be deleted are indicated by the file name. A file cannot be deleted when it is read-only or if it is currently open. A file can be automatically deleted by setting one of two flag bits when the file is created. One flag bit determines whether a file is to be treated as temporary or permanent. If a file is marked as temporary, it will be deleted after the last open is closed. If a file is marked as a permanent file, the file will remain after the last CLOSE. The other flag bit that may be selected when the file is created determines what action will be taken if a file with the same name exists. If this flag bit is set, the existing file will be deleted before the new file is created. If this bit is not set, an error will be returned.

Access Modes: Access modes determine if a file may be shared. If the file is shared, the following modes are selected when the file is opened:

- Exclusive access by calling process
- Allow reads by other processes
- Allow reads and writes by other processes

Exclusive access to a file in one process prevents any other process from sharing the file. Exclusive access to a file is denied if another process has the file open. If a process tries to open a file with WRITE privilege and the file has been opened in ALLOW-READS mode, then the OPEN is denied and an error is returned.

ALLOW/READ/WRITE mode has two options: shared or unique file pointer. The shared file pointer mode is only available to processes with the same family ID, and all processes in the family must specify this mode. For processes outside the family, the file appears in exclusive mode. There are no restrictions when the unique file pointer option is selected.

File Pointers: The IBM 4690 Operating System supports both sequential and random access to disk files by using the file pointer. Sequential file access is supported by a file pointer which is incremented with each read or write to maintain the position within the file. Random file access is supported by an offset specified with each read or write call. The offset can be specified by the file pointer, the beginning of the file, or the end of the file.

The file pointer is initialized to zero when a file is created or opened. Subsequent READs and WRITEs move the file pointer to the byte position of the next sequential location. For example, if a new file is created and 12 bytes are written, the file pointer would be pointing at the 13th byte (essentially the EOF marker).

Separate processes sharing access to the same file can share the same file pointer or can have separate ones. File pointer sharing is limited to processes with the same family identification (FID) number. When the pointer is shared, reads or writes by any process update the file pointer. The seek function can be used to determine the file pointer's location or to position the file pointer.

Pipe Management

Two or more processes can communicate by using a type of file known as a pipe which is supported through a special device known as *pi:*. Creating a pipe establishes a buffer used for the deposit and withdrawal of messages. Pipe files have two ends, one to write into and the other to read from. Messages are deposited and withdrawn from the pipe on a first-in-first-out (FIFO) basis. The pipe length is the only limit to the number of messages you can store in a pipe at one time.

In all calls that require a pipe name, the pipe name must be preceded with the device name (*pi:*) or a logical name may be defined that includes the *pi:* reference.

Creating and Deleting Pipes: Use the CREATE function to make a pipe. All pipes are handled in the same manner as sequential files. The CREATE parameters are used as follows:

- Set the flags to request READ, WRITE, or DELETE privileges and to request the access mode. The privileges have the same meaning for pipes as they do for disk files.
- The pipe name must include the device name, (*pi:*) plus up to eight (8) alphanumeric characters. Pipe names are case sensitive. The default is lowercase.
- The record size parameter controls the message blocks. For example, if a record size of four is specified, all pipe I/O is conducted in four-byte blocks. Record size of zero or one must be specified if the application uses the WAIT function with the pipe.
- Set the size to the pipe buffer length. The size is independent of the message length but must be a multiple of the record size.

Use a DELETE to remove a pipe. A pipe that is marked as temporary when it is created will be automatically deleted on the last CLOSE. If a pipe marked as temporary is used to communicate between two processes, the pipe is deleted automatically from the system when the processes terminate because files are automatically closed when a process ends.

Pipe Access: Pipe access privileges are affected by existing access modes. The following rules govern the privileges available:

- A process' open access is never restricted by an open connection previously made by the same process.
- The READ and WRITE ends of a pipe are considered separate with respect to open restrictions. For example, an OPEN with exclusive READ does not restrict a process from opening a pipe as shared WRITE.
- Any exclusive OPEN prevents other access requests to the same end.

- A shared OPEN prevents other exclusive access requests but allows other shared requests to the same end.
- A shared file pointer request restricts pipe access to processes with the same FID. All processes sharing the pipe must select the shared file pointer mode. A process that requests a different mode is denied access. For processes outside the family, the request functions as an exclusive request.

A pipe is used differently if an end is opened in exclusive or shared mode. If one end of a pipe is opened in exclusive mode and then closed, a READ or WRITE attempt to the other end results in an EOF error. It does not matter how the other end was opened.

If one end of a pipe is opened in shared mode and then closed, the IBM 4690 Operating System uses the pipe as if it were still open on the other end. Therefore, any process accessing the pipe waits until the operation is complete. A pipe opened in shared file pointer mode is shared only by those processes with the same FID. Notice the distinction between shared mode and shared file pointer mode. If one end of a pipe is opened in shared file pointer mode, and then the pipe is closed by all of the processes accessing that end, any processes accessing the other end will receive an EOF error.

Interprocess Communications: The READ and WRITE functions operate the same way for pipes as for files and the READ and WRITE flags and parameters are used in the same way. Any number of processes can participate in the exchange.

The amount of data written to and read from the pipe is independent of the pipe size. The following procedures are observed when the amount exceeds the size:

- On WRITEs when the pipe is full, the process waits for another process to read data from the other end. When the reading process removes enough to allow the data to be written, the operation completes.
- On READs when the pipe is empty, the process waits for another process to write data to the other end. The operation completes when enough data has been written to satisfy the READ request.

A READ request issued when there is no data in the pipe will cause the process to wait until there is enough data available in the pipe to satisfy the read request. To avoid a possible hang, use the WAIT operation to wait for a specified time. Then the application can select whether or not to wait again if the time limit expires before data is available to read.

Synchronization and Exclusion: A pipe may be created with a zero-length buffer size for use as a simple semaphore. For semaphore pipes, a READ operation obtains the pipe and a WRITE releases it. If another process has obtained the pipe previously, the calling process waits until a WRITE to that pipe has been performed. WRITE operations, on the other hand, never wait; if the pipe was released previously, the call returns without an error.

Nondestructive Read: The information stored in a pipe can be previewed using the READ operation by setting the specific flag bit to request a nondestructive read. This allows a pipe to be used as a common data area among multiple applications. It also allows an application to pre-read a length field or message type field within a message and then read the complete message at a later time. To read records of varying lengths, specify record length of one when the pipe is created so that the operating system will not perform record checking; otherwise, an invalid record size error will be returned.

Warning: Nondestructive reads can be dangerous if there are multiple readers of a pipe. It is the responsibility of the application to handle synchronization of pipe usage when there are multiple processes involved.

Pipe Routing Services: PRS for communications between a store controller and a terminal. The WAIT operation available is the same as for regular pipes. Pipe Routing Services (PRS) enables applications to exchange data with applications in other store controllers or terminals by using pipes. These pipes are

identified by a pipe ID, which is a letter between A and Z. Each store controller or terminal can have up to 26 IDs (A through Z). Each ID in a store controller or a terminal must be unique. For example, if several applications are running in a store controller at once, each must use a different pipe ID.

On the 4690 store controller, pipes are treated like sequential files. A PRS pipe must first be created. Then the application should wait for data to be available before requesting a READ. For PRS pipes in the store controller, the READ buffer may be large but in the terminal the limit is 240 bytes. The maximum size for all PRS messages is 120 bytes.

To write to a PRS pipe, the PRS driver must be initialized. This initialization must be requested only once for each load of an application. After the driver is initialized, a write can be performed. All PRS pipes are temporary. A pipe will be deleted when the last process that has access to it has ended. The PRS functions described for C language and COBOL can only be used in store controller applications.

File and Pipe Services

This section contains examples of C and COBOL interfaces for keyed, non-keyed, and direct files. It also contains examples for pipes.

Create Point-of-Sale Keyed File: Creating a point-of-sale keyed file sets up the file as a keyed file and write the keyed file control block as the first record. See “Keyed File Control Record” on page 6-21 for a description of the keyed file control block. The file is opened if no error occurred. The file must be closed if no access is needed.

C Interface:

```
void ADX_CCREATE_KFILE(long *fnum, unsigned int flags, char *filename, long filesize,
                       unsigned int *buffadr, long buffsize);
```

COBOL Interface

```
77  FNUM           PIC S9(8)      USAGE IS COMP-5.
77  FLAGS          PIC 9(4)       USAGE IS COMP-5.
77  FILENAME       PIC X(n)       USAGE IS DISPLAY.
*       n = length of FILE-NAME including
            terminating NULL or blank.
77  FILESIZE       PIC 9(8)       USAGE IS COMP-5.
77  BUFFADR                       USAGE IS POINTER.
77  BUFFSIZE       PIC 9(8)       USAGE IS COMP-5.

CALL "ADX_CCREATE_KFILE" USING FNUM,
BY VALUE FLAGS, BY REFERENCE FILENAME,
BY VALUE FILESIZE, BY VALUE BUFFADR, BY VALUE BUFFSIZE.
```

Parameters:

flags

bit 0: 1 = Delete file
0 = No delete

bit 1: Reserved (must be 0)

bit 2: 1 = Write
0 = No write

bit 3: 1 = Read
0 = No read

bit 4: 1 = Shared
0 = Exclusive

bit 5: 1 = Allow shared commands if shared
0 = Allow shared READ or WRITE commands if shared

bit 6–7: Reserved (must be zero)

bit 8: 1 = Temporary—delete on last close
0 = Permanent

bit 9: Reserved (must be zero)

bit 10: 1 = Delete file if it already exists
0 = Return error if file exists

bit 11 to 15: Reserved (must be zero)

filename Address of a NULL or blank terminated name string, or a previously defined logical name. If the file is not in the current directory, the string must include the path specification. The maximum length is 128 bytes including the NULL or blank.

filesize The size must be derived from the following algorithm and rounded up to the nearest 512-byte multiple. The maximum size for a keyed file record is 508.

T = Total number of records
L = Logical keyed record size
NL = 508/L (integer division)

If (T divided by NL has a remainder)

size = 512 + (512 × (1 + T/ NL))

Else (no remainder)

size = 512 + (512 × (T/ NL))

The total number of records should be at least 20% greater than the maximum number of records expected to account for the way the records must be distributed in the file and to allow for future growth.

buffadr The address of the buffer containing keyed file information (BUF14 or BUF18 (see bit 11 of pflags)).

buffsize The size of buffer (BUF14 size = 14. BUF18 size = 18.)

BUF14—Information buffer for creating a keyed file less than 32MB. Size = 14 bytes. Figure 16-1 on page 16-9 illustrates how the bytes are allocated if the *buffsize* is 14.

BUF14

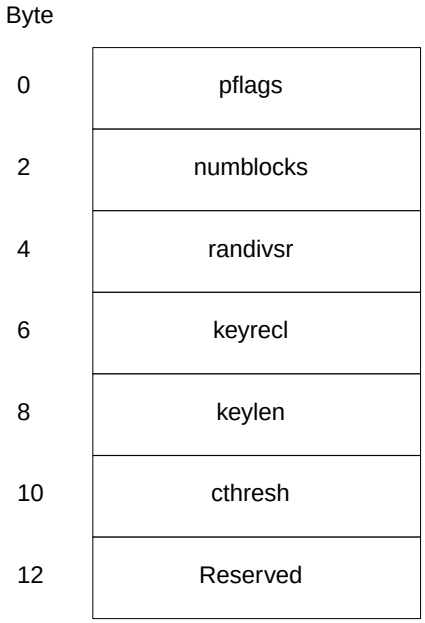


Figure 16-1. 14-Byte Buffsize

BUF18 – Information buffer for creating a keyed file greater than or equal to 32 megabytes. Size = 18 bytes. Figure 16-2 illustrates how the bytes are allocated if the *buffsize* is 18.

BUF18

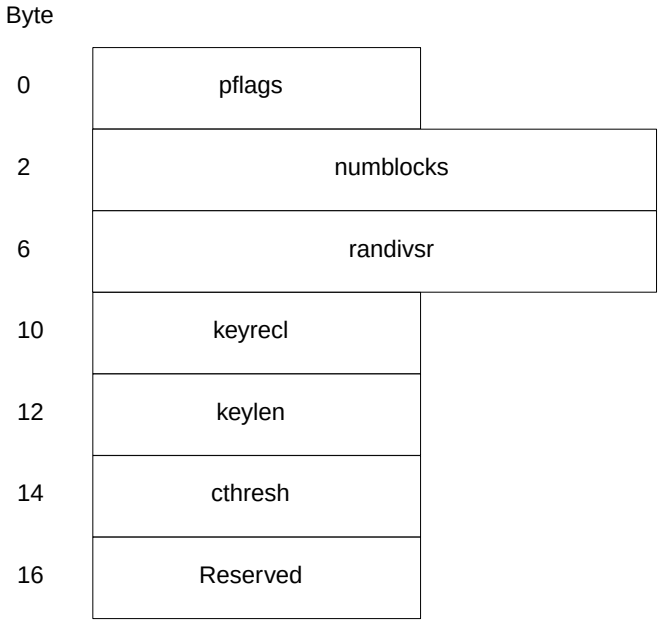


Figure 16-2. 18-Byte Buffsize

pflags

bit 0: 1 = Keyed file create

bit 1 to 3: 0 = Reserved (must be zero)

bit 4:	1 = File is mirrored (see note 1) 0 = File is not mirrored
bit 5:	1 = File is compound (see note 1) 0 = File is not compound
bit 6:	0 = Reserved (must be zero)
bit 7:	1 = File is local only (see note 1) 0 = File is not local
bit 8:	1 = Distributed at close (see note 2) 0 = No Distribution at close
bit 9:	1 = Distribution per update (see note 2) 0 = No Distribution per update
bit 10:	Reserved (must be zero)
bit 11:	1 = This information structure is for files greater than or equal to 32 megabytes. (See format BUF18.) 0 = This information structure is for files less than 32 megabytes. (See format BUF14.)
bit 12:	1 = The data blocks will not be cleared to NULLs. (If this option is used, the user application must clear all data blocks to NULLs before adding records to the file.) 0 = All data blocks will be cleared to NULLs
bits 13 to 15:	0 Reserved

Notes:

1. Bits 4, 5, and 7 are mutually exclusive (only one of the three types can be chosen).
2. Bits 8 and 9 are mutually exclusive (only one of the two types can be chosen).

numblocks Number of 512-byte physical records in the file. Must be = filesize (as calculated previously) / 512.

randivsr File randomizing divisor.

This must be greater than zero and less than numblocks. This value determines how the keyed records are dispersed in the file.

keyrecl Logical keyed record size. Must be in range 1 to 508.

keylen Length of record key found in logical keyed records.

cthresh Chaining threshold value. Must be in range 1 to 255. The value is the number of sectors that are checked to find a keyed record before a warning is sent that a file is becoming inefficient. The application is not notified that the limit has been exceeded, and data is still returned to the application.

fnum Return code. It contains the file number if no error occurred. The file is automatically opened. The calling process must close the file if no access is needed. If an error occurred the error code will be returned and a file will **not** be created.

Refer to the *IBM 4690 Store System: Messages Guide* for system errors.

Open Keyed File: This operation opens a keyed file.

C Interface:

void ADX_COPEN_KFILE(long *fnum, unsigned int flags, char *filename, unsigned int *parmbuff, long pbuffsize);

COBOL Interface

```
77  FNUM          PIC S9(8)          USAGE IS COMP-5.
77  FLAGS         PIC 9(4)           USAGE IS COMP-5.
77  FILENAME      PIC X(n)           USAGE IS DISPLAY.
*   n=length of FILE-NAME including terminating NULL or blank.
77  PARMBUFF                        USAGE IS POINTER.
77  PBUFSIZE      PIC 9(8)           USAGE IS COMP-5.

CALL "ADX_COPEN_KFILE" USING FNUM, BY VALUE FLAGS,
BY REFERENCE FILENAME, BY VALUE PARMBUFF, BY VALUE PBUFSIZE.
```

Parameters:

flags

bit 0: 1 = Delete file
0 = No delete

bit 1: 1 = Execute
0 = No execute

bit 2: 1 = Write
0 = No write

bit 3: 1 = Read
0 = No read

bit 4: 1 = Shared
0 = Exclusive

bit 5: 1 = Allow shared reads if shared
0 = Allow shared read or write if shared

bits 6 to 15: Reserved (must be zero)

filename Address of NULL or blank terminated name string or a previously defined logical name. If the file is not in the current directory, the string must include the path specification. The maximum length is 128 bytes, including the NULL or blank.

parmbuff User address where the keyed record size and key length will be returned. The record size is in the first two bytes of the buffer and the key length is in the second two bytes of the buffer. The buffer must be at least four bytes in size. If pbufsize = 0, no values will be returned.

pbufsize Size of parmbuff, in bytes. If pbufsize = 0, no values will be returned in parmbuff.

fnum Return code. It will contain the file number if no error occurred. If an error occurred, the file will be closed and an error code is returned.

Refer to the *IBM 4690 Store System: Messages Guide* for system errors.

Close Keyed File: This operation closes a keyed file and frees all associated buffer space. A partial CLOSE flushes the associated I/O buffer but leaves the file open.

| ***C Interface:***

| void ADX_CCLOSE_KFILE(long *ret, unsigned int option, unsigned int flags, long fnum)

COBOL Interface

```
77  RET          PIC S9(8)          USAGE IS COMP-5.
77  OPTION       PIC 9(4)           USAGE IS COMP-5.
77  FLAGS        PIC 9(4)           USAGE IS COMP-5.
77  FNUM         PIC S9(8)          USAGE IS COMP-5.

CALL "ADX_CCLOSE_KFILE" USING RET,
BY VALUE OPTION, BY VALUE FLAGS, BY VALUE FNUM.
```

Parameters:

option 0 = close file
1 = zero and close file (only valid for keyed files)

flags 0 = full close
1 = partial close (flush only)

fnum File number of file to be closed, as returned from an OPEN or CREATE.

ret Return code. An error code is returned if an error occurred.

Refer to the *IBM 4690 Store System: Messages Guide* for system errors.

Read Keyed Record: This operation reads data from the indicated record in the specified keyed file.

| ***C Interface:***

| void ADX_CREAD_KREC(long *nbytes, unsigned int option, long fnum, char *buffadr, long buffsize,
| long keylen);

Example:

COBOL Interface

```
77  NBYTES           PIC S9(8)          USAGE IS COMP-5.
77  OPTION           PIC 9(4)           USAGE IS COMP-5.
77  FNUM             PIC S9(8)          USAGE IS COMP-5.
77  BUFFADR                            USAGE IS POINTER.
77  BUFFSIZE         PIC 9(8)           USAGE IS COMP-5.
77  KEYLEN           PIC 9(8)           USAGE IS COMP-5.

CALL "ADX_CREAD_KREC" USING NBYTES,
BY VALUE OPTION, BY VALUE FNUM, BY VALUE BUFFADR,
BY VALUE BUFFSIZE, BY VALUE KEYLEN.
```

Parameters:

option 0 = Read no lock
1 = Read and lock

The record is locked before it is read. The application program must wait for the record to become available.

fnum File number of file from which to read data. The file must be activated by a CREATE or OPEN before requesting a READ.

buffadr Address of buffer in which to put data that is read. The key for the record to read must begin at offset zero in this buffer.

buffsize Number of bytes to read. The size must equal the record length specified when the file was created.

keylen Length of the key string passed in the read buffer. This value must equal the key length specified when the keyed file was created.

nbytes Return code. It will contain the number of bytes read if no error occurred. An error code is returned if an error occurred.

Refer to the *IBM 4690 Store System: Messages Guide* for system errors.

Write Keyed Record: This operation writes a keyed record in the specified file.

C Interface:

```
void ADX_CWRITE_KREC(long *nbytes, unsigned int option, unsigned int flags, long fnum, char *bufaddr,
long buffsize);
```

COBOL Interface

```
77  NBYTES          PIC S9(8)          USAGE IS COMP-5.
77  OPTION          PIC 9(4)           USAGE IS COMP-5.
77  FLAGS           PIC 9(4)           USAGE IS COMP-5.
77  FNUM            PIC S9(8)          USAGE IS COMP-5.
77  BUFFADR                            USAGE IS POINTER.
77  BUFFSIZE        PIC 9(8)           USAGE IS COMP-5.

CALL "ADX_CWRITE_KREC" USING NBYTES,
BY VALUE OPTION, BY VALUE FLAGS, BY VALUE FNUM,
BY VALUE BUFFADR, BY VALUE BUFFSIZE.
```

Parameters:

option

bit 0: 0 = Unlock = no
1 = Unlock = yes

The record is unlocked after being written.

bit 1: 0 = Do not hold the write
1 = Hold the write

The hold flag prevents the data from being physically written to a disk file until the next write with hold option is issued by this process.

bits 2 to 15: Must be zero

flags Not used

fnum File number where data is to be written, as returned from a CREATE or an OPEN.

buffadr Address of buffer containing data to write. The buffer must contain the desired record's key at offset 0.

buffsize Number of bytes to write.

nbytes Return code. It contains the number of bytes written if no error occurred. Notice that a zero (0) return value is a special case for the WRITE with HOLD and is considered a correct value. An error code is returned if an error occurred.

Refer to the *IBM 4690 Store System: Messages Guide* for system errors.

Delete Keyed Record: This operation deletes a specified record from a keyed file.

C Interface:

void ADX_CDELETE_KREC(long *ret, long fnum, char *buffadr, long buffsize);

COBOL Interface

```
77  FNUM            PIC S9(8)          USAGE IS COMP-5.
77  BUFFADR                           USAGE IS POINTER.
77  BUFFSIZE        PIC 9(8)           USAGE IS COMP-5.
77  RET             PIC S9(8)          USAGE IS COMP-5.

CALL "ADX_CDELETE_KREC" USING RET,
BY VALUE FNUM, BY VALUE BUFFADR, BY VALUE BUFFSIZE.
```

Parameters:

fnum	File number of file containing record to delete, as returned by an OPEN or CREATE.
buffadr	Address of buffer containing the key of the record to be deleted.
buffsize	Length of key string pointed to by *buffadr*.
ret	Return code. It contains an error code if an error occurred.

Refer to the *IBM 4690 Store System: Messages Guide* for system errors.

Create Point-of-Sale Non-Keyed File: This operation will create a point-of-sale nonkeyed file. A point-of-sale file is different from any other file because it may be distributed to other controllers as a mirrored or a compound file. After the file is created, it will be opened if no error occurred. The file must be closed if no access is needed.

C Interface:

void ADX_CCREATE_POSFILE(long *fnum, unsigned int flags, char *filename, long filesize, unsigned int recsize, unsigned int ftype, unsigned int fdistrib);

COBOL Interface

```
77  FLAGS            PIC 9(4)            USAGE IS COMP-5.
77  FILENAME         PIC X(n)            USAGE IS DISPLAY.
*   n = length of FILE-NAME including terminating
    NULL or blank.
77  FILESIZE         PIC 9(8)            USAGE IS COMP-5.
77  RECSIZE          PIC 9(4)            USAGE IS COMP-5.
77  FTYPE            PIC 9(4)            USAGE IS COMP-5.
77  FDISTRIB         PIC 9(4)            USAGE IS COMP-5.
77  FNUM             PIC S9(8)           USAGE IS COMP-5.

CALL "ADX_CCREATE_POSFILE" USING FNUM,
BY VALUE FLAGS, BY REFERENCE FILENAME, BY VALUE FILESIZE,
BY VALUE RECSIZE, BY VALUE FTYPE, BY VALUE FDISTRIB.
```

Parameters:

flags

bit 0:	1 = Delete file 0 = No delete
bit 1:	Reserved (must be zero)
bit 2:	1 = Write 0 = No write
bit 3:	1 = Read 0 = No read
bit 4:	1 = Shared 0 = Exclusive
bit 5:	1 = Allow shared READ commands if shared 0 = Allow shared READ or WRITE commands if shared
bit 6:	1 = Shared file pointer 0 = Unique file pointer
bit 7:	Reserved (must be zero)
bit 8:	1 = Temporary—delete on last close 0 = Permanent
bit 9:	Reserved (must be zero)
bit 10:	1 = Delete file if it already exists 0 = Return error if file exists
bit 11 to 15:	Reserved (must be zero)

filename Address of NULL or blank terminated name string or a previously defined logical name. If the file is not in the current directory, the string must include the path specification. The maximum length is 128 bytes, including the NULL or blank.

filesize File size in bytes

recsize The READ, WRITE, and LOCK operations use this value to ensure that the requested action falls on record boundaries. Use a record size of zero or one if you do not want boundary checks performed.

ftype File distribution type

0 = Local only
1 = Mirrored
2 = Compound file

fdistrib File distribution method

0 = Distribute at close
1 = Distribution per update

fnum Return code. It contains the file number if no error occurred. The file is automatically opened; therefore, the calling process must close the file if no access is needed. If an error occurs, the file is closed and the error code is returned.

Refer to the *IBM 4690 Store System: Messages Guide* for system errors.

Create Non-Point-of-Sale File or Pipe: This operation will create a non-point-of-sale file or a pipe. The file is opened if no error occurred and it should be closed if no access is needed.

C Interface:

void ADX_CCREATE_FILE(long *fnum, unsigned int flags,char *filename, long filesize, unsigned int recsize);

Example:

COBOL Interface

```
77  FLAGS          PIC 9(4)            USAGE IS COMP-5.
77  FILENAME       PIC X(n)            USAGE IS DISPLAY.
*   n = length of FILE-NAME including
    terminating NULL or blank.
77  RECSIZE        PIC 9(4)            USAGE IS COMP-5.
77  FILESIZE       PIC 9(8)            USAGE IS COMP-5.
77  FNUM           PIC S9(8)           USAGE IS COMP-5.

CALL "ADX_CCREATE_FILE" USING FNUM,
BY VALUE FLAGS, BY REFERENCE FILENAME,
BY VALUE FILESIZE, BY VALUE RECSIZE.
```

Parameters:

flags

bit 0: 1 = Delete file
0 = No delete

bit 1: Reserved (must be zero)

bit 2: 1 = Write
0 = No write

bit 3: 1 = Read
0 = No read

bit 4: 1 = Shared
0 = Exclusive

bit 5: 1 = Allow shared READ commands if shared
0 = Allow shared READ or WRITE commands if shared

bit 6: 1 = Shared file pointer (disk files only)
0 = Unique file pointer

bit 7: Reserved (must be zero)

bit 8: 1 = Temporary—delete on last close
0 = Permanent

bit 9: Reserved (must be zero)

bit 10: 1 = Delete file if it already exists
0 = Return error if file exists

bit 11 and 12: Reserved (must be zero)

bit 13: 1 = Force case to media default (pipes only)
0 = Do not force case on name

bit 14 and 15: Reserved (must be zero)

filename Address of NULL or blank terminated name string or a previously defined logical name. If the file is not in the current directory, the string must include the path specification. The maximum length is 128 bytes, including the NULL or blank. The name for a pipe must include *pi:* either in this string or in the logical name definition prefix.

recsize The READ, WRITE, and LOCK operations use this value to make sure that the requested action falls on record boundaries. Use a record size of zero or one for files if no boundary checks are desired, or for pipes if the WAIT function will be used.

filesize File size in bytes

fnum Return code. It contains the file number if no error occurred. The file is automatically opened and the calling process must close the file if no access is needed. If an error occurred, the file is closed and the error code is returned.

Refer to the *IBM 4690 Store System: Messages Guide* for system errors.

Open File or Pipe: This operation will open a point-of-sale nonkeyed file, non-point-of-sale file, or a pipe. Use Open Keyed File option to open a keyed file. The file pointer is initialized to zero when the file is opened.

C Interface:

```
void ADX_COPEN_FILE(long *fnum, unsigned int flags, char *filename);
```

COBOL Interface

```
77  FNUM            PIC S9(8)           USAGE IS COMP-5.
77  FLAGS           PIC 9(4)            USAGE IS COMP-5.
77  FILENAME        PIC X(n)            USAGE IS DISPLAY.
*   n = length of FILE-NAME including terminating NULL or blank

CALL "ADX_COPEN_FILE" USING FNUM, BY VALUE FLAGS,
BY REFERENCE FILENAME.
```

Parameters:

flags

bit 0:	1 = Delete file 0 = No delete
bit 1:	1 = Execute 0 = No execute
bit 2:	1 = Write 0 = No write
bit 3:	1 = Read 0 = No read
bit 4:	1 = Shared 0 = Exclusive
bit 5:	1 = Allow shared reads if shared 0 = Allow shared R/W if shared
bit 6:	1 = Shared file pointer (disk files only) 0 = Unique file pointer
bits 7 to 12:	Reserved (must be zero)
bit 13:	1 = Force case to media default (pipes only) 0 = Do not affect name case
bit 14 and 15:	Reserved (must be zero)

filename Address of NULL or blank terminated name string, or a previously defined logical name. If the file is not in the current directory, the string must include the path specification. The maximum length is 128 bytes, including the NULL or blank. The name for a pipe must include *pi:* either in this string or in the logical name definition prefix.

fnum Return code. It contains the file number if no error occurred. If an error occurred, the file is closed and the error code is returned.

Refer to the *IBM 4690 Store System: Messages Guide* for system errors.

Close File or Pipe: This operation closes a file or a pipe and frees all associated buffer space. A partial CLOSE flushes the associated I/O buffer but leaves the file open.

| ***C Interface:***

| void ADX_CCLOSE_FILE(long *ret, unsigned int flags, long fnum);

COBOL Interface

```
77  RET             PIC S9(8)          USAGE IS COMP-5.
77  FLAGS           PIC 9(4)           USAGE IS COMP-5.
77  FNUM            PIC S9(8)          USAGE IS COMP-5.

CALL "ADX_CCLOSE_FILE" USING RET, BY
VALUE FLAGS, BY VALUE FNUM.
```

Parameters:

flags 0 = Full close
1 = Partial close

fnum File number of file to be closed, as returned from an OPEN or CREATE.

ret Return code. It contains an error code if an error occurred.

Refer to the *IBM 4690 Store System: Messages Guide* for system errors.

Read Record from File or Pipe: This operation reads data from the indicated record in a specified non-keyed file or a pipe file. The file pointer is updated on every READ to be the byte position immediately following the last data byte that was read.

C Interface:

void ADX_CREAD_REC(long *nbytes, unsigned int flags, long fnum, char *buffadr, long buffsize, long boffset);

Example:

COBOL Interface

```
77  NBYTES          PIC S9(8)           USAGE IS COMP-5.
77  FLAGS           PIC 9(4)            USAGE IS COMP-5.
77  FNUM            PIC S9(8)           USAGE IS COMP-5.
77  BUFFADR                            USAGE IS POINTER.
77  BUFFSIZE        PIC 9(8)            USAGE IS COMP-5.
77  BOFFSET         PIC S9(8)           USAGE IS COMP-5.

CALL "ADX_CREAD_REC" USING NBYTES,
BY VALUE FLAGS, BY VALUE FNUM, BY VALUE BUFFADR,
BY VALUE BUFFSIZE, BY VALUE BOFFSET.
```

Parameters:

flags

bit 0: 1 = Read from device
0 = Read from internal buffers

bit 1: Reserved (must be zero)

bit 2: 1 = Nondestructive read
0 = Normal read

bits 3 to 7: Reserved (must be zero)

bits 8 and 9: Interpretation of offset field

00 = Relative to beginning of file
01 = Relative to file pointer (disk file only)
10 = Relative to end of file (disk file only)

bits 10 to 15 Reserved (must be zero)

fnum File number from which to read data, as returned from OPEN or CREATE.

buffadr Address of buffer in which to put data that is read.

buffsize Number of bytes to READ.

boffset Byte offset to begin reading, relative to the position indicated by flag bits 8 and 9. Negative offsets are allowed. Offset used for disk files only; set = 0 for pipes.

nbytes Return code. It will contain the number of bytes read if no error occurred. Where *nbytes* is positive and not equal to *buffsize*, an end-of-file was encountered. An error code is returned if an error occurred. For pipes, if the buffer is empty, this operation waits for enough data to be written in the buffer to satisfy the read request.

Refer to the *IBM 4690 Store System: Messages Guide* for system errors.

Write a Record to a File (nonkeyed) or Pipe: This operation writes data into the indicated record of a specified nonkeyed file or a pipe. See "Write Keyed Record" for keyed files. The file pointer is updated on every WRITE to be the byte position immediately following the last data byte that was written.

| ***C Interface:***

| void ADX_CWRITE_REC(long *nbytes, unsigned int option, unsigned int flags, long fnum, char *buffadr,
| long buffsize, long boffset);

Example:

COBOL Interface

```
77  NBYTES          PIC S9(8)          USAGE IS COMP-5.
77  OPTION          PIC 9(4)           USAGE IS COMP-5.
77  FLAGS           PIC 9(4)           USAGE IS COMP-5.
77  FNUM            PIC S9(8)          USAGE IS COMP-5.
77  BUFFADR                            USAGE IS POINTER.
77  BUFFSIZE        PIC 9(8)           USAGE IS COMP-5.
77  BOFFSET         PIC S9(8)          USAGE IS COMP-5.

CALL "ADX_CWRITE_REC" USING NBYTES,
BY VALUE OPTION, BY VALUE FLAGS, BY VALUE FNUM,
BY VALUE BUFFADR, BY VALUE BUFFSIZE, BY VALUE BOFFSET.
```

Parameters:

option 0 = Do not hold the write.
1 = Hold the write (not valid for pipes).

The Hold flag prevents the data from being physically written to a disk file until the next write with hold option is issued by this process. Each record must be less than or equal to 512 bytes in length when using the HOLD option.

flags

bit 0: 1 = Flush buffers after write (disk file only).
0 = Do not flush buffers.

This forces the data to the media. If this is a zero length request, the media is updated with any pending writes.

bits 1 to 7: Reserved (must be zero).

bits 8 and 9: Determine how the offset field is interpreted:

00 = Relative to beginning of file
01 = Relative to file pointer (disk file only)
10 = Relative to end of file (disk file only)

bits 10 to 15: Reserved (must be zero)

fnum File number where data is to be written, as returned from an OPEN or CREATE.

buffadr Address of buffer containing data to write.

buffsize Number of bytes to write.

boffset Offset into file to start writing, depending on bits 8 and 9 of flags. Offset is used for disk files only; set = 0 for pipes.

nbytes Return code. It will contain the number of bytes transferred if no error occurred. Note that a zero (0) return value is a special case for the WRITE with HOLD and is considered a correct value. Where *nbytes* is positive and not equal to *buffsize*, an end-of-media (disk or diskette full) condition exists. For pipes, if the buffer is full this operation will wait until enough is read from the other end to allow the WRITE to complete. An error code is returned if an error occurred.

Refer to the *IBM 4690 Store System: Messages Guide* for system errors.

Lock and Unlock Record: Access to records in a nonkeyed file are controlled by selectively locking and unlocking the record. LOCK the record before reading it, then UNLOCK the record after writing to it. The area to lock or unlock is determined from the offset and how it is used. This operation is only valid for disk files.

| ***C Interface:***

| void ADX_CLOCK_REC(long *ret, unsigned int flags, long fnum, long boffset, long nbytes);

COBOL Interface

```
77  FLAGS          PIC 9(4)          USAGE IS COMP-5.
77  FNUM           PIC S9(8)         USAGE IS COMP-5.
77  BOFFSET        PIC S9(8)         USAGE IS COMP-5.
77  NBYTES         PIC S9(8)         USAGE IS COMP-5.
77  RET            PIC S9(8)         USAGE IS COMP-5.

CALL "ADX_CLOCK_REC" USING RET, BY VALUE FLAGS,
BY VALUE FNUM, BY VALUE BOFFSET, BY VALUE NBYTES.
```

Parameters:

flags

bits 0 and 1: Lock Mode

00 = Unlock—release the indicated area
01 = Exclusive lock—prevents other processes from locking, reading from, or writing to the locked area
10 = Exclusive write lock—allows other processes to read the area but not to write to it or lock it
11 = Shared write lock—allows other processes to read the area and establish shared write lock but not to write to the area

bits 2 and 3: Reserved (must be zero)

bit 4: 1 = Return error on lock conflict
0 = Wait on lock conflict

bits 5 to 7: Reserved (must be zero)

bits 8 and 9: Interpretation of offset field

00 = Relative to beginning of file
01 = Relative to the pointer
10 = Relative to the end of file

bits 10 to 15: Reserved (must be zero)

fnum File number of file containing record to lock or unlock, as returned by a CREATE or OPEN.

boffset Offset of region to lock in file. See bits 8 and 9 in flags.

nbytes Length of region to lock, in bytes

ret Return code. An error code is returned if an if error occurred.

Refer to the *IBM 4690 Store System: Messages Guide* for system errors.

Delete File or Pipe: This operation will delete the designated file or pipe.

| ***C Interface:***

| void ADX_CDELETE_FILE(long *ret, unsigned int flags, char *filename);

COBOL Interface

```
77  FLAGS            PIC 9(4)            USAGE IS COMP-5.
77  FILENAME         PIC X(n)            USAGE IS DISPLAY.
*   n = length of FILE-NAME including terminating NULL or blank.
77  RET              PIC S9(8)           USAGE IS COMP-5.

CALL "ADX_CDELETE_FILE" USING RET, BY VALUE FLAGS,
BY REFERENCE FILENAME.
```

Parameters:

flags 1 = Force case to media default (pipes only).
0 = Do not affect name case.

filename Address of NULL or blank terminated name string or a previously defined logical name. If the file is not in the current directory, the string must include the path specification. The maximum length is 128 bytes including the NULL or blank. The name for a pipe must include *pi:* either in this string or in the logical name definition prefix.

ret Return code. An error code is returned if an if error occurred.

Refer to the *IBM 4690 Store System: Messages Guide* for system errors.

Rename a File: The rename operation changes the name of an existing disk file. If the file is currently open by another process, the file is not renamed and an error code is returned. If the new file name specifies another directory, the file is moved to that location. This feature is limited to directories on the same drive. Attributes, ownership, protection and date stamps are not changed.

| ***C Interface:***

| void ADX_CRENAME_FILE(long *ret, char *filename, char *newname);

COBOL Interface

```
77  FILENAME        PIC X(n)           USAGE IS DISPLAY.
*   n = length of FILE-NAME including terminating NULL or blank.
77  NEWNAME        PIC X(m)           USAGE IS DISPLAY.
*   m = length of NEW-NAME including terminating NULL or blank.
77  RET             PIC S9(8)          USAGE IS COMP-5.

CALL "ADX_CRENAME_FILE" USING RET,
BY REFERENCE FILENAME, BY REFERENCE NEWNAME.
```

Parameters:

filename Address of NULL or blank terminated string containing the current name of the file (Max length = 128 including NULL)

newname Address of NULL or blank terminated string containing the new name for the file (Max length = 128 including NULL)

ret Return code. It will contain an error code if an error occurred.

Refer to the *IBM 4690 Store System: Messages Guide* for system errors.

Seek (Change or Get File Pointer): This operation either returns or changes the file pointer position for the specified file. To get the current pointer position, select the Relative to file pointer option in flag bits 8 and 9 and specify an offset of 0. Any other combination of values for flag bits 8 and 9 and the offset cause a change in the file pointer position. For all calls, a positive return value indicates the current file pointer position.

The offset value can be positive or negative. An error is returned, however, if the new pointer position is less than 0. If the file consists of multibyte records, the offset must fall on a record boundary.

C Interface:

```
void ADX_CSEEK_PTR(long *pposit, unsigned int flags, long fnum, long boffset);
```

COBOL Interface

```
77  PPOSIT          PIC S9(8)          USAGE IS COMP-5.
77  FLAGS           PIC 9(4)           USAGE IS COMP-5.
77  FNUM            PIC S9(8)          USAGE IS COMP-5.
77  BOFFSET         PIC S9(8)          USAGE IS COMP-5.

CALL "ADX_CSEEK_PTR" USING PPOSIT, BY VALUE FLAGS,
BY VALUE FNUM, BY VALUE BOFFSET.
```

Parameters:

flags

bits 0 to 7: Reserved (must be zero)

bits 8 and 9: Determine how the offset field is interpreted

00 = Relative to beginning of file
01 = Relative to file pointer
10 = Relative to end of file

bits 10 to 15: Reserved (must be zero)

fnum File number as returned from an OPEN or a CREATE.

boffset Number of bytes relative to reference selected in flag bits 8 and 9.

pposit Return code. It contains the current position of the file pointer after the call or an error code if an error occurred.

Refer to the *IBM 4690 Store System: Messages Guide* for system errors.

Change File Attributes: This operation will change disk file attributes to enable a file to be distributed. To use this operation, the file must be open on the store controller with ownership of the file. The master controller owns compound files and the master file server owns mirrored files. After the attributes have been changed at least one record in the file must be written so that the operating system will mark the file for distribution. If the file has never been distributed or if there is currently no copy on the other store controllers, the receiving store controllers must be IPLed for the file to be distributed.

C Interface:

```
void ADX_CCHANGE_ATTRIB(long *ret, long fnum, unsigned int ftype, unsigned int fdistrib, long recsize);
```

COBOL Interface

```
77  FNUM            PIC S9(8)          USAGE IS COMP-5.
77  FTYPE           PIC 9(4)           USAGE IS COMP-5.
77  FDISTRIB        PIC 9(4)           USAGE IS COMP-5.
77  RECSIZE         PIC 9(8)           USAGE IS COMP-5.
77  RET             PIC S9(8)          USAGE IS COMP-5.

CALL "ADX_CCHANGE_ATTRIB" USING RET,
BY VALUE FNUM, BY VALUE FTYPE, BY VALUE FDISTRIB,
BY VALUE RECSIZE.
```

Parameters:

fnum File number returned by a create or an open.

ftype
0 = Local only file
1 = Mirrored file
2 = Compound file

fdistrib
0 = Distribute at close
1 = Distribute Per Update

recsize Size of record, as specified when the file was created

ret Return code. An error code is returned if an error occurred.

Refer to the *IBM 4690 Store System: Messages Guide* for system errors.

Canceling the Shared Use of a File: ADX_CFILES cancels the shared use of a file such as the transaction log. Without the use of ADX_CFILES, a shared file cannot be renamed or deleted because it is in use by more than one user.

Some of the conditions that can cause file sharing problems are incomplete transactions, terminal hardware failures, incomplete controller functions, and software failures. ADX_CFILES provides the following functions to manage the canceling of shared file usage:

- Restricting a file for exclusive use
- Unrestricting a file that was restricted
- Determining despool status

ADX_CFILES Restrict: ADX_CFILES restrict forces the exclusive use of a single file. This function is intended to be used only for store closing procedures and should not be used as a general purpose function.

ADX_CFILES restrict function causes all applications currently using that file to lose their access to that file until they have closed and reopened the file. When an application attempts to use a file that has been restricted, the file request is rejected and a new return code is returned. In the controller the return code is 80F306F0. In the terminal, the first terminal access to a restricted file receives a 80F306F0 and subsequent accesses (by the same or other terminals) receive a 80004007 (bad file number). When an application has a file open and receives either of these return codes for a file request, it should close and reopen that file.

- Purpose:

  To restrict the use of a file by all other applications. The restrict applies to applications on all controllers and all terminals. To restrict the use of a mirrored or compound file you restrict the prime version of the file on the file server or master respectively. You cannot use restrict for a distribute-on-close type file. After a file is restricted:

  - It cannot be opened by any application.
  - An application that is using a file that is restricted by another application must close and reopen a file to use the file again.

- Restrictions:

  - Only one ADX_CFILES to restrict a file can be active at a time.
  - To restrict a file on a file server or a master the controller application executing the restrict must be connected to the active file server or master.
  - To restrict a mirrored file or compound file an application must restrict the prime version of the file.
  - A distribute-on-close type file cannot be restricted.

- Location of usage:

  - Any application on any controller.
  - It cannot be used by a terminal application.

C Interface:

void ADX_CFILES(long *ret, unsigned int func, char *filename);

COBOL Interface

```
This function is currently not supported for COBOL.
```

Parameters:

ret = 4-byte integer that indicates the status of the restrict function

hi lo

xx xx yy yy = Indicates how the file was being used when the restrict was executed:

xxxx = Number of other controller applications that were using this file when it was restricted.

yyyy = Number of controllers where terminal applications were using this file when it was restricted.

0000 = No other application has the file open.

80 F3 06 F4 = Application attempted to restrict a file while another restrict is active.
80 F3 06 F5 = Application attempted to restrict a distribute-on-close file.
80 F3 06 F6 = Application attempted to restrict the file on the wrong node.

8x xx xx xx = Any other operating system error return code.
-1201 = Invalid function code used for the FUNC values defined for ADX_CFILES.
-1203 = FILENAME is not defined.
-1204 = FILENAME is not a valid file name.
-1205 = Force Close support is not installed.

func = 1 (This is the restrict function code for ADX_CFILES.)

filename = String containing the file name of the file to be restricted. The name may be a logical name or a fully-qualified file name. To reference a mirrored or compound file use the generic node names for the file server and the master:

- for file server use ADXLXACN::
- for master use ADXLXAAN::

Note: When an application attempts to use a file that has been restricted, you receive either an 80F306F0 or an 80004007. The error recovery should provide a delay and retry mechanism because the file remains restricted until it is unrestricted by the application.

ADX_CFILES Unrestrict: ADX_CFILES unrestrict stops the effect of the ADX_CFILES restrict. The unrestrict is requested for the same file name that was used for the restrict even if the file was renamed while it was restricted. After the unrestrict is executed that file name may be used by all applications again.

- Purpose:

  To unrestrict the use of a file that had been previously restricted. To unrestrict the use of a Mirrored or Compound file, unrestrict the prime version of the file on the File Server or Master respectively. After a file is unrestricted:

  – The file name can be used to open files according to the normal guidelines.
  – An application that lost access to a file due to restrict must issue a CLOSE followed by an OPEN after the unrestrict is issued to gain access to the file again.

- Prerequisites:

  The application executing the unrestrict ADX_CFILES must have executed the restrict ADX_CFILES.

- Restrictions:

  If an application is unrestricting a file on a file server or a master, the controller executing the application must be connected to the active file server or master.

- Location of usage:

  – Any application on any controller.
  – It cannot be used by a terminal application.

C Interface:

```
void ADX_CFILES(long *ret, unsigned int func, char *filename);
```

COBOL Interface

```
This function is currently not supported for COBOL.
```

Parameters:

ret = 4-byte integer that identifies the unrestrict status.

hi lo
00 00 00 00 = Unrestrict is successful.

80 F3 06 F2 = Application attempted to do an unrestrict without doing a restrict.
80 F3 06 F3 = Application attempted to unrestrict a file that it did not have restricted.
8x xx xx xx = Any other OS error return code.
-1201 = Invalid function code.
-1203 = FILENAME is not defined.
-1204 = FILENAME is not a valid file name.
-1205 = Force Close support is not installed.

When an unsuccessful unrestrict is executed because of a LAN failure (80 60 *xx xx*), the application should wait 30 seconds and retry the unrestrict. This should be repeated for a total of 7 executions of unrestrict.

func = 2 (This is the unrestrict function code for ADX_CFILES.)

filename = String containing the file name of the file to be restricted. The name can be a logical name or a fully qualified file name. To reference a mirrored or compound file use the generic node names for the file server and the master store controller:

- For file server use ADXLXACN::
- For master use ADXLXAAN::

ADX_CFILES Despool: ADX_CFILES despool determines how many total bytes of data remain in all the spool files and how many controllers have spool files. By using this function the applications can determine that the store personnel should be notified that a store closing must be delayed and can give the store personnel an idea of the length of the delay.

- Purpose:

  This function determines the status of the operating system despooling of files. This function determines how many bytes of data are yet to be despooled and how many controllers have data in their spool files to be despooled. The values determined by this function are probably different than the sizes of the spool files because the size of the spool files are not set to zero until all the data has been despooled from them.

- Prerequisites:

  None currently identified.

- Restrictions:

  This function can only determine despool status for controllers that are currently in session with this controller on the LAN.

- Location of Usage:
  - Any application on any controller.
  - It cannot be used by a terminal application.

| ***C Interface:***

| void ADX_CFILES(long *ret, unsigned int func, char *filename);

| ***COBOL Interface***

| `This function is currently not supported for COBOL.`

| **Parameters:**

| *RET* = 4-byte integer that specifies the despool status.

| *hi lo*

| *0w xx yy yy* = where:

| | | **w** = Status of LAN communications.
| | | 0 = All controllers are communicating with this controller.
| | | 8 = One or more controllers are not communicating with this controller.
| | | **xx** = Number of communicating controllers with data to despool.
| | | **yyyy** = Total number of bytes (in 1000s) of data to be despooled by controllers communicating.
| | *00 00 00 00* | = The system supports LAN and there is no despooling to do, or the system does not support LAN.
| | *8x xx xx xx* | = Indicates any operating system error return code:
| | *-1201* | = Function code is not valid.
| | *-1205* | = System supports LAN but Force Close support is not installed.
| *FUNC* | = 3 This is the despool function code for ADX_CFILES.
| *FILENAME* | = Unused; the value is ignored.

Pipe Routing Services

Create a Pipe Routing Services Pipe: Pipe Routing Services pipes are created for exclusive, READ mode only.

| ***C Interface:***

| void ADX_CPRS_CREATE(long *pnum, long psize, char *pipeid);

COBOL Interface

```
77  PNUM          PIC S9(8)          USAGE IS COMP-5.
77  PSIZE         PIC 9(8)           USAGE IS COMP-5.
77  PIPEID        PIC X              USAGE IS DISPLAY.

CALL "ADX_CPRS_CREATE" USING PNUM,
BY VALUE PSIZE, BY REFERENCE PIPEID.
```

Parameters:

psize	Pipe size, in bytes. The maximum size for store controller pipe is 65,536 bytes.
pipeid	One alphabetic character (A to Z) to identify the pipe.
pnum	Return code. It will be the pipe identifier or an error code if the create was unsuccessful.

The unique error codes are “-1000 Invalid pipe id” and “-1001 Pipe already exists.” Refer to *IBM 4690 Store System: Messages Guide* for system errors.

Read from a Pipe Routing Services Pipe

| ***C Interface:***

| void ADX_CPRS_READ(long *nbytes, long pnum, char *buffadr long buffsize);

COBOL Interface

```
77  NBYTES          PIC S9(8)          USAGE IS COMP-5.
77  PNUM            PIC S9(8)          USAGE IS COMP-5.
77  BUFFADR                            USAGE IS POINTER.
77  BUFFSIZE        PIC 9(8)           USAGE IS COMP-5.

CALL "ADX_CPRS_READ" USING NBYTES,
BY VALUE PNUM, BY VALUE BUFFADR, BY VALUE BUFFSIZE.
```

Parameters:

pnum	Pipe identifier returned from pipe routing services CREATE.
buffadr	Buffer to receive data
buffsize	Number of bytes to read
nbytes	Return code. It will contain the number of bytes read or an error code if an error occurred.

Refer to the *IBM 4690 Store System: Messages Guide* for system errors.

Initialize Pipe Routing Service Driver: The Pipe Routing Services Driver must be initialized before an application can write to a pipe routing services pipe. It should be initialized only once for each load of an application.

C Interface:

```
void ADX_CPRS_INIT(long *prsnum);
```

COBOL Interface

```
77  PRSNUM          PIC S9(8)          USAGE IS COMP-5.

CALL "ADX_CPRS_INIT" USING PRSNUM.
```

Parameters:

prsnum	Return code. It will contain the PRS identifier or an error code if an error occurred.

Refer to the *IBM 4690 Store System: Messages Guide* for system errors.

Write to a Pipe Routing Services Pipe

C Interface:

void ADX_CPRS_WRITE(long *ret, long prsnum, char *buffadr, long buffsize, char *dest);

COBOL Interface

```
77  RET            PIC S9(8)          USAGE IS COMP-5.
77  PRSNUM         PIC S9(8)          USAGE IS COMP-5.
77  BUFFADR                           USAGE IS POINTER.
77  BUFFSIZE       PIC 9(8)           USAGE IS COMP-5.
77  DEST           PIC X(4)           USAGE IS DISPLAY.

CALL "ADX_CPRS_WRITE" USING RET,
BY VALUE PRSNUM, BY VALUE BUFFADR, BY VALUE BUFFSIZE,
BY REFERENCE DEST.
```

Parameters:

prsnum PRS identifier returned from ADX_CPRS_INIT

buffadr Buffer containing data to write

buffsize Number of bytes to write

dest Destination address (where to send data). It contains four characters in the form *aaaw*. The *aaaw* indicates which terminal or store controller to send the data to. The *w* part of the destination address is the pipeID for a pipe routing services pipe created by an application executing in the specified store controller or terminal. For terminals, *aaa* is the terminal number in ASCII. For store controllers, it is *0xy* where *0* is an ASCII zero, *x* and *y* are ASCII characters between C and Z. There are two special values for *0xy* for store controllers: *0AA* and *0BB*. Use *0AA* when the destination is the master store controller and use *0BB* when the destination is the store controller where the calling application is executing (in the local store controller). Pipe routing services translates these special destination addresses so that the application does not need to define the actual address assigned to the physical machine. If the operating system switches destinations when a configuration changes, PRS will translate the change and no change is required for the application because of the switch.

ret Return code. Table 16-1 shows the return codes for the Pipe Routing Services function.

Table 16-1. Pipe Routing Services Return Codes

Return Code	Description
0	Good completion.
-1010	Invalid destination specified.
-1011	Destination not found.
-1012	Error on write to destination.
-1013	Data greater than 120-byte maximum.

Conditional Write to a Pipe Routing Services Pipe

C Interface:

void ADX_CPRS_CWRITE(long *ret, long prsnum, char *buffadr, long buffsize, char *dest);

COBOL Interface

```
77  RET            PIC S9(8)          USAGE IS COMP-5.
77  PRSNUM         PIC S9(8)          USAGE IS COMP-5.
77  BUFFADR                           USAGE IS POINTER.
77  BUFFSIZE       PIC 9(8)           USAGE IS COMP-5.
77  DEST           PIC X(4)           USAGE IS DISPLAY.

CALL "ADX_CPRS_CWRITE" USING RET,
BY VALUE PRSNUM, BY VALUE BUFFADR, BY VALUE BUFFSIZE,
BY REFERENCE DEST.
```

Parameters:

prsnum PRS identifier returned from ADX_CPRS_INIT

buffadr Buffer containing data to write

buffsize Number of bytes to write

dest Destination address (where to send data). It contains four characters in the form *aaaw*. The *aaaw* indicates the terminal or store controller to which send the data. The *w* part of the destination address is the pipe ID for a pipe routing services pipe created by an application executing in the specified store controller or terminal. For terminals, *aaa* is the terminal number in ASCII. For store controllers, it is *0xy* where *0* is an ASCII zero, *x* and *y* are ASCII characters between C and Z. There are two special values for *0xy* for store controllers: *0AA* and *0BB*. Use *0AA* when the destination is the master store controller and use *0BB* when the destination is the store controller where the calling application is executing (in the local store controller). Pipe routing services translates these special destination addresses so that the application does not need to define the actual address assigned to the physical machine. If the operating system switches destinations when a configuration changes, PRS translates the change and no change is required for the application because of the switch.

ret Return code. Table 16-2 contains return codes for the Conditional Write to Pipe Routing Services Pipe function.

Table 16-2. Return Codes for Conditional Write to a Pipe Routing Services Pipe

Return Code	Description
0	Good completion occurred.
-1	Destination pipe is full or does not have enough space available in the pipe to hold the data written.
-1010	The specified destination specified is not valid.
-1011	Destination is not found.
-1012	Error on write to destination.
-1013	Data greater than 120-byte maximum

Usage: This write is similar to ADX_CPRS_WRITE with the following exception: If the destination pipe is full or does not have enough room left to contain the entire message written, the write does not wait for room to become available. Instead, the application is given control immediately with a -1 return code. At this point the application must make a decision to either discard the data being written or retry the write at a later time.

The intended use for the conditional pipe write is for situations where it is undesirable for an application to wait for an extended period of time.

Communications Services

The following application interfaces are described in the *IBM 4690 Store System: Communications Programming Reference*:

ADX_COPEN_LINK Open communications link
ADX_COPEN_SESS Open session
ADX_CCLOSE_LS Close communications link or session
ADX_CREAD_HOST Read data from link or session
ADX_CWRITE_HOST Write data to link or session
ADX_CGET_STAT Obtain status from link or session
ADX_CSEND_REQ Requests to the driver

Specialized Services

The Specialized Services function provide a variety of functions for controller applications written in C language and COBOL. For background information, see Chapter 15 for a description of these services for BASIC applications.

Operator Authorization: This authorization function can be used to create and maintain authorization records that enable operators to sign on and use the system.

This authorization function is only valid for store controller applications written in C language and COBOL. If the authorization function requested is change or add, the user will be prompted for input. When the add or change is complete, the screen will be cleared and the cursor will be enabled and returned to the home position.

C Interface:

```
void ADX_CAUTH(long *ret, int func, char *opid, char *password, char *opid2);
```

COBOL Interface

```
77  RET             PIC S9(8)          USAGE IS COMP-5.
77  FUNC            PIC 9(4)           USAGE IS COMP-5.
77  OPID            PIC X(9)           USAGE IS DISPLAY.
77  PASSWORD        PIC X(8)           USAGE IS DISPLAY.
77  OPID2           PIC X(19)          USAGE IS DISPLAY.

CALL "ADX_CAUTH" USING RET, BY VALUE FUNC,
BY REFERENCE OPID, BY REFERENCE PASSWORD, BY REFERENCE OPID2.
```

Parameters:

func Action to be taken:

1 = CHANGE an operator authorization record
2 = ADD an operator authorization record
3 = DELETE an operator authorization record
8 = CHANGE PASSWORD only
9 = MAKE operator ID have the same authorization as the operator ID specified by opid2. If opid2 does not exist, a new ID is created with limited (default) authorization.
10 = MAKE WITH CHECK—same as 9 except opid2 has template ID and authority ID. Authorization for new ID may not be higher than authority ID even if the template authorization is higher.

opid Operator ID on which action is to be taken. This ID should be an ASCII string of up to nine characters. If the ID is less than nine characters it must be terminated with a blank or a NULL. This parameter should have no leading blanks. Leading blanks and zeros are counted as part of the ID.

password Password for ID. The password is an ASCII string of up to eight characters. If the string is less than eight characters it must be terminated with a blank or NULL. This parameter should have no leading blanks. Leading zeros are counted as part of the password.

opid2 Current operator ID for functions 1, 2, 3, and 8 or template ID for functions 9 and 10, depending on action requested. This ID may be up to nine ASCII characters and it must be terminated with a blank or NULL if it is less than nine characters. However, if the action to be taken is MAKE WITH CHECK, opid2 must have the template ID of up to nine characters, then a colon, and then the current operator ID of up to nine characters terminated with a blank or NULL if either ID is less than nine characters. There should be no leading or imbedded blanks. Leading blanks and zeros are counted as part of the ID.

ret Return code. It will contain a negative integer if an error occurred. Refer to Table 16-3 on page 16-34 for a list of error codes.

Note: At least one ID on every system should be authorized for all system functions. The default authorization allows the operator to sign on and select only primary or secondary applications. The current operator ID making a change to a record cannot be the same as the operator ID being changed.

- If the action to be taken is ADD or CHANGE, the system displays several screens to select the system functions that can be used. The current operator (opid2) can select only those functions for which the current operator ID is authorized.
- If the action to be taken is a CHANGE for an ID that does not exist, the ID is added using default authorization and error code -1010 is returned.
- If the action to be taken is an ADD for an ID that already exists, the action is handled as a CHANGE and error code -1010 is returned.
- If the action to be taken is MAKE or MAKE WITH CHECK, an ID can be added using a template in opid2 without having to select each system function from the various screens. The authorization allowed will be the same as the template. For a MAKE WITH CHECK, the authorization will only include functions for which both the template ID and the current operator ID have authorization. If opid2 is missing, or for MAKE WITH CHECK if either part is missing, error code -1011 is returned and the default authorization is used as the template.

Table 16-3 on page 16-34 shows the return codes returned by this function.

Table 16-3. Function Return Codes

Error Code	Description
0	Function completed successfully.
-1000	Unknown function code.
-1001	File not found.
-1002	Error reading or writing the disk.
-1003	OPID missing or not valid.
-1004	Password missing or not valid.
-1005	OPID2 missing or not valid.
-1010	One of these conditions exists: • Add function was handled as change because ID already exists. • Change function was handled as an add because ID was not found. • Delete requested for ID that was not found.
-1011	Function handled as requested using default authorization because OPID2 not found.
-1020	Could not allocate memory for ID search.

For any system errors that are returned, refer to the *IBM 4690 Store System: Messages Guide*.

Password Encryption: This function encrypts an eight-character ASCII password. The IBM 4690 Operating System uses one-way encrypted passwords for authorization to sign on to the system. The encryption method can also be used by an application to establish authorization for use of applications, data files, or other things that need access controlled by the application.

| ***C Interface:***

| void ADX_CCRYPT(long *ret, char *pwin, char *pwout);

COBOL Interface

```
77  RET             PIC S9(8)          USAGE IS COMP-5.
77  PWIN            PIC X(8)           USAGE IS DISPLAY.
77  PWOUT           PIC X(8)           USAGE IS DISPLAY.

CALL "ADX_CCRYPT" USING RET, PWIN, PWOUT.
```

Parameters:

pwin Password to be encrypted. Must be terminated with a NULL or blank if less than eight characters.

pwout Encrypted value returned.

ret Return code = 0 indicates encryption completed. If PWIN is blank or has a leading blank, error code -1100 is returned.

The password to be encrypted should be an ASCII string of up to eight alphanumeric characters. This parameter can have no leading blanks. Trailing blanks are ignored. Leading zeros are counted as part of the password. The encrypted value returned in PWOUT is an eight-character string of ASCII characters that represents decimal digits.

Common Application Services (ADX_CSERVE): This function can be called from a store controller application to request one of the application services.

The parameters here are slightly different from those described for ADXSERVE.

C Interface:

```
void ADX_CSERVE(long *ret, int funcnum, char *databuff, int dbuffsize);
```

COBOL Interface

```
77  RET             PIC S9(8)            USAGE IS COMP-5.
77  FUNCNUM         PIC 9(4)             USAGE IS COMP-5.
77  DATABUFF                             USAGE IS POINTER.
77  DBUFFSIZE       PIC 9(4)             USAGE IS COMP-5.

CALL "ADX_CSERVE" USING RET, BY VALUE FUNC-NUM,
BY VALUE DATA-BUFF, BY VALUE DBUFF-SIZE.
```

Parameters:

funcnum	Function number for the service requested.
databuff	Buffer for data sent to service requested or for data received from service requested.
dbuffsize	Size (bytes) of data-buff or data for requested service if data-buff is not used.
ret	Return code values vary with the service requested. An error code is returned if an error occurred.

Special error codes are returned. See Table 15-7 on page 15-18 for a list of the return codes. For any system errors that are returned, refer to the *IBM 4690 Store System: Messages Guide*.

Application Services for C-language and COBOL: The following is a list of the Application Services available when ADX_CSERVE is called. The function number and the required data, if any, are listed for each service.

Dump System Storage: The Dump System Storage function causes all of the storage in the controller to be dumped to a disk file named ADXCSLCF.DAT in the root directory. Both the application and the operating system storage are dumped.

This function uses the following parameters:

FUNC-NUM = 1
DATA-BUFF = Unused
DBUFF-SIZE = Unused

Enable Terminal Storage Retention: This function enables storage retention in all of the terminals on the TCC Network of the store controller requesting the enable.

The Enable Terminal Storage Retention function uses the following parameters:

FUNC-NUM = 2
DATA-BUFF = Unused
DBUFF-SIZE = Unused

Disable Terminal Storage Retention: This function disables storage retention in all of the terminals on the TCC Network of the store controller requesting the disable.

The Disable Terminal Storage Retention function uses the following parameters:

FUNC-NUM = 3
DATA-BUFF = Unused
DBUFF-SIZE = Unused

Get Application Status Information: The Get Application Status Information function returns the store controller application status. See “Get Application Status Information” on page 15-19 for the format of the data returned.

This function uses the following parameters:

FUNC-NUM = 4
DATA-BUFF = Address of buffer to receive status information
DBUFF-SIZE = 80 bytes

Programmable Power: The programmable power function allows terminal or controller applications to issue program calls to enable or disable the programmable power feature, and to issue program calls to power OFF a terminal or controller.

This function uses the following parameters:

FUNC-NUM 5
DATA-BUFF Eight-byte buffer containing:

- Two-byte integer set to 5 (for function 5)
- Two-byte integer specifying subfunction. Valid values are 1, 2, 3, 4, or 5. These values correspond to PARM5 values on ADXSERVE.
- Four-byte pointer to a character string. The character string pointed to by this pointer can have these valid formats:
  - *DDHHMM* where:

    DD = The day of the month (01-31).
    HH = The hours of the day (00-24).
    MM = The minutes of the hour (00-59).
  - *DDHHMMTTT* where:

    DD = The day of the month (01-31).
    HH = The hours of the day (00-24).
    MM = The minutes of the hour (00-59).
    TTT = The terminal number (001-999).
  - *DDHHMMCC* where:

    DD = The day of the month (01-31).
    HH = The hours of the day (00-24).
    MM = The minutes of the hour (00-59).
    CC = The controller ID (CC through ZZ).

DBUFF-SIZE = Size of the DATA-BUFF (eight bytes).

Display Application Status Message: The Display Application Status Message function displays the specified message on the WINDOW CONTROL screen in the description field of the window for the application that called this function.

This function uses the following parameters:

FUNC-NUM = 25
DATA-BUFF = Address of buffer containing message to display
DBUFF-SIZE = Size (bytes) of message, (maximum = 79 bytes.)

Display Background Application Status Message: The Display Background Application Status Message function displays the specified message on the BACKGROUND APPLICATION CONTROL screen in the message field of the requesting background application. The message is displayed until the message is changed or the application ends.

This function uses the following parameters:

FUNC-NUM = 26
DATA-BUFF = Address of buffer containing message to display
DBUFF-SIZE = Size (bytes) of message, (maximum = 46 bytes).

Stop Application with Message: The Stop Application with Message function displays the specified message on the WINDOW CONTROL screen used to start the application. The message appears after the application is stopped. This function provides a way to indicate problems that are preventing an application from running properly.

This function uses the following parameters:

FUNC-NUM = 27
DATA-BUFF = Address of buffer containing message to display
DBUFF-SIZE = Size (bytes) of message. Maximum = 79 bytes.

Get Disk Free Space: The Get Disk Free Space function returns the free space on the specified remote or local disk drive. Example: local = C:\, non-local = ADXLNX*nn*N::C:\ (where *nn* = store controller ID). Count of characters should be exact, not general size of DATA-BUFF.

This function uses the following parameters:

FUNC-NUM = 28
DATA-BUFF = Address of buffer containing the node name (if non-local) and the drive, or a logical name for the node &/or the drive
DBUFF-SIZE = Number of characters in name. Maximum = 127 bytes.

Get Configured Controllers on the Network: The Get Configured Controllers on the Network function returns the IDs for all of the store controllers on the network. Each ID is two bytes long. Store controller IDs range from CC through ZZ. If there are less than 20 controllers, 00 (ASCII zeros, not numeric) indicates the end of the list.

This function uses the following parameters:

FUNC-NUM = 29
DATA-BUFF = Address of buffer to receive the list of store controllers.
DBUFF-SIZE = 40 bytes

Get The Controller ID for a Specified Terminal: The Get The Controller ID for a Specified Terminal function returns the store controller ID for the specified terminal. The ID is returned in the RET parameter as ASCII value CC through ZZ or X'0' if the terminal was not defined. These values are returned only if the store controller requesting the ID is the master store controller or if the terminal is local to the store controller.

This function uses the following parameters:

FUNC-NUM = 30
DATA-BUFF = Unused
DBUFF-SIZE = Terminal number for which the ID is requested

Convert ASCII Characters to EBCDIC Characters: This function converts ASCII characters to EBCDIC characters. The characters are changed byte by byte, therefore the original characters are no longer present when the function completes the conversion.

This function uses the following parameters:

FUNC-NUM = 31
DATA-BUFF = Address of buffer containing ASCII characters to convert
DBUFF-SIZE = Number of characters to convert

Convert EBCDIC Characters To ASCII Characters: This function converts EBCDIC characters to ASCII characters. The characters are changed byte by byte, therefore the original characters are no longer present when the function completes the conversion.

The function uses the following parameters:

FUNC-NUM = 32
DATA-BUFF = Address of buffer containing EBCDIC characters to convert
DBUFF-SIZE = Number of characters to convert

Set/Reset/Query Terminal Dump Preservation Flag: This function lets you set, reset, and query the terminal dump preservation flag. Setting the preservation flag prevents a terminal dump from being written to the terminal dump file. Resetting the preservation flag allows a dump to be written to the file. The query request returns the status of the preservation flag.

A return code of 1 indicates that the preservation flag is ON. A return code of 0 indicates that the preservation flag is OFF.

If the user logical name ADXTDUMP has not been created to enable the Terminal Dump Preservation Function, you will receive a return code of -1022 if you try to access this function.

This function uses the following parameters:

FUNC-NUM = 33
DATA-BUFF = Unused
DBUFF-SIZE = Specify one of the following:
0 To turn off the terminal dump preservation flag
1 To Turn on the terminal dump preservation flag
2 To query whether the terminal dump preservation flag is ON or OFF

Get Loop Message: This function gets the three most recent system messages for the store loop or token-ring adapter specified in DATA-BUFF. DATA-BUFF is a string consisting of node (for example, CD), TCC Network (1 or 2), and three TCC Network messages.

The node and the TCC Network must be the first three characters of the string when the ADX_CSERVE function is called. When the ADX_CSERVE function returns, the three most recent messages will follow the node and TCC Network in the string. If no messages exist for the specified node and TCC Network, blanks will be returned for the messages. The oldest message will be put in the buffer first. Each message is 133 characters long.

The function uses the following parameters:

FUNC = 34
DATA-BUFF = Address of the buffer
DBUFF-SIZE = 402 bytes

Get Loop Status: This function returns the configuration and current status of the two loop adapters. Data is returned in RET in the form *WWXXYYZZ* (hex) where:

ZZ = First adapter configuration
YY = First adapter status
XX = Second adapter configuration
WW = Second adapter status

The configuration is defined as:

00 = Not used
01 = Primary
02 = Secondary
04 = 2400 bps loop
80 = Auto resume of primary loop control

The status is defined as:

03 = Standby
04 = Controlling
05 = Prevented

The function uses the following parameters:

FUNC-NUM = 35
DATA-BUFF = Unused; the value is ignored.
DBUFF-SIZE = Unused; the value is ignored.

Get All Active Controllers on the Network: This function returns the IDs of all active store controllers on the network. Each ID is two bytes long. A store controller ID of 00 indicates the end of the list.

The function uses the following parameters:

FUNC-NUM = 36
DATA-BUFF = Address of buffer to receive IDs
DBUFF-SIZE = 40 bytes

Get Controller ID and Loop for a Specified Terminal: The data returned in RET is two bytes for the loop ID followed by the two bytes for the store controller ID. A X'01' is returned if the terminal number cannot be found.

Note: The RET is valid only if this function is issued at the master store controller.

The function uses the following parameters:

FUNC-NUM = 37
DATA-BUFF = Address of buffer containing terminal number
DBUFF-SIZE = 2 bytes

Get the Controller Machine Model and Type: This function returns the store controller model number and type. The function uses the following parameters:

FUNC-NUM = 38
DATA-BUFF = Eight-byte integer containing:
- 2-byte integer set to 38 (for function 38)
- 2-byte integer specifying subfunction 1. The valid value is 1.
- 4-byte pointer to a 4-byte buffer. The buffer pointed to by this pointer should have a length of four bytes. It contains the machine model and type. For example, for a 4693-541, the values returned are X'F8' X'3E' X'00' X'00'.

DBUFF-SIZE Size of the DATA-BUFF (8 bytes).

| ***Check the Master or File Server Exception Log:*** This function returns whether or not there are any
| entries in the exception log.

| This function uses the following parameters:

| *RET* = One of the following values:
| 0 = No entries in the exception log
| 1 = Entries exist in the exception log
| 8xxxxxxx = Error code indicating why the status of the exception log can not be obtained.
| *FUNC* = 39
| *PARM1* Specify one of the following values:
| 1 = Check the Master exception log
| 2 = Check the File Server exception log
| *PARM2* = Unused

Set Terminal Sleep Mode Inactive Timeout: This function allows an application running in a store controller to set the Terminal Sleep Mode Inactive Timeout. When you enable Terminal Storage Retention, you set this value to determine how many minutes a terminal will remain idle before being powered-down.

Note: This function is supported only on the store controller. In order for the sleep mode inactive timeout to take effect, you must invoke this function before enabling the Terminal Storage Retention. You may also specify the terminal sleep mode inactive timeout by selecting the Enable Terminal Storage Retention option on the TERMINAL FUNCTIONS screen. The default for the terminal sleep mode inactive timeout is 30 minutes.

This function uses the following parameters:

FUNC-NUM = 41
DATA-BUFF = 2-byte buffer containing a two-byte integer specifying the terminal sleep mode inactive timeout. Valid values are 0 through 255. You can use a 0 value to disable the terminal sleep mode.
DBUFF-SIZE = Size of the DATA-BUFF (2 bytes).

Starting a Background Application: This operation can be called from an application written in C and COBOL to start a background application on the 4690 Operating System. The ability to set a priority level for the background application is included. This function is valid only for store controller applications. See “ADXSTART” on page 15-6 for a description of starting as background application from a CBASIC application.

| ***C Interface:***

| void ADX_CSTARTP(long *pid, char *bacappl, char *parms, int parmlen, char *initmsg, int imsglen, int
| cpriority);

COBOL Interface

```
77  BACAPPL         PIC X(22)          USAGE IS DISPLAY.
77  PARMS            PIC X(46)          USAGE IS DISPLAY.
77  PARMLEN          PIC 9(4)           USAGE IS COMP-5.
77  INITMSG          PIC X(46)          USAGE IS DISPLAY.
77  IMSGLEN          PIC 9(4)           USAGE IS COMP-5.
77  CPRIORITY        PIC 9(4)           USAGE IS COMP-5.
77  PID              PIC S9(8)          USAGE IS COMP-5.

CALL "ADX_CSTARTP" USING PID,
BACAPPL, PARMS, BY VALUE PARMLEN, BY REFERENCE INITMSG,
BY VALUE IMSGLEN, BY VALUE CPRIORITY.
```

Parameters:

bacappl Background application name. The name must be terminated with a NULL or a blank. Maximum length = 22 characters including the ending blank or NULL.

parms Parameter list to be passed to background application. Note the system automatically passes BACKGRND as the first parameter and appends the parameters in PARMS.

parmlen Length of parameter list. Maximum length = 46 characters.

initmsg The initial message to be displayed on the BACKGROUND APPLICATION CONTROL screen when the application is started.

imsglen Length of the initial message. Maximum length = 46 characters.

cpriority Value for setting priority. May be from 1 to 9. This value is added to 195 to give the priority 196 to 204. The recommended value is 5 to yield priority 200. A lower value will affect other applications that may be running with a different priority.

pid Return code. It will be the process ID or an error if an error occurred.

Table 16-4 shows unique error codes that you may receive:

Table 16-4. Error Codes

Error Code	Description
-1170	Application name missing or not valid.
-1171	All background application list entries are in use.
-1172	Maximum number of background applications already active.
-1175	Invalid parameter.
-1176	Internal error.
-1177	Specified priority out of range.

For any system errors that are returned, refer to the *IBM 4690 Store System: Messages Guide*.

Logging an Error: This function can be called from a store controller application written in C or COBOL to log an error in the application error log. See “ADXERROR (Application Event Logging)” on page 15-29 for a description of logging an error from a BASIC application. The function will look for a file of error messages to display along with the unique data. These messages should be in file ADXCSOZF.DAT in the form specified. The application name is automatically included in the log entry.

There is no return code for this function.

| ***C Interface:***

| void ADX_CERROR(int msggrp, int msgnum, int severity, int event, char *unique, int ulen);

COBOL Interface

```
77  MSGGRP          PIC 9(4)            USAGE IS COMP-5.
77  MSGNUM          PIC 9(4)            USAGE IS COMP-5.
77  SEVERITY        PIC 9(4)            USAGE IS COMP-5.
77  EVENT           PIC 9(4)            USAGE IS COMP-5.
77  UNIQUE          PIC X(10)           USAGE IS DISPLAY.
77  ULEN            PIC 9(4)            USAGE IS COMP-5.

CALL "ADX_CERROR" USING BY VALUE MSGGRP,
BY VALUE MSGNUM, BY VALUE SEVERITY, BY VALUE EVENT,
BY REFERENCE UNIQUE, BY VALUE ULEN.
```

Parameters

msggrp Two-byte integer that contains the ASCII equivalent of the message group character used to identify the error messages for a product. This character is unique for each product and may be in the range J to S. Example: MSGGRP = 75 for the letter K.

msgnum Two-byte integer message number, if any. If the message number is zero, no message will be displayed. This number is converted to three printable decimal digits and appended to the message group letter to form the message identifier. This identifier is used to search the Application Message file for a message to display.

severity Two-byte integer ranging from 1 to 5 that is used to indicate the importance of each message. This number is a message level indicator with the most important messages as severity = 1. An operator can request messages to be displayed. The messages with severity level less than or equal to the level requested will be displayed.

event Two-byte integer that may be set by the application to indicate a specific situation or problem. This must be in the range 64 to 79 for the controller. The system uses the log data to generate Network Problem Determination Alert messages.

unique Short string of characters to be included in message. Maximum length is 10 bytes. If the message is longer than 10 bytes, only the first 10 bytes will be used. If the message is less than 10 bytes, blanks will be added.

ulen Number of characters in unique message including imbedded blanks.

Miscellaneous Services

The Miscellaneous Services functions provide a variety of functions to end a program, exit a program, get additional storage, and so on.

Ending a Program: This operation removes a process from the system. Any outstanding events for the process are canceled, opened files are closed, and memory is released. A process can only be ended by another process with the same user and group or by a superuser.

| ***C Interface:***

| void ADX_CABORT(long *ret, long pid);

COBOL Interface

```
77  PID             PIC S9(8)           USAGE IS COMP-5.
77  RET             PIC S9(8)           USAGE IS COMP-5.

CALL "ADX_CABORT_PROS" USING RET, BY VALUE PID.
```

Parameters:

pid Process ID of target process to end.
ret Return code. An error code is returned if an error occurred.

Refer to the *IBM 4690 Store System: Messages Guide* for information on the error codes returned by this function.

Exiting a Program: This operation terminates the program, returns control to the operating system, and passes back the completion status value to the calling program. Any outstanding events are canceled and open files closed.

The low order word of the status can be used by an application to indicate status when the application was exited. Bits 0–14 of this application status word are available to the application. By convention, a 0 value is used to indicate success while positive values indicate some form of partial completion. Bit 15 is set by the operating system (making the application status word negative) when the attempt to create the process resulted in an error or the process was abnormally terminated. This error can be used if the program is started from a batch file.

There is no return code for this function.

C Interface:

```
void ADX_CEXIT(long estat);
```

COBOL Interface

```
77  ESTAT           PIC S9(8)           USAGE IS COMP-5.

CALL "ADX_CEXIT_PROS" USING  BY VALUE ESTAT.
```

Parameters:

estat A 32-bit value. The low order word is the completion status. The high order word is reserved.

Bits 0–14 may be used to indicate completion status.

Bits 15–31 are reserved and must = 0.

Getting Additional Storage: This operation either adds contiguous memory to the end of an existing heap or allocates a new heap. Use the option field to select one or the other and the Memory Parameter Block to specify the minimum and maximum memory requirements. Set the Memory Parameter Block's start parameter to the base address of the existing heap for option 0 or to zero for option 1.

Note: Processes are not automatically given an initial heap allocation. Consequently, option 1 must be called the first time that heap space is needed.

When option 0 is selected, the designated heap is extended contiguously. The Memory Parameter Block start address (start) and minimum allocation (min) are modified to reflect the new starting address and actual allocation, respectively. The original heap's base address and contents remain unchanged.

When option 1 is selected, the new heap may or may not be contiguous with any previously allocated heap. ADX_CMEM_GET modifies the Memory Parameter Block's start and min values to indicate the new heap's base address and actual allocation. The new heap may be allocated such that an existing heap is no longer expandable.

C Interface:

void ADX_CMEM_GET(long *ret, int option, long mpbptr[3])

Note: A COBOL interface is not available for this operation.

Parameters:

option 0 = Expand existing heap
1 = Allocate a new heap

mpbptr Address of Memory Parameter Block.

ret Return code. An error code is returned if an error occurred.

Memory Parameter Block

Byte

0	start
4	min
8	max

start For option equal 0, set the base address of the heap segment to be expanded in this field. The base address of the added memory portion will be put here when the allocation has completed. For option equal 1, set this field to zero and the base address of the new heap will be put here.

min Specify the minimum number of bytes required. The actual number allocated will be returned.

max Specify the maximum number of bytes required. This value will not be changed.

Refer to the *IBM 4690 Store System: Messages Guide* for information on the error codes returned by this function.

Freeing Storage: This operation releases the memory in a heap from the address specified to the end of the heap.

C Interface:

void ADX_CMEM_FREE(long *ret, void *mstart)

Note: A COBOL interface is not available for this operation.

Parameters:

mstart Beginning address of heap to free.

ret Return code. An error code is returned if an error occurred.

Refer to the *IBM 4690 Store System: Messages Guide* for information on the error codes returned by this function.

Suspended Processing for Indicated Duration: This operation delays the calling process until the specified time or until the specified period of time expires.

If absolute time is specified and the current time of day is beyond it, the process delays until the specified time on the next day.

C Interface:

```
void ADX_CTIMER_SET(long *ret, unsigned int flags, long stime);
```

COBOL Interface

```
77  FLAGS          PIC 9(4)          USAGE IS COMP-5.
77  STIME          PIC 9(8)          USAGE IS COMP-5.
77  RET            PIC S9(8)         USAGE IS COMP-5.

CALL "ADX_CTIMER_SET" USING RET,
BY VALUE FLAGS, BY VALUE STIME.
```

Parameters:

flags 1—absolute
0—relative

stime If FLAGS = 1 (absolute), stime indicates the number of milliseconds to delay after midnight.
If FLAGS = 0 (relative), number of milliseconds to delay.

ret Return code. An error code is returned if error occurred.

Refer to the *IBM 4690 Store System: Messages Guide* for information about the error codes returned by this function.

Waiting for Event Completion: An application can initiate a WAIT. This operation waits for data to be available in a pipe or for a change of status from the host. Several WAITs may be initiated in one call. The first WAIT to be satisfied will be indicated in the return code. The WAIT will also terminate if the specified time to wait elapses before any event completes.

If more than one WAIT is satisfied at the same time, the one that occurs first in the parameter list will be indicated in the return code. Thus, the order of the parameters in the list may be significant. If no time limit is specified, the operating system will wait indefinitely until at least one of the waits is satisfied.

For pipes, the wait for data to be available in a pipe is satisfied when at least one byte is in the pipe. For change in status from the host, the application must have requested the status before calling for a wait because the change is considered as change since the status was last requested.

The maximum number of waits that may be requested at a time is 30. However, the OS also uses waits, so this maximum may not be available. If more waits are requested than are available, the application will end and cause a dump if the dump is enabled.

C Interface:

```
struct waitblk
{
long fnum;
char wtype;
} wblk[n];   /*n == number of waits required by the application. */

void ADX_CWAIT(long *ret, long wtime, int wcount, struct waitblk wblk[]);
```

COBOL Interface

```
01  WAITBLK OCCURS n TIMES INDEXED BY NWAITS.
*   Where n is the maximum number of waits that the
*    application requires.
     02  FNUM       PIC S9(8)          USAGE IS COMP-5.
     02  WTYPE      PIC 9(2)           USAGE IS COMP-5.
77  RET             PIC S9(8)          USAGE IS COMP-5.
77  WTIME           PIC S9(8)          USAGE IS COMP-5.
77  WCOUNT          PIC 9(4)           USAGE IS COMP-5.
77  WBLK                               USAGE IS POINTER.

SET WBLK TO ADDRESS OF WAITBLK (1).
CALL "ADX_CWAIT" USING RET,
BY VALUE WTIME, BY VALUE WCOUNT, BY VALUE WBLK.
```

Parameters:

wtime Time to wait, in milliseconds. For example, to wait 1 second set wtime = 1000.

Note: 0000 = infinite.

wcount Count of *fnum*s entered in *wblk*. This should be the actual count of wait events to initiate and not the maximum. For most applications this count will be less than 10 and usually 1 or 2. Maximum count = 30.

fnum For pipes, fnum is the file number or pipe identifier returned when the pipe was created. For host communications, fnum is the link number or session number returned when the link or session was opened.

wtype Type of event for wait. (This is a one-byte integer, not an ASCII character.)

1 = pipe
2 = host

Any other value will cause an error to be returned.

ret Return code. If ret is positive an event completed and ret is the index number of the completed event. For example, if wcount = 2 when ADX_CWAIT is called, ret = 1 indicates the first event completed, ret = 2 indicates the second event completed. If ret = 0, then the specified time expired before an event completed. If ret is negative, then an error occurred.

Table 16-5 on page 16-48 shows the error codes unique to this function.

Table 16-5. Unique Error Codes

Error Code	Description
-1000	wtime < 0
-1001	wcount < = 0 or wcount > 30
-1002	wtype value not valid

Refer to the *IBM 4690 Store System: Messages Guide* for any system error that is returned.

Converting HEX to ASCII: This function will convert four hexadecimal bytes to eight bytes of ASCII characters. This can be used to convert the 4690 system error codes from hexadecimal characters to printable ASCII characters.

C Interface:

void ADX_CPRTHEX(char *anum, long hnum);

COBOL Interface

```
77  ANUM            PIC X(8)            USAGE IS DISPLAY.
77  HNUM            PIC S9(8)           USAGE IS COMP-5.

CALL "ADX_CPRTHEX" USING ANUM, BY VALUE HNUM.
```

Parameters:

anum Buffer to receive ASCII characters. It must be eight bytes.
hnum Hexadecimal number to convert. It must be four bytes.

Guidelines and Restrictions for Assembly Language Applications

- All applications must be relocatable.
- Do not use instructions that are restricted to 80286 or 80386 privileged mode. These instructions are:
  - IN/INS and OUT/OUTS
  - CLI and STI
  - HLT
- Do not address any absolute memory location such as:
  - Interrupt vector table (0000-03FF)
  - ROM communication area (400-5FF)
  - Display screen buffers (B0000-B3FFF and B8000-BBFFF)
  - Physical addresses for memory mapped I/O adapters
  - BIOS routines
- Do not attempt to address any area of memory that has not been assigned to the application either at load time or by a dynamic memory allocation.
- Do not load anything but a valid address that has been provided by the system into a segment register.
- Do not perform address arithmetic in a segment register.
- Do not depend on the initial value stored in any segment register for purposes other than addressing. Do not assume the value of one segment by examining the value of another segment.
- Do not attempt to execute code in a data segment and do not attempt to write data in a code segment.
- Language subroutines addressed by the interrupt vector table must be reentrant to allow for multiple accesses from applications executing at the same time.

- Non-reentrant subroutines must be addressed by call mechanisms linked with the application that is using the subroutines to ensure a unique copy of the subroutines for each application.

Following are the currently known differences between the 80286 or 80386 and the 8088 or 8086 instructions. You can reference the currently available Intel** documents for the details of the following items and for any additional differences.

Some of these functional differences may be handled by the IBM 4690 Operating System; however, all of the known differences are listed here.

The following differences are handled by the IBM 4690 Operating System:

- The interrupts that only occur for instructions that are new in the 80286 or 80386 or for protection exceptions. The interrupts are for:

Interrupt Number	Description
5	BOUND instruction fault
6	Undefined opcode attempted
7	Processor extension not available
8	Double fault
9	Processor extension segment overrun
10	Invalid Task State Segment (TSS)
11	Segment not present
12	Stack exception
13	General protection exception
16	Math fault

- Divide exceptions point at the DIV instruction.
- Do not single step external interrupt handlers.
- Do not rely on NMI interrupting NMI handlers.

The following differences may impact an application:

- Most instructions take fewer clock cycles in the 80286 or 80386 than in the 8088 or 8086.
- PUSH SP in the 80286 puts the value of SP before the instruction was executed onto the stack. POP SP works accordingly.
- The 80286 masks all shift and rotate counts to the low 5 bits (maximum of 31 bits).
- Do not duplicate prefixes. The 80286 sets an instruction length limit to 10 bytes.
- Do not rely on IDIV exceptions for quotients of 80h or 8000h.
- Instructions or data items may not wrap around a segment.
- Do not attempt to change the sense of any reserved or unused bits in the flag word by IRET.

Chapter 17. Using IBM DOS Applications

Note: IBM DOS Applications work **only** on the 80286 processor.

The IBM 4690 Operating System includes an interface that emulates the environment of the IBM Personal Computer Disk Operating System (IBM DOS) Version 2.1. This chapter gives you the information you need to run or write applications for that environment. The chapter contains information on software interrupts, Personal Computer Basic Input/Output System (PC BIOS) calls, and guidelines for applications written to run under the IBM DOS environment.

An IBM DOS application should run under the 4690 DOS emulation provided:

- It meets the guidelines for IBM DOS applications as described
- It uses only the hardware listed.

To help you determine if an application is suitable for the 4690 DOS emulator, four optional debug reports are available. The four reports are activated using the DEFINE command and setting the EOPTIONS parameter.

Starting Applications in the IBM DOS Environment

The 4690 IBM DOS emulator executes a IBM DOS application in the protected mode. In this mode an application is restricted from the execution of some machine instructions and is restricted from accessing any memory that is not initially assigned to it.

To run in the IBM 4690 Operating System, IBM DOS applications must conform to the following guidelines.

The program **must:**

- Use IBM DOS function calls to perform all system functions and data I/O.
- Use the IBM DOS system call to obtain additional memory.
- Limit direct BIOS calls (interrupt requests to the BIOS) to the following functions:

  10H 13H
  11H 16H
  12H 17H

The program **must not:**

- Use instructions that are restricted to the privileged mode. These instructions include:
  - IN, INS, OUT, and OUTS except to the CRT controller
  - CLI and STI (the emulator ignores these instructions)
  - LOCK (causes program termination)
  - All unique protection control instructions (causes program termination)
- Jump to or call BIOS routines directly.
- Address IBM DOS flags, data buffers, tables, and work areas.
- Address any memory that has not been assigned to the application at load time.
- Set the video display mode any way other than with BIOS int 10H, subfunction 0 or by accessing the CRT controller with an OUT instruction.
- Define the IBM DOS reserved areas of the PSP and FCB.
- Depend on the environment string.

Generally, you should not access absolute addresses in memory directly. The only exceptions are the following virtual hexadecimal addresses:

- Screen region buffers B0000-B3FFF (monochrome) and B8000-BBFFF (color)
- Zero page 0-5FF; however, do not depend on the values in 400-5FF.

For better program performance, avoid instructions that load segment registers (SR). These include:

```
LDS
LES
POP sr
MOV sr,...
CALLF
RETF
JMPF
```

In addition, small memory model programs perform better than programs written in other memory models.

IBM DOS Program Memory Allocation

IBM DOS is a single-tasking operating system. Because only one task is intended to run at a time, DOS allows a single program to occupy all of user memory. There is no need to share memory because there is never another program with which to share it.

Because the 4690 Operating System is a multitasking system in which several programs run at the same time, memory must be carefully allocated. Use the ADDMEM parameter to allocate memory, if needed.

The assumption made by the emulator is for a 128 KB (DOS) machine. If the DOS program is designed to work in a 128 KB or less memory, no memory adjustments are required. If the program requires more than 128 KB, you must define the ADDMEM parameter with the correct machine size.

Allocating Memory Using ADDMEM

The ADDMEM parameter of the DEFINE command lets you control the size of the emulated DOS machine. The system applies the memory allocation on a process family (FID) basis. An ADDMEM memory allocation applies only to programs loaded under the window on which the DEFINE command was invoked. Regular users of IBM DOS applications should include a DEFINE ADDMEM command in a batch (BAT) file used to invoke the application.

The DEFINE command used to define the DOS machine has the following form:

```
DEFINE addmem=n
```

Where *n* specifies the amount of memory in kilobytes.

If the program fails to load because of a lack of memory, a message indicating the amount of memory required will be displayed. The message will look like:

```
Code: zzzzzzzz - Not enough memory.  Need xxx KB.
Requested machine size was: yyy KB.

Run has been aborted.
```

Where *xxx* and *yyy* will be numbers appropriate to the situation. An ADDMEM value of *xxx* should permit the program to load. Code *zzzzzzzz* is explained in “Emulator Messages” on page 17-6.

Optional Emulator Reports

It is difficult to determine if a program is appropriate for 4690 DOS emulation. The optional reports will slow the execution of a DOS program but they can provide the data needed to identify unsupported function or explain unusual results.

To activate the reports, you must define the EOPTIONS parameter with the desired report selected; otherwise no reports will be created.

Selecting Reports Using EOPTIONS

The EOPTIONS parameter of the DEFINE command allows you to select one or more reports that will be written during the execution of all subsequent DOS applications. For each execution of a DOS application, the previous reports will be erased.

All reports are added to a file called E_DATA in the root directory of the C: drive. You must rename, copy, or move this file if you want to keep the results of the DOS application execution.

The DEFINE command used to select all reports has the following form:

```
DEFINE eoptions=abcd
```

Where *abcd* must be “yyyy” to activate all (4) available reports. An “n” in any position will prevent that report.

Report “a”—Errors

Report “a” records all errors encountered by the emulator. An example of this output is:

```
    INT21 Subfunction 49h illegal.
    Execution has been aborted.
```

Report “b”—Startup Data

Report “b” produces a display at startup time showing the initial conditions for the emulated program. This display is also recorded in the report file and could look like:

```
               Emulation Options are yyyy

                DOS   E M U L A T I O N

Environment:

        Program name:   h0:/edit.exe
        Input data:     ''
        Machine size:   128 KB
        Display Type:   Color
        286 installed?: Yes
        # of floppies:  1
        # of hardfiles: 1

        Do you wish to continue?  (y/n):
```

Report “c”—Interrupt Trace

Report “c” produces a report tracing all interrupts and recording the registers before and after the interrupt. The trace report could look like:

```
  CS   IP    Service           AX  BX   CX  DX   DS  SI   ES  DI   SS  SP   BP   FL
1C0E:002B  INT 11h         16490000 00001000 16490000 16490000 10100289 0000 0293
1C0E/002B  INT 11h         00230000 00001000 16490000 16490000 10100289 0000 0293
1C0E:0032  INT 21h         19230000 00001000 16490000 16490000 10100289 0000 0293
1C0E/0032  INT 21h         19020000 00001000 16490000 16490000 10100289 0000 0292
```

Report “d”—OUT, OUTS, IN, INS Trace

Report “d” produces a report tracing all IN, INS, OUT, and OUTS and record the registers before the operation. The trace report could look like:

```
  CS   IP    Service           AX  BX   CX  DX   DS  SI   ES  DI   SS  SP   BP   FL
103A:5172  OUT EEh         00070304 07070305 16491020 08000000 10100271 0000 0206
103A:5179  OUT EEh         00000305 07070304 16491020 08000000 10100271 0000 0202
```

IBM DOS BIOS Calls and Software Interrupts

Following is a list of the IBM DOS BIOS software interrupts supported.

Note: You cannot mix IBM DOS calls with IBM 4690 Operating System calls in the same program.

BIOS Calls

Note: Only BIOS calls and subfunctions documented in this section are supported. All others are unsupported.

Int 10H, Subfunction n:

00H: Supported. Can also set mode by writing to the CRT controller.

01H: Supported. Sets no cursor if no cursor or a bad cursor value is specified else sets blinking line cursor.

02H: Supported. The video page field is ignored.

03H: Supported. The video page field is ignored.

06H: Supported.

07H: Supported.

08H: Supported. The display page is ignored.

09H: Supported. The display page is ignored.

0AH: Supported. The display page is ignored.

0FH: Supported. The active display page is always zero.

Int 11H: Supported. It returns 287 presence and initial video mode plus the following static values:

- IPL present.
- One floppy drive.
- High byte always 0.

Int 12H: Supported. Returns memory allocated to the current process.

Int 13H, Subfunction n:

00H: Supported.

01H: Supported.

02H: Supported.

03H: Supported with restrictions to maintain system integrity.

04H: Supported.

Int 16H, Subfunction n:

00H: Supported.

01H: Supported.

02H: Returns zero.

Int 17H: Supported.

Software Interrupts

Int 20H: Supported.

Int 22H: Supported.

Int 23H: Supported.

Int 24H: Supported.

Int 25H: Supported.

Int 26H: Supported with restrictions to maintain system integrity.

DOS Function Calls

DOS function calls are supported as defined in the following (ascending) ordered list. Gaps in the ascending order imply that the missing function is **not** supported.

Int 21H, Subfunction n:

00H-0CH: Supported.

0EH-15H: Supported.

16H: Supported without the ability to create read-only files.

17H: Supported.

18H: Returns zero.

19H-1CH: Supported.

1DH-1EH: Returns zero.

20H: Returns zero.

21H: Supported.

23H-2AH: Supported.

2CH-2DH: Supported.

2FH-30H: Supported.

33H: Set has no effect; Get always returns TRUE.

35H-36H: Supported.

37H: Set has no effect; Get returns constant values.

39H-3AH: Supported.

3BH: Supported, defines default: at the process level.

3CH: Supported, cannot create read-only files.

3DH-43H: Supported.

44H: Subfunctions 0, 1, 6, 7 are supported.

45H-47H: Supported.

48H: Effective if function 7AH is first called to shrink memory allocation by the size desired.

49H-4AH: Supported.

4CH: Supported.

4DH: Returns zero. Processes continue asynchronously.

4EH-51H: Supported.

54H: Returns zero.

55H-57H: Supported.

Emulator Messages

Potential emulator messages follow:

Informational Execution has been ended.

Warning: “Greater than 640 KB” request has been reduced to 640 KB.

Warning

INT*yy* Subfunction *xx*h ignored

INT*yy* ignored

IN instruction to port *xx*h ignored

OUT instruction to port *xx*h ignored

OUT instruction. DX reg *xx*h ignored

OUT instruction. Op code *xx*h ignored

Fatal

INTyy Subfunction *xx*h illegal.

INT*yy* illegal

Code: *zzzzzzzz*—Program not found. Try again.

Code: *zzzzzzzz*—Not enough memory. Need *xx* KB. Requested machine size was: *xx* KB.

Code: *zzzzzzzz*—Bad environment.

Code: *zzzzzzzz*—User requested termination.

Code: *zzzzzzzz*—Bad (EXE or COM) file format.

Note: *zzzzzzzz*—if negative is described in the *IBM 4690 Store System: Messages Guide*. Positive numbers indicate the internal (to the emulator) error number. The code should be reported if an emulation error is suspected.

Appendixes

Appendix A. IBM 4690 Operating System Disk Directory

The IBM 4690 Operating System supports a hierarchical directory structure. This structure begins with the root directory on each fixed disk or diskette. The root directory may contain entries for files or entries for more directories. Each directory may contain entries for files or more directories. The directories beyond the root are referred to as subdirectories. This hierarchical structure allows a file to be placed in the root or in any subdirectory. The sequence of subdirectories starting with the root and proceeding to the subdirectory containing the file is called the *subdirectory path*.

The IBM 4690 Operating System has a predefined set of subdirectories for the use of the operating system and the application programs. You may also define additional subdirectories for other uses. All subdirectories predefined for the operating system are defined from the root directory. This means that they are only one level deep. These subdirectories are created on the C drive during the installation process.

To use the IBM 4690 Apply Software Maintenance procedures, you must have a set of three subdirectories on the same drive. The names for these subdirectories must have the same first five characters and must end with PGM, MNT, and BUL. The names must begin with ADX_, and they must be defined as logical subdirectory names in the logical names files.

Protecting the IBM 4690-Provided Subdirectories

The installation process creates a set of subdirectories on the fixed disks. In general, the ADX_SPGM subdirectories are used for the 4690 Store System programs, the ADX_IPGM subdirectories are used for the terminal and store controller point-of-sale programs, and the ADX_UPGM subdirectories are used for other programs and program development activity. An example of this activity is creating and editing source files, compiling, and linking object modules.

The IBM-provided 4690 subdirectories are created as follows:

Subdirectory	User ID	Group ID	World RWED*	Group RWED*	Owner RWED*
ADX_SPGM	1	1	1 0 1 0	1 0 1 0	1 1 1 1
ADX_SMNT	1	1	1 0 0 0	1 0 0 0	1 0 0 0
ADX_SBUL	1	1	1 0 0 0	1 0 0 0	1 0 0 0
ADX_SDT1	1	1	1 0 1 0	1 0 1 0	1 1 1 1
ADX_IPGM	1	2	1 0 1 0	1 0 1 0	1 1 1 1
ADX_IMNT	1	2	1 0 0 0	1 0 0 0	0 0 0 0
ADX_IBUL	1	2	1 0 0 0	1 0 0 0	1 0 0 0
ADX_IDT1	1	2	1 0 1 0	1 0 1 0	1 1 1 1
ADX_IDT4	1	2	1 0 1 0	1 0 1 0	1 1 1 1
ADX_UPGM	1	3	1 0 1 0	1 0 1 0	1 1 1 1
ADX_UMNT	1	3	1 0 0 0	1 0 0 0	1 0 0 0
ADX_UBUL	1	3	1 0 0 0	1 0 0 0	1 0 0 0
ADX_UDT1	1	3	1 0 1 0	1 0 1 0	1 1 1 1

* Access privileges:

R = Read
W = Write
E = Execute
D = Delete

When copying files to ADX_xPGM and ADX_xDT1 subdirectories, you must be authorized as the same user ID and group ID of the destination subdirectory.

Naming Conventions for 4690 Operating System Files

The files that are added to the 4690 Operating System are named using the following convention:

ADX*xxxxx.eee*

where:

ADX = 4690 Operating System prefix
xxxxx = Remainder of file name (5 characters)
eee = File extension (0 to 3 characters)

Base files from the 4690 Operating System do not follow this format (for example, CHKDSK.286).

Most ADX files follow another convention in which the last character of the file name and the file extension identify the type of file. For more information, see “Rules for Naming Subdirectories and Files” on page 2-8.

Dictionary of 4690 Operating System Files

The following table lists the names of predefined subdirectories, file names, and the subdirectories where the files can be located and a description of their function. Some files can be located in more than one subdirectory.

ADX_BSX to ADX_UPGM

Table A-1 (Page 1 of 2). Dictionary of Predefined Subdirectories and Their Contents

Subdir.	Directory	Contents
ADX_BSX	root	Symbol files.
ADX_IBUL	root	Backup level of maintenance modules for application programs. Modules that were replaced from ADX_IPGM by the modules in ADX_IMNT by Apply Software Maintenance.
ADX_IDT1	root	Data files used by the application programs. This subdirectory is used on every drive.
ADX_IDT4	root	Data files used by the application programs. This subdirectory is used on every drive.
ADX_IMNT	root	Maintenance modules for application programs. Maintenance modules for the modules in ADX_IPGM that are to be maintained by Apply Software Maintenance.
ADX_IOSS	root	Print spooler data and controls.
ADX_IPGM	root	Active application programs. Terminal and store controller application programs and associated files for messages, display screens, configuration data, and so on. This subdirectory is used for the programs that provide store checkout and accounting functions. If the IBM Licensed Program for the IBM 4690 Store System is used, it will be placed in the set of ADX_Ixxx subdirectories.
ADX_KBUL	root	Backup level for ADX_KMNT.
ADX_KDT1	root	Data files for SSRT.
ADX_KMNT	root	Maintenance modules for ADX_KPGM.
ADX_KPGM	root	SSRT code and code related data.
ADX_SBUL	root	Backup level of maintenance modules for system programs. Modules that were replaced from ADX_SPGM by the modules in ADX_SMNT by Apply Software Maintenance.
ADX_SDT1	root	Data files used by the system programs. This subdirectory is used on every drive.
ADX_SMNT	root	Maintenance modules for system programs. Maintenance modules for the modules in ADX_SPGM that are to be maintained by Apply Software Maintenance.
ADX_SPGM	root	Active system programs. Terminal and store controller system programs and associated files for messages, display screens, configuration data, and so on.
ADX_UBUL	root	Backup level of maintenance modules for user programs. Modules that were replaced from ADX_UPGM by the modules in ADX_UMNT by Apply Software Maintenance.
ADX_UDT1	root	Data files used by the user programs.

Table A-1 (Page 2 of 2). Dictionary of Predefined Subdirectories and Their Contents

Subdir.	Directory	Contents
ADX_UMNT	root	Maintenance modules for your applications. This subdirectory is used on every drive. Maintenance modules for the modules in ADX_UPGM that are to be maintained by Apply Software Maintenance.
ADX_UPGM	root	Active user programs. This subdirectory should be used for program development activities in a development environment or may be used for additional programs in a store environment. The HCP names supported for files in this subdirectory have a different structure than the names for the ADX_S*xxx* and ADX_I*xxx* subdirectories.

The following tables include a complete directory of file names, extensions and directories where files are located.

ADX316KF to ADXCSCCF

Table A-2 (Page 1 of 2). Dictionary of File Names, Extensions, and Directories Where Files are Located

File Name	Ext.	Directory	Description
ADX316KF	DAT	ADX_UPGM	3270-3151/61/64 keyboard template
ADXACRBW	SRL	ADX_SPGM	Controller BASIC shared runtimes
ADXACRCL	L86	ADX_IPGM	Controller operating system application services runtime subroutines
ADXACRMF	DAT	ADX_SPGM	System application common messages
ADXACROS	DAT	ADX_SPGM	System application common output screens
ADXADMAL	L86	ADX_UPGM	Display Manager runtime library for COBOL/2
ADXADMBL	L86	ADX_UPGM	Display Manager runtime library for BASIC
ADXADMHL	L86	ADX_UPGM	Display Manager runtime library for C
ADXAPABL	L86	ADX_UPGM	Operating system interface routines
ADXAPACL	L86	ADX_UPGM	Operating system interface routines
ADXASMSF	DAT	ADX_SMNT	Message file for ASMBUNDL.BAT
ADXASTCF	DAT	ADX_SDT1	Auto-STC trigger file
ADXCxxxF.DAT	DAT	ADX_SPGM	Display character sets for 16x60 and 16x80 terminal VGA video display formats.
ADXCOP0L	286	ADX_SPGM	Communications control functions
ADXCPxxx	DAT	ADX_SPGM	Display character sets for controller VGA consoles, and 12x40 and 25x80 terminal VGA video display formats.
ADXCS1AF	DAT	ADX_SDT1	Alarmed messages file
ADXCS1AS	DAT	ADX_SPGM	Build audible alarm message screens
ADXCS1DF	DAT	ADX_SPGM	Audible alarm activation file
ADXCS1MF	DAT	ADX_SPGM	Audible alarm message file
ADXCS1RF	DAT	ADX_SDT1	Audible alarm report file
ADXCS1WF	DAT	root	Audible alarm report work file
ADXCS10L	286	ADX_SPGM	Audible alarm program
ADXCS2MF	DAT	ADX_SPGM	System functions message file
ADXCS20L	286	ADX_SPGM	System functions program
ADXCS3AS	DAT	ADX_SPGM	Compression/decompression screens
ADXCS3MF	DAT	ADX_SPGM	Compression/decompression messages
ADXCS30L	286	ADX_SPGM	Program for compression/decompression
ADXCS3PF	DAT	ADX_SDT1	Status file for RCP-started compression
ADXCS5MF	DAT	ADX_SPGM	Staged IPL messages files
ADXCS50L	286	ADX_SPGM	Staged IPL Utility
ADXCS60L	286	ADX_SPGM	Optical Drive Utility
ADXCS6AS	DAT	ADX_SPGM	Optical drive screen file
ADXCS6BF	DAT	ADX_SDT1	Optical drive debug file

Table A-2 (Page 2 of 2). Dictionary of File Names, Extensions, and Directories Where Files are Located

File Name	Ext.	Directory	Description
ADXCS6DF	DAT	ADX_SDT1	Optical drive report file
ADXCS6MF	DAT	ADX_SPGM	Optical drive message file
ADXCS6TF	DAT	N/A	Optical drive temporary file
ADXCS6WF	DAT	ADX_SDT1	Optical drive work file
ADXCS70F	DAT	ADX_SPGM	Remote operator message file
ADXCS71L	286	ADX_SPGM	Remote operator LAN support program (PRPQ)
ADXCS70L	286	ADX_SPGM	Remote operator feature program
ADXCSB0L	286	ADX_SPGM	Build ASM control file
ADXCSBCS	DAT	ADX_SPGM	Build ASM control file screens
ADXCSBMF	DAT	ADX_SPGM	Build Product Control File messages file
ADXCSC0F	DAT	ADX_SPGM	Model 3 or 4 printer active special character definition
ADXCSC1F	DAT	ADX_SPGM	Model 3 or 4 printer inactive special character definition
ADXCSC2F	DAT	ADX_SPGM	Model terminal loads
ADXCSC3F	DAT	ADX_SPGM	Model keyboard layouts
ADXCSC4F	DAT	ADX_SPGM	Model ANPOS/4693 keyboard layouts
ADXCSC0L	286	ADX_SPGM	System configuration activation
ADXCSC1L	286	ADX_SPGM	Communications configuration activation
ADXCSC2L	286	ADX_SPGM	Communications configuration tree utility
ADXCSC3L	286	ADX_SPGM	Terminal configuration section
ADXCSC4L	286	ADX_SPGM	Controller configuration section
ADXCSCAF	DAT	ADX_SPGM	Active terminal alphanumeric display character set
ADXCSCBF	DAT	ADX_SPGM	Inactive alphanumeric display character set
ADXCSCCF	DAT	ADX_SPGM	Active file sizes

ADXCSCCS to ADXCSCRF

Table A-3. Dictionary of File Names, Extensions, and Directories Where Files are Located

File Name	Ext.	Directory	Description
ADXCSCCS	DAT	ADX_SPGM	Controller load definition screens
ADXCSCDF	DAT	ADX_SPGM	Active terminal device groups
ADXCSCEF	DAT	ADX_SPGM	Inactive terminal device groups
ADXCSCFF	DAT	ADX_SPGM	Inactive file sizes
ADXCSCDS	DAT	ADX_SPGM	Print configuration screens
ADXCSCGF	DAT	ADX_SPGM	Inactive vital product data file
ADXCSCHF	DAT	ADX_SPGM	Active host communications link and line definition
ADXCSCHS	DAT	ADX_SPGM	Host screens
ADXCSCIF	DAT	ADX_SPGM	Inactive host communications link and line definition
ADXCSCIS	DAT	ADX_SPGM	Configuration screen file
ADXCSCJF	DAT	ADX_SPGM	Host configuration work file
ADXCSCKF	DAT	ADX_SPGM	Active keyboard definition (also includes system configuration)
ADXCSCKS	DAT	ADX_SPGM	Terminal keyboard definition screens
ADXCSCLF	DAT	ADX_SPGM	Inactive keyboard definition (also includes system configuration)
ADXCSCMF	DAT	ADX_SPGM	Inactive system configuration data
ADXCSCMS	DAT	ADX_SPGM	System configuration main menu screens
ADXCSCNF	DAT	ADX_SPGM	Controller erase list work file
ADXCSCOF	DAT	ADX_SPGM	Inactive system options (activates into ADXCSCKF.DAT)
ADXCSCPF	DAT	ADX_SPGM	Active Model 1 and 2 printer character set
ADXCSCQF	DAT	ADX_SPGM	Inactive Model 1 and 2 printer character set
ADXCSCRF	DAT	ADX_SPGM	Inactive keyboard definition

ADXCSCSF to ADXCSHSF

Table A-4. Dictionary of File Names, Extensions, and Directories Where Files are Located

File Name	Ext.	Directory	Description
ADXCSCSF	DAT	ADX_SPGM	Inactive primary and secondary application definition
ADXCSCTF	DAT	ADX_SPGM	Active terminal load
ADXCSCTS	DAT	ADX_SPGM	Terminal load definition screens
ADXCSCUF	DAT	ADX_SPGM	Inactive terminal load definition
ADXCSCUS	DAT	ADX_SPGM	System configuration screens
ADXCSCVF	DAT	ADX_SPGM	Active vital product data file
ADXCSCWF	DAT	ADX_SPGM	Host configuration default file
ADXCSCXF	DAT	ADX_SPGM	Active background application definition
ADXCSCXS	DAT	ADX_SPGM	Terminal load screens
ADXCSCYF	DAT	ADX_SPGM	Active terminal keyboard definition
ADXCSCZF	DAT	ADX_SPGM	Logical name work file
ADXCSC0L	286	ADX_SPGM	System configuration
ADXCSD0L	286	ADX_SPGM	Format configuration report
ADXCSDAS	DAT	ADX_SPGM	Print configuration screens
ADXCSDCS	DAT	ADX_SPGM	Print controller configuration screens
ADXCSDHS	DAT	ADX_SPGM	Print host configuration screens
ADXCSDIS	DAT	ADX_SPGM	Configuration screen file
ADXCSDMF	DAT	ADX_SPGM	Print configuration messages
ADXCSDTF	DAT	ADX_SDT1	Print configuration report file
ADXCSDWF	DAT	ADX_SDT1	Print configuration work file
ADXCSE0L	286	ADX_SPGM	User-modifiable end-of-day program
ADXCSEAB	B86	ADX_UPGM	End-of-day program source
ADXCSEDF	J86	ADX_UPGM	End-of-day program include file
ADXCSEGX	B86	ADX_UPGM	End-of-day program exit
ADXSEUR	B86	ADX_UPGM	End-of-day program user exit
ADXCSH0L	286	ADX_SPGM	Remote Command Processor (RCP) Program
ADXCSHAF	DAT	ADX_SDT1	Alternate RCP status file
ADXCSHCF	DAT	ADX_IDT1	RCP selection file (see ADXCSHRC)
ADXCSHDF	DAT	ADX_IDT1	RCP IPL selection file
ADXCSHMF	DAT	ADX_SPGM	RCP messages
ADXCSHOF	DAT	ADX_SPGM	RCP system application output file list
ADXCSHSF	DAT	ADX_SDT1	RCP status file

ADXCSHUF to ADXCSKWF

Table A-5. Dictionary of File Names, Extensions, and Directories Where Files are Located

File Name	Ext.	Directory	Description
ADXCSHUF	DAT	ADX_SDT1	RCP user application output file list
ADXCSI0L	286	ADX_SPGM	Input state table build
ADXCSIAS	DAT	ADX_SPGM	Modulo table screens
ADXCSIIS	DAT	ADX_SPGM	Input state table screens
ADXCSILS	DAT	ADX_SPGM	Label format table screens
ADXCSIMF	DAT	ADX_SPGM	Input state table build message file
ADXCSIMS	DAT	ADX_SPGM	Input state table build screen
ADXCSJ0L	286	ADX_SPGM	Display/alter program
ACXCSJMF	DAT	ADX_SPGM	Display/alter messages
ADXCSJMS	DAT	ADX_SPGM	Display/alter screens
ADXCSK0F	DAT	root	Keyed File Utility (KFU) report file
ADXCSK0L	286	ADX_SPGM	KFU program
ADXCSK0S	DAT	ADX_SPGM	KFU screens
ADXCSKAF	DAT	ADX_SDT1	KFU temporary work file for sort
ADXCSKCF	DAT	ADX_SDT1	KFU temporary work file for report
ADXCSKCP	DAT	ADX_SDT1	KFU checkpoint file
ADXCSKCK	DAT	ADX_SDT1	KFU temporary checkpoint file
ADXCSKDF	DAT	ADX_SDT1	KFU temporary work file
ADXCSKOF	DAT	ADX_SDT1	KFU report file for file output
ADXCSKPF	DAT	ADX_SDT1	KFU parameter file
ADXCSKSS	DAT	ADX_SDT1	KFU checkpoint sector table file
ADXCSKST	DAT	ADX_SDT1	KFU sector table file
ADXCSKTF	DAT	ADX_SDT1	KFU temporary file
ADXCSKWF	DAT	ADX_SDT1	KFU temporary work file for chaining

ADXCSL0F to ADXCSORL

Table A-6. Dictionary of File Names, Extensions, and Directories Where Files are Located

File Name	Ext.	Directory	Description
ADXCSL0F	DAT	ADX_SDT1	Dump file for first ARTIC adapter card
ADXCSL1F	DAT	ADX_SDT1	Dump file for second ARTIC adapter card
ADXCSL0L	286	ADX_SPGM	Dump formatter
ADXCSLAF	DAT	ADX_SDT1	Dump file for ARTIC adapter card (previous file which is replaced by ADXCSL0F.DAT and ADXCSL1F.DAT)
ADXCSLAS	DAT	ADX_SPGM	Format dump screens
ADXCSLCF	DAT	root	Controller dump file
ADXCSLMF	DAT	ADX_SPGM	Print/display dump messages
ADXCSLRF	DAT	ADX_SDT1	Dump summary report
ADXCSLTF	DAT	ADX_SDT1	Terminal dump file
ADXCSM0L	286	ADX_SPGM	Format trace
ADXCSMMF	DAT	ADX_SPGM	Trace Report messages file
ADXCSM*n*F	DAT	ADX_SPGM	Print/display trace messages (*n* = 1 to 4)
ADXCSMAS	DAT	ADX_SPGM	Print/display trace screens
ADXCSMTF	DAT	ADX_SDT1	Trace report file
ADXCSMWF	DAT	ADX_SDT1	Format trace work file
ADXCSN0L	286	ADX_SPGM	Error log scan
ADXCSNAS	DAT	ADX_SPGM	Error log scan screens
ADXCSNDF	DAT	ADX_SPGM	Error log scan messages
ADXCSNMF	DAT	ADX_SPGM	Error log scan messages
ADXCSNRF	DAT	ADX_SDT1	Error log scan report file (formatted)
ADXCSNUF	DAT	ADX_SDT1	Error log scan report file (unformatted)
ADXCSOAF	DAT	ADX_SDT1	System log bucket for controller HW
ADXCSOBF	DAT	ADX_SDT1	System log bucket for terminal HW
ADXCSOCF	DAT	ADX_SDT1	System log bucket for terminal event
ADXCSODF	DAT	ADX_SDT1	System log bucket for controller event
ADXCSOEF	DAT	ADX_SDT1	System log bucket for system event
ADXCSOFF	DAT	ADX_SDT1	System log bucket for application event
ADXCSOHF	DAT	ADX_SDT1	System trace file
ADXCSOIF	DAT	ADX_SDT1	Controller performance data
ADXCSOJF	DAT	ADX_SDT1	Terminal performance data
ADXCSOKL	286	ADX_SPGM	Controller Keyboard Driver
ADXCSOMF	DAT	ADX_SPGM	System messages
ADXCSONF	DAT	ADX_SDT1	System message display queue
ADXCSOXF	DAT	ADX_SPGM	Keyboard table
ADXCSO0L	286	ADX_SPGM	Operator console facility driver
ADXCSORL	286	ADX_SPGM	Driver used by the remote operator feature

ADXCSOSF to ADXCST-D

Table A-7 (Page 1 of 2). Dictionary of File Names, Extensions, and Directories Where Files are Located

File Name	Ext.	Directory	Description
ADXCSOSF	DAT	ADX_SPGM	OCF screens
ADXCSOTF	DAT	ADX_SPGM	Host translate table
ADXCSOUF	DAT	ADX_IDT1	System authorization file
ADXCSOVL	286	ADX_SPGM	VGA console device driver
ADXCSOXF	DAT	ADX_SPGM	Active controller keyboard translate table
ADXCSOYF	DAT	ADX_SPGM	Active display character set for a VGA console
ADXCSOZF	DAT	ADX_IPGM	System message display file
ADXCSOZL	286	ADX_SPGM	Auxillary console device driver
ADXCSP0L	286	ADX_SPGM	Print/display performance data
ADXCSPAS	DAT	ADX_SPGM	Print/display performance data screens
ADXCSPDF	DAT	ADX_SPGM	Display/alter performance data messages
ADXCSPRF	DAT	ADX_SDT1	Performance monitor report file
ADXCSQ0L	286	ADX_SPGM	Start performance trace
ADXCSQAS	DAT	ADX_SPGM	Start performance trace screens
ADXCSQMF	DAT	ADX_SPGM	Start performance messages
ADXCSR0L	286	ADX_SPGM	Build problem analysis diskette
ADXCSRAS	DAT	ADX_SPGM	Build problem analysis diskette screens
ADXCSRCF	DAT	ADX_SDT1	Problem analysis diskette problem abstract and list of compressed files
ADXCSRxF	DAT	ADX_SDT1	Compressed problem analysis files where x is a counter starting with zero.
ADXCSS0L	286	ADX_SPGM	Format module level report
ADXCSSAS	DAT	ADX_SPGM	Report module level screens
ADXCSSDF	DAT	ADX_SDT1	Module level report file
ADXCSSWF	DAT	ADX_SDT1	Module level work file
ADXCST0L	286	ADX_SPGM	Apply software maintenance
ADXCSTAS	DAT	ADX_SPGM	Apply software maintenance screens
ADXCSTAD	DAT	ADX_IPGM	User exit file in Price Management
ADXCSTBD	DAT	ADX_UPGM	Operating system optional file
ADXCSTDD	DAT	ADX_UPGM	C Basic Compiler
ADXCSTFD	DAT	ACX_IPGM	General sales application EFT feature
ADXCSTGD	DAT	ADX_IPGM	Product control file in IBM application
ADXCSTHD	DAT	ADX_UPGM	Product control file in user exits product
ADXCSTID	DAT	ADX_IPGM	Inventory control file
ADXCSTJD	DAT	ADX_IPGM	Product control file in Supermarket and General Sales applications TOF
ADXCSTLD	DAT	ADX_IPGM	Modified chain drugs limited base file
ADXCSTQD	DAT	ADX_SPGM	Operating system remote operator feature

Table A-7 (Page 2 of 2). Dictionary of File Names, Extensions, and Directories Where Files are Located

File Name	Ext.	Directory	Description
ADXCSTTD	DAT	ADX_UPGM	EFT user exits
ADXCST7D	DAT	ADX_IPGM	Canadian tax file
ADXCST8D	DAT	ADX_SPGM	SDLC autodial file
ADXCST9D	DAT	ADX_SPGM	Operating system remote operator LAN
ADXCST@D	DAT	ADX_SPGM	DFM target server
ADXCST-D	DAT	ADX_UPGM	SMA source base file

ADXCSTJI to ADXCSW0L

Table A-8. Dictionary of File Names, Extensions, and Directories Where Files are Located

File Name	Ext.	Directory	Description
ADXCSTJI	DAT	ADX_IPGM	Special case file in Supermarket and General Sales application TOF
ADXCSTMF	DAT	ADX_SPGM	Apply software maintenance message file
ADXCSTPD	DAT	ADX_IPGM	Product control file in Price Management
ADXCSTRD	DAT	ADX_SPGM	Product control file in Multiple Controller Feature
ADXCSTSD	DAT	ADX_SPGM	Product control file in 4690 Operating System
ADXCxTxD	DAT	ADX_xPGM	Product control files in general format
ADXCSU0L	286	ADX_SPGM	Distributed File Utility
ADXCSUAS	DAT	ADX_SPGM	Distributed File Utility screens
ADXCSUMF	DAT	ADX_SPGM	Distributed File Utility messages
ADXCSURF		root	Distributed File Utility work file
ADXCSV0L	286	ADX_SPGM	Streaming Tape Drive Utility
ADXCSVAS	DAT	ADX_SPGM	Tape streaming screens
ADXCSVDF	DAT	ADX_SDT1	Tape streaming report
ADXCSVMF	DAT	ADX_SPGM	Tape streaming messages
ADXCSVTF	DAT		Tape streaming (temporary name for file being restored)
ADXCSVWF	DAT	ADX_SDT1	Tape streaming work file
ADXCSW0L	286	ADX_SPGM	Disk Surface Analysis Utility

ADXCSZ0L to ADXCT6SL

Table A-9. Dictionary of File Names, Extensions, and Directories Where Files are Located

File Name	Ext.	Directory	Description
ADXCSZ0L	286	ADX_SPGM	Activate logical names
ADXCSZIL	286	ADX_SPGM	Configuration activation - IPL part
ADXCSZOS	DAT	ADX_SPGM	Configuration screen file
ADXCSZPS	DAT	ADX_SPGM	Configuration screen file
ADXCT1SL	286	root	Bootable 4690 Operating System on Installation Diskette
ADXCT4SL	286	ADX_SPGM	Controller operating system bootable (286)
ADXCT6SL	286	ADX_SPGM	Controller operating system on supplemental
ADXCT8SL	286	ADX_SPGM	Controller operating system bootable (386)

ADXDAiiF to ADXEMBGF

Table A-10. Dictionary of File Names, Extensions, and Directories Where Files are Located. The ADXDxiiF files are configuration files. ii is the store controller's LAN node ID.

File Name	Ext.	Directory	Description
ADXDA*ii*F	DAT	ADX_SPGM	Active system logical names for *ii*
ADXDB*ii*F	DAT	ADX_SPGM	Inactive system logical names for *ii*
ADXDC*ii*F	DAT	ADX_SPGM	Active application logical names for *ii*
ADXDD*ii*F	DAT	ADX_SPGM	Inactive application logical names for *ii*
ADXDE*ii*F	DAT	ADX_SPGM	Active user logical names for *ii*
ADXDF*ii*F	DAT	ADX_SPGM	Inactive user logical names for *ii*
ADXDG*ii*F	DAT	ADX_SPGM	Active controller configuration for *ii*
ADXDH*ii*F	DAT	ADX_SPGM	Inactive controller configuration for *ii*
ADXDI*ii*F	DAT	ADX_SPGM	Active primary and secondary application definition for *ii*
ADXDJ*ii*F	DAT	ADX_SPGM	Inactive primary and secondary application definition for *ii*
ADXDK*ii*F	DAT	ADX_SPGM	Active background application definition for *ii*
ADXDL*ii*F	DAT	ADX_SPGM	Inactive background application definition for *ii*
ADXDM*ii*F	DAT	ADX_SPGM	Active file sizes for *ii*
ADXDN*ii*F	DAT	ADX_SPGM	Inactive file sizes for *ii*
ADXDP*ii*F	DAT	ADX_SPGM	Configuration work file
ADXDQ*ii*F	DAT	ADX_SPGM	Active multiport and controller RAM disk
ADXDR*ii*F	DAT	ADX_SPGM	Inactive multiport and controller RAM disk
ADXDS*ii*F	DAT	ADX_SPGM	Active communications configuration
ADXDT*ii*F	DAT	ADX_SPGM	Inactive communications configuration
ADXE*xxy*F	DAT	ADX_SDT1	Dump analyzer output file. The file parameter *xx* is the node ID and *y* is *T* for terminal dump and *C* for store controller dump.
ADXEMB*x*F	DAT	ADX_IPGM	PTR number file in general format
ADXEMBAF	DAT	ADX_IPGM	User exit file in Price Management
ADXEMBBF	DAT	ADX_UPGM	Operating system optional file
ADXEMBDF	DAT	ADX_UPGM	C Basic Compiler
ADXEMBFF	DAT	ADX_IPGM	General sales application EFT feature
ADXEMBGF	DAT	ADX_IPGM	PTR number file for an application

ADXEMBHF to ADXHSNLL

Table A-11 (Page 1 of 2). Dictionary of File Names, Extensions, and Directories Where Files are Located

File Name	Ext.	Directory	Description
ADXEMBHF	DAT	ADX_UPGM	APAR control file for user exits
ADXEMBIF	DAT	ADX_IPGM	Inventory control file
ADXEMBJF	DAT	ADX_IPGM	APAR control file in terminal offline
ADXEMBLF	DAT	ADX_IPGM	Modified chain drugs limited base file
ADXEMBPF	DAT	ADX_IPGM	APAR control file in Price Management
ADXEMBQF	DAT	ADX_SPGM	Operating system remote operator feature
ADXEMBRF	DAT	ADX_SPGM	APAR control file in the MCF
ADXEMBSF	DAT	ADX_IPGM	APAR control file in 4690 Operating System
ADXEMBTF	DAT	ADX_UPGM	EFT user exits
ADXEMB7F	DAT	ADX_IPGM	Canadian tax file
ADXEMB8F	DAT	ADX_SPGM	SDLC autodial file
ADXEMB9F	DAT	ADX_SPGM	Operating system remote operate LAN
ADXEMB@F	DAT	ADX_SPGM	DFM target server
ADXEMB-F	DAT	ADX_UPGM	SMA source base file
ADXEME*x*F	DAT	ADX_*x*PGM	APAR tracking file in general format. Subdirectory placement and the letter *x* follow the same convention as ADXEMB*x*F.DAT
ADXESS0L	286	ADX_SPGM	Dump analysis program
ADXESSAD	DAT	ADX_SDT1	Dump analysis output file
ADXESSBD	DAT	ADX_SDT1	Dump analysis parameter file
ADXESSMF	DAT	ADX_SPGM	Dump analysis messages file
ADXESSNF	DAT	ADX_SPGM	Dump analyzer machine information
ADXETBSL	286	ADX_SPGM	Terminal Bootstrap Loader for Ethernet
ADXETH0L	286	ADX_SPGM	Media Access Control Driver for Ethernet
ADXETH1F	DAT	ADX_SPGM	Ethernet Installation Flag
ADXETHIL	286	ADX_SPGM	IBM ISA bus Ethernet adapter driver
ADXETHLL	286	ADX_SPGM	Logical Link Control Driver for Ethernet
ADXETHXL	286	ADX_SPGM	NetBIOS Driver for Ethernet
ADXE2BSL	286	ADX_SPGM	4694 bootstrap
ADXFISBL	286	ADX_SPGM	Model 3 Fiscal Printer READ command interface (big memory model)
ADXFISRL	286	ADX_SPGM	Model 3 Fiscal Printer READ command interface (medium memory model)
ADXFONTF	DAT	ADX_SPGM	Active display character set for 16x60 and 16x80 terminal VGA video display formats.
ADXFNT0F	DAT	ADX_SPGM	Active display character set for 12x40 and 25x80 terminal VGA video display formats.
ADXFSF4F	DAT	root	File CMOS error dump
ADXFSM0L	286	ADX_SPGM	Controller RAM disk driver
ADXFSP0L	286	ADX_SPGM	Loadable loop driver

Table A-11 (Page 2 of 2). Dictionary of File Names, Extensions, and Directories Where Files are Located

File Name	Ext.	Directory	Description
ADXFSS0L	286	ADX_SPGM	SIOAM loadable driver
ADXFSSRL	286	ADX_SPGM	Terminal ROL Driver (replaces ADXFSSRH)
ADXFSSSF	SPL	root	LAN spool file for 4683 matrix writes
ADXGLU0L	286	ADX_SPGM	Driver for pseudo loop in controller/terminal
ADXHS10L	286	ADX_SPGM	SNA driver
ADXHS1FF	DAT	ADX_SPGM	APPC
ADXHS20L	286	ADX_SPGM	3270 emulation—SNA program
ADXHS30L	286	ADX_SPGM	3270 emulation application—console application
ADXHS30F	DAT	ADX_SPGM	3270 emulation translate tables
ADXHS50E	EXE	ADX_SPGM	Host support for X.25 code resident on ARTIC adapter card
ADXHSA0L	286	ADX_SPGM	Host support for ASYNC support
ADXHSB0L	286	ADX_SPGM	Host support for BSC support
ADXHSCAF	DAT	ADX_SPGM	Host support for the alert table
ADXHSD0L	286	ADX_SPGM	Host common support
ADXHSDMG	DAT	ADX_SPGM	Host configuration file
ADXHSDRL	286	ADX_SPGM	Stop SNA Link
ADXHSH0L	286	ADX_SPGM	Host support for HCP support
ADXHSHDF	DAT	ADX_SPGM	Host support for HCP translate names table
ADXHSHFF	DAT	ADX_SPGM	Host support for HCP status save
ADXHSK0L	286	ADX_SPGM	3270 Emulation
ADXHSL0L	286	ADX_SPGM	Host support for SDLC driver for MCA and SDLC cards
ADXHSM0E	EXE	ADX_SPGM	Host support for SDLC code resident on ARTIC adapter card
ADXHSN0L	286	ADX_SPGM	Host support for SNA support
ADXHSNDF	DAT	ADX_SPGM	Host support—SNA messages
ADXHSNLL	286	ADX_SPGM	Host support for enable link application

ADXHSNPL to ADXLNDAF

Table A-12 (Page 1 of 2). Dictionary of File Names, Extensions, and Directories Where Files are Located

File Name	Ext.	Directory	Description
ADXHSNPL	286	ADX_SPGM	Host support for the Start User program
ADXHSNSL	286	ADX_SPGM	Host support for the Stop Link application
ADXHSO0L	286	ADX_SPGM	Serial port subdriver
ADXHSP0L	286	ADX_SPGM	Host support for the Canadian datapac version of ASYNC support
ADXHSR0F	DAT	ADX_SDT1	RCMS host support
ADXHSR0L	286	ADX_SPGM	RCMS host support
ADXHSR1L	286	ADX_SPGM	RCMS background processor
ADXHSR*n*F	DAT	ADX_SDT1	RCMS host support (*n* = 0 to 9)
ADXHSRNF	DAT	ADX_SPGM	Logical names - RCMS
ADXHSROF	DAT	ADX_SDT1	RCMS host support
ADXHSS0L	286	ADX_SPGM	SDLC host subdriver
ADXHSS2L	286	ADX_SPGM	SDLC host subdriver for PS/2
ADXHST0L	286	ADX_SPGM	3270 Emulation
ADXHSV0L	L86	ADX_UPGM	LU 6.2 CPI Communication verb libraries for BASIC applications
ADXHSV1L	L86	ADX_UPGM	LU 6.2 CPI Communication verb libraries for COBOL applications
ADXHSV2L	L86	ADX_UPGM	LU 6.2 CPI Communication verb libraries for C applications
ADXHSX0L	286	ADX_SPGM	ARTIC adapter card subdriver
ADXHSX2L	286	ADX_SPGM	ARTIC adapter card microcode
ADXHSXPE	EXE	ADX_SPGM	Arctic adapter performance monitor
ADXHSY0L	286	ADX_SPGM	BSC driver on ARTIC adapter card
ADXHSY1L	EXE	ADX_SPGM	BSC routines resident on ARTIC adapter card
ADXHSZ0L	286	ADX_SPGM	ASYNC driver on ARTIC adapter card
ADXHSZ1L	EXE	ADX_SPGM	ASYNC routines resident on ARTIC adapter card
ADXHSZ2L	EXE	ADX_SPGM	Routine resident on ARTIC adapter card
ADXHSZ3L	286	ADX_SPGM	ARTIC adapter card microcode
ADXHSZ5L	286	ADX_SPGM	ASYNC driver, serial ports
ADXIL*nn*F	DAT	ADX_SPGM	ABIOS patch files (*nn*= 00 to 99)
ADXILIOL	286	ADX_SPGM	Controller IPL
ADXILI0F	DAT	ADX_SDT1	IPL command processor command file
ADXILI3F	DAT	ADX_SPGM	List of ABIOS patches
ADXILI4L	286	ADX_SPGM	Initializes ABIOS and loads the 4690 Operating System
ADXILIPF	DAT	ADX_SDT1	Performance Monitor parameters
ADXILIPL	286	ADX_SPGM	Performance Monitor initialization
ADXILT0L	286	ADX_SPGM	ASM for IPL
ADXIOP0L	286	ADX_SPGM	Controller parallel printer driver
ADXIOP1L	286	ADX_SPGM	Controller serial printer driver
ADXIOP2L	286	ADX_SPGM	TCP/IP LPR driver

Table A-12 (Page 2 of 2). Dictionary of File Names, Extensions, and Directories Where Files are Located

File Name	Ext.	Directory	Description
ADXIOS0L	286	ADX_SPGM	Print spooler/despooler
ADXIOSPD	*nnn*	ADX_IOSS	Print spool print files (*nnn* = a number)
ADXIOSPF	DAT	ADX_SPGM	Print spooler messages
ADXIOSQ*n*	DAT	ADX_IOSS	Print spooler queue control block for printer PRN*n* (*n* = 1 to 8)
ADXIOSQ9	DAT	ADX_IOSS	Print spooler hold queue control block
ADXIPL0L	286	ADX_SPGM	Routine to IPL selected terminals
ADXLAS0L	286	ADX_SPGM	Loop Status Application
ADXLE*xx*F	DAT	ADX_SDT1	Partial exception tracking files (where *xx* represents two characters in the range 0 to Z) A partial exception file contains missed updates for a single file for all the nodes on a LAN (MCF Network)
ADXLND0L	286	ADX_SPGM	Active LAN (MCF Network) data distribution file
ADXLNDAF	DAT	ADX_SPGM	Active LAN (MCF Network) node list file

ADXLNDCF to ADXPI5AF

Table A-13 (Page 1 of 3). Dictionary of File Names, Extensions, and Directories Where Files are Located

File Name	Ext.	Directory	Description
ADXLNDCF	DAT	ADX_SPGM	Configuration file indicating LAN (MCF Network) changes
ADXLNDEF	DAT	ADX_SDT1	Master LAN (MCF Network) exception log (old style) for 4690 Operating System
ADXLNDGF	DAT	ADX_SDT1	File server LAN (MCF Network) exception log (old style) for 4690 Operating System
ADXLNDIF	DAT	ADX_SPGM	Inactive LAN (MCF Network) node list file
ADXLNDMF	CK1	ADX_SDT1	Stage 1 checkpoint file for master exception log
ADXLNDMF	CKP	ADX_SDT1	Stage 2 checkpoint file for master exception log
ADXLNDMF	CKR	ADX_SDT1	Record-level checkpoint for exception log update
ADXLNDMF	DAT	ADX_SDT1	Master LAN (MCF Network) exception log
ADXLNDNF	DAT	ADX_SDT1	Node mask list for partial reconciliation
ADXLNDSF	CK1	ADX_SDT1	Stage 1 checkpoint file for file server exception log
ADXLNDSF	CKP	ADX_SDT1	Stage 2 checkpoint file for file server exception log
ADXLNDSF	CKR	ADX_SDT1	Record-level checkpoint for exception log update
ADXLNDSF	DAT	ADX_SDT1	File server LAN (MCF Network) exception log
ADXLNDTF	DAT	ADX_SPGM	Active configuration file indicating LAN (MCF Network) changes
ADXLNDXF	DAT	ADX_SDT1	Flag to DDA not to attempt distribution
ADXLNDXX	BAD		Temporary error file created by MCF
ADXLNM0L	286	ADX_SPGM	LAN resource manager
ADXLNR0L	286	ADX_SPGM	LAN requestor
ADXLNS0L	286	ADX_SPGM	LAN server processes
ADXLPBSL	286	ADX_SPGM	Terminal Bootstrap Loader - Loop
ADXLSD0L	286	ADX_SPGM	Store loop
ADXLTDAL	286	ADX_SPGM	Tape streamer driver - TECMAR external device. Copied to ADXLTD1L.286 by the TAPESTRM.BAT command (selects a tape streamer device driver)
ADXLTDBL	286	ADX_SPGM	Tape streamer driver - IBM PS/2 internal device. Copied to ADXLTD1L.286 by the TAPESTRM.BAT command (selects a tape streamer device driver)
ADXLTDCL	286	ADX_SPGM	Tape streamer driver - TECMAR internal device. Copied to ADXLTD1L.286 by the TAPESTRM.BAT command (selects a tape streamer device driver)
ADXLTDDL	286	ADX_SPGM	Tape streamer driver - DualStor internal device.
ADXLTD0F	DAT	ADX_SPGM	Tape streamer device driver - selection file.
ADXLTD0L	286	ADX_SPGM	Tape streamer - IBM 6157 driver
ADXLTD1L	286	ADX_SPGM	Tape streamer - see ADXLTDAL, ADXLTDBL, or ADXLTDCL
ADXLHF*x*F	DAT	ADX_SDT1	Product history file in general format. The letter *x* follows the same conventions as for ADXEMB*x*F.DAT
ADXLVL*x*F	DAT	ADX_SDT1	Product-level file in general format. The letter *x* follows the same conventions as for ADXEMB*x*F.DAT

Table A-13 (Page 2 of 3). Dictionary of File Names, Extensions, and Directories Where Files are Located

File Name	Ext.	Directory	Description
ADXMC50F	DAT	ADX_SPGM	4693 keyboard microcode control file
ADXMEL0L	L86	ADX_UPGM	In-memory file subroutines, big memory compilation
ADXMEL1L	L86	ADX_UPGM	In-memory file subroutines, big memory compilation
ADXMEM0L	L86	ADX_UPGM	In-memory file subroutines, medium memory compilation
ADXMEM1L	L86	ADX_UPGM	In-memory file subroutines, medium memory compilation
ADXMICRF	DAT	ADX_IDT1	MICR Format file
ADXN?30F	DAT	ADX_SPGM	3270 Emulation translate tables
ADXN*xxx*Z	BAT		BAT files used in operating system installation
ADXNRK00	*nnn*	root	Supplemental diskette sequence numbers (where *nnn* is the diskette number)
ADXNLSAF	DAT	ADX_SPGM	NLS Activation file
ADXNLSAL	286	ADX_SPGM	NLS File Support
ADXNSAxF	DAT	ADX_SPGM	Controller keyboard translate tables
ADXNSK00	*nnn*	root	Install diskette sequence numbers (*nnn* is the diskette number)
ADXNSK0L	286	ADX_SPGM	Driver used by the Disk Rebuild Utility
ADXNSL0L	286	ADX_SPGM	Disk Rebuild Utility on Supplemental Diskette
ADXNSL0S	DAT	ADX_SPGM	Screens for the Disk Rebuild Utility
ADXNSLMF	DAT	ADX_SPGM	Messages for the Disk Rebuild Utility
ADXNSL1F	DAT	ADX_SDT1	Disk Rebuild Utility audit trail
ADXNS*ii*F	DAT	ADX_SDT1	IPL command processor output for node *ii*
ADXNSS3F	DAT	ADX_SPGM	Node dependent file list
ADXNSSAF	DAT	root	Installation package information
ADXNSSLG		root	Installation log for operating system installation
ADXNS*xx*L	286	root	Programs used in operating system installation
ADXNST0L	286	ADX_SPGM	IPL command processor
ADXNSXxF	DAT	ADX_SPGM	Controller keyboard translate tables
ADXNSX0L	286	root	Zero CMOS or set controller node ID utility found on supplemental diskette
ADXNSXZL	286	ADX_SPGM	Multiple file archiver with compression
ADXNSZ*x*F	DAT	ADX_SPGM	Code pages for auxiliary consoles
ADXNT3xF	DAT	ADX_SPGM	Terminal ANPOS keyboard scancode translate tables
ADXNT5xF	DAT	ADX_SPGM	Terminal 4693 ANPOS keyboard scancode translate tables
ADXNTKxF	DAT	ADX_SPGM	Terminal alphanumeric keyboard scancode translate tables
ADXOPT0L	286	ADX_SPGM	Optical device driver
ADXPI10L	286	ADX_SPGM	I/O processor driver if ANPOS keyboard support, 3270 emulation, or full screen video is configured for a 4683 terminal. This file is the I/O processor driver for all other terminals.
ADXPI20L	286	ADX_SPGM	Terminal dual-track MSR driver
ADXPI21L	286	ADX_SPGM	Dual-track MSR driver
ADXPI30L	286	ADX_SPGM	Terminal ANPOS keyboard driver

Table A-13 (Page 3 of 3). Dictionary of File Names, Extensions, and Directories Where Files are Located

File Name	Ext.	Directory	Description
ADXPI50L	286	ADX_SPGM	Terminal 4693 keyboard driver
ADXPI3AF	DAT	ADX_SPGM	Active terminal ANPOS keyboard scancode translate table
ADXPI5AF	DAT	ADX_SPGM	Active terminal 4693 ANPOS keyboard scancode translate table
ADXPIA0L	286	ADX_SPGM	Terminal alphanumeric display driver
ADXPIAxF	DAT	ADX_SPGM	Terminal alphanumeric character sets
ADXPIB0L	286	ADX_SPGM	Model 3 or 4 printer driver (terminal)
ADXPIBSF	DAT	ADX_SPGM	Model 3 or 4 printer code page (terminal)
ADXPIC0L	286	ADX_SPGM	Terminal coin dispenser driver
ADXPID0L	286	ADX_SPGM	Terminal cash drawer driver
ADXPIE0L	286	ADX_SPGM	Terminal operator display driver
ADXPIETF	DAT	ADX_SPGM	Active terminal operator display character set translate table
ADXPIExF	DAT	ADX_SPGM	Terminal operator display character set translate tables
ADXPIF0L	286	ADX_SPGM	Terminal shopper display driver
ADXPIFTF	DAT	ADX_SPGM	Active terminal VFD II and LCD display character set translate table
ADXPIFxF	DAT	ADX_SPGM	Terminal VFD II and LCD display character set translate tables table
ADXPIG0L	286	ADX_SPGM	Model 3 fiscal printer driver (terminal)
ADXPII0L	286	ADX_SPGM	I/O processor driver if ANPOS keyboard support, 3270 emulation, or full screen video is not configured in a 4683 terminal.

ADXPIK0L to ADXTSDDL

Table A-14 (Page 1 of 2). Dictionary of File Names, Extensions, and Directories Where Files are Located

File Name	Ext.	Directory	Description
ADXPIK0L	286	ADX_SPGM	Terminal keyboard driver
ADXPIKAF	DAT	ADX_SPGM	Active terminal alphanumeric keyboard scan code translate table
ADXPIL0L	286	ADX_SPGM	Terminal magnetic wand driver
ADXPIM0L	286	ADX_SPGM	Terminal MSR driver
ADXPIP0L	286	ADX_SPGM	Model 1 and 2 printer driver (terminal)
ADXPIR0L	286	ADX_SPGM	Terminal RS232 driver
ADXPIR1L	286	ADX_SPGM	4684/4693/4694 Terminal RS232 driver
ADXPIS0L	286	ADX_SPGM	Terminal scanner driver
ADXPIT0L	286	ADX_SPGM	Terminal totals retention driver
ADXPIU0L	286	ADX_SPGM	Model 2 fiscal printer driver
ADXPIV0L	286	ADX_SPGM	Terminal Feature A video display driver
ADXPIV1L	286	ADX_SPGM	Terminal VGA video display driver
ADXPIVTF	DAT	ADX_SPGM	Active Terminal Feature A video display character set translate table
ADXPIVxF	DAT	ADX_SPGM	Terminal Feature A video display character set translate tables
ADXPIW0L	286	ADX_SPGM	Terminal scale driver
ADXPIZ0L	286	ADX_SPGM	Terminal touch screen driver
ADXPIZ1F	DAT	ADX_SPGM	Terminal touch screen system function screen
ADXPIZ1L	286	ADX_SPGM	Terminal touch screen pseudo keyboard driver
ADXPLB0L	286	ADX_SPGM	Loadable terminal initializing driver
ADXPLZ0L	286	ADX_SPGM	Terminal program loader
ADXPPC0L	286	ADX_SPGM	Programmable Power
ADXRCP*ii*	DAT	ADX_IDT1	RCP internal command file (where *ii* is the store controller's LAN (MCF Network) node ID)
ADXRDISK	DAT	root	RAM disk files on Installation and Supplemental Diskette
ADXRFSHF	DAT	ADX_SPGM	Refresh file
ADXRPL0L	286	ADX_SPGM	Remote Program Load - Token Ring
ADXRPL1L	286	ADX_SPGM	Remote Program Load - Ethernet
ADXRPLCF	DAT	ADX_SPGM	RPL Control File
ADXRSL0L	286	ADX_SPGM	Terminal file services
ADXRSM0L	286	ADX_SPGM	Terminal RAM disk driver
ADXRT1SL	286	ADX_SPGM	Terminal operating system
ADXRT8EL	286	ADX_SPGM	Terminal Load Module for Ethernet (4693)
ADXRT8IL	286	ADX_SPGM	Terminal Load Module for Ethernet (4694)
ADXRT8LL	286	ADX_SPGM	4693/4694 Loop operating system
ADXRT8SL	286	ADX_SPGM	4693/4694 Token-ring operating system
ADXRT8TL	286	ADX_SPGM	Terminal Load Module for Token Ring
ADXRT8XL	286	ADX_SPGM	Loadable terminal section for controller/terminal (4693/4694)

Table A-14 (Page 2 of 2). Dictionary of File Names, Extensions, and Directories Where Files are Located

File Name	Ext.	Directory	Description
ADXRTXSL	286	ADX_SPGM	Loadable terminal section for terminal/controller (4684)
ADXSCI0L	286	ADX_SPGM	SCSI installation driver
ADXSCSDF	DAT	ADX_SDT1	SCSI device driver debug file
ADXSCS0L	286	ADX_SPGM	SCSI device driver
ADXSSD0L	286	ADX_SPGM	Loadable terminal RAM dumper
ADXTRBSL	286	ADX_SPGM	Terminal Bootstrap Loader - Token Ring
ADXTSAAL	286	ADX_SPGM	On Line Exercisers
ADXTSAML	286	ADX_SPGM	Set terminal characteristics (STC) 4683-001
ADXTSARL	286	ADX_SPGM	Set terminal characteristics (STC) 4683-002
ADXTSDAL	286	ADX_SPGM	Exerciser: Display*
ADXTSDBL	286	ADX_SPGM	Exerciser:
ADXTSDCL	286	ADX_SPGM	Exerciser: Cash Drawer 2
ADXTSDDL	286	ADX_SPGM	Exerciser: Cash Drawer

ADXTSDFL to ADXZE30L

Table A-15. Dictionary of File Names, Extensions, and Directories Where Files are Located

File Name	Ext.	Directory	Description
ADXTSDFL	286	ADX_SPGM	Exerciser:
ADXTSDHL	286	ADX_SPGM	Exerciser: Hand-held scanner
ADXTSDIL	286	ADX_SPGM	Exerciser: RS232
ADXTSDKL	286	ADX_SPGM	Exerciser: Keyboard
ADXTSDMF	DAT	ADX_SPGM	STC, RAS, DEBUG messages
ADXTSDML	286	ADX_SPGM	Exerciser:
ADXTSDOL	286	ADX_SPGM	Exerciser: OCR wand
ADXTSDPL	286	ADX_SPGM	Exerciser: Printer
ADXTSDRL	286	ADX_SPGM	Exerciser: MSR
ADXTSDSL	286	ADX_SPGM	Exerciser: Scanner
ADXTSDTL	286	ADX_SPGM	Exerciser: Totals retention
ADXTSDVL	286	ADX_SPGM	Exerciser: Video
ADXTSDXL	286	ADX_SPGM	Exerciser: Storage retention
ADXTSDYL	286	ADX_SPGM	Exerciser:
ADXTSMAL	286	ADX_SPGM	Default terminal application
ADXTSMBL	286	ADX_SPGM	Terminal diagnostics for setup
ADXTSMCL	286	ADX_SPGM	Terminal diagnostics for exercisers
ADXTSMDL	286	ADX_SPGM	Default terminal application
ADXTSMEL	286	ADX_SPGM	Italian fiscal printer utility
ADXTST0L	286	ADX_SPGM	Terminal services loadable driver
ADXTSTWF	DAT	ADX_SPGM	Terminal messages
ADXUCRTL	L86	ADX_IPGM	Terminal operating system application services runtimes
AD*XxxXX*F	DAT	ADX_SPGM	ISP file (where *XX* is the controller ID) (For ISP customers only)
ADXXPT1L	286	ADX_SPGM	Terminal Controller Communications driver for Ethernet
ADXXPTCF	DAT	ADX_SPGM	Active Token Ring TCC
ADXXPTCL	286	ADX_SPGM	Terminal Controller Communications driver for Token Ring
ADXXZ*ii*F	DAT	ADX_SPGM	Communications configuration for node *ii* in SNAPS format
ADXZE30L	286	ADX_SPGM	3270 terminal emulation

ASMBUNDL to DMED

Table A-16. Dictionary of File Names, Extensions, and Directories Where Files are Located

File Name	Ext.	Directory	Description
ASMBUNDL	BAT	ADX_SMNT	Utility to compress and combine files in a maintenance update.
ATHD	286	ADX_SPGM	Fixed disk driver
BASIC	286	ADX_UPGM	BASIC compiler: front end
BASICCG	286	ADX_UPGM	BASIC compiler: code generator
BASICDBL	L86	ADX_UPGM	Controller debug library
BASICDBM	L86	ADX_UPGM	Terminal debug library
BASICLST	SRL	ADX_UPGM	Pseudo product control file
BACKUP	286	ADX_SPGM	Disk backup utility
CBLINK	BAT		COBOL link
CBLAPI	SRL		4690 interface from COBOL shared library
CBLAPI	L86		COBOL access to CBLAPI.SRL
CBL4680	L86		4690 replacement for LCOBOL.L86
FLEXOS**	SYS	root	4690 Operating System loader
BOOTLOAD	IMG	root	4690 Operating System loader
CHKDSK	286	ADX_SPGM	Disk statistics utility
COMMAND	286	ADX_SPGM	Command shell
COMP	286	ADX_SPGM	File compare utility
CONFIG	286	ADX_SPGM	Specify serial ports utility
COPY	286	ADX_SPGM	File copy utility
CPIC_BAS	DEF	ADX_UPGM	BASIC include for CPIC call definitions
CPIC_BAS	EQU	ADX_UPGM	BASIC include for CPIC call definitions
CPIC_BAS	SUB	ADX_UPGM	BASIC include for CPIC call definitions
CPIC_CBL	H	ADX_UPGM	COBOL include for CPIC call definitions
CPIC_C	H	ADX_UPGM	C include for CPIC call definitions
CPREP	BAT	ADX_SPGM	BAT to prepare C disk on supplemental
DDACMOS	CK1	root	Checkpoint file for writing DDA CMOS
DDACMOS	CKP	root	Checkpoint file for DDA PLD recovery
DDACMOS	OLD	root	Previous copy of DDACMOS.CKP for debug
DESPOOL	286	ADX_SPGM	Despooler facility for V1R2 and earlier versions
DISKCOMP	286	ADX_SPGM	Disk compare utility
DISKCOPY	286	ADX_SPGM	Disk copy utility
DSKINFO		O:	Optical drive disk label
DISKSET	286	ADX_SPGM	Disk protect utility
DMED	286	ADX_UPGM	Display Manager editor for a monochrome monitor

DMEDCOL to TAPESTRM

Table A-17. Dictionary of File Names, Extensions, and Directories Where Files are Located

File Name	Ext.	Directory	Description
DMEDCOL	286	ADX_UPGM	Display Manager editor for a color monitor
DMEDHLP	OVR	ADX_UPGM	Display Manager editor overlays
DMEDOVR	OVR	ADX_UPGM	Display Manager
DMEXTR	J86	ADX_UPGM	Display Manager for BASIC function definitions
DMORDERS	DAT	ADX_UPGM	Sample display manager screen file
DPREP	BAT	ADX_SPGM	BAT to prepare D disk on supplemental
DREDIX	286	ADX_SPGM	DR Editor
FD	286	ADX_SPGM	Diskette driver
FIND	286	ADX_SPGM	Find string utility
FORMAT	286	ADX_SPGM	Disk format utility
FSET	286	ADX_SPGM	File attributes utility
HELP	EDX	ADX_SPGM	Editor help file
ICAAIM	COM	ADX_SPGM	Realtime Interface Co-processor Multiport module
IXSI0	OBJ		Replacement ISAM module for COBOL/2
K*xxx*	BIN		Controller console keyboard templates
LIB86	286	ADX_UPGM	Library utility
LINK86	286	ADX_UPGM	Link editor utility
LSN	EDX	ADX_SPGM	Editor tutorial file
MORE	286	ADX_SPGM	Display screen one-at-a-time utility
NETDEV	286	ADX_SPGM	Network device driver/connection manager
NSD	286	ADX_SPGM	Network name service driver/socket manager
POSTLINK	286	ADX_UPGM	Post processor for fast loading
PREBASIC	286	ADX_UPGM	Debug pre-processor
PRINT	286	ADX_SPGM	Print command
PRINTER	286	ROOT (installation disk)	Controller parallel printer driver
TAPESTRM	BAT	ADX_SPGM	Command to select a tape streamer device driver.

RENAME to DUMMY

Table A-18. Dictionary of File Names, Extensions, and Directories Where Files are Located

File Name	Ext.	Directory	Description
RENAME	286	ADX_SPGM	File rename utility
REST4680	286	ADX_SPGM	4680 Version of Restore Command
RESTORE	286	ADX_SPGM	Disk restore utility
SB286L	L86	ADX_IPGM	BASIC store controller runtimes used at link
SB286M	L86	ADX_IPGM	BASIC terminal runtimes at link
SB286TVL	L86	ADX_IPGM	BASIC store controller runtime library
SB286TVM	L86	ADX_IPGM	BASIC terminal runtime library
SHELLSRL	SRL	ADX_SPGM	Shared runtime library for Command Mode Utilities
SORT	286	ADX_SPGM	Line sort utility
TPR	C	ADX_UPGM	Sample C LU 6.2 file requestor program
TPS	C	ADX_UPGM	Sample C LU 6.2 file server program
TPRSBAS	BAS	ADX_UPGM	Sample BASIC LU 6.2 file requestor program
TPRCBAS	BAS	ADX_UPGM	Sample BASIC LU 6.2 file server program
TPRCOBOL	CBL	ADX_UPGM	Sample COBOL LU 6.2 file requestor program
TPRCOBOL	CBL	ADX_UPGM	Sample COBOL LU 6.2 file server program
TREE	286	ADX_SPGM	Directory path display
TRDLC	286	ADX_SPGM	Token-ring LAN code (4680 Operating System Version 2)
TRXPORT	286	ADX_SPGM	Token-ring transporter (4680 Operating System Version 2)
TYPE	286	ADX_SPGM	File contents display
UTILMSG	SRL	ADX_SPGM	Shared runtime library for Command Mode Utilities
UTOOL_SB	SRL	ADX_SPGM	Shared runtime library for Command Mode Utilities
VER	286	ADX_SPGM	Version display
VOL	286	ADX_SPGM	Disk volume label display
XFERLAN	DOC	ADX_SMNT	ADCS translate file names for MCF
XFEROS	DOC	ADX_SMNT	ADCS translate file names for operating system
VOLINFO		O:	Optical drive volume label
%C*xxxxxx*	%CC		COPY command work files left behind by failed COPY
*	$$$		DDA work files
*	TYP	ADX_SDT1	START.BAT work files
DUMMY		root	START.BAT work file

Appendix B. Error Messages

This appendix contains error messages that occur while using the library utility (LIB86), the POSTLINK utility (POSTLINK), and the linker utility (Link86).

LIB86 Error Messages

LIB86 can produce error messages during processing. With each message, LIB86 displays additional information appropriate to the error, such as the file name or module name, to help isolate the location of the problem. This section describes each error message, its cause, the library action, and the user response.

CANNOT CLOSE:

Explanation: LIB86 cannot close an output file.

Library Action: LIB86 terminates and displays this message, followed by the name of the file.

User Response: Make sure the correct disk is in the drive and that it is not write-protected.

DIRECTORY FULL:

Explanation: There is not enough directory space for the output files.

Library Action: LIB86 terminates and displays this message.

User Response: Erase unnecessary files or use a disk with fewer files.

DISK FULL:

Explanation: There is not enough disk space for the output files.

Library Action: LIB86 terminates and displays this message.

User Response: Erase unnecessary files or use a disk with more space.

DISK READ ERROR:

Explanation: LIB86 detects a disk error while reading the indicated file.

Library Action: LIB86 terminates and displays this message, followed by the name of the file.

User Response: Try to regenerate the file.

INVALID COMMAND OPTION:

Explanation: LIB86 encounters an unrecognized option in the command line.

Library Action: LIB86 terminates and displays this message.

User Response: Retype the command line or edit the INP file.

LIB86 ERROR 1:

Explanation: Internal LIB86 error.

Library Action: LIB86 terminates and displays this message.

User Response: Copy the library, the files you are trying to add, replace, and so on, (if any) onto a diskette. Then run the library command again, but add the following to the end of the command line, **preceded by a single blank space:**

```
>filename.ext
```

This creates a file that captures the console output of the library utility. Copy filename.ext onto the same diskette with the library and other files. Contact your service representative when you have gathered the above information.

MODULE NOT FOUND:

Explanation: The indicated module name, which appeared in a REPLACE, SELECT, or DELETE command line option, could not be found.

Library Action: LIB86 terminates and displays this message, followed by the name of the module.

User Response: Retype the command line, or edit the INP file.

MULTIPLE DEFINITION:

Explanation: The indicated symbol is defined as PUBLIC in more than one module.

Library Action: LIB86 displays this message, followed by the name of the symbol.

User Response: Correct the problem in the source file, regenerate the object file, and try again.

NO FILE:

Explanation: LIB86 could not find the indicated file.

Library Action: LIB86 terminates and displays this message, followed by the name of the file.

User Response: Correct the filename or drive identifier and try again.

OBJECT FILE ERROR:

Explanation: LIB86 detected an error in the object file. This is caused by a compiler error, or a bad disk file.

Library Action: LIB86 terminates and displays this message, followed by the name of the file.

User Response: Regenerate the object file and try again. If the error still occurs, copy the source file and the object file on a diskette. Then run the library command again, but add the following to the end of the command line, **preceded by a single blank space:**

```
>filename.ext
```

This creates a file that captures the console output of the library utility. Copy filename.ext onto the same diskette with the library and other files. Contact your service representative when you have gathered the above information.

RENAME ERROR:

Explanation: LIB86 cannot rename a file.

Library Action: LIB86 terminates and displays this message.

User Response: Make sure the disk is not write-protected, and then try again.

SYMBOL TABLE OVERFLOW:

Explanation: There is not enough memory for the symbol table.

Library Action: LIB86 terminates and displays this message.

User Response: Reduce the number of command line options in the command line (MAP and XREF both use symbol table space), or use a system with more memory.

SYNTAX ERROR:

Explanation: LIB86 detected a syntax error in the command line, probably due to an improper filename or a command option that is not valid.

Library Action: LIB86 stops, displays this message, and echoes the command line up to the point where it found the error.

User Response: Retype the command line or edit the INP file, and try again.

POSTLINK Error Messages

During the course of operation, POSTLINK can display error messages. This section describes each error message, its cause, the action taken by the postprocessor utility, and the user response.

CANNOT ERASE OLD FILE:

Explanation: POSTLINK was started and the input file was open to another process.

Postlinker Action: POSTLINK terminates and displays error message.

User Response: Correct the error by rerunning the linker and then the postlinker.

CANNOT READ FIXUPS:

Explanation: POSTLINK was started and a disk read error occurred.

Postlinker Action: POSTLINK terminates and displays error message.

User Response: Correct the error by rerunning the linker and then the postlinker.

CANNOT RENAME FILE:

Explanation: POSTLINK was started and the input file was open to another process.

Postlinker Action: POSTLINK terminates and displays error message.

User Response: Correct the error by rerunning the linker and then the postlinker.

CANNOT SEEK TO FIXUPS:

Explanation: POSTLINK was started and a disk seek error occurred.

Postlinker Action: POSTLINK terminates and displays error message.

User Response: Correct the error by rerunning the linker and then the postlinker.

COULD NOT OPEN FILE filename.ext

Explanation: POSTLINK was started and could not open the given file. This is because the file does not exist, or the user does not have authorization to use POSTLINK.286 or create files in the subdirectory where POSTLINK or the specified file resides.

Postlinker Action: POSTLINK terminates and displays error message.

User Response: Correct the error by keying in POSTLINK and the file name.

COULD NOT OPEN POSTOUT.286:

Explanation: POSTLINK was started and a disk open error occurred.

Postlinker Action: POSTLINK terminates and displays error message.

User Response: Correct the error by rerunning the linker and then the postlinker.

COULD NOT READ FILE:

Explanation: POSTLINK was started and a disk read error occurred.

Postlinker Action: POSTLINK terminates and displays error message.

User Response: Correct the error by rerunning the linker and then the postlinker.

COULD NOT READ HEADER:

Explanation: POSTLINK was started and a disk read error occurred.

Postlinker Action: POSTLINK terminates and displays error message.

User Response: Correct the error by rerunning the linker and then the postlinker.

COULD NOT READ OLD BUCKET:

Explanation: POSTLINK was started and a disk read error occurred.

Postlinker Action: POSTLINK terminates and displays error message.

User Response: Correct the error by rerunning the linker and then the postlinker.

COULD NOT READ SRTL HDR:

Explanation: POSTLINK was started and a disk read error occurred.

Postlinker Action: POSTLINK terminates and displays error message.

User Response: Correct the error by rerunning the linker and then the postlinker.

COULD NOT SEEK TO BEGINNING OF FILE:

Explanation: POSTLINK was started and a disk seek error occurred.

Postlinker Action: POSTLINK terminates and displays error message.

User Response: Correct the error by rerunning the linker and then the postlinker.

COULD NOT SEEK TO READ OLD BUCKET:

Explanation: POSTLINK was started and a disk seek error occurred.

Postlinker Action: POSTLINK terminates and displays error message.

User Response: Correct the error by rerunning the linker and then the postlinker.

COULD NOT SEEK TO SRTL HDR:

Explanation: POSTLINK was started and a disk seek error occurred.

Postlinker Action: POSTLINK terminates and displays error message.

User Response: Correct the error by rerunning the linker and then the postlinker.

COULD NOT WRITE BUCKET:

Explanation: POSTLINK was started and a disk write error occurred.

Postlinker Action: POSTLINK terminates and displays error message.

User Response: Correct the error by rerunning the linker and then the postlinker.

COULD NOT WRITE HEADER TO OUTPUT FILE:

Explanation: POSTLINK was started and a disk write error occurred.

Postlinker Action: POSTLINK terminates and displays error message.

User Response: Correct the error by rerunning the linker and then the postlinker.

COULD NOT WRITE LDT:

Explanation: POSTLINK was started and a disk write error occurred.

Postlinker Action: POSTLINK terminates and displays error message.

User Response: Correct the error by rerunning the linker and then the postlinker.

COULD NOT WRITE SRTL:

Explanation: POSTLINK was started and a disk write error occurred.

Postlinker Action: POSTLINK terminates and displays error message.

User Response: Correct the error by rerunning the linker and then the postlinker.

COULD NOT WRITE TO FILE:

Explanation: POSTLINK was started and a disk write error occurred.

Postlinker Action: POSTLINK terminates and displays error message.

User Response: Correct the error by rerunning the linker and then the postlinker.

FILE ALREADY POST PROCESSED:

Explanation: POSTLINK was started and found the POSTLINK step has run for this file.

Postlinker Action: POSTLINK terminates and displays error message.

User Response: Correct the error by rerunning the linker and then the postlinker.

FIXUP # TOO LARGE:

Explanation: POSTLINK was started and an incorrect fixup record was found.

Postlinker Action: POSTLINK terminates and displays error message.

User Response: Correct the error by rerunning the correct linker for your compiler.

INVALID FIXUP:

Explanation: POSTLINK was started and an incorrect fixup record was found.

Postlinker Action: POSTLINK terminates and displays error message.

User Response: Correct the error by rerunning the correct linker for your compiler.

INVALID INPUT FILE:

Explanation: POSTLINK was started and the header of the input file was not valid.

Postlinker Action: POSTLINK terminates and displays error message.

User Response: Correct the error by rerunning the correct linker for your compiler.

SEEK ERROR READING FILE:

Explanation: POSTLINK was started and a disk seek error occurred.

Postlinker Action: POSTLINK terminates and displays error message.

User Response: Correct the error by rerunning the linker and then the postlinker.

SEEK ERROR WRITING TO FILE:

Explanation: POSTLINK was started and a disk seek error occurred.

Postlinker Action: POSTLINK terminates and displays error message.

User Response: Correct the error by rerunning the linker and then the postlinker.

WRONG NUMBER OF PARAMETERS:

Explanation: POSTLINK was started and more than one argument was given.

Postlinker Action: POSTLINK terminates and displays error message.

User Response: Correct the error by keying in POSTLINK and the file name.

LINK86 Error Messages

During the course of operation, LINK86 can display error messages. This section describes each error message, its cause, the linker action, and the user response.

ALIGN TYPE NOT IMPLEMENTED:

Explanation: The object file contains a segment align type not implemented in LINK86. The object file is incompatible with LINK86, possibly because it was produced by an unsupported compiler or assembler, or because it was corrupted.

Linker Action: LINK86 terminates and displays this error message.

User Response: Correct the object file and restart LINK86 or use the correct linker for your compiler.

CANNOT CLOSE:

Explanation: LINK86 cannot close an output file.

Linker Action: LINK86 terminates and displays this error message, followed by the name of the file.

User Response: Restart LINK86 after making sure the correct disk is in the drive and that it is not write-protected.

CLASS NOT FOUND:

Explanation: The class name specified in the command line does not appear in any of the files linked.

Linker Action: LINK86 terminates and displays this error message, followed by the name of the missing class.

User Response: Restart LINK86 with the correct class name in the command line or change the class name in the files being linked.

COMBINE TYPE NOT IMPLEMENTED:

Explanation: The object file contains a segment combine type not implemented in LINK86. The object file is incompatible with LINK86, possibly because it was produced by an unsupported compiler or assembler, or because it was corrupted.

Linker Action: LINK86 terminates and displays this error message.

User Response: Correct the object file and restart LINK86 or use the correct linker for your compiler.

COMMAND TOO LONG:

Explanation: The total length of command input to LINK86, including the input file, exceeds the maximum of 2048 characters.

Linker Action: LINK86 terminates and displays this error message.

User Response: Reduce the command to within the maximum and restart LINK86.

DIRECTORY FULL:

Explanation: Not enough directory space exists for the output files.

Linker Action: LINK86 terminates and displays this error message.

User Response: Either erase some unnecessary files or get another disk with more directory space and run LINK86 again.

DISK READ ERROR:

Explanation: LINK86 cannot read an object or library file. This error is usually the result of an unexpected end-of-file.

Linker Action: LINK86 terminates and displays this error message, followed by the name of the file.

User Response: Replace the named file and try again.

DISK WRITE ERROR:

Explanation: A file cannot be written, probably because the disk is full.

Linker Action: LINK86 terminates and displays this error message, followed by the name of the file it was trying to write.

User Response: Use a disk with enough space for the file or take other appropriate action to make space available, and try again.

ERROR IN LIBATTR MODULE:

Explanation: The LIBATTR module in one of the libraries does not conform to established requirements.

Linker Action: LINK86 terminates and displays this error message.

User Response: Fix the LIBATTR module and rebuild the library in question. Then restart LINK86.

FIXUP TYPE NOT IMPLEMENTED:

Explanation: The object file uses a fixup type not implemented in LINK86. The object file is incompatible with LINK86, possibly because it was produced by an unsupported compiler or assembler, or because it was corrupted.

Linker Action: LINK86 terminates and displays this error message.

User Response: Correct the object file and restart LINK86, or use the correct linker for your compiler.

GROUP NOT FOUND:

Explanation: The group name specified in the command line does not appear in any of the files linked.

Linker Action: LINK86 terminates and displays this error message, followed by the name of the missing group.

User Response: Enter the correct group name in the command line, or change the group name in the files being linked and try again.

GROUP OVER 64K:

Explanation: The group listed is larger than 64K.

Linker Action: LINK86 terminates and displays this error message, followed by the name of the group.

User Response: Delete segments from the group, divide it into two or more groups, or do not use groups. Then restart LINK86.

GROUP TYPE NOT IMPLEMENTED:

Explanation: The object file contains a segment that is not an element of any known group.

Linker Action: LINK86 terminates and displays this error message, followed by the name of the segment.

User Response: Correct the object file and restart LINK86.

INVALID LIBRARY-REQUESTED SUFFIX:

Explanation: The load module suffix requested by the LIBATTR module in a library is not supported.

Linker Action: LINK86 terminates and displays this error message, followed by the load module suffix.

User Response: Correct the LIBATTR module within the library and restart LINK86.

LINK86 ERROR 1:

Explanation: An inconsistency exists in the LINK86 internal tables.

Linker Action: LINK86 terminates and displays this error message.

User Response: If an internal linker error occurs during the linking of your application program, copy your object files, runtime libraries, and input file onto a diskette. Then relink your application with the same command line options, but add the following to the end of the command line, **preceded by a single blank space:**

```
>filename.ext
```

This command creates a file that captures the console output of the linker. Copy filename.ext onto the same diskette as the files and libraries. Contact your service representative when you have gathered this information.

MORE THAN ONE MAIN PROGRAM:

Explanation: The source program has more than one main program.

Linker Action: LINK86 terminates and displays this error message.

User Response: Correct the source program, recompile, and restart LINK86.

MULTIPLE DEFINITION:

Explanation: The indicated symbol is defined as PUBLIC in more than one module.

Linker Action: LINK86 terminates and displays this error message, followed by the name of the symbol.

User Response: Correct the problem in the source files, regenerate the object files, and try again.

NO FILE:

Explanation: LINK86 cannot find the indicated input, object, or library on the indicated drive.

Linker Action: LINK86 terminates and displays this error message, followed by the name of the missing file.

User Response: Correct the file name or drive identifier and try again.

OBJECT FILE ERROR nn:

Explanation: LINK86 detected an error in the object file. This error is caused by a compiler error or by a bad disk file. The error codes (nn) are defined on page B-14.

Linker Action: LINK86 terminates and displays this error message, followed by the file name, record number, and item number.

User Response: Regenerate the object file and relink. If the error still occurs, copy the source file used to create the object file and copy both files on a diskette. Then relink your application with the same command line options, but add the following to the end of the command line, **preceded by a single blank space:**

```
>filename.ext
```

This creates a file that captures the console output of the linker. Copy filename.ext onto the same diskette as the files and libraries. Contact your service representative when you have gathered this information.

RECORD TYPE NOT IMPLEMENTED:

Explanation: The object file contains a record type not implemented in LINK86. The object file is incompatible with LINK86, possibly because it was produced by an unsupported compiler or assembler, or because it was corrupted.

Linker Action: LINK86 terminates and displays this error message, followed by the name of the record type.

User Response: Correct the object file and restart LINK86, or use the correct linker for your compiler.

SEGMENT ATTRIBUTE ERROR:

Explanation: The combine type of the indicated segment is not the same as the type of segment in a previously linked file.

Linker Action: LINK86 terminates and displays this error message, followed by the name of the segment.

User Response: Change the segment attributes in your source file as needed, regenerate the object file, and then relink.

SEGMENT CLASS ERROR:

Explanation: The class of a segment is not one of the following: CODE, DATA, STACK, EXTRA, X1, X2, X3, or X4.

Linker Action: LINK86 terminates and displays this error message, followed by the name of the segment.

User Response: Correct the object file and restart LINK86.

SEGMENT COMBINATION ERROR:

Explanation: An attempt is made to combine segments that cannot be combined, such as LOCAL segments.

Linker Action: LINK86 terminates and displays this error message.

User Response: Change the segment attributes in your source file, regenerate the object file, and relink.

SEGMENT NOT FOUND:

Explanation: The segment name specified in the command line does not appear in any of the files linked.

Linker Action: LINK86 terminates and displays this error message, followed by the name of the segment.

User Response: Enter the correct segment name in the command line or change the segments names in the files being linked, and try again.

SEGMENT OVER 64K:

Explanation: The indicated segment has a total length greater than 64K bytes.

Linker Action: LINK86 terminates and displays this error message, followed by the name of the segment.

User Response: Reduce the segment's size, or do not combine it with PUBLIC segments that have the same name. If the CODE segment exceeds 64K, be sure that all libraries (.L86 files) are linked using the SEARCH option to minimize code size.

SRTL DATA OVERLAP:

Explanation: The data from two SRTLs overlaps.

Linker Action: LINK86 terminates and displays this error message, followed by the name of the SRTL.

User Response: Change the base address in the LIBATTR module of one of the SRTLs, and restart LINK86.

STACK COLLIDES WITH SRTL DATA:

Explanation: The base address of SRTL data does not allow enough room for the requested amount of stack space.

Linker Action: LINK86 terminates and displays this error message, followed by the name of the SRTL.

User Response: Change the base of the SRTL data in the LIBATTR module, or request less stack space. Then restart LINK86.

SYMBOL TABLE OVERFLOW:

Explanation: LINK86 ran out of symbol table space.

Linker Action: LINK86 terminates and displays this error message.

User Response: Either reduce the number or length of PUBLIC and global symbols in the program, or, if there is not enough memory available for the linker to obtain a 64K segment, relink on a system with more memory available.

SYNTAX ERROR:

Explanation: LINK86 detected a syntax error in the command line, probably because of an improper file name or an command option that is not valid.

Linker Action: LINK86 stops, displays this error message, and echoes the command line up to the point where it found the error.

User Response: Retype the command line or edit the INP file, and try again.

TARGET OUT OF RANGE:

Explanation: The target of a fixup cannot be reached from the location of the fixup. This usually means the fixup and target are more than 64K bytes apart.

Linker Action: LINK86 terminates and displays this error message.

User Response: Correct your source files, regenerate the object files, and try again.

TOO MANY MODULES IN LIBRARY:

Explanation: The library contains more modules than LINK86 can handle.

Linker Action: LINK86 terminates and displays this error message, followed by the name of the library.

User Response: Split the library into two or more libraries and restart LINK86.

TOO MANY MODULES LINKED FROM LIBRARY:

Explanation: A library is supplying more than 256 modules during a single execution of LINK86.

Linker Action: LINK86 terminates and displays this error message, followed by the name of the library.

User Response: Split the library into two or more libraries and restart LINK86.

UNDEFINED SYMBOLS:

Explanation: The symbols following this message are referenced but not defined in any of the modules being linked.

Linker Action: LINK86 terminates and displays this error message, followed by the undefined symbols.

User Response: Edit your source files to define the symbols in the modules being linked, regenerate the object files, and try again.

XSRTL MUST BE LINKED BY ITSELF:

Explanation: Other files are being linked at the same time as an executable shared runtime library (XSRTL).

Linker Action: LINK86 terminates and displays this error message.

User Response: Run LINK86 on the XSRTL alone.

XSRTLs INCOMPATIBLE WITH OVERLAYS:

Explanation: The application program being linked with the executable shared runtime library contains overlays.

Linker Action: LINK86 terminates and displays this error message, followed by the name of the XSRTL.

User Response: Remove the overlays and restart LINK86 or specify the NOSHARED option for the runtime library and restart LINK86.

Object File Error Codes

The following error codes appear only when LINK86 encounters an object file or library file that does not conform to the Intel 8086 Object Module Format specification.

Error Code	Description
1	File name in COMENT record has more than eight characters.
2	LEDATA record has more than 1024 bytes of data.
3	Data in LEDATA/LIDATA record extends past end of segment.
4	Checksum error.
5	Record type is not valid.
6	Library record found where not expected.
7	No library record found where expected.
8	Index out of range.
9	File or module does not start with THEADR or LIBHED record.
10	Name too long (more than 40 characters).
11	Character in name is not valid.
12	Record length is not valid.
13	Repeat count = 0 in LIDATA record.
14	Error expanding LIDATA record.
15	Bad field in MODEND record (MODTYP L=0).
16	Bad fixup type in MODEND record.
20	Target thread (method field > 3) is not valid.
21	Frame thread (method field > 6) is not valid.
22	Loc field (lof > 4) is not valid.
23	Frame field in FIXDAT (frame > 3 when thread fixup) is not valid.
24	Reference to nonexistent frame thread.
25	Frame field in FIXDAT (frame > 6 when explicit fixup) is not valid.
26	Reference to nonexistent target thread.
27	Self-relative fixup (not low byte or offset byte) is not valid.
28	Fixup goes past LEDATA record size.
29	Cannot reach start address specified in MODEND record.

Appendix C. Character Sets and Check Printing Application

This appendix contains the normal and double width character sets used to print checks. It also contains an example application that was tested for check printing. For more information, see “Printing Checks” on page 3-62.

Example of a Normal Width Character Set

The following is an example of the character set used in check printing. It contains normal width characters (5 x 8). The values are in hexadecimal.

```
00,00,00,00,00,00,00,00,00,00,00,00,00,00,00   SP
1F,00,00,00,1F,00,00,00,1F,00,00,00,1F,00,00,00   !
0A,00,0A,00,0A,00,00,00,00,00,00,00,00,00,00,00   "
00,00,1F,00,00,00,1F,00,00,00,1F,00,00,00,00,00   #
00,00,00,1F,00,00,00,1F,00,00,00,1F,00,00,00,00   $
1F,00,00,00,1F,00,00,00,1F,00,00,00,1F,00,00,00   %
04,00,0A,00,00,0A,04,00,08,00,15,00,12,00,0D,00   &
04,00,04,00,04,00,00,00,00,00,00,00,00,00,00,00   '
02,04,08,00,08,00,00,10,00,00,08,00,08,04,02,00   (
08,04,02,00,02,00,00,01,00,00,02,00,02,04,08,00   )
00,00,11,00,0A,00,1F,00,0A,00,11,00,00,00,00,00   *
00,00,00,00,00,00,0C,00,0C,00,04,08,10,00,00,00   ,
00,00,00,00,00,00,1F,00,00,00,00,00,00,00,00,00   -
00,00,00,00,00,00,00,00,00,00,00,00,0C,00,0C,00   .
01,00,02,00,02,00,04,00,04,00,08,00,08,00,10,00   /
0E,00,11,00,11,02,11,04,11,08,11,00,11,00,0E,00   0
04,00,0C,00,04,00,04,00,04,00,04,00,04,00,0E,00   1
0E,00,11,00,02,00,04,00,08,00,10,00,10,00,1F,00   2
1E,00,01,00,01,00,07,00,01,00,01,00,01,00,1E,00   3
11,00,11,00,11,00,11,00,1F,00,01,00,01,00,01,00   4
1F,00,10,00,10,00,1E,00,01,00,01,00,01,00,1E,00   5
0E,00,11,00,10,00,1E,00,11,00,11,00,11,00,0E,00   6
1F,00,01,00,02,00,04,00,08,00,10,00,10,00,10,00   7
```

```
0E,00,11,00,11,00,0E,00,11,00,11,00,11,00,0E,00   8
0E,00,11,00,11,00,0F,00,01,00,01,00,01,00,1E,00   9
02,00,04,00,08,00,10,00,10,00,08,00,04,00,02,00   <
08,00,04,00,02,00,01,00,01,00,02,00,04,00,08,00   >
04,00,0A,00,11,00,11,00,1F,00,11,00,11,00,11,00   A
1E,00,11,00,11,00,1E,00,11,00,11,00,11,00,1E,00   B
0E,00,11,00,10,00,10,00,10,00,10,00,11,00,0E,00   C
1C,02,11,00,11,00,11,00,11,00,11,00,11,02,1C,00   D
1F,00,10,00,10,00,1C,00,10,00,10,00,10,00,1F,00   E
1F,00,10,00,10,00,1C,00,10,00,10,00,10,00,10,00   F
0E,00,11,00,10,00,10,00,17,00,11,00,11,00,0E,00   G
11,00,11,00,11,00,1F,00,11,00,11,00,11,00,11,00   H
0E,00,04,00,04,00,04,00,04,00,04,00,04,00,0E,00   I
02,00,02,00,02,00,02,00,02,00,02,00,12,00,0C,00   J
11,00,12,00,14,00,18,00,18,00,14,00,12,00,11,00   K
10,00,10,00,10,00,10,00,10,00,10,00,10,00,1F,00   L
11,00,1B,00,15,00,15,00,11,00,11,00,11,00,11,00   M
11,00,19,00,19,00,15,00,13,00,13,00,11,00,11,00   N
0E,00,11,00,11,00,11,00,11,00,11,00,11,00,0E,00   O
1E,00,11,00,11,00,1E,00,10,00,10,00,10,00,10,00   P
0E,00,11,00,11,00,11,00,11,00,15,00,13,00,0F,00   Q
1E,00,11,00,11,00,1E,00,18,00,14,00,12,00,11,00   R
0E,00,11,00,10,00,0E,00,01,00,01,00,11,00,0E,00   S
1F,00,04,00,04,00,04,00,04,00,04,00,04,00,04,00   T
11,00,11,00,11,00,11,00,11,00,11,00,11,00,0E,00   U
11,00,11,00,11,00,11,00,11,00,11,00,0A,00,04,00   V
11,00,11,00,11,00,11,00,15,00,15,00,1B,00,11,00   W
11,00,11,00,0A,00,04,00,04,00,0A,00,11,00,11,00   X
11,00,11,00,0A,00,04,00,04,00,04,00,04,00,04,00   Y
1F,00,00,01,00,02,00,04,00,08,00,10,00,00,1F,00   Z
```

Example of a Double Width Character Set

This example contains double width characters (8 x 8). The values are in hexadecimal.

```
7E,00,83,00,85,00,89,00,91,00,A1,00,C1,00,7E,00   0
18,00,28,00,08,00,08,00,08,00,08,00,08,00,3E,00   1
7E,00,81,00,01,02,04,08,10,20,40,00,80,00,FF,00   2
FC,02,01,00,01,02,0C,02,01,00,01,00,01,02,FC,00   3
41,00,41,00,41,00,41,00,7F,00,01,00,01,00,01,00   4
FE,00,80,00,80,00,FC,02,01,00,01,00,01,02,7C,00   5
6E,40,80,00,80,00,FC,02,81,00,81,00,81,42,3C,00   6
FF,00,01,02,00,04,00,08,00,10,20,00,20,00,00,20   7
3C,42,81,00,81,42,3C,42,81,00,81,00,81,42,3C,00   8
3C,42,81,00,81,00,7F,00,01,00,01,00,01,02,7C,00   9
7E,00,54,00,2A,00,54,00,2A,00,54,00,2A,00,7E,00  Box
```

Example Application for Printing Checks on the Model 2 Printer

The following example demonstrates the APACS Check Printing Capability of the Model 2 printer. It prints a check on the document insert station.

The application begins by opening the document insert station and performing a PUTLONG. This statement begins the check printing mode. Then the paper advances to the amount field and the amount is printed in double width characters. This process takes ten print passes including one last blank print pass. The remainder of the check data is printed in 36 passes. Check printing normally takes a maximum of 9.5 seconds.

The example application includes the check data in the program as data statements. Your application would not use data statements. The data would be read in from a lookup table or a disk file. This application has minimal error recovery.

```
%ENVIRON T
INTEGER*2 I%
INTEGER*2 J%
INTEGER*4 X%
INTEGER*1 TEMP%(1)
DIM TEMP%(381)
SUB ASYNCSUB(RFLAG,OVER)
INTEGER*2 RFLAG
STRING OVER
WAIT; 10000
! Display the error.
CLEARS 10
WRITE #10; "ASYNC ERROR = ",ERR
! Do not retry.
RFLAG = 0
EXIT SUB
END SUB
ON ASYNC ERROR CALL ASYNCSUB
ON ERROR GOTO ERR.HNDLR
```

```
! Load the input state table. This is a table
! that sets up a motor key.
LOAD "ISTBL = R::ADX_UPGM:APAC@.TBL"
! Open the DI Station
OPEN "DI:" AS 5
! Open the display with a greeting.
OPEN "ANDISPLAY:" AS 10
CLEARS 10
WRITE #10; "APACS CHECK PRINTING"
WRITE #10; "DEMO"
! Leave message up five seconds.
WAIT; 5000
! Open the I/O Processor and unlock to the initial state.
OPEN "IOPROC:" AS 11
UNLOCKDEV 11, 1
! Put the printer in check printing mode and auto-insert mode.
Putlong 5, 00000078H
! Open Loop
WHILE 1
! Wait to press the ENTER key.
   READ #11; LINE A$
   LOCKDEV 11, PURGE
! Advance the paper to the amount field.
   WRITE FORM "C38 A9";#5; "
! Print field starts at 94 primary positions to the left of the
! home position, and continues 72 print positions.
   TEMP%(1) = 94
   TEMP%(2) = 72
! Print the amount field using double wide characters.
! It is necessary to advance the paper 9 steps after
! every print pass. Because each print pass has 72 bytes,
! there are (380 - 3 control bytes) 377 bytes to send print
! data. 5 print passes can be written at a time. The amount field
! consists of a total of 10 passes, so it can do this in two writes.
! The first pass is blank to prevent incomplete line feeding
! on the first pass.
   TEMP%(3) = 5
   TEMP%(381) = 9
   FOR J%=1 TO 2
       FOR I%=4 to 363
! 72 Bytes per print pass,
! 5 print passes per write
       READ TEMP%(I%)
       NEXT I%
       WRITE LOGO #5; TEMP%(1)
   NEXT J%
```

```
! Print the rest of the check. This part of the check consists
! of normal sized characters (5x8 font). The paper should be
! advanced 6 steps after printing each pass. On the last print
! pass, turn on the high order bit of byte 381. This tells the
! driver to return the print head to home position after printing
! the last line of the WRITE LOGO. A TCLOSE can also return
! the print head to home position, but it forces the application
! to wait until all queued prints are done.
   TEMP%(381) = 6
   FOR J%=1 to 7
     FOR I%=4 to 363
! 72 bytes per print pass, 5 print passes per write
        READ TEMP%(I%)
     NEXT I%
     WRITE LOGO #5; TEMP%(1)
   NEXT J%
! Do only one pass this time.
   TEMP%(3) = 1
! High order bit of line feed byte to home head set to ON.
   TEMP%(381) = 86H
   FOR I%=4 to 75
     READ TEMP%(I%)
   NEXT I%
   WRITE LOGO #5; TEMP%(1)
! Allow keyboard input
   UNLOCKDEV 11, 1
! Reposition the data statement pointer to the beginning
   RESTORE
WEND
ERR.HNDLR
! Display the error.
WAIT; 10000
CLEARS 10
WRITE #10; "SYNC ERROR = ",ERR
RESUME
! Passes 1-10 are for the double printing sections of the check.
! Pass 1  - blank
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0
! Pass 2  - "box" character
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0, 126,   0,  84,   0,  42,   0,  84,   0
DATA   42,   0,  84,   0,  42,   0, 126,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0
```

```
! Pass 3  - "4"
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,  65,   0,  65,   0,  65,   0,  65,   0
DATA  127,   0,   1,   0,   1,   0,   1,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0
! Pass 4  - "2"
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0, 126,   0,-127,   0,   1,   2,   4,   8
DATA   16,  32,  64,   0,-128,   0,  -1,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0
! Pass 5  - "-"
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,  31,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0
! Pass 6  - "8"
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,  60,  66,-127,   0,-127,  66,  60,  66
DATA -127,   0,-127,   0,-127,  66,  60,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0
! Pass 7  - "7"
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,  -1,   0,   1,   2,   0,   4,   0,   8
DATA    0,  16,  32,   0,  32,   0,   0,  32,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0
```

```
! Pass 8  - "3"
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,  -4,   2,   1,   0,   1,   2,  12,   2
DATA    1,   0,   1,   0,   1,   2,  -4,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0
! Pass 9  - "box" character
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0, 126,   0,  84,   0,  42,   0,  84,   0
DATA   42,   0,  84,   0,  42,   0, 126,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0
! Pass 10  - blank
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0
! This is the normal width part of the check.
! Pass 11
DATA   14,   0,  17,   0,  17,   0,  14,   0,  17,   0
DATA   17,   0,  17,   0,  14,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0
! Pass 12
DATA   14,   0,  17,   0,  17,   0,  14,   0,  17,   0
DATA   17,   0,  17,   0,  14,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0
```

```
! Pass 13
DATA   30,   0,  17,   0,  17,   0,  30,   0,  24,   0
DATA   20,   0,  18,   0,  17,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0
! Pass 14
DATA    4,   0,  10,   0,  17,   0,  17,   0,  31,   0
DATA   17,   0,  17,   0,  17,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0
! Pass 15
DATA   17,   0,  27,   0,  21,   0,  21,   0,  17,   0
DATA   17,   0,  17,   0,  17,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0
! Pass 16
DATA   14,   0,  17,   0,  16,   0,  30,   0,  17,   0
DATA   17,   0,  17,   0,  14,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0
! Pass 17
DATA    4,   0,  12,   0,   4,   0,   4,   0,   4,   0
DATA    4,   0,   4,   0,  14,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0
```

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! Pass 18
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,  17,   0,  10,   0,  31,   0
DATA   10,   0,  17,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0
! Pass 19
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,  17,   0,  10,   0,  31,   0
DATA   10,   0,  17,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0
! Pass 20
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,  31,   0,   4,   0,   4,   0,   4,   0
DATA    4,   0,   4,   0,   4,   0,   4,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0
! Pass 21
DATA   30,   0,  17,   0,  17,   0,  30,   0,  24,   0
DATA   20,   0,  18,   0,  17,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,  17,   0,  17,   0,  17,   0,  31,   0
DATA   17,   0,  17,   0,  17,   0,  17,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0
! Pass 22
DATA   31,   0,  16,   0,  16,   0,  28,   0,  16,   0
DATA   16,   0,  16,   0,  31,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,  14,   0,  17,   0,  16,   0,  16,   0
DATA   23,   0,  17,   0,  17,   0,  14,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0
```

```
! Pass 23
DATA   14,   0,  17,   0,  16,   0,  14,   0,   1,   0
DATA    1,   0,  17,   0,  14,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,  14,   0,   4,   0,   4,   0,   4,   0
DATA    4,   0,   4,   0,   4,   0,  14,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0
! Pass 24
DATA   17,   0,  17,   0,  17,   0,  17,   0,  17,   0
DATA   17,   0,  17,   0,  14,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,  31,   0,  16,   0,  16,   0,  28,   0
DATA   16,   0,  16,   0,  16,   0,  31,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0
! Pass 25
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,  17,   0,  17,   0,  10,   0,   4,   0
DATA    4,   0,   4,   0,   4,   0,   4,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0
! Pass 26
DATA   17,   0,  27,   0,  21,   0,  21,   0,  17,   0
DATA   17,   0,  17,   0,  17,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,  31,   0,   4,   0,   4,   0,   4,   0
DATA    4,   0,   4,   0,   4,   0,   4,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0
! Pass 27
DATA   31,   0,  16,   0,  16,   0,  28,   0,  16,   0
DATA   16,   0,  16,   0,  31,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,  17,   0,  25,   0,  25,   0,  21,   0
DATA   19,   0,  19,   0,  17,   0,  17,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0
```

```
! Pass 28
DATA   31,   0,   4,   0,   4,   0,   4,   0,   4,   0
DATA    4,   0,   4,   0,   4,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,  31,   0,  16,   0,  16,   0,  28,   0
DATA   16,   0,  16,   0,  16,   0,  31,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0
! Pass 29
DATA   14,   0,  17,   0,  16,   0,  14,   0,   1,   0
DATA    1,   0,  17,   0,  14,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,  17,   0,  17,   0,  17,   0,  17,   0
DATA   17,   0,  17,   0,  10,   0,   4,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0
! Pass 30
DATA   17,   0,  17,   0,  10,   0,   4,   0,   4,   0
DATA    4,   0,   4,   0,   4,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,  31,   0,  16,   0,  16,   0,  28,   0
DATA   16,   0,  16,   0,  16,   0,  31,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0
! Pass 31
DATA   14,   0,  17,   0,  16,   0,  14,   0,   1,   0
DATA    1,   0,  17,   0,  14,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,  14,   0,  17,   0,  16,   0,  14,   0
DATA    1,   0,   1,   0,  17,   0,  14,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0
```

```
! Pass 32
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   4,   0,  10,   0,   0,  10,   4,   0
DATA    8,   0,  21,   0,  18,   0,  13,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0
! Pass 33
DATA   31,   0,  16,   0,  16,   0,  28,   0,  16,   0
DATA   16,   0,  16,   0,  31,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,  28,   2,  17,   0,  17,   0,  17,   0
DATA   17,   0,  17,   0,  17,   2,  28,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0
! Pass 34
DATA   30,   0,  17,   0,  17,   0,  30,   0,  24,   0
DATA   20,   0,  18,   0,  17,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,  31,   0,  16,   0,  16,   0,  28,   0
DATA   16,   0,  16,   0,  16,   0,  31,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,  17,   0
DATA   10,   0,  31,   0,  10,   0,  17,   0,   0,   0
DATA    0,   0
! Pass 35
DATA   14,   0,  17,   0,  17,   0,  17,   0,  17,   0
DATA   17,   0,  17,   0,  14,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,  30,   0,  17,   0,  17,   0,  30,   0
DATA   24,   0,  20,   0,  18,   0,  17,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,  17,   0
DATA   10,   0,  31,   0,  10,   0,  17,   0,   0,   0
DATA    0,   0
! Pass 36
DATA   31,   0,   4,   0,   4,   0,   4,   0,   4,   0
DATA    4,   0,   4,   0,   4,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,  28,   2,  17,   0,  17,   0,  17,   0
DATA   17,   0,  17,   0,  17,   2,  28,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,  30,   0,  17,   0
DATA   17,   0,  30,   0,  16,   0,  16,   0,  16,   0
DATA   16,   0
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! Pass 37
DATA   14,   0,  17,   0,  16,   0,  14,   0,   1,   0
DATA    1,   0,  17,   0,  14,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,  17,   0,  25,   0,  25,   0,  21,   0
DATA   19,   0,  17,   0,  17,   0,  17,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,  17,   0,  17,   0
DATA   17,   0,  17,   0,  31,   0,   1,   0,   1,   0
DATA    1,   0
! Pass 38
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,  17,   0,  17,   0,  17,   0,  17,   0
DATA   17,   0,  17,   0,  17,   0,  14,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,  14,   0,  17,   0
DATA    2,   0,   4,   0,   8,   0,  16,   0,  16,   0
DATA   31,   0
! Pass 39
DATA   14,   0,  17,   0,  17,   2,  17,   4,  17,   8
DATA   17,   0,  17,   0,  14,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,  17,   0,  17,   0,  17,   0,  31,   0
DATA   17,   0,  17,   0,  17,   0,  17,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,  14,   0,  17,   0
DATA   16,   0,  14,   0,   1,   0,   1,   0,  17,   0
DATA   14,   0
! Pass 40
DATA   14,   0,  17,   0,  17,   0,  14,   0,  17,   0
DATA   17,   0,  17,   0,  14,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,  31,   0,  16,   0,  16,   0,  28,   0
DATA   16,   0,  16,   0,  16,   0,  31,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,  28,   2,  17,   0
DATA   17,   0,  17,   0,  17,   0,  17,   0,  17,   2
DATA   28,   0
! Pass 41
DATA   14,   0,  17,   0,  16,   0,  30,   0,  17,   0
DATA   17,   0,  17,   0,  14,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,  31,   0,  16,   0,  16,   0,  28,   0
DATA   16,   0,  16,   0,  16,   0,  31,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,  17,   0,  25,   0
DATA   25,   0,  21,   0,  19,   0,  19,   0,  17,   0
DATA   17,   0
```

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! Pass 42
DATA   17,   0,  17,   0,  17,   0,  17,   0,  31,   0
DATA    1,   0,   1,   0,   1,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,  30,   0,  17,   0,  17,   0,  30,   0
DATA   24,   0,  20,   0,  18,   0,  17,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,  17,   0,  17,   0
DATA   17,   0,  17,   0,  17,   0,  17,   0,  17,   0
DATA   14,   0
! Pass 43
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,  17,   0,  17,   0,  17,   0,  31,   0
DATA   17,   0,  17,   0,  17,   0,  17,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,  14,   0,  17,   0
DATA   17,   0,  17,   0,  17,   0,  17,   0,  17,   0
DATA   14,   0
! Pass 44
DATA   17,   0,  27,   0,  21,   0,  21,   0,  17,   0
DATA   17,   0,  17,   0,  17,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,  31,   0,   4,   0,   4,   0,   4,   0
DATA    4,   0,   4,   0,   4,   0,   4,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,  30,   0,  17,   0
DATA   17,   0,  30,   0,  16,   0,  16,   0,  16,   0
DATA   16,   0
! Pass 45
DATA   30,   0,  17,   0,  17,   0,  30,   0,  17,   0
DATA   17,   0,  17,   0,  30,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,  17,   0,  10,   0,  31,   0
DATA   10,   0,  17,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,  17,   0
DATA   10,   0,  31,   0,  10,   0,  17,   0,   0,   0
DATA    0,   0
! Pass 46
DATA   14,   0,   4,   0,   4,   0,   4,   0,   4,   0
DATA    4,   0,   4,   0,  14,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,  17,   0,  10,   0,  31,   0
DATA   10,   0,  17,   0,   0,   0,   0,   0,   0,   0
DATA    0,   0,   0,   0,   0,   0,   0,   0,  17,   0
DATA   10,   0,  31,   0,  10,   0,  17,   0,   0,   0
DATA    0,   0
```

Glossary

This glossary defines terms and abbreviations used in this book. Consult the *IBM Dictionary of Computing*, SC20-1699, and the index of this book for terms that you do not find in this glossary.

A

absolute value. Magnitude of a number, independent of its sign.

active. (1) Able to communicate on the network. A token-ring network adapter is active if it is able to transmit and receive on the network. (2) Operational. (3) Pertaining to a node or device that is connected or is available for connection to another node or device. (4) Currently transmitting or receiving.

adapter. (1) In the point-of-sale terminal, a circuit card that, with its associated software, enables the terminal to use a function or feature. (2) In a LAN, within a communicating device, a circuit card that, with its associated software and/or microcode, enables the device to communicate over the network.

ADCS. Advanced Data Communications for Stores.

address. (1) In data communication, the IEEE-assigned unique code or the unique locally administered code assigned to each device or workstation connected to a network. (2) A character, group of characters, or a value that identifies a register, a particular part of storage, a data source, or a data link. The value is represented by one or more characters. (3) To refer to a device or an item of data by its address. (4) The location in the storage of a computer where data is stored.

address space. The complete range of addresses that is available to a programmer.

addressing. (1) The assignment of addresses to the instructions of a program. (2) In data communication, the way in which a station selects the station to which it is to send data.

Advanced Data Communications for Stores (ADCS). An IBM-licensed product that functions at the host processor to permit host-to-store communication.

advanced program-to-program communications (APPC). An implementation of the SNA/SDLC LU 6.2 protocol that allows interconnected systems to communicate and share the processing of programs.

alert. (1) An error message sent to the system services control point (SSCP) at the host system. (2) For IBM LAN management products, a notification indicating a possible security violation, a persistent error condition, or an interruption or potential interruption in the flow of data around the network. See also *network management vector transport*. (3) In SNA, a record sent to a system problem management focal point to communicate the existence of an alert condition. (4) In the NetView program, a high-priority event that warrants immediate attention. This data base record is generated for certain event types that are designed by user-constructed filters.

all points addressable (APA). In computer graphics, pertaining to the ability to address and display or not display each picture element (pel) on a display surface.

alphanumeric. Pertaining to a character set containing letters, digits, and other special characters.

Alphanumeric point-of-sale keyboard (ANPOS keyboard). This keyboard consists of a section of alphanumeric keys, a programmable set of point-of-sale keys, a numeric keypad, and system function keys.

Alternate File Server. A store controller that maintains image versions of all non-system mirrored files and that can assume control if the configured File Server becomes disabled.

American National Standard Code for Information Interchange (ASCII). 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 characters and graphics characters.

American National Standards Institute (ANSI). An organization for the purpose of establishing voluntary industry standards.

ANPOS keyboard. Alphanumeric point-of-sale keyboard.

ANSI. American National Standards Institute.

APAR. Authorized program analysis report.

API. Application program interface.

APPC. Advanced program-to-program communications.

application program. (1) A program written for or by a user that applies to the user's own work. (2) A program written for or by a user that applies to a

particular application. (3) A program used to connect and communicate with stations in a network, enabling users to perform application-oriented activities.

application program interface (API). The formally defined programming language interface that is between an IBM system control program or a licensed program and the user of the program.

architecture. A logical structure that encompasses operating principles including services, functions, and protocols. See *computer architecture, network architecture, Systems Application Architecture (SAA), Systems Network Architecture (SNA)*.

array. An arrangement of elements in one or more dimensions.

ARTIC adapter. A family of communications coprocessor adapters that, with appropriate electrical interfaces, can support a wide range of communication devices. For the IBM Store System, an ARTIC adapter provides communications support for ASYNC, BSC, SDLC, and X.25 communications.

ASCII. American National Standard Code for Information Interchange.

assembler. Computer program that translates assembly language statements into machine code.

async. asynchronous.

asynchronous (async). (1) Pertaining to two or more processes that do not depend upon the occurrence of specific events such as timing signals. (2) Without regular time relationship; unexpected or unpredictable with respect to the execution of program instructions.

attach. (1) To connect a device physically. (2) To make a device a part of a network logically. Compare with *connect*.

attaching device. Any device that is physically connected to a network and can communicate over the network.

Authorized Program Analysis Report (APAR). A report of a problem caused by a suspected defect in a current unaltered release of a program.

available memory. In a personal computer, the number of bytes of memory that can be used after memory requirements for the operating system, device drivers, and other application programs have been satisfied.

B

background. On a color display, the part of the display screen that surrounds a character.

background application. A non-interactive program that can be selected from the background application screen or that can start automatically when the system is IPLed or when the controller is activated as the master or file server. Contrast with *foreground application*.

backup. Pertaining to a system, device, file, or facility that can be used in the event of a malfunction or the loss of data.

bar code. A code representing characters by sets of parallel bars of varying thickness and separation that are read optically by transverse scanning.

base address. A numeric value that is used as a reference in the calculation of addresses in the execution of a computer program, to or through which, the input/output devices are connected.

baseband. (1) A frequency band that uses the complete bandwidth of a transmission medium. Contrast with *broadband, carrierband*. (2) A method of data transmission that encodes, modulates, and impresses information on the transmission medium without shifting or altering the frequency of the information signal.

base unit. The part of the IBM 4683 Point of Sale terminal that contains the power supply and the interfaces.

BASIC. Beginner's All-purpose Symbolic Instruction Code. A programming language that uses common English words.

Basic Input/Output System (BIOS). In IBM Personal Computers with PC I/O channel architecture, microcode that controls basic hardware operations such as interactions with diskette drives, fixed disk drives, and the keyboard.

batch. Smaller subdivisions of price change records within an event. Each batch has a 12-character ID and a 30-character description field.

batch file. A file that contains a series of commands to be processed sequentially.

baud. The rate at which signal conditions are transmitted per second. Contrast with *bits per second (bps)*.

BCD. Binary-coded decimal notation.

beacon. (1) A frame sent by an adapter on a ring network indicating a serious ring problem, such as a broken cable. It contains the addresses of the beaconing station and its nearest active upstream neighbor (NAUN). (2) To send beacon frames continuously. An adapter is *beaconing* if it is sending such a frame.

beaconing. An error-indicating function of token-ring adapters that assists in locating a problem causing a hard error on a token-ring network.

binary. (1) Pertaining to a system of numbers to the base two; the binary digits are 0 and 1. (2) Pertaining to a selection, choice, or condition that has two possible different values or states.

binary-coded decimal notation (BCD). A binary-coded notation in which each of the decimal digits is represented by a binary numeral. For example, in binary-coded decimal notation that uses the weights 8, 4, 2, 1, the number “twenty three” is represented by 0010 0011. In the pure binary numeration system, its representation is 10111.

binary synchronous communication (BSC). A form of telecommunication line control that uses a standard set of transmission control characters and control character sequences, for binary synchronous transmission of binary-coded data between stations. Contrast with *synchronous data link control (SDLC)*.

BIOS. Basic Input/Output System.

bit. Either of the binary digits: a 0 or 1.

bits per second (bps). The rate at which bits are transmitted per second. Contrast with *baud*.

block size. (1) The minimum size that frames are grouped into for retransmission. (2) The number of data elements (such as bits, bytes, characters, or records) that are recorded or transmitted as a unit.

bps. Bits per second.

Bps. Bytes per second.

bridge. (1) An attaching device connected to two LAN segments to allow the transfer of information from one LAN segment to the other. A bridge may connect the LAN segments directly by network adapters and software in a single device, or may connect network adapters in two separate devices through software and use of a telecommunications link between the two adapters. (2) A functional unit that connects two LANs that use the same logical link control (LLC) procedures but may use the same or different medium access control (MAC) procedures. Contrast with *gateway* and *router*.

broadband. A frequency band divisible into several narrower bands so that different kinds of transmissions such as voice, video, and data transmission can occur at the same time. Synonymous with *wideband*. Contrast with *baseband*.

broadcast. Simultaneous transmission of data to more than one destination.

BSC. Binary synchronous communication.

buffer. (1) A portion of storage used to hold input or output data temporarily. (2) A routine or storage used to compensate for a difference in data rate or time of occurrence of events, when transferring data from one device to another.

bypass. To eliminate an attaching device or an access unit from a ring network by allowing the data to flow in a path around it.

byte. A string consisting of 8 bits that is treated as a unit, and that represents a character. See *n-bit byte*.

C

C. A high-level programming language designed to optimize run time, size, and efficiency.

CMOS. Complementary metal-oxide semiconductor.

code page. A particular assignment of hexadecimal identifiers to graphic characters.

complementary metal-oxide semiconductor (CMOS). A technology that combines the electrical properties of n-type semiconductors and p-type semiconductors.

cable loss (optical). The loss in an optical cable equals the attenuation coefficient for the cables fiber times the cable length.

cable segment. A section of cable between components or devices on a network. A segment may consist of a single patch cable, multiple patch cables connected together, or a combination of building cable and patch cables connected together. See *LAN segment, ring segment*.

call. The action of bringing a function or subprogram into effect, usually by specifying the entry conditions and jumping to an entry point.

carrierband. A frequency band in which the modulated signal is superimposed on a carrier signal (as differentiated from baseband), but only one channel is present on the medium. Contrast with *baseband, broadband*.

cash drawer. A drawer at a point-of-sale terminal that can be programmed to open automatically. See *till*.

CD. Corrective diskette.

chain. (1) Transfer of control from the currently executing program to another program or overlay. (2) Referencing a data record from a previous data record.

chaining. A method of storing records in which each record belongs to a list or group of records and has a linking field for tracing the chain.

chaining threshold. The number of chains in a keyed file that causes a message to be logged by the operating system.

channel. (1) A functional unit, controlled by a host computer, that handles the transfer of data between processor storage and local peripheral equipment. (2) A path along which signals can be sent. (3) The portion of a storage medium that is accessible to a given reading or writing station.

charge. A sales transaction in which a customer has the partial or total value of purchased merchandise added to an account for later payment.

charge account. An account established by a merchant that permits the customer to buy goods or services and defer payment until billed.

checkpoint. A point at which information about the status of a job and the system can be recorded so that the job step can be restarted later.

checksum. (1) The sum of a group of data associated with the group and used for checking purposes. (2) On a diskette, data written in a sector for error-detection purposes. A calculated checksum that does not match the checksum of data written in the sector indicates a bad sector. **Note:** The data is either numeric or other character strings regarded as numeric for the purpose of calculating the checksum. See also *module integrity value*.

clear. To delete data from a screen or from memory.

cluster. The allocation unit used by the operating system to allocate space when creating files on disks and diskettes. The operating system will allocate space to files in cluster increments; therefore the space allocated for a file is always some multiple of this allocation unit. The minimum allocation for a file is one cluster. Cluster size expressed in bytes is always a power of 2. Cluster size is set during formatting and cannot be changed by the user.

COBOL. Common business-oriented language. A high-level programming language, based on English, that is used primarily for business applications.

code generator. One of the components of the compiler. The code generator produces object code, which once linked, is machine-executable.

command. (1) A request for performance of an operation or execution of a program. (2) A character string from a source external to a system that represents a request for system action.

Common Programming Interface-Communications (CPI-C). Provides languages, commands, and calls that allow the development of applications that are more easily integrated and moved across environments supported by Systems Applications Architecture (SAA).

communications and systems management (C & SM). A set of tools, programs, and network functions used to plan, operate, and control an SNA communications network. C & SM runs on the store controller and must also exist at the host site.

compile. (1) To translate all or part of a program expressed in a high-level language into a computer program expressed in an intermediate language, an assembly language, or a machine language. (2) To prepare a machine language program from a computer program written in another programming language by making use of the overall logic structure of the program, or generating more than one computer instruction for each symbolic statement, or both, as well as performing the function of an assembler. (3) To translate a source program into an executable program (an object program). (4) To translate a program written in a high-level programming language into a machine language program.

compiler. A program that decodes instructions written as pseudo codes and produces a machine language program to be executed at a later time. Contrast with *interpretive routine*. Synonymous with *compiling program*.

compiler directive. A nonexecutable statement that supplies information to a compiler to affect its action but which usually does not directly result in executable code.

compiling program. Synonym for compiler.

component. (1) Any part of a network other than an attaching device, such as an IBM 8228 Multistation Access Unit. (2) Hardware or software that is part of a functional unit.

compound files. Files that are kept on all store controllers.

computer architecture. The organizational structure of a computer system, including hardware and software.

concatenate. To join one string to another.

configuration. The group of devices, options, and programs that make up a data processing system or network as defined by the nature, number, and chief characteristics of its functional units. More specifically, the term may refer to a hardware configuration or a software configuration. See also *system configuration*.

configuration file. The collective set of definitions that describes a configuration.

connect. In a LAN, to physically join a cable from a station to an access unit or network connection point. Contrast with *attach*.

constant. String or numeric value that does not change throughout program execution.

contiguous. Touching or joining at the edge or boundary; adjacent. For example, an unbroken consecutive series of memory locations.

control block. (1) A storage area used by a computer program to hold control information. (2) In the IBM Token-Ring Network, a specifically formatted block of information provided from the application program to the Adapter Support Interface to request an operation.

control character. A character whose occurrence in a particular context initiates, modifies, or stops a control operation. A control character may be recorded for use in a subsequent action, and it may have a graphic representation in some circumstances.

controller. A unit that controls input/output operations for one or more devices.

conversation partner. One of the two programs involved in a conversation.

conversation state. The condition of a conversation that reflects what the past action on that conversation has been and that determines what the next set of actions may be.

corrective diskette (CD). A set of diskettes that contain modules to replace the modules in the active program subdirectory. The first diskette of the set must contain a product control file that describes which product the modules are to be applied to and a list of all modules that are to be replaced.

CRC. Cyclic redundancy check.

cursor. A movable point of light (or a short line) that indicates where the next character is to be entered on the display screen.

customer receipt. An itemized list of merchandise purchased and paid for by the customer.

cyclic redundancy check (CRC). Synonym for *frame check sequence (FCS)*.

D

data. (1) A representation of facts, concepts, or instructions in a formalized manner suitable for communication, interpretation, or processing by human or automatic means. (2) Any representations such as characters or analog quantities to which meaning is or might be assigned.

data circuit-terminating equipment (DCE). In a data station, the equipment that provides the signal conversion and coding between the data terminal equipment (DTE) and the line.

data file. A collection of related data records organized in a specific manner; for example, a payroll file (one record for each employee, showing such information as rate of pay and deductions) or an inventory file (one record for each inventory item, showing such information as cost, selling price, and number in stock.) See also *data set, file*.

data integrity. (1) The condition that exists as long as accidental or intentional destruction, alteration, or loss of data does not occur. (2) Preservation of data for its intended use.

data link. (1) Any physical link, such as a wire or a telephone circuit, that connects one or more remote terminals to a communication control unit, or connects one communication control unit with another. (2) The assembly of parts of two data terminal equipment (DTE) devices that are controlled by a link protocol, and the interconnecting data circuit, that enable data to be transferred from a data source to a data link. (3) In SNA, see also *link*. **Note:** A telecommunication line is only the physical medium of transmission. A data link includes the physical medium of transmission, the protocol, and associated devices and programs; it is both physical and logical.

data processing system. A network, including computer systems and associated personnel, that accepts information, processes it according to a plan, and produces the desired results.

data set. Logically related records treated as a single unit. See also *file*.

data terminal equipment (DTE). (1) That part of a data station that serves as a data source, data receiver, or both. (2) Equipment that sends or receives data, or both.

data type. The mathematical properties and internal representation of data and functions.

DCE. Data circuit-terminating equipment.

DDA. Data Distribution Application.

debug. To detect, diagnose, and eliminate errors in computer programs.

declaration statement. A nonexecutable statement that supplies information about data in a computer program. Synonymous with *declarative statement*.

default. Pertaining to an attribute, value, or option that is assumed when none is explicitly specified.

default value. The value the system supplies when the user does not specify a value.

delimiter. (1) A character used to indicate the beginning or end of a character string. (2) A bit pattern that defines the beginning or end of a frame or token on a LAN.

destination. Any point or location, such as a node, station, or particular terminal, to which information is to be sent.

destination address. A field in the medium access control (MAC) frame that identifies the physical location to which information is to be sent. Contrast with *source address*.

device. (1) A mechanical, electrical, or electronic contrivance with a specific purpose. (2) An input/output unit such as a terminal, display, or printer. See also *attaching device*.

device driver. The code needed to attach and use a device on a computer or a network.

diagnostic diskette. A diskette containing diagnostic modules or tests used by computer users and service personnel to diagnose hardware problems.

diagnostics. Modules or tests used by computer users and service personnel to diagnose hardware problems.

direct file. A file in which records are assigned specific record positions. No matter what order the records are put in a direct file, they always occupy the assigned position. A direct file is the same as a random file except that a direct file contains no delimiting characters, such as quotes enclosing string fields.

directory. (1) A table of identifiers and references that correspond to items of data. (2) An index that a control program uses to locate one or more blocks of data that are stored in separate areas of a data set in direct access storage.

disabled. (1) Pertaining to a state of a processing unit that prevents the occurrence of certain types of interruptions. (2) Pertaining to the state in which a transmission control unit or audio response unit cannot accept incoming calls on a line.

disk. A round, flat plate coated with a magnetic substance on which computer data is stored. See also *integrated disk, fixed disk*.

diskette. A thin, flexible magnetic disk permanently enclosed in a protective jacket. A diskette is used to store information for processing.

diskette drive. The mechanism used to seek, read, and write data on diskettes.

Disk Operating System (DOS). An operating system for computer systems that use disks and diskettes for auxiliary storage of programs and data.

display. (1) A visual presentation of data. (2) A device that presents visual information to the point-of-sale terminal operator and to the customer, or to the display station operator.

distributed. Physically separate but connected by cables.

Distributed Systems Executive (DSX). An IBM licensed program available for IBM host systems that allows the host system to get, send, and remove files, programs, formats and procedures in a network of computers.

domain. An SSCP and the resources that it can control.

DOS. Disk Operating System.

driver. Software component that controls a device.

DSX. Distributed Systems Executive.

DTE. Data terminal equipment.

dump. (1) To write at a particular instant the contents of storage, or part of storage, onto another data medium for the purpose of safeguarding or debugging the data. (2) Data that has been dumped.

duplex. In data communication, pertaining to a simultaneous two-way independent transmission in both directions. Synonymous with *full-duplex*. Contrast with *half-duplex*.

E

EAN. European article number.

EBCDIC. Extended binary-coded decimal interchange code.

EIA. Electronic Industries Association. See *EIA interface*.

EIA interface. An industry-accepted interface for connecting devices having voltage-related limits.

element. (1) In a set, an object, entity, or concept having the properties that define a set. (2) A parameter value in a list of parameter values.

emulation. (1) The imitation of all or part of one computer system by another, primarily by hardware, so that the imitating system accepts the same data, executes the same programs, and achieves the same results as the imitated computer system. (2) The use of programming techniques and special machine features to permit a computing system to execute programs written for another system.

enabled. (1) On a LAN, pertaining to an adapter or device that is active, operational, and able to receive frames from the network. (2) Pertaining to a state of a processing unit that allows the occurrence of certain types of interruptions. (3) Pertaining to the state in which a transmission control unit or an audio response unit can accept incoming calls on a line.

end-of-file. An internal label, immediately following the last record of a file, signaling the end of that file.

error condition. The condition that results from an attempt to use instructions or data that are invalid.

error message. A message that is issued because an error has been detected.

European article number (EAN). A number that is assigned to and encoded on an article of merchandise for scanning in some countries.

evaluation. Reduction of an expression to a single value.

event. (1) Processing unit containing price changes and item file updates. All records in an event share common characteristics such as type of change and event due date. (2) An occurrence of significance to a task; for example, the completion of an asynchronous operation, such as an I/O operation.

exception. An abnormal condition such as an I/O error encountered in processing a data set or a file. See also *overflow exception* and *underflow exception*.

executable statement. A statement that specifies one or more actions to be taken by a computer program at execution time; for example, instructions for calculations to be performed, conditions to be tested, flow of control to be altered.

execute. To perform the actions specified by a program or a portion of a program.

execution. The process of carrying out an instruction or instructions of a computer program by a computer.

exit. To execute an instruction or statement within a portion of a program in order to terminate the execution of that portion. **Note:** Such portions of programs include loops, routines, subroutines, and modules.

expansion board. In a personal computer, a panel containing microchips that a user can install in an expansion slot to add memory or special features. Synonymous with *expansion card*, *extender card*.

expansion card. Synonym for *expansion board*.

expression. A notation, within a program, that represents a value: a constant or a reference appearing alone, or combinations of constants and references with operators.

extended binary-coded decimal interchange code (EBCDIC). A coded character set consisting of 8-bit coded characters.

extender card. Synonym for *expansion board*.

F

fault. An accidental condition that causes a functional unit to fail to perform its required function.

feature. A part of an IBM product that may be ordered separately by the customer.

Feature Expansion. A card that plugs into an IBM 4683 Point of Sale Terminal and allows additional devices to be used.

field. On a data medium or a storage medium, a specified area used for a particular category of data; for example, a group of character positions used to enter or display wage rates on a panel.

FIFO. First-in–first-out.

file. A named set of records stored or processed as a unit. For example, an invoice may form a record and the complete set of such records may form a file. See also *data file* and *data set*.

file access. Methods of entering a file to retrieve the information stored in the file.

file allocation table (FAT). A table used by the operating system to allocate space on a disk for a file and to locate and chain together parts of the file that may be scattered on different sectors so that the file can be used in a random or sequential manner.

file extension. Extension to a file name. A file extension is optional and can be up to three characters long. All characters permitted in a file name are permitted in a file extension. The file extension must be separated from the file name by a period.

file mode. The attribute of a file that specifies when it is distributed.

file name. (1) A name assigned or declared for a file. (2) The name used by a program to identify a file.

file server. (1) A store controller that maintains prime versions of all non-system mirrored files. (2) A high-capacity disk storage device or a computer that each computer on a network can access to retrieve files that can be shared among the attached computers.

file sharing. The ability of a disk file to be shared by more than one program.

file specification. Unique file identifier. A file specification includes an optional drive specification followed by a colon, a primary file name of one to eight characters, and an optional period and file type of zero to three characters.

file type. The attribute of a file that specifies to which store controllers it is distributed.

first-in–first-out (FIFO). A queuing technique in which the next item to be retrieved is the item that has been in the queue for the longest time.

fixed disk (drive). In a personal computer system unit, a disk storage device that reads and writes on rigid magnetic disks. It is faster and has a larger storage capacity than a diskette and is permanently installed.

flag. A character or indicator that signals the occurrence of some condition, such as the setting of a switch, or the end of a word.

foreground. On a color display, the part of the display area that is the character itself.

foreground application. An interactive program that can be selected by system menus or started in command mode. Contrast with *background application*.

format string. Specification in an I/O statement that determines the format for reading or writing data.

frame. (1) The unit of transmission in some LANs, including the IBM Token-Ring Network. It includes delimiters, control characters, information, and checking characters. On a token-ring network, a frame is created from a token when the token has data appended to it. On a token-bus network, all frames including the token frame contain a preamble, start delimiter, control address, optional data and checking characters, end delimiter, and are followed by a minimum silence period. (2) A housing for machine elements. (3) In synchronous data link control (SDLC), the vehicle for every command, every response, and all information that is transmitted using SDLC procedures. Each frame begins and ends with a flag.

frame check sequence (FCS). (1) A system of error checking performed at both the sending and receiving station after a block-check character has been accumulated. (2) A numeric value derived from the bits in a message that is used to check for any bit errors in transmission. (3) A redundancy check in which the check key is generated by a cyclic algorithm. Synonymous with *cyclic redundancy check (CRC)*.

frequency. The rate of signal oscillation, expressed in hertz (cycles per second).

front end. One of the two main components of the compiler. The front end consists of the lexical analyzer, the parser, and the symbol table generator.

full-duplex. Synonym for *duplex*.

function. (1) A specific purpose of an entity, or its characteristic action. (2) A subroutine that returns the value of a single variable. (3) In data communications, a machine action such as a carriage return or line feed.

function key. A key on a terminal, such as an ENTER key, that causes the transmission of a signal not associated with a character that can be printed or displayed. Detection of the signal usually causes the system to perform some predefined action for the operator or determined by the application program.

G

gateway. A device and its associated software that interconnect networks of systems of different architectures. The connection is usually made above the Reference Model network layer. For example, a gateway allows LANs access to System/370 host computers. Contrast with *bridge* and *router*.

global. Pertaining to that which is defined in one subdivision of a computer program and used in at least one other subdivision of that computer program.

group. (1) A set of related records that have the same value for a particular field in all records. (2) A collection of users who can share access authorities for protected resources. (3) A list of names that are known together by a single name.

H

half-duplex. In data communication, pertaining to transmission in only one direction at a time. Contrast with *duplex*.

hardware. Physical equipment as opposed to programs, procedures, rules, and associated documentation.

hashing. In an indexed data set, using an algorithm to convert the key of a record to an address for that record, for storing and retrieving data. Synonymous with *randomizing*.

HCP. Host command processor for advanced data communications.

HCP. Host command processor.

header. The portion of a message that contains control information for the message such as one or more destination fields, name of the originating station, input sequence number, character string indicating the type of message, and priority level for the message.

header record. A record containing common, constant, or identifying information for a group of records that follows.

heap. Dynamic data storage area used to store data that can vary in size during the execution of a program, such as strings and arrays.

home record. The first record in a chain of records.

host command processor (HCP). The SNA logical unit of the programmable Store System store controller.

host computer. (1) The primary or controlling computer in a multi-computer installation or network. (2) In a network, a processing unit in which resides a network access method. Synonymous with *host processor*.

host node. A subarea node that contains a system services control point (SSCP).

host processor. (1) In a network, a computer that primarily provides services such as computation, data base access, or special programs or programming languages. (2) Synonym for *host computer*.

host processor. (1) A processor that controls all or part of a user application network. (2) In a network, the processing unit in which resides the access method for the network. (3) In an SNA network, the processing unit that contains a system services control point (SSCP). (4) A processing unit that executes the access method for attached communication controllers. (5) The processing unit required to create and maintain PSS. Synonymous with host computer.

I

IBM Disk Operating System (DOS). A disk operating system based on MS-DOS**.

identifier. String of characters used to name elements of a program, such as variable names, reserved words, and user-defined function names.

IEEE. Institute of Electrical and Electronics Engineers.

image version. Copy of a prime version of a file. See *prime version*.

inactive. (1) Not operational. (2) Pertaining to a node or device not connected or not available for connection to another node or device. (3) In the IBM Token-Ring Network, pertaining to a station that is only repeating frames or tokens, or both.

information (I) frame. A frame in I format used for numbered information transfer. See also *supervisory frame, unnumbered frame.*

initialize. In a LAN, to prepare the adapter (and adapter support code, if used) for use by an application program.

initial program load (IPL). The initialization procedure that causes an operating system to begin operation.

input device. Synonym for *input unit*.

input/output (I/O). (1) Pertaining to a device whose parts can perform an input process and an output process at the same time. (2) Pertaining to a functional unit or channel involved in an input process, output process, or both, concurrently or not, and to the data involved in such a process.

input sequence table. Defines all input data that is expected by the application from the keyboard, OCR device, point-of-sale scanner, and wand on the IBM point-of-sale terminal. The table allows the terminal I/O processor to recognize operator input and organize it into a form the application expects.

input unit. A device in a data processing system by means of which data can be entered into the system. Synonymous with *input device*.

insert. To make an attaching device an active part of a LAN.

instruction. In a programming language, a meaningful expression that specifies one operation and identifies its operands, if any.

integrated disk. An integral part of the processor that is used for magnetically storing files, application programs, and diagnostics. Synonymous with *disk*.

interactive. Pertaining to an application or program in which each entry calls forth a response from a system or program. An interactive program may also be conversational, implying a continuous dialog between the user and the system.

interface. (1) A shared boundary between two functional units, defined by functional characteristics, common physical interconnection characteristics, signal characteristics, and other characteristics as appropriate. (2) A shared boundary. An interface may be a hardware component to link two devices or a portion of storage or registers accessed by two or more computer programs. (3) Hardware, software, or both, that links systems, programs, or devices.

interpretive routine. A routine that decodes instructions written as pseudocodes and immediately executes the instructions. Contrast with *compile*.

interrupt. (1) A suspension of a process, such as execution of a computer program, caused by an external event and performed in such a way that the process can be resumed. (2) To stop a process in such a way that it can be resumed. (3) In data communication, to take an action at a receiving station that causes the sending station to end a transmission. (4) A means of passing processing control from one software or microcode module or routine to another, or of requesting a particular software, microcode, or hardware function.

I/O. Input/output.

I/O device. Equipment for entering and receiving data from the system.

I/O processor. Equipment that receives data from, processes data, and sends data to one or more I/O devices.

I/O session number. Unique identification number you assign to a file device driver, pipe, or communication link or session with the CREATE or OPEN statement. I/O session numbers can be any numeric expression. If the expression evaluates to a real number, it is converted to an integer.

IPL. Initial program load.

item. (1) One member of a group. (2) In a store, one unit of a commodity, such as one box, one bag, or one can. Usually an item is the smallest unit of a commodity to be sold.

K

K. When referring to storage capacity, a symbol that represents two to the tenth power, or 1024.

keyboard. A group of numeric keys, alphabetic keys, special character keys, or function keys used for entering information into the terminal and into the system.

keyed file. Type of file composed of keyed records. Each keyed record has two parts: a key and data. A key is used to identify and access each record in the file.

L

label. Constant, either numeric or literal, that references a statement or function.

LAN. Local area network.

LAN segment. (1) Any portion of a LAN (for example, a single bus or ring) that can operate independently but is connected to other parts of the establishment network by bridges. (2) An entire ring or bus network without bridges. See *cable segment, ring segment*.

LCD. Liquid Crystal display.

LDSN. Logical drive and subdirectory name.

LED. Light-emitting diode.

LFN. Logical file name.

light-emitting diode (LED). A semiconductor chip that gives off visible or infrared light when activated.

link. (1) In the IBM Store System, the logical connection between nodes including the end-to-end link control procedures. (2) The combination of physical media, protocols, and programming that connects devices on a network. (3) In computer programming, the part of a program, in some cases a single instruction or an address, that passes control and parameters between separate portions of the computer program. (4) To interconnect items of data or portions of one or more computer programs. (5) In SNA, the combination of the link connection and link stations joining network nodes. See also *link connection*. **Note:** A link connection is the physical medium of transmission; for example, a telephone wire or a microwave beam. A link includes the physical medium

of transmission, the protocol, and associated devices and programming; it is both logical and physical.

linkage editor. A computer program used to create one load module from one or more object modules or load modules by resolving cross references among the modules. Synonymous with *linker*.

linker. Synonym for *linkage editor*.

link connection. (1) All physical components and protocol machines that lie between the communicating link stations of a link. The link connection may include a switched or leased physical data circuit, a LAN, or an X.25 virtual circuit. (2) In SNA, the physical equipment providing two-way communication and error correction and detection between one link station and one or more other link stations. (3) In the IBM Store System, the logical link providing two-way communication of data from one network node to one or more other network nodes.

listing. A printout of source code.

literal. In a source program, an explicit representation of the value of an item, which value must be unaltered during any translation of the source program; for example, the word “ENTER” in the instruction: “If X = 0 print ‘ENTER’.”

load. In computer programming, to enter data into memory or working registers.

local area network (LAN). A computer network located on a user’s premises within a limited geographical area. **Note:** Communication within a LAN is not subject to external regulations; however, communication across the LAN boundary may be subject to some form of regulation.

logging. The chronological recording of events occurring in a system or a subsystem for accounting or data collection purposes.

logical file name (LFN). An abbreviated file name used to represent either an entire file name or the drive and subdirectory path part of the file name.

logical link. In an MVS/VS multisystem environment, the means by which a physical link is related to the transactions and terminals that can use the physical link.

logical unit (LU). (1) In SNA, a port through which an end user accesses the SNA network in order to communicate with another end user and through which the end user accesses the functions provided by system services control points (SSCPs). An LU can support at least two sessions, one with an SSCP and one with another LU, and may be capable of supporting many sessions with other logical units. (2) A type of network addressable unit that enables end users to communicate with each other and gain access to network resources.

logon (n). The procedure for starting up a point-of-sale terminal or store controller for normal sales operations by sequentially entering the correct security number and transaction number. Synonymous with *sign-on*.

log on (v). (1) To initiate a session. (2) In SNA products, to initiate a session between an application program and a logical unit (LU). Synonymous with *sign-on*.

loop. (1) A set of instructions that may be executed repeatedly while a certain condition prevails. See also *store loop*. (2) A closed unidirectional signal path connecting input/output devices to a network.

LU. Logical unit.

LU-LU session type 6.2. In SNA, a type of session for communication between peer systems. Synonymous with *APPC protocol.*

M

MICR. Magnetic ink character recognition.

magnetic stripe. The magnetic material (similar to recording tape) on merchandise tickets, credit cards, and employee badges. Information is recorded on the stripe for later “reading” by the magnetic stripe reader (MSR) or magnetic wand reader attached to the point-of-sale terminal.

magnetic stripe reader (MSR). A device that reads coded information from a magnetic stripe on a card, such as a credit card, as it passes through a slot in the reader.

maintenance analysis procedure (MAP). Deprecated term for *procedure*. See *procedure*.

Manufacturing Automated Protocol (MAP). A broadband LAN with a bus topology that passes tokens from adapter to adapter on a coaxial cable.

MAP. (1) Maintenance analysis procedure. (2) Manufacturing Automated Protocol.

mapping. Establishing a correspondence between the elements of one set and the elements of another set.

master store controller. The store controller that maintains prime versions of system mirrored files and all compound files.

master terminal. An IBM Point of Sale Terminal that controls a satellite IBM Point of Sale terminal.

Mb. Megabit.

MB. Megabyte.

MCF Network. Multiple store controllers communicating on a network using DDA. This provides data redundancy among the store controllers.

media. Plural form of *medium*.

medialess. Not fitted with a direct access storage device, such as a diskette drive or fixed disk drive, as in some models of IBM Point of Sale Terminals.

medium. (1) A physical carrier of electrical or optical energy. (2) A physical material in or on which data may be represented.

megabit (Mb). A unit of measure for throughput. 1 megabit = 1,048,576 bits.

megabyte (MB). A unit of measure for data. 1 megabyte = 1,048,576 bytes.

memory. Program-addressable storage from which instructions and other data can be loaded directly into registers for subsequent execution or processing.

memory mapped I/O (MMIO). In an IBM Personal Computer, a method of accessing an input or output port as if it were a memory location.

memory model. Predetermined format for program structure. A memory model determines the sizes of the different program areas (code, data, and stack), and the initial values for segment registers. IBM 4680 BASIC supports three memory models: medium, big, and large.

message. (1) An arbitrary amount of information whose beginning and end are defined or implied. (2) A group of characters and control bit sequences transferred as an entity. (3) In telecommunication, a combination of characters and symbols transmitted from one point to another. (4) A logical partition of the user device's data stream to and from the adapter. See also *error message, operator message*.

Micro Channel. The architecture used by IBM Personal System/2 computers, Models 50 and above. This term is used to distinguish these computers from personal computers using a PC I/O channel, such as an IBM PC, XT, or an IBM Personal System/2 computer, Model 25 or 30.

microcode. (1) One or more microinstructions. (2) A code, representing the instructions of an instruction set, that is implemented in a part of storage that is not program-addressable. (3) To design, write, and also test one or more microinstructions.

mirrored files. Files that are kept on both the Master Store Controller and the Alternate Master Store Controller or on both the File Server and Alternate File Server. System mirrored files are kept on the Master Store Controller and Alternate Store Controller and non-system mirrored files are kept on the File Server and Alternate File Server.

Mod1. A generic name used to refer to a point-of-sale terminal in the IBM 4690 Store System that loads and executes programs. A Mod1 can be any of the following models: 4683-001, 4683-A01, 4683-P11, 4683-P21, 4683-P41, 4683-421, 4684, and 4693-*xx*1 (terminal part if a controller/terminal).

Mod2. A generic name used to refer to a point-of-sale terminal in the IBM 4690 Store System that does not load and execute programs, but attaches to a terminal that does. A Mod2 can be one of the following models: 4683-002, 4683-A02, or 4693-2*x2*.

module. A program unit that is discrete and identifiable with respect to compiling, combining with other units, and load; for example, the input to, or output from, an assembler, compiler, linkage editor, or executive routine.

module integrity value (checksum). A 3-byte value that is calculated for each module when a product control file is built. The checksum is recalculated when activating the maintenance and is compared against the value in the product control file.

modulo check. A function designed to detect most common input errors by performing a calculation on values entered into a system by an operator or scanning device.

modulus. In the modulo check function, the number by which the summed digits are divided. See also *modulo check*.

monitor. (1) A functional unit that observes and records selected activities for analysis within a data processing system. Possible uses are to show significant departures from the norm, or to determine levels of utilization of particular functional units. (2) Software or hardware that observes, supervises, controls, or verifies operations of a system.

monochrome display. A display device that presents display images in only one color.

MSR. Magnetic stripe reader.

multiple controller system. Synonym for *MCF Network*.

multitasking. (1) Pertaining to the concurrent execution of two or more tasks by a computer. (2) Multiprogramming that provides for the concurrent

performance, or interleaved execution, of two or more tasks.

N

name. An alphanumeric term that identifies a data set, statement, program, or cataloged procedure.

n-bit byte. A string that consists of n bits.

NetView. A host-based IBM network management licensed program that provides communication network management (CNM) or communications and systems management (C & SM) services.

NetView Distribution Manager (NetView DM). A component of the NetView family supporting resource distribution within *Change Management*, and providing central control of software and microcode distribution and installation, to processors in a distributed/departmental (SNA) network system. It allows a similar control of user data objects across the network, and provides the facilities to support the remote initiation of command lists.

network. (1) A configuration of data processing devices and software connected for information interchange. (2) An arrangement of nodes and connecting branches. Connections are made between data stations.

network administrator. A person who manages the use and maintenance of a network.

network architecture. The logical structure and operating principles of a computer network. See also *systems network architecture (SNA)* and *Open Systems Interconnect (OSI) architecture*. **Note:** The operating principles of a network include those of services, functions, and protocols.

network management vector transport (NMVT). The portion of an alert transport frame that contains the alert message.

Network Problem Determination Application (NPDA). A program product that assists the user in identifying network problems from a central control point using interactive display techniques.

node. (1) Any device, attached to a network, that transmits and/or receives data. (2) An end point of a link, or a junction common to two or more links in a network. Nodes can be processors, controllers, or workstations. Nodes can vary in routing and other functional capabilities. (3) In a network, a point where one or more functional units interconnect transmission lines.

nonvolatile random access memory (NVRAM). Random access memory that retains its contents after electrical power is shut off.

NPDA. Network Problem Determination Application.

nonvolatile random access memory (NVRAM). Random access memory that retains its contents after electrical power is shut off.

null string. A string containing no entity.

NVRAM. Nonvolatile Random Access Memory.

O

object code. Output of an assembler or compiler that executes on the target processor.

OCF. Operator console facility.

OCR. Optical character recognition.

OCR reader. A device that reads hand-written or machine-printed symbols into a computing system.

offline. Operation of a functional unit without the control of a computer or control unit.

online. Operation of a functional unit that is under the continual control of a computer or control unit. The term also describes a user's access to a computer using a terminal.

open. (1) To make an adapter ready for use. (2) A break in an electrical circuit. (3) To make a file ready for use.

Open Systems Interconnect (OSI). (1) The interconnection of open systems in accordance with specific ISO standards. (2) The use of standardized procedures to enable the interconnection of data processing systems. **Note:** OSI architecture establishes a framework for coordinating the development of current and future standards for the interconnection of computer systems. Network functions are divided into seven layers. Each layer represents a group of related data processing and communication functions that can be carried out in a standard way to support different applications.

Open Systems Interconnect (OSI) architecture. Network architecture that adheres to a particular set of ISO standards that relates to Open Systems Interconnect (OSI).

Open Systems Interconnect (OSI) Reference Model. A model that represents the hierarchical arrangement of the seven layers described by the Open Systems Interconnect (OSI) architecture.

operating system. Software that controls the execution of programs. An operating system may provide services such as resource allocation, scheduling, input/output control, and data management. Examples are IBM DOS and IBM OS/2.

Operating System/2 (OS/2). A set of programs that control the operation of high-speed large-memory IBM Personal Computers (such as the IBM Personal System/2 computer, Models 50 and above), providing multitasking and the ability to address up to 16 MB of memory. Contrast with *Disk Operating System (DOS)*.

operation. (1) A defined action, namely, the act of obtaining a result from one or more operands in accordance with a rule that completely specifies the result for any permissible combination of operands. (2) A program step undertaken or executed by a computer. (3) An action performed on one or more data items, such as adding, multiplying, comparing, or moving.

operator. (1) A symbol that represents the action being performed in a mathematical operation. (2) A person who operates a machine.

Operator console facility (OCF). A component of Subsystem Support Services that handles input and output on the host processor console printer.

operator message. A message from the operating system or a program telling the operator to perform a specific function or informing the operator of a specific condition within the system, such as an error condition.

optical character recognition (OCR). The machine identification of printed characters through the use of light-sensitive devices.

option. (1) A specification in a statement, a selection from a menu, or a setting of a switch, that may be used to influence the execution of a program. (2) A hardware or software function that may be selected or enabled as part of a configuration process. (3) A piece of hardware (such as a network adapter) that can be installed in a device to modify or enhance device function.

OS. Operating system.

OS/2. Operating System/2.

OSI. Open Systems Interconnect.

output device. A device in a data processing system by which data can be received from the system. Synonymous with *output unit*.

output unit. Synonym for *output device*.

overflow exception. A condition caused by the result of an arithmetic operation having a magnitude that exceeds the largest possible number. See also *underflow exception*.

overlay. Part of a larger program read into a computer's main memory only when needed. An overlay replaces other portions of the larger program that are no longer needed. The use of overlays reduces the amount of main memory required by a program. An overlay is only supported on the store controller and requires its own copy of the runtime subroutine library.

owner. In relation to files, an owner is the user that creates the file and therefore has complete access to the file.

P

pacing. A technique by which a receiving component controls the rate of transmission by a sending component to prevent overrun or congestion.

packet. (1) In data communication, a sequence of binary digits, including data and control signals, that is transmitted and switched as a composite whole. (2) Synonymous with *data frame*. Contrast with *frame*.

packet assembler/disassembler (PAD). A functional unit that enables data terminal equipments (DTEs) not equipped for packet switching to access a packet switched network.

packing. Method of conserving disk storage space by stripping the high-order nibbles from ASCII numerals and storing the remaining low-order nibbles two to a byte.

PAD. Packet assembler/disassembler.

page. (1) The portion of a panel that is shown on a display surface at one time. (2) To move back and forth among the pages of a multiple-page panel. See also *scroll*. (3) In a virtual storage system, a fixed-length block that has a virtual address and is transferred as a unit between main storage and auxiliary storage.

parallel port. (1) A port that transmits the bits of a byte in parallel along the lines of the bus, one byte at a time, to an I/O device. (2) On a personal computer, it is used to connect a device that uses a parallel interface, such as a dot matrix printer, to the computer. Contrast with *serial port*.

parameter. (1) A name in a procedure that is used to refer to an argument passed to that procedure. (2) A variable that is given a constant value for a specified application and that may denote the application. (3) An

item in a menu or for which the user specifies a value or for which the system provides a value when the menu is interpreted. (4) Data passed between programs or procedures.

parity (even). A condition when the sum of all of the digits in an array of binary digits is even.

parity (odd). A condition when the sum of all of the digits in an array of binary digits is odd.

partner. See *conversation partner*.

partner terminal. The term used to describe the relationship of a Mod 1 terminal and Mod 2 terminal when they are attached to each other.

password. In computer security, a string of characters known to the computer system and a user, who must specify it to gain full or limited access to a system and to the data stored within it.

path. (1) Reference that specifies the location of a particular file within the various directories and subdirectories of a hierarchical file system. (2) In a network, any route between any two nodes. (3) The route traversed by the information exchanged between two attaching devices in a network. (4) A command in IBM DOS and IBM OS/2 that specifies directories to be searched for commands or batch files that are not found by a search of the current directory.

peer node. Any *other* SNA type (2.1) node (another 4680/4690 store controller, AS/400, or others).

peer-to-peer communication. Pertaining to data communications between two nodes that have equal status in the interchange. Either node can begin the conversation. See also *LU-LU session type 6.2.*

personal computer (PC). A desk-top, free-standing, or portable microcomputer that usually consists of a system unit, a display, a keyboard, one or more diskette drives, internal fixed-disk storage, and an optional printer. PCs are designed primarily to give independent computing power to a single user and are inexpensively priced for purchase by individuals or small businesses. Examples include the various models of the IBM Personal Computers, and the IBM Personal System/2 computer.

phase. The relative timing (position) of periodic electrical signals.

pipe. A sequential file in a memory buffer that is used to pass messages from one program to another.

PLD. Power line disturbance.

plug. (1) A connector for attaching wires from a device to a cable, such as a store loop. A plug is inserted into a receptacle or plug. (2) To insert a connector into a receptacle or socket.

pointer. (1) An identifier that indicates the location of an item of data in memory. (2) A data element that indicates the location of another data element. (3) A physical or symbolic identifier of a unique target.

point-of-sale terminal. A unit that provides point-of-sale transaction, data collection, credit authorization, price look-up, and other inquiry and data entry functions.

polling. (1) Interrogation of devices for purposes such as to avoid contention, to determine operational status, or to determine readiness to send or receive data. (2) In data communication, the process of inviting data stations to transmit, one at a time. The polling process usually involves the sequential interrogation of several data stations.

polling characters (address). A set of characters specific to a terminal and the polling operation; response to these characters indicates to the computer whether the terminal has a message to enter.

port. (1) An access point for data entry or exit. (2) A connector on a device to which cables for other devices such as display stations and printers are attached. Synonymous with *socket*.

post. (1) To affix to a usual place. (2) To provide items such as return code at the end of a command or function. (3) To define an appendage routine. (4) To note the occurrence of an event.

POST. Power-On Self Test.

power line disturbance (PLD). Interruption or reduction of electrical power.

Power-On Self Test (POST). A series of diagnostic tests that are run automatically each time the computer's power is switched on.

presentation space (PS). In 3270 emulation, the image of the 3270 screen data that is held in random access memory. This screen appears on the store controller or the terminal display when 3270 emulation is used in operator console mode; it is the virtual screen for applications using the 3270 emulator API. The presentation space is fixed as 24 lines of 80 characters on the display.

primary application. A program that controls the normal operating environment of your store (for example, programs that provide sales support).

prime version. The version of a file to which updates are made. The prime version of a file may be maintained on either the Master Store Controller or the

File Server. Copies of the prime version, called image versions, are distributed to other store controllers.

privilege. An identification that a product or installation defines in order to differentiate SNA service transaction programs from other programs, such as application programs.

problem determination. The process of determining the source of a problem as being a program component, a machine failure, a change in the environment, a common-carrier link, a user-supplied device, or a user error.

procedure. (1) A set of related control statements that cause one or more programs to be performed. (2) In a programming language, a block, with or without formal parameters, whose execution is invoked by means of a procedure call. (3) A set of instructions that gives a service representative a step-by-step procedure for tracing a symptom to the cause of failure.

processor. In a computer, a functional unit that interprets and executes instructions.

product control file (PCF). A file used by Apply Software Maintenance to control the process of applying maintenance.

prompt. A character or word displayed by the operating system to indicate that it is ready to accept input.

protection exception. The result of an attempt to access memory that is not in a program's authorized data space. Protection exception causes the application to abort.

protocol. (1) A set of semantic and syntactic rules that determines the behavior of functional units in achieving communication. (2) In SNA, the meanings of and the sequencing rules for requests and responses used for managing the network, transferring data, and synchronizing the states of network components. (3) A specification for the format and relative timing of information exchanged between communicating parties.

PS. Presentation space.

public switched (telephone) network (PSN). A telephone network that provides lines and exchanges to the public. It is operated by the communication common carriers in the USA and Canada, and by the PTT Administrations in other countries.

Q

queue. A line or list formed by items in a system waiting for service; for example, tasks to be performed or messages to be transmitted in a message routing system.

R

RAM. Random access memory.

RAM disk. Synonym for *virtual drive*.

random access. An access mode in which specific logical records are obtained from or placed into a mass storage file in a nonsequential manner.

random access memory (RAM). A computer's or adapter's volatile storage area into which data may be entered and retrieved in a nonsequential manner.

random file. A disk file in which records are assigned specific record positions. No matter what order the records are put in a direct file, they always occupy the assigned position. A random file is the same as a direct file except that a random file requires delimiting characters, such as quotes enclosing string fields, commas between fields, and carriage returns and line feeds between records.

randomizing. Synonym for *hashing*.

randomizing divisor. When creating a keyed file, a number used to calculate the number of sectors that can contain data in a keyed file. It is usually the largest prime number less than the total number of sectors in the file. When a record is searched for, the randomizing divisor is used to calculate the location of the record.

RCMS. Remote change management server.

read. To acquire or to interpret data from a storage device, from a data medium, or from another source.

read-only memory (ROM). A computer's or adapter's storage area whose contents cannot be modified by the user except under special circumstances.

receive. To obtain and store information transmitted from a device.

record. A collection of related items of data, treated as a unit; for example, in stock control, each invoice could constitute one record. A complete set of such records may form a file.

record key. One or more characters within a file record (or data set record) that is used to identify the record or control its use.

record number. Position of a specific record in a fixed-length file, relative to record number 1.

reentrant. The attribute of a program or routine that allows the same copy of that program or routine to be used concurrently by two or more tasks.

reference diskette. A diskette shipped with the point-of-sale equipment. The diskette contains code and files used for configuration of options and for hardware diagnostic testing.

register. (1) A storage area in a computer's memory where specific data is stored. Registers are used in the actual manipulation of data values during the execution of a program. (2) A storage device having a specified storage capacity such as bit, byte, or computer word, and usually intended for a special purpose. (3) In the IBM Store System, a term that refers to the point-of-sale terminal.

REM. Ring error monitor.

remodulator. In broadband networks, an active device that demodulates inbound information and remodulates it on the higher frequency outbound channel. A remodulator may or may not provide frame error detection and does not amplify inbound noise distortion. It provides network clocking by broadcasting continuous idle when the inbound channel is not transmitting information. Contrast with *translator*.

remote change management server (RCMS). The IBM Store System function that interfaces with the host DSX program for file transmission.

remote program load (RPL). To load a program remotely.

remove. (1) To take an attaching device off a network. (2) To stop an adapter from participating in data passing on a network.

request for price quotation (RPQ). A customer request for a price quotation on alterations or additions to the functional capabilities of a computing system, hardware product, or device.

reserved word. A word that is defined in a programming language for a special purpose, and that must not be used as a user-declared identifier.

response. The information the network control program sends to the access method, usually in answer to a request received from the access method. (Some responses, however, result from conditions occurring within the network control program, such as accumulation of error statistics.)

retransmit. To repeat the transmission of a message or a segment of a message.

retry. In data communication, sending the current block of data a prescribed number of times or until it is entered correctly and accepted.

return code. (1) A value (usually hexadecimal) provided by an adapter or a program to indicate the result of an action, command, or operation. (2) A code used to influence the execution of succeeding instructions. (3) A value established by the programmer to be used to influence subsequent program action. This value can be printed as output or loaded in a register.

ring error monitor (REM). A function that compiles error statistics reported by adapters on a network, analyzes the statistics to determine probable error cause, sends reports to network manager programs, and updates network status conditions. It assists in fault isolation and correction.

ring network. A network configuration in which a series of attaching devices is connected by unidirectional transmission links to form a closed path. A ring of an IBM Token-Ring Network is referred to as a LAN segment or as a Token-Ring Network segment.

ring segment. Any section of a ring that can be isolated (by unplugging connectors) from the rest of the ring. A segment can consist of a single lobe, the cable between access units, or a combination of cables, lobes, and/or access units. See *cable segment, LAN segment*.

ROM. Read-only memory.

root directory. Highest or base level directory in a hierarchical file system. Subdirectories branch off of the root directory.

router. An attaching device that connects two LAN segments, which use similar or different architectures, at the Reference Model network layer. Contrast with *bridge* and *gateway*.

routine. Part of a program, or a sequence of instructions called by a program, that may have some general or frequent use.

routing. (1) The assignment of the path by which a message will reach its destination. (2) The forwarding of a message unit along a particular path through a network, as determined by the parameters carried in the message unit, such as the destination network address in a transmission header.

RPQ. Request for price quotation.

runtime error. Error occurring during program execution.

runtime subroutine library (RTSL). Set of common, frequently needed program operations that is linked to a compiled program for execution.

S

SAA. Systems Application Architecture.

sales transaction. See *transaction*.

scan. To pass an item over or through the scanner so that the encoded information is read. See also *wanding*.

scanner. A device that examines the bar code on merchandise tickets, credit cards, and employee badges and generates analog or digital signals corresponding to the bar code.

scroll. To move all or part of the display image vertically or horizontally to display data that cannot be observed within a single display image. See also *page (2)*.

SCSI. Small computer system interface.

SDLC. Synchronous Data Link Control.

secondary application. A user-written program that is designed to operate with operator intervention.

sector. A 512-byte area of the control unit diskette, the amount of data that is transferred at one time to or from the diskette.

segment. See *cable segment, LAN segment, ring segment*.

sequential access. Type of file structure in which records are obtained from or placed into a file in such a way that each successive access to the file refers to the next record in the file.

sequential file. A disk file in which records are read from or placed into the file according to the order they are processed.

serial port. On personal computers, a port used to attach devices such as display devices, letter-quality printers, modems, plotters, and pointing devices such as light pens and mice; it transmits data one bit at a time. Contrast with *parallel port*.

server. (1) A device, program, or code module on a network dedicated to providing a specific service to a network. (2) On a LAN, a data station that provides facilities to other data stations. Examples are a file server, print server, and mail server.

session. (1) A connection between two application programs that allows them to communicate. (2) In SNA, a logical connection between two network addressable units that can be activated, tailored to provide various protocols, and deactivated as requested. (3) The data transport connection resulting from a call or link between two devices. (4) The period of time during which a user of a node can communicate with an interactive system, usually the elapsed time between log on and log off. (5) In network architecture, an association of facilities necessary for establishing, maintaining, and releasing connections for communication between stations.

shared runtime library (SRTL). A runtime library that can be used by more than one user.

signal. (1) A time-dependent value attached to a physical phenomenon for conveying data. (2) A variation of a physical quantity, used to convey data.

sign-on. (1) A procedure to be followed at a terminal or workstation to establish a link to a computer. (2) To begin a session at a workstation.

SKU. Stock keeping unit.

small computer system interface (SCSI). An input and output bus that provides a standard interface between the system and peripheral devices.

SNA. Systems Network Architecture.

socket. Synonym for *port (2)*.

source. The origin of any data involved in a data transfer.

source address. A field in the medium access control (MAC) frame that identifies the location from which information is sent. Contrast with *destination address*.

source program. A computer program expressed in a source language.

stack. Data structure to which values are added and from which values are removed at only one end. That is, the last value placed onto the stack must be the first value removed from the stack. The stack is used to pass variables from one routine to another and to store all local variables for each iteration of a recursive procedure.

stand-alone. Pertaining to operation that is independent of any other device, program, or system.

start-stop tape drive. A magnetic tape unit that stops at each inter-block gap when reading or writing data. Contrast with *streaming tape drive.*

state. See *conversation state*.

static data. Data that does not vary in size during the execution of a program, such as integers and real numbers.

station. (1) A point-of-sale terminal that consists of a processing unit, a keyboard, and a display. It can also have input/output devices, such as a printer, a magnetic stripe reader or cash drawers. (2) A communication device attached to a network. The term used most often in LANs is an *attaching device* or *workstation*. (3) An input or output point of a system that uses telecommunication facilities; for example, one or more systems, computers, terminals, devices, and associated programs at a particular location that can send or receive data over a telecommunication line. See also *attaching device, workstation*.

stock keeping unit (SKU). An identifier, having up to 21 characters, for each item of merchandise. It is the lowest level of numeric identification for merchandise, usually identified by department, class, vendor, style, color, size, and location.

store controller. A programmable unit in a network used to collect data, to direct inquiries, and to control communication within a point-of-sale system.

store loop. In the IBM Store System, a cable over which data is transmitted between the store controller and the point-of-sale terminals.

Store Loop Adapter. A hardware component used to connect the loop to a store controller.

streamer. Synonym for streaming tape drive.

streaming tape drive. A magnetic tape unit especially designed to make a nonstop dump or restore of magnetic disks without stopping at inter-block gaps. Synonymous with *streamer.* Contrast with *start-stop tape drive.*

string variable. A variable whose values can be either bit strings or character strings.

subdirectory. Any level of file directory lower than the root directory within a hierarchical file system.

subprogram. Section of code that performs a specific task and is logically separate from the main program. A subprogram differs from a function in that parameters are passed by reference rather than by value.

subroutine. Section of code that performs a specific task and is logically separate from the rest of the program.

summary journal. A record of the terminal operational activity that is printed at the terminal.

supervisory (S) frame. A frame in supervisory format used to transfer supervisory control functions. See also *information frame, unnumbered frame.*

switch. On an adapter, a mechanism used to select a value for, enable, or disable a configurable option or feature.

symbolic name. In a LAN, a name that may be used instead of an adapter or bridge address to identify an adapter location.

symbol table. During compilation and link editing the symbol table keeps track of all the identifiers for address resolution.

synchronous. (1) Pertaining to two or more processes that depend upon the occurrence of a specific event such as a common timing signal. (2) Occurring with a regular or predictable timing relationship.

Synchronous Data Link Control (SDLC). A discipline conforming to subsets of the Advanced Data Communication Control Procedures (ADCCP) of the American National Standards Institute (ANSI) and High-level Data Link Control (HDLC) of the International Organization for Standardization, for managing synchronous, code-transparent, serial-by-bit information transfer over a link connection. Transmission exchanges may be duplex or half-duplex over switched or nonswitched links. The configuration of the link connection may be point-to-point, multipoint, or loop.

system. In data processing, a collection of people, machines, and methods organized to accomplish a set of specific functions. See also *data processing system* and *operating system*.

system board. In a system unit, the main circuit board that supports a variety of basic system devices, such as a keyboard or a mouse, and provides other basic system functions.

system configuration. A process that specifies the devices and programs that form a particular data processing system.

system disk(ette). A personal computer fixed disk or diskette that has been formatted with IBM DOS or Operating System/2 (OS/2) by using the FORMAT command with the /S option.

system programs. Testing and utility programs that reside in the system partition of a fixed disk that are used to maintain the system. Typically these programs are the same as those provided on the reference and diagnostic diskettes.

Systems Application Architecture (SAA). An architecture developed by IBM that consists of a set of selected software interfaces, conventions, and protocols, and that serves as a common framework for application development, portability, and use across different IBM hardware systems.

Systems Network Architecture (SNA). The description of the logical structure, formats, protocols, and operational sequences for transmitting information units through, and controlling the configuration and operation of, networks. **Note:** The layered structure of SNA allows the ultimate origins and destinations of information, that is, the end users, to be independent of, and unaffected by, the specific SNA network services and facilities used for information exchange.

T

task. A basic unit of work.

TCC. Terminal Controller Communications

TCC Network. A system in which the terminals and controllers communicate using either a store loop or token ring.

terminal. In data communication, a device, usually equipped with a keyboard and a display, capable of sending and receiving information over a communication channel.

terminal number. A number assigned to a terminal to identify it for addressing purposes.

text editor. A program used to create, modify, and print or display text files.

threshold. (1) A level, point, or value above which something is true or will take place and below which it is not true or will not take place. (2) In IBM bridge programs, a value set for the maximum number of frames that are not forwarded across a bridge due to errors, before a “threshold exceeded” occurrence is counted and indicated to network management programs. (3) An initial value from which a counter is decremented from an initial value. When the counter reaches zero or the threshold value, a decision is made and/or an event occurs.

till. A tray in the cash drawer of the point-of-sale terminal, used to keep the different denominations of bills and coins separated and easily accessible.

token. A sequence of bits passed from one device to another on the token-ring network that signifies permission to transmit over the network. It consists of a starting delimiter, an access control field, and an end delimiter. The frame control field contains a token bit that indicates to a receiving device that the token is ready to accept information. If a device has data to send along the network, it appends the data to the token. When data is appended, the token then becomes a frame. See *frame*.

token ring. A network with a ring topology that passes tokens from one attaching device (node) to another. A node that is ready to send can capture a token and insert data for transmission.

token-ring network. (1) A ring network that allows unidirectional data transmission between data stations by a token-passing procedure over one transmission medium so that the transmitted data returns to and is removed by the transmitting station. The IBM Token-Ring Network is a baseband LAN with a star-wired ring topology that passes tokens from network adapter to network adapter. (2) A network that uses a ring topology, in which tokens are passed in a circuit from node to node. A node that is ready to send can capture the token and insert data for transmission. (3) A group of interconnected token rings.

TP. Transaction program.

trace. (1) A record of the execution of a computer program. It exhibits the sequences in which the instructions were executed. (2) A record of the frames and bytes transmitted on a network.

transaction. (1) The process of recording item sales, processing refunds, recording coupons, handling voids, verifying checks before tendering, and arriving at the amount to be paid by or to a customer. The receiving of payment for merchandise or service is also included in a transaction. (2) In an SNA network, an exchange between two programs that usually involves a specific set of initial input data that causes the execution of a specific task or job. Examples of transactions include the entry of a customer’s deposit that results in the updating of the customer’s balance, and the transfer of a message to one or more destination points.

transaction log. A record of transactions performed at the point-of-sale terminal. This log is magnetically recorded on the disk or diskette. See *logging*.

transaction program (TP). A program that processes transactions in or through a logical unit (LU) type 6.2 in an SNA network. Application transaction programs are end users in an SNA network; they process transactions for service transaction programs and for other end users. Service transaction programs are IBM-supplied

programs that typically provide utility services to application transaction programs.

translator. In broadband networks, an active device for converting an inbound channel to a higher frequency outbound channel. The conversion is done by removing the inbound carrier, adding the outbound carrier, and amplifying the signal. (A translator amplifies inbound errors and noise distortion.) Contrast with *remodulator*.

transmission. The sending of data from one place for reception elsewhere.

transmission frame. See *frame*.

transmit. To send information from one place for reception elsewhere.

truncate. To remove the beginning or ending elements of a string.

U

underflow exception. A condition caused by the result of an arithmetic operation having a magnitude less than the smallest possible nonzero number. See also *overflow exception*.

universal product code (UPC). An encoded number that can be assigned to and printed on or attached to an article of merchandise for scanning.

unnumbered (U) frame. A frame in unnumbered format, used to transfer unnumbered control functions. See also *information frame, supervisory frame.*

UPC. Universal product code.

usability. The quality of a system, program, or device that enables it to be easily understood and conveniently employed by a user.

user. (1) Category of identification defined for file access protection. (2) A person using a program or system.

user exit. A point in an IBM-supplied program at which a user-written program may be given control.

user exit routine. A routine written by a user to take control of a program supplied by IBM at a user exit.

utility program. (1) A computer program in general support of the processes of a computer; for instance, a diagnostic program, a trace program, a sort program. (2) A program designed to perform an everyday task such as copying data from one storage device to another.

V

VFD. Vacuum Fluorescent display.

variable. (1) A named entity that is used to refer to data and to which values can be assigned. Its attributes remain constant, but it can refer to different values at different times. (2) In computer programming, a character or group of characters that refers to a value and, in the execution of a computer program, corresponds to an address. (3) A quantity that can assume any of a given set of values.

vector. One or more related fields of data, in a specified format. A quantity usually characterized by an ordered set of numbers.

verb. In SNA, the general name for a transaction program's request for communication services.

version. A separate IBM-licensed program, based on an existing IBM-licensed program, that usually has significant new code or new function.

video display. (1) An electronic transaction display that presents visual information to the point-of-sale terminal operator and to the customer. (2) An electronic display screen that presents visual information to the display operator.

virtual drive. Computer memory used as if it were a direct access storage device. Synonym for *RAM disk*.

W

wand. A commercially available device used to read information encoded on merchandise tickets, credit cards, and employee badges.

wanding. Passing the tip of the wand reader over information encoded on a merchandise ticket, credit card, or employee badge.

wideband. Synonym for *broadband*.

work file. A file that is both created and deleted in the same job.

workstation. (1) An I/O device that allows either transmission of data or the reception of data (or both) from a host system, as needed to perform a job: for example, a display station or printer. (2) A configuration of I/O equipment at which an operator works. (3) A terminal or microcomputer, usually one connected to a mainframe or network, at which a user can perform tasks.

world. Category of identification defined for file access protection.

X

X.25. A CCITT Recommendation that defines the physical level (physical layer), link level (data link layer), and packet level (network layer), of the OSI Reference Model. An X.25 network is an interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) operating in the packet mode, and connected to public data networks by dedicated circuits. X.25 networks use the connection-mode network service.

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