

IMS



Application Programming: Transaction Manager

Version 9

IMS



Application Programming: Transaction Manager

Version 9

Note

Before using this information and the product it supports, be sure to read the general information under "Notices" on page 415.

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This edition applies to Version 9 of IMS (product number 5655-J38) and to all subsequent releases and modifications until otherwise indicated in new editions.

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About This Book

This book is a guide to application programming in a IMS Transaction Manager (TM) environment. This book provides guidance for the tasks involved in creating and running application programs. It covers basic information on coding transaction management message calls for TM programs, and it provides information on creating REXX EXECs under Time-Sharing Option Extensions (TSO/E). This book is divided into three parts:

- Part 1, “Writing Application Programs,” provides basic information on coding DL/I calls for IMS TM application programs.
- Part 2, “Message Format Service,” discusses application programming with MFS.
- Part 3, “Reference,” provides additional reference information you need to write your application program.

This information is available as part of the DB2 Information Management Software Information Center for z/OS Solutions. To view the information within the DB2 Information Management Software Information Center for z/OS Solutions, go to <http://publib.boulder.ibm.com/infocenter/dzichelp>. This information is also available in PDF and BookManager formats. To get the most current versions of the PDF and BookManager formats, go to the IMS Library page at www.ibm.com/software/data/ims/library.html.

This book is designed for IMS™ application and system programmers who use IMS Transaction Manager (TM).

Prerequisite Knowledge

IBM® offers a wide variety of classroom and self-study courses to help you learn IMS. For a complete list, see the IMS home page on the World Wide Web at: www.ibm.com/ims.

Before using this book, you should understand the concepts of application design described in *IMS Version 9: Application Programming: Design Guide*, which assumes you understand basic IMS concepts and the IMS environments.

This book is an extension to *IMS Version 9: Application Programming: Design Guide*. The IMS concepts explained in this manual are limited to those concepts pertinent to developing and coding application programs. You should also know how to use assembler language, C language, COBOL, Pascal, or PL/I.

IBM Product Names Used in This Information

In this information, the licensed programs shown in Table 1 are referred to by their short names.

Table 1. Licensed Program Full Names and Short Names

Licensed program full name	Licensed program short name
IBM Application Recovery Tool for IMS and DB2®	Application Recovery Tool
IBM CICS® Transaction Server for OS/390®	CICS
IBM CICS Transaction Server for z/OS®	CICS
IBM DB2 Universal Database™	DB2 Universal Database

Table 1. Licensed Program Full Names and Short Names (continued)

Licensed program full name	Licensed program short name
IBM DB2 Universal Database for z/OS	DB2 UDB for z/OS
IBM Enterprise COBOL for z/OS and OS/390	Enterprise COBOL
IBM Enterprise PL/I for z/OS and OS/390	Enterprise PL/I
IBM High Level Assembler for MVS™ & VM & VSE	High Level Assembler
IBM IMS Advanced ACB Generator	IMS Advanced ACB Generator
IBM IMS Batch Backout Manager	IMS Batch Backout Manager
IBM IMS Batch Terminal Simulator	IMS Batch Terminal Simulator
IBM IMS Buffer Pool Analyzer	IMS Buffer Pool Analyzer
IBM IMS Command Control Facility for z/OS	IMS Command Control Facility
IBM IMS Connect for z/OS	IMS Connect
IBM IMS Connector for Java™	IMS Connector for Java
IBM IMS Database Control Suite	IMS Database Control Suite
IBM IMS Database Recovery Facility for z/OS	IMS Database Recovery Facility
IBM IMS Database Repair Facility	IMS Database Repair Facility
IBM IMS DataPropagator™ for z/OS	IMS DataPropagator
IBM IMS DEDB Fast Recovery	IMS DEDB Fast Recovery
IBM IMS Extended Terminal Option Support	IMS ETO Support
IBM IMS Fast Path Basic Tools	IMS Fast Path Basic Tools
IBM IMS Fast Path Online Tools	IMS Fast Path Online Tools
IBM IMS Hardware Data Compression-Extended	IMS Hardware Data Compression-Extended
IBM IMS High Availability Large Database (HALDB) Conversion Aid for z/OS	IBM IMS HALDB Conversion Aid
IBM IMS High Performance Change Accumulation Utility for z/OS	IMS High Performance Change Accumulation Utility
IBM IMS High Performance Load for z/OS	IMS HP Load
IBM IMS High Performance Pointer Checker for OS/390	IMS HP Pointer Checker
IBM IMS High Performance Prefix Resolution for z/OS	IMS HP Prefix Resolution
IBM Tivoli® NetView® for z/OS	Tivoli NetView for z/OS
IBM WebSphere® Application Server for z/OS and OS/390	WebSphere Application Server for z/OS
IBM WebSphere MQ for z/OS	WebSphere MQ
IBM WebSphere Studio Application Developer Integration Edition	WebSphere Studio
IBM z/OS	z/OS

Additionally, this information might contain references to the following IBM product names:

- "IBM C/C++ for MVS" or "IBM C/C++ for MVS/ESA" is referred to as either "C/MVS" or "C++/MVS."

- "IBM CICS for MVS" is referred to as "CICS."
- "IBM COBOL for MVS & VM," "IBM COBOL for OS/390 & VM," or "IBM COBOL for z/OS & VM" is referred to as "COBOL."
- "IBM DataAtlas for OS/2" is referred to as "DataAtlas."
- "IBM Language Environment for MVS & VM" is referred to as "Language Environment."
- "IBM PL/I for MVS & VM" or "IBM PL/I for OS/390 & VM" is referred to as "PL/I."

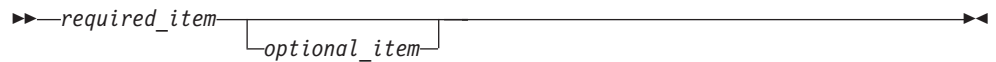
How to Read Syntax Diagrams

The following rules apply to the syntax diagrams that are used in this information:

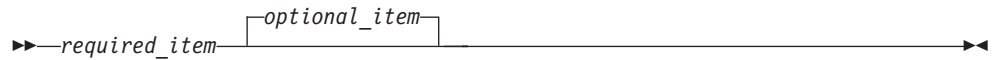
- Read the syntax diagrams from left to right, from top to bottom, following the path of the line. The following conventions are used:
 - The >>--- symbol indicates the beginning of a syntax diagram.
 - The ---> symbol indicates that the syntax diagram is continued on the next line.
 - The >--- symbol indicates that a syntax diagram is continued from the previous line.
 - The ---< symbol indicates the end of a syntax diagram.
- Required items appear on the horizontal line (the main path).



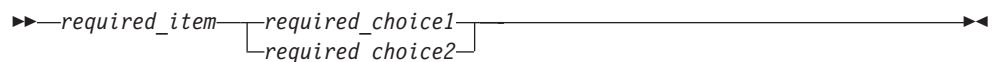
- Optional items appear below the main path.



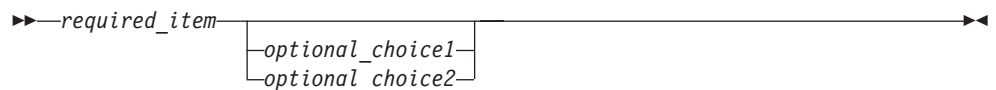
If an optional item appears above the main path, that item has no effect on the execution of the syntax element and is used only for readability.



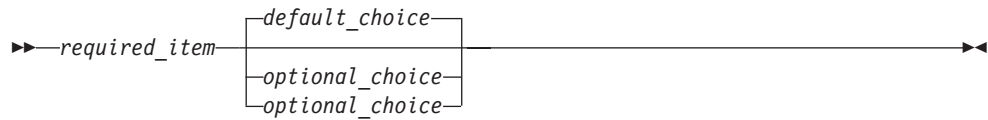
- If you can choose from two or more items, they appear vertically, in a stack. If you *must* choose one of the items, one item of the stack appears on the main path.



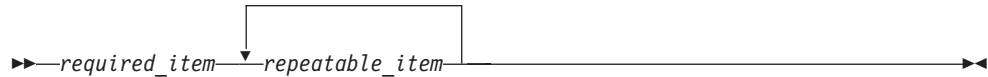
If choosing one of the items is optional, the entire stack appears below the main path.



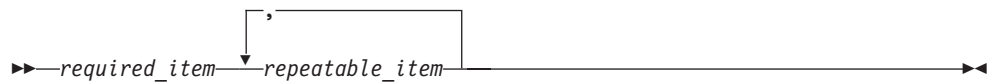
If one of the items is the default, it appears above the main path, and the remaining choices are shown below.



- An arrow returning to the left, above the main line, indicates an item that can be repeated.



If the repeat arrow contains a comma, you must separate repeated items with a comma.

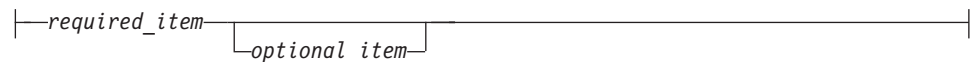


A repeat arrow above a stack indicates that you can repeat the items in the stack.

- Sometimes a diagram must be split into fragments. The syntax fragment is shown separately from the main syntax diagram, but the contents of the fragment should be read as if they are on the main path of the diagram.



fragment-name:



- In IMS, a b symbol indicates one blank position.
- Keywords, and their minimum abbreviations if applicable, appear in uppercase. They must be spelled exactly as shown. Variables appear in all lowercase italic letters (for example, *column-name*). They represent user-supplied names or values.
- Separate keywords and parameters by at least one space if no intervening punctuation is shown in the diagram.
- Enter punctuation marks, parentheses, arithmetic operators, and other symbols, exactly as shown in the diagram.
- Footnotes are shown by a number in parentheses, for example (1).

How to Send Your Comments

Your feedback is important in helping us provide the most accurate and highest quality information. If you have any comments about this or any other IMS information, you can take one of the following actions:

- Go to the IMS Library page at www.ibm.com/software/data/ims/library.html and click the Library Feedback link, where you can enter and submit comments.
- Send your comments by e-mail to imspubs@us.ibm.com. Be sure to include the title, the part number of the title, the version of IMS, and, if applicable, the

specific location of the text on which you are commenting (for example, a page number in the PDF or a heading in the Information Center).

Summary of Changes

Changes to This Book for IMS Version 9

No technical changes have been made to this version.

Library Changes for IMS Version 9

Changes to the IMS Library for IMS Version 9 include the addition of one title, a change of one title, organizational changes, and a major terminology change. Changes are indicated by a vertical bar (|) to the left of the changed text.

The IMS Version 9 information is now available in the DB2 Information Management Software Information Center for z/OS Solutions, which is available at <http://publib.boulder.ibm.com/infocenter/dzichelp>. The DB2 Information Management Software Information Center for z/OS Solutions provides a graphical user interface for centralized access to the product information for IMS, IMS Tools, DB2 Universal Database (UDB) for z/OS, DB2 Tools, and DB2 Query Management Facility (QMF™).

New and Revised Titles

The following list details the major changes to the IMS Version 9 library:

- *IMS Version 9: IMS Connect Guide and Reference*

The library includes new information: *IMS Version 9: IMS Connect Guide and Reference*. This information is available in softcopy format only, as part of the DB2 Information Management Software Information Center for z/OS Solutions, and in PDF and BookManager® formats.

IMS Version 9 provides an integrated IMS Connect function, which offers a functional replacement for the IMS Connect tool (program number 5655-K52). In this information, the term *IMS Connect* refers to the integrated IMS Connect function that is part of IMS Version 9, unless otherwise indicated.

- The information formerly titled *IMS Version 8: IMS Java User's Guide* is now titled *IMS Version 9: IMS Java Guide and Reference*. This information is available in softcopy format only, as part of the DB2 Information Management Software Information Center for z/OS Solutions, and in PDF and BookManager formats.
- To complement the IMS Version 9 library, a new book, *An Introduction to IMS* by Dean H. Meltz, Rick Long, Mark Harrington, Robert Hain, and Geoff Nicholls (ISBN # 0-13-185671-5), is available starting February 2005 from IBM Press. Go to the IMS Web site at www.ibm.com/ims for details.

Organizational Changes

Organization changes to the IMS Version 9 library include changes to:

- *IMS Version 9: IMS Java Guide and Reference*
- *IMS Version 9: Messages and Codes, Volume 1*
- *IMS Version 9: Utilities Reference: System*

The chapter titled "DLIModel Utility" has moved from *IMS Version 9: IMS Java Guide and Reference* to *IMS Version 9: Utilities Reference: System*.

The DLIModel utility messages that were in *IMS Version 9: IMS Java Guide and Reference* have moved to *IMS Version 9: Messages and Codes, Volume 1*.

Terminology Changes

IMS Version 9 introduces new terminology for IMS commands:

type-1 command

A command, generally preceded by a leading slash character, that can be entered from any valid IMS command source. In IMS Version 8, these commands were called *classic* commands.

type-2 command

A command that is entered only through the OM API. Type-2 commands are more flexible than type-1 commands and can have a broader scope. In IMS Version 8, these commands were called *IMSplex* commands or *enhanced* commands.

Accessibility Enhancements

Accessibility features help a user who has a physical disability, such as restricted mobility or limited vision, to use software products. The major accessibility features in z/OS products, including IMS, enable users to:

- Use assistive technologies such as screen readers and screen magnifier software
- Operate specific or equivalent features using only the keyboard
- Customize display attributes such as color, contrast, and font size

User Assistive Technologies

Assistive technology products, such as screen readers, function with the IMS user interfaces. Consult the documentation of the assistive technology products for specific information when you use assistive technology to access these interfaces.

Accessible Information

Online information for IMS Version 9 is available in BookManager format, which is an accessible format. All BookManager functions can be accessed by using a keyboard or keyboard shortcut keys. BookManager also allows you to use screen readers and other assistive technologies. The BookManager READ/MVS product is included with the z/OS base product, and the BookManager Softcopy Reader (for workstations) is available on the IMS Licensed Product Kit (CD), which you can download from the Web at www.ibm.com.

Keyboard Navigation of the User Interface

Users can access IMS user interfaces using TSO/E or ISPF. Refer to the *z/OS V1R1.0 TSO/E Primer*, the *z/OS V1R5.0 TSO/E User's Guide*, and the *z/OS V1R5.0 ISPF User's Guide, Volume 1*. These guides describe how to navigate each interface, including the use of keyboard shortcuts or function keys (PF keys). Each guide includes the default settings for the PF keys and explains how to modify their functions.

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Chapter 1. How Application Programs Work with IMS Transaction Manager

Application programs use Data Language I (DL/I) to communicate with IMS. This chapter gives an overview of the application programming techniques and the application programming interface for IMS Transaction Manager.

Related Reading:

- If your installation uses IMS Database Manager, see *IMS Version 9: Application Programming: Database Manager* for information on writing applications that access IMS databases.
- Information on DL/I EXEC commands is in the *IMS Version 9: Application Programming: EXEC DLI Commands for CICS and IMS*.

The following topics provide additional information:

- “Application Program Environments”
- “DL/I Elements”
- “DL/I Calls” on page 7

Application Program Environments

Your application program can run in different IMS environments. The three online environments are database/data communication (DB/DC), database control (DBCTL), and data communications control (DCCTL). The two batch environments are database manager batch (DBB) and transaction manager batch (TMB). This book explains the DB/DC, DCCTL, and TM batch environments.

Related Reading: For additional information on DCCTL and TM Batch environments, see *IMS Version 9: Administration Guide: System*.

DL/I Elements

The information in this section applies to all application programs that run in IMS. The main elements in an IMS application program consist of the following:

- Program entry
- Program Communication Block (PCB) or Application Interface Block (AIB) definition
- I/O area definition
- DL/I calls
- Program termination

Figure 1 on page 6 shows how these elements relate to each other. The numbers on the right in Figure 1 on page 6 refer to the notes that follow.

Getting Started with DL/I

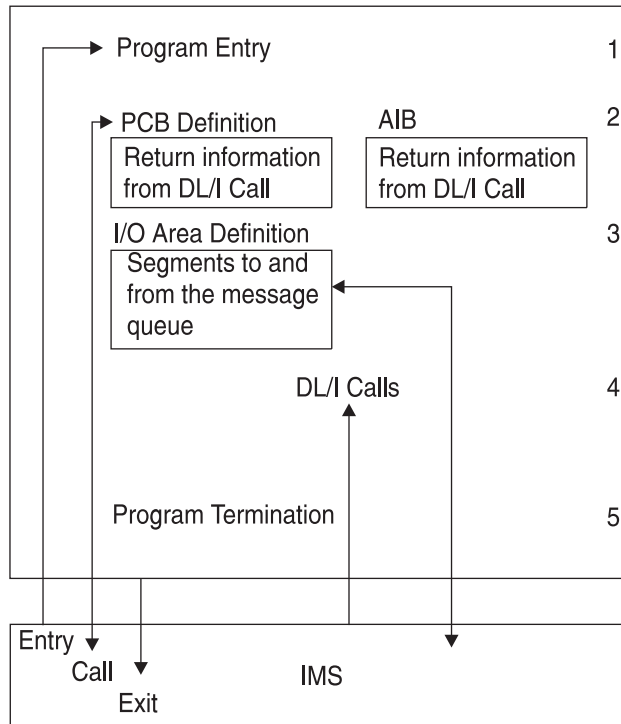


Figure 1. DL/I Program Elements

Notes to Figure 1:

- 1. Program entry.** IMS passes control to the application program with a list of associated PCBs.
- 2. PCB or AIB.** IMS describes the results of each DL/I call using the AIBTDLI interface in the application interface block (AIB) and, when applicable, the program communication block (PCB). To find the results of a DL/I call, your program must use the PCB that is referenced in the call. To find the results of the call using the AIBTDLI interface, your program must use the AIB.
Your application program can use the PCB address that is returned in the AIB to find the results of the call. To use the PCB, the program defines a mask of the PCB and can then reference the PCB after each call to determine the success or failure of the call. An application program cannot change the fields in a PCB; it can only check the PCB to determine what happened when the call was completed.
- 3. Input/output (I/O) area.** IMS passes segments to and from the program in the program's I/O area.
- 4. DL/I calls.** The program issues DL/I calls to perform the requested function.
- 5. Program Termination.** The program returns control to IMS DB when it has finished processing. In a batch program, your program can set the return code and pass it to the next step in the job.

Recommendation: If your program does not use the return code in this way, it is a good idea to set it to 0 as a programming convention. Your program can use the return code for this same purpose in BMPs. (MPPs cannot pass return codes.)

DL/I Calls

A DL/I call consists of a call statement and a list of parameters. The parameters for the call provide information IMS needs to execute the call. This information consists of the call function, the name of the data structure IMS uses for the call, the data area in the program into which IMS returns, and any condition the retrieved data must meet.

You can issue calls to perform transaction management functions (message calls) and to obtain IMS TM system services (system service calls):

Message Call Functions

The IMS TM message processing calls are:

AUTH	Authorization
CHNG	Change
CMD	Command
GCMD	Get Command
GN	Get Next
GU	Get Unique
ISRT	Insert
PURG	Purge
SETO	Set Options

System Service Call Functions

The IMS TM system service calls are:

APSB	Allocate PSB
CHKP	Checkpoint (Basic)
CHKP	Checkpoint (Symbolic)
DPSB	Deallocate PSB
GMSG	Get Message
GSCD ¹	Get System Contents Directory
ICMD	Issue Command
INIT	Initialize
INQY	Inquiry
LOG	Log
RCMD	Retrieve Command
ROLB	Roll Back
ROLL	Roll
ROLS	Roll Back to SETS
SETS	Set Synchronization Point

1. GSCD is a Product-sensitive programming interface.

Using DL/I Calls

SETU	Set Synchronization Point (Unconditional)
SYNC	Synchronization
XRST	Extended Restart

Related Reading: The DL/I calls are discussed in detail in Chapter 9, “DL/I Calls for Transaction Management,” on page 265 and Chapter 10, “DL/I Calls for System Services,” on page 297. Reference tables for the calls appear in “Transaction Management Call Summary” on page 265.

Status, Return, and Reason Codes

To provide information on the results of each call, IMS TM places a 2-character status code in the PCB after each IMS TM call issued by your program. After every IMS TM call, your program should check the status code in the PCB. If the status code is not checked, the program might continue to run even if the last call caused an error.

The status codes your program should test for are those that indicate exceptional but valid conditions. Your program should first check for blanks, which indicate that the call was completely successful. If the status code IMS TM returns after a call is not one that you expected, your program should branch to an error routine.

Status codes returned in the PCB and return and reason codes returned in the AIB supply information for your calls.

Related Reading: For detailed information on these codes, see *IMS Version 9: Messages and Codes, Volume 1*.

Exceptional Condition Status Code

Some status codes do not mean that your call was successful or unsuccessful; they just give you information about the results of the call. Your program uses this information to determine what to do next. The meanings of these status codes depend on the call.

In a typical program, you should test for status codes that apply only to Get calls. Some status codes indicate exceptional conditions for other calls. When your program is retrieving messages, there are situations that you should expect and for which you should provide routines other than error routines. For example, QC means that no additional input messages are available for your program in the message queue, and QD means that no additional segments are available for this message.

Error Routines

If, after checking for blanks and exceptional conditions in the status code, you find that there has been an error, your program should branch to an error routine and print as much information as possible about the error before terminating. Print the status code as well. Determining which call was being executed when the error occurred, the parameter of the IMS call, and the contents of the PCB will be helpful in understanding the error.

Two kinds of errors can occur. First, programming errors are usually your responsibility; they are the ones you can find and fix. These errors are caused by things like an invalid parameter, an invalid call, or an I/O area that is too long. The other kind of error is something you cannot usually fix; this is a system or I/O error.

When your program has this kind of error, the system programmer or the equivalent specialist at your installation should be able to help.

Because every application program should have an error routine available to it, and because each installation has its own ways of finding and debugging program errors, installations usually provide their own standard error routines.

Using DL/I Calls

Chapter 2. Defining Application Program Elements

This section describes the elements of your application program that are used to communicate with IMS. Your application program must define these elements. The section also describes formatting DL/I calls for language interfaces and provides language calls information for assembler language, C language, COBOL, Pascal, and PL/I.

The following topics provide additional information:

- “Formatting DL/I Calls for Language Interfaces”
- “Application Programming for Assembler Language” on page 12
- “Application Programming for C Language” on page 14
- “Application Programming for COBOL” on page 17
- “Application Programming for Pascal” on page 20
- “Application Programming for PL/I” on page 22
- “Relationship of Calls to PCB Types” on page 25
- “Specifying the I/O PCB Mask” on page 26
- “Specifying the Alternate PCB Mask” on page 30
- “Specifying the AIB Mask” on page 30
- “Specifying the I/O Areas” on page 32
- “AIBTDLI Interface” on page 33
- “Specifying Language-Specific Entry Points” on page 33
- “Program Communication Block (PCB) Lists” on page 36
- “Language Environments” on page 37
- “Special DL/I Situations” on page 38

Related Reading: For detailed information on specific parameters for the DL/I calls see Chapter 9, “DL/I Calls for Transaction Management,” on page 265 and Chapter 10, “DL/I Calls for System Services,” on page 297.

Formatting DL/I Calls for Language Interfaces

When you use DL/I calls in a programming language supported by IMS (assembler language, C language, COBOL, Pascal, or PL/I), you must call the DL/I language interface to initiate the functions specified with the DL/I calls. IMS offers several interfaces for DL/I calls:

- A language-independent interface for any programs that are Language Environment conforming (CEETDLI)
- Language-specific interfaces for all supported languages (xxxTDLI)
- A non-language-specific interface for all supported languages (AIBTDLI)

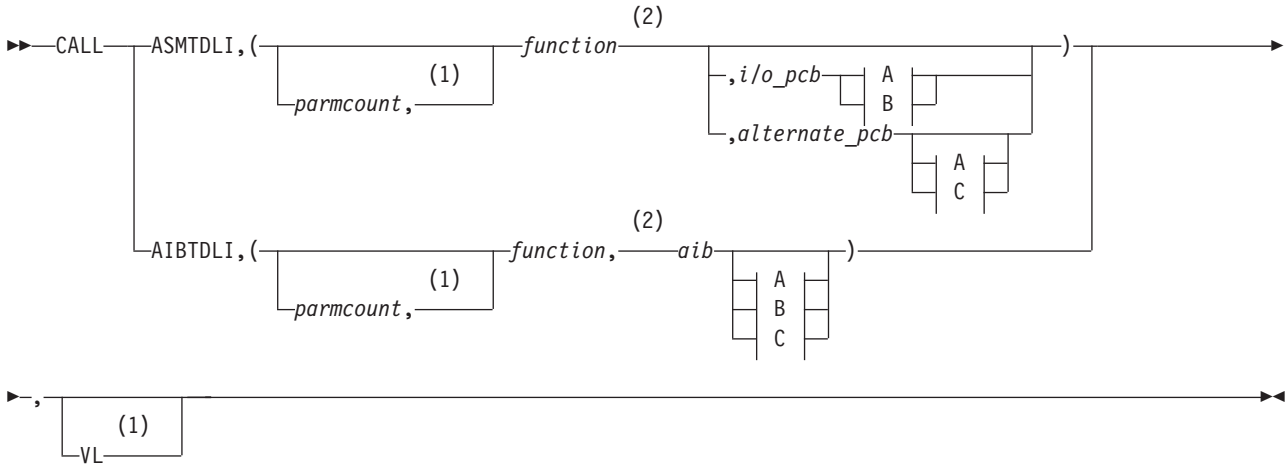
Because the exact syntax for calling the language interfaces varies among the programming languages, the following sections describe the language-specific format. Not every DL/I call uses all the parameters shown.

Related Reading: For descriptions of the call functions and the parameters they use, see Chapter 9, “DL/I Calls for Transaction Management,” on page 265 and Chapter 10, “DL/I Calls for System Services,” on page 297.

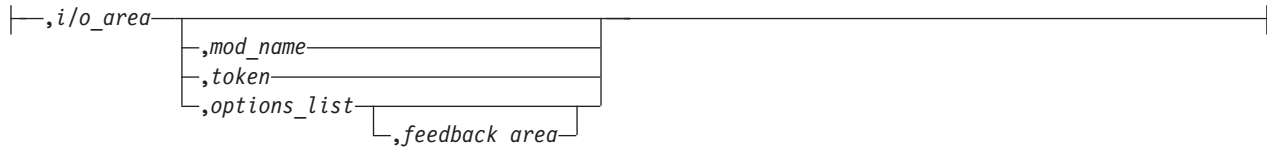
Application Programming for Assembler Language

This section contains the format, parameters, and sample DL/I call formats for IMS application programs in assembler language. In assembler language programs, all DL/I call parameters that are passed as addresses can be passed in a register, which, if used, must be enclosed in parentheses.

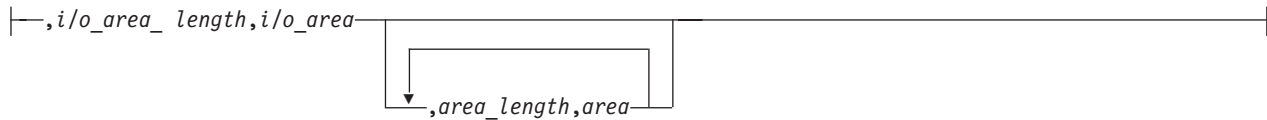
Format



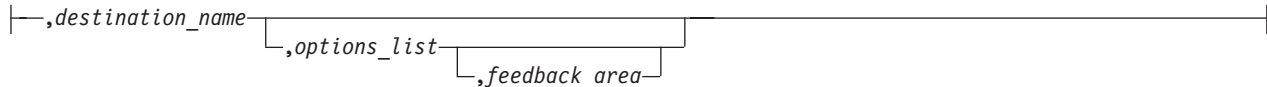
A:



B:



C:



Notes:

- 1 Assembler language must use either *parmcount* or VL.
- 2 See Chapter 9, “DL/I Calls for Transaction Management,” on page 265 and Chapter 10, “DL/I Calls for System Services,” on page 297 for descriptions of call functions and parameters.

Parameters

parmcount

Specifies the address of a 4-byte field in user-defined storage that contains the number of parameters in the parameter list that follows *parmcount*. Assembler language application programs must use either *parmcount* or VL.

function

Specifies the address of a 4-byte field in user-defined storage that contains the call function to be used. The call function must be left-justified and padded with blanks. For example, (GU**bb**) is a call function.

i/o pcb

Specifies the address of the I/O program communication block (PCB). The I/O PCB address is the first address passed on entry to the application program in the PCB list, given the following circumstances:

- A program executing in DLI or database management batch (DBB) regions where CMPAT=YES is coded on the PSB.
- Any program executing in batch message processing program (BMP), message processing program (MPP), or IMS Fast Path (IFP) regions regardless of the CMPAT= value.

alternate pcb

Specifies the address of the alternate PCB to be used for the call. The PCB address must be one of the PCB addresses passed on entry to the application program in the PCB list.

aib

Specifies the address of the application interface block (AIB) in user-defined storage. For more information on the contents of the AIB, see "AIBTDLI Interface" on page 33.

i/o area

Specifies the address of the I/O area in user-defined storage used for the call. The I/O area must be large enough to contain the returned data.

i/o area length

Specifies the address of a 4-byte field in user-defined storage that contains the I/O area length (specified in binary).

area length

Specifies the address of a 4-byte field in user-defined storage that contains the length (specified in binary) of the area immediately following it in the parameter list. Up to seven area length/area pairs can be specified.

area

Specifies the address of the area in user-defined storage to be checkpointed. Up to seven area length/area pairs can be specified.

token

Specifies the address of a 4-byte field in user-defined storage that contains a user token.

options list

Specifies the address of the *options list* in user-defined storage that contains processing options used with the call.

feedback area

Specifies the address of the feedback area in user-defined storage that receives information about options list processing errors.

Assembler Language

mod name

Specifies the address of an 8-byte area in user-defined storage that contains the user-defined MOD name used with the call. The *mod name* parameter is used only with MFS.

destination name

Specifies the address of an 8-byte field in user-defined storage that contains the name of the logical terminal or transaction code to which messages resulting from the call are sent.

VL

Signifies the end of the parameter list. Assembler language programs must use either *parmcount* or VL.

Example DL/I Call Formats

DL/I AIBTDLI interface:

```
CALL AIBTDLI,(function,aib,i/o area),VL
```

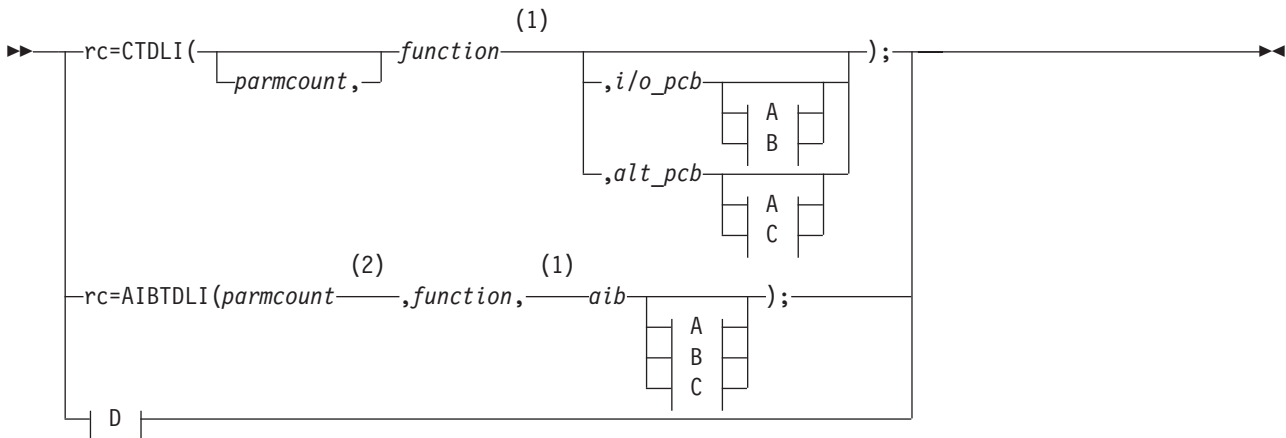
DL/I language-specific interface:

```
CALL ASMTDLI,(function,i/o pcb,i/o area),VL
```

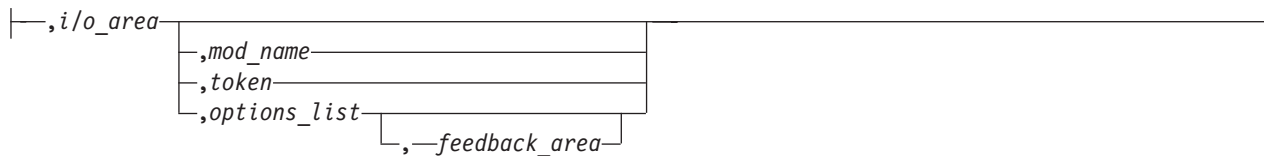
Application Programming for C Language

This section contains the format, parameters, and sample DL/I call formats for IMS application programs in C language.

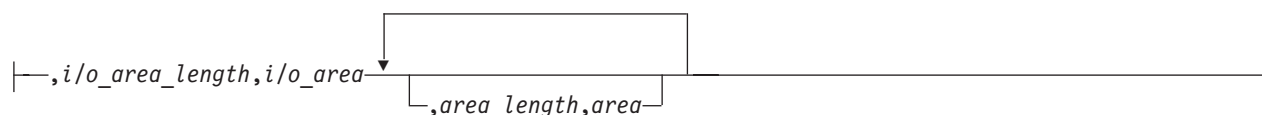
Format



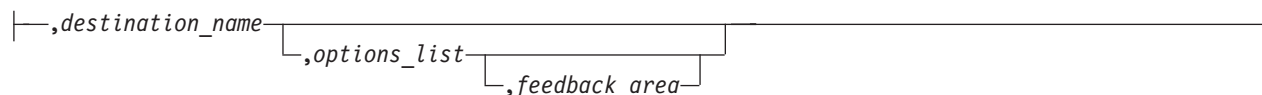
A:



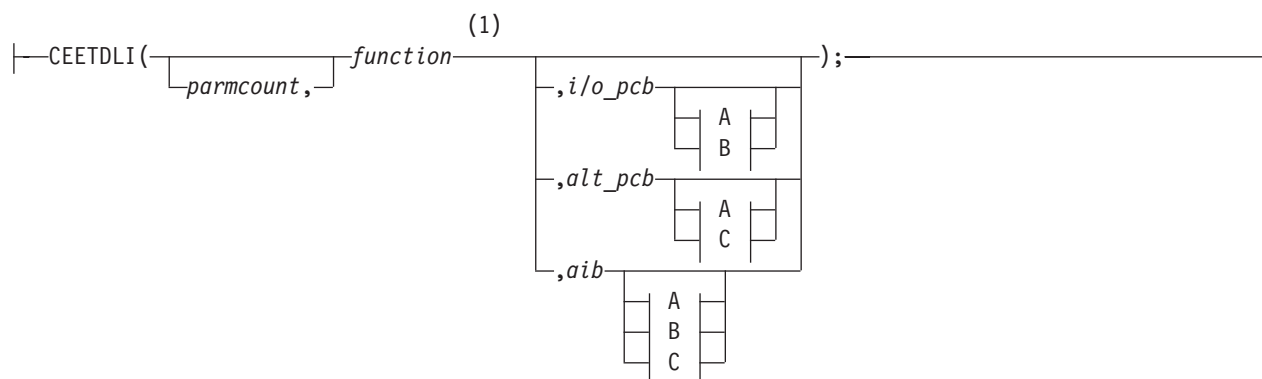
B:



C:



D:

**Notes:**

- 1 See Chapter 9, “DL/I Calls for Transaction Management,” on page 265 and Chapter 10, “DL/I Calls for System Services,” on page 297 for descriptions of call functions and parameters.
- 2 For AIBTDLI, *parmcount* is required for applications.

Parameters

rr Receives the DL/I status or return code. It is a 2-character field shifted into the 2 lower bytes of an integer variable (*int*). If the status or return code is two blanks, 0 is placed in the field. You can test the *rc* parameter with an *if* statement; for example, *if (rc == 'IX')*. You can also use *rc* in a *switch* statement. You can choose to ignore the value placed in *rc* and use the status code returned in the program communication block (PCB) instead.

parmcount

Specifies the name of a fixed-binary (31) variable in user-defined storage that is a pointer to the number of parameters in the parameter list that follows *parmcount*. The *parmcount* field is a pointer to long.

function

Specifies the name of a character (4) variable, left-justified, in user-defined storage, which contains the call function to be used. The call function must be padded with blanks. For example, (GU**bb**) is a call function.

i/o pcb

Specifies the address of the I/O PCB. The I/O PCB address is the first address passed on entry to the application program in the PCB list, given the following circumstances:

C Language

- A program executing in DLI or database management batch (DBB) regions where CMPAT=YES is coded on the PSB.
- Any program executing in batch message processing program (BMP), message processing program (MPP), or IMS Fast Path (IFP) regions regardless of the CMPAT= value.

alternate pcb

Specifies the name of a pointer variable that contains the address of the I/O PCB or alternate PCB to be used for the call. The PCB address must be one of the PCB addresses passed on entry to the application program in the PCB list.

aib

Specifies the name of the pointer variable that contains the address of the structure that defines the application interface block (AIB) in user-defined storage. For more information on the contents of the AIB, see "AIBTDLI Interface" on page 33.

i/o area

Specifies the name of a pointer variable to a major structure, array, or character string that defines the I/O area in user-defined storage to be used for the call. The I/O area must be large enough to contain the returned data.

i/o area length

Specifies the name of a fixed-binary (31) variable in user-defined storage that contains the I/O area length.

area length

Specifies the name of a fixed-binary (31) variable in user-defined storage that contains the length of the area immediately following it in the parameter list. Up to seven area length/area pairs can be specified.

area

Specifies the name of the pointer variable that contains the address of the structure that defines the user-defined storage to be checkpointed. Up to seven area length/area pairs can be specified.

token

Specifies the name of a character (4) variable in user-defined storage that contains a user token.

options list

Specifies the name of the pointer variable that contains the address of the structure that defines the user-defined storage that contains processing options used with the call.

feedback area

Specifies the name of the pointer variable that contains the address of the structure that defines the user-defined storage that receives information about options list processing errors.

mod name

Specifies the name of a character (8) variable in user-defined storage that contains the user-defined MOD name used with the call. The *mod name* parameter is used only with MFS.

destination name

Specifies the name of a character (8) variable in user-defined storage that contains the name of the logical or terminal transaction code to which messages resulting from the call are sent.

I/O Area

In C language, the I/O area can be of any type, including structure or array. The `ceetdli` declarations in `leawi.h` and the `ctdli` declarations in `ims.h` do not have any prototype information, so no type checking of the parameters is done. The I/O area can be auto, static, or allocated (with `malloc` or `calloc`). Give special consideration to C-strings because DL/I does not recognize the C convention of terminating strings with nulls (`'\0'`). Instead of using the `strcpy` and `strcmp` functions, you might want to use the `memcpy` and `memcmp` functions.

Example DL/I Call Formats

DL/I CEEDTLI interface:

```
#include <leawi.h>
ceetdli(function,aib,i/o_area)
```

DL/I AIBTDLI interface:

```
int rc;
:
rc = aibtcli(parmcount,function,aib,i/o_area)
```

DL/I language-specific interface:

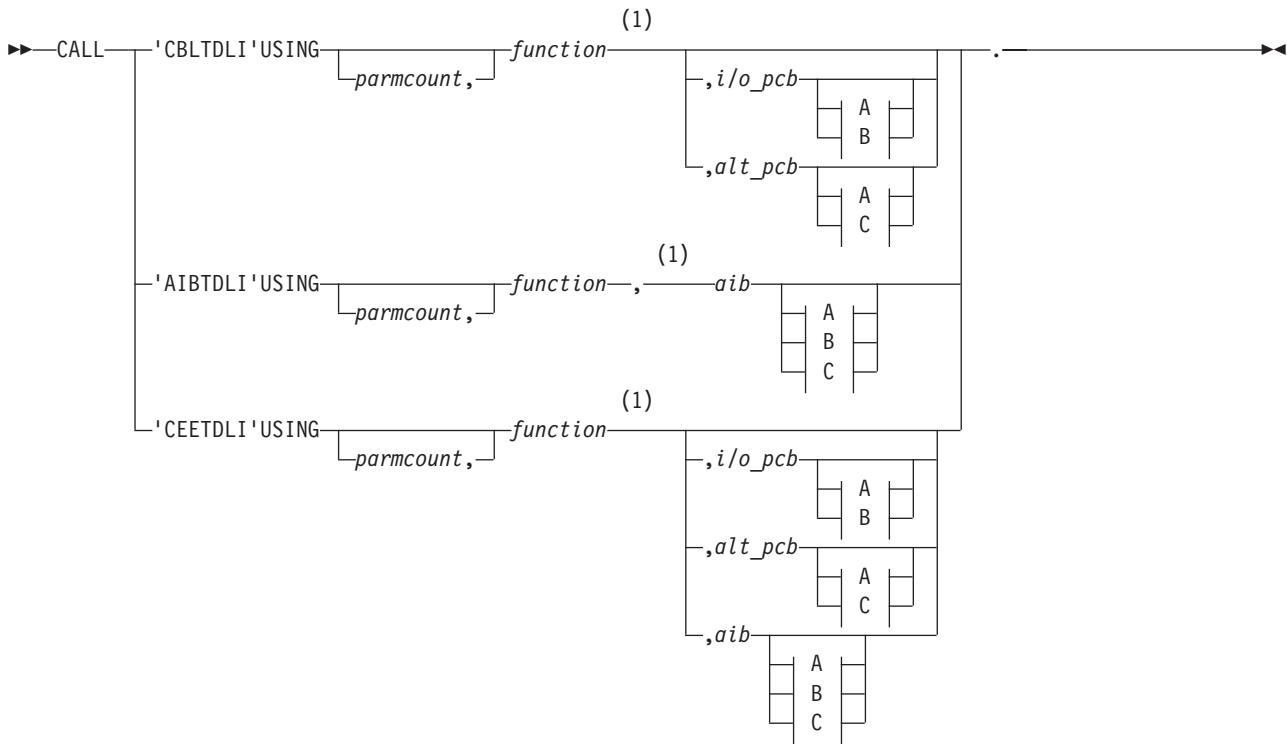
```
#include <ims.h>
int rc;
:
rc = ctdli(function,i/o_pcb,i/o_area)
```

Application Programming for COBOL

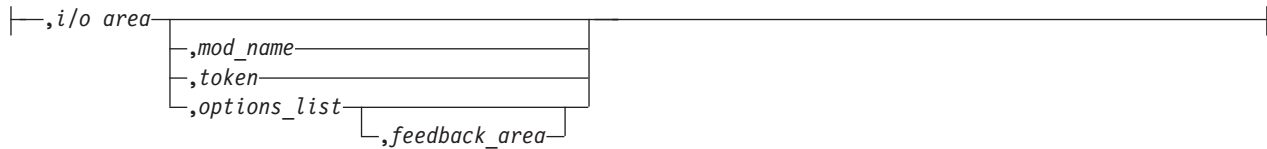
This section contains the format, parameters, and DL/I call sample formats for IMS application programs in COBOL.

COBOL

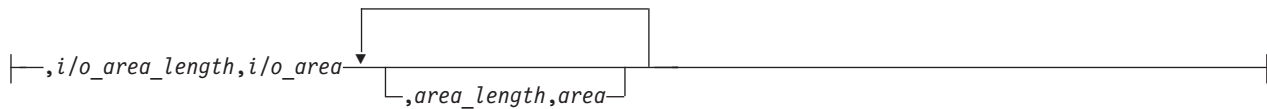
Format



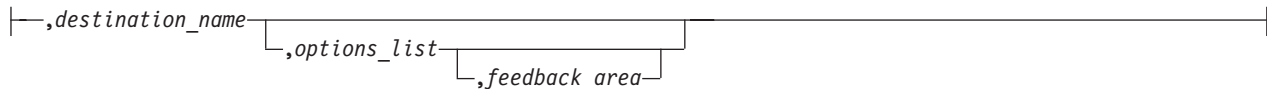
A:



B:



C:



Notes:

- 1 See Chapter 9, "DL/I Calls for Transaction Management," on page 265 and Chapter 10, "DL/I Calls for System Services," on page 297 for descriptions of call functions and parameters.

Parameters

parmcount

Specifies the identifier of a usage binary (4) byte data item in user-defined storage that contains the number of parameters in the parameter list that follows *parmcount*.

function

Specifies the identifier of a usage display (4) byte data item, left-justified, in user-defined storage, which contains the call function to be used. The call function must be padded with blanks. For example, (GU**bb**) is a call function.

i/o pcb

Specifies the address of the I/O program communication block (PCB). The I/O PCB address is the first address passed on entry to the application program in the PCB list, given the following circumstances:

- A program executing in DLI or database management batch (DBB) regions where CMPAT=YES is coded on the PSB.
- Any program executing in batch message processing program (BMP), message processing program (MPP), or IMS Fast Path (IFP) regions regardless of the CMPAT= value.

alternate pcb

Specifies the identifier of the I/O PCB or alternate PCB group item from the PCB list that is passed to the application program on entry. This identifier is used for the call.

aib

Specifies the identifier of the group item that defines the application interface block (AIB) in user-defined storage. For more information on the contents of the AIB, see "AIBTDLI Interface" on page 33.

i/o area

Specifies the identifier of a group item, table, or usage display data item that defines the I/O area to be used for the call. The I/O area must be large enough to contain the returned data.

i/o area length

Specifies the identifier of a usage binary (4) byte data item in user-defined storage that contains the I/O area length.

area length

Specifies the identifier of a usage binary (4) byte data item in user-defined storage that contains the length of the area immediately following it in the parameter list. Up to seven area length/area pairs can be specified.

area

Specifies the identifier of the group item that defines the area to be checkpointed. Up to seven area length/area pairs can be specified.

token

Specifies the identifier of a usage display (4) byte data item that contains a user token.

options list

Specifies the identifier of the group item that defines the user-defined storage that contains processing options used with the call.

feedback area

Specifies the identifier of the group item that defines the user-defined storage that receives information about options list processing errors.

COBOL

mod name

Specifies the identifier of a usage display (8) byte data item in user-defined storage that contains the user-defined MOD name used with the call.

destination name

Specifies the identifier of a usage display (8) byte data item that contains the name of the logical terminal or transaction code to which messages resulting from the call are sent.

Example DL/I Call Formats

DL/I CEETDLI interface:

CALL 'CEETDLI' USING function, aib,i/o area.

DL/I AIBTDLI interface:

CALL 'AIBTDLI' USING function, aib,i/o area.

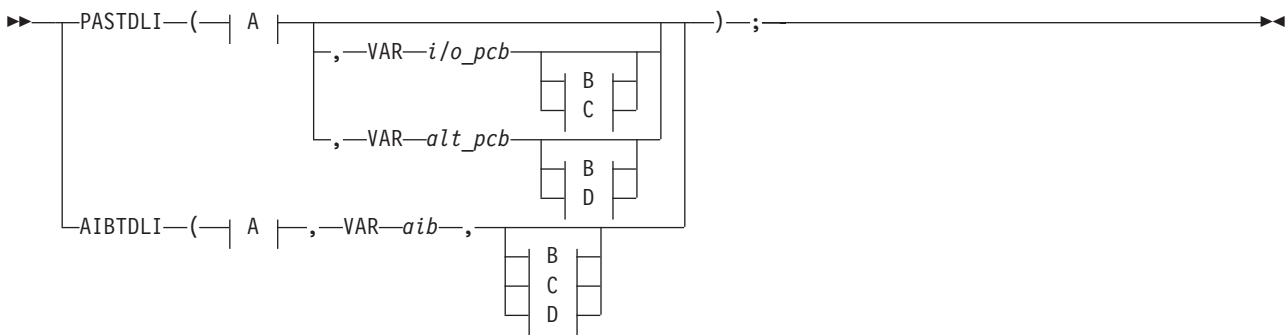
DL/I language-specific interface:

CALL 'CBLTDLI' USING function, i/o pcb, i/o area.

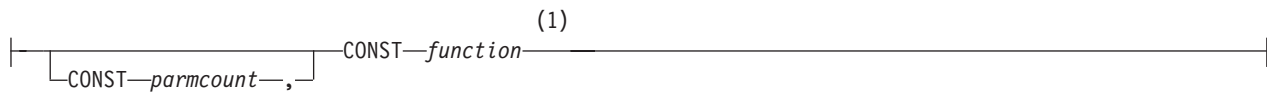
Application Programming for Pascal

This section contains the format, parameters, and DL/I call sample formats for IMS application programs in Pascal.

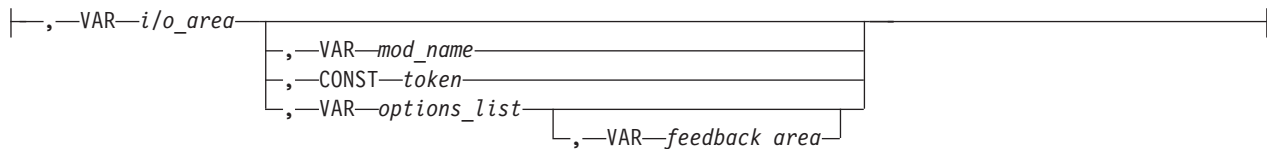
Format



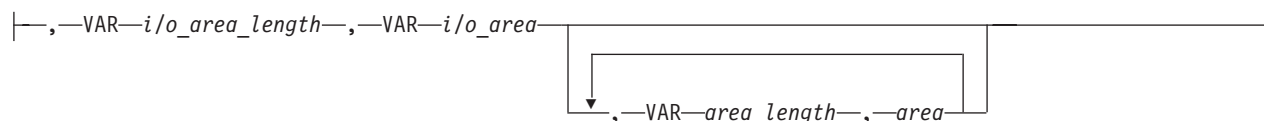
A:



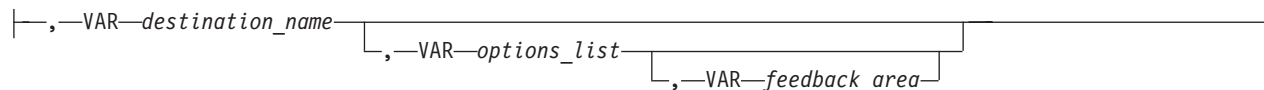
B:



C:



D:

**Notes:**

- 1 See Chapter 9, “DL/I Calls for Transaction Management,” on page 265 and Chapter 10, “DL/I Calls for System Services,” on page 297 for descriptions of call functions and parameters.

Parameters*parmcount*

specifies the address of a fixed-binary (31) variable in user-defined storage that contains the number of parameters in the parameter list that follows *parmcount*.

function

Specifies the name of a character (4) variable, left-justified, in user-defined storage, which contains the call function to be used. The call function must be padded with blanks. For example, (GUbb) is a call function.

i/o pcb

Specifies the address of the program communication block (I/O PCB). The I/O PCB address is the first address passed on entry to the application program in the PCB list, given the following circumstances:

- A program executing in DLI or database management batch (DBB) regions where CMPAT=YES is coded on the PSB.
- Any program executing in batch message processing program (BMP), message processing program (MPP), or IMS Fast Path (IFP) regions regardless of the CMPAT= value.

alternate pcb

Specifies the name of a pointer variable that contains the address of the I/O PCB defined in the call procedure statement.

aib

Specifies the name of a pointer variable that contains the address of the structure that defines the application interface block (AIB) in user-defined storage. For more information on the contents of the AIB, see “AIBTDLI Interface” on page 33.

i/o area

Specifies the name of a pointer variable to a major structure, array, or character string that defines the I/O area in user-defined storage to be used for the call. The I/O area must be large enough to contain the returned data.

i/o area length

Specifies the name of a fixed-binary (31) variable in user-defined storage that contains the I/O area length.

Pascal

area length

Specifies the name of a fixed binary (31) variable in user-defined storage that contains the length (specified in binary) of the area immediately following it in the parameter list. Up to seven area length/area pairs can be specified.

area

Specifies the name of a pointer variable that contains the address of the structure that defines the area in user-defined storage to be checkpointed. Up to seven area length/area pairs can be specified.

token

Specifies the name of a character (4) variable in user-defined storage that contains a user token.

options list

Specifies the name of a pointer variable that contains the address of the structure that defines the user-defined storage that contains processing options used with the call.

feedback area

Specifies the name of the pointer variable that contains the address of the structure that defines the user-defined storage that receives information about options list processing errors.

mod name

Specifies the name of a character (8) variable in user-defined storage that contains the user-defined MOD name used with the call.

destination name

Specifies the name of a character (8) variable in user-defined storage that contains the name of the logical terminal or transaction code to which messages resulting from the call are sent.

Example DL/I Call Formats

DL/I AIBTDLI interface:

```
AIBTDLI(CONST function,  
        VAR aib,  
        VAR I/O area);
```

DL/I language-specific interface:

```
PASTDLI(CONST function,  
area    VAR I/O PCB  
        VAR I/O area);
```

Application Programming for PL/I

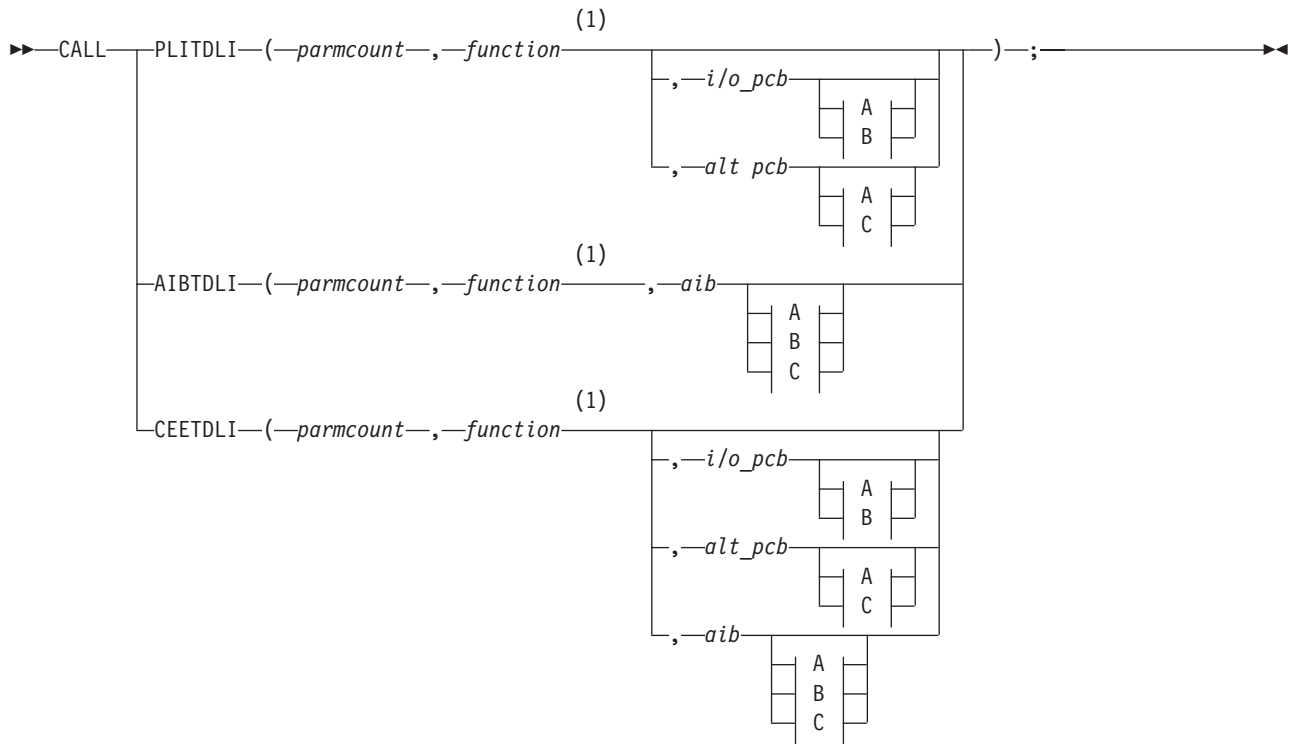
This section contains the format, parameters, and DL/I call sample formats for IMS application programs in PL/I.

For the PLITDLI interface all parameters except *parmcount* are indirect pointers; for the AIBTDLI interface, all parameters are direct pointers.

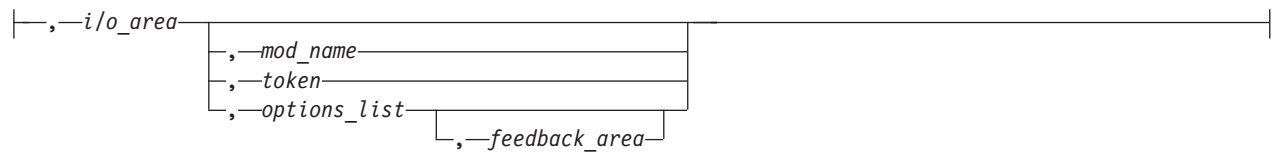
The following topics provide additional information:

- “Format” on page 23
- “Parameters” on page 24
- “Example DL/I Call Formats” on page 25

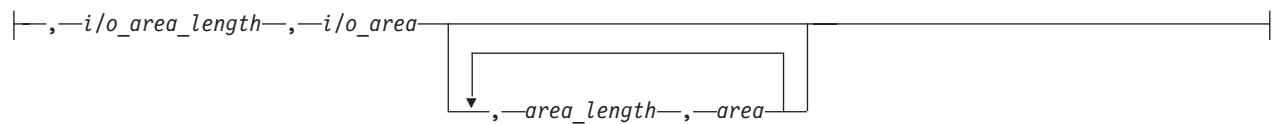
Format



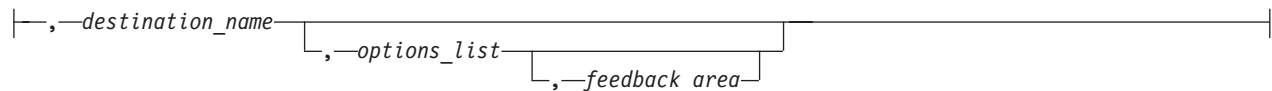
A:



B:



C:



Notes:

- 1 See Chapter 9, "DL/I Calls for Transaction Management," on page 265 and Chapter 10, "DL/I Calls for System Services," on page 297 for descriptions of call functions and parameters.

Parameters

parmcount

Specifies the name of a fixed-binary (31-byte) variable that contains the number of arguments that follow *parmcount*.

function

Specifies the name of a character (4-byte) variable, left justified, blank padded character string that contains the call function to be used. For example, (GU**bb**) is a call function.

i/o pcb

Specifies the address of the program communication block (I/O PCB). The I/O PCB address is the first address passed on entry to the application program in the PCB list, given the following circumstances:

- A program executing in DLI or DBB regions where CMPAT=YES is coded on the PSB.
- Any program executing in batch message processing program (BMP), message processing program (MPP), or IMS Fast Path (IFP) regions regardless of the CMPAT= value.

alternate pcb

Specifies the structure associated with the I/O PCB or alternate PCB to be used for the call. This structure is based on a PCB address that must be one of the PCB addresses passed on entry to the application program.

aib

Specifies the name of the structure that defines the application interface block (AIB). For more information on the contents of the AIB, see "AIBTDLI Interface" on page 33.

i/o area

Specifies the name of the I/O area used for the call. The I/O area must be large enough to contain the returned data.

i/o area length

Specifies the name of a fixed binary (31) variable in user-defined storage that contains the I/O area length (specified in binary).

area length

Specifies the name of a fixed binary (31) variable that contains the length (specified in binary) of the area immediately following it in the parameter list. Up to seven area length/area pairs can be specified.

area

Specifies the name of the area to be checkpointed. Up to seven area length/area pairs can be specified.

token

Specifies the name of a character (4) variable that contains a user token.

options list

Specifies the name of a structure that contains processing options used with the call.

feedback area

Specifies the name of a structure that receives information about options list processing errors.

mod name

Specifies the name of a character (8) variable character string containing the user-defined MOD name used with the call.

destination name

Specifies the name of a character (8) variable character string containing the logical terminal or transaction code to which messages resulting from the call are sent.

Example DL/I Call Formats

DL/I CEETDLI interface:

```
%INCLUDE CEEIBMWA;
CALL CEETDLI (function, i/o pcb, i/o area);
```

DL/I AIBTDLI interface:

```
CALL AIBTDLI (parmcount, function, aib, i/o area);
```

DL/I language-specific interface:

```
CALL PLITDLI (parmcount, function, i/o pcb, i/o area);
```

Relationship of Calls to PCB Types

Table 2 shows the relationship of DL/I calls to I/O and alternate program communication blocks (PCBs). The PCB can be specified in one of two ways, depending on which xxxTDLI interface is used:

- As a parameter in the call list
- In the AIB

Table 2. Call Relationship to PCBs and AIBs

Call	I/O PCBs	ALT PCBs
APSB ¹		
AUTH	X	
CHKP (basic)	X	
CHKP (symbolic)	X	
CHNG ²		X
CMD	X	
DPSB ¹		
GCMD	X	
GN	X	
GSCD	X	
GU	X	
INIT	X	
INQY	X	X
ISRT	X	X
LOG	X	
PURG	X	X
ROLB	X	
ROLS	X	
ROLL ¹		
SETO	X	X
SETS	X	

Table 2. Call Relationship to PCBs and AIBs (continued)

Call	I/O PCBs	ALT PCBs
SETU	X	
SYNC	X	
XRST	X	

Notes:

1. This call is not associated with a PCB.
2. The alternate PCB used by this call must be modifiable.

Specifying the I/O PCB Mask

After your program issues a call with the I/O program communications block (PCB), IMS returns information about the results of the call to the I/O PCB. To determine the results of the call, your program must check the information that IMS returns.

Issuing a system service call requires an I/O PCB. Because the I/O PCB resides outside your program, you must define a mask of the PCB in your program to check the results of IMS calls. The mask must contain the same fields, in the same order, as the I/O PCB. Your program can then refer to the fields in the PCB through the PCB mask.

An I/O PCB contains the fields listed in Table 3. Table 3 also describes these fields, their lengths, and which environments are applicable for each field.

Table 3. I/O PCB Mask

Descriptor	Byte Length	DB/DC	DBCTL	DCCTL	DB Batch	TM Batch
Logical terminal name ¹	8	X		X		
Reserved for IMS ²	2	X		X		
Status code ³	2	X	X	X	X	X
4-byte Local date and time ⁴						
Date	2	X		X		
Time	2	X		X		
Input message sequence number ⁵	4	X		X		
Message output descriptor name ⁶	8	X		X		
Userid ⁷	8	X		X		
Group name ⁸	8	X		X		
12-Byte Time Stamp ⁹						
Date	4	X		X		
Time	6	X		X		
UTC Offset	2	X		X		
Userid Indicator ¹⁰	1	X		X		
Reserved for IMS ²	3					

Notes:**1. Logical Terminal Name**

This field contains the name of the terminal that sent the message. When your program retrieves an input message, IMS places the name of the logical terminal that sent the message in this field. When you want to send a message back to this terminal, you refer to the I/O PCB when you issue the ISRT call, and IMS takes the name of the logical terminal from the I/O PCB as the destination.

2. Reserved for IMS

These fields are reserved.

3. Status Code

IMS places the status code describing the result of the DL/I call in this field. IMS updates the status code after each DL/I call that the program issues. Your program should always test the status code after issuing a DL/I call.

The three status code categories are:

- Successful status codes or status codes with exceptional but valid conditions. This category does not contain errors. If the call was completely successful, this field contains blanks. Many of the codes in this category are for information only. For example, a QC status code means that no more messages exist in the message queue for the program. When your program receives this status code, it should terminate.
- Programming errors. The errors in this category are usually ones that you can correct. For example, an AD status code indicates an invalid function code.
- I/O or system errors.

For the second and third categories, your program should have an error routine that prints information about the last call that was issued program termination. Most installations have a standard error routine that all application programs at the installation use.

4. Local Date and Time

The current local date and time are in the prefix of all input messages except those originating from non-message-driven BMPs. The local date is a packed-decimal, right-aligned date, in the format yyddd. The local time is a packed-decimal time in the format hhmmssst. The current local date and time indicate when IMS received the entire message and enqueued it as input for the program, rather than the time that the application program received the message. To obtain the application processing time, you must use the time facility of the programming language you are using.

For a conversation, for an input message originating from a program or for a message received using Multiple System Coupling (MSC), the time and date indicate when the original message was received from the terminal.

Note: Be careful when comparing the local date and time in the I/O PCB with the current time returned by the operating system. The I/O PCB date and time may not be consistent with the current time. It may even be greater than the current time for the following reasons:

- The time stamp in the I/O PCB is the local time that the message was received by IMS. If the local time was changed after the message arrived, it is possible for the current time to appear to be

earlier than the I/O PCB time. This effect would be likely to occur in the hour immediately after the fall time change, when the clock is set back by one hour.

- The time stamp in the I/O PCB is derived from an internal IMS time stamp stored with the message. This internal time stamp is in Coordinated Universal Time (UTC), and contains the time zone offset that was in effect at the time the message was enqueued. This time zone offset is added to the UTC time to obtain the local time that is placed in the I/O PCB. However, the time zone offset that is stored is only fifteen minutes. If the real time zone offset was not an integer multiple of fifteen minutes, the local time passed back in the I/O PCB will differ from the actual time by plus or minus 7.5 minutes. This could cause the I/O PCB time to be later than the current time. See *IMS Version 9: Operations Guide* for further explanation.

Concerns about the value in the local time stamp in the I/O PCB can be reduced by using the extended time stamp introduced in IMS V6. The system administrator can choose the format of the extended time stamp to be either local time or UTC. In some situations, it may be advantageous for the application to request the time in UTC from the operating system and compare it to the UTC form of the extended time stamp. This is an option available in installations where there is no ETR to keep the IMS UTC offset in sync with the z/OS UTC offset over changes in local time.

5. Input Message Sequence Number

The input message sequence number is in the prefix of all input messages except those originating from non-message-driven BMPs. This field contains the sequence number IMS assigned to the input message. The number is binary. IMS assigns sequence numbers by physical terminal, which are continuous since the time of the most recent IMS startup.

6. Message Output Descriptor Name

You only use this field when you use MFS. When you issue a GU call with a message output descriptor (MOD), IMS places its name in this area. If your program encounters an error, it can change the format of the screen and send an error message to the terminal by using this field. To do this, the program must change the MOD name by including the MOD name parameter on an ISRT or PURG call.

Although MFS does not support APPC, LU 6.2 programs can use an interface to emulate MFS. For example, the application program can use the MOD name to communicate with IMS to specify how an error message is to be formatted.

Related Reading: For more information on the MOD name and the LTERM interface, see *IMS Version 9: Administration Guide: Transaction Manager*.

7. Userid

The use of this field is connected with RACF® signon security. If signon is not active in the system, this field contains blanks.

If signon is active in the system, the field contains one of the following:

- The user's identification from the source terminal.
- The LTERM name of the source terminal if signon is not active for that terminal.
- The authorization ID. For batch-oriented BMPs, the authorization ID is dependent on the value specified for the BMPUSID= keyword in the DFSDCxxx PROCLIB member:

- If BMPUSID=USERID is specified, the value from the USER= keyword on the JOB statement is used.
- If USER= is not specified on the JOB statement, the program's PSB name is used.
- If BMPUSID=PSBNAME is specified, or if BMPUSID= is not specified at all, the program's PSB name is used.

Related Reading: For more information about authorizing resource use in a dependent region, see *IMS Version 9: Administration Guide: System*.

8. Group Name

The group name, which is used by DB2 to provide security for SQL calls, is created through IMS transactions.

Three instances that apply to the group name are:

- If you use RACF and signon on your IMS system, the RACROUTE SAF (extract) call returns an eight-character group name.
- If you use your own security package on your IMS system, the RACROUTE SAF call returns any eight-character name from the package and treats it as a group name. If the RACROUTE SAF call returns a return code of 4 or 8, a group name was not returned, and IMS blanks out the group name field.
- If you use LU 6.2, the transaction header can contain a group name.

Related Reading: See *IMS Version 9: Administration Guide: Transaction Manager* for more information on LU 6.2.

9. 12-Byte Time Stamp

This field contains the current date and time fields, but in the IMS internal packed-decimal format. The time stamp has the following parts:

Date	yyyydddf
	This packed-decimal date contains the year (yyyy), day of the year (ddd), and a valid packed-decimal + sign such as (f).
Time	hhmmss thmi ju
	This packed-decimal time consists of hours, minutes, and seconds (hhmmss) and fractions of the second to the microsecond (thmi ju). No packed-decimal sign is affixed to this part of the time stamp.
UTC Offset	aqq\$
	The packed-decimal UTC offset is prefixed by 4 bits of attributes (a). If the 4th bit of (a) is 0, the time stamp is UTC; otherwise, the time stamp is local time. The control region parameter, TSR=(U/L), specified in the DFSPBxxx PROCLIB member, controls the representation of the time stamp with respect to local time versus UTC time.
	The offset value (qq\$) is the number of quarter hours of offset to be added to UTC or local time to convert to local or UTC time respectively.
	The offset sign (\$) follows the convention for a packed-decimal plus or minus sign.
	Field 4 on the I/O PCB Mask always contains the local date and time. For a description of field 4, see the notes for Table 3 on page 26.

Related Reading: For a more detailed description of the internal packed-decimal time-format, see *IMS Version 9: Database Recovery Control (DBRC) Guide and Reference*.

10. **Userid Indicator**

The Userid Indicator is provided in the I/O PCB and in the response to the INQY call. The Userid Indicator contains one of the following:

- U - The user’s identification from the source terminal during signon
- L - The LTERM name of the source terminal if signon is not active
- P - The PSBNAME of the source BMP or transaction
- O - Other name

The value contained in the Userid Indicator field indicates the contents of the userid field.

Specifying the Alternate PCB Mask

An alternate program communication block (PCB) mask contains three fields. Table 4 describes these fields, the field length, and in which environment the field applies.

Table 4. Alternate PCB Mask

Descriptor	Byte Length	DB/DC	DBCTL	DCCTL	DB Batch	TM Batch
Logical terminal name ¹	8 bytes	X		X		
Reserved for IMS ²	2 bytes	X		X		
Status code ³	2 bytes	X		X		

Notes:

1. **Logical Terminal Name**

This field contains the name of the logical terminal, LU 6.2 descriptor or the transaction code to which you want to send the message.

Related Reading: For more information on LU 6.2, see *IMS Version 9: Administration Guide: Transaction Manager*.

2. **Reserved for IMS**

This 2-byte field is reserved.

3. **Status Code**

This field contains the 2-byte status code that describes the results of the call that used this PCB most recently.

For information on when to use an alternate PCB, see “Sending Messages to Other Terminals and Programs” on page 56.

Specifying the AIB Mask

The AIB is used by your program to communicate with IMS, when your application does not have a program communication block (PCB) address or the call function does not use a PCB. The AIB mask enables your program to interpret the control block defined. The AIB structure must be defined in working storage, on a fullword boundary, and initialized according to the order and byte length of the fields as shown in Table 5 on page 31. The table’s notes describe the contents of each field.

Table 5. AIB Fields

Descriptor	Byte Length	DB/DC	DBCTL	DCCTL	DB Batch	TM Batch
AIB identifier ¹	8	X	X	X	X	X
DFSAIB allocated length ²	4	X	X	X	X	X
Subfunction code ³	8	X	X	X	X	X
Resource name ⁴	8	X	X	X	X	X
Reserved ⁵	16					
Maximum output area length ⁶	4	X	X	X	X	X
Output area length used ⁷	4	X	X	X	X	X
Reserved ⁸	12					
Return code ⁹	4	X	X	X	X	X
Reason code ¹⁰	4	X	X	X	X	X
Error code extension ¹¹	4	X		X		
Resource address ¹²	4	X	X	X	X	X
Reserved ¹³	48					

Notes:

1. AIB Identifier (AIBID)

This 8-byte field contains the AIB identifier. You must initialize AIBID in your application program to the value DFSAIBbb. before you issue DL/I calls. This field is required. When the call is completed, the information returned in this field is unchanged.

2. DFSAIB Allocated Length (AIBLEN)

This field contains the actual 4-byte length of the AIB as defined by your program. You must initialize AIBLEN in your application program before you issue DL/I calls. The minimum length required is 128 bytes. When the call is completed, the information returned in this field is unchanged. This field is required.

3. Subfunction Code (AIBSFUNC)

This 8-byte field contains the subfunction code for those calls that use a subfunction. You must initialize AIBSFUNC in your application program before you issue DL/I calls. When the call is completed, the information returned in this field is unchanged.

4. Resource Name (AIBRSNM1)

This 8-byte field contains the name of a resource. The resource varies depending on the call. You must initialize AIBRSNM1 in your application program before you issue DL/I calls. When the call is complete, the information returned in this field is unchanged. This field is required.

For PCB related calls where the AIB is used to pass the PCB name instead of passing the PCB address in the call list, this field contains the PCB name. The PCB name for the I/O PCB is IOPCBbb. The PCB name for other types of PCBs is defined in the PCBNAME= parameter in PSBGEN.

5. Reserved

This 16-byte field is reserved.

Specifying the AIB Mask

6. **Maximum Output Area Length (AIBOALEN)**

This 4-byte field contains the length of the output area in bytes that was specified in the call list. You must initialize AIBOALEN in your application program for all calls that return data to the output area. When the call is completed, the information returned in this area is unchanged.

7. **Used Output Area Length (AIBOAUSE)**

This 4-byte field contains the length of the data returned by IMS for all calls that return data to the output area. When the call is completed this field contains the length of the I/O area used for this call.

8. **Reserved**

This 12-byte field is reserved.

9. **Return code (AIBRETRN)**

When the call is completed, this 4-byte field contains the return code.

10. **Reason Code (AIBREASN)**

When the call is completed, this 4-byte field contains the reason code.

11. **Error Code Extension (AIBERRXT)**

This 4-byte field contains additional error information depending on the return code in AIBRETRN and the reason code in AIBREASN.

12. **Resource Address (AIBRSA1)**

When the call is completed, this 4-byte field contains call-specific information. For PCB related calls where the AIB is used to pass the PCB name instead of passing the PCB address in the call list, this field returns the PCB address.

13. **Reserved**

This 48-byte field is reserved.

The application program can use the returned PCB address, when available, to inspect the status code in the PCB and to obtain any other information needed by the application program.

Specifying the I/O Areas

Use an I/O area to pass segments between the application program and IMS TM. What the I/O area contains depends on the type of call you are issuing:

- When your program retrieves a segment, IMS TM places the segment your program requested in the I/O area.
- When your program adds a new segment, your program first builds the new segment in the I/O area.
- Before modifying a segment, your program must first retrieve the segment. When your program retrieves the segment, IMS TM places the segment in an I/O area.

The format of the record segments you pass between your program and IMS can be fixed length or variable length. Only one difference is important to the application program: a message segment contains a 2-byte length field (or 4 bytes for the PLITDLI interface) at the beginning of the data area of the segment.

The I/O area for IMS TM calls must be large enough to hold the largest message segment your program retrieves from or sends to IMS TM.

AIBTDLI Interface

This section explains how to use the application interface block (AIB), an interface between your application program and IMS.

Restriction: No fields in the AIB can be used by the application program except as defined by IMS.

When you use the AIBTDLI interface, you specify the program communication block (PCB) requested for the call by placing the PCB name (as defined by PSBGEN) in the resource name field of the AIB. You do not specify the PCB address. Because the AIB contains the PCB name, your application program can refer to the PCB name rather than the PCB address. Your application program does not need to know the relative PCB position in the PCB list. At completion of the call, the AIB returns the PCB address that corresponds to the PCB name passed by the application program.

The names of DB PCBs and alternate PCBs are defined by the user during PSBGEN. All I/O PCBs are generated with the PCB name *bbb*. For a generated program specification block (GPSB), the I/O PCB is generated with the PCB name *IOPCBbbb*, and the modifiable alternate PCB is generated with the PCB name *TPPCB1bb*.

The ability to pass the PCB name means that you do not need to know the relative PCB number in the PCB list. In addition, the AIBTDLI interface enables your application program to make calls on PCBs that do not reside in the PCB list. The *LIST=* keyword controls whether the PCB is included in the PCB list. The *LIST=* keyword is defined in the PCB macro during PSBGEN.

Related Reading: See *IMS Version 9: Utilities Reference: System* for more information.

The AIB resides in user-defined storage that is passed to IMS for DL/I calls that use the AIBTDLI interface. Upon call completion, IMS updates the AIB. Allocate at least 128 bytes of storage for the AIB.

Specifying Language-Specific Entry Points

IMS gives control to an application program through an entry point. The formats for coding entry statements in assembler language, C language, COBOL, Pascal, and PL/I are shown in this section. Your entry point must refer to the program communication blocks (PCBs) in the order in which they are defined in the PSB.

IMS passes the PCB pointers to a PL/I program differently than it passes them to an assembler language, C language, COBOL, or Pascal program. In addition, Pascal requires that IMS pass an integer before passing the PCB pointers. IMS uses the *LANG* keyword or the *PSBGEN* statement of *PSBGEN* to determine the type of program to which it is passing control. Therefore, you must be sure that the language specified during *PSBGEN* is consistent with the language of the program.

Application interfaces that use the AIB structure (AIBTDLI or CEETDLI) use the PCB name rather than the PCB structure and do not require the PCB list to be passed at entry to the application program.

Entry Point

When you code each DL/I call, you must provide the PCB you want to use for that call. For all IMS TM application programs, the list of PCBs the program can access is passed to the program at its entry point.

Assembler Language

You can use any name for the entry statement to an assembler language DL/I program. When IMS passes control to the application program, register 1 contains the address of a variable-length fullword parameter list. Each word in the list contains the address of a PCB. Save the parameter list address before you overwrite the contents of register 1. IMS sets the high-order byte of the last fullword in the list to X'80' to indicate the end of the list. Use standard z/OS linkage conventions with forward and backward chaining.

C Language

When IMS passes control to your program, it passes the addresses, in the form of pointers, for each of the PCBs your program uses. The usual `argc` and `argv` arguments are not available to a program invoked by IMS. The IMS parameter list is made accessible by using the `__pcblist` macro. You can directly reference the PCBs by `__pcblist[0]`, `__pcblist[1]`, or you can define macros to give these more meaningful names. I/O PCBs must be cast to get the proper type:

```
(IO_PCB_TYPE *)(__pcblist[0])
```

The entry statement for a C language program is the main statement.

```
#pragma runopts(env(IMS),plist(IMS))
#include <ims.h>

main()
{
  :
}
```

The `env` option specifies the operating environment in which your C language program is to run. For example, if your C language program is invoked under IMS and uses IMS facilities, specify `env(IMS)`. The `plist` option specifies the format of the invocation parameters received by your C language program when it is invoked. When your program is invoked by a system support services program such as IMS, the format of the parameters passed to your main program must be converted into the C language format: `argv`, `argc`, and `envp`. To do this conversion, you must specify the format of the parameter list received by your C language program. The `ims.h` include file contains declarations for PCB masks.

You can finish in three ways:

- End the main procedure without an explicit return statement.
- Execute a return statement from main.
- Execute an `exit` or an `abort` call from anywhere, or alternately issue a `longjmp` back to main, and then do a normal return.

One C language program can pass control to another by using the system function. The normal rules for passing parameters apply. For example, when using the system function, the `argc` and `argv` arguments can be used to pass information. The initial `__pcblist` is made available to the invoked program.

COBOL

The procedure statement must refer to the I/O PCB first, then to any alternate PCB it uses, and finally to the DB PCBs it uses. The alternate PCBs and DB PCBs must be listed in the order in which they are defined in the PSB.

Procedure division using the PCB-NAME-1 [,...,PCB-NAME-N]

On previous versions of IMS, using might be coded on the entry statement to reference PCBs. However, IMS continues to accept such coding on the entry statement.

Recommendation: Use the procedure statement rather than the entry statement to reference the PCBs.

Pascal

The entry point must be declared as a REENTRANT procedure. When IMS passes control to a Pascal procedure, the first address in the parameter list is reserved for Pascal's use and the other addresses are the PCBs the program uses. The PCB types must be defined before this entry statement. The IMS interface routine PASTDLI must be declared with the GENERIC directive.

```
procedure ANYNAME(var SAVE: INTEGER;
                  var pcb1-name: pcb1-name-type[;
                  ...
                  var pcbn-name: pcbn-name-type]); REENTRANT;
procedure ANYNAME;
(* Any local declarations *)
  procedure PASTDLI; GENERIC;
begin
  (* Code for ANYNAME *)
end;
```

PL/I

The entry statement can be any valid PL/I name and must appear as the first executable statement in the program. When IMS passes control to your program, it passes the addresses of each of the PCBs your program uses in the form of pointers. When you code the entry statement, make sure you code the parameters of this statement as pointers to the PCBs, and not the PCB names.

```
anyname: PROCEDURE (pcb1_ptr [,..., pcbn_ptr]) OPTIONS (MAIN);
:
:
RETURN;
```

CEETDLI and AIBTDLI Interface Considerations

This section explains the interfaces: CEETDLI and AIBTDLI

The considerations are:

- For PL/I programs, the CEETDLI entry point is defined in the CEEIBMAW include file. Alternatively, you can declare it yourself. But it must be declared as an assembler language entry (DCL CEETDLI OPTIONS(ASM);).
- For C language applications, you must specify env(IMS) and plist(IMS); these specifications enable the application to accept the PCB list of arguments. The CEETDLI function is defined in <leawi.h>; the CTDLI function is defined in <ims.h>.

The considerations are:

Entry Point

- When using the AIBTDLI interface for C/MVS™, COBOL, or PL/I language applications, the language run-time options for suppressing abend interception (that is, NOSPIE and NOSTAE) must be specified. However, for Language Environment-conforming applications, the NOSPIE and NOSTAE restriction is removed.
- The AIBTDLI entry point for PL/I programs must be declared as an assembler language entry (DCL AIBTDLI OPTIONS(ASM);).
- For C language applications, you must specify env(IMS) and plist(IMS); these specifications enable the application to accept the PCB list of arguments.

Program Communication Block (PCB) Lists

This section describes the formats of program communication block (PCB) lists and GPSB PCB lists and provides a description of PCBs in various types of application programs.

PCB List Format

This is the format of a PCB:

```
[IOPCB]
[Alternate PCB ... Alternate PCB]
[DB PCB ... DB PCB]
[GSAM PCB ... GSAM PCB]
```

Each PSB must contain at least one PCB. An I/O PCB or alternate PCB is required for transaction management calls, and an I/O PCB is required for most system service calls. DB PCBs for DL/I databases are used only with the IMS Database Manager, but can be present even though your program is running under DCCTL or TM Batch. (A DB PCB can be a full-function PCB, a DEDB PCB, or an MSDB PCB.) GSAM PCBs can be used with DCCTL or TM batch.

GPSB PCB List Format

A generated program specification block (GPSB) has the following format:

```
[IOPCB]
[Alternate PCB]
```

A GPSB contains only an I/O PCB and one modifiable alternate PCB. It can be used by all transaction management application programs, and permits access to the PCBs specified without the need for PSBGEN.

The PCBs in a GPSB have predefined PCB names. The name of the I/O PCB is IOPCBbb. The name of the alternate PCB is TPPCB1bb.

PCB Summary

This section summarizes the information concerning I/O PCBs and alternate PCBs in various types of application programs.

TM Batch Programs

Alternate PCBs are always included in the list of PCBs supplied to the program by IMS TM. The I/O PCB is always present in the PCB list regardless of the CMPAT options specified in PSBGEN.

BMPs, MPPs, and IFPs

The I/O PCB is always present in the PCB list and is always the first address in the list, regardless of the CMPAT options specified in the PSB.

The PCB list always contains the address of the I/O PCB followed by the addresses of any alternate PCBs, followed by the addresses of the DB PCBs.

Language Environments

IBM Language Environment for MVS & VM provides the strategic execution environment for running your application programs written in one or more high level languages. It provides not only language-specific run-time support, but also cross-language run-time services for your applications, such as support for initialization, termination, message handling, condition handling, storage management, and National Language Support. Many of Language Environment's services are accessible explicitly through a set of Language Environment interfaces that are common across programming languages; these services are accessible from any Language Environment-conforming program.

Language Environment-conforming programs can be compiled with the following compilers:

- IBM C/C++ for MVS/ESA™
- IBM COBOL for MVS & VM
- IBM PL/I for MVS & VM

These programs can be produced by programs coded in the Assembler language. All of these programs can use CEETDLI, the Language Environment-provided language-independent interface to IMS, as well as older language-dependent interfaces to IMS, such as CTDLI, CBLTDLI, and PLITDLI.

Although they do not conform to Language Environment, programs compiled with the following older compilers can run under Language Environment:

- IBM C/370™
- COBOL
- IBM OS PL/I

Restriction: These programs cannot use CEETDLI, but they can use the older language-dependent interfaces to IMS.

The CEETDLI interface to IMS

The language-independent CEETDLI interface to IMS is provided by Language Environment. It is the only IMS interface that supports the advanced error handling capabilities provided by Language Environment. The CEETDLI interface supports the same functionality as the other IMS application interfaces, and it has the following characteristics:

- The parmcount variable is optional.
- Length fields are 2 bytes long.
- Direct pointers are used.

Related Reading: For more information about Language Environment, see *IBM Language Environment for MVS & VM Programming Guide* and *Language Environment for MVS & VM Installation and Programming*.

LANG= Option on PSBGEN for PL/I Compatibility

For IMS PL/I applications running in a compatibility mode that uses the PLICALLA entry point, you must specify LANG=PLI on the PSBGEN. Your other option is to

Language Environment

change the entry point and add SYSTEM(IMS) to the EXEC PARM of the compile step so that you can specify LANG=blank or LANG=PLI on the PSBGEN. Table 6 summarizes when you can use LANG=blank and LANG=PLI.

Table 6. Using LANG= Option in a Language Environment for PL/I Compatibility

Compile exec statement is PARM=(...,SYSTEM(IMS)...	Entry point name is PLICALLA	Valid LANG= value
Yes	Yes	LANG=PLI
Yes	No	LANG=blank or LANG=PLI
No	No	Note: Not valid for IMS PL/I applications
No	Yes	LANG=PLI

PLICALLA is only valid for PL/I compatibility with Language Environment. If a PL/I application using PLICALLA entry at link-edit time is link-edited using Language Environment with the PLICALLA entry, the link-edit will work; however, you must specify LANG=PLI in the PSB. If the application is re-compiled using PL/I for z/OS & VM Version 1 Release 1 or later, and then link-edited using Language Environment Version 1 Release 2 or later, the link-edit will fail. You must remove the PLICALLA entry statement from the link-edit.

Special DL/I Situations

This section contains information on mixed-language programming, using the extended addressing capabilities of MVS/ESA, COBOL compiler options for preloaded programs, and considerations for the DCCTL environment.

Mixed-Language Programming

When an application program uses the Language Environment language-independent interface, CEETDLI, IMS does not need to know the language of the calling program.

When the application program calls IMS in a language-dependent interface, IMS determines the language of the calling program according to the entry name specified in the CALL statement:

- CALL CBLTDLI indicates the program is in COBOL.
- CALL PLITDLI indicates the program is in PL/I.
- CALL PASTDLI indicates the program is in Pascal.
- ctdli(...) indicates the program is in C language.
- CALL ASMTDLI indicates the program is in assembler language.

If a PL/I program calls an assembler language subroutine and the assembler language subroutine makes DL/I calls by using CALL ASMTDLI, the assembler language subroutine should use the assembler language calling convention, not the PL/I convention.

In this situation, where the I/O area uses the LLZZ format, the LL is a halfword, not the fullword that is used for PLITDLI.

For more information on Language Environment, see “Language Environments” on page 37.

Using Language Environment Routine Retention

If you run programs in an IMS TM dependent region that requires Language Environment (such as an IMS message processing region), you can improve performance if you use Language Environment library routine retention along with the existing PREINIT feature of IMS TM.

Using the Extended Addressing Capabilities of MVS/ESA

The two modes in MVS/ESA with extended addressing capabilities are: the addressing mode (AMODE) and the residency mode (RMODE).

Related Reading: For more detailed information about the AMODE and RMODE, see *MVS/ESA System Programming Library: 32-bit Addressing*. IMS places no constraints on the RMODE and AMODE of an application program. The program can reside in the extended virtual storage area. The parameters referenced in the call can also be in the extended virtual storage area.

Preloaded Programs

If you compile your COBOL program with the COBOL for z/OS & VM compiler and preload it, you must use the COBOL compiler option RENT. Alternatively, if you compile your COBOL program with the VS COBOL II compiler and preload it, you must use the COBOL compiler options RES and RENT.

DCCTL

In a DCCTL environment, the application can only reference the address of an I/O PCB, alternate PCB, or GSAM PCB. An application program can use a PSB that contains PCBs referencing databases; however, these PCBs cannot be used during processing. Entry statements for COBOL, PL/I, C, and Pascal must refer to all PCBs included in the PSB, including PCBs which you might not be able to process, as PCBs must be included in the order in which they are listed in the PSB. This includes all PCBs prior to the last referenced PCB and can include DB PCBs. If you used a GSAM PCB, all PCBs ahead of it must be referenced.

IMS Problem Determination

Chapter 3. Message Processing

This chapter explains message processing concepts and techniques that extend what IMS TM application programs can do. It also provides examples of message-driven program structure in Assembler language, C language, COBOL, Pascal, and PL/I.

The following topics provide additional information:

- “How Your Program Processes Messages”
- “How IMS TM Edits Messages” on page 46
- “Message Processing Considerations for DB2” on page 55
- “Sending Messages to Other Terminals and Programs” on page 56
- “Communicating with Other IMS TM Systems Using MSC” on page 61
- “IMS Conversations” on page 64
- “Processing Conversations with APPC” on page 74
- “Processing Conversations with OTMA” on page 77
- “Backing out to a Prior Commit Point: ROLL, ROLB, and ROLS Calls” on page 77
- “Backing out to an Intermediate Backout Point: SETS/SETU and ROLS” on page 81
- “Writing Message-Driven Programs” on page 84
- “Coding DC Calls and Data Areas” on page 84

How Your Program Processes Messages

To retrieve and send messages, an IMS TM application program issues calls to IMS TM. When your program issues a call to retrieve a message, IMS TM places the input message in the I/O area you name in the call. Before you issue a call to send a message, you must build the output message in an I/O area in your program.

Message Types

An operator at a terminal can send four kinds of messages to IMS TM. The destination of an IMS TM message identifies which kind of message is being sent:

- **Another terminal.** A logical terminal name in the first 8 bytes means that this is a message switch destined for another terminal. For a user at a logical terminal to send a message to another logical terminal, the user enters the name of the receiving logical terminal followed by the message. The IMS TM control region routes the message to the specified logical terminal. This kind of message does not result in the scheduling of any activity in a message processing program (MPP).
- **An application program.** A transaction code in the first 8 bytes means that the message is destined for an application program. IMS TM uses a transaction code to identify MPPs and transaction-oriented batch message processing programs (BMPs). To use a particular application program to process requests, the user enters the transaction code for that application program.
- **IMS TM.** A “/” (slash) in the first byte means that the message is a command destined for IMS TM.
- **Message switch service.** A system service DFSAPPC request is destined for the message switch service.

How Your Program Processes Messages

An application program can send three kinds of messages:

- **Commands.** A “/” in the first byte of the message text means that the message is a command for IMS TM. Programmers design applications to issue commands when they want a program to perform tasks that an operator at a terminal usually performs. This is called automated operator interface (AOI) and is described in *IMS Version 9: Customization Guide*.

Use the CMD call to issue commands. Do not use the ISRT call for issuing commands, because a message created with ISRT can contain a slash in the first byte without being a command.

- **Messages to logical terminals by specifying a logical terminal name.**
- **Program-to-program switches using a transaction code.**

The messages that your program receives and sends are made up of segments. Use a GU call to retrieve the first segment of a new message, and use GN calls to retrieve the remaining segments of the message. Figure 2 shows three messages. Message A contains one segment, message B contains two segments, and message C contains three segments.

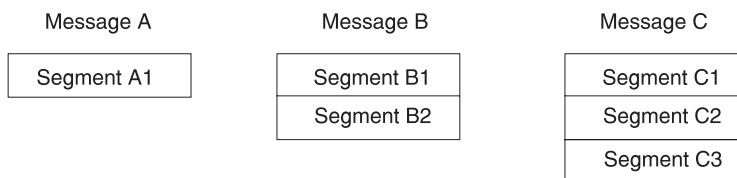


Figure 2. Message Segments

To retrieve message A, you only have to issue a GU call. To retrieve messages B and C, issue one GU call to retrieve the first segment, then a GN call for each remaining segment. This assumes that you know how many segments each message contains. If you do not know this, issue GN calls until IMS TM returns a QD status code, indicating that all of the segments for that message have been retrieved.

If you inadvertently issues a GU call after retrieving the first segment of the multi-segment messages, IMS TM returns a QC status code. This status indicates that no more messages are present, without your program retrieving the additional segments associated with the message. Data would have been lost without any indication that it happened.

Input Message Format and Contents

The input message that an application program receives from a terminal or another program always has these fields: the length field, the ZZ field, the transaction code field, and the text field. The tables that follow show the message input layouts. The input message field names are in the first row of each table. The number below each field name is the length in bytes that has been defined for that field. Table 7 shows the format of an input message for the AIBTDLI, ASMTDLI, CBLTDLI, CEETDLI, CTDLI, and PASTDLI interfaces. The message is slightly different for the PLITDLI interface as shown in Table 8 on page 43.

Table 7. Input Message Format

Field Name	Field Length
LL	2
ZZ	2

Table 7. Input Message Format (continued)

Field Name	Field Length
TRANCODE	8
Text	Variable

Table 8. Input Message Format for the PLITDLI interface

Field Name	Field Length
LLLL	4
ZZ	2
TRANCODE	8
Text	Variable

The contents of the input message fields are:

LL or LLLL

The length field contains the length of the input message segment in binary, including LL (or LLLL) and ZZ. IMS TM supplies this number in the length field when you retrieve the input message.

For the AIBTDLI, ASMTDLI, CBLTDLI, CEETDLI, CTDLI, and PASTDLI interfaces, define the LL field as 2 bytes long.

For the PLITDLI interface, define the LLLL field as 4 bytes long. The value in the LLLL field is the input message length minus 2 bytes. For example, if the text is 12 bytes, then the fullword LLLL contains a value of 24 bytes. This value is the total of LLLL (4 bytes) + ZZ (2 bytes) + TRANCODE (8 bytes) + text (12 bytes) – 2 bytes.

ZZ The ZZ field is a 2-byte field that is reserved for IMS TM. Your program does not modify this field.

TRANCODE

The TRANCODE is the transaction code for the incoming message.

Text

This field contains the message text sent from the terminal to the application program. The first segment of a message can also contain the transaction code associated with the program in the beginning of the text portion of the message. Input messages do not have to include the transaction code, but you can provide it for consistency.

The text field's contents in the input message and the formatting of the contents when your program receives the message depends on the editing routine your program uses.

Output Message Format and Contents

The format of the output message that you build to send back to a terminal or to another program is similar to the format of the input message, but the fields contain different information.

Output messages contain four fields: the length field, the Z1 field, the Z2 field, and the text field. Table 9 on page 44 and Table 10 on page 44 show the message output layouts. The output message field names are in the first row of each table. The number below each field name is the length in bytes that has been defined for that field. Table 9 on page 44 shows the format of an output message for AIBTDLI,

How Your Program Processes Messages

ASMTDLI, CBLTDLI, CEETDLI, CTDLI, and PASTDLI interfaces. The format for PLITDLI is slightly different as shown in Table 10.

Table 9. Output Message Format

Field Name	Field Length
LL	2
Z1	1
Z2	1
Text	Variable

Table 10. Output Message Format for PLITDLI

Field Name	Field Length
LLLL	4
Z1	1
Z2	1
Text	Variable

The contents of the output message fields are:

LL or LLLL

The field length contains the length of the message in binary, including the LL (or LLLL), Z1, and Z2 fields. For output message segments, supply this length when you are ready to send the message segment.

For the AIBTDLI, ASMTDLI, CBLTDLI, CEETDLI, CTDLI, and PASTDLI interfaces, the LL field must be 2 bytes long. For the PLITDLI interface, the LLLL field must be 4 bytes long and contain the length of the message segment, minus 2 bytes.

Z1 The Z1 field is a 1-byte field that must contain binary zeros. It is reserved for IMS TM.

Z2 The Z2 field is a 1-byte field that can contain special device-dependent instructions (such as instructions to ring the alarm bell, instructions to disconnect a switched line, or paging instructions) or device-dependent information (such as information about structured field data or bypassing MFS).

If you do not use any of these instructions, the Z2 field must contain binary zeros. For MFS, this field contains the number of the option that is being used for this message.

Text

The text portion of the message segment contains the data that you want to send to the logical terminal or to an application program. (Text messages are typically EBCDIC characters.) The length of the text depends on the data that you want to send.

When a Message is Processed

A program's response to a message will depend on the type of message the program receives. A transaction code associates a request for information from a terminal with the application program that can process and respond to that request. IMS TM schedules an MPP when there are messages to be processed that contain the transaction code associated with that MPP.

How Your Program Processes Messages

Example: Suppose you have an MPP that processes the transaction code “INVINQ” for inventory inquiry. The MPP receives a request from a user at a terminal for information on the inventory of parts. When the user enters the transaction code for that application program, IMS TM schedules the application program that can process the request.

When you enter INVINQ and one or more part numbers, the MPP sends your program the quantity of each part on hand and the quantity on order.

When you enter INVINQ at the terminal, IMS TM puts the message on the message queue for the MPP that processes INVINQ. Then, after IMS TM has scheduled the MPP, the MPP issues GU and GN calls to retrieve the message. To retrieve the messages from LTERM1, the application program issues a GU for the first segment of a message, then issues GN calls until IMS TM returns a QD status code. This means that the program has retrieved all of the segments of that message. The program then processes the request, and sends the output message to the queue for your logical terminal. (The logical terminal name is in the I/O PCB.) When the MPP sends the output message, IMS TM sends it to the queue for that logical terminal, and the message goes to the physical terminal. Figure 3 shows the flow of a message between the terminal and the MPP.

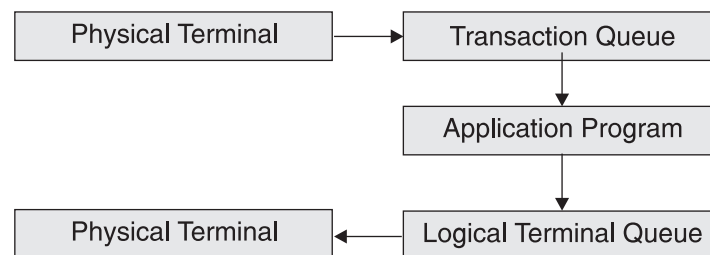


Figure 3. Transaction Message Flow

Figure 4 on page 46 shows the calls you use, the status codes, and what the input and output for the inventory inquiry would look like. To show you how to use GU and GN to retrieve messages, and how you insert multiple-segment messages, this example shows messages containing three segments. If input and output messages in this example were single segment messages, the program would issue only a GU to retrieve the entire message, and only one ISRT to send the message.

The message formats shown in Figure 4 on page 46 are examples; not all messages are in this format. When the program receives the input message in the I/O area, the first field of each segment contains the length of that segment. This is the LL field in the figure. For clarity, Figure 4 on page 46 shows this length in decimal; in the input message, however, it is in binary. The second field (ZZ) is reserved for IMS TM; it is 2 bytes long. The text of the message follows the reserved 2 bytes. The first message segment contains the transaction code in the 8 bytes following the ZZ field. These are the first 8 bytes of the text portion of the message.

The format of the output messages is the same. You do not need to include the name of the logical terminal, because it is in the first 8 bytes of the I/O PCB.

PART, QTY, and ON ORDER in Figure 4 on page 46 are headings. These are values that you can define as constants that you want to appear on the terminal screen. To include headings in MFS output messages, define them as literals.

How Your Program Processes Messages

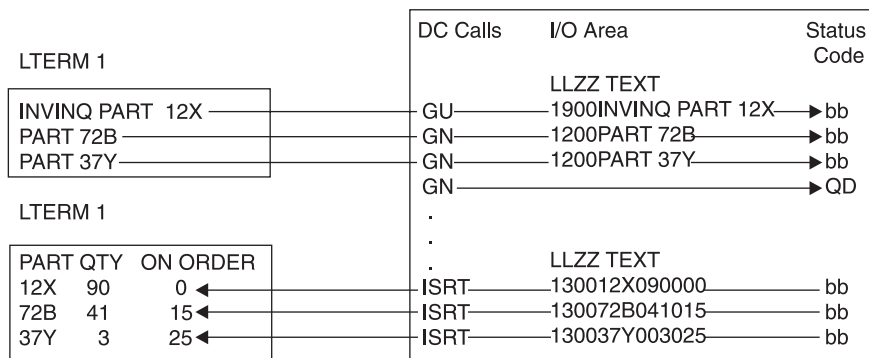


Figure 4. Inventory Inquiry MPP Example

Results of a Message: I/O PCB

After your program issues a call, IMS TM returns information about the results of the call in the I/O PCB. To find out about the results of the call, your application program must check the information that IMS TM returns to the I/O PCB.

When your application program retrieves a message, IMS TM returns this information about the message to the I/O PCB:

- The name of the terminal that sent the message.
- A 2-character status code describing the results of the call. If the program receives a status code of QC after issuing a call to retrieve a message, no more messages are available for the program to process.
- The current date, time, and sequence number for the message.
- The user ID of the person at the terminal or the transaction code for the program that sent the message.

Because the I/O PCB resides in storage outside of your program, you define a mask of the PCB in your program based at this address to check the results of IMS TM calls. The mask contains the same fields in the same order as the I/O PCB.

Related Reading: For more information on I/O PCB masks, see “Specifying the I/O PCB Mask” on page 26.

How IMS TM Edits Messages

When an application program passes messages to and from a terminal, IMS TM edits the messages before the program receives the message from the terminal and before the terminal receives the message from the application program. IMS TM gives you many choices about how you want your messages to appear both on the terminal screen and in the program’s I/O area. You need to know which editing routines have been specified for your program and how they affect your programming.

The three editing routines available to non-LU 6.2 terminals in IMS TM are:

Basic Edit

Performs basic edit functions if you do not use MFS and if the message does not originate at an LU 6.1 device. You must provide control characters for some formatting functions.

Intersystem Communication (ISC) Edit

Provides the default edit for messages that originate from an LU 6.1 device. You can enter binary data in addition to text.

Message Format Service (MFS)

Formats messages through control blocks. You define the way the messages look with the control blocks.

For LU 6.2 devices, use the LU 6.2 Edit exit routine to edit input and output messages.

Related Reading: For more information on LU 6.2, see *IMS Version 9: Administration Guide: Transaction Manager*. For more information on LU 6.2 Edit exit routine, see *IMS Version 9: Customization Guide*.

Printing Output Messages

You must provide the horizontal and vertical control characters that are necessary to format your output messages.

To print your output at a printer terminal, include these control characters where necessary within the text of the message:

X'05' Skip to the tab stop, but stay on the same line.

X'15' Start a new line at the left margin.

X'25' Skip to a new line, but stay at the same place horizontally.

If you want to skip multiple lines, you can start a new line (X'15'), then skip as many lines as necessary (X'25').

Using Basic Edit

If you do not use MFS or an LU 6.1 device, IMS TM does some editing automatically. The editing IMS TM does to the first message segment is different from the editing IMS TM does for subsequent message segments. See *IMS Version 9: Administration Guide: Transaction Manager* for a complete description of Basic Edit.

Editing Input Messages

When IMS TM receives the first segment of an input message for your application program, IMS TM:

- Removes leading and trailing control characters.
- Removes leading and trailing blanks.
- Removes backspaces (from a printer terminal).
- Translates to uppercase, if this is specified with the EDIT=UC specification on the system definition TRANSACT macro.

If the message segment contains a password, IMS TM edits the segment by:

- Removing the password and inserting a blank in place of the password.
- Removing the password if the first character of the text is a blank. IMS TM does not insert the blank.
- Left-justifying the text of the segment.

For subsequent input message segments, IMS TM does not remove leading blanks from the text of the message. The other formatting features are the same.

How IMS TM Edits Messages

Editing Output Messages

For output messages, Basic Edit:

- Changes nongraphic characters in the output message before the data goes to the output device.
- Inserts any necessary idle characters after new line, line feed, and tab characters.
- Adds line control characters for the operation of the communication line.

Using Intersystem Communication Edit

Intersystem Communication (ISC) edit is the default edit for messages from LU 6.1 devices. It is not valid for any other device types. One advantage of using ISC edit is that IMS TM does not edit the text of a message, allowing you to enter binary data.

Editing Input Messages

The editing IMS TM does to input messages depends on whether the Function Management (FM) header contains the SNA-defined primary resource name (PRN) parameter. In either case, IMS TM removes the FM header before the input message is received by the application program.

If the FM header does not contain the PRN parameter:

- IMS TM removes leading control characters and blanks when it receives the first segment of an input message for your application program.
- If the message segment contains a password, IMS TM removes the password and inserts a blank where the password was.
- IMS TM does not edit the text of the message (the data following the password).

If the FM header contains the PRN parameter:

- The PRN is treated as the transaction code and is received by your application program as the first field in the message segment.
- The message segment is not edited by IMS TM.

Editing Output Messages

ISC edit does not edit output messages.

Message Format Service

MFS is a part of IMS TM that uses control blocks that you define to format messages between a terminal and an MPP. The MFS control blocks indicate to IMS TM how you want your input and output messages arranged:

- For input messages, MFS control blocks define how the message that the terminal sends to your MPP is arranged in the I/O area.
- For output messages, MFS control blocks define how the message that your MPP sends to the terminal is arranged on the screen or at the printer. You can also define words or other data that appear on the screen (headings, for example) but do not appear in the program's I/O area. This data, called a literal, can be a field in the output message from the application program or a field in the input message from the terminal.

For detailed information on MFS, see Part 2, "Message Format Service," on page 105.

Terminals and MFS

Whether your program uses MFS depends on the types of terminals and secondary logical units (SLUs) your network uses. You can bypass MFS formatting of an output message for a 3270 device or for SLU Type 2 devices. When MFS is bypassed, you construct the entire 3270 data stream from within your program.

Restriction: MFS cannot be used with LU 6.2 devices (APPC).

Related Reading: For more information on LU 6.2 and APPC, see *IMS Version 9: Administration Guide: Transaction Manager*.

The decisions about using MFS are high-level design decisions that are separate from the tasks of application design and application programming; many installations that use MFS have a specialist who designs MFS screens and message formats for all applications that use MFS.

MFS makes it possible for an MPP to communicate with different types of terminals without having to change the way it reads and builds messages. When the MPP receives a message from a terminal, the message's format in the MPP I/O area depends on the MFS options specified and not on what kind of terminal sent it. MFS shields the MPP from the physical device that is sending the message in the same way that a DB PCB shields the program from what the data in the database actually looks like and how it is stored.

MFS Input Message Formats

You define a message to MFS in fields just as you would define fields within a database segment. When you define the fields that make up a message segment, you give MFS information such as:

- The field length
- The fill character used when the length of the input data is less than the length defined for the field
- Whether the data in the field is left-justified or right-justified
- If the field is truncated, whether it is truncated on the left or right

The order and length of these fields within the message segment depends on the MFS option that your program is using. You specify the MFS option in the MID. The decision of which option to use for an application program is based on:

- How complex the input data is
- How much the input data varies
- The language the application program is written in
- The complexity of the application program
- Performance factors

The Z2 field in MFS messages contains the MFS formatting option being used to format the messages to and from your program. If something is wrong in the way that IMS TM returns the messages to your I/O area, and you suspect that the problem might be with the MFS option used, you can check this field to see if IMS TM is using the correct option. A X'00' in this field means that MFS did not format the message at all.

One way to understand how each of the MFS options formats your input and output messages is to look at examples of each option.

How IMS TM Edits Messages

Example: Suppose that you have defined the four message segments shown in Table 11. Each of the segments contains a 2-byte length field and a 2-byte ZZ field. The first segment contains the transaction code that the person at the terminal entered to invoke the application program. The number of bytes defined for each field appears below the name of the field in the figure.

When you use the PLITDLI interface, you must define the length field as a binary fullword, LLLL. When you use the AIBTDLI, ASMTDLI, CBLTDLI, CEETDLI, CTDLI, or PASTDLI interfaces, you must define the length field as a halfword, LL. The value provided by the PL/I application program must represent the actual segment length minus 2 bytes. For example, if the output text is 10 bytes, then the value of the fullword LLLL is 14 and is the sum of the length of LLLL (4 bytes – 2 bytes) + Z1 (1 byte) + Z2 (1 byte) + TEXT (10 bytes).

Table 11. Four-segment Message

Segment Number	Field Name	Field Length	Field Value
1	LL	2	0027
	ZZ	2	XXXX
	TRANCODE	8	YYYY
	Text	5	PATIENT#
	Text	10	NAME
2	LL	2	0054
	ZZ	2	XXXX
	Text	50	ADDRESAF
3	LL	2	0016
	ZZ	2	XXXX
	Text	6	CHARGES
	Text	6	PAYMENTS
4	LL	2	0024
	ZZ	2	XXXX
	Text	10	TREATMENT
	Text	10	DOCTOR

For these examples, assume that:

- The transaction code is defined in the MID as a literal.
- All of the fields are left-justified.
- The fill character is defined as a blank. When the length of the data in a field is less than the length that has been defined for that field, MFS pads the field with fill characters. Fill characters can be:
 - Blanks
 - An EBCDIC character
 - An EBCDIC graphic character
 - A null, specified as X'3F'

When you specify that the fill character is to be a null, MFS compresses the field to the length of the data if that length is less than the field length.

The fields for segment 4 of the message in Table 11 are arranged on the terminal screen in the format shown in Figure 5 on page 51.

Example: Assume the person enters the name of a patient, and the charges and payments associated with that patient.

PATIENT#:	NAME: MC ROSS
ADDRESAF:	
CHARGES: 106.50	PAYMENTS: 90.00
TREATMENT:	
DOCTOR:	

Figure 5. Terminal Screen for MFS Example

MFS provides three options for message formatting:

- “MFS Option 1”
- “MFS Option 2” on page 52
- “MFS Option 3” on page 53

MFS Option 1: Use this option when the program receives and transmits most of the fields in the message segments. The way that option 1 formats messages depends on whether you have defined a null as the fill character for any of the fields in the segment.

If none of the fields in the message were defined as having a fill character of null:

- The program receives all the segments in the message.
- Each segment is the length that was specified for it in the MID.
- Each segment contains all its fields.
- Each field contains data, data and fill characters, or all fill characters.

Table 12 shows the Option 1 Format of segments received by the application program.

Table 12. MFS Option 1 Message Format

Segment Number	Field Name	Field Length	Field Value
1	LL	2	0027
	Z1	1	XX
	Z2	1	01
	TRANCODE	8	YYYY
	Text	5	blanks
	Text	10	MCROSSbbbb
2	LL	2	0054
	Z1	1	XX
	Z2	1	01
	Text	50	blanks

How IMS TM Edits Messages

Table 12. MFS Option 1 Message Format (continued)

Segment Number	Field Name	Field Length	Field Value
3	LL	2	0016
	Z1	1	XX
	Z2	1	01
	Text	6	010650
	Text	6	009000
4	LL	2	0024
	Z1	1	XX
	Z2	1	01
	Text	10	blanks
	Text	10	blanks

The message format for option 1 output messages is the same as the input message format. The program builds output messages in an I/O area in the format shown for segment 4 in Table 12 on page 51. The program can truncate or omit fields in one of two ways:

- Inserting a short segment
- Placing a null character in the field

If one or more of the fields are defined as having a null fill character, the message is different. In this case, the message has these characteristics:

- If a field has been defined as having a fill character of null and the terminal offers not data, the field is eliminated from the message segment.
- If all of the fields in a segment have a null fill character and none of the fields contains any literals, the segment is eliminated from the message.
- If only some of the fields in a segment have a null fill character, any field containing nulls is eliminated from the segment. The relative positions of the fields remaining within the segments are changed.
- When the length of the data that is received from the originating terminal is less than the length that is been defined for the field, the field is truncated to the length of the data.

MFS Option 2: Use this option when the program processes multisegment messages where most of the fields are transmitted but some of the segments are omitted. Option 2 formats messages in the same way that option 1 does, unless the segment contains no input data from the terminal after IMS TM has removed the literals. If this is true, and if no additional segments in the message contain input data from the terminal, IMS TM ends the message. The last segment that the program receives is the last segment that contains input data from the terminal.

Sometimes a segment that does not have any input data from the terminal is followed by segments that do contain input data from the terminal. When this happens, MFS gives the program the length field and the Z fields for the segment, followed by a 1-byte field containing X'3F'. This indicates to the program that this is a null segment.

If the message segments shown in Table 11 on page 50 are formatted by option 2, they appear in the format shown in Table 13 on page 53.

Table 13. MFS Option 2 Message Format

Segment Number	Field Name	Field Length	Field Value
1	LL	2	0027
	Z1	1	XX
	Z2	1	02
	TRANCODE	8	YYYY
	Text	5	blanks
	Text	10	MCROSSbbbb
2	LL	2	0005
	Z1	1	XX
	Z2	1	02
	Text	1	X'3F'
3	LL	2	0016
	Z1	1	XX
	Z2	1	02
	Text	6	010650
	Text	6	009000

Segment 2 in Table 13 contains only a X'3F' because that segment is null, but Segment 3 contains data. This message does not contain a segment 4 because it is null.

MFS Option 3: Use this option when the program receives and transmits only a few of the fields within a segment. When you use option 3, the program receives only those fields that have been received from the terminal. The program receives only segments that contain fields received from the originating terminal. Segments and fields can be of variable length if you have defined option 3 as having a null fill character.

A segment in an option 3 message is identified by its relative segment number—in other words, what position in the message it occupies. The fields within a segment are identified by their offset count within the segment.

Example: The NAME field in segment 1 (MCROSSbbbb) has an offset value of 17. The value 17 is the sum of the lengths of the fields preceding the NAME field and includes an 8-byte transaction code and a 5-byte field of blanks. It does not include the 2-byte relative segment number field (field A in Table 14 on page 54), the 2-byte length field (field B), or the 2-byte relative offset field (field C).

Option 3 messages do not contain literals defined in the MID. This means that the transaction code is removed from the message, except during a conversation. If the transaction that the program is processing is a conversational transaction, the transaction code is not removed from the message. The transaction code still appears in the Scratch Pad Area (SPA).

Each segment the program receives contains the relative number of this segment in the message (field A in Table 14 on page 54). In addition, each data field within the segment is preceded by two fields:

How IMS TM Edits Messages

- A 2-byte length field (B). Including the length field itself, the 2-byte relative field offset, and the data in the field.
- A 2-byte relative field offset (C), giving the field's position in the segment as defined in the MID.

These two fields are followed by the data field. MFS includes these fields for each field that is returned to the application program.

If the message segments shown in Table 11 on page 50 are formatted by option 3, they appear in the format shown in Table 14. The notes for the tables explain the letters A, B, C, and D, which are in the first row of segment 1 and segment 3.

Table 14. MFS Option 3 Message Format

Segment Number	Field Name	Field Length	Field Value
1	LL	2	0020
	Z1	1	XX
	Z2	1	03
	A	2	0001
	B	2	0014
	C	2	0017
	D	10	MCROSSbbbb
2	LL	2	0000
	Z1	1	XX
	Z2	1	03
	A	2	0003
	B	2	0010
	C	2	0004
	D	6	010650
	B	2	0010
	C	2	0010
	D	6	009000

Notes to Table 14:

- The fields marked A contain the relative segment number. This number gives the segment's position within the message.
- The fields marked B contain the field length. This length is the sum of the lengths of B field (2 bytes) + C field (2 bytes) + D field (the length of the data).
- The fields marked C contain the relative field offset. This gives each field's position within the segment.
- The fields marked D contain the data from the terminal. In this example, the fill character was defined as blank, so the data field is always its defined length. IMS TM does not truncate it. If you define the fill character as null, the lengths of the data fields can differ from the lengths defined for them in the segment. With a null fill character, if the length of the data from the terminal is less than the length defined for the field, IMS TM truncates the field to the length of the data. Using a null fill with option 3 reduces the space required for the message even further.

MFS Output Message Formats

For output messages, define to MFS what it is to receive from the application program. If using option 1 or option 2, the output message format is the same as it is for input messages. Present all fields and segments to MFS. You can present null segments. All fields in output messages are fixed length and fixed position. Output messages do not contain option numbers.

Option 3 output messages are similar to input messages, except that they do not contain option numbers. The program submits the fields as required in their segments with the position information.

Using LU 6.2 User Edit Exit Routine (Optional)

This exit routine edits input and output messages from LU 6.2 devices when the implicit application program interface support is used. If it is not provided, then messages are presented without modification. IMS does not invoke the exit for CPI-C driven transactions because IMS does not participate in the data flows when the application program uses the CPI directly.

The LU 6.2 User Edit exit routine is called once for each message segment or inbound control flow. You can call the exit routine for data messages and use it to:

- Examine the contents of a message segment.
- Change the contents of a message segment.
- Expand or compact the contents of a message segment.
- Discard a message segment and process subsequent segments, if any.
- Use the Deallocate_Abend command to end the conversation.

For more information on LU 6.2 User Edit exit routine, see *IMS Version 9: Customization Guide* and *IMS Version 9: Administration Guide: Transaction Manager*.

Message Processing Considerations for DB2

For the most part, the message processing function of a dependent region that accesses DB2 databases is similar to that of a dependent region that accesses only DL/I databases. The method each program uses to retrieve and send messages and back out database changes is the same. The differences are:

- DL/I statements are coded differently from SQL (structured query language) statements.
- When an IMS TM application program receives control from IMS TM, IMS has already acquired the resources the program is able to access. IMS TM schedules the program, although some of the databases are not available. DB2 does not allocate resources for the program until the program issues its first SQL statement. If DB2 cannot allocate the resources your program needs, your program can optionally receive an initialization error when it issues its first SQL call.
- When an application issues a successful checkpoint call or a successful message GU call, DB2 closes any cursors that the program is using. This means that your program should issue its OPEN CURSOR statement after a checkpoint call or a message GU.

IMS TM and DB2 work together to keep data integrity in these ways:

- When your program reaches a commit point, IMS TM makes any changes that the program has made to DL/I databases permanent, releases output messages

DB2 Considerations

for their destinations, and notifies DB2 that the program has reached a commit point. DB2 then makes permanent any changes that the program has made to DB2 databases.

- When your program terminates abnormally or issues one of the IMS TM rollback calls (ROLB, ROLS without a token, or ROLL), IMS TM cancels any output messages your program has produced, backs out changes your program has made to DL/I databases since the last commit point, and notifies DB2. DB2 backs out the changes that the program has made to DB2 databases since the last commit point.

Through the Automated Operator Interface (AOI), IMS TM application programs can issue DB2 commands and IMS TM commands. To issue DB2 commands, the program issues the IMS TM /SSR command followed by the DB2 command. The output of the /SSR command is routed to the master terminal operator (MTO).

Sending Messages to Other Terminals and Programs

When an application program processes a message from a terminal, it usually sends the response to the terminal that sent the input message. But sometimes you might want to send output messages to a terminal other than the originating terminal, or to other terminals in addition to the originating terminal. You might also want to send messages to other application programs.

To send a message to a different terminal or to an application program, issue the ISRT call, but reference an alternate program communication block (PCB) instead of the TP PCB. Alternate PCBs can be defined for a particular terminal or program, or they can be defined as modifiable. If the alternate PCB is not modifiable, only issue an ISRT call referencing the alternate PCB to send a message to the terminal or program that it represents. If the alternate PCB is modifiable, set the destination for the alternate PCB before issuing the ISRT call. To do this, use a CHNG call.

When you use an alternate PCB:

- If you want to send output messages to one alternate destination, define the alternate PCB for that destination.
- If you want to send output messages to more than one alternate destination, and you want to be able to change the destination of the alternate PCB, define the alternate PCB as modifiable during program specification block (PSB) generation. Then, before you issue the ISRT call, you issue a CHNG call to set the destination of the alternate modifiable PCB for the destination program or terminal.

The *express alternate PCB* is a special kind of alternate PCB that is defined during PSB generation, by specifying EXPRESS=YES.

When you use an express alternate PCB, messages you send using that PCB are sent to their final destinations immediately. Messages sent with other PCBs are sent to temporary destinations until the program reaches a commit point. Messages sent with express PCBs are sent if the program subsequently terminates abnormally, or issues one of the rollback calls: ROLL, ROLB, or ROLS. Using an express alternate PCB in this kind of situation is a way to ensure that the program can notify the person at the terminal, even if abnormal termination occurs. For all PCBs, when a program abnormally terminates or issues a ROLL, ROLB, or ROLS call, messages inserted but not made available for transmission are cancelled, while messages made available for transmission are never cancelled.

For a nonexpress PCB, the message is not made available for transmission to its destination until the program reaches a commit point. The commit point occurs

when the program terminates, issues a CHKP call, or requests the next input message and the transaction has been defined with MODE=SNGL.

For an express PCB, when IMS TM knows that it has the complete message, it makes the message available for transmission to the destination. In addition to occurring at a commit point, this also occurs when the application program issues a PURG call using that PCB or requests the next input message.

A PSBGEN can also specify an alternate PCB as an alternate response PCB defined during PSB generation.

- If you want to send a message to an LU 6.2 device, you can specify the LU 6.2 descriptor name that is associated with that device.

Related Reading: For more information on sending messages to alternate PCBs, see “Sending Messages to Other Terminals and Programs” on page 56.

Sending Messages to Other Terminals

To reply to a different terminal, also use the ISRT call, but use an alternate (program communication block) PCB instead of the TP PCB.

Just as the TP PCB represents the terminal that sent the message, an alternate PCB represents the terminal to which you want to send the message.

Single Alternate Terminal

If you are going to send messages to only one alternate terminal, you can define the alternate PCB for that terminal during PSB generation. When you define an alternate PCB for a particular destination, you cannot change that destination during program execution. Each time you issue an ISRT call that references that PCB, the message goes to the logical terminal whose name was specified for the alternate PCB. To send a message to that terminal, place one message segment at a time in the I/O area, and issue an ISRT call referring to the alternate PCB, instead of the TP PCB.

Several Alternate Terminals

To send messages to several terminals, you can define the alternate PCB as modifiable during PSB generation. Therefore, the alternate PCB represents more than one alternate terminal. You can change the destination while your program is running.

Before you can set or change the destination of an alternate PCB, you must indicate to IMS TM that the message you have been building so far with that PCB is finished. To do this, issue a PURG call.

PURG allows you to send multiple output messages while processing one input message. When you do not use PURG, IMS TM groups message segments into a message and sends them when the program issues a GU for a new message, terminates, or reaches a commit point. A PURG call tells IMS TM that the message built against this TP PCB or alternate PCB (by issuing one ISRT call per message segment) is complete. IMS TM collects the message segments that you have inserted into one PCB as one message and sends it to the destination represented by the alternate PCB you have referenced.

A PURG call that does not contain the address of an I/O area indicates to IMS TM that this message is complete. If you include an I/O area in the call, PURG acts as an ISRT call as well. IMS TM treats the data in the I/O area as the first segment of a new message. When you include an I/O area on a PURG call, you can also include a MOD name to change the format of the screen for this message. Although

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specifying the MOD name is optional, when you use it, you can specify it only once per message or in only the first ISRT or PURG that begins the message.

To set the destination of a modifiable alternate PCB during program execution, you use a CHNG call. When you issue the CHNG call you supply the name of the logical terminal to which you want to send the message. The alternate PCB you use then remains set with that destination until you do one of the following:

- Issue another CHNG call to reset the destination.
- Issue another GU to the message queue to start processing a new message. In this case, the name still appears in the alternate PCB, even though it is no longer valid.
- Terminate your program. When you do this, IMS TM resets the destination to blanks.

The first 8 bytes of the alternate PCB contain the name of the logical terminal to which you want to send the message.

When you issue a CHNG call, give IMS TM the address of the alternate PCB you are using and the destination name you want set for that alternate PCB.

When you use the PURG call, you give IMS TM only the address of the alternate PCB. IMS TM sends the message you have built using that PCB.

To indicate an error situation, you can send a message by issuing an ISRT call followed by a PURG call against an express PCB. These calls send the message to its final destination immediately.

Example: The program could go through these steps:

1. The program issues a GU call (and GN calls, if necessary) to retrieve an input message.
2. While processing the message, the program encounters an abnormal situation.
3. The program issues a PURG call to indicate to IMS TM the start of a new message.
4. The program issues a CHNG call to set the destination of an express PCB to the name of the originating logical terminal. The program can get this name from the first 8 bytes of the I/O PCB.
5. The program issues ISRT calls as necessary to send message segments. The ISRT calls reference the express PCB.
6. The program issues a PURG call referencing the express PCB. IMS TM then sends the message to its final destination.
7. The program can then terminate abnormally, or it can issue a ROLL, ROLB, or ROLS call to back out its database updates and cancel the output messages it has created since the last commit point.

If your output messages contained three segments, and you used the PURG call to indicate the end of a message (and not to send the next message segment), you could use this call sequence:

```
CHNG ALTPCB1, LTERMA
ISRT ALTPCB1, SEG1
ISRT ALTPCB1, SEG2
ISRT ALTPCB1, SEG3
PURG ALTPCB1
```

```
CHNG ALTPCB1, LTERMB
ISRT ALTPCB1, SEG4
ISRT ALTPCB1, SEG5
ISRT ALTPCB1, SEG6
```

Sending Messages to Other Application Programs

A program-to-program message switch occurs when one (message processing program) MPP sends a message to another online program (another MPP or a transaction-oriented BMP). To do this, use an alternate (program control block) PCB and use some of the same options in an alternate PCB to send messages to alternate terminals. If you send messages to only one application program, then you can define the alternate PCB with the transaction code for that application program during PSB generation. If you send messages to more than one application program, you can define the alternate PCB as modifiable.

If you use an alternate modifiable PCB, IMS TM does some security checking when you issue the CHNG call to set the destination of the alternate modifiable PCB. The terminal that enters the transaction code that causes the message switch must be authorized to enter the transaction code that the CHNG call places in the alternate modifiable PCB. IMS TM does not do any security checking when you issue the ISRT call.

The security checking that is done in RACF when you issue a CHNG call for a program-to-program message switch is the same checking that is done in an environment that uses the Security Maintenance utility (SMU). When an IMS TM application program issues a CHNG call, that call invokes RACF, and a check is made to determine whether the originating terminal is authorized for the transaction code just issued. If, instead of using the CHNG call, the program issues an ISRT call against a preset alternate PCB, no security check is made, regardless of the environment.

When you do a program-to-program message switch, you have the same considerations as when you communicate with a logical terminal. You have to remember these points:

- Create an I/O area large enough to hold the largest segment that you are sending.
- Use an alternate PCB, not the TP PCB, to send the message.
- Issue a CHNG call before the ISRT call to place the program's transaction code in the first field of the alternate PCB. If the alternate PCB was set to this transaction code in the PSBGEN, then you just issue the ISRT call.
- IMS TM must know the transaction code. Define it at system definition.
- A nonconversational program can do a program-to-program message switch to another nonconversational program, but not to a conversational program.
- A conversational program can do a program-to-program message switch to either another conversational program or a nonconversational program.

A message switch to another conversational program transfers the SPA and the responsibility to respond to the originating terminal to the new application program. (See "Passing the Conversation to another Conversational Program" on page 69.) A message switch to a nonconversational program does not change the responsibilities of the conversational program. The conversational program must still return the SPA to IMS TM (if the SPA has been modified) and must respond to the originating terminal. Table 15 on page 60 and Table 16 on page 60 show the format for an output message to an application program.

Sending Messages

Table 15. Message Format for Program-to-Program Message Switch for AIBTDLI, ASMTDLI, CBLTDLI, CEETDLI, CTDLI, and PASTDLI Interfaces

Field Name	Field Length
LL	2
Z1	1
Z2	1
Text	Variable

Table 16. Message Format for Program-to-Program Message Switch for the PLITDLI Interface

Field Name	Field Length
LLLL	4
Z1	1
Z2	1
Text	Variable

As you can see, the format is the same as for output messages to terminals. Z1 and Z2 are fields that must contain binary zeros. These fields are reserved for IMS. The text field contains the message segment that you want to send to the application program.

If the program that is processing the message expects the transaction code, include Program B's transaction code as part of the message text of the message's first segment, because IMS TM does not automatically include the transaction code in the first segment of a switched message. Including the transaction code in the first segment's message text keeps the first segments of all messages in the same format, regardless of whether they are sent from terminals or other programs.

How the VTAM I/O Facility Affects Your VTAM Terminal

VTAM[®] terminals can fail to respond to requests sent by IMS. The master terminal operator or an automated operator interface application program can optionally activate a "timeout" facility. This allows a message stating a specific amount of time has passed to be sent to the master terminal operator.

IMS TM can be set up to do one of the following:

- Do nothing, which means that your terminal remains inactive. This is the default.
- Send a message to the master terminal operator stating that the specified period of time has passed. The operator can then determine what action, if any, should be taken.
- Send a message to the master terminal operator stating that the specified period of time has passed. IMS TM then issues the VTAM VARY NET, INACT command followed by a VTAM VARY NET, ACT command. If the terminal is defined to IMS TM as non-shared and operable, and if IMS TM is not shutting down, IMS TM issues an OPNDST for the terminal.

Restriction: This option does not apply to ISC terminals. If your installation chooses this option and an ISC terminal times out, a message is sent to the master terminal stating that the specified period of time has passed. The operator can determine what action, if any, should be taken.

Communicating with Other IMS TM Systems Using MSC

In addition to communicating with programs and terminals in your IMS TM system, your program can communicate with terminals and programs in other IMS TM systems through Multiple Systems Coupling (MSC). MSC makes this possible by establishing links between two or more separate IMS TM systems. The terminals and transaction codes within each IMS TM system are defined as belonging to that system. Terminals and transaction codes within your system are called “local,” and terminals and transaction codes defined in other IMS TM systems connected by MSC links are called “remote.”

Related Reading: For an overview of MSC, see *IMS Version 9: Administration Guide: Transaction Manager*.

The following topics provide additional information:

- “Implications of MSC for Program Coding”
- “Receiving Messages from Other IMS TM Systems” on page 62
- “Sending Messages to Alternate Destinations in Other IMS TM Systems” on page 63

Implications of MSC for Program Coding

For the most part, communicating with a remote terminal or program does not affect how you code your program. MSC handles the message routing between systems.

Example: If you receive an input message from a remote terminal, and you want to reply to that terminal, you issue an ISRT call against the I/O PCB—just as you would reply to a terminal in your system.

In the following two situations, MSC might affect your programming:

- When your program needs to know whether an input message is from a remote terminal or a local terminal. For example, if two terminals in separate IMS TM systems had the same logical terminal name, your program’s processing might be affected by knowing which system sent the message.
- When you want to send a message to an alternate destination in another IMS TM system.

Restriction: If a transaction allocated by an LU 6.2 device is destined to a remote system through MSC links, IMS rejects the transaction with the message TP_NOT_Avail_No_Retry.

Related Reading: For more information on LU 6.2, see *IMS Version 9: Administration Guide: Transaction Manager*.

Directed routing makes it possible for your program to find out whether an input message is from your system or from a remote system, and to set the destination of an output message for an alternate destination in another IMS TM system. With directed routing, you can send a message to an alternate destination in another IMS TM system, even if that destination is not defined in your system as remote.

Restriction: MSC directed routing does not support a program-to-program switch between conversational transactions.

Related Reading: For more information about MSC directed routing, see *IMS Version 9: Administration Guide: System*.

Communicating with Other IMS TM Systems

Receiving Messages from Other IMS TM Systems

When an application program retrieves an input message, the program can determine whether the input message is from a terminal or program in its IMS TM system, or from a terminal or program in another IMS TM system. There might be situations in which the application program's processing is changed if the input message is from a remote terminal, rather than from a local terminal.

Example: Suppose that your IMS TM system is system A, and that it is linked to another IMS TM system called system B. MSC links are one-way links. The link from system A to system B is called LINK1, and the link from system B to system A is called LINK2. The application program named MPP1 runs in system A. The logical terminal name of the master terminals in both systems is MASTER. Figure 6 shows systems A and B.

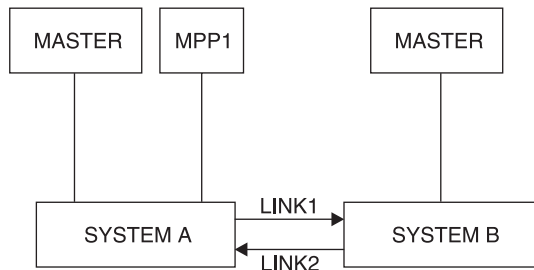


Figure 6. MSC Example

If the MASTER terminal in system B sends a message indicating that the system is shutting down to MPP1 in system A, MPP1 needs to know that the message is from MASTER in system B and not MASTER in system A.

If you have specified ROUTING=YES on the TRANSACT macro during IMS TM system definition, IMS TM does two things to indicate to the program that the message is from a terminal in another IMS TM system.

First, instead of placing the logical terminal name in the first field of the I/O PCB, IMS TM places the name of the MSC logical link in this field. In the example, this is LINK1. This is the logical link name that was specified on the MSNAME macro at system definition. However, if the message is subsequently sent back to the originating system, the originating LTERM name is reinstated in the first field of the I/O PCB.

Second, IMS TM turns on a bit in the field of the I/O PCB that is reserved for IMS. This is the second bit in the first byte of the 2-byte field. Figure 7 shows the location of this bit within the reserved field.

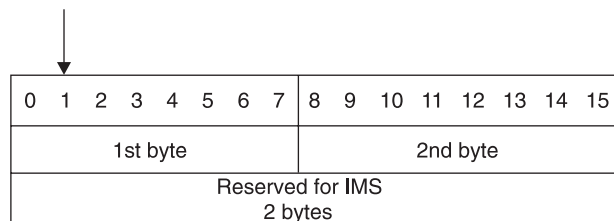


Figure 7. Directed Routing Bit in I/O PCB

MPP1 tests this bit to determine if the message is from MASTER in system A. If it is, MPP1 should terminate immediately. However, if the message is from MASTER in system B, MPP1 could perform some local processing and send transactions for system B to a message queue so that those transactions could be processed later on, when system B is up.

Sending Messages to Alternate Destinations in Other IMS TM Systems

To send an output message to an alternate terminal in another IMS TM system, your system must have an MSC link with the system to which you want to send the message. To do this, issue a CHNG call against an alternate PCB and supply the name of the MSC link (in the example this is LINK1) that connects the two IMS TM systems.

Example: If you were sending a message to TERMINAL 1 in system B after you received a message from some other terminal, you would first issue this CHNG call:
CHNG altpcb, LINK1

Then issue an ISRT call (or calls) to send the message just as you would send a message to a local terminal. Table 17 and Table 18 show the format of the Direct Routing Output Message.

Table 17. Directed Routing Output Message Format for AIBTDLI, ASMTDLI, CBLTDLI, CEETDLI, CTDLI, and PASTDLI Interfaces

Field Name	Field Length
LL	2
ZZ	2
DESTNAME	1 - 8
b	1
Text	Variable

Table 18. Directed Routing Output Message Format for the PLITDLI Interface

Field Name	Field Length
LLLL	4
ZZ	2
DESTNAME	1 - 8
b	1
Text	Variable

The field formats in a directed routing output message are listed below:

- The LL and ZZ fields are 2 bytes each (For the PLITDLI interface, use the 4-byte field LLLL). LL (or LLLL) contains the total length of the message. This is the sum of all of the fields in the message, including the LL field (and in PL/I, LLLL contains the total length minus 2). ZZ is reserved for IMS.
- The destination name, DESTNAME, is the name of the logical terminal to which you are sending the message. This field is from 1 to 8 bytes long and it must be followed by a blank.

If the destination in the other system is a terminal, IMS TM removes the DESTNAME from the message. If the destination in the other system is a program, IMS TM does not remove the DESTNAME.

Communicating with Other IMS TM Systems

- The TEXT field contains the text of the message. Its length depends on the message you are sending.

If your message contains a security violation, MSC detects it in the receiving system (in this case, system B), and reports it to the person at the originating terminal (system A).

IMS Conversations

Definitions:

- A *conversational program* is a message processing program (MPP) that processes transactions made up of several steps. It does not process the entire transaction at the same time. A conversational program divides processing into a connected series of terminal-to-program-to-terminal interactions. You use conversational processing when one transaction contains several parts.
- A *nonconversational program* receives a message from a terminal, processes the request, and sends a message back to the terminal. A conversational program receives a message from a terminal, and replies to the terminal, but saves the data from the transaction in a scratchpad area (SPA). Then, when the person at the terminal enters more data, the program has the data it saved from the last message in the SPA, so it can continue processing the request without the person at the terminal having to enter the data again.

A Conversational Example

For this example, suppose that you want to find out if someone can qualify for a car loan. This inquiry contains two parts. First, you give the name and address of the person requesting the loan and the number of years for which the person wants the loan. After you give this information, IMS TM asks you for the information on the car: model, year, and cost. You enter this information, IMS TM invokes the program that processes this information, and the program tells you whether the loan can be granted.

If you use MFS, the process involves these steps:

1. Enter the format command (/FORMAT) and the MOD name. This tells IMS to format the screen in the way defined by this message output descriptor (MOD).

If the MOD name is CL, the command is:

```
/FORMAT CL
```

IMS TM then takes that MOD from the MFS library and formats your screen in the way defined by the MOD. When the MOD for the car loan application formats your screen, it looks like this:

```
CARLOAN  
NAME:  
ADDRESS:  
YEARS:
```

The word "CARLOAN" is the transaction code for this application. Each transaction code is associated with an application program, so when IMS TM receives the transaction code "CARLOAN,"IMS TM knows what application program to schedule for this request.

2. Enter the customer's name and address, and the length of the loan. When you enter this information, your screen looks like this:

```
CARLOAN  
NAME: JOHN EDWARDS  
ADDRESS: 463 PINWOOD  
YEARS: 5
```

3. IMS TM reads the transaction code, CARLOAN, and invokes the program that handles that transaction code. MFS formats the information from the screen for the MPP's I/O area by using the DIF and the MID.

When the MPP issues its first call, which is usually a GU for the SPA, IMS TM clears the SPA to binary zeros and passes it to the application program.

4. Next, the MPP processes the input data from the terminal and does two things. It moves the data that it will need to save to the SPA, and it builds the output message for the terminal in the I/O area. The information that the MPP saves in the SPA is the information the MPP will need when the second part of the request comes in from the terminal. You do not save information in the SPA that you can get from the database. In this example, you save the name of the customer applying for the loan, because if the customer is granted the loan, the program uses the customer name to locate the information to be updated in the database.

The program then issues an ISRT call to return the SPA to IMS, and another ISRT call to send the output message to the terminal.

The response that the MPP sends to the terminal gives IMS TM the name of the MOD to format the screen for the next cycle of the conversation. In that cycle, you need to supply the model, year, and cost of the car that John Edwards wants to buy. Your screen looks like this:

```
MODEL:
YEAR:
COST:
```

5. IMS TM again uses the device input format (DIF) and message input descriptor (MID) associated with the transaction code, and sends the information back to the MPP. The MPP has not been running all this time. When IMS TM receives the terminal input with the transaction code CARLOAN, IMS TM invokes the MPP that processes that transaction again for this cycle of the conversation.
6. IMS TM returns the updated SPA to the MPP when the MPP issues a GU, then returns the message to the MPP when the MPP issues a GN. The MPP does the required processing (in this case, determining whether the loan can be granted and updating the database if necessary), and is then ready to end the conversation. To do this, the MPP blanks out the transaction code in the SPA, inserts it back to IMS, then sends a message to the terminal saying whether the loan can be granted.

Conversational Structure

Structuring your conversational program depends on the interactions between your program and the person at the terminal. To understand what conversational processing involves, see "IMS Conversations" on page 64.

Before structuring your program, you need to know:

- What should the program do in an error situation?

When a program in a conversation terminates abnormally, IMS TM backs out only the last cycle of the conversation. A cycle in a conversation is one terminal/program interaction. Because the conversation can terminate abnormally during any cycle, you should be aware of some things you can do to simplify recovery of the conversation:

- The ROLB or ROLS call can be used in conversational programs to back out database updates that the program has made since the last commit point. ROLL can also be used in conversational programs, but terminates the conversation. "Using ROLB, ROLL, and ROLS in Conversations" on page 69 explains how these calls work with conversational processing.

IMS Conversations

- If possible, updating the database should be part of the last cycle of the conversation so that you do not have different levels of database updates resulting from the conversation.

- If your program encounters an error situation and it has to terminate, it can use an express alternate (program control block) PCB to send a message to the originating terminal, and, if desired, to the master terminal operator.

To do this, the program issues a CHNG call against the express alternate PCB and supplies the name of the logical terminal from the TP PCB, then an ISRT call that references that PCB and the I/O area that contains the message. The program can then issue another CHNG call to set the destination of the express alternate PCB for the master terminal, and another ISRT call that references that PCB, and the I/O area that contains the output message.

- Does your application program process each cycle of the conversation?

A conversation can be processed by one or several application programs. If your program processes each stage of the conversation (in other words, your program processes each input message from the terminal), the program has to know what stage of the conversation it is processing when it receives each input message.

When the person at the terminal enters the transaction code that starts the conversation, IMS TM clears the SPA to binary zeros and passes the SPA to the program when the program issues a GU call. On subsequent passes, however, the program has to be able to tell which stage of the conversation it is on so that it can branch to the section of the program that handles that processing.

One technique that the program can use to determine which cycle of the conversation it is processing is to keep a counter in the SPA. The program increments this counter at each stage of the conversation. Then, each time the program begins a new cycle of the conversation (by issuing a GU call to retrieve the SPA), the program can check the counter in the SPA to determine which cycle it is processing, then branch to the appropriate section.

- How can your program pass control of the conversation to another conversation program?

Sometimes it is more efficient to use several application programs to process a conversation. This does not affect the person at the terminal. It depends on the processing that is required.

In the car loan example, one MPP could process the first part of the conversation (processing the name, address, and number of years), and another MPP could process the second part of the conversation (processing the data about the car and responding with the status of the loan).

A program can:

- Reply to the originating terminal using a *deferred program switch*.
- Pass the SPA (and, optionally, a message) to another conversational program without responding to the terminal using an *immediate program switch*. In this case, it is the next program's responsibility to respond to the originating terminal.

Definitions:

- A *deferred program switch* responds to the terminal but causes the next input from the terminal to go to another conversational program.
- An *immediate program switch* passes the conversation directly to another conversational program.

A conversational program must:

1. Retrieve the SPA and the message using GU and GN calls.

If your MPP is starting this conversation, test the variable area of the SPA for zeros to determine if this is the beginning of the conversation. If the SPA does not contain zeros, it means that you started the conversation earlier and that you are now at a later stage in the conversation. If this is true, you would branch to the part of your program that processes this stage of the conversation to continue the conversation.

If another MPP has passed control to your MPP to continue the conversation, the SPA contains the data you need to process the message, so you do not have to test it for zeros. Start processing the message immediately.

2. Process the message, including handling any necessary database access.
3. Send the output message to the terminal by using an ISRT call against the I/O PCB. This step can follow step 4.
4. Store the data (that your program, or the program that you pass control to, needs to continue processing) in the SPA using an ISRT call to the I/O PCB. (This step can precede step 3.) IMS TM determines which segment is the SPA by examining the ZZZZ field of the segment shown in Table 19 and Table 20.

To end the conversation, move blanks to the area of the SPA that contains the transaction code, and then insert the SPA back to IMS TM by issuing an ISRT call and referencing the I/O PCB.

If your MPP passes the conversation to another conversational program, the steps after the program processes the message are somewhat different. “Passing the Conversation to another Conversational Program” on page 69 explains this.

Also, your program should be designed to handle the situation that occurs when the first GU call to the I/O PCB does not return a message to the application program. This can happen if the person at the terminal cancels the conversation by entering the /EXIT command before the program issues a GU call. (This happens if the message from this terminal was the only message in the message queue for the program.)

The Contents of SPA

The SPA that IMS TM gives your program when you issue a GU contains the four parts shown in Table 19 and Table 20.

Table 19. SPA Format for AIBTDLI, ASMTDLI, CBLTDLI, CEETDLI, CTDLI, and PASTDLI Interfaces

Field Name	Field Length
LL	2
ZZZZ	4
TRANCODE	8
User Work Area	Variable

Table 20. SPA Format for the PLITDLI Interface

Field Name	Field Length
LLLL	4
ZZZZ	4
TRANCODE	8
User Work Area	Variable

The SPA format fields are:

IMS Conversations

LL or LLLL

A length field that gives the total length of the SPA. This length includes 2 bytes for the LL field. (For the PLITDLI interface, use a 4-byte field. Its contents include 4 bytes for LLLL, minus 2.)

ZZZZ

A 4-byte field reserved for IMS TM that your program must not modify.

TRANCODE

The 8-byte transaction code for this conversation.

User Work Area

A work area that you use to save the information that you need to continue the conversation. The length of this area depends on the length of the data you want to save. This length is defined at system definition.

When your program retrieves the SPA with a GU to start the conversation, IMS TM removes the transaction code from the message. In your first message segment, you receive only the data from the message that the person at the terminal entered.

The following list indicates the ways that an application program processes the SPA. The program must:

- Not modify the first 6 bytes of the SPA (LL and ZZZZ). IMS TM uses these fields to identify the SPA.
If the program modifies the SPA, the program must return the SPA to IMS TM (or, for a program switch, to the other program).
- Not return the SPA to IMS TM more than once during one cycle of the conversation.
- Not insert the SPA to an alternate PCB that represents a nonconversational transaction code or a logical terminal. The program can use an alternate response PCB if it represents that same physical terminal as the originating logical terminal.

Restriction: If you are using MFS, the IMS TM does not always remove the transaction code.

The Appearance of Messages in a Conversation

Because the first segment contains the SPA, conversational input messages are made up of at least two segments. The input message starts in the second message segment.

The input message segment in a conversation contains only the data from the terminal. During the first step in the conversation, IMS TM removes the transaction code from the input message and places it in the SPA. When the program issues the first GU, IMS TM returns the SPA. To retrieve the first message segment, the program must issue a GN.

The format for the output messages that you send to the terminal is no different than the format for output messages in nonconversational programs.

Saving Information in the SPA

After you have processed the message and are ready to reply to the terminal, you can save the necessary data in the SPA. The part of the SPA in which you save data is the work area portion. Use the ISRT call to save data to the work area. This is a special use of the ISRT call, because you are not sending the SPA to a terminal, but rather saving it for future use.

If your program processes each stage of the conversation, you just issue an ISRT call to the I/O PCB and give the name of the I/O area that contains the SPA. For example:

```
ISRT  I/O PCB, I/O AREA
```

This returns the updated SPA to IMS TM so that IMS TM can pass it to your program at the next cycle of the conversation.

If you do not modify the SPA, you do not need to return it to IMS. However, the SPA will be passed by IMS TM to your program at the next cycle of the conversation.

Replying to the Terminal

For a conversation to continue, the originating terminal must receive a response to each of its input messages. The person at the terminal cannot enter any more data to be processed (except IMS TM commands) until the response has been received at the terminal.

To continue the conversation, the program must respond to the originating terminal by issuing the required ISRT calls to send the output message to the terminal. To send a message to the originating terminal, the ISRT calls must reference either the TP PCB or an alternate response PCB. Use an alternate response PCB in a conversation when the terminal you are responding to has two components—for example, a printer and a punch—and you want to send the output message to a component that is separate from the component that sent the input message. If the program references an alternate response PCB, the PCB must be defined for the same physical terminal as the logical terminal that sent the input message.

The program can send only one output message to the terminal for each input message. Output messages can contain multiple segments, but the program cannot use the PURG call to send multiple output messages. If a conversational program issues a PURG call, IMS TM returns an AZ status code to the application program and does not process the call.

Using ROLB, ROLL, and ROLS in Conversations

Issuing a ROLB or ROLS in a conversational program causes IMS TM to back out the messages that the application program has sent. This means that, if the program issues a ROLB or ROLS and then reaches a commit point without sending the required response to the originating terminal, IMS TM terminates the conversation and sends the message DFS2171I NO RESPONSE CONVERSATION TERMINATED. to the originating terminal.

If you issue ROLL during a conversation, IMS TM backs out the updates and cancels output messages, but it also terminates the conversation.

If the application program has processed input as a result of a protected conversation with RRS/MVS, the ROLB will result in IMS abnormally terminating the application program with an ABENDU0711, Reason Code X'20'. IMS will discard the input message.

Passing the Conversation to another Conversational Program

A conversational program can pass the conversation to another conversational program in two ways:

- A deferred switch.

The program can respond to the terminal but cause the next input from the terminal to go to another conversational program by:

- Issuing an ISRT call against the I/O PCB to respond to the terminal
- Placing the transaction code for the new conversational program in the SPA
- Issuing an ISRT call referencing the I/O PCB and the SPA to return the SPA to IMS TM

IMS TM then routes the next input message from the terminal to the program associated with the transaction code that was specified in the SPA. Other conversational programs can continue to make program switches by changing the transaction code in the SPA.

- An immediate switch.

The program can pass the conversation directly to another conversational program by issuing an ISRT call against the alternate PCB that has its destination set to the other conversational program.

The first ISRT call must send the SPA to the other program, but the program passing control can issue subsequent ISRT calls to send a message to the new program. If the program does this, in addition to routing the SPA to the other conversational program, IMS TM updates the SPA as if the program had returned the SPA to IMS. If the program does an immediate switch, the program cannot also return the SPA to IMS TM or respond to the original terminal.

Restrictions on Passing the Conversation

These are restrictions that apply to passing the conversation to another conversational program:

- When an immediate program switch occurs and the MPP receives an XE status code, the program attempts to insert the SPA to an alternate express PCB. Remove the EXPRESS=YES option from the PCB or define and use another PCB that is not express. This restriction prevents the second transaction from continuing the conversation if the first transaction abends after inserting the SPA. The person at the terminal can issue the /SET CONV XX command, where XX is the program that is to be scheduled in order to process the next step of the conversation.
- The SPA size for a conversational program-to-program switch on a remote MSC system also has restrictions when the source system (where the inputting terminal resides) or an intermediate MSC system is IMS Version 5 or earlier:
 - When the ISRT occurs in the local IMS Version 5 system, conversational program-to-program switches can occur to a transaction with a SPA that is larger than, smaller than, or equal to the SPA size of the current transaction.
 - If the SPA ISRT is on a remote MSC system, and is going back to the inputting terminal on the source IMS system, the SPA must be smaller than or equal to the SPA size of the current transaction.
 - If the SPA ISRT is on a remote MSC system, and the destination is a transaction, the SPA must be equal in size to the SPA of the current transaction.
- APPC or OTMA protected transactions do not allow immediate program or deferred program switches. If either of these switches occur, the MPP receives an X6 status code.

Defining the SPA Size

Define the SPA size with the TRANSACT macro. An option to capture truncated data is also defined with the TRANSACT macro. The format is:

```
TRANSACT SPA=(size,STRUNC|RTRUNC)
```

The default is to support truncated data (STRUNC). When a conversation is initially started, and on each program switch, the truncated data option is checked and set or reset as specified. When the truncated data option is set, it remains set for the life of the conversation, or until a program switch occurs to a transaction that specifies that the option be reset.

Example: Assume you have three transactions defined as follows:

TRANA SPA=100

TRANB SPA=050

TRANC SPA=150

For TRANC to receive the truncated data (which is the second 50 bytes from TRANA that TRANB does not receive) from TRANA, one of the following sets of specifications can be used:

- TRANA - STRUNC or none, TRANB - STRUNC or none, TRANC - STRUNC or none
- TRANA - RTRUNC, TRANB - STRUNC, TRANC - STRUNC or none

Conversational Processing and MSC

If your installation has two or more IMS TM systems, and they are linked to each other through MSC, a program in one system can process a conversation that originated in another system.

- If a conversational program in system A issues an ISRT call that references a response alternate PCB in system B, system B does the necessary verification. This is because the destination is implicit in the input system. The verification that system B does includes determining whether the logical terminal that is represented by the response alternate PCB is assigned to the same physical terminal as the logical terminal that sent the input message. If it is not, system B (the originating system) terminates the conversation abnormally without issuing a status code to the application program.
- Suppose program A processes a conversation that originates from a terminal in system B. Program A passes the conversation to another conversational program by changing the transaction code in the SPA. If the transaction code that program A supplies is invalid, system B (the originating system) terminates the conversation abnormally without returning a status code to the application program.
- When the source system (where the inputting terminal resides) is IMS Version 5 or earlier, the SPA size for a conversational program-to-program switch has restrictions. For more information, see “Restrictions on Passing the Conversation” on page 70.

Ending the Conversation

To end the conversation, a program blanks out the transaction code in the SPA and returns it to IMS TM by issuing an ISRT call and referencing the I/O PCB and the SPA. This terminates the conversation as soon as the terminal has received the response.

The program can also end the conversation by placing a nonconversational transaction code in the transaction field of the SPA and returning the SPA to IMS. This causes the conversation to remain active until the person at the terminal has entered the next message. The transaction code will be inserted from the SPA into the first segment of the input message. IMS TM then routes this message from the terminal to the MPP or BMP that processes the transaction code that was specified in the SPA.

IMS Conversations

In addition to being ended by the program, a conversation can be ended by the person at the originating terminal, the master terminal operator, and IMS.

- The person at the originating terminal can end the conversation by issuing one of several commands:

/EXIT The person at the terminal can enter the /EXIT command by itself, or the /EXIT command followed by the conversational identification number assigned by the IMS TM system.

/HOLD The /HOLD command stops the conversation temporarily to allow the person at the terminal to enter other transactions while IMS TM holds the conversation. When IMS TM responds to the /HOLD command, it supplies an identifier that the person at the terminal can later use to reactivate the conversation. The /RELEASE command followed by this identifier reactivates the conversation.

- **/START LINE.** The master terminal operator can end the conversation by entering a /START LINE command (without specifying a PTERM) or /START NODE command for the terminal in the conversation or a /START USER command for a signed-off dynamic user in conversation.
- IMS TM ends a conversation if, after the program successfully issues a GU call or an ISRT call to return the SPA, the program does not send a response to the terminal. In this situation, IMS TM sends the message DFS2171I NO RESPONSE, CONVERSATION TERMINATED to the terminal. IMS TM then terminates the conversation and performs commit point processing for the application program.

Message Switching in APPC Conversations

With the system service DFSAPPC, you can transfer messages between separate LU 6.2 devices and between an LU 6.2 device and another terminal supported by IMS TM. Message delivery with DFSAPPC is asynchronous, so messages are held on the IMS TM message queue until they can be delivered.

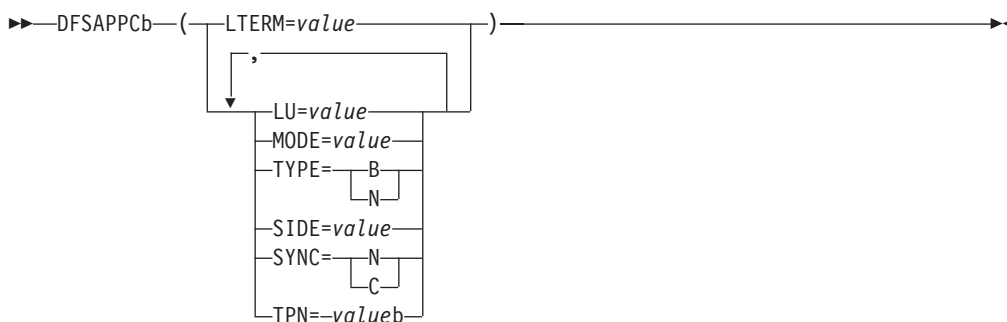
To send a message with DFSAPPC, specify the logical terminal name of an IMS TM terminal or the Transaction Program (TP) name of an LU 6.2 device.

DFSAPPC Format

The message format for DFSAPPC is as follows:

DFSAPPC (*options*)*user_data*

DFSAPPC can be coded as follows:



A blank (b) is required between DFSAPPC and the specified options.

Blanks are valid within the specified options except within keywords or values. Either commas or blanks can be used as delimiters between options, but because the use of commas is valid, the TP name must be followed by at least one blank.

If an LU 6.2 conversation has not been established from other sources (for example, during a CPI-C driven application program), DFSAPPC is used to establish the conversation with a partner LU 6.2 device. If no options are specified with DFSAPPC, IMS TM default options are used.

Option Keywords

LTERM=

Specifies the LTERM name of an IMS TM logical terminal. An LTERM name can contain up to eight alphanumeric or national (@, \$, #) characters. If you specify LTERM, you cannot specify the other option keywords.

LU=

Specifies the LU name of the partner in an LU 6.2 conversation. The LU name can contain up to eight alphanumeric or national characters, but the first character must be a letter or a national character. If both LU and SIDE options are specified, LU overrides the LU name contained in the side information entry but does not change that LU name.

If the LU name is a network-qualified name, it can be up to 17 characters long and consist of the network ID of the originating system, followed by a '.', and the LU name (for example, netwrkid.luname). The LU name and the network ID can be up to eight characters long.

MODE=

Specifies the MODE name of the partner in an LU 6.2 conversation. The MODE name can contain up to eight alphanumeric or national characters, but the first character must be a letter or a national character. If both MODE and SIDE option keywords are specified, MODE overrides the MODE name contained in the side information entry but does not change that MODE name.

TPN=

Specifies the transaction program (TP) name of the partner in an LU 6.2 conversation. The TP name can contain up to 64 characters from the 00640 character set. Because the character set allows commas, at least one blank must follow the TP name. If both TPN and SIDE option keywords are specified, TPN overrides the TP name contained in the side information entry but does not change that name.

Related Reading: The *Common Programming Interface Communications Reference* describes the 00640 character set, which contains all alphanumeric and national characters and 20 special characters.

SIDE=

Specifies the name of the side information entry for the partner in an LU 6.2 conversation. The side information entry name can contain up to eight characters from the 01134 character set. If the SIDE option keyword is specified, it can be overridden with LU, MODE, and TPN option keywords.

Related Reading: The *Common Programming Interface Communications Reference* describes the 01134 character set, which contains the uppercase alphabet and the digits, 0-9.

SYNC=NIC

Specifies the synchronization level of the LU 6.2 conversation. N selects none as the synchronization level, and C selects confirm as the synchronization level.

TYPE=BIM

Specifies the conversation type for the LU 6.2 conversation. B selects a basic conversation type, and M selects a mapped conversation type.

Processing Conversations with APPC

APPC/IMS supports three different types of application programs:

- Standard: No explicit use of CPI Communications facilities.
- Modified: Uses the I/O PCB to communicate with the original input terminal. Uses CPI Communications calls to allocate new conversations and to send and receive data.
- CPI Communications driven: Uses CPI Communications calls to receive the incoming message and to send a reply on the same conversation. Uses the DL/I APSB call to allocate a PSB to access IMS databases and alternate PCBs.

In the modified or CPI Communications driven application programs, if an APPC conversation is allocated with SYNCLVL=SYNCPT, z/OS manages the sync-point process for the APPC conversation participants: the application program and IMS. Transaction rollback and rescheduling is possible, because IMS issues the SRRCMIT or SRRBACK calls on behalf of the modified IMS APPC application program. If the CPI-C driven program is linked with the IMS stub code (DFSCPIR0) as required in previous releases, IMS also issues the SRRCMIT or SRRBACK calls. If the program is not linked with the stub code, then IMS is driven by the z/OS sync point manager when the application issues these calls. With z/OS as the sync point manager, failures can also be backed out.

You can schedule your standard and modified application programs locally and remotely using MSC or APPC/MVS. The logic flow for local scheduling differs from the logic flow for remote scheduling.

Scheduling programs remotely through MSC is not supported if an APPC/MVS conversation with SYNCLVL=SYNCPT is specified.

Ending the APPC Conversation

The two ways to end a conversation using LU 6.2 devices are to:

- Issue the CPI-C verb, DEALLOCATE
- Insert a blank transaction code into the SPA for IMS conversational transactions

Restriction: You cannot use the /EXIT command for LU 6.2 conversations.

Several error conditions can exist at the end of an LU 6.2 conversation:

- If your application program sends data to the LU 6.2 device just before deallocating conversation, IMS TM issues a SENDERROR and SENDDATA of the DFS1966 error message. This indicates that the transaction ended, but that the last message could not be delivered. For SENDERROR to be activated, specify a synchronization level of CONFIRM.
- If IMS TM encounters an error sending output from an IMS TM conversational transaction to the LU 6.2 device, the output is discarded, and the conversation is terminated for both IMS TM and LU 6.2.
- If an IMS TM conversational application program abends during an LU 6.2 conversation, a DFS555 error message is sent to the originating LU 6.2 device, and the conversation is terminated for both IMS TM and LU 6.2.

Coding a Conversational Program

Before coding a conversational program, obtain this information:

- The transaction code to use for a program to which you pass control
- The data that you should save in the SPA
- The maximum length of that data

A SPA contains four fields:

- The 2-byte length field.
- The 4-byte field that is reserved for IMS TM.
- The 8-byte transaction code.
- The work area where you store the conversation data. The length of this field is defined at system definition.

Standard IMS Application Programs

Standard IMS application programs use the existing IMS call interface. Application programs that use the IMS standard API can take advantage of the LU 6.2 protocols. Standard IMS application programs use a DL/I GU call to get the incoming transaction. These standard IMS application programs also use DL/I ISRT calls to generate output messages to the same or different terminals, regardless of whether LU 6.2 is used.² The identical program can work correctly for both LU 6.2 and non-LU 6.2 terminal types. IMS generates the appropriate calls to APPC/MVS services.

When an advanced program-to-program communication (APPC) application program enters an IMS transaction that executes on a remote IMS, an LU 6.2 conversation is established between the APPC application program and the local IMS system. The local IMS is considered the partner LU of the LU 6.2 conversation. The transaction is then queued on the remote transaction queue of the local IMS system. From this point on, the transaction goes through normal MSC processing. After the remote IMS system executes the transaction, the output is returned to the local IMS system and is then delivered to the originating LU 6.2 application program.

Modified IMS Application Programs

Modified IMS application programs use a DL/I GU call to get the incoming transaction. These modified IMS application programs also use DL/I ISRT calls to generate output messages to the same or different terminals, regardless of whether LU 6.2 is used.³ Unlike standard IMS application programs, modified IMS application programs use CPI Communications calls to allocate new conversations, and to send and receive data. IMS has no direct control of these CPI Communications conversations.

Modified IMS transactions are indistinguishable from standard IMS transactions until program execution. In fact, the same application program can be a standard IMS application on one execution, and a modified IMS application on a different execution. The distinction is simply whether the application program uses CPI Communications resources.

2. A non-message-driven BMP is considered a standard IMS application program when it does not use the explicit API.

3. A non-message-driven BMP is considered a modified standard IMS application program when it uses the explicit API.

Processing Conversations with APPC

Modified IMS programs are scheduled by IMS TM, and the DL/I calls are processed by the DL/I language interface. The conversation, however, is maintained by APPC/MVS, and any failures that involve APPC/MVS are not backed out by IMS TM. The general format of a modified IMS application program is shown in Figure 8.

Related Reading: For more information on failure recovery and modified DL/I application program design, see *IMS Version 9: Application Programming: Design Guide*.

```
GU      IOPCB
        ALLOCATE
        SEND
        RECEIVE
        DEALLOCATE
ISRT    IOPCB
```

Figure 8. General Format of a Modified DL/I Application Program

Restriction: The APPC conversation cannot span sync points. If the conversation is not deallocated before a sync point is reached, IMS causes the conversation to be terminated by issuing a clean TP call (ATBCMTP). A new APPC conversation can be allocated after each sync point.

When an APPC program enters an IMS transaction that executes on a remote IMS system, an LU 6.2 conversation is established between the APPC program and the local IMS system. The local IMS system is considered the partner LU of the LU 6.2 conversation. The transaction is then queued on the local IMS system's remote transaction queue. From this point on, the transaction goes through normal MSC processing. After the remote IMS system executes the transaction, the output is returned to the local IMS and is then delivered to the originating LU 6.2 program.

CPI-C Driven Application Programs

CPI Communications driven application programs are defined only in the APPC/MVS TP_Profile data set; they are not defined to IMS. Their definition is dynamically built by IMS when a transaction is presented for scheduling by APPC/MVS, based on the APPC/MVS TP_Profile definition after IMS restart. The definition is keyed by TP name. APPC/MVS manages the TP_Profile information.

When a CPI Communications driven transaction program requests a PSB, the PSB must already be defined to IMS through the APPLCTN macro for system definition and through PSBGEN or ACBGEN when APPLCTN PSB= is specified. When APPLCTN GPSB= is specified, a PSBGEN or ACBGEN is not required.

CPI-C driven application programs must begin with the CPI-C verbs, ACCEPT and RECEIVE, to initiate the LU 6.2 conversation. You can then issue the APSB call to allocate a PSB for use by the application program. After the APSB call is issued, you can issue additional DL/I calls using the PCBs that were allocated. You then issue the SRRCMIT verb to commit changes or the SRRBACK verb to back out changes. To use SRRCMIT and SRRBACK, your application program must be linked with DFSCPIR0.

Restriction: The I/O PCB cannot be used for message processing calls by CPI-C driven application programs. See the description of each call for specific CPI restrictions.

To deallocate the PSB in use, issue the DPSB call. You can then issue another APSB call, or use the CPI-C verb, DEALLOCATE, to end the conversation.

CPI-C driven application programs are considered discardable (unless they are allocated with a SYNCLVL=SYNCPT) by IMS TM and are therefore not recovered automatically at system failure. If they are allocated with a SYNCLVL=SYNCPT, a two-phase commit process is used to recover from any failures. The general format of a CPI-C driven application program is shown in Figure 9.

Related Reading: For more information on recovery procedures and CPI-C driven application program design, see *IMS Version 9: Application Programming: Design Guide*.

```
ACCEPT
RECEIVE
  APSB
    GU DBPCB
    REPL DBPCB
    SRRCMIT
  DPSB
DEALLOCATE
```

Figure 9. General Format of a CPI-C Driven Application Program

Restriction: The APPC conversation cannot span sync points. If the conversation is not deallocated before a sync point is reached, IMS causes the conversation to be terminated by issuing a clean TP call (ATBCMTP). A new APPC conversation can be allocated after each sync point.

Processing Conversations with OTMA

You can run IMS conversational transactions through OTMA. Refer to *IMS Version 9: Open Transaction Manager Access Guide and Reference*.

Backing out to a Prior Commit Point: ROLL, ROLB, and ROLS Calls

When a program determines that some of its processing is invalid, you can use these calls to remove the effects of its incorrect processing: Roll Back calls ROLL, ROLS using a database PCB, ROLS with no I/O area or token, and ROLB. When you issue one of these calls, IMS does the following:

- Backs out the database updates that the program has made since the program's most recent commit point.
- Cancels the non-express output messages that the program has created since the program's most recent commit point.

The main difference among these calls is that ROLB returns control to the application program after backing out updates and canceling output messages, ROLS does not return control to the application program, and ROLL terminates the program with a user abend code of 0778. ROLB can return to the program the first message segment since the most recent commit point, but ROLL and ROLS cannot.

The ROLL and ROLB calls, and the ROLS call without a token specified, are valid when the PSB contains PCBs for Generalized Sequential Access Method (GSAM) data sets. However, segments inserted in the GSAM data sets since the last commit

Backing out to a Prior Commit Point: ROLL, ROLS, and ROLB Calls

point are not backed out by these calls. An extended checkpoint-restart can be used to reposition the GSAM data sets when restarting.

You can use a ROLS call either to back out to the prior commit point or to back out to an intermediate backout point established by a prior SETS call. This section refers only to the form of ROLS that backs out to the prior commit point. For information about the other form of ROLS, see “Backing out to an Intermediate Backout Point: SETS/SETU and ROLS” on page 81.

Table 21 summarizes the similarities and differences among the ROLL, ROLS and ROLB calls when specific actions are taken.

The following topics provide additional information:

- “Comparison of ROLB, ROLL, and ROLS”
- “ROLL” on page 79
- “ROLB” on page 79

Comparison of ROLB, ROLL, and ROLS

Table 21. Comparison of ROLB, ROLL, and ROLS

Actions Taken	ROLB	ROLL	ROLS
Back out database updates since the last commit point.	X	X	X
Cancel output messages created since the last commit point.	X ¹	X ¹	X ¹
Delete the message in process from the queue. Previous messages (if any) processed since the last commit point are returned to the queue to be reprocessed.		X	
Return the first segment of the first input message since the most recent commit point.	X ²		
3303 abnormal termination and returns the processed input messages to the message queue.			X ³
778 abnormal termination, no dump.		X	
No abend; program continues processing.	X		

Notes:

1. ROLB, ROLL, or ROLS cancel output messages sent with an express PCB unless the program issued a PURG.

Example: If the program issues the call sequence below, MSG1 would be sent to its destination because the PURG tells IMS that MSG1 is complete and the I/O area now contains the first segment of the next message (which in this example is MSG2). MSG2, however, would be canceled:

```
ISRT    EXPRESS PCB, MSG1
PURG    EXPRESS PCB, MSG2
ROLB    I/O PCB
```

Because IMS has the complete message (MSG1) and because an express PCB is being used, the message can be sent before a commit point.

2. Returned only if you supply the address of an I/O area as one of the call parameters.
3. The transaction is suspended and requeued for subsequent processing.

ROLL

A ROLL call backs out the database updates and cancels any non-express output messages the program has created since the last commit point. It also deletes the current input message. Any other input messages processed since the last commit point are returned to the queue to be reprocessed. IMS then terminates the program with a user abend code 0778. This type of abnormal termination terminates the program without a storage dump.

When you issue a ROLL call, the only parameter you supply is the call function, ROLL.

You can use the ROLL call in a batch program. If your system log is on direct access storage, and if dynamic backout has been specified through the use of the BKO execution parameter, database changes since the last commit point will be backed out. Otherwise they will not be backed out. One reason for issuing ROLL in a batch program is for compatibility.

After backout is complete, the original transaction is discarded if it is discardable, and it is not re-executed. IMS issues the APPC/MVS verb ATBCMTP TYPE(ABEND) specifying the TPI to notify remote transaction programs. Issuing the APPC/MVS verb causes all active conversations (including any spawned by the application program) to be DEALLOCATED TYP(ABEND_SVC).

ROLB

The advantage of using ROLB is that IMS returns control to the program after executing ROLB, so the program can continue processing. The parameters for ROLB are:

- The call function ROLB
- The name of the I/O PCB or AIB

The total effect of the ROLB call depends on the type of IMS application that issued it.

- For current IMS application programs:
After IMS backout is complete, the original transaction is represented to the IMS application program. Any resources that cannot be rolled back by IMS are ignored. For example, output sent to an express alternate PCB and a PURG call is issued before the ROLB.
- For modified IMS application programs:
The same consideration for the current IMS application programs applies. It is the responsibility of the application program to notify any spawned conversations that a ROLB was issued.
- For CPI-C driven IMS application programs:
Only IMS resources are affected. All database changes are backed out. Any messages inserted to nonexpress alternate PCBs are discarded. Also, any messages inserted to express PCBs that have not had a PURGE call are discarded. It is the responsibility of the application program to notify the originating remote program and any spawned conversations that a ROLB call was issued.

In MPPs and Transaction-Oriented BMPs

If the program supplies the address of an I/O area as one of the ROLB parameters, the ROLB call acts as a message retrieval call and returns the first segment of the first input message since the most recent commit point. This is true only if the

Backing out to a Prior Commit Point: ROLL, ROLS, and ROLB Calls

program has issued a GU call to the message queue since the last commit point; if it has not, it was not processing a message when it issued the ROLB call.

If the program issues a GN to the message queue after issuing the ROLB, IMS returns the next segment of the message that was being processed when ROLB was issued. If there are no more segments for that message, IMS returns a QD status code.

If the program issues a GU to the message queue after the ROLB call, IMS returns the first segment of the next message to the application program. If there are no more messages on the message queue for the program to process, IMS returns a QC status code to the program.

If you include the I/O area parameter, but you have not issued a successful GU call to the message queue since the last commit point, IMS returns a QE status code to your program.

If you do not include the address of an I/O area in the ROLB call, IMS does the same things for you. If the program has issued a successful GU in the commit travel, and then issues a GN, IMS returns a QD status code. If the program issues a GU after the ROLB, IMS returns the first segment of the next message, or a QC status code if there are no more messages for the program.

If you have not issued a successful GU since the last commit point, and you do not include an I/O area parameter on the ROLB call, IMS backs out the database updates and cancels the output messages created since the last commit point.

In Batch Programs

If your system log is on direct access storage, and if dynamic backout has been specified through the use of the BKO execution parameter, you can use the ROLB call in a batch program. The ROLB call does not process messages as it does for message processing programs (MPPs); it backs out the database updates since the last commit point and returns control to your program. You cannot specify the address of an I/O area as one of the parameters on the call; if you do, an AD status code is returned to your program. You must, however, have an I/O PCB for your program. Specify CMPAT=YES on the CMPAT keyword in the PSBGEN statement for your program's PSB.

Related Reading: For more information on using the CMPAT keyword, see *IMS Version 9: Utilities Reference: System*. For information on coding the ROLB call, see "ROLB Call" on page 324.

ROLS

The two ways that you can use the ROLS call to back out to the prior commit point and return the processed input messages to IMS for later reprocessing are:

- Have your program issue the ROLS call using the I/O PCB but without an I/O area or token in the call. The parameters for this form of the ROLS call are:
 - The call function ROLS
 - The name of the I/O PCB or AIB
- Have your program issue the ROLS call using a database PCB that has received one of the data-unavailable status codes. This has the same result as if unavailable data were encountered, and the INIT call was not issued. ROLS must be the next call for that PCB. Intervening calls using other PCBs are permitted.

On a ROLS with a token, message queue repositioning can occur for all non-express messages including all messages processed by IMS. This processing using

Backing out to a Prior Commit Point: ROLL, ROLS, and ROLB Calls

APPC/MVS calls and includes the initial message segments. The original input transaction can be represented to the IMS application program. Input and output positioning is determined by the SETS call. This positioning applies to current and modified IMS application programs but does not apply to CPI-C driven IMS programs. The IMS application program must notify all remote transaction programs of the ROLS.

On a ROLS without a token, IMS issues the APPC/MVS verb, ATBCMTP TYPE(ABEND), specifying the TPI. Issuing this verb causes all conversations associated with the application program to be DEALLOCATED TYPE(ABEND_SVC). If the original transaction was entered from an LU 6.2 device and IMS received the message from APPC/MVS, a discardable transaction is discarded rather than being placed on the suspend queue like a non-discardable transaction.

Related Reading: For more information on LU 6.2, see *IMS Version 9: Administration Guide: Transaction Manager*.

The parameters for this form of the ROLS call are:

- The call function, ROLS
- The name of the DB PCB that received the BA or BB status code

In both of the ways to use ROLS calls, the ROLS call causes a 3303 abnormal termination and does not return control to the application program. IMS keeps the input message for future processing.

Backing out to an Intermediate Backout Point: SETS/SETU and ROLS

You can use a ROLS call either to back out to an intermediate backout point established by a prior SETS or SETU call or to back out to the prior commit point. This section refers only to the form of ROLS that backs out to the intermediate backout point. For information about the other form of ROLS, see “Backing out to a Prior Commit Point: ROLL, ROLB, and ROLS Calls” on page 77.

The ROLS call that backs out to an intermediate point backs out only DL/I changes. This version of the ROLS call does not affect CICS changes using CICS file control or CICS transient data.

The SETS and ROLS calls set intermediate backout points within the call processing of the application program and then backout database changes to any of these points. Up to nine intermediate backout points can be set. The SETS call specifies a token for each point. IMS then associates this token with the current processing point. A subsequent ROLS call, using the same token, backs out all database changes and discards all non-express messages that were performed following the SETS call with the same token. Figure 10 on page 82 shows how the SETS and ROLS calls work together.

In addition, to assist the application program in reestablishing other variables following a ROLS call, user data can be included in the I/O area of the SETS call. This data is then returned when the ROLS call with the same token is issued.

Backing out to an Intermediate Backout Point: SETS/SETU and ROLS

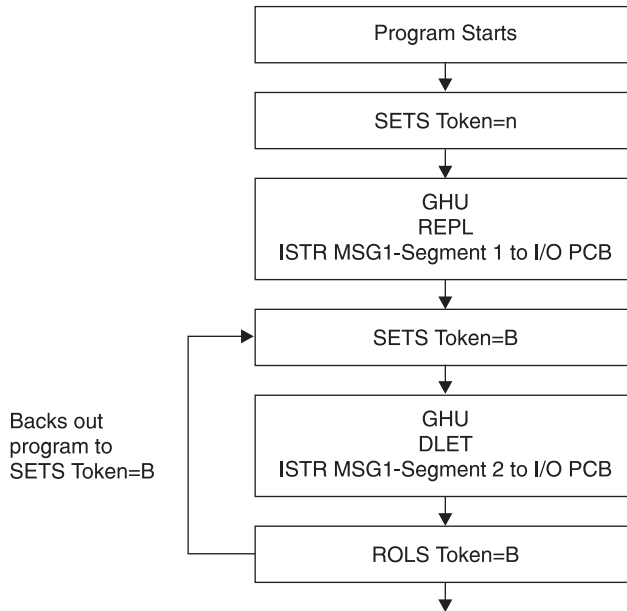


Figure 10. SETS and ROLS Calls Working Together

SETS/SETU

The SETS call sets up to nine intermediate backout points or cancels all existing backout points. By using the SETS call, you can back out pieces of work. If the necessary data to complete one piece of work is unavailable, you can complete a different piece of work and then return to the former piece.

To set an intermediate backout point, issue the call using the I/O PCB and include an I/O area and a token. The I/O area has the format LLZZ user-data, where LL is the length of the data in the I/O area including the length of the LLZZ portion. The ZZ field must contain binary zeros. The data in the I/O area is returned to the application program on the related ROLS call. If you do not want to save some data to be returned on the ROLS call, you must set the LL that defines the length of the I/O area to 4.

For PLITDLI, you must define the LL field as a fullword rather than a halfword as it is for the other languages. The content of the LL field for PLITDLI is consistent with the I/O area for other calls using the LLZZ format; that is, the content is the total length of the area including the length of the 4-byte LL field minus 2.

A 4-byte token associated with the current processing point is also required. This token can be a new token for this program execution or match a token issued by a preceding SETS call. If the token is new, no preceding SETS calls are canceled. If the token matches the token of a preceding SETS call, the current SETS call assumes that position. In this case, all SETS calls that were issued subsequent to the SETS call with the matching token are canceled.

The parameters for this form of the SETS call are:

- The call function SETS
- The name of the I/O PCB or AIB
- The name of the I/O area containing the user data

Backing out to an Intermediate Backout Point: SETS/SETU and ROLS

- The name of an area containing the token

For the SETS call format, see “SETS/SETU Call” on page 328.

To cancel all previous backout points, the call is issued using the I/O PCB but does not include an I/O area or a token. When no I/O area is included in the call, all intermediate backout points set by prior SETS calls are canceled.

The parameters for this form of the SETS call are:

- The call function SETS
- The name of the I/O PCB or AIB

Because it is not possible to back out committed data, commit point processing causes all outstanding SETS to be canceled.

If PCBs for DEDB, MSDB, and GSAM organizations are in the PSB, or if the program accesses an attached subsystem, a partial backout is not possible. In that case, the SETS call is rejected with an SC status code. If the SETU call is used instead, it is not rejected because of unsupported PCBs, but returns an SC status code as a warning that the PSB contains unsupported PCBs and the function is not applicable to these unsupported PCBs.

Related Reading: For the status codes that are returned after the SETS call and the explanation of those status codes and the response required, see *IMS Version 9: Messages and Codes, Volume 1*.

ROLS

The ROLS call backs out database changes to a processing point set by a previous SETS or SETU call, or to the prior commit point and returns the processed input messages to the message queue.

To back out database changes and message activity that have occurred since a prior SETS call, you issue the ROLS call using the I/O PCB and specifying an I/O area and token in the call. If the token does not match a token set by a preceding SETS call, an error status is returned. If the token does match the token of a preceding SETS call, the database updates made since this corresponding SETS call are backed out, and all non-express messages inserted since the corresponding SETS are discarded. The ROLS call returns blanks if the call is processed, and returns a status code if an error or warning occurs. If you are using SETU with ROLS and have an external subsystem, the ROLS call will not be rejected, but an RC status code will be returned as a warning. All SETS points that were issued as part of the processing that was backed out are then canceled, and the existing database position for all supported PCBs is reset. For the ROLS call format, see “ROLS Call” on page 327.

The parameters for this form of the ROLS call are:

- The call function ROLS
- The name of the I/O PCB or AIB
- The name of the I/O area to receive the user data
- The name of an area containing the 4-byte token

Related Reading: For the status codes that are returned after the ROLS call and the explanations of those status codes and the response required, see *IMS Version 9: Messages and Codes, Volume 1*.

Writing Message-Driven Programs

A message-driven program is similar to an MPP: it retrieves messages and processes them, and it can read and update MSDBs, DEDBs, and full-function databases.

Message-driven programs can send messages to these destinations:

- The logical terminal that sent the input message, by issuing an ISRT call referencing the I/O PCB
- A different component of the physical terminal that sent the input message, by issuing an ISRT call referencing an alternate response PCB
- A different physical terminal from the one that sent the input message, by issuing an ISRT call referencing an alternate PCB

The message processing functions available to a message-driven program have some restrictions. These restrictions apply only to messages received or sent by the I/O PCB. The input message for a message-driven program must be a single segment message. Therefore, GU is the only call you can use to obtain the input message. The response message sent by the I/O PCB also must be a single segment message.

The transactions are in the response mode. This means that you must respond before the next message can be sent. You cannot use SPAs because a message-driven program cannot be a conversational program.

Not all of the system service calls are available. These system service calls are valid in a message-driven region:

CHKP (basic)
DEQ
INIT
LOG
SETS
ROLB
ROLS

However, other conditions might restrict their function in this environment. The options or calls issued using alternate terminal PCBs have no constraints.

Coding DC Calls and Data Areas

The way you code DC calls and data areas depends on the application programming language you use.

Before Coding Your Program

In addition to the information you need about the database processing that your program does, you need to know about message processing. Before you start to code, be sure you are not missing any of this information. Also, be aware of the standards at your installation that affect your program.

Information you need about your program's design:

- The names of the logical terminals that your program will communicate with

- The transaction codes, if any, for the application program's MPP skeleton to which your program will send messages
- The DC call structure for your program
- The destination for each output message that you send
- The names of any alternate destinations to which your program sends messages

Information you need about input messages:

- The size and layout of the input messages your program will receive (if possible)
- The format in which your program will receive the input messages
- The editing routine your program uses
- The range of valid data in input messages
- The type of data that input messages will contain
- The maximum and minimum length of input message segments
- The number of segments in a message

Information you need about output messages:

- The format in which IMS expects to receive output from your application program MPP skeleton
- The destination for the output messages
- The maximum and minimum length of output message segments

Skeleton MPP

For examples of skeleton MPPs, refer to:

Language	See
C	Figure 11 on page 86
COBOL	Figure 12 on page 88
Pascal	Figure 13 on page 90
PL/I	Figure 14 on page 92

These programs do not have all the processing logic that a typical MPP has. The purpose of providing these programs is to show you the basic MPP structure in COBOL, C language, Pascal, and PL/I. All the programs follow these steps:

1. The program retrieves an input message segment from a terminal by issuing a GU call to the I/O PCB. This retrieves the first segment of the message. Unless this message contains only one segment, your program issues GN calls to the I/O PCB to retrieve the remaining segments of the message. IMS places the input message segment in the I/O area that you specify in the call. In each of skeleton MPP examples, this is the MSG-SEG-IO-AREA.
2. The program retrieves a segment from the database by issuing a GU call to the DB PCB. This call specifies an SSA, SSA-NAME, to qualify the request. IMS places the database segment in the I/O area specified in the call. In this case, the I/O area is called DB-SEG-IO-AREA.
3. The program sends an output message to an alternate destination by issuing an ISRT call to the alternate PCB. Before issuing the ISRT call, the program must build the output message segment in an I/O area, and then the program specifies the I/O area in the ISRT call. The I/O area for this call is ALT-MSG-SEG-OUT.

Coding DC Calls and Data Areas

The sample program is simplified for demonstration purposes; for example, the call to initiate sync point is not shown in the sample program. Include other IMS calls in a complete application program.

Coding Your Program in Assembler Language

The coding conventions of an assembler language MPP are the same as those for a DL/I assembler program. An assembler language MPP receives a PCB parameter list address in register 1 when it executes its entry statement. The first address in this list is a pointer to the TP PCB; the addresses of any alternate PCBs that the program uses come after the I/O PCB address, and the addresses of the database PCBs that the program uses follow. Bit 0 of the last address parameter is set to 1.

Coding Your Program in C Language

The program shown in Figure 11 is a skeleton MPP written in C language. The numbers to the right of the program refer to the notes that follow the program.

All storage areas that are referenced in the parameter list of your C language application program call to IMS can reside in the extended virtual storage area.

```
#pragma runopts(env(IMS),plist(IMS))
#include <ims.h>
#include <stdio.h>
/*
/*          ENTRY POINT
/*
main() {
    static const char func_GU[4] = "GU ";
    static const char func_ISRT[4] = "ISRT";

    #define io_pcb ((IO_PCB_TYPE *)(_pcblist[0])
    #define alt_pcb (_pcblist[1])
    #define db_pcb  (_pcblist[2])

    int rc;

    #define io_pcb ((IO_PCB_TYPE *)(_pcblist[0])
    #define alt_pcb (_pcblist[1])
    #define db_pcb  (_pcblist[2])

    rc = ctdli(func_GU, io_pcb, msg_seg_io_area);

    rc = ctdli(func_GU, db_pcb, db_seg_io_area, ssa_name);

    rc = ctdli(func_ISRT, alt_pcb, alt_msg_seg_out);

}
C language interface
```

NOTES
1
2
3
4
5
6
7
8
9
10
11

Figure 11. Skeleton MPP Written in C

Notes for C Language Program:

1. The env(IMS) establishes the correct operating environment and the plist(IMS) establishes the correct parameter list, when invoked under IMS. The ims.h header file contains declarations for PCB layouts, __pcblist, and the ctdli routine. The PCB layouts define masks for the DB PCBs that the program uses as structures. These definitions make it possible for the program to check fields in the DB PCBs.

The `stdio.h` header file contains declarations for `sprintf`, which is useful for building SSAs.

2. After IMS has loaded the application program's PSB, IMS passes control to the application program through this entry point.
3. These are convenient definitions for the function codes and could be in one of your include files.
4. These could be structures, with no loss of efficiency.
5. The return code (status value) from DL/I calls can be returned and used separately.
6. The C language run-time sets up the `__pcblist` values. The order in which you refer to the PCBs must be the same order in which they have been defined in the PSB: first the TP PCB, then any alternate PCBs that your program uses, and finally the database PCBs that your program uses.
7. The program issues a GU call to the I/O PCB to retrieve the first message segment. You can leave out the `rc =`, and check the status in some other way.
8. The program issues a GU call to the DB PCB to retrieve a database segment. The function codes for these two calls are identical; the way that IMS identifies them is by the PCB to which each call refers.
9. The program then sends an output message to an alternate destination by issuing an ISRT call to an alternate PCB.
10. When there are no more messages for the program to process, the program returns control to IMS by returning from `main` or by calling `exit()`.
11. IMS provides a language interface module (DFSLI000) that gives a common interface to IMS. This module must be made available to the application program at link-edit time.

Coding Your Program in COBOL

The program shown in Figure 12 on page 88 is a skeleton MPP in COBOL that shows the main elements of an MPP. The numbers to the right of each part of the program refer to the notes that follow the program.

If you plan to preload your IBM COBOL for z/OS & VM program, you must use the compiler option `RENT`. Alternatively, if you plan to preload your VS COBOL II program, you must use the compiler options `RES` and `RENT`.

If you want to use the IBM COBOL for z/OS & VM compiler to compile a program that is to execute in `AMODE(31)` on z/OS, you must use the compiler option `RENT`. Alternatively, if you want to use the VS COBOL II compiler to compile a program that is to execute in `AMODE(31)` on z/OS, you must use the compiler options `RES` and `RENT`. All storage areas that are referenced in the parameter lists of your calls to IMS can optionally reside in the extended virtual storage area.

IBM COBOL for z/OS & VM and VS COBOL II programs can coexist in the same application.

NOTES:

```

ENVIRONMENT DIVISION.
.
.
DATA DIVISION.
WORKING-STORAGE SECTION.                                1
    77 GU-CALL PICTURE XXXX VALUE 'GU '.
    77 ISRT-CALL PICTURE XXXX VALUE 'ISRT'.
    77 CT PICTURE S9(5) COMPUTATIONAL VALUE +4.
    01 SSA-NAME.
.
    01 MSG-SEG-IO-AREA.                                    2
.
    01 DB-SEG-IO-AREA.
.
    01 ALT-MSG-SEG-OUT.
.
LINKAGE SECTION.
    01 IO-PCB.                                           3
.
    01 ALT-PCB.
.
    01 DB-PCB.
.
PROCEDURE DIVISION USING IO-PCB, ALT-PCB, DB-PCB        4
.
    CALL 'CBLTDLI' USING GU-CALL, IO-PCB,                5
        MSG-SEG-IO-AREA.
.
    CALL 'CBLTDLI' USING GU-CALL, DB-PCB,                6
        DB-SEG-IO-AREA, SSA-NAME.
.
    CALL 'CBLTDLI' USING ISRT-CALL, ALT-PCB,            7
        ALT-MSG-SEG-OUT.
.
    GOBACK.                                              8
COBOL LANGUAGE INTERFACE                                9
    
```

Figure 12. Skeleton MPP Written in COBOL

Notes to COBOL Program:

1. To define each of the call functions that your program uses, use a 77 or 01 level working-storage statement. Assign the value to the call function in a picture clause defined as four alphanumeric characters.
2. Use a 01 level working-storage statement for each I/O area that you will use for message segments.
3. In the linkage section of the program, use a 01 level entry for each PCB that your program uses. You can list the PCBs in the order that you list them in the entry statement, but this is not a requirement.
4. On the procedure statement, list the PCBs that your program uses in the order they are defined in the program's PSB: first the TP PCB, then any alternate PCBs, and finally the database PCBs that your program uses.
5. The program issues a GU call to the I/O PCB to retrieve the first segment of an input message.
6. The program issues a GU call to the DB PCB to retrieve the segment that would be described in the SSA-NAME area.
7. The program sends an output message segment to an alternate destination by using an alternate PCB.

8. When there are no more messages for your MPP to process, you return control to IMS by issuing the GOBACK statement.
If you compile all of your COBOL programs in the task with VS COBOL II, you can use STOP RUN, EXIT PROGRAM, and GOBACK, with their normal COBOL-defined semantics.
9. If the COBOL compiler option NODYNAM is specified, you must link edit the language interface module, DFSLI000, with your compiled COBOL application program. If the COBOL compiler option DYNAM is specified, do not link edit DFSLI000 with your compiled COBOL program.

Coding Your Program in Pascal

The program shown in Figure 13 on page 90 is a skeleton MPP written in Pascal. The numbers to the right of the program refer to the notes that follow the program.

All storage areas that are referenced in the parameter list of your Pascal application program's call to IMS can reside in the extended virtual storage area.

Coding DC Calls and Data Areas

```
segment PASCIMS; 1
type
  CHAR4 = packed array [1..4] of CHAR;2
  CHARn = packed array [1..n] of CHAR;
  IOPCBTYPE = record 3
    (* Field declarations *)
  end;
  ALTPCBTYPE = record
    (* Field declarations *)
  end;
  DBPCBTYPE = record
    (* Field declarations *)
  end;
procedure PASCIMS (var SAVE: INTEGER; 4
  var IOPCB: IOPCBTYPE;
  var ALTPCB: ALTPCBTYPE;
  var DBPCB: DBPCBTYPE); REENTRANT;

procedure PASCIMS; 5
type
  SSATYPE = record
    (* Field declarations *)
  end;

  MSG_SEG_IO_AREA_TYPE = record
    (* Field declarations *)
  end;

  DB_SEG_IO_AREA_TYPE = record
    (* Field declarations *)
  end;

  ALT_MSG_SEG_OUT_TYPE = record
    (* Field declarations *)
  end;
var 6
  MSG_SEG_IO_AREA : MSG_SEG_IO_AREA_TYPE;
  DB_SEG_IO_AREA : DB_SEG_IO_AREA_TYPE;
  ALT_MSG_SEG_OUT : ALT_MSG_SEG_OUT_TYPE;
const 7
  GU = 'GU ';
  ISRT = 'ISRT';
  SSANAME = SSATYPE(...);
procedure PASTDLI; GENERIC; 8
begin
  PASTDLI(const GU, 9
    var IOPCB,
    var MSG_SEG_IO_AREA);
  PASTDLI(const GU, 10
    var DBPCB,
    var DB_SEG_IO_AREA,
    const SSANAME);
  PASTDLI(const ISRT, 11
    var ALTPCB,
    var ALT_MSG_SEG_OUT);
end; 12
Pascal language interface 13
```

Figure 13. Skeleton MPP Written in Pascal

Notes to Pascal Program:

1. Define the name of the Pascal compile unit.
2. Define the data types needed for the PCBs used in your program.
3. Define the PCB data types used in your program.

4. Declare the procedure heading for the REENTRANT procedure called by IMS. The first word in the parameter list should be an INTEGER, which is reserved for VS Pascal's use, and the rest of the parameters will be the addresses of the PCBs received from IMS.
5. Define the data types needed for the SSAs and I/O areas.
6. Declare the variables used for the SSAs and I/O areas.
7. Define the constants (function codes, SSAs, and so forth) used in the PASTDLI DL/I calls.
8. Declare the IMS interface routine with the GENERIC Directive. GENERIC identifies external routines that allow multiple parameter list formats. A GENERIC routine's parameters are "declared" only when the routine is called.
9. The program issues a GU call to the I/O PCB to retrieve the first segment of an input message. The declaration of the parameters in your program might differ from this example.
10. The program can issue a GU call to a DB PCB to retrieve a database segment. The function codes for these two calls are identical; the way that IMS distinguishes between them is by the PCB to which each call refers. The declaration of the parameters in your program might differ from this example.
11. The program sends an output message segment to an alternate destination by issuing an ISRT call to an alternate PCB. The declaration of the parameters in your program might differ from this example.
12. When there are no more messages for your MPP to process, you return control to IMS by exiting the PASCIMS procedure. You can also code a RETURN statement to leave at another point.
13. You must link-edit your program to the IMS language interface module, DFSLI000, after you have compiled your program.

Coding Your Program in PL/I

The program shown in Figure 14 on page 92 is a skeleton MPP written in PL/I. The numbers to the right of the program refer to the notes for the program.

All storage areas that are referenced in the parameter list of your PL/I application program call to IMS can optionally reside in the extended virtual storage area.

If you plan to execute PL/I programs in 31-bit addressing mode, see *OS PL/I Version 2 Programming Guide*.

Coding DC Calls and Data Areas

	NOTES
/*	*/
/*	*/
/*	*/
UPDMASTER: PROCEDURE (IO_PTR, ALT_PTR, DB_PTR)	1
OPTIONS (MAIN);	
DCL FUNC_GU CHAR(4) INIT('GU ');	2
DCL FUNC_ISRT CHAR(4) INIT('ISRT');	
.	
DCL SSA_NAME...;	
.	
DCL MSG_SEG_IO_AREA CHAR(n);	3
DCL DB_SEG_IO_AREA CHAR(n);	
DCL ALT_MSG_SEG_OUT CHAR(n);	
.	
DCL 1 IO_PCB BASED (IO_PTR),...;	4
DCL 1 ALT_PCB BASED (ALT_PTR),...;	
DCL 1 DB_PCB BASED (DB_PTR),...;	
.	
DCL THREE FIXED BINARY(31) INIT(3);	5
DCL FOUR FIXED BINARY(31) INIT(4);	
DCL PLITDLI ENTRY EXTERNAL;	
.	
CALL PLITDLI (THREE, FUNC_GU, IO_PTR, MSG_SEG_IO_AREA);	6
.	
CALL PLITDLI (FOUR, FUNC_GU, DB_PTR, DB_SEG_IO_AREA, SSA_NAME);	7
.	
CALL PLITDLI (THREE, FUNC_ISRT, ALT_PTR, ALT_MSG_SEG_OUT);	8
.	
END UPDMASTER;	9
PL/I LANGUAGE INTERFACE	10

Figure 14. Skeleton MPP Written in PL/I

Notes to PL/I Program:

1. This is the standard entry point to a PL/I Optimizing Compiler MPP. This statement includes a pointer for each PCB that the MPP uses. You must refer to the PCBs in the same order as they are listed in the PSB: first the TP PCB, then any alternate PCBs that your program uses, and finally the database PCBs that your program uses.
2. The program defines each call function that it uses in its data area. In PL/I, you define the function codes as character strings and assign the appropriate values to them.
3. Define PCB Masks as major structures based on the addresses passed in the PROCEDURE statement. Although not shown in the example, you will code the appropriate additional fields in the structure, depending on the type of PCB to which the mask is associated.
4. To define your PCBs, use major structure declarations.
5. PL/I calls have a parameter that is not required in COBOL programs or assembler language programs. This is the parmcount, and it is always the first parameter. You define the values that your program will need for the parmcount in each of its calls. The parmcount gives the number of parameters that follow parmcount itself.
6. The program issues a GU call to the I/O PCB to retrieve the first message segment.
7. The program can issue a GU call to a DB PCB to retrieve a database segment. The function codes for these two calls are identical; the way that IMS distinguishes between them is by the PCB to which each call refers.

8. The program then sends an output message to an alternate destination by issuing an ISRT call to an alternate PCB.
9. When there are no more messages for the program to process, the program returns control to IMS by issuing the END statement or the RETURN statement.
10. You must link-edit your program to the IMS language interface module, DFSLI000, after you have compiled your program.

Message Processing Considerations for DB2

For the most part, the message processing function of a dependent region that accesses DB2 databases is similar to that of a dependent region that accesses only DL/I databases. The method each program uses to retrieve and send messages and back out database changes is the same. The differences are:

- DL/I statements are coded differently from SQL (structured query language) statements.
- When an IMS TM application program receives control from IMS TM, IMS has already acquired the resources the program is able to access. IMS TM schedules the program, although some of the databases are not available. DB2 does not allocate resources for the program until the program issues its first SQL statement. If DB2 cannot allocate the resources your program needs, your program can optionally receive an initialization error when it issues its first SQL call.
- When an application issues a successful checkpoint call or a successful message GU call, DB2 closes any cursors that the program is using. This means that your program should issue its OPEN CURSOR statement after a checkpoint call or a message GU.

IMS TM and DB2 work together to keep data integrity in these ways:

- When your program reaches a commit point, IMS TM makes any changes that the program has made to DL/I databases permanent, releases output messages for their destinations, and notifies DB2 that the program has reached a commit point. DB2 then makes permanent any changes that the program has made to DB2 databases.
- When your program terminates abnormally or issues one of the IMS TM rollback calls (ROLB, ROLS without a token, or ROLL), IMS TM cancels any output messages your program has produced, backs out changes your program has made to DL/I databases since the last commit point, and notifies DB2. DB2 backs out the changes that the program has made to DB2 databases since the last commit point.

Through the Automated Operator Interface (AOI), IMS TM application programs can issue DB2 commands and IMS TM commands. To issue DB2 commands, the program issues the IMS TM /SSR command followed by the DB2 command. The output of the /SSR command is routed to the master terminal operator (MTO).

Chapter 4. Spool API

The IMS Spool API support provides feedback to the application program when IMS detects errors in the print data set options of the CHNG and SET0 calls. For convenience, your application program can display these errors by sending a message to an IMS printer or by performing another action that lets you examine the parameter lists and feedback area without looking at a dump listing.

This information applies only to the calls as they are used with Spool API support.

Related Reading: For more detailed information on Spool API, see *IMS/ESA JES Spool API User's Guide*.

The following topics provide additional information:

- “Understanding Parsing Errors”
- “Understanding Allocation Errors” on page 99
- “Understanding Dynamic Output for Print Data Sets” on page 99
- “Sample Program Using the Spool API” on page 100

Understanding Parsing Errors

When you are diagnosing multiple parsing error return codes, the first code returned is usually the most informative.

Keywords

The CHNG and SET0 calls have two types of keywords. The type of keyword determines what type of keyword validation IMS should perform. The keyword types are:

- Keywords valid for the calls (for example, IAFP, PRTO, TXTU, and OUTN)
- Keywords valid as operands of the PRTO keyword (for example CLASS and FORMS).

Incorrectly specified length fields can cause errors when IMS checks for valid keywords. When IMS is checking the validity of keywords on the CHNG and SET0 calls, one set of keywords is valid. When IMS is checking the validity of keywords on the PRTO keyword, another set of keywords is valid. For this reason, incorrectly specified length fields can cause a scan to terminate prematurely, and keywords that appear to be valid are actually invalid because of where they occur in the call list. IMS might report that a valid keyword is invalid if it detects a keyword with an incorrect length field or a keyword that occurs in the wrong place in the call list.

Status Codes

The status code returned for the call can also suggest the location of the error. Although exceptions exist, generally, an AR status code is returned when the keyword is invalid for the call. An AS status code is returned when the keyword is invalid as a PRTO option.

Error Codes

This topic contains information on Spool API error codes that your application program can receive. “Diagnosis Examples” on page 97 contain examples of errors and the resulting error codes provided to the application program.

Parsing Errors

Error Code	Reason
(0002)	<p>Unrecognized option keyword.</p> <p>Possible reasons for this error are:</p> <ul style="list-style-type: none">• The keyword is misspelled.• The keyword is spelled correctly but is followed by an invalid delimiter.• The length specified field representing the PRTO is shorter than the actual length of the options.• A keyword is not valid for the indicated call.
(0004)	<p>Either too few or too many characters were specified in the option variable. An option variable following a keyword in the options list for the call is not within the length limits for the option.</p>
(0006)	<p>The length field (LL) in the option variable is too large to be contained in the options list. The options list length field (LL) indicates that the options list ends before the end of the specified option variable.</p>
(0008)	<p>The option variable contains an invalid character or does not begin with an alphabetic character.</p>
(000A)	<p>A required option keyword was not specified.</p> <p>Possible reasons for this error are:</p> <ul style="list-style-type: none">• One or more additional keywords are required because one or more keywords were specified in the options list.• The specified length of the options list is more than zero but the list does not contain any options.
(000C)	<p>The specified combination of option keywords is invalid. Possible causes for this error are:</p> <ul style="list-style-type: none">• The keyword is not allowed because of other keywords specified in the options list.• The option keyword is specified more than once.
(000E)	<p>IMS found an error in one or more operands while it was parsing the print data set descriptors. IMS usually uses z/OS services (SJF) to validate the print descriptors (PRTO= option variable). When IMS calls SJF, it requests the same validation as for the TSO OUTDES command. Therefore, IMS is insensitive to changes in output descriptors. Valid descriptors for your system are a function of the MVS release level. For a list of valid descriptors and proper syntax, use the TSO HELP OUTDES command.</p> <p>IMS must first establish that the format of the PRTO options is in a format that allows the use of SJF services. If it is not, IMS returns the status code AS, the error code (000E), and a descriptive error message. If the error is detected during the SJF process, the error message from SJF will include information of the form (R.C.=xxxx,REAS.=yyyyyyyy), and an error message indicating the error.</p> <p>Related Reading: For more information on SJF return and reason codes, see <i>MVS Application Development Guide: Authorized Assembler Language Programs</i>.</p>

The range of some variables is controlled by the initialization parameters. Values for the maximum number of copies, allowable remote destination, classes, and form names are examples of variables influenced by the initialization parameters.

Diagnosis Examples

This topic contains examples of mistakes that can generate the various spool API error codes, and diagnosis of the problems. Some length fields are omitted when they are not necessary to illustrate the example. The feedback and options lists that are shown on multiple lines are contiguous.

Error Code (0002)

Two examples of the error code 0002 are shown in this section.

For the first example the options list contains both the keywords PRTO and TXTU. The keyword, TXTU, is invalid for the SETO call.

```
CALL = SETO
  OPTIONS LIST = PRTO=04DEST(018),CLASS(A),TXTU=SET1
  FEEDBACK = TXTU(0002)
  STATUS CODE = AR
```

For the second example, the length field of the PRTO options is too short to contain all of the options. This means that IMS finds the COPIES and FORMS keywords outside the PRTO options list area and indicates that they are invalid on the CHNG call.

```
CALL = CHNG
  OPTIONS LIST = IAFF=N0M,PRTO=0FDEST(018),LINECT(200),CLASS(A),
                COPIES(80),FORMS(ANS)
  FEEDBACK = COPIES(0002),FORMS(0002)
  STATUS CODE = AR
```

Error Code (0004)

For this example, the operand for the OUTN keyword is 9 bytes long and exceeds the maximum value for the OUTPUT JCL statement.

```
CALL = CHNG
  OPTIONS LIST = IAFF=N0M,OUTN=OUTPUTDD1
  FEEDBACK = OUTN(0004)
  STATUS CODE = AR
```

Error Code (0006)

The length of the options list for this call is too short to contain all of the operands of the PRTO keyword.

This example shows an options list that is X'48' bytes long and is the correct length. The length field of the PRTO keyword incorrectly indicates a length of X'5A'. The length of the PRTO options exceeds the length of the entire options list so IMS ignores the PRTO keyword and scans the rest of the options list for valid keywords. The feedback area contains the PRTO(0006) code (indicating a length error) and the (0002) code (indicating that the PRTO keywords are in error). This is because the keywords beyond the first PRTO keyword, up to the length specified in the options list length field, have been scanned in search of valid keywords for the call. The status code of AR indicates that the keywords are considered invalid for the call and not the PRTO keyword.

```
CALL = CHNG
                0400                05
  OPTIONS LIST = 0800IAFF=N0M,PRTO=0ADEST(018),LINECT(200),CLASS(A),
```

Parsing Errors

```
                                COPIES(3),FORMS(ANS)
FEEDBACK = PRTO(0006),LINECT(0002),CLASS(0002),COPIES(0002),
                                FORMS(0002)
STATUS CODE = AR
```

Error Code (0008)

In this example, the message option of the IAFP keyword is incorrectly specified as "Z".

```
CALL = CHNG
                                00
OPTIONS LIST = IAFP=N0Z,PRTO=0BDEST(018)
FEEDBACK = IAFP(0008) INVALID VARIABLE
STATUS CODE = AR
```

Error Code (000A)

In this example, the valid keyword TXTU is specified, but the call also requires that the IAFP keyword be specified if the TXTU keyword is used.

```
CALL = CHNG
OPTIONS LIST = TXTU=SET1
FEEDBACK = TXTU(000A)
STATUS CODE = AR
```

Error Code (000C)

The **AR** status code is returned with the (0002) error code. This implies that the problem is with the call options and not with the PRTO options.

The call options list contains the PRTO and TXTU keywords. These options cannot be used in the same options call list.

```
CALL = CHNG
                                00
OPTIONS LIST = IAFP=A00,PRTO=0BCOPIES(3),TXTU=SET1
FEEDBACK = TXTU(000C)
STATUS CODE = AR
```

Error Code (000E)

In this example, the COPIES parameter has the incorrect value "RG" specified as one of its operands. The error message indicates that the values for these operands must be numeric.

```
CALL = CHNG
                                01
OPTIONS LIST = IAFP=A00,PRTO=0BCOPIES((3),(8,RG,18,80))
FEEDBACK = PRTO(000E) (R.C.=0004,REAS.=00000204) COPIES/RG VALUE
                                MUST BE NUMERIC CHARACTERS
STATUS CODE = AS
```

This example includes an invalid PRTO operand. The resulting reason code of X'000000D0' indicates that the XYZ operand is invalid.

```
CALL = CHNG
                                00
OPTIONS LIST = IAFP=A00,PRTO=0AXYZ(018)
FEEDBACK = PRTO(000E) (R.C.=0004,REAS.=000000D0) XYZ
STATUS CODE = AS
```

Understanding Allocation Errors

The IMS Spool API interface defers dynamic allocation of the print data set until data is actually inserted into the data set. Incorrect data set print options on the CHNG or SETO call can cause errors during dynamic allocation. The print data set options can be parsed during the processing of the CHNG and SETO calls but some things, for example the *destination name* parameter, can be validated only during dynamic allocation.

If one of the print options is incorrect and dynamic allocation fails when the IMS performs the first insert for the data set, IMS returns a **AX** status code to the ISRT call. IMA also issues message DFS0013E and writes a diagnostic log record (67D0) that you can use to evaluate the problem. The format of the error message indicates the type of service that was invoked and the return and reason codes that were responsible for the error. The error message can indicate these services:

DYN MVS dynamic allocation (SVC99)
OPN MVS data set open
OUT MVS dynamic output descriptors build (SVC109)
UNA MVS dynamic unallocation (SVC99)
WRT MVS BSAM write

If the DFS0013E message indicates an error return code from any of these services, you should consult the corresponding MVS documentation for more information on the error code. If the service is for dynamic allocation, dynamic unallocation, or dynamic output descriptor build, see *MVS/ESA Programming: Authorized Assembler Services Guide* for the appropriate return and reason codes.

One common mistake is the use of an invalid destination or selection of integrity option 2 (non-selectable destination) when the destination of IMSTEMP has not been defined to JES. If you specify an invalid destination in the *destination name* parameter, the call will result in a dynamic unallocation error when IMS unallocates the print data set.

Understanding Dynamic Output for Print Data Sets

IMS can use the z/OS services for Dynamic Output (SVC109) for print data sets. IMS uses this service to specify the attributes provided by the application for the print data sets being created. The service can be used on the CHNG call with the PRTO, TXTU, and OUTN options.

Related Reading: For more information, see *MVS/ESA Programming: Authorized Assembler Services Guide*.

CHNG Call with PRTO Option

When you use the CHNG call and PRTO option, IMS activates SJF to verify the print options to call z/OS services for Dynamic Output. This creates the output descriptors that are used when the print data set is allocated. This is the simplest way for the application to provide print data set characteristics. However, it also uses the most overhead because parsing must occur for each CHNG call. If your application is WFI or creates multiple data sets with the same print options, use another option to reduce the parsing impact.

Dynamic Output for Print Data Sets

CHNG Call with TXTU Option

If your application can manage the text units necessary for Dynamic Output, then you can avoid parsing for many of the print data sets. You can do this in one of two ways:

- The application can build the text unit in the necessary format within the application area and pass these text units to IMS with the CHNG call and TXTU option.
- The application can provide the print options to IMS with a SET0 call and provide a work area for the construction of the text units. After z/OS has finished parsing and text construction, the work area passed will contain the text units necessary for Dynamic Output after a successful SET0 call. The application must not relocate this work area because the work area contains address sensitive information.

Regardless of the method the application uses to manage the text units, applications that can reuse the text units can often achieve better performance by using the TXTU option on the CHNG call.

CHNG Call with OUTN Option

The dependent region JCL can contain OUTPUT JCL statements. If your application can use this method, you can use the CHNG call and OUTN option to reference OUTPUT JCL statements. When you use the OUTN option, IMS will reference the OUTPUT JCL statements at dynamic allocation. JES will obtain the print data set characteristics from the OUTPUT JCL statement.

Sample Program Using the Spool API

The Spool API provides functions that allow an application program to write data to the IMS Spool using the same techniques for sending data to native IMS printers.

The Spool API provides functions such as error checking for invalid OUTDES parameters. Error checking makes application programs more complex. To simplify these application programs, develop a common routine to manage error information, then make the diagnostic information from the Spool API available for problem determination.

The sample programs in this section show how DL/I calls can be coded to send data to the IMS Spool. Only the parts of the application program necessary to understand the DL/I call formats are included. The examples are in assembler language.

Application PCB Structure

The application PCBs are as follows:

- I/O PCB
- ALTPCB1
- ALTPCB2
- ALTPCB3
- ALTPCB4

GU Call to I/O PCB

IMS application programs begin with initialization and a call to the I/O PCB to obtain the input message. The example in Figure 15 shows how to issue a GU call to the I/O PCB.

```

*****
*          ISSUE GU ON IOPCB          *
*****
      L      9,IOPCB                I/O PCB ADDRESS
      LA     9,0(9)
      MVC    FUNC,=CL4'GU'          GU FUNCTION
      CALL   ASMTDLI,(FUNC,(9),IOA1),VL
      BAL    10,STATUS              CHECK STATUS
*      ADDITIONAL PROGRAM LOGIC HERE
FUNC    DC    CL4' '
IOA1    DC    AL2(IOA1LEN),AL2(0)
TRAN    DS    CL8                  TRANSACTION CODE AREA
DATA    DS    CL5                  DATA STARTS HERE
      DC    20F'0'
IOA1LEN EQU  *-IOA1

```

Figure 15. Issuing a GU Call to the I/O PCB

After completing the GU call to the I/O PCB, the application program prepares output data for the IMS Spool.

CHNG Call to Alternate PCB

In the same way that other programs specify the destination of the output using the CHNG call, this program specifies the IMS Spool as the output destination. For a native IMS printer, the DEST NAME parameter identifies the output LTERM name. When a CHNG call is issued that contains the IAFP= keyword, the DEST NAME parameter is used only if integrity option '2' is specified. If option '2' is not specified, the DEST NAME parameter can be used by the application program to identify something else, such as the routine producing the change call. The destination for the print data set is established using a combination of initialization parameters or OUTDES parameters.

The example in Figure 16 shows how to issue a CHNG call to the alternate modifiable PCB.

Spool API Sample Program

```
*****
*      ISSUE CHNG ON ALTPCB4      *
*****
      L      9,ALTPCB4          ALT MODIFIABLE PCB
      LA      9,0(9)            CLEAR HIGH BYTE/BIT
      MVC     FUNC,=CL4'CHNG'    CHNG FUNCTION
      CALL    ASMTDLI,(FUNC,(9),DEST2,OPT1,FBA1),VL
      BAL     10,STATUS          CHECK STATUS OF CALL
*      ADDITIONAL PROGRAM LOGIC HERE
FUNC    DC     CL4' '
DEST2   DC     CL8'IAFP1'        LTERM NAME
*
      DC     C'OPT1'            OPTIONS LIST AREA
OPT1    DC     AL2(OPT1LEN),AL2(0)
      DC     C'IAFP='
OCC     DC     C'M'            DEFAULT TO MACHINE CHAR
OOPT    DC     C'1'            DEFAULT TO HOLD
OMSG    DC     C'M'            DEFAULT TO ISSUE MSG
      DC     C', '
      DC     C'PRTO='
PRT01   EQU    *
      DC     AL2(PRT01LEN)
      DC     C'COPIES(2),CLASS(T),DEST(RMT003)'
PRT01LEN EQU    *-PRT01
      DC     C' '
OPT1LEN EQU    *-OPT1
*
FBA1    DC     AL2(FBA1LEN),AL2(0)
      DC     CL40' '
FBA1LEN EQU    *-FBA1
```

Figure 16. Issuing a CHNG Call to the Alternate Modifiable PCB

After the CHNG call is issued, the application program creates the print data set by issuing ISRT calls.

ISRT Call to Alternate PCB

Once the IMS Spool is specified as the destination of the PCB, ISRT calls can be issued against the alternate PCB.

The example in Figure 17 shows how to issue the ISRT call to the alternate modifiable PCB.

```
*****
*      ISSUE ISRT TO ALTPCB4      *
*****
      L      9,ALTPCB4          ALT MODIFIABLE PCB
      LA      9,0(9)            CLEAR HIGH BYTE/BIT
      MVC     FUNC,=CL4'ISRT'    ISRT FUNCTION
      CALL    ASMTDLI,(FUNC,(9),IOA2),VL
      BAL     10,STATUS          CHECK STATUS OF CALL
*      ADDITIONAL PROGRAM LOGIC HERE
FUNC    DC     CL4' '
IOA2    DC     AL2(IOA2LEN),AL2(0)
IOA21   DC     AL2(MSG2LEN),AL2(0)
      DC     C' '                CONTROL CHARACTER
      DC     C'MESSAGE TO SEND TO IMS SPOOL'
MSG2LEN EQU    *-IOA21
IOA2LEN EQU    *-IOA2
```

Figure 17. Issuing an ISRT Call to the Alternate Modifiable PCB

The print data streams can be stored in databases or generated by the application, depending on the requirements of the application program and the type of data set being created.

Program Termination

After the calls are issued, the program sends a message back to originating terminal, issues a GU call to the I/O PCB, or terminates normally.

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Chapter 5. Introduction to Message Format Service (MFS)

The IMS message format service (MFS) is a facility of the IMS Transaction Manager environment that formats messages to and from terminal devices, so that IMS application programs do not deal with device-specific characteristics in input or output messages. In addition, MFS formats messages to and from user-written programs in remote controllers and subsystems, so that application programs do not deal with transmission-specific characteristics of the remote controller.

MFS uses control blocks you specify to indicate to IMS how input and output messages are arranged.

For input messages, MFS control blocks define how the message sent by the device to the application program is arranged in the program's I/O area.

For output messages, MFS control blocks define how the message sent by the application program to the device is arranged on the screen or at the printer.

Data that appears on the screen but not in the program's I/O area, such as a literal, can also be defined.

In IMS Transaction Manager systems, data passing between the application program and terminals or remote programs can be edited by MFS or basic edit. Whether an application program uses MFS depends on the type of terminals or secondary logical units (SLUs) your network uses.

Restriction: MFS does not support message formatting for LU 6.2 devices.

The following topics provide additional information:

- “Advantages of Using MFS”
- “MFS Control Blocks” on page 111
- “Overview of MFS Components and Operation” on page 117
- “Devices and Logical Units That Operate with MFS” on page 120
- “Using Distributed Presentation Management (DPM)” on page 122

Advantages of Using MFS

The advantages of using MFS are as follows:

- MFS simplifies developing and maintaining terminal-oriented applications by performing common application functions and providing independence from specific devices or remote programs.
- MFS improves online performance by using control blocks for online processing.

Simplify Development and Maintenance

To simplify IMS application development and maintenance, MFS performs many common application program functions and gives application programs a high degree of independence from specific devices or remote programs.

With the device independence offered by MFS, one application program can process data to and from multiple device types while still using their different capabilities. Thus, MFS can minimize the number of required changes in application programs when new terminal types are added.

MFS makes it possible for an application program to communicate with different types of terminals without having to change the way it reads and builds messages.

Advantages of Using MFS

When the application receives a message from a terminal, how the message appears in the program's I/O area is independent of what kind of terminal sent it; it depends on the MFS options specified for the program. If the next message the application receives is from a different type of terminal, you do not need to do anything to the application. MFS shields the application from the physical device that is sending the message in the same way that a DB program control block (PCB) shields a program from what the data in the database actually looks like and how it is stored.

Other common functions performed by MFS include left or right justification of data, padding, exits for validity checking, time and date stamping, page and message numbering, and data sequencing and segmenting. When MFS assumes these functions, the application program handles only the actual processing of the message data.

Figure 18 shows how MFS can make an application program device-independent by formatting input data from the device or remote program for presentation to IMS, and formatting the application program data for presentation to the output device or remote program.

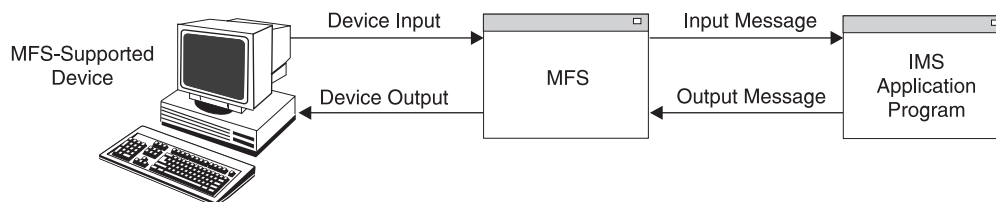


Figure 18. Message Formatting Using MFS

Improve Online Performance of a Terminal

MFS also improves online performance of a terminal-oriented IMS by using control blocks designed for online processing. The MFS control blocks are compiled offline, when the IMS Transaction Manager system is not being executed, from source language definitions. MFS can check their validity and make many decisions offline to reduce online processing. In addition, during online processing, MFS uses look-aside buffering of the MFS control blocks to reduce CPU and channel costs of input/output activity.

Because MFS control blocks are reentrant and can be used for multiple applications, online storage requirements are reduced. Optional real storage indexing and anticipatory fetching of the control blocks can also reduce response time. Further performance improvements can be gained when IMS is generated for z/OS, since multiple I/O operations can execute concurrently to load the format blocks from the MFS format library.

In addition, MFS uses z/OS paging services; this helps to reduce page faults by the IMS control region task.

MFS can reduce use of communication lines by compressing data and transmitting only required data. This reduces line load and improves both response time and device performance.

MFS Control Blocks

There are four types of MFS control blocks that you specify to format input and output for the application program and the terminal or remote program:

Message Output Descriptors (MODs)

Define the layout of messages MFS receives from the application program.

Device Output Formats (DOFs)

Describe how MFS formats messages for each of the devices the program communicates with.

Device Input Formats (DIFs)

Describe the formats of messages MFS receives from each of the devices the program communicates with.

Message Input Descriptors (MIDs)

Describe how MFS further formats messages so that the application program can process them.

Throughout this information, the term “message descriptors” refers to both MIDs and MODs. The term “device formats” refers to both DIFs and DOFs.

Each MOD, DOF, DIF and MID deals with a specific message. There must be a MOD and DOF for each unique message a program sends, and a DIF and MID for each unique message a program receives.

MFS Examples

One way to understand the relationship between the MFS control blocks is to look at a message from the time a user enters it at the terminal to the time the application program processes the message and sends a reply back to the terminal. Though MFS can be used with both display terminals and printer devices, for clarity in this example, a display terminal is being used.

Figure 19 shows the relationships between the MFS control blocks.

MFS Control Blocks

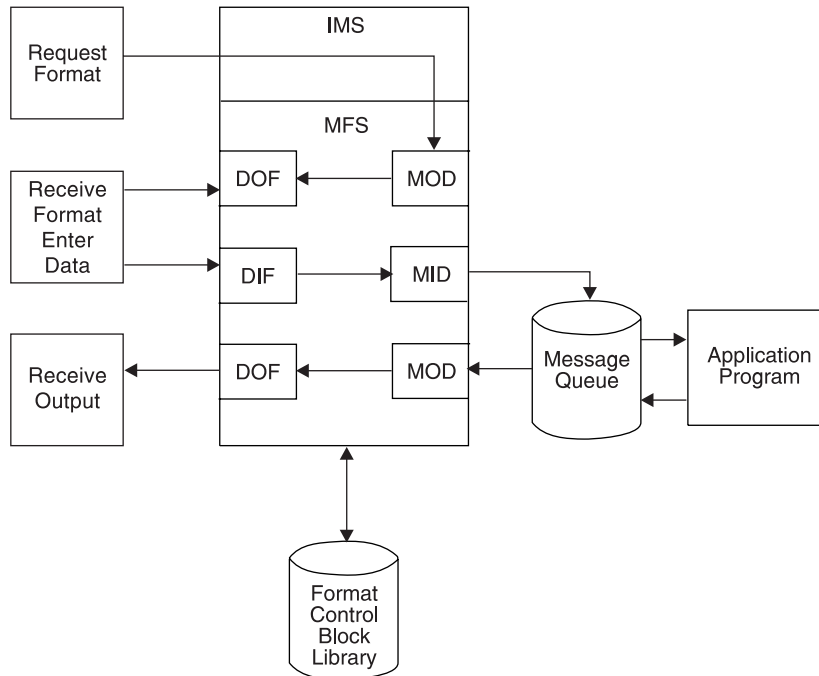


Figure 19. MFS Control Block Relationships

Looking at Payroll Records

Suppose your installation has a message processing program used to view employee payroll records. From a display terminal, issue the IMS format command (/FORMAT), and the MOD name. This formats the screen in the way defined by the MOD written by the MFS programmer. When you enter the MOD name, the screen contains only literals and no output data from the application program. At this stage, no application program is involved. (For more information about /FORMAT, see *IMS Version 9: Command Reference*.)

In this example, suppose the name of the MOD that formats the screen for this application is PAYDAY. Enter this command:

```
/FORMAT PAYDAY
```

IMS locates the MFS MOD control block with the name PAYDAY and arranges the screen in the format defined by the DOF. Figure 23 on page 117 shows an example of the MFS control statements that define a MID, MOD, DIF, and DOF.

Figure 20 shows how this screen looks.

```

*EMPLOYEE PAYROLL*
*****

FIRST NAME:                               LAST NAME:
EMPLOYEE NO:

INPUT:

```

Figure 20. PAYDAY Screen, Formatted by DOF

The DOF defines a terminal format that asks you to give the employee’s name and employee number. PAYUP is the transaction code associated with the application that processes this information. When you enter the MOD name, the transaction code is included in the first screen format displayed. This means that you do not need to know the name of the program that processes the data; you only need the name of the MOD that formats the screen.

After the screen format is displayed, you can enter the information. There are four stages to sending a message to the program and receiving the reply:

1. Enter the information at the terminal. For this example, enter the prompted information.

Figure 21 shows how this screen looks after information is entered.

```

*EMPLOYEE PAYROLL*
*****

FIRST NAME: Joe                               LAST NAME: Blutzen
EMPLOYEE NO: 60249

INPUT:

```

Figure 21. PAYDAY Screen, with Filled Input Fields

2. When IMS receives this data, MFS uses the DIF and the MID control blocks to translate the data from the way it was entered on the terminal screen to the way that the application program is expecting to receive it. The DIF control block tells MFS the format of the data to come in from the terminal. The MID control block tells MFS how the application program expects to receive the data. When the application program issues a message call, IMS places the “translated” message in the program’s I/O area.

When the application receives the message in its I/O area, the message looks like this:

```
PAYUP JOE BLUTZEN 60249
```

“PAYUP” is the transaction code. The name of the logical terminal does not appear in the message itself; IMS places it in the first field of the I/O PCB.

3. The application program processes the message, including any required database access, and builds the output message in the application program’s I/O area. After retrieving the information from the database, the program builds the output message segment for the employee, with social security and rate of pay information. The application program’s I/O area contains:

```
LLZZJOE BLUTZEN 60249532596381150.00
```

MFS Control Blocks

The LL is a 2-byte field in MFS messages that indicates the length of the field. How the LL field is defined depends on what programming language used to write the application program. For the AIBTDLI, ASMTDLI, CEETDLI, or PASTDLI interfaces, the LL field must be defined as a binary half word. For the PLITDLI interface, the LL field must be defined as a binary fullword. The value provided in the PLITDLI interface must represent the actual segment length minus 2 bytes.

The ZZ is a 2-byte length field in MFS messages that contains the MFS formatting option that is being used to format the messages to and from the application program. MFS options are discussed in further detail in “Input Message Formatting Options” on page 126.

4. When the application program sends the message back to the terminal, MFS translates the message again, this time from the application program format to the format in which the terminal expects the data.

The MOD tells MFS the format that the message will be in when it comes from the application program’s I/O area. The DOF tells MFS how the message is supposed to look on the terminal screen. MFS translates the message and IMS displays the translated message on the terminal screen.

Figure 22 shows how the screen looks.

```

                                     *EMPLOYEE PAYROLL*
                                     *****

FIRST NAME: Joe                      LAST NAME: Blutzen
EMPLOYEE NO: 60249
SOC SEC NO: 532-59-6381
RATE OF PAY: $150.00

INPUT:
```

Figure 22. PAYDAY Screen, Output Formatted by DOF and Displayed

Listing a Subset of Employees

Suppose you have an MPP that answers this request:

List the employees who have the skill “ENGINEER” with a skill level of “3.” List only those employees who have been with the firm for at least 4 years.

To enter the request from a display terminal, issue the format command (/FORMAT) and the MOD name. This formats the screen in the way defined by the MOD you supply. When you enter the MOD name, the screen contains only literals and no output data from an application program. At this stage, an MPP is not involved. Suppose the name of the MOD that formats the screen for this request is LE, for “locate employee.” Enter this:

```
/FORMAT LE
```

IMS locates the MFS MOD control block with the name LE and arranges your screen in the format defined by the DOF. Your screen then looks like this:

```
SKILL
LEVEL
YEARS
      LOCEMP
```

The DOF defines a terminal format that asks you to qualify your request for an employee by giving the skill, level, and number of years of service of the employee

you want. LOCEMP is the transaction code that is associated with the MPP that can process this request. When you enter the MOD name, the transaction code is included in the first screen format that is displayed for you. This means that you do not need the name of the program that processes your request; you only need the name of the MOD that formats the screen.

After the screen format is displayed, you can enter your request. There are four stages in sending a message to the program and receiving the reply.

1. Enter the information at the terminal. In this example, enter the values of the qualifications that IMS has given you on the screen: the skill is "eng" (engineer), the skill level is "3," and the number of years with the firm is "4".

After you enter your request, your screen contains this data:

```
SKILL ENG
LEVEL 3
YEARS 4
      LOCEMP
```

2. When IMS receives this data, MFS uses the DIF and the MID control blocks to translate the data from the way you entered it on the terminal screen to the way that the application program is expecting to receive it. The DIF control block tells MFS how the data is going to come in from the terminal. The MID control block tells MFS how the application program is expecting to receive the data. When the application program issues a GU call to the I/O PCB, IMS places the "translated" message in the program's I/O area.

When the MPP receives the message in its I/O area, the message looks like this:

```
LOCEMP ENG0304
```

"LOCEMP" is the transaction code. The name of the logical terminal does not appear in the message itself; IMS places it in the first field of the I/O PCB.

3. The MPP processes the message, including any required database access, and builds the output message in the MPP's I/O area.

Suppose more than one employee meets these qualifications. The MPP can use one message segment for each employee. After retrieving the information from the database, the program builds the output message segment for the first employee. The program's I/O area contains:

```
LLZZJONES,CE 3294
```

When the program sends the second segment, the I/O area contains:

```
LLZZBAKER,KT 4105
```

4. When the application program sends the message back to the terminal, MFS translates the message again, this time from the application program format to the format in which the terminal expects the data.

The MOD tells MFS the format that the message will be in when it comes from the application program's I/O area. The DOF tells MFS how the message is supposed to look on the terminal screen. MFS translates the message and IMS displays the translated message on the terminal screen. The screen then contains the following data:

```
SKILL  ENG
NAME   NO
JONES,CE 3294
BAKER,KT 4105
```

Relationship Between MFS Control Blocks and Screen Format

This section discusses the relationship between MFS source language definitions and formats you see at the device. The sample code is designed for a 3270 display.

The standard way for an end-user or operator to receive an initial format is to request it with a `/FORMAT` command, specifying the name of a MOD. In Figure 23 on page 117, the label on the MOD is PAYDAY. This MOD contains the parameter `SOR=PAYF`, which points to a device output format, or DOF, with the same label.

The initial DOF also becomes the format for device input. Therefore, if you specify `DIV TYPE=INOUT` in the DOF, a device input format (DIF) is also generated. In the sample code, PAYF is both a DOF and a DIF, since it also describes the format of the next input. The final output message can be displayed with a format that is specified for output only and no DIF is generated.

Both the MOD and the MID point to the same DOF, thus establishing the relationship between device-related and message-related control blocks.

For output, MFS moves fields defined in a MOD to fields on the screen defined by a DOF. When a field definition is coded (MFLD) in a MOD, it is given a label. The same label is used in the coding of the device field (DFLD) in the DOF, defining where the field appears on the screen.

MFS moves data fields from output messages to screen fields; this is referred to as *mapping*. For input, MFS moves modified screen fields to data fields in the input message for the program by mapping identically labeled fields in the DIF and MID. For more detailed information on specifying these control blocks, see *IMS Version 9: Utilities Reference: Database and Transaction Manager*.

The MFS control blocks are generated from the source statements like those in Figure 23 during execution of the MFS language utility program. The control blocks are stored in the various MFS libraries.

DOF/DIF

```

PAYF      FMT          TYPE=(3270,2),FEAT=IGNORE,DSCA=X'00A0'
          DEV
          DIV          TYPE=INOUT
          DPAGE        CURSOR=((5,15))
          DFLD         '*****',POS=(1,21)
          DFLD         '* EMPLOYEE PAYROLL *',POS=(2,21)
          DFLD         '*****',POS=(3,21)
          DFLD         'FIRST NAME:',POS=(5,2)
FNAME     DFLD         POS=(5,15),LTH=16
          DFLD         'LAST NAME:',POS=(5,36)
LNAME     DFLD         POS=(5,48),LTH=16
          DFLD         'EMPLOYEE NO:',POS=(7,2)
EMPNO     DFLD         POS=(7,16),LTH=6
          DFLD         'SOC SEC NO:',POS=(9,2)
SSN       DFLD         POS=(9,15),LTH=11
          DFLD         'RATE OF PAY: $',POS=(11,2)
RATE      DFLD         POS=(11,17),LTH=9
          DFLD         'INPUT:',POS=(16,2)
INPUT     DFLD         POS=(16,10),LTH=30
          FMTEND

```

MID

```

PAYIN     MSG          TYPE:INPUT,SOR=(PAYF,IGNORE)
          SEG
          MFLD         'PAYUP '      SUPPLIES TRANCODE
          MFLD         LNAME,LTH=16
          MFLD         FNAME,LTH=16
          MFLD         EMPNO,LTH=6
          MFLD         SSN,LTH=11
          MFLD         RATE,LTH=9
          MFLD         INPUT,LTH=30,JUST=R,FILL=C'0'
          MSGEND

```

MOD

```

PAYDAY    MSG          TYPE:OUTPUT,SOR=(PAYF,IGNORE)
          SEG
          MFLD         LNAME,LTH=16
          MFLD         FNAME,LTH=16
          MFLD         EMPNO,LTH=6
          MFLD         SSN,LTH=11
          MFLD         RATE,LTH=9
          MFLD         INPUT,LTH=30,JUST=R,FILL=C'0'
          MSGEND

```

Figure 23. Sample MFS Control Block Coding

Overview of MFS Components and Operation

MFS has the following components:

- The **MFS language utility**, which generates control blocks from user-written control statements and places them in a library called IMS.FORMAT.
- The **MFS service utility**, which is used for maintaining the control blocks in IMS.FORMAT.
- The **MFS device characteristics table utility**, which is used to add new screen sizes in the device characteristics table (DCT) and generate new MFS default formats for the screen size without system definition.
- The **MFS message editor**, which formats messages according to the control block specifications generated by the language utility.

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- The **MFS pool manager** keeps the MFS control blocks required by the message editor in the real storage MFBP (message format buffer pool).
- The **MFSTEST pool manager**, which replaces the MFS pool manager when the language utility is being used in test mode.

The **IMS online change utility** also plays an important part in updating the MFS libraries, even though it is not an MFS utility. The online change utility allows the control block libraries to be modified while the IMS control region is executing.

Related Reading: For a more complete description of online change, see *IMS Version 9: Utilities Reference: System*.

MFS Language Utility (DFSUPAA0)

The MFS language utility processes user-written control statements. The primary function of this utility is to create MFS control blocks used in online execution. Definition control statements define the MFS control blocks.

Additional functions of the MFS language utility include:

- SYSPRINT listing control
- SYSIN/SYSLIB record stacking and unstacking
- Repetitive generation of message and device fields
- Equate processing
- Alphabetic character generation
- Copying SYSLIB members into the utility input stream
- Printing statistics of counters maintained by the utility

A number of parameters on the JCL EXEC statement used during compilation can be varied to control printed output, compress the partitioned data set libraries IMS.FORMAT and IMS.REFERAL, and prevent definitions with a specified level of error from being written in IMS.REFERAL.

The language utility can operate in three modes: standard, test, and batch. All produce the same control blocks. They differ in their ability to operate concurrently with the IMS online control region and in their use of the MFS libraries.

In standard mode, the MFSUTL job control procedure can execute concurrently with the IMS control region. It stores control blocks in the IMS.FORMAT library.

In test mode, the MFSTEST procedure can execute concurrently with the IMS online control region. It stores control blocks in the IMS.TFORMAT library.

In batch mode, the MFSBTCH1 procedure places the control blocks in a temporary library, IMS.MFSBATCH. The MFSBTCH2 procedure transfers the control blocks to IMS.FORMAT. The MFSBTCH1 procedure can be executed many times, and control blocks can be accumulated in IMS.MFSBATCH before they are transferred to the staging library.

The language utility checks the syntax of the source language definitions and converts them to a form intermediate between the source language and the final online control block, called an *intermediate text block* (ITB). In standard mode, it writes these ITBs in the historical reference library, IMS.REFERAL. Although most ITBs are immediately converted to online control blocks and written in the staging library, IMS.FORMAT, the ITBs and the relationships between them are still retained

in IMS.REFERAL. When the language utility begins processing, a table of all ITBs currently in IMS.REFERAL and their interrelationships is created. Each new definition is then checked against the table. Newly entered definitions that have valid syntax, that belong to a complete format set (complete with DIF or DOF and associated MID or MOD), and have consistent references to other ITBs in the set, are converted to online control blocks and are immediately written in the IMS.FORMAT library (in standard mode) or the IMS.TFORMAT library (in test mode).

Two IMS commands are available to request format sets while using the language utility. To request use of a format set, a terminal operator enters the /FORMAT command. To test the format sets in IMS.TFORMAT, the terminal operator enters the /TEST MFS command. Then the /FORMAT command can be used to call test format sets from IMS.TFORMAT (and format sets from IMS.FORMAT, if necessary) into the communication line buffer pool for test MFS operation. After successful testing, the format sets can be written in the staging library, IMS.FORMAT.

The use of the MFS commands /FORMAT and /TEST is explained in the discussion of those commands in the *IMS Version 9: Command Reference*.

MFS Service Utility (DFSUTSA0)

The MFS service utility performs optional indexing, reporting, and maintenance functions. The INDEX function puts index entries for specified IMS.FORMAT control blocks in a special real storage directory, to allow faster access to the control blocks. Other functions are used to delete or obtain reports on the contents of the libraries and directories.

Related Reading: For more information about the MFS service utility, see *IMS Version 9: Utilities Reference: Database and Transaction Manager*.

MFS Device Characteristics Table Utility (DFSUTB00)

The MFS device characteristics table (MFS DCT) utility is used to add new screen sizes to the DCT and generate new MFS default formats for those screen sizes without performing an IMS system definition. The definition of the new screen sizes to the utility is made on the new ETO device descriptor. New screen size definitions are added to screen sizes that were previously defined.

Related Reading: For an example of an MFS device descriptor used by the DCT, or for more information on ETO, see *IMS Version 9: Administration Guide: Transaction Manager*. For more information on the MFS DCT utility, see *IMS Version 9: Utilities Reference: Database and Transaction Manager*.

MFS Message Editor

The MFS message editor formats messages according to the control block specifications generated by the language utility from control statement definitions you enter. The editor can also give control to optional user-written or IMS-provided field and segment editing routines (such as validity checks). The IMS-provided editing routines are shown in *IMS Version 9: Customization Guide*.

MFS Pool Manager

MFS tries to minimize I/O to the format library by keeping referenced blocks in storage. This storage is managed by the MFS pool manager. The INDEX function of the MFS service utility allows you to customize this function, by constructing a list of

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the directory addresses for specified format blocks, eliminating the need for IMS to read the data set directory before fetching a block.

For more information, refer to the *IMS Version 9: Administration Guide: Transaction Manager*.

MFSTEST Pool Manager

If the optional MFSTEST facility is used, MFS control blocks are managed by the MFSTEST pool manager. The communication line buffer pool space allowed for MFS testing is specified at system definition, but the space can be changed when the IMS control region is initialized. This space value is the maximum amount used for MFSTEST blocks at any one time—it is not a reserved portion of the pool.

Devices and Logical Units That Operate with MFS

In addition to 3270 devices, MFS operates with the 3600 and 4700 Finance Communication System (FIN), the 3770 Data Communication System, the 3790 Communication System, and with Secondary Logical Unit (SLU) types 1, 2, 6, and P. Network Terminal Operations (NTO) devices are supported as secondary logical unit type 1 consoles.

Table 22 shows which devices or logical units can be defined for MFS operation in the IMS system by their number (3270, for example), and which can be defined by the type of logical unit to which they are assigned (SLU 1, for example). Though the 3600 devices are included in the FIN series, you can specify them with their 36xx designations; MFS messages use the Flxx designations regardless of which form of designation you specify. In general, however, application designers and programmers using this information only need to know how the devices they are defining control blocks for have been defined to the IMS system in their installation.

Table 22. Terminal Devices That Operate with MFS

Device	Devices Defined by Number ¹	NTO Devices ²	SNA Devices or Logical Units ³			
			SLU 1	SLU 2	SLU P	LU 6.1
3180	X ⁴			X ⁴		
3270	X ⁴			X ⁴		
3290	X ⁴			X ⁴		
5550	X ⁴			TYPE: 3270-An 3270-Ann		
3270 printers; 5553, 5557	X ⁴		COMPT _n = MFS-SCS1			
3730					X	
3767			COMPT _n = MFS-SCS1			
3770 console, printers, print data set			COMPT _n = MFS-SCS1		X	
3770 readers, punches, transmit data set			COMPT _n = MFS-SCS2		X	

Table 22. Terminal Devices That Operate with MFS (continued)

Device	Devices Defined by Number ¹	NTO Devices ²	SNA Devices or Logical Units ³			
			SLU 1	SLU 2	SLU P	LU 6.1
3790 print data set (bulk)			COMPT _n = MFS-SCS1		COMPT _n = MFS-SCS1 DPM-An	
3790 transmit data set			COMPT _n = MFS-SCS2			
3790 attached 3270				X ⁴		
6670						
8100					X	
8100 attached 3270			X	X ⁴		
8100 attached Series/1					X	
8100 attached S/32			X			
8100 attached S/34					X	
8100 attached S/38			X			
Finance	X				COMPT _n = MFS-SCS1 DPM-An	
TTY		X				
3101		X				
Other systems (IMS to IMS or IMS to other)						COMPT _n = DPM=Bn

Notes:

1. With options= (...MFS,...) in the TERMINAL or TYPE macro.
2. Defined with UNITYPE= on the TYPE macro and PU= on the TERMINAL macro.
3. Defined by logical unit type or logical unit type with COMPT_n= or TYPE= in the TERMINAL macro or ETO logon descriptor. The LU 6.1 definition refers to ISC subsystems.
4. Defaults to operate with MFS.

The definition for SLU 1 can specify an MFS operation with SNA character strings (SCS) 1 or 2. SCS1 designates that messages are sent to a printer or the print data set or received from a keyboard in the 3770 Programmable or 3790 controller disk storage; SCS2 designates that messages are sent to or received from card I/O or a transmit data set.

Terminals defined as SLU 2 have characteristics like the 3270, and like the 3270, can be defined to operate with MFS. In general, a 3290 terminal operates like a 3270 terminal, and references to 3270 terminals in this information are applicable to 3290 devices. However, 3290 partitioning and scrolling support is only provided for 3290 devices defined to IMS as SLU 2.

Generally, the 3180 and 5550 terminals operate like a 3270 terminal, and references to 3270 terminals also apply to these devices. Likewise, the 5553 and 5557 printer devices operate like a 3270P.

MFS Devices and Logical Units

Restriction: 5550 Kanji support is only provided for the 5550 terminal defined as an SLU 2 and for the 5553 and 5557 defined as SCS1 printers.

If IMS is to communicate with the user-written remote program in a 3790 or an FIN controller, the device must be defined as an SLU P. Definitions for SLU P must specify MFS operation as either MFS-SCS1 or DPM-An, where DPM means distributed presentation management and An is a user-assigned number (A1 through A15).

Most of the MFS formatting functions currently available to other devices, except specific device formatting, are available to the user-written program. Under user control, these formatting functions (such as paging) can be divided between MFS and the remote program.

Using Distributed Presentation Management (DPM)

With distributed presentation management (DPM), formatting functions usually performed by MFS are distributed between MFS and a user-written program for SLU P devices or ISC nodes. If the 3790 or FIN controller has previously been defined to IMS by unit number, some changes must be made to convert to DPM.

With DPM, the physical terminal characteristics of the secondary logical unit do not have to be defined to MFS. MFS has to format only the messages for transmission to the user program in the remote controller or ISC node, which must assume responsibility for completing the device formatting, if necessary, and present the data to the physical device it selects.

For remote programs using DPM, the data stream passing between MFS and the remote programs can be device independent. The messages from the IMS application program can include some device control characters. If so, the IMS application program and the data stream to the remote program might lose their device independence.

If IMS is to communicate with other subsystems (such as IMS, CICS or user-written), the other subsystem must be defined as an ISC subsystem. Definitions for ISC must:

- Specify MFS operation as DPM-Bn, where DPM is as described in “Using Distributed Presentation Management (DPM)” and Bn is a user-assigned number (B1 through B15).
- Define TYPE:LUTYPE6 on the TERMINAL macro during system definition.

DPM with ISC provides:

- Output paging on demand that allows paging to be distributed between IMS and another system
- Automatically paged output that allows MFS pages to be transmitted to another system without intervening paging requests
- Transaction routing that allows application programs to view the routing information when it is provided in the input message

Chapter 6. Message Formatting Functions

This chapter describes the message formatting functions of MFS. It elaborates on the control blocks introduced in Chapter 1, “How Application Programs Work with IMS Transaction Manager,” on page 5. It also explains how the control blocks format messages for different device types.

The following topics provide additional information:

- “Input Message Formatting”
- “General Rules for Multiple DPAGE Input” on page 142
- “3270 and SLU 2 Input Substitution Character” on page 142
- “Input Format Control for ISC (DPM-Bn) Subsystems” on page 143
- “Output Message Formatting” on page 145
- “Output Format Control for ISC (DPM-Bn) Subsystems” on page 169
- “Your Control of MFS” on page 177
- “MFS Format Sets Supplied by IMS” on page 187
- “MFS Formatting for the 3270 or SLU 2 Master Terminal” on page 189
- “MFS Device Characteristics Table” on page 190
- “Version Identification Function for DPM Formats” on page 191

Input Message Formatting

This section describes how MFS is selected, and how MFS formats input messages, with examples of input messages before and after formatting.

How MFS Is Selected

Only input data from devices that are defined to IMS TM as operating with MFS can be processed by MFS. However, the use of MFS for specific input messages depends on the message content and, in some cases, on the previous output message.

274X, 3770, SLU 1, and NTO

For MFS to process data from a 274X, 3770, SLU 1, or NTO, these devices must be defined to operate with MFS at IMS TM system definition or with user descriptors if the extended terminal option (ETO) is available.

Related Reading: For more information on ETO, see *IMS Version 9: Administration Guide: Transaction Manager*.

After the device is defined to operate with MFS, the terminal still operates in unformatted mode (using basic edit, not MFS) until one of the following occurs:

- `//midname` is entered and sent to IMS.
- An output message to the terminal is processed using a message output descriptor (MOD) that names a message input descriptor (MID) to be used to process subsequent input data.

When `//midname` is received, MFS gets control to edit the data using the named MID. If any data follows `//midname` (`//midname` must be followed by a blank when data is also entered), MFS discards the `//midname` and the blank and formats the data according to the named MID. If no data follows `//midname`, MFS considers the next line received from the terminal to be the first line of the message.

Input Message Formatting

When an output message is processed by a MOD that names a MID, the MID is used to format the next input from that terminal. This output message can be created by an application program, the IMS TM /FORMAT command, a message switch, or some other IMS TM function.

Related Reading: For more information about the /FORMAT command, see the *IMS Version 9: Command Reference*.

Once in “formatted mode” (using MFS, not IMS TM basic edit), the device continues to operate in formatted mode until one of the following occurs:

- // or //b (// followed by a blank) is received. The terminal returns to unformatted mode and the // (and blank) are discarded. The two slashes are escape characters.
- //bH and data are received. The terminal is returned to unformatted mode, the // blank is discarded, and the data is formatted by IMS TM basic edit.
- An output message whose MOD does not name a MID is sent to the terminal.

3270 and SLU 2

All 3270 and SLU 2 devices are automatically defined to operate with MFS.

Exception: Situations in which 3270 and SLU 2 devices do not operate in formatted mode are:

- When first powered on
- After the CLEAR key is pressed
- When the MOD used to process an output message does not name a MID to use for the next input data received
- When MFS is bypassed by the application program using the DFS.EDT or DFS.EDTN modname

While in unformatted mode, input is limited to IMS TM commands, terminal test requests for BTAM (3270 only) or VTAM, paging requests, and transaction code or message switch data that does not require MFS.

Finance and SLU P Workstations

For MFS to process data from a Finance or SLU P workstation, the terminal must be defined to operate with MFS at IMS TM system definition or with user descriptors if ETO is available. For more information on ETO, see the *IMS Version 9: Administration Guide: Transaction Manager*. Even when so defined, the workstation operates in unformatted mode (using IMS TM basic edit, not MFS) until one of the following occurs:

- The Finance or SLU P workstation remote application program requests MFS formatting by specifying the name of a MID in the input message header.
- //midname is entered by a workstation operator and is sent to IMS TM by the remote application program as the first or only part of the input message itself.

For proper SLU P formatting, include in the input message header a version identification (version ID). The version ID ensures that the correct level of MFS descriptor (Device Input Format, or DIF) is provided in mapping the input message. If this verification is not desired, the version ID can be sent with hexadecimal zeros (X'0000') or it can be omitted from the message header. For the specification of the version ID and additional details, see “Version Identification” on page 176.

Processing occurs as described for the 274X.

When an output message sent to an SLU P or Finance workstation is formatted using a MOD that names a MID, IMS TM sends the name of the MID to the workstation as part of the output message header. Because IMS TM does not have direct control of the terminal devices in these systems, IMS TM cannot guarantee the proper MID is used to process the next input. It is the responsibility of the remote program to save the MID name and to include it in the next input message it sends to IMS TM as the DPN.

Finance and SLU P workstations continue in formatted mode only when the current message has an associated MID or MOD.

Intersystem Communication (ISC) Subsystems

For data from an ISC subsystem to be processed by MFS, the ISC subsystem must be defined as UNITYPE=LUTYPE6 on the TYPE macro at IMS TM system definition or with ETO user descriptors. For more information on ETO, see the *IMS Version 9: Administration Guide: Transaction Manager*. Even when so defined, the ISC subsystem operates in unformatted mode (using IMS TM basic edit or ISC edit, not MFS) until the ISC application program requests MFS formatting by specifying the name of a MID in the DPN field of the input message header.

When an output message sent to an ISC subsystem is formatted using a MOD that names a MID, IMS TM sends the name of the MID to the ISC subsystem in the RDPN field of the output message header. Because IMS TM does not have direct control of the ISC subsystem, IMS TM cannot guarantee the proper MID is used to process the next input. It is the responsibility of the ISC application program to save the MID name and to include it in the next input message it sends to IMS.

ISC subsystems continue in formatted mode only when the current message has an associated MID or MOD.

Related Reading: For an overview of ISC, see *IMS Version 9: Administration Guide: Transaction Manager*.

Formatting Messages from Terminals in Preset Destination Mode

Preset destination mode is used to fix a destination for all messages entered from a terminal. Use the /SET command to enter preset destination mode (/SET is described in *IMS Version 9: Command Reference*). When a terminal is in preset mode, all input messages (processed by either MFS or basic edit) are routed to the destination established by the /SET command. You do not have to include the message destination in the input message.

When IMS TM basic edit processes input from a preset terminal, the preset destination name is added to the beginning of the first segment. When MFS processes input from a preset terminal, the preset destination name is not added to the beginning of the first segment; input message format is a result of your message definition and input. MFS provides many methods for reserving space in an input segment or for inserting a transaction code, without requiring you to specify a message destination.

Formatting of Messages Using Fast Path

If you plan to implement Fast Path, MFS functions like other IMS TM applications, with the restriction that all messages must be single-segment messages.

How MFS Formats Input Messages

Input data from MFS-supported devices in formatted mode is formatted based on the contents of two MFS control blocks—the message input descriptor (MID) and

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the device input format (DIF). The MID defines how the data should be formatted for presentation to the IMS TM application program and points to the DIF associated with the input device. The DIF describes the data as the data is received from the device.

If the message built by the MID is a command, the command must conform to the command format and syntax rules as documented in *IMS Version 9: Command Reference*.

Input Message Formatting Options

MFS supports three message formatting options. The option selected determines how MFS interprets the MID definition and thereby formats the data into message fields for presentation to the application program. The MID's MFLD statement or statements describes message fields in terms of:

- Length
- The device field from which input data is to be obtained
- Literal data for message fields which will not or do not receive device data
- Fill characters to use when the input data does not fill the message field
- Field justification (left or right) or truncation (left or right) specifications
- Whether the first 2 bytes of the field should be reserved for attribute data

The formatting option is specified in the MID's MSG statement (OPT=). The selection of the proper option for an application is a design decision that should be based on the complexity and variability of the device data stream, the programming language used, and the complexity of the program required to process the application under a given option. In the option descriptions, a NULL character is X'3F'.

MFS Option 1: The effect of option 1 depends on whether a fill character of NULL has been defined. When no field in an option 1 message is defined to the MFS Language utility as having a fill character of NULL:

- Messages always contain the defined number of segments.
- Each segment is always of the defined length and contains all defined fields.
- All fields are filled with data, data and fill characters, or fill characters.

When fields in an option 1 message are defined as having a fill character of NULL:

- Each field with null fill and no input data from the device is eliminated from the message segment. If all fields in a segment are eliminated in this manner and no literals (explicit or default) are defined, the segment is eliminated; otherwise, the length of the segment is reduced and the relative position of succeeding fields in the segment is altered.
- Fields with null fill that receive device data that does not fill the field are not padded—the number of characters received for the device field becomes the number of characters of the input data. This alters the length of the segment and the relative position of all succeeding fields in the segment.

MFS Option 2: Option 2 formatting is identical to option 1 unless a segment contains no input data from the device after editing. If this occurs and there are no more segments containing input data from the device, the message is terminated, and the last segment in the message is the last segment that contained input data from the device. If a segment is created that has no input data from the device, but there are subsequent segments that do contain data from the device, a segment is created with a single byte of data (X'3F') signifying that this is a pad or null

segment. If this occurs on a first segment that is defined to contain a literal, an invalid transaction code could result because MFS does not insert explicit or default literals into segments for which no device input data is received.

MFS Option 3: Option 3 formatting supplies the program with only the fields received from the input device. A segment is presented only if it contains fields that were received from the device. Segments are identified by a relative segment number and fields within a segment are identified by a segment offset. Segments and fields are both of variable length if they are described as having a fill character of NULL. Empty fields (fields without data) are not padded with fill characters. Segments that are presented to the application program appear in relative segment number sequence. Fields within the segment are in segment offset sequence.

Option 3 messages do not contain literals (explicit or default) specified in the MID.

If option 3 is used with conversational transactions, the transaction code is not removed from the message, since fields and offsets of fields are maintained within the text. The transaction code is still found in the SPA also.

Restriction: You cannot use option 3 input message formats to enter IMS TM commands. However, IMS TM commands can be entered by using IMS-supplied default formats, from the cleared screen, or from your defined option 1 and option 2 input message formats.

Examples of Message Segment Definitions

The examples illustrate the message segment definitions, then for options 1, 2, and 3, the contents, length in bytes, and a code for the type for each field.

The field types are labeled as shown in Table 23.

Table 23. Input Message Field Types

Type Code	Description
A	Total segment length, including fields A, B, C, 2 bytes, binary
B	Z1 field—reserved for IMS TM usage
C	Z2 field—indicates formatting option 1 byte, binary
D	Relative segment number 2 bytes, binary
E	Field length, including length of fields E, F, 2 bytes, binary
F	Relative field offset in the defined segment 2 bytes, binary
G	Field

Notes:

1. No boundary alignment is performed for fields A, D, E, or F.
2. Fields A, B, and D must be on halfword boundaries. To do this, ensure the I/O area is on a boundary when the GU or GN call to IMS TM is made.
3. For the PLITDLI interface, the length (LL) field must be declared as a binary fullword. The value in the LL field is the segment length minus 2 bytes. For example, if the input message segment is 16 bytes, LL is 14 bytes, which is the sum of the lengths of LL (4 bytes minus 2 bytes), ZZ (2 bytes), and TEXT (10 bytes).

Example 1: Input Message Format: Table 24 on page 128 describes the definition for an input message.

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Table 24. Example 1: Input Message Definition

Segment Number	Field Name	Field Length	Field Value
1	LL	2	0072
	ZZ	2	XXXX
	TRANCODE	8	YYYY
	Text	10	MAN NO.
	Text	50	NAME
2	LL	2	0059
	ZZ	2	XXXX
	Text	5	DEPT
	Text	50	LOCATION
3	LL	2	0064
	ZZ	2	XXXX
	Text	10	PART NO.
	Text	50	DESCRIPTION
4	LL	2	0019
	ZZ	2	XXXX
	Text	10	QUANTITY
	Text	5	ORDER PRIORITY

All fields defined as left justified, with a fill character of blank.

You enter:

Field Name	Input
NAME	ABJONES
PART NO.	23696
DESCRIPTION	WIDGET

The transaction code is provided from the message input description as a literal. The input message would appear to the application program as shown in one of the following tables: Table 25, Table 26 on page 129, or Table 27 on page 130.

Table 25. Example 1: Application Program View for Option 1

Segment Number	Field Type	Field Length	Field Value
1	A	2	0072
	B	1	XX
	C	1	01
	TRANCODE	8	YYYY
	Text	10	blanks
	Text	50	ABJONES

Table 25. Example 1: Application Program View for Option 1 (continued)

Segment Number	Field Type	Field Length	Field Value
2	A	2	0059
	B	1	XX
	C	1	01
	Text	5	blanks
	Text	50	blanks
3	A	2	0064
	B	1	XX
	C	1	01
	Text	10	23696
	Text	50	WIDGET
4	A	2	0019
	B	1	XX
	C	1	01
	Text	10	blanks
	Text	5	blanks

Table 26. Example 1: Application Program View for Option 2

Segment Number	Field Type	Field Length	Field Value
1	A	2	0072
	B	1	XX
	C	1	02
	TRANCODE	8	YYYY
	Text	10	blanks
	Text	50	ABJONES
2	A	2	0005
	B	1	XX
	C	1	02
	Text	1	X'3F'
3	A	2	0064
	B	1	XX
	C	1	02
	Text	10	23696
	Text	50	WIDGET

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Table 27. Example 1: Application Program View for Option 3

Segment Number	Field Type	Field Length	Field Value
1	A	2	0060
	B	1	XX
	C	1	03
	D	2	0001
	E	2	0054
	F	2	0022
	G	50	ABJONES
2	A	2	0074
	B	1	XX
	C	1	03
	Text	2	0003
	D	2	0014
	E	2	0004
	F	2	23696
	G	2	0054
	F	2	0014
	G	50	WIDGET

The option 3 example shows no transaction code in the first segment because literals are not inserted into option 3 segments. This message would be rejected unless it is received from a terminal in conversational or preset destination mode, because transaction code validation is performed after the messages are formatted.

Example 2: Input Message Format: The segments are similar to those in example 1. Fields are defined as in example 1, except for the following:

Field Name	Contents
NAME	null pad
DEPT	null pad
LOCATION	null pad
PART NO.	right justify, pad of EBCDIC zero
QUANTITY	null pad

You enter:

Field Name	Input
NAME	ABJONES
PART NO.	23696
DESCRIPTION	WIDGET
PRIORITY	HI

Transaction code is provided as a 3270 program function key literal or a special data field from a 274X or Finance workstation. The input message appears as shown in one of the following tables: Table 28 on page 131, Table 29 on page 131,

or Table 30 on page 132.

Table 28. Example 2: Application Program View for Option 1

Segment Number	Field Type	Field Length	Field Value
1	A	2	0029
	B	1	XX
	C	1	01
	TRANCODE	8	YYYY
	Text	10	blanks
	Text	50	ABJONES
2	No second segment is presented because all of its fields were null padded and no input data was received from the device for these fields.		
3	A	2	0064
	B	1	XX
	C	1	01
	Text	10	0000023696
	Text	50	WIDGET
4	A	2	0009
	B	1	XX
	C	1	01
	Text	5	HI

Table 29. Example 2: Application Program View for Option 2

Segment Number	Field Type	Field Length	Field Value
1	A	2	0029
	B	1	XX
	C	1	02
	TRANCODE	8	YYYY
	Text	10	blanks
	Text	7	ABJONES
2	A	2	0009
	B	1	XX
	C	1	02
	Text	1	X'3F'
3	A	2	0064
	B	1	XX
	C	1	02
	Text	10	0000023696
	Text	50	WIDGET

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Table 29. Example 2: Application Program View for Option 2 (continued)

Segment Number	Field Type	Field Length	Field Value
4	A	2	0009
	B	1	XX
	C	1	02
	Text	5	HI

Table 30. Example 2: Application Program View for Option 3

Segment Number	Field Type	Field Length	Field Value
1	A	2	0029
	B	1	XX
	C	1	03
	D	2	0001
	E	2	0012
	F	2	0004
	G	8	TRANCODE
	E	2	0011
	F	2	0022
	G	7	ABJONES
2	A	2	0074
	B	1	XX
	C	1	03
	D	2	0003
	E	2	0014
	F	2	0004
	G	10	0000023696
	E	2	0054
	F	2	0014
	G	50	WIDGET
3	A	2	0015
	B	1	XX
	C	1	03
	D	2	0004
	E	2	0009
	F	2	0014
	G	5	HI

Cursor Position Input and FILL=NULL

With MFS, a problem might arise when the application program is told the cursor position on input. This problem occurs when:

- The input message uses formatting option 1 or 2.
- The MFLD used for cursor position data is defined in a segment where at least one MFLD is defined to use null fill (FILL=NULL).

When these conditions occur, cursor position 63 (X'3F') results in a 3-byte field containing compressed cursor data, rather than a normal 4-byte field. The MFLD with this potential problem is flagged with the message "DFS1150".

To avoid this problem, change the MFLD statement for the cursor data field to specify EXIT=(0,2). This will cause the IMS TM-provided field edit routine to convert the field contents from binary to EBCDIC. The application program must also be changed to handle the EBCDIC format.

Input Logical Page Selection

An input logical page (LPAGE) determines the content of the input message that is presented to the application program. It consists of a user-defined group of related message segment and field definitions. An input LPAGE is identified by an LPAGE statement. When no LPAGE statement is present, all message field definitions in the MSG are treated as a single LPAGE. An input LPAGE identified by an LPAGE statement can refer to one or more input device pages (DPAGE).

An input DPAGE defines a device format that can be used for an input LPAGE. It consists of a user-defined group of device field definitions. An input DPAGE is identified by a DPAGE statement. When no DPAGE statement is present, all device field definitions following the DIV statement are treated as a single DPAGE. If multiple DPAGES are defined, each DPAGE statement must be labeled. A DPAGE identified by a labeled DPAGE statement must be referred to by an LPAGE statement.

3270 and SLU 2 device input data is always processed by the currently displayed DPAGE. For other devices, if multiple DPAGES are defined in their formats, a conditional test is performed on the first input record received from the device. The results of this test determine which DPAGE is selected for input data processing. The LPAGE that refers to the selected DPAGE is used for input message formatting.

If input LPAGES are not defined, message fields can refer to device fields in any DPAGE, but input data from the device for any given input message is limited to fields defined in a single DPAGE.

Input Message Field and Segment Edit Routines

To simplify programming, MFS application designers should consider using (for all but SLU P devices) input message field and segment edit routines to perform common editing functions such as numeric validation or conversion of blanks to numeric zeros. While use by existing applications is unlikely, field and segment edit routines can simplify programming of new applications by using standard field edits to perform functions that would otherwise need to be coded in each application program. *IMS Version 9: Customization Guide* lists the field and segment edit routines provided by IMS. The input message field or segment edit routines can be disabled for SLU P (DPM-An and ISC) devices, because editing is probably done by the remote program.

Using field and segment edit routines causes extra processing in the IMS TM control region and, if used extensively, creates a measurable performance cost. However, these edit routines can improve performance by reducing processing time in the message processing region, reducing logging and queuing time, and by allowing field verification and correction without scheduling an application program. Efficiency of these user-written routines should be a prime concern.

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Because these routines execute in the IMS TM control region, an abend in the edit routine causes an abend of the IMS TM control region.

IMS-Supplied Field and Segment Edit Routines: IMS TM provides both a field and a segment edit routine that the MFS application designer might want to use. *IMS Version 9: Customization Guide* lists the IMS-supplied routines.

Under z/OS, any code written to replace these IMS-supplied routines must be able to execute in RMODE 24, AMODE 31 and be capable of 31-bit addressing even if they do not reference any 31-bit addressable resources. AMODE refers to addressing mode; when running modules in AMODE 31, Extended Architecture processors interpret both instruction and data addresses to be 31 bits wide.

Related Reading: For more information on running modules under z/OS, refer to *MVS JES3 Conversion Note*.

Field Edit Routine (DFSME000): The functions of the field edit routine are based on the entry vector. It can use all three formatting options. For options 1 and 2, entry vector 1 can produce undesirable results if FILL=NULL was specified in the MFLD statement.

Input Message Literal Fields

Input message fields can be defined to contain literal data that you specify during definition of the MID:

- You can define a default literal that MFS always inserts as part of the input message.
- You can define a literal that MFS inserts as part of the input message when no data for the field is received from the device.

Using a default literal can simplify application programming. When used, application programs no longer need to test for “no data” conditions or to provide exception handling. Default literals make it possible for an application program to distinguish between zero-value data you enter and a condition of “no data entered”.

Example: Consider this MFLD definition:

```
MFLD (DFLD1,'NO DATA'),LTH=7,JUST=R,FILL=C'0'
```

For example, an application program would view your entries as follows:

Your Entry	Program Data Viewed
296	0000296
0	0000000
no data entered	NO DATA

Without a default literal, the results of entering a value of 0 and of entering no data are the same—0000000.

Defaults can be altered without changing application programs, and multiple defaults can be provided by using different message descriptors or different input logical pages.

Default literals can also expand device independence by providing a device-independent method of inserting data in an input message field if no data is entered from the device for that field. This function of the default literal is used often for 3270 or SLU 2 devices, which have the same device format for input as for

output. For these devices, the default (transaction code, data, or both) can be provided if you specify a default literal on input (MID).

Input Message Field Attribute Data

Nonliteral input message fields can be defined to allow for attribute data, extended attribute data, or both. When defined to do so, MFS initializes to blanks and reserves the first bytes of the message field for attribute or extended attribute data. These first bytes are filled in by a field edit routine or in its preparation of an output message. When attribute or extended attribute space is specified, the specified field length must include space for the attribute or extended attribute bytes.

Sometimes input messages are updated by an application program and returned to the device. The application program can simplify message definitions if the message uses attribute data as the output message, and the attribute data bytes are defined in the input message, also.

When a field edit routine is used, it can be designed (as the IMS-supplied field edit routine is) to set attribute bytes on fields in error. In this way, erroneous fields can be highlighted before the segment edit routine returns the message to the device. In this case, the application program is not concerned with attribute bytes.

IMS TM Password

The IMS TM password portion of an input message is defined in the input message definition. One or more input message fields can be defined to create the IMS TM password. Using this method of password definition allows passwords to be created from field data you enter, from data read by a 3270, SLU 2, 3770 operator identification card reader, or data from a 3270 magnetic stripe reader.

Recommendation: If you use an SLU 2 or a 3270, you can also define a specific device field as the location of the IMS TM password, but the method discussed in this section takes precedence if both an input message field and a device field are defined.

Fill Characters for Input Message Fields

MFS uses fill characters to pad message fields when the length of the data received from the device is less than the specified field length, no data for the field is received and no default literal is defined, or the data received from SLU P contains nulls and NULL=DELETE is specified. The fill characters that can be selected are a blank (X'40'), any EBCDIC hexadecimal character (X'hh'), or an EBCDIC graphic character (C'c'). Null compression, which causes compression of the message to the left by the amount of missing data, can also be selected. How MFS actually pads the message fields is a function of the selected fill character and the message formatting option being used (refer to "Input Message Formatting Options" on page 126).

Input Modes (Devices Other Than 3270, SLU 2, or ISC Subsystems)

MFS expects input message fields to be entered in the sequence in which they were defined to the MFS Language utility program. For devices other than SLU 2 and 3270, MFS application designers have a choice of how fields are defined and how MFS should scan those fields. You can select record mode or stream mode. Record mode is the default.

In record mode:

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- Input fields are defined as occurring within a specific record (a line or card from the 274X, 3770, or SLU 1; a transmission from the Finance or SLU P workstation) that is sent from the input device.
- Fields must not be split across record boundaries.
- Fields defined within a record must appear on that record to be considered by MFS.
- When MFS locates the end of a record, the current field is terminated and any other fields defined for that record are processed with no device data (message fill).
- If the record received by IMS TM contains more data fields than the number of fields defined for the record, the remaining data fields are not considered by MFS.

For input data from a Finance or SLU P workstation remote program, the input message header or *//midname* can be transmitted separately if the data fields for the first record do not fit in the same record. If no data follows the input message header or the *//midname*, MFS considers the next transmission received to be the first record of the input message.

In stream mode:

- Fields are defined as a contiguous stream of data unaffected by record boundaries.
- Fields can be split across input records and fields can be entered from any input record as long as they are entered in the defined sequence.

Input Field Tabs (Devices Other Than 3270 or SLU 2)

An input field tab (FTAB) is a character defined in the DEV statement for separating input fields if the length of the data entered is less than the defined field length, or for when no data is specified for a field. An FTAB causes the MFS input scan to move to the first position of the next defined field. FTABs can be defined only for input from devices other than the 3270 or SLU 2. When no FTABs are defined, each device input field is assumed to be of its defined length.

Select a character for input field separation that is never used for other user data in the data stream. If FTAB is not unique, the data might be misinterpreted by MFS.

Example: Figure 24 shows some DFLD field definitions and the device format that results from these definitions.

Field Definition		MODE=STREAM	MODE=RECORD
A	DFLD	POS=1,LTH=4	POS=(1,1),LTH=4
B	DFLD	POS=6,LTH=3	POS=(1,6),LTH=3
C	DFLD	POS=9,LTH=5	POS=(1,9),LTH=5

'Device Format'



Figure 24. FTAB Qualification Descriptions

When an FTAB is defined, its use is qualified by specifying FORCE, MIX, or ALL. See Figure 25 on page 138 for how the descriptions in Figure 24 are read.

Figure 24 on page 136 shows how the FTAB qualification affects the results of an MFS input scan following variable operator input of a three-field message.

Figure 25 on page 138 provides examples of correct and failed results produced by FTAB specifications. The double-headed arrows indicate that the FTAB qualification does not affect input scan. Input examples 2, 3, and 6 produce correct results using any of the FTAB qualifications but example 8 does not produce correct results regardless of FTAB qualifications. The following sections (FORCE, MIX, and ALL) specify which examples have failed results and why these results are undesirable.

FORCE: FORCE is the default value. Each device input field is assumed to be of its defined length until an FTAB is encountered. When the first FTAB is encountered, it signifies the end of data for the current field. The byte of data following the FTAB is considered the first byte of the next field. In record mode, all subsequent fields in the current record require an FTAB. In stream mode, all subsequent fields require an FTAB. FTABs used on subsequent fields indicate that the character following the FTAB is the first for the next defined field. (This is as if ALL were specified).

In Figure 25 on page 138, examples 1, 2, 3, 5, 6, and 7 produce the desired result. Example 4 fails because no FTAB is supplied following field B (compare with example 5). Example 8 fails because no FTABs are entered, the 0 is occupying the blank (undefined) position, and subsequent fields are thus incorrect (compare with example 1).

MIX: Each device input field is assumed to be of its defined length until an FTAB is encountered. When the first FTAB is encountered, it signifies the end of data for the current field. The byte of data following the FTAB is considered the first byte of the next field. Subsequent fields of the defined length do not require an FTAB; if one is entered and the next field is contiguous (like fields B and C in the example), undesirable results occur (see example 5). Mixed FTABs operate just like a typewriter with tab stops set at the first position of each defined field (columns 1, 6, and 9 in the example).

In Figure 25 on page 138, examples 1, 2, 3, 4, 6, and 7 produce the desired result. Example 5 fails because field B is of its defined length and does not require an FTAB; the FTAB is interpreted to indicate no data for field C (compare with example 4). Example 8 fails because no FTABs are entered, the 0 is occupying the blank (undefined) position, and subsequent fields are thus incorrect (compare with example 1).

ALL: When ALL is specified, each device input field must be terminated by an FTAB regardless of whether it is greater than, less than, or equal to the defined length. When an FTAB is encountered, it signifies the end of data for the current field. The byte of data following the FTAB is considered the first byte of the next field.

In Figure 25, examples 2, 3, 5, and 6 produce the desired result. Examples 1, 4, 7, and 8 fail because the required FTABs are not entered.

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OPERATOR INPUT EXAMPLE	FIELD	MFS DFLD DATA					
		FTAB=(',',FORCE)		FTAB=(',',MIX)		FTAB=(',',ALL)	
		LTH	DATA	LTH	DATA	LTH	DATA
PART02315231	A	4	PART	4	PART	4	PART
	B	3	023	3	023	0	
	C	5	15231	5	15231	0	
P1,23,15231	A	2	P1	2	P1	2	P1
	B	2	23	2	23	2	23
	C	5	15231	5	15231	5	15231
PART,23,15	A	4	PART	4	PART	4	PART
	B	2	23	2	23	2	23
	C	2	15	2	15	2	15
PART,02315231	A	4	PART	4	PART	4	PART
	B	3	023	3	023	3	023
	C	0		5	15231	0	
PART,023,15231	A	4	PART	4	PART	4	PART
	B	3	023	3	023	3	023
	C	5	15231	0		5	15231
PART,,15231	A	4	PART	4	PART	4	PART
	B	0		0		0	
	C	5	15231	5	15231	5	15231
PARTb,15231	A	4	PART	4	PART	4	PART
	B	0		0		3	152
	C	5	15231	5	15231	0	
PART02315231	A	4	PART	4	PART	4	PART
	B	3	231	3	231	0	
	C	4	5231	4	5231	0	

Note: In this example, the comma is used as the FTAB character.

Figure 25. MFS Input Scan When FTABs Are Defined with FORCE, MIX, and ALL

Optional Deletion of Null Characters for DPM-An

MFS provides for optional deletion of trailing null characters in transmission records and input data fields from SLU P (DPM-An) remote programs. (A null character is a hexadecimal zero, X'00'.) In the DIV statement, the device input format can specify NULL=KEEP or NULL=DELETE. NULL=DELETE means that MFS scans data fields and transmission records for trailing nulls and deletes them. KEEP is the default and means that MFS leaves trailing nulls in the data and treats them as valid data characters.

If trailing null characters have been replaced by fill characters by the remote program, MFS treats the fill characters as valid data characters.

When NULL=DELETE is specified, nulls at the end of a record are deleted before the data fields are scanned. In record mode, the end of the record is determined either by the FTAB or by the first other non-null character found (searching backward from the end of the record). In stream mode, trailing nulls at the end of the record are deleted only if an FTAB indicates the end of the record; otherwise, the record is handled as received from the remote program.

During the data field scan, the first trailing null character encountered in the field signifies the end of the data for the current field. The data is edited into the message field using the message fill character to pad the field if required. If the entire field contains nulls (such as nulls at the end of the record), the entire message field is padded with the specified fill character.

The scan for trailing null characters within fields is performed for each record transmitted. If an FTAB character is encountered in the current record being processed, the scan for trailing nulls characters within fields is discontinued for that record and resumes with the next record.

Transmitting null characters to either IMS TM or the delete operation is costly in execution time. Weigh the relative costs when you decide whether to use the NULL=DELETE option or to delete the nulls using the remote program. You must also consider the effects of the FTAB options FORCE, MIX, and ALL. These costs are affected by the following:

- When FTAB=ALL is specified with NULL=DELETE, only trailing null characters at the end of the record can be removed by MFS.
- In stream mode, with NULL=DELETE, an FTAB should be used to show an omitted field at the end of a record. Otherwise, nulls (equal to the number of characters defined for the field or fields) must be transmitted.
- If FTABs are specified and NULL=DELETE, nulls and FTABs can be mixed. FTABs can be used for one record, nulls for the next. The nulls are removed from the record with no FTABs. With FTABs in the record, null characters are treated as data.
- With NULL=DELETE, binary data that might contain valid trailing hexadecimal zeros (not intended as null characters) must be preceded by an FTAB character for a previous field to prevent deletion of the trailing X'00'.

Examples of Optional Null Character Deletion for DPM-An

In the three examples that follow, the comma is the specified FTAB, X'5F' is input hexadecimal data, and characters are defined as follows:

```
X'6B'=C",
X'C1'=C"A"
X'C2'=C"B"
X'C3'=C"C"
C"b"=blank
X'40'=C"b"
```

Example 1: Input Binary Data and Nulls:

Device Input Format	Message Input Definition
INFMT FMT	INMSG MSG TYPE=INPUT,SOR=INFMT
DEV TYPE=DPM-A1, FTAB=(;MIX)	SEG
DIV TYPE=INPUT, NULL=DELETE	
PPAGE	
A DFLD LTH=3	MFLD A, LTH=3
B DFLD LTH=2	MFLD B, LTH=2
FMTEND	MSGEND

Input Message	Record	Field	DFLD Data	MFLD Data
(1) X'C1C2C3005F'	1	A	C"ABC"	C"ABC"
		B	X'005F'	X'005F'

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Input Message	Record	Field	DFLD Data	MFLD Data
(2) X'C1C26B005F'	1	A	C"AB"	C"ABb"
		B	X'005F'	X'005F'
(3) X'C1C200005F'	1	A	C"AB"	C"ABb"
		B	X'005F'	X'005F'
(4) X'C1C2C35F00'	1	A	C"ABC"	C"ABC"
		B	X'5F'	X'5F40'
(5) X'C1C26B5F00'	1	A	C"AB"	C"ABb"
		B	X'5F'	X'5F40'

Note: The X'00' (null) at the end of the record in input messages (4) and (5) is deleted before the data fields (A and B) are scanned. Therefore, the results are the same for field B, even though an FTAB (comma in this example) follows field A. If X'00' is to be considered as data for field B, an FTAB (comma in this example) should be entered following the X'5F00'.

Example 2: Record Mode Input:

```

Device Input Format           Message Input Definition
INFMT FMT                   INMSG MSG  TYPE=INPUT,SOR=INFMT
      DEV TYPE=DPM-A1, FTAB=(;MIX), SEG
      MODE=RECORD
      DIV TYPE=INPUT, RCDCTL=12,   MFLD A,LTH=3,FILL=C'*'
      NULL=DELETE
      PPAGE                       MFLD B,LTH=3,FILL=C'*'
A     DFLD LTH=3                 MFLD C,LTH=3,FILL=C'*'
B     DFLD LTH=3                 MFLD D,LTH=3,FILL=C'*'
C     DFLD LTH=3                 SEG
D     DFLD LTH=3                 MFLD E,LTH=5,FILL=C'*'
E     DFLD LTH=5                 MFLD F,LTH=7,FILL=C'*'
F     DFLD LTH=7                 SEG
G     DFLD LTH=5                 MFLD G,LTH=5,FILL=C'*'
      FMTEND                     MSGEND
  
```

Input Message	Record	Field	DFLD Data	Segment	MFLD Data
(1) X'C10000C20000C3C3C3000000'	1	A	C'A'	1	C'A***
		B	C'B'		C'B***
		C	C'CCC'		C'CCC'
		D	no data		C'****
X'C5C56BC6C66B000000000000'	2	E	C'EE'	2	C'EE****
		F	C'FF'		C'FF*****
X'00000000000'	3	G	no data	3	C'*****
(2) X'C10000C20000C3C3C3'	1	A	C'A'	1	C'A***
		B	C'B'		C'B***
		C	C'CCC'		C'CCC'
		D	no data		C'****
X'C5C56BC6C6'	2	E	C'EE'	2	C'EE****
		F	C'FF'		C'FF*****
no input record	3	G	no data	3	C'*****

Note: In this example, no input data was entered for fields D and G. Input message 1 contains nulls in place of omitted fields. Input message 2 does not contain nulls for omitted fields, but the results are the same for both input messages.

Example 3: Stream Mode Input:

```

Device Input Format          Message Input Definition
  INFMT FMT                INMSG MSG  TYPE=INPUT,SOR=INFMT
                        DEV TYPE=DPM-A1, FTAB=(;;MIX), SEG
                        MODE=STREAM
                        DIV TYPE=INPUT, NULL=DELETE      MFLD A,LTH=3,FILL=C'*'
  PPAGE                    MFLD B,LTH=3,FILL=C'*'
A   DFLD LTH=3            MFLD C,LTH=3,FILL=C'*'
B   DFLD LTH=3            MFLD D,LTH=3,FILL=C'*'
C   DFLD LTH=3            SEG
D   DFLD LTH=3            MFLD E,LTH=5,FILL=C'*'
E   DFLD LTH=5            MFLD F,LTH=7,FILL=C'*'
F   DFLD LTH=7            SEG
G   DFLD LTH=5            MFLD G,LTH=5,FILL=C'*'
                        FMTEND                          MSGEND
    
```

Input Message	Record	Field	DFLD Data	Segment	MFLD Data	
(1) X'C10000C20000C3C3C3000000'	1	A	C'A'	1	C'A***	
		B	C'B'		C'B***	
		C	C'CCC'		C'CCC'	
		D	no data		C'****'	
X'C5C56BC6C66B0000000000000'	2	E	C'EE'	2	C'EE****'	
		F	C'FF'		C'FF*****'	
X'0000000000000000'	3	G	no data	3	C'*****'	
(2) X'C10000C20000C3C3C3'	1	A	C'A'	1	C'A***	
		B	C'B'		C'B***	
		C	C'CCC'		C'CCC'	
	2	D	C'EE'		C'EE*'	
		X'C5C56BC6C6'	E	C'FF'	2	C'FF****'
			F	no data		C'*****'
no input record	3	G	no data	3	C'*****'	

Note: In this example, no input data was entered for fields D and G. Input message 1 contains nulls in place of omitted fields. Input message 2 does not contain nulls for omitted fields and produces undesirable results for fields D, E, and F.

Multiple Physical Page Input Messages (3270 and SLU 2 Display Devices)

Specifying multiple physical page input for 3270 and SLU 2 display devices allows creation of identical input messages for a transaction regardless of the physical capacity of the device being used. When this facility is used, an input message consisting of multiple physical pages can be entered using multiple physical pages of a single output logical page. If multiple physical pages are defined for output (see "Physical Paging of Output Messages" on page 149), the only action required to obtain multiple physical page input is to specify MULT=YES in the DPAGE statement.

For the 3290 Information Display Panel in partitioned mode, multiple physical page input from a single partition is supported only if the DPAGE statement for the current partition specifies MULT=YES. The multiple physical pages for a single input message must come from a single partition.

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If MULT=YES is not specified on the DPAGE statement for the current partition, one physical page of a single partition constructs a single input message and the input message is restricted to a single logical page.

Input messages can be created from multiple DPAGEs. This function is available for devices other than 3270 and SLU 2.

General Rules for Multiple DPAGE Input

The general rules apply to multiple DPAGE input are:

1. If any mapped input LPAGE contains no data segments (as a result of segment routines canceling all segments, for example), the input message is rejected and an error message is sent to the other subsystem.
2. MFS echo to the input terminal is ignored.
3. MFS password creation occurs from any DPAGE, but once created, any other password is ignored. If the password is included in the attach FM header, this password is used for DPM-Bn.
4. Input message options 1, 2, and 3 apply to LPAGEs. If option 2 is requested, null segments at end of an LPAGE are eliminated. This alters the relative positions of the segments in the next LPAGE (if any) in the input message. If option 1 or 2 is requested, the first segment of the second and all subsequent LPAGEs have the page bit (X'40') in the Z2 field turned on regardless of any null segments resulting at the end of the previous LPAGE. If option 3 is requested, the segment ID is equal to 1 for every first segment in the new LPAGE.
5. Multiple DPAGE input requested in MFS definitions does not restrict message creation from the single DPAGE.
6. If your control request is entered with the first input DPAGE, the request is processed and the input message is rejected. If your control request is entered with an input DPAGE other than the first, the request is ignored and the input message is accepted.
7. If your logical page request is entered with the first input DPAGE (that is, an equals sign (=) in the first position of the input segment), the request is processed and the input message is rejected.

If multiple DPAGE input is not requested of MFS definitions, message creation from more than one DPAGE is not permitted and these rules apply:

1. If a single transmission contains more data than defined for the DPAGE selected, the input message is rejected and an error message is sent to the other subsystem.
2. If the message has multiple transmissions, the input message is rejected and an error message is sent to the other subsystem.

3270 and SLU 2 Input Substitution Character

A X'3F' can be received on input by IMS TM from some terminals (such as by using the ERROR key). The substitution character (X'3F') provides a means of informing the host application that an error exists in the field. MFS also uses X'3F' for IMS TM functions on input data streams. To eliminate the confusion resulting from the two uses of the X'3F' characters, a parameter (SUB=) is provided on the DEV statement for use with 3270 and SLU 2 display devices.

With this parameter, a user-specified character can be defined to replace any X'3F' characters received by MFS in the 3270 and SLU 2 data stream. No translation occurs if any of the following is true:

- The SUB= parameter is not specified.
- The SUB= parameter is specified as X'3F'.
- The input received bypasses MFS.

The specified SUB character should not appear elsewhere in the data stream, so, it should be nongraphic.

Input Format Control for ISC (DPM-Bn) Subsystems

This section describes the major input message formatting functions of MFS with ISC nodes.

Input Message Formatting

This section describes the DPAGE selection options and the creation of a message from multiple DPAGEs.

Input DPAGE Selection

The OPTIONS=(DNM) parameter on the DIV statement allows for DPAGE selection using data structure name (DSN).

If more than one DPAGE is defined, a DPAGE label must be specified in every DPAGE. If no DPAGE is selected, the message is rejected and an error message is sent to the other subsystem.

If OPTIONS=NODNM and multiple DPAGEs are defined, a conditional test is performed on the first input record. The results of the test (matching the COND= specification with the data) determines which DPAGE is selected for input data formatting. If the condition is not satisfied and all defined DPAGEs are conditional, the input message is rejected and an error message is sent to the other subsystem.

Single Transmission Chain

For single transmission chains, DPAGEs can be selected using conditional data.

DPAGE Selection Using Conditional Data: For multiple DPAGE input with single transmission chain, use the OPTIONS=NODNM parameter. The data in the first input record is used to select the first (or only) DPAGE for formatting. If the data supplied does not match any COND= defined, the last defined DPAGE is selected if the COND= is not specified for this DPAGE. If the condition is not satisfied and all defined DPAGEs are conditional, the input message is rejected and an error message is sent to the other subsystem. If the DSN is supplied in the DD header, it is ignored. For any additional DPAGE (more data supplied than defined for the DPAGE selected), the data in the subsequent record is used to select the next DPAGE for formatting.

Multiple Transmission Chains

For multiple transmission chains, DPAGEs can be selected using DSN or by using a conditional test.

DPAGE Selection Using DSN: For multiple DPAGE input with multiple transmission chains, use the OPTIONS=DNM parameter. The DSN supplied in the DD header with each chain of the message is used to select the DPAGE for

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formatting. If no match is found, the message is rejected and an error message (DFS2113) is sent to the other subsystem.

DPAGE Selection Using Conditional Test on the Data: If DSN is supplied in the DD header with each chain (or any chain) of the message and OPTIONS=NODNM is specified on the DIV statement, the DSN is ignored. The data in the first record of each chain is used to select the DPAGE for formatting. If no condition is satisfied and the last defined DPAGE is unconditional (that is, COND= parameter is not specified), this DPAGE is selected for formatting. If the condition is not satisfied and all defined DPAGES are conditional, the input message is rejected and an error message is sent to the other subsystem.

How conditional and unconditional DPAGES are specified depends on whether OPTIONS=DNM or OPTIONS=NODNM is specified.

- For OPTIONS=DNM, conditional is specified with a label in the DPAGE statement.
- For OPTIONS=NODNM:
 - To specify conditional, specify the COND= keyword on the DPAGE statement.
 - To specify unconditional, omit the COND= keyword.

Input Modes

MFS supports two input modes: record and stream.

Record Mode

In record mode, one record presented to MFS by the ATTACH manager corresponds to one record defined to MFS. Records and fields defined for each record are processed sequentially. Fields must not be split across record boundaries. The data for fields defined in a record must be present in this record to be considered by MFS. If no data exists for fields defined at the end of the record, a short record can be presented to MFS. If the data for a field not at the end of the record is less than the length defined for the corresponding DFLD, or if no data exists for the field, then a field tab separator character must be inserted to show omission or truncation. If no data exists for the entire record, a null or a 1-byte record (containing a single FTAB character) must be present if additional data records follow it. The record can be omitted:

- At the end of the DPAGE for single DPAGE input.
- At end of the DPAGE for multiple DPAGE input with multiple transmission chains.
- At the end of the last DPAGE for multiple DPAGE input with a single transmission chain. The record cannot be eliminated from the DPAGE if data for another DPAGE follows.

Stream Mode

In stream mode, record boundaries are ignored and fields can span record boundaries. Data omitted for fields anywhere in the DPAGE must be indicated by an FTAB.

FTABs are not required for the data omitted to the end of the DPAGE:

- At the end of the DPAGE for single DPAGE input.
- At the end of the DPAGE for multiple DPAGE input with multiple transmission chains.
- At the end of the last DPAGE for multiple DPAGE input with single transmission chain. The FTABs cannot be eliminated from the DPAGE if data for another DPAGE follows.

On input to IMS, the ATTACH manager provides for four deblocking algorithms, UNDEFINED, RU, VLVB, and CHAINED ASSEMBLY, which specify the following:

- UNDEFINED or RU specify that one RU is equal to one MFS record processed. IMS TM defaults to the RU algorithm when UNDEFINED is specified in the ATTACH FM header.
- VLVB specifies that one VLVB record is equal to one MFS record processed.
- CHAINED ASSEMBLY specifies that one input chain is equal to a single MFS record processed for the entire DPAGE.

For MFS RECORD mode, use the VLVB deblocking algorithm. For MFS RECORD mode, do not use:

- CHAINED ASSEMBLY, because the entire input chain would be processed as a single MFS record.
- UNDEFINED or RU, because MFS record definitions would be dependent on the size of the RUs.

For the MFS STREAM mode, all deblocking options can be used. In most cases the UNDEFINED and RU algorithms use less buffer space.

Paging Requests

Use the FM headers for entering paging requests when using ISC.

Output Message Formatting

This section discusses MFS output message formatting, physical and logical paging, and requirements for output devices.

How MFS Is Selected

Whether an output message is processed by IMS TM basic edit or MFS depends on the device type, the device definition, and the message being processed.

Output messages to SLU 2 and 3270 devices are processed by MFS, unless bypassed by the application program.

Output messages to a 274X, 3770, Finance workstation, SLU 1, NTO, SLU P, or ISC subsystem are processed by MFS, if these devices are defined during IMS TM system definition to operate with MFS.

Even when a device is defined to operate with MFS, MFS does not process an output message unless a MOD name was specified by the application program, the MID associated with the previous input message, or the /FORMAT command. Also, message switches from other MFS devices are processed by MFS if the message has an associated MOD.

If you attempt to access a transaction that is to be changed or deleted when the online change utility is run, and you do this after the online change command /MODIFY PREPARE has been issued but before /MODIFY COMMIT has been issued, you receive an error message. This is described in *IMS Version 9: Command Reference*.

How MFS Formats Output Messages

Output messages processed by MFS are formatted based on the contents of two MFS control blocks: the message output descriptor (MOD) and the device output format (DOF). The MOD defines output message content and, optionally, literal data

Output Message Formatting

to be considered part of the output message. Message fields (MFLDs) refer to device field locations through the device field (DFLD) definitions in the DOF. The device output format (DOF) specifies the use of hardware features, device field locations and attributes, and constant data considered part of the format.

Output Message Formatting Options

MFS provides three message formatting options for output data. The option selected determines how the data is formatted and governs the way in which the application program builds the output message. Option 1, 2, or 3 is specified in the OPT= operand of the MOD MSG statement. For examples of input messages formatted with the three options, see “Input Message Formatting” on page 123. Examples of output message formats are shown in “Option 1 or 2—Output Segment Example” and “Option 3—Output Segment Example” on page 147.

Segments inserted by the application program must be in the sequence defined to the MFS Language utility program. Not all segments in a logical page must be present, but be careful when you omit segments (see “Logical Paging of Output Messages” on page 147). An option 1 or 2 segment can be omitted if all subsequent segments to the end of the logical page are omitted; otherwise, a null segment (X'3F') must be inserted to indicate segment position. Option 3 output message segments must include a 2-byte relative segment number.

Message fields in option 1 and 2 output segments are defined as fixed-length and fixed position. Fields can be truncated or omitted by two methods:

- One method is by inserting a short segment.
- The other method is by placing a NULL character (X'3F') in the field. Fields are scanned left to right for a null character; the first null encountered terminates the field. If the first character of a field is a null character, the field is effectively omitted, depending on the fill character used. Positioning of all fields in the segment remains the same regardless of null characters. Fields truncated or omitted are padded as defined to the MFS Language utility.

Message fields in option 3 segments can be placed in any order and with any length that conforms to the segment size restriction. Short fields or omitted fields are padded as defined to the MFS Language utility. Each field must be preceded by a 4-byte field prefix of the same format provided by MFS for option 3 input fields.

While option 3 fields do not have to be in sequence in the output segment, all fields must be contiguous in the segment; that is, the field prefix of the second field must begin in the byte beyond the first field's data. Null characters in option 3 fields have no effect on the data transmitted to the device. Like other nongraphic characters, they are replaced with a blank.

Restriction: Device control characters are invalid in output message fields under MFS. For 3270 display and SLU 2 terminals, the control characters HT, CR, LF, NL, and BS are changed to null characters (X'00'). For other devices, these characters are changed to blanks (X'40'). All other nongraphic characters (X'00' through X'3F' and X'FF') are changed to blanks before transmission, with the exception of the shift out/shift in (SO/SI) characters (X'0E' and X'0F') for EGCS capable devices. (The SO/SI characters are translated to blanks only for straight DBCS fields.) An exception is allowed for SLU P (DPM-An) remote programs and ISC (DPM-Bn) subsystems, for which GRAPHIC=NO can be specified on output. If nongraphic data is allowed through this specification, the null (X'3F') cannot be used to truncate segments in options 1 and 2.

Option 1 or 2—Output Segment Example:

Definition Segment	Output data length
Field, length=10	4
Field, length=20	field omitted
Field, length=5	5
Field, length=15	15

The segment shown produces the following results:

```
CONTENTS |54|0|0| DATA 1|*|   |*   | DATA 3 | DATA 4|
-----
LENGTH   2  1  1  4      1  5  20      5      15
```

Option 3—Output Segment Example: An option 3 segment that produces the same result appears as follows (the * represents a null (X'3F') character):

```
CONTENTS |42|0|0|04|08|04| DATA 1|09|34| DATA 3 |19|39| DATA 4|
-----
LENGTH   2  1  1  2  2  2  4      2  2  5      2  2  15
```

The examples under “Input Message Formatting Options” on page 126 explain the sequence of fields within the segment for different formatting options.

Logical Paging of Output Messages

Logical paging is the means by which output message segments are grouped for formatting. When logical paging is used, an output message is defined with one or more logical pages (LPAGEs). Each LPAGE relates one segment, or a series of segments, produced by an application program to a corresponding device format.

Using logical paging, the simplest message definition consists of one LPAGE and one segment. As shown in Table 31, each segment produced by the application program is formatted in the same manner using the corresponding device page.

Table 31. Output Message Definition with One LPAGE Consisting of One Segment

MSG Definition	Device Page	Application Program Output
LPAGE1	DPAGE1	Segment 1
SEG1		
		or
		Segment 1
		Segment 1
		Segment 1

The next level of complexity, shown in Table 32, is a message defined with one LPAGE consisting of a series of segments. When these messages are built by the application program, the segments must be inserted in the sequence in which they were defined. Not all segments in an LPAGE have to be present, but be careful when you omit segments. An option 1 or 2 segment can be omitted if all segments to the end of the LPAGE are omitted; otherwise, a null segment must be inserted to indicate segment position. Option 3 output message segments must include the segment number identifier.

Table 32. Output Message Definition with One LPAGE Consisting of a Series of Segments

MSG Definition	Device Page	Application Program Output
LPAGE1	DPAGE1	Segment 1 ¹

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Table 32. Output Message Definition with One LPAGE Consisting of a Series of Segments (continued)

MSG Definition	Device Page	Application Program Output
SEG1		Segment 2
SEG2		⋮
⋮		Segment <i>n</i>
⋮		
SEGN		Segment 1 ¹
		Segment 2
		⋮
		Segment 1 ²
		Segment 2
		⋮
		Segment <i>n</i>

Notes:

1. Page bit optional.
2. Page bit required.

Multiple series of segments can be presented to IMS as an output message. If the LPAGE is defined as having *n* segments, segment *n* + 1 is edited as if it were segment 1, unless a segment with the page bit (X'40') in the Z2 field is encountered prior to segment *n* + 1. When multiple series of output segments are presented and segments are omitted, the segment which begins a series must have bit 1 (X'40') of the Z2 field turned on.

A message definition with multiple LPAGEs is the most complex. Table 33 shows an example of such a definition, with application output.

Table 33. Output Message Definition with Multiple LPAGEs

MSG Definition	Device Page	Application Program Output
LPAGE1	DPAGE1	Segment 1 ¹ (LPAGE1 condition specified)
SEG1		Segment 2
SEG2		⋮
⋮		Segment <i>n</i>
⋮		
SEGN		Segment 1 ¹ (LPAGE2 condition specified)
LPAGE2	DPAGE2	Segment 2
SEG1		
SEG2		Segment 1 ¹ (LPAGE2 condition specified)
		Segment 2

Table 33. Output Message Definition with Multiple LPAGEs (continued)

MSG Definition	Device Page	Application Program Output
		Segment 1 ¹ (LPAGE2 condition specified)
		Segment 1 ² (LPAGE1 condition specified)
		Segment 2
		⋮
		Segment <i>n</i>

Notes:

1. Page bit optional.
2. Page bit required.

When multiple LPAGEs are defined, the LPAGE to be used for formatting is based on a user-defined condition present (provided by the application program) in the data of the first segment in the series. If the LPAGE to be used cannot be determined from that segment, the last defined LPAGE is used. The rules for segment omission described in “Logical Paging of Output Messages” on page 147 apply here as well.

LPAGE definitions enable specification of a MID name to use to format the input expected in response to the output logical page. If specified, this MID name overrides the name specified in the MOD’s MSG statement.

Operator Logical Paging of Output Messages

Output messages can be defined to permit operator logical paging (PAGE= operand in the MOD’s MSG statement). Use operator logical paging to request a specific logical page of an output message.

Related Reading: For a complete description of operator logical paging and other MFS control functions see “Your Control of MFS” on page 177.

Operator logical paging is also available to your written remote program for SLU P (DPM-An) or ISC subsystem (DPM-Bn). The remote program can request IMS to provide a specific logical page of the output message.

Physical Paging of Output Messages

A logical page can be defined to consist of one or more physical pages. Physical paging allows data from a logical page to be displayed in several physical pages on the device. Physical page assignments are made in the format definition. For display devices, the size of a physical page is defined by the screen capacity (the number of lines and columns that can be referred to). For most printer devices, a physical page is defined by the user-specified page length (number of lines) and the printer’s line length.

For SLU P (DPM-An) or ISC subsystems (DPM-Bn), a physical page is defined by the user-specified paging option and the DPAGE or PPAGE statement specifying device pages or presentation pages. Physical paging allows data from a message to be transmitted to the remote program or subsystem in several presentation pages or logical pages.

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Typically, a logical page has just one physical page. Multiple physical pages per logical page are generally only used when the logical page is designed for a large screen but is also to be displayed on a small screen device. The physical pages can have a totally different format from the pages defined for the large screen device. Figure 26 illustrates the use of physical paging with a message that creates one physical page on a 3277 model 2 or on a 3276/3278 with 24x80 screen size.

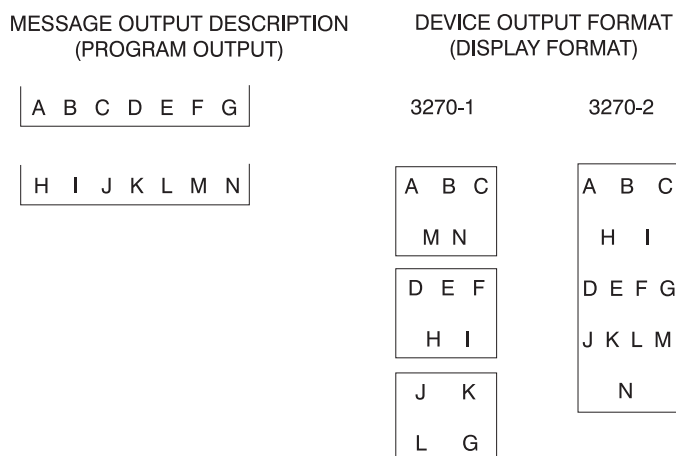


Figure 26. Physical Paging for 3270 or SLU 2

Fill Characters for Output Device Fields

MFS uses fill characters to pad output device fields when the length of the data received from the application program is less than the specified length or no data for the field is received. A fill character is defined in the message definition (MSG statement), the format definition (DPAGE statement), or both. If a fill character is specified in both, the fill character specified in the DPAGE is used. If FILL=NONE is specified in the DPAGE statement, the fill character from the MSG statement is used. The fill character specified in the MSG statement is used for all nonliteral fields defined in the DOF, not just those defined by MFLDs in the MOD. Using a fill character tailored to the device type generally improves message presentation and device performance. You can select the following fill characters on a DPAGE statement:

- Blank (X'40')
- Blank (C' ')
- Any hexadecimal EBCDIC graphic character (X'hh')
- An EBCDIC graphic character (C'c')

You can select the following characters on a MSG statement:

- Blank (C' ')
- EBCDIC graphic character (C'c')

For the 3270 or SLU 2 display, the EBCDIC graphic fill character fills in any fields or partial fields on the formatted display that do not receive any data or only partial data. This erases information remaining on the display from the previous message, however, using the fill character increases transmission time.

Null fill can be specified, in which case fields are not filled on the 3270 or SLU 2 formatted screen (and data from the previous message that is not updated by the current message is still displayed). For devices other than 3270 or SLU 2 display, compacted lines are produced when message data does not fill device fields. Using

null fill for 3270 or SLU 2 display devices reduces transmission time, but might result in confusion if a partial field does not cover all the data remaining from a previous display. Using null fill for other devices causes additional processing in the IMS control region but reduces transmission and printing time.

For 3270 or SLU 2 formatted screen, a program tab function can be requested that erases any data remaining in a device field after new data for this field has been displayed, but does not produce any fill characters. With program tab fill, display fields on a formatted screen are not cleared unless new data is transmitted to them.

When the program sends only a few of the output data fields, the unwanted display of leftover data in unprotected fields can be prevented by specifying the “erase all unprotected” function in the system control area “System Control Area (SCA) and Default SCA (DSCA).”

For 3270 output when EGCS fields are present, specify only FILL=PT or FILL=NULL on the DPAGE or MSG statement. Any other specification can result in the device rejecting the message.

System Control Area (SCA) and Default SCA (DSCA)

The system control area (SCA) is the means by which specific device operations are requested when an output message is sent to the device. These device requests can be defined in the message field (using the SCA) or in the device format definition (using the default SCA, or DSCA). An SCA is defined as a message field. The IMS application program can use the SCA to specify device operations to be performed when output is sent to a terminal device.

The 3270 and SLU 2 functions that can be requested are:

- Force format write.
- Erase unprotected fields before write.
- Erase all partitions before sending message.
- Sound device alarm.
- Unprotect screen for this message.
- Copy output to candidate printer.

For 3270 and SLU 2 devices, MFS interprets the IMS application program information and performs the specified operations.

A “sound device alarm” can be requested for output to an FIN workstation in the SCA; in this case, MFS in turn specifies “device alarm” in the header of the output message sent to the FIN workstation.

For an SLU P (DPM-An) or ISC subsystem (DPM-Bn), all the functions allowed for the 3270 and FIN can be specified by the IMS application program in a message field defined as an SCA. Define a device field (DFLD statement) as an SCA in the DOF. For the SLU P remote programs or ISC subsystems, MFS does not interpret the specifications from IMS. MFS only relays the specifications in the user-defined device field SCA that it sends to the remote program or ISC subsystem.

For devices other than 3270, SLU 2, FIN, SLU P, and ISC, the SCA is ignored.

For all devices that can have SCAs, a default system control area (DSCA) can also be defined in the DOF (in the DEV statement) in which the same kinds of functions can be specified. Whenever the DOF DSCA is used, the functions are performed if appropriate for the destination device. DSCA-specified functions are performed

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regardless of whether an SCA field is provided. If DSCA and SCA requests conflict, only the DSCA function is performed. Any invalid flag settings in the DSCA specifications are reset, and only the valid settings are used.

For SLU P remote programs, DSCA information can similarly override SCA specifications. The SCA or DSCA information is not interpreted by MFS but is transmitted to the remote program in the device field defined as an SCA.

IMS application programs that control output through specifications in the SCA can be device-dependent.

Related Reading: For additional information, see “System Control Area (SCA) and Default SCA (DSCA)” on page 151 and *IMS Version 9: Utilities Reference: Database and Transaction Manager*.

Output Message Literal Fields

Output message fields can be defined to contain literal data you specified during definition of the MOD. MFS includes the specified literal in the output message before sending the message to the device.

You can define your own literal field, select a literal from a number of literals provided by MFS, or both. The MFS-provided literals are called *system literals*, and include:

- Various date formats
- The time stamp
- The output message sequence number
- The logical terminal name
- The number of the logical page
- The queue number of the message waiting

Related Reading: For a description of EGCS literals, see the *IMS Version 9: Utilities Reference: Database and Transaction Manager*. For a description of the system literals, see MFLD Statement in *IMS Version 9: Utilities Reference: Database and Transaction Manager*.

Output Device Field Attributes

Device field attributes are defined in the DOF's DFLD statement. For 3270 display devices, specific attributes can be defined in the ATTR= keyword or EATTR= keyword of the DFLD statement, or default attributes are assumed.

For 3270 printers, 274X and 3770 terminals, and 3601 workstations, attribute simulation can be defined by specifying ATTR=YES or ATTR=nn in the DFLD statement. The message field definition corresponding to the device field can specify that the application program can dynamically modify, replace, or simulate device field attributes.

Extended Field Attributes for Output Devices

Extended field attributes apply to 3270 display devices and to printers defined as 3270P or SCS1, that support the 3270 Structured Field and Attribute Processing option. These attributes also apply to 3270P or SCS1 printers that support the Extended Graphics Character Set (EGCS) if field outlining or DBCS operation is desired. These extended field attributes provide additional field attribute definition beyond that provided in the existing 3270 field attribute. They are associated with a

field of characters just as the existing 3270 field attributes are, but they do not take up display positions in the characters buffer. They can define such field characteristics as:

- Color (seven-color models only)
- Highlighting
- Programmed Symbols (PS)
- Validation
- Field outlining
- Input control of mixed DBCS/EBCDIC data

Extended field attributes are defined in the EATTR= keyword of the DFLD statement. They can be dynamically modified by specifying ATTR=*nn* on the ATTR=YES or ATTR=*nn*. corresponding MFLD statement.

Any combination of existing and extended field attributes (except protect and validate) can be transmitted in one display output stream.

When dynamic attribute modification (ATTR=YES) is specified for a device field with predefined attributes, an attribute is sent to the device for that field in every output operation, even if the data for this device field is not included in the output message.

These attributes are used:

- If the output message field has an attribute and the attribute is valid, then the dynamic attribute modification is performed.
- If the message field is not included in the LPAGE being used or the attribute is not valid, the predefined attribute for the device field is used.

The default attributes for nonliteral 3270 display device fields are:

- Alphabetic
- Not protected
- Normal display intensity
- Not modified

The default attributes for literal display device fields are:

- Numeric
- Normal display intensity

The forced attributes for literal display device fields are:

- Protected
- Not modified

Attribute simulation can be defined for non-3270 display devices but these attributes are applied only when requested by an application program. The device field definition reserves the first byte of the field for attribute data. If the application program then specifies an attribute request, that request is represented in the first byte of the device field.

Field attributes that can be simulated are:

Attribute	Action Taken
High-intensity display	An asterisk (*) is placed in the first byte

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Modified field	An underscore character (_) is placed in the first byte
High-intensity and modified field	An exclamation point (!) is placed in the first byte
No display	No data is sent regardless of other attributes, except for DPM

Cursor position for the 3604 can also be specified as a simulated attribute.

If a field is defined to receive simulated attribute data but none is provided by the application program, the first byte is a blank.

For an application program to modify, replace, or simulate attribute data, the message field definition must specify ATTR=YES or ATTR=nn. When attributes are defined this way, the first bytes of the output message field are reserved for attribute data. Any error in the specification causes the DFLD ATTR= or EATTR= specification for that attribute byte to be used, although other attribute or extended attribute specifications are processed.

For DPM devices, fields can be defined to receive attribute data, extended attribute data, or both, from the IMS application program by specifying ATTR=YES or ATTR=nn on the DFLD statement corresponding to the MFLD definition with ATTR=YES or ATTR=nn. The 3270 attributes from the IMS application program can either be converted to simulated attributes and placed in the first byte of the device field or placed unchanged (2 binary bytes as received from the IMS application program) in the first 2 bytes of the device field. The decision to send attributes, extended attributes or simulated attributes is made when the device format is defined. If a field is defined to receive attribute data but none is provided by the IMS application program, the first byte contains a blank if attribute simulation was requested, or the first 2 bytes contain binary zeros if binary attributes were requested.

Extended Graphic Character Set (EGCS)

Extended Graphic Character Sets (EGCS) extend the number of graphic characters beyond the limit available using EBCDIC. This is an extension of the programmed symbol feature. The programmed symbol is an optional feature on the IBM 3270 Information Display Station and SCS1 printers that store and use the additional character sets.

Where DBCS or DBCS/EBCDIC mixed fields are discussed in context with 3270 displays or SCS1 printer devices, it is assumed that these devices are capable of handling DBCS data. Such devices include, for example, the 5550, supported as a 3270 display, and the 5553 and 5557, supported as SCS1 printers.

Definition: The *Double Byte Character Set* (DBCS) is a subset of EGCS. In it, each graphic character is represented by 2 bytes. The valid code range is X'4040' or X'41' through X'FE' for byte 1, and X'41' through X'FE' for byte 2.

An EGCS field is defined by the EATTR= parameter on the DFLD statement for 3270 displays or SCS1 device types.

All EGCS literals are in the form G'SO XX XX SI', where SO (shift out)=X'0E' and SI (shift in)=X'0F'.

For SCS1 device types, EGCS is specified as a pair of control characters framing the data in the form of: G'SO XX XX XX SI'. The framing characters SO (shift out) and SI (shift in) are not actual characters, but are 1-byte codes: X'0E' or X'0F'.

EGCS literals must be specified as an even number of characters; otherwise, a warning message is issued. All characters (X'00' through X'FF') are valid in an EGCS literal; however, a warning message is issued for all characters not within the range of defined graphics, X'40' through X'FE'.

Restriction: An EGCS literal cannot be equated using the EQU statement if a hexadecimal value within the literal is an X'7D', which is equivalent to a quote character.

For the MFS Language utility to recognize an EGCS literal, observe the following restrictions when defining the EGCS literal:

- SO and SI characters cannot be defined as alphabetic characters using the ALPHA statement.
- The three characters G'SO (SO is a single character) must not span continuation lines as input to the MFS Language utility, but must appear on the same line. The same is true for the two characters SI'.

An EGCS literal can be continued on the next line. An SI character can be coded in column 70, 71, or 72 to terminate EGCS data and is not included in the literal. If an SI is in column 70, the data in column 71 is ignored, except when it is a single quotation mark. On continuation lines for literals, an SO character is not required but can be used, if it is placed in column 15. (This indicates the beginning of EGCS data and is not included in the literal).

Restriction: IMS does not support a 2-byte fill function, inbound or outbound. For outbound data, the MFS fill function is at the message level. To avoid MFS insertion of RA (Repeat to Address) orders for EGCS fields that contain no data or are omitted in the output message, FILL=PT (the default) or FILL=NULL must be specified.

The MFS Language utility uses SO and SI characters in its output listing only for the initial input statement and for error messages that display EGCS literals from the input record. EGCS literals that are a part of the device image map are displayed as a series of Gs. Additional utility output that is created by using the EXEC PARM= operands DIAGNOSTIC, COMPOSITE, and SUBSTITUTE, and that contains EGCS literals, does not have the G, SO, and SI characters inserted. Only the data between the SO and SI characters is included.

You must define the screen location (row and column) where the field is to be displayed. This includes any screen placement constraints imposed by a particular product implementation. Warning messages are issued when:

- The DFLD attribute is EGCS and the field position parameter does not specify an odd column number (3270 only)
- An EGCS literal is not specified as an even number of characters
- The DFLD length is not specified as an even number

When defining an EGCS field for a 3283 Model 52, you must ensure that the length specified is an even number and, if an EGCS field spans device lines, specify WIDTH= and POS= so that an even number of print positions are reserved on each of the device lines.

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Mixed DBCS/EBCDIC Fields

The Double Byte Character Set (DBCS) is a graphic character set in which each character is represented by 2 bytes. It is a subset of the Extended Graphic Character Set (EGCS). DBCS is used to represent some Asian languages, such as Chinese, Japanese, and Korean; because each of these written languages consists of more than 256 characters that can be represented by one byte. As with EGCS, this representation is accomplished by an extension of the programmed symbol feature.

Because DBCS is a subset of EGCS, DBCS fields are specified using EGCS keywords and parameters and are treated by MFS in much the same way as EGCS data. However, DBCS data can be used in two field types, a DBCS field and a DBCS/EBCDIC mixed field. The DBCS field accepts only DBCS data and no special control characters are needed with this type of field. (The valid code range of DBCS data is X'4040', or X'41' through X'FE' for both bytes.) But, in a mixed field, where DBCS data is *mixed* with EBCDIC data, the DBCS data must be enclosed by SO (shift out) and SI (shift in) control characters.

Using DBCS requires display and printer devices capable of handling DBCS data. One such group of devices is the 5550 Family (as 3270); however, other 3270 DBCS devices are available.

Mixed DBCS and EBCDIC Fields: When DBCS data is enclosed by SO/SI characters, a mixed field on a 3270 DBCS device accepts both EBCDIC and DBCS data. Such a mixed field can contain multiple DBCS data entries enclosed by SO/SI control characters, as shown in Figure 27.

The DBCS data should always be enclosed by SO/SI control characters for both inbound and outbound data to a 3270 display. However, if the data is inbound, the control characters are automatically created by the terminal. To explicitly specify DBCS/EBCDIC mixed fields, use the keywords MIX and MIXS on the EATTR= parameter of the DFLD statement.

Example: Figure 27 shows the case of a DBCS/EBCDIC mixed field.

The DBCS/EBCDIC mixed data shown in Figure 27 consists of the following 16 characters:

- EBCDIC data 'ABCD' and 'EF' (6 bytes)
- DBCS data 'GGGG' and 'GG' (6 bytes)
- Two sets of SO/SI control characters (4 bytes)

The SO control character is represented by X'0E' and the SI control character is represented by X'0F'.

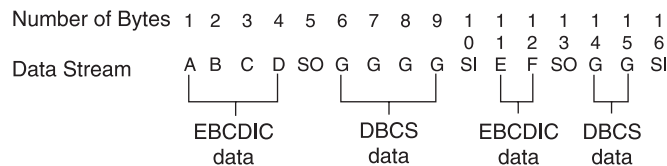


Figure 27. DBCS/EBCDIC Mixed Data

When DBCS is used, MFS sends the data directly to the 3270 display but performs SO/SI blank print processing before sending it to the SCS1 printer. The SO/SI control characters for 3270 displays and SCS1 printers are treated as follows:

- On 3270 displays, an SO or SI control character takes up one position on the display and appears as a blank.
- On SCS1 printers:
 - If EATTR=MIXS is specified, an SO or SI control character does not take up a position on the listing. To prevent insertion of blanks, specify EATTR=MIXS (SO/SI blank print suppress option).
 - If EATTR=MIX is specified, the SO/SI blank print option inserts a blank before an SI control character and after an SI control character in a mixed data field. Specifying MIX results in identical 3270 display output and SCS1 printer output.

The length of the mixed data containing SO/SI in the application program is different from the length of the same data on the printed output.

The length of the DBCS/EBCDIC mixed data shown in Figure 27 on page 156 is 16 bytes in the application program. If the string is sent to a field specified with DFLD EATTR=MIX, the data is printed as a 16-byte string. However, if sent to a field specified as DFLD EATTR=MIXS, the data is printed as a 12-byte string (4 bytes of SO/SI control characters are suppressed). The length attributes of the DFLDs are LTH=16 and LTH=12, respectively.

SO/SI Control Character Processing: For 3270 displays, DBCS data enclosed by SO/SI control characters can be included as part of an existing EBCDIC field. When DBCS data is mixed in an existing EBCDIC field, the IMS application program must check that correct DBCS data is placed in the 3270 display field. DBCS data within an EBCDIC field is correct when the following conditions are met:

- The length of DBCS characters is an even number of bytes.
- There are no unpaired SO or SI control characters.

When MIX or MIXS is specified on the DFLD statement, MFS checks these conditions, aligns the DBCS data enclosed by SO/SI control characters, and corrects invalid SO/SI control characters.

DBCS/EBCDIC Mixed Literals: DBCS/EBCDIC mixed literals can be specified as DFLD/MFLD literals, as shown in Figure 28.

```
literal format: ' .....SO__SI..SO__SI'

DFLD
'literal'

MFLD
,'literal'
,(dlfdname,'literal')
```

Figure 28. DBCS/EBCDIC Mixed Literal

The DBCS data in a DBCS/EBCDIC mixed literal is expressed as a series of Gs in the device image map in the MFS listing.

When the MFS Language utility specifies a DFLD/MFLD literal containing DBCS/EBCDIC mixed data within an EBCDIC field without specifying EATTR=, a check for mixed field is performed for both 3270 display and SCS1 printer output. A DBCS/EBCDIC mixed field attribute with EATTR=MIX is assigned for SCS1 only. The LTH parameter is ignored even if specified. As a result, the field length is the same as the length of the literal.

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Table 34 shows the processing performed by the IMS MFS Language utility for SO/SI control characters within a DBCS/EBCDIC mixed field. The Device and Field are listed, followed by the DFLD/MFLD output literal, and the MFLD input literal.

Table 34. SO/SI Processing Performed by IMS MFS Language Utility

Device, Field	DFLD/MFLD Output Literal	MFLD Input Literal
3270 display, DBCS/EBCDIC mixed field	<ul style="list-style-type: none"> • Check SO/SI pairing. • Check even length. • Adjust boundary alignment (with warning message). 	SO/SI checking not done
SCS1 printer, DBCS/EBCDIC mixed field	<ul style="list-style-type: none"> • Check SO/SI pairing. • Check even length. • Perform SO/SI correction and boundary adjustment according to SO/SI blank print option. 	Not applicable

Table 35 shows the processing performed by the MFS message editor on SO/SI control characters within a DBCS/EBCDIC field. The Device and Field are listed, followed by the outbound data fields and the inbound data fields.

Table 35. SO/SI Processing Performed by MFS Message Editor

Device, Field	Outbound Data Fields	Inbound Data Fields
3270 display, DBCS/EBCDIC mixed field	<ul style="list-style-type: none"> • Check SO/SI pairing. • Check even length. • Adjust boundary alignment. 	SO/SI checking not done
SCS1 printer, DBCS/EBCDIC mixed field	<ul style="list-style-type: none"> • Check SO/SI pairing. • Check even length. • Perform SO/SI correction and boundary alignment according to SO/SI blank print option. 	Not applicable

Continuation Rules for DBCS/EBCDIC Mixed Literals: The continuation rules for mixed literals are the same as the continuation rules for EGCS literals. The continuation rules are as follows:

- An EGCS literal can be continued on the next line.
- An SI character can be coded in column 70, 71, or 72 to terminate EGCS data and is not included in the literal. If an SI is in column 70, the data in column 71 is ignored, except when the character is a single quotation mark.
- On continuation lines for literals, an SO character is not required, but can be used in column 15. (This indicates the beginning of EGCS data and is not included in the literal.)

Because mixed literals have the DBCS character string, there are some considerations for their continuation:

- When data is mixed EBCDIC and DBCS, the DBCS data must be enclosed by SO and SI control characters. The SI characters can be located from column 70 to 72 in an EGCS literal; in a mixed literal, SO and SI are part of the user data. Therefore, you must fill the data up to column 71, put a non-blank character in column 72, and start the next line from column 15 (if SO) or from column 16. Examples of continuations in mixed literals are shown in Figure 29.

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even length and performs SO/SI correction and boundary adjustment if necessary. In this way, the DBCS/EBCDIC field appears correctly on the 3270 display screen or SCS1 printer output.

When receiving DBCS/EBCDIC data from a mixed field, MFS passes the data as is. This is because SO/SI pairing and even length are always ensured when using the 3270 display.

However, when sending DBCS/EBCDIC data to a DBCS/EBCDIC field and receiving user-entered DBCS/EBCDIC data from the same field, the application program must account for changes in the data. When receiving user-entered DBCS data, the 3270 display builds the data and SO/SI control characters and then truncates or realigns the data to assure SO/SI pairing and even length. The IMS application program must take this into account when using a part of the send data as receive data.

DBCS/EBCDIC Mixed Field and Horizontal Tab (SCS1 Printer): When using an online horizontal tab setting, tabs are not set within a DBCS/EBCDIC field. This is because it is not possible to determine beforehand whether the actual position of the DBCS data within a mixed field is on an odd or even boundary.

Field Outlining: This function is used for user-defined 3270 display and SCS1 printer fields.

Field outlines are referred to as OVER, UNDER, LEFT, and RIGHT lines and they can be specified independently or in any combination.

The area at the left and right ends of the field shown in Figure 30 are:

- For 3270 displays, 3270 basic attribute bytes. The left attribute byte describes the first field; the right attribute byte describes the following field.
- For SCS1 printers, left and right blanks, reserved for the user-defined field by MFS.

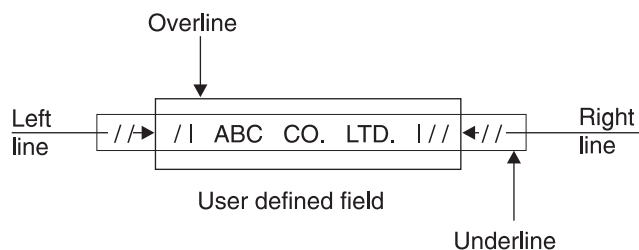


Figure 30. User Field and Field Outlining

Connecting Field Outlines and Joining Fields: You can outline multiple fields jointly as shown in Figure 31.

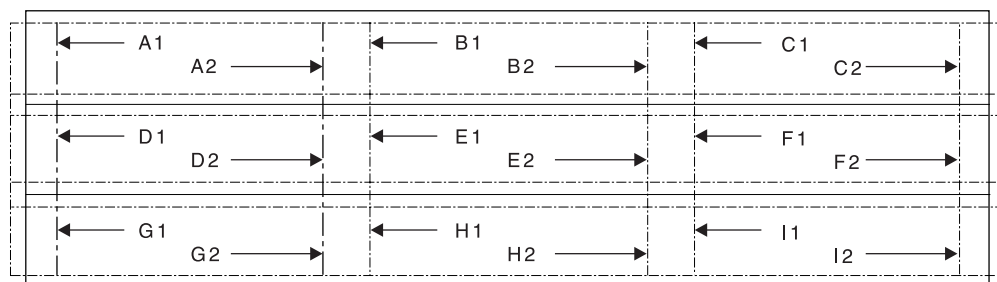


Figure 31. Field Outlining When Connecting User Fields

Figure 31 consists of nine logical fields. A1, B1, ... I1 are fields defined for the 3270 display and A2, B2, ... I2 are fields defined for the SCS1 printer. Note that for 3270 displays, 3270 basic attribute bytes are placed between fields. For SCS1 printers, the fields are connected without losing any print positions and the field outlines are connected. The outline specification for each field in Figure 31 is shown in Table 36.

Table 36. Outline Specification for Each Field

Fields	LEFT	RIGHT	OVER	UNDER
A1, A2	X		X	
B1, B2			X	
C1, C2		X	X	
D1, D2	X		X	
E1, E2			X	
F1, F2		X	X	
G1, G2	X		X	X
H1, H2			X	X
I1, I2		X	X	X

You need to define only the message field for 3270 displays in your IMS application program to produce the same output on displays and printers.

When field outlining is specified for an SCS1 printer, the MFS Language utility attempts to reserve 1 byte for the left and right lines, but if adjacent fields cannot be reserved, a warning message is issued.

Cursor Positioning

On 3270, 3604, or SLU 2 display devices, the cursor is positioned by its line and column position on a physical page. When a specific cursor position is always required (and device-dependence is not an issue), you can define cursor position in the DPAGE statement.

The DPAGE statement can also be defined so that cursor position is known to the application program on input and is specified dynamically by the application program on output. To dynamically define cursor position on output, specify a device field name along with its line and column position. If this field is then referred to by a MID MFLD statement, the cursor position is provided in that message field on message input. If the message field is referred to in a MOD MFLD statement, the message field can be used by the application program to specify cursor position on output.

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The application program cursor position request is used if its specified size is within the line and column specifications of the SIZE= operand of the TERMINAL macro for device type 3270-An; or within the line and column boundaries of 3270, model 1 or 2. Otherwise, the line and column positions specified on the DPAGE statement or the default positions (line 1, column 2) are used.

Related Reading: For a description of the TERMINAL macro, see *IMS Version 9: Installation Volume 2: System Definition and Tailoring*.

The option of providing cursor location on input is available only for 3270 or SLU 2 devices. This method of cursor positioning is not recommended for output, because it requires the application to use a specific device field position, making the application device-dependent. MFS considers cursor position as a device field attribute; the field attribute facility can be used to establish cursor position.

Application programs can dynamically replace, modify, or simulate attributes for a device field whose corresponding message field is defined as ATTR=YES or ATTR=nn. At least the first 2 bytes of a message field defined in this way are reserved for attribute data or extended attribute data provided by the application program.

For a 3290 in partitioned-format mode, the first partition descriptor (PD) statement defined in the partition descriptor block (PDB) is the first partition created. The cursor is placed in this partition, which becomes the active partition unless overridden by the Jump Partition key or by the ACTVPID= keyword in the DPAGE statement associated with a subsequent output message.

Using the Jump Partition key causes the cursor to jump to the next sequential partition defined by the application program and that partition becomes the active one. The ACTVPID= keyword allows the application program to activate and locate the cursor in a specific partition.

Prompt Facility

The prompt facility provides a way to automatically notify you if the current page of output is the last page of the message. The notification text is defined as a literal which MFS inserts into a specified device field when it formats the last logical page of the message. To further assist you, the prompting text can be used to tell you what input is expected next.

Recommendation: For a 3270 or SLU 2 device, the combination of PROMPT and FILL=NULL should be used with care because, once the prompt literal is displayed, it can remain on the screen if your input does not cause reformatting of the screen.

System Message Field (3270 or SLU 2 Display Devices)

Output formats for 3270 or SLU 2 display devices can be defined to include a system message field. If defined in this way, all IMS messages except REQUESTED FORMAT BLOCK NOT AVAILABLE are sent to the system message field whenever the device is in formatted mode. Using a system message field or setting byte 1 bit 5 to B'0' in the DSCA specification prevents an IMS message from destroying a screen format.

When MFS sends a message to the system message field, it activates the device alarm (if any) but does not reset modified data tags (MDTs), move the cursor, or change the protect/unprotect status of the display, except in the event of a multi-segment message. In this case, the status is changed to protected, and the enter key must be pressed to view the next segment or segments of the message.

Because IMS error messages are an immediate response to MDTs in input, MDTs remain as they were at entry and you must correct the portion of the input that was in error.

After input from an operator identification (OID) card reader, the device is no longer in formatted mode. Therefore, an IMS message is not sent to a SYMSG field; it is sent using the default system message format. This is also the case after an XRF (Extended Recovery Facility) takeover because the device is no longer in formatted mode.

Printed Page Format Control

The PAGE= keyword of the DEV statement provides much of the formatting control of the format of output messages sent to printer devices.

The WIDTH= keyword provides additional formatting control. In conjunction with the FEAT=(1...10) keyword, WIDTH= provides additional formatting control for printer devices specified as 3270P. (See WIDTH= under the DEV statement for additional information.) The WIDTH= keyword, in conjunction with the HTAB=, VTAB=, VT=, SLDI= and SLDP= keywords, provides additional formatting control for 3770 or SLU 1 printer devices.

Using a PAGE= operand (DEFN, SPACE, FLOAT, or EJECT), with the page depth (the number of lines per page), determines how MFS controls the printing of the output message. These are the PAGE= operands:

- | | | | | | |
|-----------------------|--|-----------------------|---|---------------|---|
| DEFN | MFS prints each line as defined by DFLD statements. In this mode, if the first DFLD defined line is greater than 1, the printer position is moved to the first defined line. The printer position is also moved over the blank lines between defined DFLDs. However, MFS does not add blank lines to the bottom of the page of output if the last defined line is less than the page depth. The next page of output begins on the line following the current line of output. The number specified in the PAGE= keyword is used to check the validity of the line specification of the DFLD POS= keyword. | | | | |
| SPACE | This produces the same printing mode as DEFN except that lines are added to the bottom of the page if the last defined line is less than the page depth. The printer is positioned through a series of new lines. This option can be used for devices that do not have the page eject feature so that pages are not grouped together. | | | | |
| FLOAT | This operand is used to request that lines not be printed if they are defined by DFLD statements, or if they contain no data after formatting (all blank or NULL). | | | | |
| EJECT | This operand is specified for FIN, 3770, or SLU 1 printers. The following options can be specified for EJECT (or any combination of these): <table><tbody><tr><td>BGNPP or ENDPP</td><td>MFS ejects the page before (BGNPP) or after (ENDPP) each physical page of the output message.</td></tr><tr><td>BGNMSG</td><td>MFS ejects the page before any data in the output message is printed.</td></tr></tbody></table> | BGNPP or ENDPP | MFS ejects the page before (BGNPP) or after (ENDPP) each physical page of the output message. | BGNMSG | MFS ejects the page before any data in the output message is printed. |
| BGNPP or ENDPP | MFS ejects the page before (BGNPP) or after (ENDPP) each physical page of the output message. | | | | |
| BGNMSG | MFS ejects the page before any data in the output message is printed. | | | | |

Output Message Formatting

ENDMSG

MFS ejects the page after all the data in the output message is printed.

MFS does not add lines to or delete lines from the page. EJECT can be specified for FIN, 3770, or SLU 1 printers.

Format Control for 3770 and SLU 1 Printers

MFS provides several specifications to control the format of output messages to 3770 printer devices and SLU 1 (print data set) (DEV TYPE=SCS1). Printer formatting features are listed and described in this section.

Print Mode: The section, “Printed Page Format Control” on page 163, describes print mode for 3770, or SLU 1 printers.

Page Depth: The page depth, as specified in the PAGE= keyword, is discussed in the section “Printed Page Format Control” on page 163.

Line Width: The WIDTH= keyword of the DEV statement is used to specify the maximum width of a print line, relative to column 1. The specified width is used in place of the physical device line width. Specification of a line width also establishes the right margin of the printed page (relative to column 1). Valid values are less than or equal to the physical device line width. For example, if WIDTH=80 is specified, data can be printed in columns 1 through 80.

Left Margin Position: The left margin operand of the HTAB= keyword of the DEV statement can be used to specify where MFS should set the left margin for the device before sending an output message. A left margin specification should be made if output fields always start at a column position other than column 1 (the default). For example, if fields are always defined in columns 5 through 80, HTAB=(5) and WIDTH=80 can be specified on the DEV statement.

Horizontal Tabbing: The HTAB= keyword of the DEV statement is used to specify where MFS should set horizontal tab stops before sending an output message.

MFS can insert tab control characters into the message to reduce the number of characters transmitted. To control when tab control characters are inserted, specify the ONLINE or OFFLINE operand for the HTAB= keyword. OFFLINE specifies that MFS insert the tab control characters during compilation of the control blocks by the offline MFS Language utility program. ONLINE specifies that MFS insert the control characters during online processing of the message. MFS can only be directed to insert tab control characters into messages that have legitimate fill characters specified (FILL=X'hh' or FILL=C'c' in the DPAGE statement), or use the default fill character, X'40'.

Specify OFFLINE when the message definition always supplies data to most defined device fields, or the fill character is not a blank. Specify ONLINE if some device fields do not receive data, or the data contains blanks. Even though the ONLINE specification increases MFS online processing, it reduces character transmission to the device.

Vertical Tabbing: The VT= keyword of the DEV statement is used to specify where MFS should insert vertical tab control characters into the page of the output message. MFS assumes that the vertical tab stops are relative to line 1 and have been set at the device by the specification of the VTAB= keyword or other means prior to message transmission. VT= must be specified if vertical tabbing is required. There are no default values. VT= is invalid if page control specifications direct MFS

to delete lines that contain no data after formatting. EJECT BGNMSG or EJECT BGNPP should be specified in conjunction with the VT= keyword to ensure proper alignment at the beginning of a page. A specification of VT= without a suitable EJECT operation defined can result in invalid device formatting.

Top and Bottom Margins: Top and bottom margins can be specified for printers specified as DEV TYPE=SCS1 by using the VTAB= keyword on the DEV statement. VTAB= is invalid if page control specifications (PAGE=n,FLOAT) direct MFS to delete lines that contain no data after formatting.

When used together, the page depth (PAGE=), vertical tab (VT=), and top and bottom margin (VTAB=) specify a “set vertical format” data stream.

Line Density: For printers specified as DEV TYPE=SCS1, the density of lines on an output page can be specified with the SLDx= keyword on the DEV statement, the DFLD statement, or both. Line density can be set in terms of lines per inch or points per inch. If SLDx= is specified on both the DEV and DFLD statements, two SLD data streams are sent, one at the beginning of a message and one within the message, just before the field on which the SLDx specification, was encountered, but after any vertical tabs and new line characters. The SLDx specification within the message changes the line density from that set at the beginning of the message to that specified within the message. The line density specified within the message remains in effect until explicitly reset.

Output Format Control for 3270P Printers

MFS provides several specifications to control the format of messages to 3270P printer devices.

Print Mode: “Printed Page Format Control” on page 163 describes print mode for 3270P printers.

Page Depth: The page depth, as specified in the PAGE= keyword, is discussed in “Printed Page Format Control” on page 163.

Line Width: The WIDTH= keyword of the DEV statement is used to specify the maximum width of a print line relative to column 1. The specified width is used in place of the physical device line width. The default for 3270P printers is 120. When WIDTH= is specified, a feature code from 1 to 10 must also be specified using the FEAT= keyword on the DEV statement.

Output Format Control for SLU P DPM-An

For SLU P devices with the DPM-An option, You can use several specifications in MFS to control the format of output messages.

The RCDCTL= operand of the DIV and RCD statements identifies a related group of device field (DFLD) definitions that are within one record, which is usually sent to a remote program as one transmission (that is, if the RCDCTL= value is less than or equal to the value in the OUTBUF= parameter of the system definition TERMINAL macro).

The number of device fields in the record is determined by the length (numeric value) specified in RCDCTL. Device fields can be arranged in records through the RCD statements. The records created can be smaller than the size specified in RCDCTL. The SPAN/NOSPAN parameter determines whether fields are allowed to span record boundaries. All output messages are sent in record mode.

Output Message Formatting

The PPAGE statement identifies a presentation page of a device format and can contain one or more records.

The DPAGE statement defines a logical page of a device format and can contain one or more records.

Paging: The MSG, DPAGE, or PPAGE operands of the OPTIONS= specification of the DIV statement is used to determine how the output message is sent to the remote program.

MSG This specifies that all the data in the output message is to be transmitted together to the remote program in one chain. This is the default.

After transmitting the message to the remote program, IMS does not transmit another output message if PROGRAM2 has been specified as the media parameter of the COMPTn operand of the system definition TERMINAL macro. An input request is required from the remote program before the next message is sent. If PROGRAM1 is specified, IMS does not wait for an input request, but sends another output message if one is available.

DPAGE This specifies that all the data in the logical page is to be transmitted together to the remote program in one chain. A paging request is required from the remote program to retrieve the next logical page of the output message.

PPAGE This specifies that all the data in the presentation page is to be transmitted together to the remote program in one chain. A paging request is required from the remote program to retrieve the next presentation page of the output message.

A paging request can be specified through the input message header or through an operator control table. For OPTIONS=DPAGE or PPAGE, when the last logical or presentation page has been sent to the remote program, IMS MFS action is the same as for 3270 and 3604 devices (shown in Table 31 on page 147) regardless of PROGRAM1 or PROGRAM2 specification.

Each chain contains an output message header. The DATANAME in the output message header is the format name if OPTIONS=MSG is specified, the current name of the device logical page (DPAGE) if OPTIONS=DPAGE is specified, or the current name of the presentation page if OPTIONS=PPAGE is specified.

The output message header is always present in the first transmission record of the chain. For OPTIONS=MSG, the first transmission record contains only the output message header, and the next transmission begins the data for the message.

For OPTIONS=DPAGE or PPAGE, the data follows the output message header in the first transmission record if either of the following occurs:

- RCDCTL=(,SPAN) is specified, and the RCDCTL length is greater than the output message header length.
- RCDCTL=(,NOSPAN) is specified, the RCDCTL length is greater than the output message header length, and at least the first data field defined in the current DPAGE or PPAGE can be fully contained within the first transmission record.

Output Message Header: The basic output message header contains the following MFS fields, presented in this sequence:

VERSION ID
MIDNAME
DATANAME

DATANAME is the FMT label for OPTIONS=MSG, the DPAGE label for OPTIONS=DPAGE, and the PPAGE label for OPTIONS=PPAGE.

If a forms literal is specified in the DEV statement, the FORMSNAME field is present in the output message header. For OPTIONS=MSG the FORMSNAME is present in the basic header after the DATANAME. For OPTIONS=DPAGE OR PPAGE, an optional forms output message header precedes the basic output message header. It contains the following fields:

MIDNAME
FORMSNAME

The forms header is sent to the remote program as the only element of a chain. A paging request is required after the header has been processed and the remote program is ready to process the first logical or presentation page of an output message.

The length of the output message header can be defined in the HDRCTL= operand of the DIV statement as fixed or variable.

The length of the fixed basic output message header (without FORMSNAME) is 23 bytes for OPTIONS=MSG and 25 bytes for OPTIONS=DPAGE or PPAGE. If FORMSNAME is present, the maximum length of the basic output message header for OPTIONS=MSG is 40 bytes, and the maximum length for OPTIONS=DPAGE or PPAGE is 33 bytes.

- If HDRCTL=FIXED is specified, the MIDNAME and DATANAME fields are always padded with blanks to the maximum definable length: MIDNAME to 8 bytes (if MIDNAME is not supplied, 8 blanks are presented), FMT name to 6 bytes, and DPAGE or PPAGE name to 8 bytes. For this reason, the position of the DATANAME is always at the same displacement in the basic output message header, and the FORMSNAME, if present, is always at the same displacement, following the FMT name if OPTIONS=MSG and following the MIDNAME if OPTIONS=DPAGE or PPAGE.
- If HDRCTL=VARIABLE is specified, neither MIDNAME nor DATANAME is padded. If MIDNAME is less than 8 bytes or is not present, the position of the DATANAME, FORMSNAME, or both within the output message header is variable.

Table 37 shows the format of the fixed output message header for OPTIONS=MSG.

Table 37. Fixed Output Message Header Format for OPTIONS=MSG

FIELD BYTES	BASE 7	LI 1	MIDNAME 8	L2 1	DATANAME 6	L3 1	FORMSNAME (user-coded literal)

BASE The base DPM-An output header with a length of 7 bytes, including the version ID.

L1 The full length of the MIDNAME plus 1. Contains the value 9.

MIDNAME Contains the MIDNAME to be used for input. If this name is less than 8 characters, it is padded with blanks to a full 8 bytes. If the MIDNAME is not specified, this field contains 8 blanks.

Output Message Formatting

- L2** The full length of the format name (DATANAME) plus 1. Contains the value 7.
- DATANAME** The name of the format that was used to format the data fields. If the format name specified is less than 6 characters, it is padded to a full 6 bytes.
- L3** Contains the length of the forms literal plus 1. The maximum value is 17.
- FORMSNAME** Contains the literal specified in the FORS= parameter of the DEV statement. It can have a length of 1-16 bytes. If FORS= is not specified in the DEV statement, the L3 and FORMSNAME fields are not included in the output message header.

If a variable output message header is specified in the HDRCTL= operand of the DIV statement, the output message header for OPTIONS=MSG will have the same format, but MIDNAME and DATANAME will have trailing blanks omitted and their length fields adjusted accordingly. If MIDNAME is not used, neither the MIDNAME field nor its length is present.

Table 38 shows the format of the fixed basic output message header (without FORMSNAME) for OPTIONS=DPAGE or PPAGE.

Table 38. Fixed Basic Output Message Header (Without FORMSNAME) for OPTIONS=DPAGE or PPAGE

FIELD BYTES	BASE 7	L1 1	MIDNAME 8	L2 1	DATANAME 8
-------------	--------	------	-----------	------	------------

- BASE** Content is the same as for OPTIONS=MSG (Table 37 on page 167).
- L1** Content is the same as for OPTIONS=MSG (Table 37 on page 167).
- MIDNAME** Content is the same as for OPTIONS=MSG (Table 37 on page 167).
- L2** This is the full length of the DPAGE or PPAGE name (DATANAME plus 1). Contains the value 9.
- DATANAME** Contains the name of the DPAGE or PPAGE that was used to format the data fields for the current logical or presentation page. If the DPAGE or PPAGE name specified is less than 8 characters, it is padded with blanks to the full 8 bytes.

Table 39 shows the format of the optional forms output message header for OPTIONS=DPAGE or PPAGE.

Table 39. Optional Forms Output Message Header for OPTIONS=DPAGE or PPAGE

FIELD BYTES	BASE 5	L1 1	MIDNAME 8	L2 1	FORMSNAME (user-coded literal)
-------------	--------	------	-----------	------	--------------------------------

- BASE** The base of the optional forms output message header does not include a version ID.
- L1** Contains the value 9.
- MIDNAME** Content is the same as for OPTIONS=MSG (Table 37 on page 167).

- L3** Contains the length of the coded forms literal plus 1.
- FORMSNAME** Contains a user-coded literal, as in the fixed output message header for OPTIONS=MSG. (See Table 37 on page 167.)

Naming Conventions: Establish naming conventions for formats, device logical pages, and presentation pages (that is, for the labels of the FMT, DPAGE, and PPAGE statements). For example, you can establish conventions for FMT, DPAGE, and PPAGE names that allow the remote program to interpret them in terms of 3790 panels or functional program subroutines. Also standardize DPM-An output message headers.

User-written labels for PPAGE statements must be unique within a format definition. It is recommended that labels also be unique within the IMS system.

If OPTIONS=PPAGE has been selected for a format definition, the PPAGE label is sent as the DATANAME in the output message header. The label should give the remote program information that can be used in deciding how to process the data. When you have not coded a label for a PPAGE, MFS generates a label for it and sends this generated name in the output message header. The MFS-generated names can be used by the remote program, but leaving the label specification up to MFS is not recommended, because the generated name for a given PPAGE can change every time the MFS definitions are recompiled.

Deletion of Null Characters in DPM Output Records: See the discussion of FILL=NULL in the DPAGE statement in *IMS Version 9: Utilities Reference: Database and Transaction Manager* for a discussion of deletion of null characters in transmission records.

Output Format Control for ISC (DPM-Bn) Subsystems

This section describes the major output message formatting functions of MFS with ISC nodes.

Format Control

For ISC nodes, MFS allows several specifications to control the format of output messages. If OPTIONS=DPAGE or OPTIONS=PPAGE is specified on the DIV statement, MFS sends an output message in multiple logical or presentation pages. Transmission of these pages within the message occurs on demand or automatically when you set byte 1 bit 5 of the system control area (SCA). For details, see “System Control Area (SCA)” on page 227.

Function Management (FM) Headers

FM headers are headers on output messages that control functions such as paging.

Paged Output Messages

For DPM-Bn paging support, if OPTIONS=DPAGE or OPTIONS=PPAGE is specified on the DIV statement, MFS sends an output message in multiple logical or presentation pages.

Demand Paging

With demand paging, the logical or presentation pages are sent only when a paging request is received from the other subsystem. The initial output for the message contains only the ATTACH FM header. If DIV OPTIONS=DNM is specified, the data structure name (DSN) is also transmitted.

Output Format Control for ISC

Autopaged Output

This option is available message-by-message, based on SCA values. With this facility, the logical or presentation pages are sent immediately, in multiple transmission chains (one transmission chain per page). With this option, the receiver obtains an entire output message in multiple transmission chains. Each transmission chain contains the DSN, if required.

Restriction: Paging requests cannot be entered to control receipt of the message.

If no data exists for variable-length fields of a page within the message, a null data chain can result.

Byte 1 bit 5 in the DSCA= operand of the DEV statement or in the SCA option of the MFLD statement indicates autopaged output.

If PAGE=YES is specified in the corresponding MSG definition and autopaged output is requested, the PAGE=YES specification (operator logical paging) function is reset and the output message is dequeued at the end of the message. Operator logical paging applies only to MFS demand paged output.

Output Modes

For output from IMS, the ATTACH manager provides for two blocking algorithms: variable length, variable blocked (VLVB) records and chained Request/Response Unit (RUs, MFS stream mode). Each record presented by MFS to the ATTACH manager is preceded by a length field when sent to the other subsystem. The length field contains the size of the record presented by MFS. The record itself is sent in as many RUs as required. Fields span RU boundaries but do not span record boundaries. The number of VLVB records in the transmission chain and the maximum size of the MFS record depend on the output mode selected and the paging option specified.

In stream mode, the way DFLDs are defined depends on the OPTIONS= keyword used:

- For OPTIONS=MSG (paging is not defined), DFLDs are defined in a DPAGE.
- For OPTIONS=DPAGE (paging is defined), DFLDs are defined in a DPAGE.
- For OPTIONS=PPAGE (paging is defined), DFLDs are defined in a PPAGE.

For all three OPTIONS= keyword settings, All the DFLDs defined in a DPAGE (or PPAGE) are grouped into a single MFS record for transmission, and all the data in one DPAGE (or PPAGE) is equal to one MFS record and equal to one output RU chain. One or more RUs are sent in the single transmission chain of the output message.

If the OFTAB parameter of a DIV or DPAGE statement is defined, contiguous output field tab separator characters are removed and are not sent to the subsystem in the following cases:

- At end of message for OPTIONS=MSG
- At end of DPAGE for OPTIONS=DPAGE
- At end of PPAGE for OPTIONS=PPAGE

In record mode, the DFLDs defined in a DPAGE or PPAGE are grouped into smaller records for transmission. The RCDCTL parameter of the DIV statement is used to define the maximum length of the MFS record created. If the RCDCTL=

parameter is not specified, the default value allows for records of up to 256 bytes in length. The RCD statement is used to start a DFLD on a new record boundary.

If the OFTAB parameter is defined, contiguous output field tab separator characters at the end of the record (for omitted fields and possible short last data field) are removed before transmission. If the entire record is thus eliminated and additional data records follow, a 1-byte record containing the single output field tab separator character is sent. The record is eliminated in the following cases:

- At end of message for OPTIONS=MSG
- At end of DPAGE for OPTIONS=DPAGE
- At end of PPAGE for OPTIONS=PPAGE

One or more VLVB records are sent in a single transmission chain of the output message (OPTIONS=MSG) or the page (OPTIONS=DPAGE or PPAGE).

Using OFTAB to Obtain Variable-Length Output Data Streams

The output field tab separator character (OFTAB) provides an alternative to fixed-length field output and reduces the number of bytes transmitted over the communication lines when only graphic data is sent.

If the length of the data supplied by an IMS application is less than the length defined for the corresponding DFLD, or if there is no data for the field, you can direct MFS to insert field tab separators to delimit output fields. You can also direct MFS to insert field tab separators for all output fields, regardless of their data length. To do this, specify the output field tab separator character (OFTAB operand). If OFTAB is used, output fields are not padded to their defined lengths.

The following definition is provided on the DIV and DPAGE statements:

```

,OFTAB=( X'hh', MIX )
         C'c'   ALL

```

Follow these rules when you specify an OFTAB operand:

1. For OPTIONS=MSG, specify the OFTAB operand on the DIV statement only. If you specify the OFTAB operand on the DPAGE statement it is ignored.
2. For OPTIONS=DPAGE and OPTIONS=PPAGE, specify the OFTAB operand on the DIV statement, the DPAGE statement, or both. If you specify the OFTAB operand on the DIV statement, the output field tab separator character specified is used as a default output field tab separator specification for each field of the entire output message. If you also specify the OFTAB operand on a DPAGE statement, the output field tab separator character specification on the DPAGE is used for the DPAGE being described.
3. The output field tab separator character cannot be defined as X'3F' or as a blank (X'40' or C' ').

Additionally, the following guidelines apply when you specify OFTAB.

- The output field tab separator specification overrides any FILL=NULL specification or default on the DPAGE or MSG statement. The MFS Language utility issues a warning diagnostic if the FILL= operand is specified on the DPAGE statement and the OFTAB= parameter is present on the DIV or the DPAGE statement.
- The user-defined output field tab separator character cannot be present in the data from the IMS application program. If it is, MFS changes it to a blank (X'40').

Output Format Control for ISC

- Any JUST=R (right-justify) specification on the MFLD statement for an output message that uses the output field tab separator is ignored and the JUST=L (left-justify) specification is assumed.
- If GRAPHIC=YES is specified on the SEG statement that maps to a DPAGE where the OFTAB specification applies, the output field tab separator should be a nongraphic character (X'FF', or X'00' through X'3E'), instead of an EBCDIC graphic character (X'40' through X'FE'), because EBCDIC characters can be present in the data from the IMS application program.
- If GRAPHIC=NO is specified in the SEG statement, an output field tab separator specification can produce undesirable results. However, MFS does not restrict the use of nongraphic data with the output field tab separator. If GRAPHIC=NO is specified on the SEG statement that maps to a DPAGE where the OFTAB specification applies, the output field tab separator character must be a unique character that is not present in your data. Additionally, if X'3F' is present in your data, it is compressed. Carefully examine your applications before you choose the above combination, because this function effectively prohibits sending binary or packed decimal data from the application program.
- If MIX is specified (or the default used), the output field tab separator character is inserted only if the data length is less than the DFLD defined length.
- If ALL is specified, the output field tab separator character is inserted after every DFLD.
- If MODE=RECORD is specified, contiguous output field tab separator characters at the end of a record are removed. Records with no data at the end of DPAGE or PPAGE are not sent. Otherwise, a 1-byte record containing the output field tab separator character is sent.

For OPTIONS=DPAGE and OPTIONS=PPAGE, the OFTAB specification on the DPAGE statement (instead of on the DIV statement) allows:

- Mixing of fixed-length fields and variable-length fields in one output message. With proper design, this function allows all graphic segments to be mapped to a DPAGE with an OFTAB specification to produce a transmission chain of variable-length fields. This function also allows any nongraphic segments to be mapped to a DPAGE without an OFTAB specification to produce a transmission chain of fixed-length fields.
- A different output field tab separator character to be used for each DPAGE.

For OPTIONS=MSG, the OFTAB specification on the DIV statement imposes the following restrictions:

- If the OFTAB= specification is used, fields in the entire message are treated as variable-length fields.
- The output field tab separator character cannot be present in the entire output message from the IMS application program. Therefore, output field tab separator characters should not be specified if nongraphic data is being sent.

FILL=NULL Specification

Specify FILL=NULL on the DPAGE or MSG statement and specify the OFTAB= parameter in the DIV or DPAGE statement to preserve field separation. If FILL=NULL is specified on the DPAGE or MSG statement and the OFTAB= parameter is not present on the DIV statement or the DPAGE statement, a compressed output data stream is produced and field separation is not evident.

Use FILL=NULL for graphic data. If GRAPHIC=NO and FILL=NULL are specified in the SEG statement, any X'3F' in the non-graphic data stream is compressed out of

the segment and undesirable results can be produced. Send non-graphic data on output as fixed length output fields and do not specify FILL=NULL.

Output message segments and message fields defined for each segment are processed sequentially by MFS if option 1 or 2 is defined in the OPT= operand of the MSG statement. Message fields in option 1 and 2 segments are defined as fixed-length fields and in fixed position. The data for these fields can be supplied as fixed-length fields, or it can be shortened by the application program. The data can be shortened by two methods:

- By inserting a short segment if no data exists for fields defined at the end of a segment.
- By placing a null character (X'3F') in the field. MFS scans segment data left to right for a null character. The first null character encountered terminates the data for a corresponding MFLD. Positioning of all fields in the segment remains the same as the positioning of defined fields regardless of null characters.

Trailing Blank Compression

Blanks at the end of segments are compressed if all of the following are true:

- OFTAB= is specified on the DIV or DPAGE statement, or if FILL=NULL or FILL=PT.
- GRAPHIC=YES is specified for the segment.
- OPT=1 or OPT=2 is specified in the MSG statement.

Specifying COMPR

You can specify trailing blank compression (COMPR=) as FIXED, SHORT, or ALL.

FIXED: If COMPR=FIXED is specified, MFS removes trailing blanks from fixed-length data fields. The resulting mapping in the DFLD is as if the application program inserted a short data field (by inserting X'3F' in the position after significant data or by inserting a short segment) or omitted the field (by inserting X'3F' in the first position of the field or by inserting a short segment) if the entire field contains blanks.

Fields shortened by an application program are not compressed in the same way as when COMPR=FIXED is specified. This option is provided for application programs that always supply maximum-length fields (such as the NAME field) for simplicity of the application program, and these blanks are not significant to the receiver. The receiver can assume that fields shortened or omitted by the compress option or by the application program have the same meaning.

SHORT: If COMPR=SHORT is specified, MFS removes trailing blanks from the data fields shortened by the application program. The resulting mapping in the DFLD is as if the application program inserted a short field with no trailing blanks or omitted the field. Fixed-length fields do not undergo this compression.

This option is provided for application programs written for the 3270 and without application program changes.

ALL: If COMPR=ALL is specified, the trailing blanks in the fixed-length and short fields are removed.

Trailing blanks in a short field or a single blank short field causes a specific operation on the 3270 (that is, to clear the entire field on the screen for a single blank and insert a program tab character (FILL=PT), or to clear the remaining portion of the updated field and insert one or more null characters (FILL=NULL)).

Saving Line Transmission Time

Line transmission time can be saved by using one of the following methods:

- Specifying COMPR=ALL, which removes the trailing blanks in fixed-length and short fields
- Defining record mode, and defining the fields as occurring at the end of the record

Blank Compression on Variable-Length Output

Examples of variable-length output with blank compression are shown in Figure 33 and in Figure 34 on page 176.

Figure 32 shows the data entered by the IMS application.

Segment 1:

DLZZ	FIELD A1	FIELD A2	FIELD A3	FIELD A4	FIELD C1	FIELD C2
0200	AAAAA44444	1234563...	43.....	A4A4A4		
0800	00000	F	0F			

Segment 2:

DLZZ	FIELD B1	FIELD B2	FIELD D1	FIELD D2	FIELD D3	FIELD E1
0300	BBBBBBBBBB	4444444444	DDDDD43.	3.....	D3D3D3D3	
0400		0000000000	0F	F		

Figure 32. Data Entered by the IMS Application

Note: Both segments entered are shortened by the program.

Table 40 shows the MFS definitions used in Figure 32.

Table 40. MFS Definitions for Data Entered by IMS Application

MSGOUT	MSG	TYPE=OUTPUT, SOR=FMTOUT
	SEG	
	MFLD	A1,LTH=10
	MFLD	A2,LTH=10
	MFLD	A3,LTH=10
	MFLD	A4,LTH=10
	MFLD	C1,LTH=10
	MFLD	C2,LTH=10
	SEG	
	MFLD	B1,LTH=10
	MFLD	B2,LTH=10
	MFLD	D1,LTH=10
	MFLD	D2,LTH=10
	MFLD	D3,LTH=10
	MFLD	E1,LTH=10
	MSGEND	
FMTOUT	FMT	

Figure 33 shows how blank compression and mapping occurs in record mode.

```

VLVB  FIELD A1 THRU A4: (First record)
01    AAAAA,123456,,A4A4A4
06
VLVB  FIELD B1:         (Second record)
00    BBBBBBBBBB
0C
VLVB  NO DATA:        (Third record)
00
03
VLVB  FIELDS D1 and D3: (Fourth record)
01    DDDDD, ,D3D3D3D3
02
    
```

Figure 33. Variable-Length Output with Blank Compression in Record Mode

Notes:

1. Field A2 was short.
2. Field A3 had no data.
3. Field A4 was short. Trailing separators in a record are not transmitted.
4. Field B2 had no data.
5. Fields C1 and C2 had no data. A 1-byte record is transmitted because more data follows.
6. Field D1 was short.
7. Field D2 had no data.
8. Field E1 had no data. A record is not transmitted because no more data follows.

Table 41 shows the MFS definitions used for record mode output as shown in Figure 33.

Table 41. MFS Definitions for Record Mode

Field	Type	Definition
	DEV	TYPE=DPM-B1, FEAT=5, MODE=RECORD
	DIV	TYPE=OUTPUT, X OFTAB=(c',MIX), COMPR=ALL
A1	DFLD	LTH=10
A2	DFLD	LTH=10
A3	DFLD	LTH=10
A4	DFLD	LTH=10
	RCD	
B1	DFLD	LTH=10
B2	DFLD	LTH=10
	RCD	
C1	DFLD	LTH=10
C2	DFLD	LTH=10
	RCD	
D1	DFLD	LTH=10
D2	DFLD	LTH=10
D3	DFLD	LTH=10
	RCD	
E1	DFLD	LTH=10

Output Format Control for ISC

Figure 34 shows how compression and mapping occur in stream mode.

```
VLVB   FIELDS A1 THROUGH D3: (Single record)
03     AAAAA,123456,,A4A4A4,BBBBBBBBBB,,,DDDDDD,,D3D3D3D3
```

Note: In stream mode, a separator is not transmitted for field D3, which is short, and for field E1, which is omitted.

Figure 34. Variable-Length Output with Blank Compression in Stream mode

Table 42 shows the MFS definitions used for stream mode output as shown in Figure 34.

Table 42. MFS Definitions for Stream Mode

Field	Type	Definition
	DEV	TYPE=DPM-B1, FEAT=6, MODE=STREAM
	DIV	TYPE=OUTPUT, X OFTAB=(c',,MIX), COMPR=ALL
A1	DFLD	LTH=10
A2	DFLD	LTH=10
A3	DFLD	LTH=10
A4	DFLD	LTH=10
B1	DFLD	LTH=10
B2	DFLD	LTH=10
C1	DFLD	LTH=10
C2	DFLD	LTH=10
D1	DFLD	LTH=10
D2	DFLD	LTH=10
D3	DFLD	LTH=10
E1	DFLD	LTH=10
	FMTEND	

Data Structure Name

The data structure name is sent in a separate DD header unless you code `OPTIONS=NODNM` on the DIV statement. If you code `OPTIONS=DNM` or the default is used, the DD header is present in each transmission chain of an output message, or each transmission chain of a demand paged output message.

In addition to the data structure name parameter in the DD header, the version identification parameter is present in the only transmission chain of an output message or in the first transmission chain of paged output messages.

Version Identification

You have an option of coding a 2-byte value on the DEV statement to be included in the DOF or DIF control block as the version ID. If this parameter is not coded, the version ID is generated by MFS using a hashing algorithm on the date and time. The value is also printed in the MFS Language utility output so that you can reference it in format definitions in remote programs.

Your Control of MFS

This section describes the MFS facilities that can assist you, or allow a remote program to control the display or transmission of output messages. These topics describe the MFS facilities that can assist you, or allow a remote program to control the display or transmission of output messages. This also describes paging action at the device, the unprotected screen option, and your control when using the 3290 Information Panel in partitioned format mode.

Operator Logical Paging

Operator logical paging allows you (or, for SLU P, a remote program, or ISC subsystems) to request a specific logical page of an output message. It is defined on a message basis in the PAGE= operand of the MOD's MSG statement.

Functions Provided

When a MOD is defined to allow operator logical paging, the following functions are available to you once the first physical page of the output message is displayed:

- Enter = to display the next logical page of the current message.
- Enter =*n*, =*nn*, =*nnn* , or =*nnnn* (where *n* is the logical page number) to display a specific logical page of the current message.
- Enter =+*n*, =+*nn*, =+*nnn* , or =+*nnnn* to display the *n* th logical page past the current logical page.
- Enter =-*n*, =-*nn*, =-*nnn* , or =>*nnnn* to display the *n* th logical page before the current logical page.
- Enter =L to display the first physical page of the last logical page of the current message.

Format Design Considerations

When operator logical paging is permitted, message and device formats should be designed to allow you to enter the page request onto a currently displayed page and have the request edited to the first field of the first input segment. If this is not done, or the PAGEREQ function is not used (see "Operator Logical Paging"), paging requests can only be entered on a cleared device.

Preferably, the installation standard for device formats should include a specific device field for you to enter logical page requests, transaction codes, and IMS commands. If the transaction code is normally provided through a message or program function key literal, the PAGEREQ function can be used, or a field can be defined at the beginning of the first segment using the null pad character. A page request field on the device can map to this field. If you do not enter a page request, the null pad causes the field to be removed from the segment and the second field (literal transaction code) appears at the beginning of the segment.

Transaction Codes and Logical Page Requests

If the PAGEREQ function is not used to specify a page request, MFS formats input data according to the defined MID prior to determining whether operator logical paging was specified, and whether the input contained a page request. If operator logical paging was not specified, the message undergoes standard IMS destination determination.

If operator logical paging was specified, MFS examines the first data of the first message segment (first field if the message uses format option 3) for an equals sign (=). If MFS does not find an equals sign, it routes the message to its

Your Control of MFS

destination. If an equals sign is present, all following characters up to a maximum of 4, or the first blank, are considered to be a page request.

A message destined for a single-segment command or transaction, as required in Fast Path applications, should be defined as single-segment in its MID. If the MID defines more than one segment, you must ensure that only one segment is created when the destination is a single-segment command or transaction. This can be achieved by careful input and the use of option 2, null compression (FILL=NULL) or both.

Operator Control Tables

Input device fields can be defined to invoke MFS control functions when either the data or the data length satisfies a predefined condition. Do this by defining one or more operator control tables and including the related table name in the device field definition. When a device field is defined with an associated operator control table, MFS processes the device input field and performs the requested control function if the input data satisfies the conditions of the operator control table.

The following control functions are available when you use operator control tables:

NEXTPP	Provides the next physical page of the current message.
NEXTLP	Provides the next logical page of the current message.
PAGEREQ	Provides the logical page requested by the second through last characters of this field. PAGEREQ functions are specified as in operator logical paging. The first character is a page request “trigger” character that you define. The remaining characters must be <i>n[nnn]</i> , <i>+n[nnn]</i> , <i>-n[nnn]</i> , or L (an equals sign (=) is not allowed).
NEXTMSG	Dequeues the current output message and provides the first physical page of the next message, if any.
NEXTMSGP	Dequeues the current output message and provides the first physical page of the next message, if any; or notifies you that there are no other messages in the queue.
ENDMPPI	Terminates a multiple physical page input message. Available only for the 3270.

Unlike operator logical paging requests, these functions are always located by MFS during the editing process.

3270 or SLU 2-Only Feature Definitions

If you use SLU 2 or a 3270, MFS provides several ways to invoke MFS control functions:

- Program function keys and display device fields defined as detectable by the selector light pen can be defined for all MFS control functions except PAGEREQ.
- The PA1 key is equivalent to, and reserved for, the NEXTPP function.
- The PA2 key is equivalent to the NEXTMSG function.
- The PA3 key, when not used for the copy function, is equivalent to the NEXTMSGP function.
- The PF12 key, or PA3 key on data entry keyboards, requests the copy function. This IMS-supported copy function causes a copy of the currently displayed physical page to be printed on an available candidate printer. This printer must be attached to the same control unit (3271 or 3274, for example) as the display station containing the information to be copied.

Restriction: The request for a copy function is ignored if the device is not defined to allow the copy function or the device does not support the copy function.

For more information about the copy function, see the DFLD statement field definitions for ALPHA/NUM and NOPROT/PROT.

Paging Action at the Device

The paging operation for an MFS device depends on MFS control block definitions, the output message content, and your input. If the device is a printer, each physical page of each logical page is transmitted to the device in sequence and the message is dequeued.

During output paging, if online change processing occurs that changes the format of the output message you access, you can get an error message or get the message in a format different from the one expected.

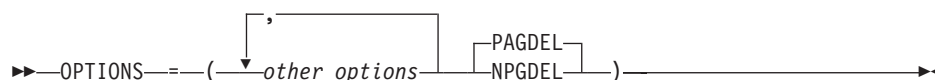
If operator logical paging is **not** specified for a 3604, 3270, SLU 2 display, or SLU P using the DPM paging option, each physical page of each logical page can be viewed in sequence using the NEXTTP function. Because operator logical paging is not specified, entering NEXTTP after the last physical page of the last logical page has been displayed causes the next message to be transmitted if only one exists in the queue. If no message is in the queue, no action takes place.

If operator logical paging is specified for a 3604, 3270, SLU 2 display, or SLU P using the DPM paging option, the NEXTTP function can be used to view pages sequentially. However, entering NEXTTP after the last physical page of the last logical page causes MFS to return an error message and reset the page position to the first page. As noted in “Operator Logical Paging of Output Messages” on page 149, if you are going to view pages out of sequence, the formats should be designed to use the PAGEREQ capability or to have the page request edited to the first field of the first input segment. If not, the screen must be cleared before the page request is entered as unformatted input. For performance reasons, avoid this method.

Table 43 on page 181 and Table 44 on page 182 describe IMS actions, and the possible message and device status from your input or remote program actions after a successful message transmission.

The following factors must be considered and are included in the figure:

- Macro/statement specifications:
 1. TERMINAL (or TYPE) macro (IMS system definition)



or



When you use the default (PAGEDEL=YES), your input that invokes processing for a new transaction causes the output message for the current

Your Control of MFS

transaction to be dequeued. To prevent current output from being dequeued, `OPTIONS=(...,NPGDEL,...)`, or `PAGDEL=NO` for nonswitched 3270 devices, must be specified.

2. MSG statement (MOD definition)



`PAGE=YES` specifies that operator logical paging is permitted. `PAGE=NO` specifies that paging is not permitted.

- Whether the last physical page of the last logical page in the current message has been sent.
- An IMS action performed automatically after successful message transmission and before your input.
- Your input or remote program action after receiving a message:
 - `PAGE ADVANCE`: `NEXTPP` request is entered (or you press PA1 key on 3270 or SLU 2).
 - `LOGICAL PAGE ADVANCE`: `NEXTLP` request is entered.
 - `=PAGE`: specific logical page is requested.
 - `PAGEREQ`: specific logical page is requested.
 - `MESSAGE ADVANCE`: `NEXTMSG` request is entered (or you press the PA2 key on a 3270 or SLU 2 device).
 - `MESSAGE ADVANCE PROTECT`: `NEXTMSGP` request is entered (or you press PA3 key on 3270 or SLU 2 when PA3 is not defined for copy function).
 - You enter (or a remote program enters) data that does not invoke an operator control function, followed by enter (or 3270 or SLU 2 PFK, CARD, IMMEDIATE DETECT).

3270 or SLU 2 operators can also press the CLEAR key. The CLEAR key causes the screen to be unprotected, and subsequent input is edited by IMS basic edit. CLEAR does not affect the status of the current output message. The result of any operator action after using CLEAR is the same as if CLEAR had not been used.

- Table 43 on page 181 and Table 44 on page 182 use the following abbreviations to describe IMS action:

MSG DEQ	Message dequeue. IMS removes the current output message from the message queue. The message is available until this action takes place.
MSG ENQ	Message enqueue. IMS places the input message in the message queue.
PROTECT	IMS prevents the device from receiving output from IMS.
UNPROTECT	IMS makes the device eligible to receive output from IMS. If a message is currently queued for this device, IMS sends it (subject to controls established by response mode, conversational or exclusive device status).

If a paged message is sent to the terminal with the unprotected screen option set to “unprotected” (during system definition or using the DSCA or SCA specification), the screen is not protected between pages and the IMS-described actions shown in Table 43 on page 181 and Table 44 on page 182 should be ignored. If the message is sent to the terminal with the unprotected screen option set to “protect”, the IMS

actions shown in Table 43 and Table 44 on page 182 apply. For more information about the unprotected screen option, see “Unprotected Screen Option” on page 183.

Table 43 and Table 44 on page 182 assume the system and message definition values and page position in the current message that apply in the following four cases:

Case 1

PAGE=NO and the last physical page of the last logical page of the current message was sent.

Case 2

PAGE=NO and the last physical page of the last logical page of the current message was *not* sent.

Case 3

PAGE=YES and the last physical page of the last logical page of the current message was sent.

Case 4

PAGE=YES and the last physical page of the last logical page of the current message was *not* sent.

Note: If an error message has been sent to the last page, Table 43 and Table 44 on page 182 do not apply. The original message is still in the queue. See *IMS Version 9: Messages and Codes, Volume 1* for the proper response to the message.

For Table 43, the IMS action, after successful IMS transmission of the message and terminal receipt of the message, for each of these four cases is PROTECT, that is, IMS prevents the device from receiving output from IMS. For Case 1, IMS also dequeues the message from the IMS message queue.

For Table 44 on page 182, the IMS action, after successful IMS transmission of the message and terminal receipt of the message, for Cases 2, 3, and 4 is PROTECT, that is, IMS prevents the device from receiving output from IMS. For Case 1, IMS dequeues the message from the IMS message queue.

Table 43. Paging Operation for a Device with MFS with PAGDEL specified. IMS-MFS Action and Resulting Terminal and Message Status

Operator Action	IMS Action for Case 1	IMS Action for Case 2	IMS Action for Case 3	IMS Action for Case 4
Request PAGE ADVANCE (NEXTPP)	Unprotected	Send next physical page unprotected	Send error message, protected ¹	Send next physical page, protected
Request LOGICAL PAGE ADVANCE (NEXTLP)	Unprotected	Send first physical page of next logical page in current msg ²	Send error message, protected ¹	Send first physical page of next logical page in current msg ²
Request specific logical page using =PAGE	Send error message, protected ³	MSG DEQ, send error message protected ³	If valid, send first physical page of requested logical page, protected. ¹ If invalid, send error message protected. ¹	

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Table 43. Paging Operation for a Device with MFS with PAGDEL specified (continued). IMS-MFS Action and Resulting Terminal and Message Status

Operator Action	IMS Action for Case 1	IMS Action for Case 2	IMS Action for Case 3	IMS Action for Case 4
Request specific logical page using PAGEREQ	Send error message, protected	Send error message, protected ¹	If valid, send first physical page of requested logical page, protected. ¹ If invalid, send error message protected. ¹	
Request MESSAGE ADVANCE (NEXTMSG)	Unprotected	MSG DEQ, unprotected	MSG DEQ, unprotected	MSG DEQ, unprotected
Request MESSAGE ADVANCE PROTECT (NEXTMSGP)	Protected ⁴	MSG DEQ, protected ₄	MSG DEQ, protected ₄	MSG DEQ, protected ₄
Enter data	MSG ENQ, unprotected	MSG DEQ, MSG ENQ, unprotected	MSG DEQ, MSG ENQ, unprotected	MSG DEQ, MSG ENQ, unprotected

Notes:

1. The original message is still in the queue. See *IMS Version 9: Messages and Codes, Volume 1* for the proper response to the message.
2. If the current page was the last logical page, no new page is sent, and device status is unprotected.
3. If the device is preset or in conversation, the input is queued; no error message is sent and the device status is unprotected.
4. If a message is in the queue and exclusive or conversational status does not prevent it from being sent, it will be sent. If no message can be sent, a system message is sent indicating that no output is available.
5. The original message is still in the queue. The first physical page of the first logical page is sent unless the device is currently involved in an active conversation. If in conversation, an error message is sent. To continue after a conversational response, NEXTMSG must be entered to dequeue that response.

Table 44. Paging Operation for a Device with MFS with NPAGDEL specified. IMS-MFS Action and Resulting Terminal and Message Status

Operator Action	IMS Action for Case 1	IMS Action for Case 2	IMS Action for Case 3	IMS Action for Case 4
Request PAGE ADVANCE (NEXTPP)	Unprotected	Send next physical page, protected	Send error message, protected ¹	Send next physical page, protected
Request LOGICAL PAGE ADVANCE (NEXTLP)	Unprotected	Send first physical page of next logical page in current msg ²	Send error message, protected ¹	Send first physical page of next logical page in current msg ²
Request specific logical page using =PAGE	Send error message, protected ³	Send error message, protected ^{1, 3}	If valid, send first physical page of requested logical page, protected. If invalid, send error message, protected. ¹	
Request specific logical page using PAGEREQ	Send error message, protected	Send error message, protected ¹	If valid, send first physical page of requested logical page, protected. If invalid, send error message, protected. ¹	

Table 44. Paging Operation for a Device with MFS with NPAGDEL specified (continued). IMS-MFS Action and Resulting Terminal and Message Status

Operator Action	IMS Action for Case 1	IMS Action for Case 2	IMS Action for Case 3	IMS Action for Case 4
Request MESSAGE ADVANCE (NEXTMSG)	Unprotected	MSG DEQ, unprotected	MSG DEQ, unprotected	MSG DEQ, unprotected
Request MESSAGE ADVANCE PROTECT (NEXTMSGP)	Protected ⁴	MSG DEQ, unprotected	MSG DEQ, protected ⁴	MSG DEQ, protected ⁴
Enter data	MSG ENQ, unprotected	MSG ENQ ⁵	MSG ENQ ⁵	MSG ENQ ⁵

Notes:

1. The original message is still in the queue. See *IMS Version 9: Messages and Codes, Volume 1* for the proper response to the message.
2. If the current page was the last logical page, no new page is sent, and device status is unprotected.
3. If the device is preset or in conversation, the input is queued; no error message is sent and the device status is unprotected.
4. If a message is in the queue and exclusive or conversational status does not prevent it from being sent, it will be sent. If no message can be sent, a system message is sent indicating that no output is available.
5. The original message is still in the queue. The first physical page of the first logical page is sent unless the device is currently involved in an active conversation. If in conversation, an error message is sent. To continue after a conversational response, NEXTMSG must be entered to dequeue that response.

Unprotected Screen Option

IMS allows you to leave the screen in unprotected status when an output message is sent to the 3270 display and the message is formatted by MFS. This option is provided on a terminal-by-terminal basis or on a message-by-message basis, except messages bypassing MFS. The terminal option of unprotected status applies to:

- All user-output messages that bypass MFS
- All IMS-generated messages (for example, error, /BROADCAST, and /DISPLAY command output)
- All messages that are formatted by MFS with one of the IMS-supplied default formats or with user-supplied formats

If you do not select the unprotected screen option your messages that are formatted by MFS with user-supplied formats or IMS-supplied default formats, and IMS-generated messages, leave the screen protected or unprotected on a message-by-message basis.

If the message is paged, the screen is unprotected between pages. Therefore, this option is not recommended for paged messages.

Use this option through one of the following:

- SCA output message option of the MFLD statement
- System definition TERMINAL macro specification
- DSCA specification on the DEV statement

Your Control of MFS

Byte 1, bit 5 in the DSCA= operand of the DEV statement and in the SCA output message option of the MFLD statement is defined for protecting or not protecting the screen when the message is sent to the 3270 display:

B'0' Protects the screen when output is sent. B'0' (protected) is the default. This bit is used for autopaged output in ISC.

B'1' The screen is unprotected when output is sent.

If the DSCA value is set to B'0' and PROT (protected) is specified or used as the default on the TERMINAL or TYPE macro, the application program can request that the screen be unprotected when this output is sent (by setting the SCA value to B'1'). If unprotected status is requested when operator logical paging (OLP) is used for the message (PAGE=YES is specified in the corresponding MSG definition), then OLP is reset. You can modify IMS-supplied default formats to set the DSCA value to B'1'.

Whether your messages that bypass MFS leave the display protected or unprotected depends on the OPTIONS specification on the TERMINAL or TYPE macro during system definition. The default is protected.

If MFS formats an IMS message sent to the SYMSG field of a user-defined format the screen is protected or unprotected depending on the DSCA or SCA option of the format on the device.

When the display is in unprotected status, IMS can send output to the terminal at any time. If you press ENTER, a PA key, or a PF key just before the IMS output, your input or request can be lost. This can be avoided if MFS is used for output and input and you enter the NEXTMSGP function or press PA3 (if PA3 is not used for copy) to obtain protected status before entering input data.

If MFS is not used or is only used for output, and the MOD name specifies DFS.EDT, then PA3 protects input data and must not be used for copying.

Table 45 illustrates the action to be taken (protected or unprotected) by IMS based on the OPTIONS specification on the TERMINAL or TYPE macro during system definition, and the type of output message sent.

Table 45. IMS Protect or Unprotect Action Based on OPTIONS Specification

Output Message	IMS System Definition (PRO)	IMS System Definition (UNPRO)
IMS-generated message with: DSCAISCA=PROTECT	PROTECT	UNPROTECT
IMS-generated message with: DSCAISCA=UNPROTECT	UNPROTECT	UNPROTECT
Message using MFS bypass	PROTECT	UNPROTECT
Your message using MFS and user-supplied format or IMS-supplied default format with: DSCAISCA=PROTECT	PROTECT	UNPROTECT
Your message using MFS and user-supplied format or IMS-supplied default format with: DSCAISCA=UNPROTECT	UNPROTECT	UNPROTECT

Table 45. IMS Protect or Unprotect Action Based on OPTIONS Specification (continued)

Output Message	IMS System Definition (PRO)	IMS System Definition (UNPRO)
Note:		
1. PROTECT: Do not send additional output; wait for input.		
2. UNPROTECT: Send output if an output message is available and eligible to be sent.		

3290 in Partitioned Format Mode

This section describes interactions with the 3290 in partitioned format mode.

Support of 3290 partitioning and scrolling is provided for devices defined to IMS as SLU 2 terminals. Partitioning and scrolling are not provided for devices using BTAM or non-SNA VTAM.

Partition Initialization Options and Paging

You can choose one of three different options for initializing the partition set and paging. The option you select determines how many logical pages of the output message are presented to their appropriate partitions at the initial transmission of a message to a partition formatted screen. (An output message consists of one or more logical pages, each destined for a particular partition according to the DPAGE specifying that partition.) The option also determines how paging requests present additional logical pages to their appropriate partitions. You can specify the option on the PAGINGOP= operand of the partition descriptor block (PDB) statement.

The three options are:

Option 1 The initial data stream presented to the 3290 LU consists of the first logical page of the output message, which is mapped using the DPAGE to the appropriate partition. Thereafter you control all paging with keyed-in paging requests. You use the PA1 and PA2 keys just as in standard, non-partitioned mode. The terminal can be using basic paging support or OLP.

When you request the next logical page, MFS gets the next sequential logical page and sends it to its associated partition. It does not matter which partition is active. A request for the next page results in the next sequential page in the message being sent to the inputting (active) partition or to another partition.

Example: If you enter =+1, the next logical page in the message is presented to the appropriate partition, whatever that partition might be. If you enter =+3, the page that is sequentially third from the last logical page presented is presented next.

Option 2 The initial data stream presented to the 3290 LU consists of the first logical page of the message and additional logical pages in sequence until the second logical page of any partition is reached, or until the end of the message. Thereafter you control all paging with keyed-in paging requests as described for Option 1.

Option 3 The initial data stream presented to the 3290 LU consists of the first logical page of each partition of the partition set. Thereafter you control all paging with keyed-in paging requests, with one crucial difference from Options 1 and 2: the order in which subsequent logical pages are presented to the partitions depends on the active

partition, from which the request is entered. All requests for logical pages apply only to logical pages associated with the active partition.

Example: If you enter +=1, the next logical page destined for the active partition is presented—not necessarily the one that happens to be sequentially next in the message. This means that, for the 3290 operator, management of logical paging within the active partition is identical to paging support in a non-partitioned environment.

Regardless of the option chosen, one partition is active after the initial data stream is sent. The active partition is the one in which the cursor is located.

An ACTVPID operand might have been specified on one of the DPAGEs that points to an initialized partition. The ACTVPID allows the application program to declare which partition is the active partition. If option 2 or 3 is being used and data has been sent to several partitions, it is possible that more than one partition has been specified by ACTVPID keywords. In that case, the last partition activated is the active partition. If no ACTVPID keywords are encountered, the active partition is the partition defined by the first partition descriptor (PD) statement in the PDB.

Clearing the Display

There are two levels of clearing the screen and buffer:

- The CLEAR key (X'6D') resets the 3290 to base state, (non-partitioned mode), sets the buffer positions to null, and places the cursor in the upper left corner of the screen. It also places the active message back onto the queue and deletes the control block structure that was created for partitioning.
- The CLEAR PARTITION key (X'6A') resets only the active partition buffer to nulls and clears the active partition viewport. It also places the cursor in the top left corner of the partition. The partition is considered unformatted; any input from it is considered unformatted by MFS and is processed by basic edit.

The JUMP PARTITION Key

Using the JUMP PARTITION key, you can move from one partition to the next, in the order that the PD statements define the partitions in the PDB.

Movement between partitions is determined by the order of the PD statements, not by the order of the associated partition identifier (PID) values.

The partition to which the cursor moves becomes the active partition. Using this key causes no interaction with the host.

Scrolling Operations

The VERTICAL SCROLLING keys cause the data to move up or down in the viewport, so that different parts of the presentation space appear in the scrolling window. The scrolling window is the portion of the presentation space that is mapped to the viewport at a given time. If the viewport has the same depth as the presentation space, the viewport is nonscrollable. If the viewport depth is smaller than the presentation space, it is scrollable.

The amount scrolled each time depends on what is specified by the SCROLLI keyword on the PD statement. The default scrolling increment is one row. Scrolling causes no interaction with the host.

3180 in Partitioned Format Mode

IMS support for the 3180 in partitioned format mode is provided through 3290 partitioning and scrolling support. Although interaction with the 3180 and the 3290 in partitioned format mode are similar, the following differences apply:

- With the 3180, only one partition with specific size limits is possible. The 3290 supports multiple partitions of various sizes.
- Logical unit display screen size and viewport location for the 3180 cannot be specified in picture elements (pels). The 3290 supports rows, columns, and pels.
- With the 3180, the single partition is the only one initialized. With the 3290, the application program can determine, with the ACTVPID keyword, which of the various partitions to initialize.

Because only one active partition is available on the 3180, you can either specify Option 1 on the PAGINGOP= operand of the PDB statement or accept the default of 1. With this option, the initial data stream presented to the 3180 LU consists of the first logical page of the output message, which is mapped by the DPAGE to the single partition. When you request the next logical page, MFS gets the logical page that is sequentially next in the message and sends it to the partition. For more information, refer to the description of Option 1 in “Partition Initialization Options and Paging” on page 185.

Clearing the display and scrolling is handled in the same way on the 3180 as on the 3290 in partitioned format mode.

MFS Format Sets Supplied by IMS

Several format sets are provided by IMS for system use and to serve as defaults when you have not supplied a correct MOD name. The IMS-supplied control blocks reside in the IMS.FORMAT library. When the MFSTEST facility is in use, these control blocks also reside in the IMS.TFORMAT library. They can be used in any IMS installation with MFS by specifying the appropriate MOD name after the /FORMAT command. In addition, the format definitions can be used independently by specifying the format name in the SOR= operand of the user-written message definition.

The format definitions supplied by IMS combine with various message definitions to create several separate message formats. All of the format sets except the MFS 3270 and the SLU 2 master terminal formats use the DFSD1, DFSD2, or DFSD4 format definitions. The format for the master terminal is described in “MFS 3270 or SLU 2 Master Terminal Format” on page 188. These format definitions include literals for two of the 3270 or SLU type 2 program function keys, PFK1 and PFK11. Pressing PFK1 inserts the /FORMAT command into the first message segment, in front of the entered data. Pressing PFK11 causes a NEXTMSGP request.

The following topics provide additional information:

- “System Message Format” on page 188
- “Multisegment System Message Format” on page 188
- “Output Message Default Format” on page 188
- “Block Error Message Format” on page 188
- “/DISPLAY Command Format” on page 188
- “Multisegment Format” on page 188
- “MFS 3270 or SLU 2 Master Terminal Format” on page 188

MFS Format Sets

- “MFS Sign-On Device Formats” on page 189

System Message Format

The system message format is used for single-segment output messages from IMS and single-segment broadcast messages. It permits two segments of input (transaction, command, or message switch). DFSDF1 is the format name. The MOD name is DFSMO1, and the MID name is DFSMI1. Messages that use this format are eligible for the SYSMMSG field on 3270 or SLU 2 devices.

Multisegment System Message Format

The multisegment system message format is used for multisegment messages from IMS and multisegment broadcast messages. It permits an output message of up to 22 segments. DFSDF2 is the format name. The MOD name is DFSMO5, and the MID name is DFSMI2. Messages that use this format are eligible for the SYSMMSG field on 3270 or SLU 2 devices. Use the PA1 key to obtain subsequent segments.

Output Message Default Format

For 3270 or SLU 2 devices, the output message default format is used for message switches from other terminals and application program output messages with no MOD name specified. It permits two segments of input (transaction, command, or message switch). DFSDF2 is the format name. The MOD name is DFSMO2, and the MID name is DFSMI2.

Block Error Message Format

The block error message format is used for the DFS057I REQUESTED BLOCK NOT AVAILABLE message sent by MFS when an error is encountered during output format block selection. This message is accompanied by a return code (indicating the severity of error) and the block name (the name of the MOD or DOF in error). It can include up to 21 segments of output per logical page. This format permits two segments of input (transaction, command, or message switch). DFSDF2 is the format name. The MOD name is DFSMO3, and the MID name is DFSMI2.

/DISPLAY Command Format

The /DISPLAY command format is used for /DISPLAY command output. Up to 22 segments per logical page are permitted. This format permits two segments of input (transaction, command, or message switch). DFSDF2 is the format name; The MOD name is DFSDSP01, and the MID name is DFSMI2.

Multisegment Format

The multisegment format is used for entering multisegment transactions and commands. A /FORMAT command specifying a MOD name of DFSMO4 can be used to obtain this format. This format is also used for multisegment output messages not exceeding four segments. Up to four segments of input are permitted. DFSDF4 is the format name. The MOD name is DFSMO4, and the MID name is DFSMI4.

MFS 3270 or SLU 2 Master Terminal Format

The MFS 3270 or SLU 2 master terminal format is used when the optional IMS-supplied MFS support for the 3270 or SLU 2 master terminal is selected. This support is described in “MFS Formatting for the 3270 or SLU 2 Master Terminal” on page 189.

MFS Sign-On Device Formats

The MFS sign-on device format is used for terminals that require user signon, such as terminals defined with the extended terminal option (ETO). (For more information about ETO, see *IMS Version 9: Administration Guide: Transaction Manager*.) The format applies to 3270 and SLU 2 devices only. For devices that can receive the formatted /SIGN ON command panel (devices with at least 12 lines and 40 columns), the MOD is DFSIGNP, and the MID is DFSIGNI. For devices with smaller screens, the MOD is DFSIGNN, and the MID is DFSIGNJ.

MFS Formatting for the 3270 or SLU 2 Master Terminal

If the IMS master terminal is a 3270 or SLU 2 display device defined as a 3275, 3277 model 2, or 3270-An with SIZE=24x80, you can select the IMS-supplied format that uses MFS. To use the IMS-supplied format you must specify OPTIONS=(...,FMTMAST,...) in the COMM macro during IMS system definition.

When this format is used, the display screen is divided into four areas and several program function keys are reserved.

The four areas of the screen are:

Message Area

This area is for IMS command output (except /DISPLAY and /RDISPLAY), message switch output, application program output that uses a MOD name beginning with DFSMO, and IMS system messages.

Display Area This area is for /DISPLAY and /RDISPLAY command output.

Warning Message Area

This area can display the following warning messages:

MASTER LINES WAITING
 MASTER MESSAGE WAITING
 DISPLAY LINES WAITING
 USER MESSAGE WAITING

You can also enter an IMS password in this area.

User Input Area

This area is for your input.

Related Reading: The format and use of these screen areas is described in *IMS Version 9: Operations Guide*.

The IMS-supplied master terminal format defines literals for nine of the 3270 or SLU 2 program function (PF) keys. PF keys 1 through 7 can be used for IMS command input. Pressing a PF key inserts a corresponding command into the first message segment in front of the entered data. The keys and their corresponding commands are:

PF Key	Command
1	/DISPLAY
2	/DISPLAY ACTIVE
3	/DISPLAY STATUS
4	/START LINE

MFS Formatting

5	/STOP LINE
6	/DISPLAY POOL
7	/BROADCAST LTERM ALL

The PF11 key issues a NEXTMSGP request, and the PF12 key requests the copy function.

Do not change the definitions for the master terminal format, with the exception of the PFK literals.

When the master terminal format is used, any message whose MOD name begins with DFSMO (except DFSMO3) is displayed in the message area. Any message whose MOD name is DFSDSPO1 is displayed in the display area. Messages with other MOD names generate the warning message: USER MESSAGE WAITING.

MFS Device Characteristics Table

The MFS Device Characteristics table (DFSUDT0x)⁴ is generated during system definition for the 3270 or SLU 2 devices defined as TYPE=3270-An in the TYPE or TERMINAL macro statement.

The MFS Device Characteristics table can be updated with the MFS Device Characteristics Table utility (DFSUTB00), which allows updates to the table without system regeneration. Each entry in the table contains the user-defined device type symbolic name (3270-An), associated screen size (from SIZE= parameter), and physical terminal features (from FEAT= parameter). Different specifications of the physical terminal features (FEAT= parameter) for the same device type symbolic name cause separate entries to be generated in the MFS Device Characteristics table.

Related Reading: For a description of the TYPE and TERMINAL macros, see *IMS Version 9: Installation Volume 2: System Definition and Tailoring*.

MFS source definitions specify TYPE=3270-An and FEAT as operands on the DEV statement. For the specified device type, MFS extracts the screen size from the specified DFSUDT0 x in the IMS.SDFSRESL library.

The MFS Language utility (DFSUPAA0) uses the screen size, feature, and device type specifications to build a DIF/DOF member in the IMS.FORMAT library to match the IMS system definition specification. Because the screen size is specified only during IMS system definition, an IMS system definition must be performed before execution of the MFS Language utility for user-defined formats with DEV TYPE=3270-An.

The MFS Device Characteristics table is created during stage 2 of IMS system definition using the same suffix as the IMS composite control block, nucleus, and security directory block modules as specified in the SUFFIX= keyword of the IMSGEN macro. If terminals defined with ETO are added to the system, the MFS Device Characteristics Table utility can be used to add to or update the table without regenerating the system definition.

4. The 'x' in DFSUDT0 x corresponds to the parameter specified on the SUFFIX= keyword of the IMSGEN macro.

Related Reading: For more information on the MFS Device Characteristics Table Utility (DFSUTB00) and the MFS Language Utility (DFSUPAA0), see *IMS Version 9: Utilities Reference: Database and Transaction Manager*.

The alphanumeric suffix (*x*) of the table name (DFSUDT0 *x*) is the level identification for the version of the table to be read. The *x* suffix can also be specified using the DEVCHAR= parameter of the EXEC statement for the MFSUTL, MFSBTCH1, MFSTEST, and MFSRVC procedures. Repetitive use of the same suffix by the MFS Language utility causes the same version of the MFS device Characteristics table to be read from the IMS.SDFSRESL library.

If an MFS Device Characteristics table is required, and either no suffix was provided or the suffixed table is not present in the IMS.SDFSRESL library, the MFS Language utility attempts to load the IMS Device Characteristics table using the default name (DFSUDT00).

Note: If no default table (DFSUDT00) was created at system definition a failure will result.

During the logon process for an ETO terminal, the MFS Device Characteristics table is used to determine the MFS device type for the terminal. The screen size from the BIND unique data and the device features from the ETO logon descriptor are used as search arguments.

Associate only one symbolic name with a given screen size. Establish a standard for relating the device type symbolic name to the screen size.

Recommendation: Use the listed screen sizes for each of the user-defined symbolic names:

User-Defined Symbolic Name Screen Size

3270-A1	12×80
3270-A2	24×80
3270-A3	32×80
3270-A4	43×80
3270-A5	12×40
3270-A6	6×40
3270-A7	27×132
3270-A8	62×160

Version Identification Function for DPM Formats

The MFS DOF defines how data is formatted for presentation to the remote program so the remote program can efficiently locate and process the data. The MFS DIF defines how data is presented to IMS from the remote program.

To ensure proper formatting and to present and interpret the data correctly the MFS DOFs and DIFs and the remote program control blocks of the data formats must be at the same level. The current level of the MFS control block is a unique 2-byte field called the version identification (version ID). The version ID is either user-supplied on the DEV statement or, if not specified, it is created by the MFS Language utility at the time the source definition is stored in the IMS.REFERRAL library in an ITB

Version Identification for DPM

format. The version ID is printed in the information messages DFS1048I and DFS1011I of the MFS Language utility for the DOF or DIF, and must be included in the remote program if verification is to be performed.

The version ID of the DOF used in mapping the output message is provided in the output message header and must be used by the remote program to verify that the control block in the remote program is at the same level as the DOF's version ID.

The version ID of the control block used in mapping the input message to IMS must be provided by the remote program in the input message header. It is used to verify that the correct level of the DIF is provided to map the data for presentation to the IMS application program. If the version ID sent on input does not match the version ID in the DIF, the input data is not accepted and an error message is sent to the remote program. If the verification is not desired, the version ID can be sent with hexadecimal zeros (X'0000') or it can be omitted from the input message header. In this case, both the remote program and MFS assume that the DIF can be used to map the data correctly.

Chapter 7. MFS Application Program Design

Design objectives for MFS application programs should focus on device independence, operator convenience, and application program simplicity. Effective design requires a fundamental understanding of the MFS functions and of the factors that affect MFS operation and performance. This section addresses those factors that should be understood and considered when MFS applications are designed.

The following topics provide additional information:

- “Relationships Between MFS Control Blocks”
- “Format Library Member Selection” on page 200
- “3270 or SLU 2 Screen Formatting” on page 203
- “Device Compatibility with Previous Versions of MFS” on page 207
- “Performance Factors” on page 213
- “MFS Definitions for Intersystem Communication” on page 219

Relationships Between MFS Control Blocks

Several levels of linkage exist between MFS control blocks. You must understand these linkages to design an application environment properly.

Figure 35 on page 194 shows the interrelationships between MFS control blocks. Figure 36 on page 195 through Figure 39 on page 197 illustrate the four levels of linkages, which are then summarized in Figure 40 on page 198.

MFS Control Blocks

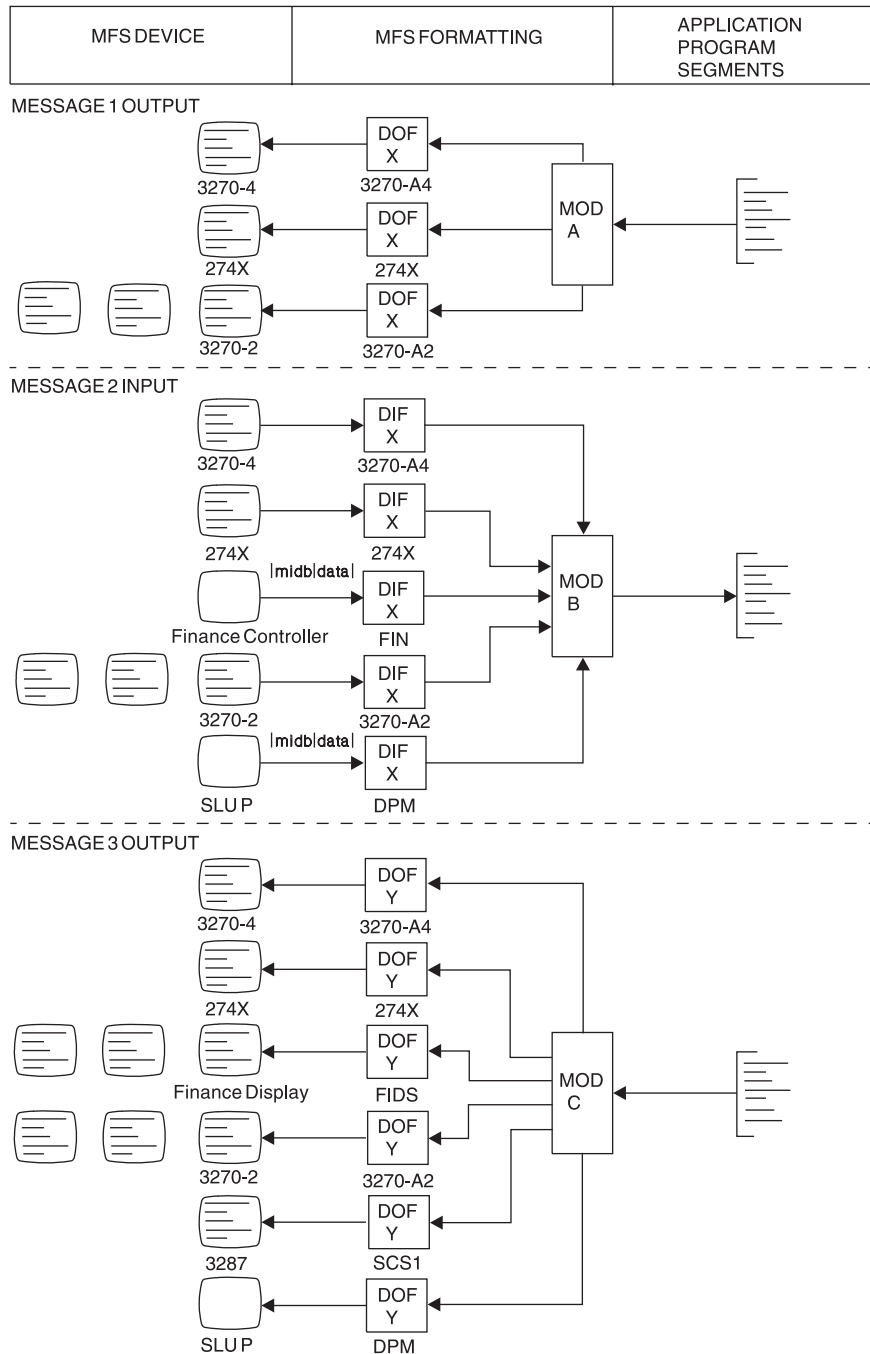


Figure 35. Control Block Interrelationships

Figure 36 on page 195 shows the highest-level linkage, that of chained control blocks.

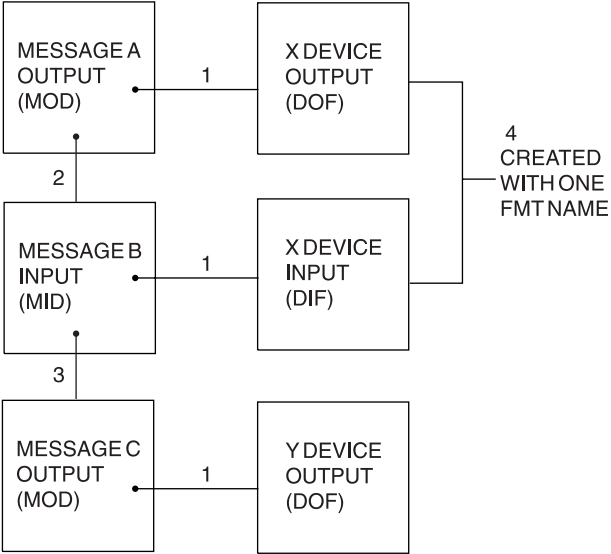


Figure 36. Chained Control Block Linkage

Notes to Figure 36:

1. This linkage must exist.
2. If the linkage does not exist, device input data from 3270 devices is not processed by MFS. For other devices, the MID name can be provided by the operator.
3. This linkage is provided for application program convenience. It provides a MOD name to be used by IMS if the application program does not provide a name by way of the format name option of the DL/I ISRT or PURG call. This MOD name is also used if the input is a message switch to an MFS-supported terminal.
4. The user-provided names for the DOF and DIF used in one output-input sequence are normally the same. The MFS language utility alters the name for the DIF to allow the MFS pool manager to distinguish between the DOF and DIF.

The direction of the linkage allows many message descriptors to use the same device format if desired. One common device format can be used for several application programs whose output and input message formats as seen at the application program interface are quite different.

Figure 37 on page 196 shows another level of linkage that exists between message fields and device fields. The dots show the direction of reference, not the direction of data flow, in the MFS language utility control statements; that is, the item at the dotted end of a line references the item at the other end of the line.

References to device fields by message fields do not need to be in any particular sequence. An MFLD does not need to refer to any DFLD. In this case, MFLD defines space in the application program segment that is to be ignored if the MFLD is for output and padded if the MFLD is for input. Device fields do not need to be referenced by message fields. In this case the fields are established on the device, but no output data is transmitted to them and any input data from them is ignored.

MFS Control Blocks

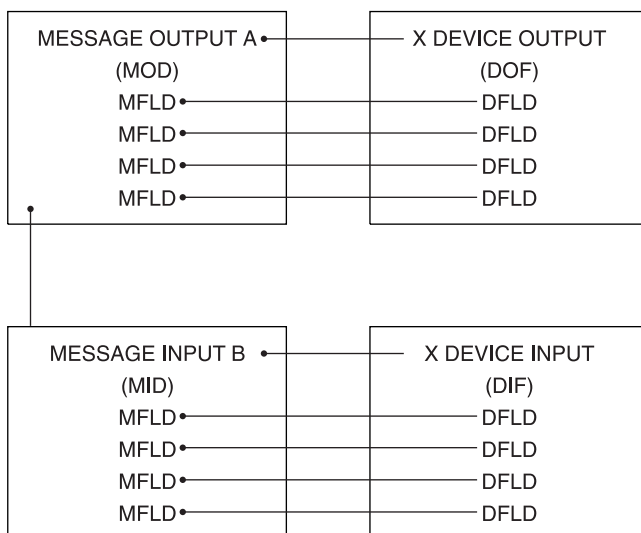


Figure 37. Linkage between Message Fields and Device Fields

Figure 38 shows a third level of linkage, which exists between the LPAGE and the DPAGE.

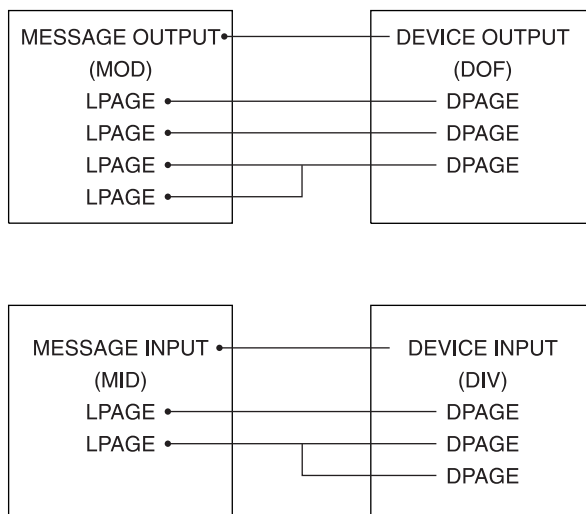


Figure 38. LPAGE and DPAGE Relationships

A MOD LPAGE must refer to a DPAGE in the DOF. However, not all DPAGES must be referred to from a given MOD.

If no MID LPAGE is defined, the defined MFLDs can refer to fields in any DPAGE. However, input data for any given input message from the device is limited to fields that are defined in a single DPAGE.

If one or more MID LPAGES are defined, each LPAGE can refer to one or more DPAGES. All DPAGES must be referred to by an LPAGE. When input data is processed as defined by a particular DPAGE, the LPAGE referring to it governs the message editing.

Figure 39 shows a fourth level of linkage that is optionally available to allow selection of the MID based on which MOD LPAGE is displayed when input data is received from the device.

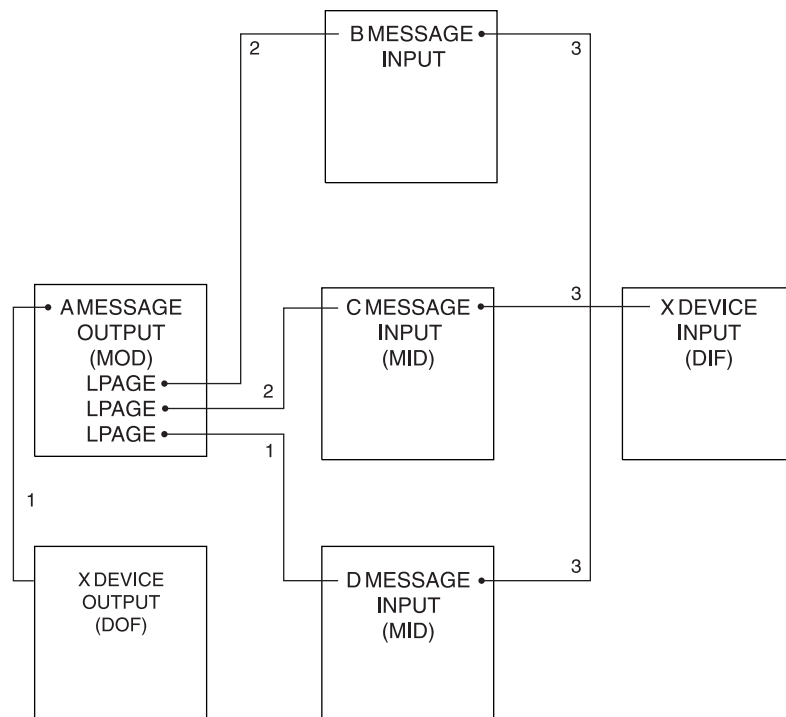


Figure 39. Optional Message Descriptor Linkage

Notes to Figure 39:

1. The next MID name provided with the MSG statement is used if no name is provided with the current LPAGE.
2. If a next MID name is provided with the current LPAGE, input is processed using this name.
3. When the format definition includes 3270 or SLU 2 devices, all MIDs must refer to the same DIF. The same user-provided name must be used to refer to the DOF when the MOD is defined.

Figure 40 summarizes the previously explained MFS control block linkages.

MFS Control Blocks

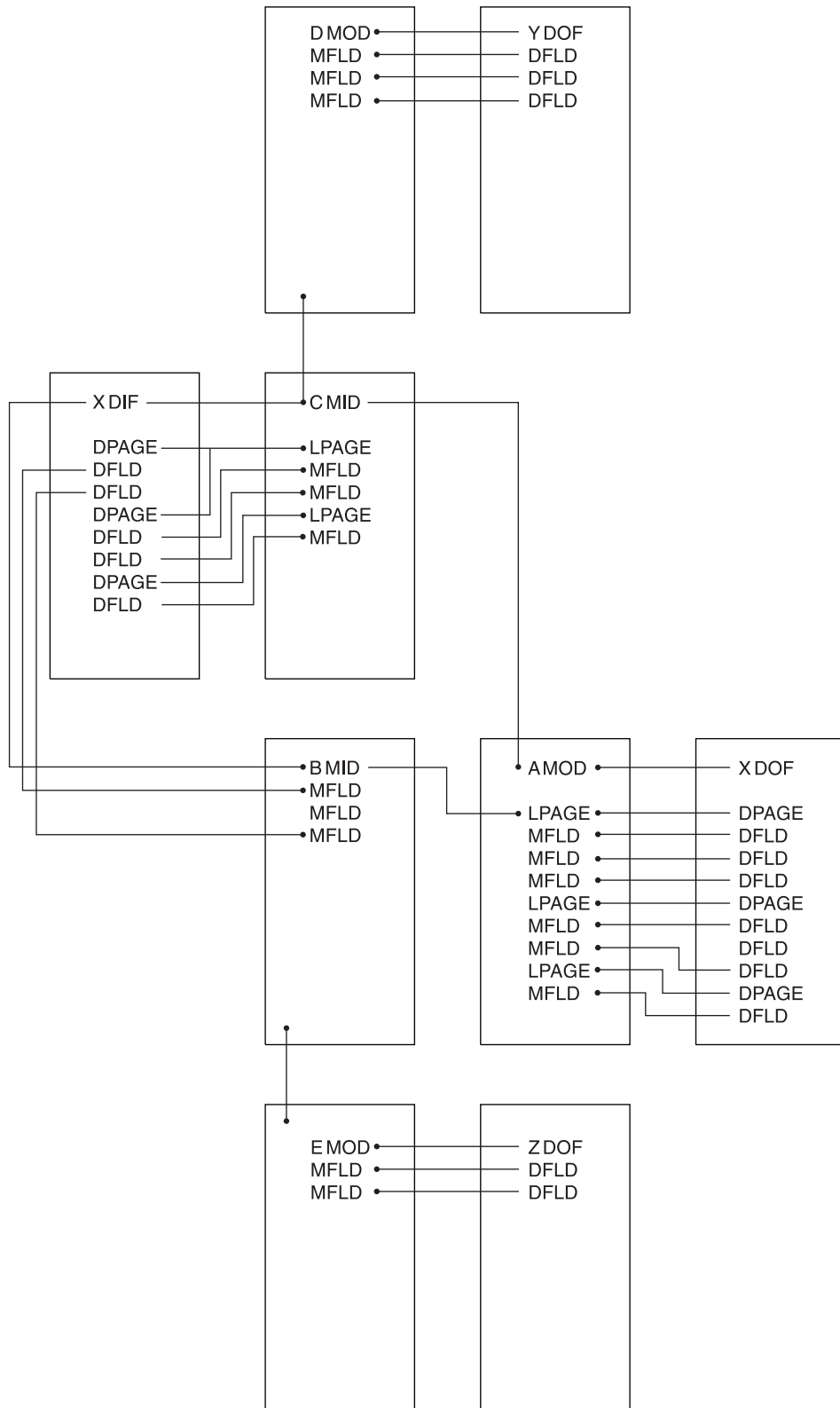


Figure 40. Summary of Control Block Linkages

Control block linkages are fundamental to MFS functions but there are a few device-oriented conditions that could affect application design.

3270 or SLU 2 Display Devices

Because output to these devices establishes fields on the device using hardware capabilities, and field locations cannot be changed by the operator, special linkage restrictions exist. Because formatted input can only occur from a screen formatted by output, the DPAGE and physical page definition used for formatting input is always the same as that used to format the previous output. Control block compilation by the MFS language utility verifies that the MID referenced by the MOD refers to the same FMT name that the MOD references. During online processing, if the DIF corresponding to the previous DOF cannot be fetched, an error message is sent to the display.

3290 Information Panel in Partitioned Format Mode

The screen of the 3290 can be divided into several rectangular areas called *partitions*. Depending on LPAGE/DPAGE selection, each logical page of an output message is sent to the partition specified on the DPAGE statement.

When the 3290 is operating in partitioned mode, the usual control block linkages are in effect. There are, however, additional functions, because the logical pages described in the MOD can be sent to different partitions. The partition descriptor block (PDB) is a type of intermediate text block (ITB). The PDB describes the set of partitions that can appear on the screen in response to a single output message. Among other things, the PDB contains one partition definition statement coded with a partition descriptor (PD) for each partition. Taken together, the PDs define a *partition set*.

The linkages work as follows:

1. A MOD is requested for a particular message. The MOD names an FMT and becomes associated with the appropriate DEV statement—in this case, the DEV statement for the 3290. A DOF is created to format the 3290 for the message.
2. The DEV statement itself names a PDB. Thus the MOD is linked to the DOF, which in turn links to the PDB through the DEV statement for the 3290. This linkage gives the logical pages of the MOD (defined by the LPAGE statements) access to the PDs in the PDB.
3. Each LPAGE statement in the MOD names a DPAGE statement in the DOF.
4. For the 3290 with partitioning, a DPAGE statement contains a PD keyword, which identifies one of the partition descriptors in the PDB.

Because of this linkage, each logical page is associated with its appropriate partition that is described by a partition descriptor. When the logical page is retrieved from the message queue, it is sent to that partition.

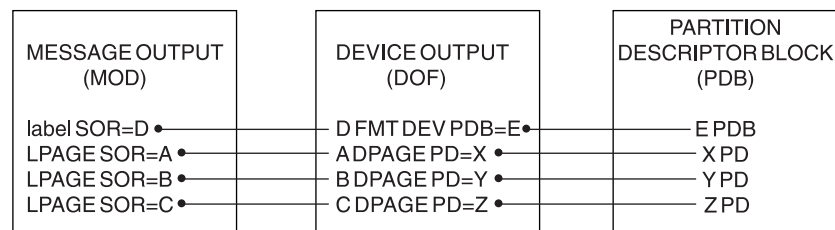


Figure 41. Linkages in Partitioned Format Mode

MFS Control Blocks

274X, Finance, 3770, SLU 1, NTO, or SLU P

Because no hardware-established field capabilities exist, no correlation is necessary between output fields and input fields on these devices. Operator input or the user-written program in the Finance or SLU P workstation controller can determine which FMT is used (by specifying a MID name) and which DPAGE within the FMT is used (by the COND= specification for the DPAGE).

Finance or SLU P Workstations

Because of the asynchronous capabilities of the Finance and SLU P workstations, MFS cannot automatically maintain the chain between the MOD and the MID. Therefore the MID name is sent to the device in the output message header. The chain can be maintained, transparent to the operator, if the user-written application program in the remote controller returns the MID name in the input message header.

ISC Subsystem (DPM-Bn)

The NXT=midname that is specified on the MSG TYPE=OUTPUT becomes the RDPN on output and, if not changed by the remote program or subsystem, becomes the DPN on input.

Format Library Member Selection

When a message is received as input or prepared for output, the DIF or DOF is selected on the basis of the user-provided name from the message descriptor and the device type and features of the terminal.

The MFS language utility constructs the member name of each DIF and DOF in the IMS.FORMAT library from the FMT label and the DEV TYPE= and FEAT= specifications as follows:

Byte Contents

- 1 Device type indicator (hexadecimal). For a list of device types by indicator, see Table 46
- 2 Device feature indicator (hexadecimal). For a list of indicators by feature, see Table 47 on page 202.
- 3 If DOF, first character of label provided in the FMT statement. If DIF, first character of label provided in the FMT statement **converted to lowercase**.
- 4-8 Remaining characters from the label of the FMT statement.

For byte 1 of the DEV specification FMT=, the device type indicators are as listed in Table 46.

Table 46. Device Type Indicators for FMT=

Device Feature	Indicator (Hex)
SLU 2, Model 1 display	00
3284-1 or 3286-1 printer	01
3277, or SLU 2, Model 2 display	02
3284-2 or 3286-2 printer	03
3604-1 or 2 (FIDS)	05
3604-3 (FIDS3)	06

Table 46. Device Type Indicators for FMT= (continued)

Device Feature	Indicator (Hex)
3604-4 (FIDS4)	07
3600 (FIN)	08
3610, 3612 journal printer (FIJP)	09
3611, 3612 passbook printer (FIPB)	0A
3618 administrative printer (FIFP)	0B
SCS1: 3770; NTO; and SLU 1 (print data set)	0C
SCS2: 3521 card punch, 3501 card reader, 2502 card reader, and SLU 1 (transmit data set),	0D
3604-7 (FIDS7)	0E
DPM-A1 through DPM-A15, respectively	11 through 1F
DPM-B1 through DPM-B15, respectively	21 through 2F
3270-A1 through 3270-A15, respectively	41 through 4F

Recommendation: You should define device formats for each device type expected to receive a given message. If the MOD or the DOF with the required device type and feature specification cannot be located during online execution, the IMS error default format (containing an error message) is used to display the output message. If the MID or the DIF with the required device type and feature specification cannot be located, input is ignored and an error message is sent to the device that entered it.

However, it is possible to use the same format for a variety of specific devices. Formats defined as TYPE=3270,2 with FEAT=IGNORE specified, can be used as default formats for users of the following devices:

- 3275
- 3276, models 2/3/4
- 3277, model 2
- 3278, models 2/3/4
- 3279, models 2/3

To define the terminal to IMS, you must specify TYPE=3270-An with SIZE=(n,80), where n≥24.

Restriction: The IGNORE feature is not supported in MFSTEST mode.

The terminal must be defined to IMS as TYPE=3270,2 or MFS searches for a block with the exact TYPE and FEAT specification, and if one is not found, MFS searches for the default TYPE=3270,2 with FEAT=IGNORE.

Another level of defaulting occurs for ETO terminals prior to the already described defaulting. If an ETO terminal is defined with a screen size of 12x40 or 24x80 in the VTAM PSERVIC information, and that format block is not found, an additional search is made for a format of the same name using TYPE=3270,1 (12x40) or TYPE=3270,2 (24x80) and using the same features. If that search is unsuccessful, the already described default search is performed. This new default search is also used when in MFSTEST mode, whereas the old default search is not.

Format Library Member Selection

Device format selection is based upon the features of the destination terminal as defined at IMS system definition. If feature selection is used, a device format must be created for every combination of features in the system that can receive a message using feature selection. Feature selection is performed based on the specification of the message descriptor (MOD or MID). If the IGNORE option is specified on the MOD, device formats must be created with the IGNORE feature option to ensure proper operation.

Because the screen size for 3270 or SLU 2 devices, other than 3270 model 1 or 2, is specified during IMS system definition, an IMS system definition must be performed before execution of the MFS language utility for user-defined formats.

Use feature selection when devices with different feature combinations are to receive or enter a message and the special features of each device are to be used.

Example: An operator at a device with program function keys can enter a literal in a field using a program function key, and another operator at a device without program function keys can enter the same literal by typing it in a field on the screen. To the application program, these literals are the same. To the application program, the following input devices can enter messages that can look identical regardless of how they were entered:

- Device Features
- Print Line 120
- Print Line 126
- Print Line 132
- Data Entry Keyboard
- Program Function Keys
- Selector Light Pen Detect
- Magnetic Card Reading Devices (OICR and MSR)
- Dual Platen
- User-defined features for the 3270, SCS1, and SCS2 devices and DPM programs

Use the device feature indicator values listed in Table 47 for byte 2 of the DEV FEAT= specification:

Table 47. Example of Device Feature Indicator Values

Device Feature	Indicator (Hex)
P.L. 120 (Print Line 120)	40
P.L. 126	50
P.L. 132	60
DEK (data entry keyboard)	C8
PFK (program function keys)	C4
SLPD (selector light pen detect)	C2
OICR/MSR (magnetic card reading devices)	C1
IGNORE	7F
DEK,SLPD	4A
DEK,OICR	C9
DEK,SLPD,OICR	4B

Table 47. Example of Device Feature Indicator Values (continued)

Device Feature	Indicator (Hex)
PFK,SLPD	C6
PFK,OICR	C5
PFK,SLPD,OICR	C7
SLPD,OICR	C3
DUAL (dual platen)	C1
P.L. 132,DUAL	61
No features (3270)	40
3270,3270P,3770,SLU 1, SLU 2, SLU P,ISC (User-defined features)	Indicators available for definition: 1. 01 2. 02 3. 03 4. 04 5. 05 6. 06 7. 07 8. 08 9. 09 10. 0A

3270 or SLU 2 Screen Formatting

MFS is designed to transmit only required data to and from the 3270 display device. Device orders to establish fields and display literals can cause significant transmission time—there can be more orders and literal data than program data. Under normal operation, when the format to be displayed already exists on a device, only user-supplied data from the message and modifiable field attributes are transmitted. The current format on the device is determined by the device output format name, the DPAGE within the format, and the physical page within the DPAGE. The following conditions cause MFS to perform a full format operation (device buffer erased and all fields and literals are transmitted) for device output:

- The device output format changes.
- The DPAGE changes within a device output format.
- The physical page number changes.
- The operator presses the CLEAR key.
- The operator presses the CLEAR PARTITION key, which causes a full format write to the cleared partition.
- DSCA option of the DEV statement requests format write.
- SCA field in the output message requests format write.
- The MFS bypass has been used.
- Terminal has been stopped as a result of a permanent I/O error.⁵
- The operator uses the operator identification card reader.⁵

5. The screen is cleared and the next output is a full format operation.

3270 or SLU 2 Screen Formatting

A full format operation must be carefully planned. Several factors can result in undesirable screen displays, program input, or both:

1. If the program depends upon the existence of data in nonliteral fields and does not include this data in the output message, the data might not be on the screen when the device receives the output message. Several actions can cause this to occur:
 - The terminal operator pressing the CLEAR key
 - A device error
 - Another message sent to the device before the response
 - An IMS restart

This dependency also makes the application 3270 device-dependent.

2. If the program sends only part of an output field, data that already exists in the nonliteral fields can cause confusion. If a partial field is transmitted to a filled-in field, any modification of the field causes the old data remaining in the field to be included in the new input. Use the PT (program tab X'05') as a fill character on the DPAGE statement to solve this problem. If the PT fill character is specified, message data fields (and message literal fields) that are to be transmitted are followed by a program tab order if the data does not fill the device field. This clears the remainder of the device field to nulls.

When a program sends only a few of the output data fields on a given display screen, it might be desirable to clear all the unprotected filled-in fields first. The unprotected fields can be cleared by specifying the “erase all unprotected” option in the application program output with the system control area (SCA) operand of the MFLD statement or the default SCA (DSCA) operand of the DEV statement.

3. Premodified attributes can be requested by the application program to ensure input of field data. If premodified attributes are requested and the message was completely transmitted to the device and not operator logically paged, then a device error, or IMS restart, prevents input. This error occurs because the screen is not reestablished with the message when the terminal is started or IMS is restarted.
4. If dynamic attribute modification is specified for a device field with predefined attributes, an attribute is sent to the device for that field in every output operation, even if the data for this device field is not included in the output message. These attributes are used:
 - If the output message field has an attribute and the attribute is valid, then the dynamic attribute modification is performed.
 - If the message field is not included in the LPAGE being used or the attribute is not valid, the predefined attribute for the device field is used.

Recommendation: For application design, you should:

1. Use a common device format for as many applications as possible. Reducing the number of full format operations can significantly reduce response time. Format block pool requirements are reduced as well as message format buffer pool I/O activity.
2. Allow MFS to determine when a format operation is required. This results in transmission time savings when formatting is not required.
3. Ensure that the application program output message contains all nonliteral data required by the device operator. Do not rely on previous data remaining on the device.
4. Use the PT fill option to ensure that fields on the device that receive program output data contain only data from the message.

5. Use the erase all unprotected option of the SCA or DSCA if the application requires that unprotected fields be cleared.

Two MFS facilities are available for controlling format operations. Both the system control area (SCA) of the message field and the default SCA (DSCA) option of the DEV statement provide the ability to cause IMS to force a reformat or to erase all unprotected fields or all partitions before transmitting output. The force format write option causes the device buffer to be erased, all fields to be established, and all literals to be transmitted. The erase all option causes all unprotected fields or all partitions to be cleared to NULLs before data is written. For more information, see "System Control Area (SCA) and Default SCA (DSCA)" on page 151.

3290 Screen Formatting

A 3290 screen can be divided into several independent areas, called *logical units* (LUs). Each LU can be in base state or formatted state. If it is in formatted state, the LU can be in standard or *partitioned* format mode. Descriptions of 3290 screen formatting follow.

Screen Division

The 3290 has a large screen, which allows the display of up to 62 rows by 160 columns for small character cells (6 × 12 pels), and up to 50 rows by 106 columns for large character cells (9 × 15 pels).

The 3290 screen can be divided into several areas, each of which interacts independently with the operator. This can be done in two ways:

- By dividing the screen into separate LUs
- By dividing a logical unit into separate partitions

In the first case, the 3290 terminal and its screen can be defined as up to four separate LUs. Each LU is independent of the others, and is defined to IMS as a separate terminal with its own address. This support is transparent to IMS. Defining multiple LUs is useful if the IMS application calls for more than one input or output message (or both) to be concurrently active between the 3290 terminal and IMS. For each logical unit, however, only one input or output message can be active.

In addition, with software partitioning, each logical unit can be divided into as many as 16 partitions. Each application message can specify a set of partitions, and each logical page of the message is associated with a particular partition of the partition set. Software partitioning is useful if:

- The operator needs to view more than one logical page at a time.
- One partition is needed to view an output page and another to input data.
- A partition is to be defined to receive IMS system error messages while the logical unit is in formatted mode. This function could be used in place of the current MFS SYSMSG field support.
- Scrolling is desired. Scrolling moves data up and down in the partition viewport. It can be defined only for a 3290 in partitioned mode. With explicit partition scrolling, you can define MFS pages for a presentation space larger than the viewport on the physical screen. This reduces the number of interactions between IMS and the terminal that must occur to display the message.

The 3290 allows a maximum of 16 partitions per physical device. Also, each LU defined in partitioned state must have available to it a minimum of 8 partitions, no matter how many partitions are actually defined for it. Thus, if one LU is defined with 9 partitions, no other LU can be in partitioned state, because there are only 7

3270 or SLU 2 Screen Formatting

partitions left for the physical device. Consequently, no more than 2 LUs (of the maximum 4 allowed) can be in partitioned state.

The following considerations also apply to defining partitions:

- Partitions must be rectangular.
- A single input message is constructed from one physical page of a single partition unless Multiple Physical Page Input is used. If it is used, then multiple physical pages for a single input message must come from a single partition.
- If the current PDB does not define a partition for system messages, and if the DOF does not define a system message field, then a system message destroys the current partitioned format mode and the 3290 (or the particular LU in question) returns to standard format mode.

Terminal States and Modes

The 3290 as a single LU, or any of the LUs into which it has been divided, can be in terminal base state or terminal formatted state.

In terminal base state, the 3290 operates in the same way as any other currently supported SLU 2 node when it is initially connected to IMS or when the clear key has been pressed. In this state, input messages to IMS are edited with basic edit, and output messages without an associated MOD are formatted using the default MFS MOD.

In terminal formatted state, the 3290 can be in:

- Standard format mode
- Partitioned format mode

The choice of format mode is made dynamically at the time of message output. The output message is associated with a MOD, which in turn names a DOF. The specifications in the DOF determine the 3290 format mode:

- The 3290 is in standard format mode if the DOF does not name a partition descriptor block (PDB). The terminal is then formatted and operated as an ordinary SLU 2 node.
- The 3290 is in partitioned format mode if the DOF names a partition descriptor block (PDB).

Partition Set Initialization, Paging, and Activation

If the 3290 (or any of the LUs into which it can be divided) is in partitioned format mode, there are various ways in which:

- The partitions are initialized with one or more logical pages from the output message.
- The operator subsequently controls the flow of logical pages to the partitions.
- One particular partition becomes the *active partition*.

Initialization and operator-controlled paging are determined by selecting one of the three options. The option is specified by the PAGINGOP operand of the PDB.

According to the selected option, initialization can consist of:

1. The message's first logical page going to the appropriate partition
2. The message's initial logical pages going to their appropriate partitions until the second logical page of any partition is reached
3. Each partition receiving its first appropriate logical page

The option also determines whether operator-controlled paging is affected, depending on which partition is active.

When the 3290 enters partitioned format mode, one particular partition is the *active* partition. This is determined in one of two ways:

- Logical pages are routed to their partitions using DPAGE statements. An ACTVPID operand might have been specified on one of the DPAGEs that points to an initialized partition. The ACTVPID allows the application program to declare which partition is the active partition.
- If no ACTVPID keywords are encountered, the active partition is the partition defined by the first PD statement in the PDB.

The active partition can be a partition that has not initially received any data.

For more details about initialization, paging, and activation, see “3290 in Partitioned Format Mode” on page 185.

3180 Screen Formatting

Like the 3290, the 3180 terminal is supported by IMS as an SLU 2 device. Partitioning and scrolling support for the 3180 is similar to what is provided for the 3290.

Exceptions: For the 3180:

- Only one partition with specific size limits can be defined. (For the 3290, multiple partitions of various sizes can be defined.)
- Logical unit display screen size and viewport location cannot be specified in picture elements (pels). (The 3290 supports pels.)
- You cannot specify an active partition. (For the 3290, active partitions can be specified.)

These restrictions apply only if you want the 3180 screen size when it is connected to IMS to differ from the 3180 screen size when it is connected to other subsystems. If no change is required, then the 3180 customer set up installation instructions can be used and no special IMS code is necessary.

Device Compatibility with Previous Versions of MFS

If you choose not to define 3270 devices during IMS system definition using the device type symbolic name (option 1), no changes to device format definitions are needed.

If you choose to define 3270 devices during IMS system definition using a device type symbolic name (3270-An) (options 2, 3, and 4), in some cases you must make changes in your 3270 device format definitions.

The examples in Table 48 include the recommended standard for relating the device type symbolic name to the screen size:

Table 48. MFS Device Definition Compatibility for 3270 Devices

Device and Screen Size	Device and Screen Size ¹	New IMS System Definition ¹
3275 or 3277 (12X40)	MFS: DEV TYPE= (3270,1) Model 1	MFS: DEV TYPE= 3270-A5 ₂₄
3275, 3276, 3277, 3278 (24X80)	MFS: DEV TYPE= (3270,2) Model 2	MFS: DEV TYPE= 3270-A2 ₂₄
3276, 3278 (12X80)	MFS: DEV TYPE= (3270,1) Model 1	MFS: DEV TYPE= 3270-A1 ₂₃

Device Compatibility

Table 48. MFS Device Definition Compatibility for 3270 Devices (continued)

Device and Screen Size	Device and Screen Size ¹	New IMS System Definition ¹
3276, 3278 (32X80)	MFS: DEV TYPE= (3270,2) Model 2	MFS: DEV TYPE= 3270-A3 ²³
3276, 3278 (43X80)	MFS: DEV TYPE= (3270,2) Model 2	MFS: DEV TYPE= 3270-A4 ²³
3278 (27X132)	MFS: DEV TYPE= (3270,2) Model 2	MFS: DEV TYPE= 3270-A7 ²³

Notes:

1. For screen sizes specified in type or terminal macro.
2. If the format will be used on the new device and will not be used on the old device, change TYPE= (3270,1) or (3270,2) to 3270-An with the corresponding screen size, and recompile.
3. See option 3 in Table 49.
4. See option 4 in Table 49.

Table 49 lists the advantages and disadvantages of selecting a specific option for the larger screen device and the required action if you choose to use existing device formats.

Table 49. Advantages and Disadvantages of Larger Screen Device

Option	Advantage	Disadvantage	Conversion Action Required
1	You can use existing MFS formats unchanged.	You cannot use full screen.	No (Use current formats as shown in Table 48.)
2	You can use full screen.	You must design new device formats.	No (Define new formats.)
3	You can use existing formats as a migration path on the new screen device and you can gradually replace them with new device formats.	You must modify existing device formats to use the device symbolic name.	Yes (Refer to Table 48.)
4	Consistency in definition for current and new screen sizes.	You must modify all formats.	Yes (Refer to Table 48.)

Using STACK/UNSTACK to Convert MFS Device Formats to Symbolic Name Formats

The IMS MFS language utility's compilation statements STACK and UNSTACK can be used to convert existing MFS 3270 device formats to the user-defined device type symbolic name formats. The STACK statement is used to delineate one or more SYSIN or SYSLIB records, and to request that those records, once processed, be kept in storage for use at a later time. The UNSTACK statement requests retrieval of a previously processed stack of SYSIN/SYSLIB records.

Example: With the following existing 3270 format definition:

```

label  FMT
        DEV      TYPE=(3270,2), ...
        DIV      TYPE=INOUT
        DPAGE    CURSOR=((2,3))
label  DFLD
label  DFLD
label  DFLD
        FMTEND

```

You can create a user-defined device type symbolic name (using TYPE=3270-An) format for the large screened display devices by using the DEV statement and the compilation statements STACK and UNSTACK as follows:

```

label  FMT
        DEV      TYPE=3270,2,...
        STACK    ON
        DIV      TYPE=INOUT
        DPAGE    CURSOR=((1,2))
label  DFLD
label  DFLD
label  DFLD
        STACK    OFF
        DEV      TYPE=3270-A2,...
        UNSTACK
        FMTEND

```

The UNSTACK statement causes the statements between STACK ON and STACK OFF to be duplicated. In addition to the 3270 model 2 device format, a device format is created for the 3270-A2, which has the same device layout as the 3270 model 2.

3270 Device Format Conversion Example

This example is provided to clarify Table 48 on page 207. Assume that the installation has 3270 model 1 and model 2 display devices and has installed additional display devices with 12x80, 24x80, 32x80, and 43x80 screen sizes. A new IMS system definition was performed for the additional devices, and the 3270 model 1 and model 2 devices were redefined to specify the device symbolic name.

The IMS system definition specifications for these 3270 displays were as follows:

- TYPE=3270-A1, SIZE=(12x80) for the additional devices with 12x80 screen size.
- TYPE=3270-A2, SIZE=(24x80) for the 3270 model 2 and additional devices with 24x80 screen size.
- TYPE=3270-A3, SIZE=(32x80) for the additional devices with 32x80 screen size.
- TYPE=3270-A4, SIZE=(43x80) for the additional devices with 43x80 screen size.
- TYPE=3270-A5, SIZE=(12x40) for the 3270 model 1 device.

The following MFS changes were required to convert existing 3270 model 1 and 2 device format definitions for use on the 3270 model 1, model 2, and on the additional devices:

Existing Definitions:

Device Format Conversion

```

label  FMT
        DEV      TYPE=(3270,1)
        DIV      TYPE=INOUT
        DPAGE
label  DFLD
label  DFLD
label  DFLD
        DEV      TYPE=(3270,2)
        DIV      TYPE=INOUT
        DPAGE
label  DFLD
label  DFLD
label  DFLD
        FMTEND

```

Changes Applied and Recompiled:

```

label  FMT
        DEV      TYPE=3270-A5 (changed from (3270,1) to 3270
                                display with 12x40 screen size)
        STACK ON
        DIV      TYPE=INOUT
        DPAGE
label  DFLD
label  DFLD
label  DFLD
        STACK OFF
        DEV TYPE=3270-A1 (3270 display with 12x80 screen
                                size)
        UNSTACK
        DEV TYPE=3270-A2 (changed from (3270,2) to 3270
                                display with 24x80 screen size)
        STACK ON
        DIV      TYPE=INOUT
        DPAGE
label  DFLD
label  DFLD
label  DFLD
        STACK OFF
        DEV TYPE=3270-A3(3270 display with 32x80 screen
                                size)
        UNSTACK ,KEEP
        DEV TYPE=3270-A4(3270 display with 43x80 screen
                                size)
        UNSTACK
        FMTEND

```

After the changes are applied and recompiled, the new device formats are designed to take advantage of each screen size, and the previous format definition can be compiled again as follows:

```

label  FMT
        DEV      TYPE=3270-A5
        DIV      TYPE=INOUT
        DPAGE
label  DFLD      ...
label  DFLD      ...
label  DFLD      ...
label  DFLD      ... (existing device fields
                using 12x40 screen size)
        DEV      TYPE=3270-A1
        DPAGE
label  DFLD      ... (new device fields using
                12x80 screen size)
        .
label  DFLD      ...
        DEV      TYPE=3270-A2
        DIV      TYPE=INOUT
        DPAGE
label  DFLD      ... (existing device fields
                using 24x80 screen size)
label  DFLD      ...
label  DFLD      ...
        DEV      TYPE=3270-A3
        DIV      TYPE=INOUT
        DPAGE
label  DFLD      ... (new device fields using
                32x80 screen size)
        .
label  DFLD      ...
        DEV      TYPE=3270-A4
        DIV      TYPE=INOUT
        DPAGE
label  DFLD      ... (new device fields using
                43x80 screen size)
        .
label  DFLD      ...
        FMTEND

```

3270 Printer and SLU 1 Compatibility

To use the extended attributes of color, highlighting, and programmed symbols, or to use the set vertical format or set line density data streams, you might need to modify your application programs.

Additional 3270 printer devices attached to a non-SNA control unit compatible with the currently installed 3270 printer devices use the existing 3270P model 1 or model 2 device formats. For the printer buffer, they use the existing IMS system definition with 480 characters (current model 1) or 1920 characters (current model 2).

MFS users choosing to change device attachment to SLU 1 must change their MFS device format definitions as shown in Table 50 on page 212. Table 50 on page 212 lists the current device, the MFS device type, new control units, system definitions, and MFS device types, and the z/OS changes required.

3270/SLU1 Compatibility

Table 50. MFS Device Definition Compatibility for 3270 Printers and SLU 1 Devices

Current Device	Current MFS DEV TYPE	New Device or Control Unit	New IMS System Definition	New MFS DEV TYPE	z/OS Changes Required
3284/3286	3270P	3827/3289 attached to a 3274 or 3276 SNA control unit	SLUTYPE1	SCS1	See Note

Note:

Change DEV TYPE=(3270P,n) to DEV TYPE=SCS1 and recompile. Or, if all printers are not changed to the new device or control unit, add the following after DEV TYPE=3270P and recompile:

```
STACK ON
(3270P DPAGE, DFLD statements)
STACK OFF
DEV TYPE=SCS1
UNSTACK
```

SLU P Compatibility

Application programs written for other MFS-supported devices can execute unchanged with SLU P (DPM-An) devices once the DIFs and DOFs appropriate for the DPM devices are defined. Changes might be required if the program depends on unique device-dependent features such as premodified fields on a 3270 display. The program would execute unchanged only if the premodified fields presented to the remote program are returned in the input message. This requires that the remote program properly interpret the attribute bytes of the output message field and handle the indicated device function in a way that satisfies the requirements of the IMS application program.

Existing IMS application programs that do not use MFS might have to be changed to adjust to the appropriate 3600 or 3790 buffer size and to ensure that message text is a compatible subset of the SCS character string.

IBM 3278-52/3283-52 and IBM 5550 Family (as 3270) Compatibility

The message format definitions for the IBM 3278-52/3283-52 are upwardly compatible. However, message formats created with Kanji functions for the 5550 family of devices cannot be used on the IBM 3278-52/3283-52.

Existing 3270 and IBM 5550 Family (as 3270) Compatibility

Note the following when adding field outlining and input control specifications to existing 3270 and 3278-52/3283-52 message formats:

- Field outlining
 - For the 3270 display, left line, right line, overline, and underline do not take up a position in the user field. The application program does not have to be modified unless dynamic modification of extended attributes is performed.
 - For the SCS1 printer, MFS reserves print positions for left and right lines. If a field starts from the leftmost column or ends at the rightmost column, the left or right line is not printed correctly because room is not available. To correct this, modify the application program to truncate 1 byte. If two adjacent fields are logically one and the overline and underline should connect, the application program does not have to be modified.

In either case, for dynamic modification, the application program must be modified.

- DBCS/EBCDIC mixed fields
 - For 3270 displays, the SO/SI control characters take up 1 byte on the screen. This means that the length on the display is equal to the message format length. Therefore, the existing application program does not have to be changed.

When assigning DBCS/EBCDIC mixed data to an existing EBCDIC field, the application program must check that the SO and SI are paired, that the EGCS data is of even length, and that neither the SO nor SI is truncated when the MFLD is mapped to the DFLD.
 - For SCS1 printers, MIX/MIXS must be specified when using DBCS/EBCDIC mixed data. In this case, the message length and the length of the output differ and the application program must modify the MFLD according to each field's characteristics.

Performance Factors

The design of message and device formats usually has only a minor effect on the time or resources required to edit a message. It can, however, have a considerable effect on transmission and response time. The considerations discussed in this section affect performance.

All MFS-Supported Devices

The IMS /DISPLAY POOL command can be used to evaluate the message format buffer pool operation. The objective should be to reduce the value of:

I/O+DI (The sum of the numbers of fetch
REQ1 I/O operations and directory I/O operations
divided by the number of block requests from
the pool.)

To reduce this value, do one or more of the following:

- Reduce format block I/O. The most significant and tunable portions of MFS processing cost are the CPU cycles and channel/device time required to read format blocks. To reduce format block I/O, use the following techniques:
 - Evaluate and implement \$\$IMSDIR, the optional MFS index directory. Index the selected MFS control blocks based on how frequently they are used. In most cases, using \$\$IMSDIR eliminates one read per format block during online operation.
 - Increase the size of the MFBP (Message Format Buffer Pool).
 - Increase the number of fetch request elements (FREs).
- Minimize the number of segments. Messages should be segmented for application program convenience or to meet segment size restrictions. Segment processing in MFS and DL/I requires a considerable number of CPU cycles, so do not segment unnecessarily.
- Use option 2 input. In some cases, the application input can be segmented so that no device input can be presented for segments under certain conditions. In such cases, option 2 input messages reduce processing time slightly and reduce IMS message queue space requirements.
- Use option 3 input. Option 3 input can provide better performance than option 1 or 2 if many fields are defined, but only a few fields are received on input. Additional buffer pool space is required during editing, but message queue space

Performance Factors

requirements are reduced. When most of the defined fields are received on input, option 3 performance is not as good as 1 or 2, either in processing time or in message queue space.

For an explanation of input message formatting options, see “Input Message Formatting Options” on page 126.

- Combine multiple DFLD literals. When multiple DFLD literals are positioned at adjacent or nearly adjacent device field locations, consideration should be given to combining the literals in fewer DFLD literal definitions. The only limitation to the number of literals combined is the maximum DFLD literal length. Combining DFLD literals reduces block size, reducing MFS processing time and, for 3270 or SLU 2 display devices, reducing transmission time.
- Do not define DFLDs that are not referred to by any MSG descriptor. Such DFLDs occupy block space and, if used extensively, could adversely affect MFS processing time.
- Combine output message fields if appropriate. Where multiple, contiguous, output message fields of a segment map to contiguous device fields of the same relative length, consider combining both the message fields and the device fields so that a single message field maps to a single device field. The greatest potential advantage is in those situations where only one blank separates the displayed fields, and message data is always present and equal to the device field length.

Combining message fields is not recommended, however, in cases where an additional formatting burden would be placed upon the application program.

- Do not define duplicate formats. If duplicate libraries exist in the concatenated libraries, there is no guarantee that the copy from the first library will be fetched.
- Do not define separate formats for simple input. Most MFS device formats should include some user input fields that allow the operator to enter any simple transaction or command, related or not related to the application for which the format was designed. Any format requires four control blocks, and formats designed specially for simple input should not be defined unnecessarily.

3270 or SLU 2 Display Devices

To enhance system performance when using 3270 or SLU 2 display devices, you can do the following:

- Use preformatted screens. This is the most significant performance consideration for MFS when 3270 or SLU 2 display devices are used. Significant amounts of data are usually required to define fields and establish literals on a screen. These field definitions and literals do not always have to be transmitted (see “3270 or SLU 2 Screen Formatting” on page 203). If the format on the device can be used, transmission time for remote terminals can be reduced up to 50 percent.
- Pad message output with nulls. The use of the FILL=NULL or PT option in the DPAGE statement reduces the amount of data transmitted to the device and the amount of processing required to format the output.
- Reduce mixed-mode operations. A mixed mode operation occurs when the selector light pen is used on an immediately detectable field and other fields on the device are modified. The mixed mode operation requires multiple I/O operations that increase response time, line utilization, and processing time. In addition, the resulting message contains the same data as would be produced by the enter key except for the indication that the selector pen was used.
- Use paging requests. Where application design permits, the PA1 (program access key 1) page advance facility should be used instead of operator entry of a

logical page request. The PA1 facility requires less operator action and less communication line time, and does not require input editing before page request processing.

- Define the length of a literal DFLD followed by a nonliteral DFLD to include space between the last significant literal character and the position preceding the attribute position of the nonliteral field. This action can reduce block size and character transmission but should only be considered when the separating space is between two and five characters.
- Increase the length of DFLDs with the PROTECT attribute. When a nonliteral DFLD is defined with the PROTECT attribute, separated from the next device field by two or more blanks, and is expected to receive output data, consider increasing its length. The output data can originate from an application program, a /FORMAT command, or an MFLD literal. Multiple MODs can be used to map message data to the DFLD. Increasing DFLD length should reduce character transmission unless character fill (FILL=C' ') is specified. Specifying FILL=C' ' is not recommended.
- Minimize the use of the CLEAR key. Advise terminal operators not to use the CLEAR key unnecessarily. In addition, explain to terminal operators the proper use of other function keys such as the ERASE INPUT and ERASE EOF.
Design screen formats with the objective of minimizing the use of the CLEAR key. Allow simple input from a formatted screen. To provide for this capability, establish the same device field location of all formatted screens as the standard device field for simple input. Enforce this standard for all format definitions.
Decreasing CLEAR key usage can improve response time and use communication lines more effectively.

3270 or SLU 2 Devices with Large Screens

In addition to the performance factors listed in this section, the following performance factors apply only to large-screen devices:

- If pages are combined for display on large screens, operator paging is reduced proportionally to the reduction of number of pages. If the OUTBUF keyword of the IMS system definition TERMINAL macro or ETO logon descriptor cannot specify the amount of data for an entire page, more than one VTAM SEND is required to send the page.

Related Reading: For more information on ETO, see *IMS Version 9: Administration Guide: Transaction Manager*.

- For remote BTAM 3270s, IMS sends a maximum of 4 KB of data in one transmission. For local 3270s and remote VTAM 3270s, IMS sends the entire message in one transmission. These facts and the line error rate should be considered when designing support for large-screen devices.

SLU P and ISC Subsystems with DPM

If OPTIONS=PPAGE is specified in the DIV statement, the set of fields in a PPAGE (presentation page) is transmitted together in one or more records. Additional presentation pages are sent on request of the remote program or ISC subsystem for demand paging. This level of paging is the simplest for the remote program or ISC subsystem to process but imposes the most burden on IMS processing time.

If OPTIONS=DPAGE is specified, all fields within a logical page are transmitted together in one or more records. Additional logical pages are sent on request of the remote program or ISC subsystem for demand paging. This level of paging makes it

Performance Factors

more difficult for the remote program or ISC subsystem to process the data if more than one presentation page is included, but imposes less burden on IMS processing time.

If `OPTIONS=MSG` is specified, all the data within a message is sent together and no paging is performed. This technique might require more processing and logic in the remote program or ISC subsystem but is the best for IMS performance if all pages are actually used by the remote program or ISC subsystem. If many pages are not used by the remote program or ISC subsystem, this option results in unnecessary line traffic and IMS processing.

If autopage is specified (SCA byte 1, bit 5) and option `PPAGE` or `DPAGE` is desired for `DPM-Bn`, all data within the message is sent and no demand paging is performed.

The `RCD` statement can be used to influence the placement of fields within records. The `DFLD` that follows the `RCD` statement begins in the first user data location of a new record. Fields can be placed in records so that no field spans a record boundary, or so that logically related fields appear together in the same record.

Restriction: For ISC subsystems, fields cannot span records.

Use of the `RCD` statement to set record boundaries can reduce transmission time and IMS processing time only if records of maximum length are created. If field placement into records is controlled using the `RCDCTL` specification only, the `SPAN` option causes the minimum number of records to be sent to the remote program. Use of `SPAN` requires, however, that the remote program put together the fields that have been split across records.

Loading Programmed Symbol Buffers

If programmed symbol (PS) buffers are desired and if they have not been loaded by another means (for example, a VTAM application), the buffers must be loaded.

Using an Application Program to Determine Whether Programmed Symbol Buffers Are Loaded

The buffers might have been loaded with the desired programmed symbols by a previous user of the device, and this knowledge can save resending the entire programmed symbol data stream. A handwritten log at the device is one method of maintaining the current status of the programmed symbol buffers for subsequent users.

Another method is a user-written application program that attempts to use the desired programmed symbols. If the desired programmed symbols are already loaded, the output from the application program is successfully displayed at the device. If the programmed symbols are not loaded, the output message is returned to the IMS message queue, the terminal is made inoperable, and a message is sent to the master terminal operator (MTO). The MTO should have a procedure to correct this condition. For example, the MTO could do one of the following:

- Reassign the `LTERM`, assign an `LTERM` that has the correct PS load message, restart the terminal, and then reassign the first `LTERM` back to the terminal.
- If the terminal does not have PS capability, reassign the `LTERM` to one that does.
- If the terminal does not have PS capability, dequeue the rejected message.

Exception: For an SLU 2 terminal, the output rejected was not a response mode reply. In this case, the MTO receives the error message and can try to enter a transaction that would cause the buffers to be loaded.

How to Load Programmed Symbol Buffers

If the operator knows the programmed symbol buffers need loading (because the device was just turned on), the operator should enter a response mode transaction that loads the programmed symbols.

Make available, to all users at the installation, a user-written application program to load the programmed symbols. The first part of the message sent by this application program should be the programmed symbol data stream, and the remainder should be some user data displayed at the device (such as THE PROGRAMMED SYMBOL LOAD FOR *programmed-symbol-name* COMPLETE). The user data displayed at the device informs the terminal operator when the programmed symbols have been loaded. This application program should use the MFS bypass option, because the write structured field (WSF) 3270 command used to send the programmed symbol message is only supported by IMS through the MFS bypass option.

When the programmed symbol buffers that are to be loaded include a printer or a different display, other techniques must be used. Programmed symbol buffer loads are restricted to 3 KB for BSC-attached devices.

Example: The following shows the loading of a programmed symbol buffer using an automated operator interface (AOI) application program.

1. The operator at display A enters a transaction (response or conversational) requesting programmed symbol loads for display A, printer B, and display C.
2. Another AOI transaction assigns LTERMs for printer B and display C, temporarily, to a special PTERM. The AOI program assigns dummy LTERMs to printer B and display C.
3. The AOI program inserts a programmed symbol message to the dummy LTERMs of printer B and display C.
4. The AOI program sends programmed symbol messages to display A.
5. The operator visually verifies messages on both displays and the printer and confirms that the transaction executed correctly.
6. Another AOI transaction reassigns LTERMs to their original status.

Solving Programmed Symbol Load Problems

If a hardware error occurs while a programmed symbol buffer is being loaded, then the following actions occur:

1. The programmed symbol load message is returned to the IMS message queue.
2. The terminal is taken out of service, except for SLU 2 devices when programmed symbols are not available.
3. The error is logged to the IMS log.
4. A message is sent to the IMS master terminal.

Once the hardware error is corrected and the terminal is in service, the programmed symbol load message is re-sent.

If the programmed symbol load failed because of an error in the programmed symbol load message, the operator must:

Performance Factors

1. Dequeue (/DEQ) the message (the master terminal operator might have to issue the /DEQ command).
2. Correct the error.
3. Reenter the transaction to send the programmed symbol load message again.

If a method is available for informing the next user of the programmed symbol buffer status, then the terminals with loaded programmed symbol buffers should not be turned off. When a power failure occurs, or a terminal is turned off, the contents of the programmed symbol buffers are lost.

When a terminal is turned on and no IMS messages are waiting to be sent to the display, load all required programmed symbol buffers using an IMS transaction (or some non-IMS method). However, if IMS messages are waiting to be sent, and these messages require the use of one or more programmed symbol buffers, the sending of the queued messages must be delayed until the programmed symbol buffers can be reloaded. This can be accomplished using response mode transactions to load the programmed symbol buffers.

If the programmed symbol buffers are not loaded and a message that requires a programmed symbol buffer is sent to the terminal, the following actions take place:

- For non-SLU 2 devices, IMS takes the terminal out of service, sends a message to the master terminal, and returns the output message to the message queue.
- For SLU 2 devices, the message is rejected and a sense code is returned to IMS. IMS then:
 - Returns the invalid message to the IMS queue.
 - Logs the error to the IMS log.
 - Sends an error message to the IMS master terminal if the output was a response mode reply, and takes the terminal out of service. If it is not in response mode, the error message is sent to the terminal and it is left in protected mode.

If the user-written application program is designed to queue an unsolicited message requiring a particular programmed symbol load buffer to an LTERM, the first part of the message could include a load programmed symbol data stream; however, this message could not be processed by MFS.

When a message is waiting on the IMS queue for a terminal and requires a programmed symbol that is not loaded, perform one of the following:

- If the terminal is attached by VTAM, load the programmed symbol buffers using a VTAM application.
- If a queued message requires a programmed symbol buffer and it is “normal” user output (for example, the output is not response mode or conversational), then the use of a response mode transaction to load the programmed symbol buffer permits the queued message to be properly displayed. If loading the buffers requires multiple messages, multiple response mode transactions can be used.
- Dequeue (/DEQ) the message (or have the master terminal operator dequeue the message) requiring use of a programmed symbol buffer; enter a transaction to load the programmed symbol buffer required; and then reenter the transaction that originally generated the queued message.
- Temporarily assign the LTERM to which the message is queued to another physical terminal. Load the programmed symbol buffer, then reassign the LTERM to the original physical terminal. The LTERM must be assigned to a terminal that

will not cause a message to be sent (as, for example, a 3270 display or SLUTYPE2 that is in protected screen mode).

MFS Definitions for Intersystem Communication

The following prototype MFS definitions can be used in an intersystem communication (ISC) system between IMS and CICS. In this example:

- CICS can request MFS editing with either 8-byte or 4-byte names.
- Messages from CICS can be multiple-page input or single-page input.
- Output to CICS can be one message of one page or multiple pages with one or more segments.
- Demand paged or autopaged output can be requested of IMS.

These formats can also be used by a 3270 terminal operator who wants to send a message to CICS using an IMS message switch. Or, for example, an IMS message switch can be invoked by a user at a 3270 terminal, the message can be switched to CICS, and a reply is returned from CICS to IMS and then to the 3270 terminal. The routing is handled by MFS.

```

FMTDIS    FMT
          DEV    TYPE=3270-A2,FEAT=IGNORE
          DIV    TYPE=INOUT
DFLDIND1  DFLD   LTH=5,POS=(1,2)
DFLDIND2  DFLD   LTH=100,POS=(1,8)
          FMTEND
FMTDP2    FMT
          DEV    TYPE=DPM-B1,FEAT=IGNORE,
          MODE=RECORD,DSCA=X'00A0'
          DIV    TYPE=OUTPUT,OPTIONS=(MSG,NODNM)
          X
PPAGE1    PPAGE
DFLDOUT1  DFLD   LTH=5
DFLDOUT2  DFLD   LTH=100
          FMTEND
FMTDPM    FMT
          DEV    TYPE=DPM-B1,FEAT=IGNORE,MODE=RECORD
          DIV    TYPE=INPUT,OPTIONS=(DPAGE,NODNM),
          PRN=DFLDINP3,
          RDPN=DFLDINP4,
          RPRN=DFLDINP5
          X
          X
          X
PPAGE2    PPAGE
DFLDINP1  DFLD   LTH=5
DFLDINP2  DFLD   LTH=100
          DIV    TYPE=OUTPUT,OPTIONS=(DPAGE,NODNM)
DPAGE2    DPAGE
DPAGE3    PPAGE
DFLDOUT3  DFLD   LTH=5
DFLDOUT4  DFLD   LTH=100
          DFLD   SCA,LTH=2
          FMTEND
MFSMOD1   MSG    TYPE=OUTPUT,SOR=(FMTDP2,IGNORE),
          NXT=MFSMID1
          X
          SEG
          MFLD   DFLDOUT1,LTH=5
          MFLD   DFLDOUT2,LTH=100
          MSGEND

```

Figure 42. Sample 1—MFS Definition Format

```

MFSMODE2 MSG TYPE=OUTPUT,SOR=(FMTDPM,IGNORE), X
          NXT=MFSMID1
          SEG
          MFLD DFLDOUT3,LTH=5
          MFLD DFLDOUT4,LTH=100
          MFLD (,SCA),LTH=2
          MSGEND
MFSMID1  MSG TYPE=INPUT,SOR=(FMTDPM,IGNORE), X
          NXT=MFSMODD
          SEG
          MFLD DFLDINP1,LTH=5
          MFLD DFLDINP3,LTH=8
          MFLD DFLDINP4,LTH=8
          MFLD DFLDINP5,LTH=8
          MFLD DFLDINP2,LTH=100
          MSGEND
MFSMIDD  MSG TYPE=INPUT,SOR=(FMTDIS,IGNORE), X
          NXT=MFSMOD1
          SEG
          MFLD DFLDIND1,LTH=5
          MFLD DFLDIND2,LTH=100
          MSGEND
MFSMODD  MSG TYPE=INPUT,SOR=(FMTDIS,IGNORE),
          NXT=MFSMIDD
          SEG
          MFLD DFLDIND1,LTH=5
          MFLD DFLDIND2,LTH=100
          MSGEND
          END

```

Figure 43. Sample 2—MFS Definition Format

Chapter 8. Application Programming Using MFS

This chapter contains information for application programmers whose programs communicate with devices using MFS. It describes general MFS items and specific device-oriented items that govern the format of input and output messages.

The following topics provide additional information:

- “Input Message Formats”
- “Output Message Formats” on page 223

Input Message Formats

MFS edits input data from a device into an IMS application message format using the message definition that the MFS application designer writes as input to the MFS language utility program. An input message consists of all segments presented to an IMS application program when the program issues a DL/I GU or GN call.

The format of input messages is defined to the MFS Language utility. Each message consists of one or more segments; each segment consists of one or more fields:

```
MESSAGE
  SEGMENTS
    FIELDS
```

Message field format is defined specifically to the utility in terms of data source, field length, justification, truncation, and use of fill (pad) characters. How MFS actually formats the field is a function of the formatting option selected for the message. The option used is identified in the second byte of the 2-byte ZZ field (Z2) preceding the message text. An application program that depends on MFS should check this field to verify that the expected option was used; a X'00' in the Z2 field indicates MFS did not format the message. The format options are explained and illustrated with examples in “Input Message Formatting Options” on page 126.

Logical Pages

For 3270 or SLU 2, the input message is created from the currently displayed DPAGE on the device. For some other devices, if the device input format has more than one DPAGE defined, the device data entered determines which input LPAGE is selected to create an input message. However, for ISC (DPM-Bn) subsystems, OPTIONS=DNM or COND= can be used for DPAGE selection. For more information, see “Input Format Control for ISC (DPM-Bn) Subsystems” on page 143.

When LPAGEs are defined, each LPAGE is related to one or more DPAGEs.

Device-Dependent Input Information (3270 or SLU 2)

Using certain options for inputting information can make the application program device-dependent. Descriptions of the effects of various input options follow.

Cursor Location

As an option of the MFS Language utility, a field in the message can contain the location of the cursor on the device when input was transmitted to IMS. This option is only available for 3270 or SLU 2 display devices and its use can make programs device-dependent. The format of the cursor information is two 2-byte binary numbers, the first containing the line number, the second containing the column

Input Message Formats

number. The minimum value for the line or column is 1. For 3270-An device types, the maximum value for the line is the first parameter of the SIZE= operand; the maximum value for the column is the second parameter of the SIZE= operand.

Table 51 lists the maximum line and column values for MFS device types.

Table 51. Maximum Line and Column Values for 3270 Device Types

MFS Device Type	Maximum Value	
	Line	Column
3270,1	12	40
3270,2	24	80
3270-An		
SIZE=(12,40)	12	40
SIZE=(12,80)	12	80
SIZE=(24,80)	24	80
SIZE=(32,80)	32	80
SIZE=(43,80)	43	80
SIZE=(27,132)	27	132
SIZE=(62,160)	62	160

Selector Pen

Use of the selector light pen can affect input fields in several ways:

- If the ATTR output field option is not used dynamically to create detectable fields, the following occurs:
 - A message field that refers to device fields defined with the attributes DET,STRIP is presented as a device-independent field.
 - The first data byte available for the message field is the byte beyond the designator character in the device field.
 - A message field that references device fields defined with the attributes IDET,STRIP is also presented with device-independent data.
 - The designator character is removed.
 - Data from this field is not presented if no modified fields exist on the device when the field is selected. In this case, the only device information available for the message is the value specified for *literal* on the PEN= operand of the DFLD statement.
- If the ATTR output field option is used dynamically to create detectable fields, then the following occurs:
 - Fields dynamically established as either deferred detectable or immediate detectable do not have designator characters removed from input.
 - If a field altered to immediate detectable is selected when no other fields on the device are modified, no device input data is available for the message.
- If a message field is defined to receive immediate detect selector pen literal data, one of the following occurs:
 - If device input is not the result of an immediate selector pen detect, the field is padded as requested.
 - If device input is the result of an immediate selector pen detect, but at least one other field on the device is modified, one data character of a question mark (?) is presented in the field with the requested padding.

- If the device input is the result of an immediate selector pen detect and no other modified fields exist on the device, that literal is placed in the message as requested if the detected field is defined with a *PEN=literal*. If the detected field is not defined with a *PEN=literal*, one data byte of a question mark (?) is placed in the message field. In either case, no other device information is provided.
- If an EGCS attribute is defined for a light-pen-detectable field, you should specify *ATTR=NOSTRIP* on the DFLD statement and design your application program to bypass or remove the two designator characters from the input data. If *ATTR=STRIP* is specified or defaulted, MFS removes only the first designator character and truncates the last data character in the field.

Magnetic Stripe Reading Devices

The use of magnetic stripe reading devices is transparent to the application program. For operator identification (OID) card readers, the framing characters (SOR, EOR, EOI, LRC) are removed and parity checking is performed before editing.

Program Function Keys

Use of program function keys is transparent to the application programs.

Program Access Keys

Program access key information is not available to application programs.

Output Message Formats

MFS edits output segments created by an IMS application program into a device format suitable for the device or remote program for which the message is destined. Normally, the output segments from the IMS program contain no device-related data. All information needed for output to a device or remote program is provided when the message format is defined to the MFS Language utility program. For a remote program with DPM, specific device-dependent information is provided by the remote program without interpretation by MFS.

An output message consists of all segments presented to IMS with an ISRT call between a GU call to the I/O PCB and either a PURG call, another GU call to the I/O PCB, or normal program termination.

The format of output messages is defined to the MFS utility just like the format of input messages—one or more segments, each with one or more fields.

```
MESSAGE
  SEGMENTs
    FIELDs
```

The following topics provide additional information:

- “Logical Pages” on page 224
- “Segment Format” on page 224
- “Field Format (Options 1 and 2)” on page 226
- “Field Format (Option 3)” on page 226
- “Device-Dependent Output Information” on page 227
- “Dynamic Attribute Modification” on page 229
- “Dynamic Modification of Extended Field Attributes” on page 231
- “Dynamic Modification of EGCS Data” on page 237
- “Dynamic Modification of DBCS/EBCDIC Mixed Data” on page 238

Output Message Formats

- “Specification of Message Output Descriptor Name” on page 239
- “MFS Bypass for the 3270 or SLU 2” on page 240

Logical Pages

Output segments can be grouped for formatting by defining logical pages (LPAGE statement).

```
MESSAGE
  LPAGEs
    SEGMENTs
      FIELDs
```

Table 31 to Table 33 on page 148 illustrate various LPAGE definitions. When LPAGEs are defined, each LPAGE is related to a specific DPAGE that defines the device format for the logical page. If LPAGEs are not defined, MFS considers the defined message as one LPAGE and the rules that apply for messages with one LPAGE apply. Those rules are:

When a message has one LPAGE with one segment, each segment inserted by the application program is edited in the same manner.

When a message has one LPAGE with multiple segments, message segments must be inserted in the defined sequence. Not all segments in an LPAGE must be presented to IMS, but be careful when segments are omitted. An option 1 or 2 segment can be omitted if all segments to the end of the LPAGE are omitted; otherwise, a null segment must be inserted to indicate segment position. Option 3 output message segments can be omitted but the segments sent must include the segment number identifier.

Multiple series of segments can be presented to IMS as an output message. If the LPAGE is defined as having N segments, segment N+1 is edited as if it were segment 1, unless a segment with the page bit (X'40') in the Z2 field is encountered prior to segment N+1. When multiple series of output segments are presented and segments are omitted, the segment which begins a series must have bit 1 (X'40') of the Z2 field turned on.

When a message has multiple LPAGEs, data in the first segment of a series determines which LPAGE the series belongs to, which determines the editing to be performed on the segments. If the LPAGE to be used cannot be determined from the first segment of a series, the last LPAGE defined is used. Rules for segment omission are the same. A bit in the Z2 field (X'80') of the message indicates structured data is present in the outbound data stream. An output message using structured data must either define the MODNAME as blanks or binary zeros, or use MFS bypass.

Segment Format

Each output segment has a 4-byte prefix that defines the length of the segment and, if required, specifies whether the segment is the first segment of an LPAGE series. Option 3 output messages must contain an additional two bytes identifying the relative segment number within the LPAGE series. Table 52 illustrates the format of an output segment.

Table 52. Format of an Output Segment

LL	Z1	Z2	SN	FIELDS
----	----	----	----	--------

Where:

LL This is a 2-byte binary field representing the total length of the message segment, including LL, Z1, and Z2 and if present, SN. The value of LL equals the number of bytes in text (all segment fields) plus 4 (6 if option 3). The application program must fill in this count. If a size limit was defined for output segments of a transaction being processed, LL must not exceed the defined limit.

The segment length must be less than the message queue buffer data size (buffer size—prefix size) specified at IMS system definition. The segment length can be less than the length defined to the MFS Language utility. If a segment is inserted that is larger than the segment defined to the MFS utility, the segment is truncated. No error messages are issued. Fields truncated or omitted are padded as requested in the format definition to the MFS Language utility.

When PL/I is used, the LL field must be defined as a binary fullword. The value provided by the PL/I application program must represent the actual segment length minus two bytes. For example, if an output message segment is 16 bytes, LL=14 and is the sum of: the length of LL (4 bytes – 2 bytes) + Z1 (1 byte) + Z2 (1 byte) + TEXT (10 bytes).

Z1 This is a 1-byte field containing binary zeros and is reserved for IMS.

Z2 This is a 1-byte field that can be used by the application program for control of various output device functions.

For more information on this field, see *IMS Version 9: Administration Guide: Transaction Manager*.

SN For option 3 only. This is a 2-byte binary field containing the relative segment number of the segment within the LPAGE. The first segment is number 1.

A NULL segment can be used to maintain position within a series of option 1 or 2 output segments within an LPAGE. A null segment must be used if segments in the middle of an LPAGE series are to be omitted. If all segments to the end of the LPAGE series are to be omitted, null segments are not required. A null segment contains one data byte (X'3F') and has a length of 5.

An example of coding a null character in COBOL is shown in Figure 44.

Output Message Formats

```
ID DIVISION.  
PROGRAM-ID. SAMPLPGM.  
ENVIRONMENT DIVISION.  
DATA DIVISION.  
WORKING-STORAGE SECTION.  
77 PART1 PIC 9(3) VALUE 123.  
77 CUR-NAME PIC 99 COMP VALUE 0.  
77 CUR-PART PIC 99 COMP VALUE 0.  
01 NULLC.  
02 FILLER PIC 9 COMP-3 VALUE 3.  
01 LINE-A.  
02 NAME-1.  
03 NAME-2 OCCURS 30 PIC X.  
02 PARTNUM.  
03 PARTNUM1 OCCURS 10 PIC 9.  
PROCEDURE DIVISION.  
MOVE 'ONES' TO NAME-1.  
MOVE 6 TO CUR-NAME.  
MOVE NULLC TO NAME-2 (CUR-NAME).  
MOVE 4 TO CUR-PART.  
MOVE NULLC TO PARTNUM1 (CUR-PART).
```

Figure 44. Coding a Null Character in COBOL

Field Format (Options 1 and 2)

All fields in option 1 and 2 output segments are defined as fixed length and fixed position. The data in the fields can be truncated or omitted by two methods:

- Inserting a short segment
- Placing a NULL character (X'3F') in the field

Fields are scanned left to right for a null character. The first null encountered terminates the field. If the first character of a field is a null character, the field is omitted (depending on the fill character used). Positioning of all fields in the segment remains the same regardless of null characters. Fields truncated or omitted are padded as defined to the MFS Language utility.

If ATTR=YES is specified in the MFLD definition, and if X'3F' is the first or second byte of the attribute portion of the field, the field is omitted and the attributes specified on the DFLD statement are used.

For an example of field truncation and omission, see “Output Message Formatting Options” on page 146.

Field Format (Option 3)

Under option 3 output, fields can be placed in their segments in any order and with any length that conforms to the segment size restriction. Short fields or omitted fields are padded as defined to the MFS Language utility. Each field must be preceded by a 4-byte field prefix of the same format provided by MFS for option 3 input fields, as shown in Table 53.

Table 53. Format of an Option 3 Output Segment

FL	FO	DATA
----	----	------

Where:

- FL** The length of the field, including the 4-byte field prefix. FL consists of 2 binary bytes, which require no alignment.
- FO** The relative offset of the field in the segment, based on the definition of the message to the MFS Language utility. FO consists of 2 binary bytes, which require no alignment. The relative offset of the first field defined in the segment is 4. The relative offset of the second field is 4 plus the length of the first field as defined to the MFS Language utility.

Errors in the contents of FL and FO cause unpredictable results.

Option 3 fields do not need to be in sequence in the output segment, but all fields must be contiguous in the segment; that is, the field prefix of the second field must begin in the byte beyond the first field's data. Null characters in option 3 fields have no effect on the data transmitted to the device. They are treated as any other nongraphic characters; that is, replaced with blanks.

Device control characters are invalid in output message fields. For 3270 display and SLU 2 terminals, the control characters HT, CR, LF, NL, and BS are changed to null characters. For all other devices, these control characters are changed to blanks. All other nongraphic characters (X'00' through X'3F', and X'FF') are changed to blanks before transmission. For DPM devices, control characters are permitted if GRAPHIC=NO has been specified.

Examples of field formats are shown under "Output Message Formatting Options" on page 146.

Device-Dependent Output Information

Using certain options for outputting information can make the application program device-dependent. Some options allow the application program to control certain features of devices receiving output. Descriptions of the effects of various output options follow.

System Control Area (SCA)

An option of the MFS Language utility allows the creation of an SCA field in the first segment of a message or, if LPAGEs are defined, in the first segment of any or all LPAGEs. This field allows application program control of specific device features when the features apply to the device for which the message is destined. The first 2 bytes of the SCA field are defined as shown in these tables:

- Table 54
- Table 55 on page 228

Usage notes follow both tables.

Table 54. Valid Bytes and Bits for TYPE=3270, SLU 2, DPM-An, or DPM-Bn

Byte	Bit	Description
0	0-7	Should be 0.
1	0	Should be 1.
	1	Force format write (erase device buffer and write all required data).
	2	Erase unprotected fields before write.
	3	Sound device alarm.
	4	Copy output to candidate printer.

Output Message Formats

Table 54. Valid Bytes and Bits for TYPE=3270, SLU 2, DPM-An, or DPM-Bn (continued)

Byte	Bit	Description
	5	B'0'—For 3270, protect the screen when output is sent. For DPM, demand paging can be performed.
		B'1'—For 3270, do not protect the screen when output is sent. For DPM-B, autopaging can be performed.
	6	For the partition formatted 3290: B'0'—do not erase existing partitions. B'1'—erase all partitions before sending message. For others, should be 0.
	7	Should be 0.

Notes:

1. For the 3290 in partition format mode, the DOF on the current message is checked to see if it is the same DOF used last. If it is, bit 6 in the SCA and DSCA operands is checked for the erase/do not erase partitions option before the output message is sent.
2. The default for bit 6 is B'0', "do not erase". If this bit is not specified, the output is sent according to the partition paging option specified, and partitions that do not receive output remain unchanged.
3. If bit 6 is set to B'1', then existing partitions will be erased and the output is sent according to the partition paging option specified. See "Partition Initialization Options and Paging" on page 185 for more information.
4. The SCA bit settings are "OR'd" to the DSCA bit settings. For example, if byte 1 bit 5 in the DSCA for DPM-B is set to B'0' in the DSCA for DPM-B, the application program can request autopaged output by setting the SCA value to B'1'. (This request is honored only if present in the first segment of the first LPAGE of the output message.)
5. SCA information is sent to the remote program or ISC subsystem in a DFLD identified by the parameter SCA (see Chapter 5, "Introduction to Message Format Service (MFS)," on page 109). Any invalid bits for the device type are reset. The valid bits are used.

Table 55. Valid Bytes and Bits for TYPE=FIDS, FIDS3, FIDS4, FIDS7, FIJP, FIPB, or FIFP

Byte	Bit	Description
0	0-7	Should be 0.
1	0	Should be 1.
	1-2	Not applicable for FIN output devices.
	3	Set "device alarm" in output message header.
	4	Not applicable for FIN output devices.
	5-7	Should be 0.

Notes:

1. Bits 1, 2, and 4 function only for 3270 and are not applicable to finance workstations. If set on by the program, and the message is edited for a finance workstation, they are ignored.
2. For TYPE=274X, SCS1, or SCS2, the SCA parameter is ignored.
3. For TYPE=3270P, all bits except "set device alarm" are ignored.

Cursor Location

An application program can set the cursor location on the screen either by setting a cursor attribute for a field or by using a special cursor positioning field in the output message.

Recommendation: Use the cursor attribute method because the application program does not need to know the position of fields on a device.

Cursor positioning using the cursor attribute method is described in “Dynamic Attribute Modification.”

Using an option of the MFS Language utility, you can define a field in an output segment to allow the application program to request cursor positioning to a specific line and column on the device. Depending on the device output format used, there can be one or more such fields per LPAGE. If the field contains an invalid number it is ignored and the cursor is positioned as requested in the device output format.

The cursor field should contain two 2-byte binary numbers (no alignment required), the first containing the line number, the second containing the column number. The minimum value for the line or column is 1. For 3270-An device types, the maximum value for the line is the first parameter of the SIZE= operand; the maximum value for the column is the second parameter of the SIZE= operand. Table 56 lists the valid line and column values.

Table 56. Maximum Line and Column Values for MFS Device Types

MFS Device Type	Maximum Value	
	Line	Column
FIDS (240 characters)	6	40
FIDS3 (480 characters)	12	40
FIDS4 (1024 characters)	16	64
FIDS7 (1920 characters)	24	80
3270,1 (480 characters)	12	40
3270,2 (1920 characters)	24	80
3270-An		
SIZE=(12,40) (480 characters)	12	40
SIZE=(12,80) (960 characters)	12	80
SIZE=(24,80) (1920 characters)	24	80
SIZE=(32,80) (2560 characters)	32	80
SIZE=(43,80) (3440 characters)	43	80
SIZE=(27,132) (3564 characters)	27	132
SIZE=(62,160) (9920 characters)	62	160

Dynamic Attribute Modification

An option of the MFS Language utility allows an IMS application program to dynamically modify, replace, or simulate the attributes of a device field. This dynamic attribute modification is requested in an output message definition by specifying ATTR=YES in an MFLD statement. MFS then reserves the first two data bytes of the output message field for attribute definition. Errors detected in the data of the 2-byte specification or X'3F' in the first or second attribute byte produce the results shown in Table 57 on page 230.

Attributes are always sent, even if no data is sent.

When dynamic attribute modification is specified for a device field with predefined attributes, an attribute is sent to the device for that field in every output operation, even if the data for this device field is not included in the output message. These attributes are used:

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- If the output message field has an attribute and the attribute is valid, then the dynamic attribute modification is performed.
- If the message field is not included in the LPAGE being used or the attribute is not valid, the predefined attribute for the device field is used.

When attribute simulation is defined, the first byte of the device field is reserved for attribute data. The following attributes can be simulated:

- Cursor position (3604 display only)
- Nondisplayable
- High-intensity displayable
- Modified attributes

The two attribute bytes are defined in Table 57.

Table 57. Definitions of the Two Attribute Bytes

Byte	Bit	Definition
0	0-1	If both bits are on, requests that the cursor be placed on the first position of this field on the device. The first cursor-positioning request encountered in an LPAGE series (first MFLD with cursor attribute or cursor line/column value) that applies to a physical page is honored; these bits must be 00 or 11.
	2-7	Must be off.
1	0	Must be on.
	1	<ol style="list-style-type: none"> 1. If on, these attribute specifications are to replace the attribute byte defined for the field. 2. If off, these attribute specifications are to be added to the attribute byte defined for the field logical "OR" operation. A zero in a bit position indicates that the defined attribute is to be used (that is, if bit 2 is 0 then the field will be protected or unprotected depending on the DFLD definition. A 1 in a bit position indicates that the corresponding attribute is to be used (that is, if bit 3 is 1 then the field will have the numeric attribute.)
	2	Protected
	3	Numeric
	4	High-intensity (forces detectable and displayable); if simulated, an * appears in the first byte of the device field.
	5	Nondisplayable (forces nondetectable); if simulated, no data is sent regardless of other attributes.
	6	Detectable (forces normal intensity).
	7	Premodified; if simulated, an underscore (_) appears in the first byte of the device field.

Notes:

1. Bits 4, 5, and 6 are incompatible. If more than one is set, bit 4 takes precedence over bits 5 and 6. Bit 5 takes precedence over bit 6.
2. If both bits 4 and 7 are simulated, an ! appears in the first byte of the device field.

Dynamic modification of attributes to detectable requires other action by the IMS application program to make the device function properly. Detectable fields must have a designator character and certain padding characters.

For DPM, field attribute information can be passed from the IMS application program to the remote program, but cannot be specified, unless ATTR=(YES,nn) appears in the MFS DFLD definitions.

See the appropriate component description manual to determine which extended attributes are available to a given terminal type.

Dynamic Modification of Extended Field Attributes

For an application program to modify extended attribute data, the MFLD statement must specify ATTR=nn. Any error causes the DFLD EATTR= specification for that extended attribute byte to be used.

For modification of the extended attributes, two additional bytes per attribute must be reserved. The values that can be specified in these extended attribute modification bytes and the resulting values that are used are:

Specification	Value Used
X'00'	Device default
Valid value	Your specification
Invalid or omitted	From EATTR= on DFLD statement
Duplicate	Last (rightmost) specification

During online execution, if ATTR=PROT is specified as a dynamic modification, any field validation attributes defined on the DFLD statement or specified as a dynamic modification are reset.

Restriction: Trigger fields are not supported by MFS.

Table 58 shows the format of the extended attribute modification bytes.

Table 58. Format of Extended Attribute Modification Bytes

ATTR 1 type	ATTR 1 value	ATTR 2 type	ATTR 2 value	ATTR n type	ATTR n value
	1	2	3	2xn_2	2xn_1

Types

Hexadecimal specifications:

- 01 Validation replacement
- 02 Validation addition
- 03 Field outlining replacement
- 04 Field outlining addition
- 05 Input control replacement
- 06 Input control addition

Field outlining applies to 3270 display devices, and to printers defined as 3270P or SCS1 that support the 3270 Structured Field and Attribute Processing option, and support the Extended Graphics Character Set (EGCS).

Character specifications (the letter C indicates character):

- C1 Highlighting

Output Message Formats

- C2** Color
- C3** Programmed Symbols

Values

Field validation in hexadecimal:

- | Bit | Meaning |
|---------------|-----------------|
| 0 to 4 | Reserved |
| 5 | Mandatory fill |
| 6 | Mandatory field |
| 7 | Reserved |

For field highlighting:

- | Character | Meaning |
|--------------|----------------|
| X'00' | Device default |
| X'F1' | Blink |
| X'F2' | Reverse video |
| X'F4' | Underline |

Field color (seven-color models only):

- | Character | Meaning |
|--------------|----------------|
| X'00' | Device default |
| X'F1' | Blue |
| X'F2' | Red |
| X'F3' | Pink |
| X'F4' | Green |
| X'F5' | Turquoise |
| X'F6' | Yellow |
| X'F7' | Neutral |

Field outlining in hexadecimal:

- | Bit | Meaning |
|---------------|----------------------|
| 0 to 3 | Reserved |
| 4 | Left line |
| 5 | Over line |
| 6 | Right line |
| 7 | Under line |
| X'00' | Default (no outline) |

Input control (of DBCS/EBCDIC mixed fields) in hexadecimal:

- | Bit | Meaning |
|---------------|----------|
| 0 to 6 | Reserved |

7 SO/SI creation
 X'00' Default (no SO/SI creation)

For the programmed symbols, valid local ID values are in the range X'40'—X'FE', or X'00' for the device default.

Ways to specify the binary validation attribute type and value in COBOL are shown in Figure 45.

```
VAL_REP_MFILL PIC 9(3) COMP VALUE 260 (replace-mandatory fill)
*
VAL_REP_MFLD PIC 9(3) COMP VALUE 258 (replace-mandatory field)
*
VAL_ADD_MFILL PIC 9(3) COMP VALUE 516 (add-mandatory fill)
*
VAL_ADD_MFLD PIC 9(3) COMP VALUE 514 (add-mandatory field)
*
```

Figure 45. Binary Validation Attribute Type and Value Specification in COBOL

Ways to specify field outlining attributes, input control types, and values in COBOL are shown in Figure 46.

```
01 BINVALUE.
  02 VAL0000 PIC S999 COMP VALUE +0.
  02 VAL0000X REDEFINES VAL0000.
    03 FILLER PIC X.
    03 VAL00 PIC X.
*
```

(NO FIELD OUTLINE)

Figure 46. Various Ways to Specify Field Outlining (Part 1 of 16)

```
02 VAL0001 PIC S999 COMP VALUE +1.
02 VAL0001X REDEFINES VAL0001.
  03 FILLER PIC X.
  03 VAL01 PIC X.
*
```

(UNDERLINE)

Figure 46. Various Ways to Specify Field Outlining (Part 2 of 16)

```
02 VAL0002 PIC S999 COMP VALUE +2.
02 VAL0002X REDEFINES VAL0002.
  03 FILLER PIC X.
  03 VAL02 PIC X.
*
```

(RIGHTLINE)

Figure 46. Various Ways to Specify Field Outlining (Part 3 of 16)

Output Message Formats

```
02 VAL0003          PIC S999 COMP  VALUE  +3.
02 VAL0003X REDEFINES VAL0003.
03 FILLER          PIC X.
03 VAL03          PIC X.
*
(RIGHTLINE & UNDERLINE)
```

Figure 46. Various Ways to Specify Field Outlining (Part 4 of 16)

```
02 VAL0004          PIC S999 COMP  VALUE  +4.
02 VAL0004X REDEFINES VAL0004.
03 FILLER          PIC X.
03 VAL04          PIC X.
*
(OVERLINE)
```

Figure 46. Various Ways to Specify Field Outlining (Part 5 of 16)

```
02 VAL0005          PIC S999 COMP  VALUE  +5.
02 VAL0005X REDEFINES VAL0005.
03 FILLER          PIC X.
03 VAL05          PIC X.
*
(OVERLINE & UNDERLINE)
```

Figure 46. Various Ways to Specify Field Outlining (Part 6 of 16)

```
02 VAL0006          PIC S999 COMP  VALUE  +6.
02 VAL0006X REDEFINES VAL0006.
03 FILLER          PIC X.
03 VAL06          PIC X.
*
(OVERLINE & RIGHTLINE)
```

Figure 46. Various Ways to Specify Field Outlining (Part 7 of 16)

```
02 VAL0007          PIC S999 COMP  VALUE  +7.
02 VAL0007X REDEFINES VAL0007.
03 FILLER          PIC X.
03 VAL07          PIC X.
*
(OVERLINE & RIGHTLINE
& UNDERLINE)
```

Figure 46. Various Ways to Specify Field Outlining (Part 8 of 16)

```
02 VAL0008          PIC S999 COMP  VALUE  +8.
02 VAL0008X REDEFINES VAL0008.
03 FILLER          PIC X.
03 VAL08          PIC X.
*
(LEFTLINE)
```

Figure 46. Various Ways to Specify Field Outlining (Part 9 of 16)

```

02 VAL0009          PIC S999 COMP  VALUE  +9.
02 VAL0009X        REDEFINES  VAL0009.
03 FILLER          PIC X.
03 VAL09           PIC X.
*
                                     (LEFTLINE & UNDERLINE)

```

Figure 46. Various Ways to Specify Field Outlining (Part 10 of 16)

```

02 VAL000A          PIC S999 COMP  VALUE  +10.
02 VAL000AX        REDEFINES  VAL000A.
03 FILLER          PIC X.
03 VAL0A           PIC X.
*
                                     (LEFTLINE & RIGHTLINE)

```

Figure 46. Various Ways to Specify Field Outlining (Part 11 of 16)

```

02 VAL000B          PIC S999 COMP  VALUE  +11.
02 VAL000BX        REDEFINES  VAL000B.
03 FILLER          PIC X.
03 VAL0B           PIC X.
*
                                     (LEFTLINE & RIGHTLINE
*                                     & UNDERLINE)

```

Figure 46. Various Ways to Specify Field Outlining (Part 12 of 16)

```

02 VAL000C          PIC S999 COMP  VALUE  +12.
02 VAL000CX        REDEFINES  VAL000C.
03 FILLER          PIC X.
03 VAL0C           PIC X.
*
                                     (LEFTLINE & OVERLINE)

```

Figure 46. Various Ways to Specify Field Outlining (Part 13 of 16)

```

02 VAL000D          PIC S999 COMP  VALUE  +13.
02 VAL000DX        REDEFINES  VAL000D.
03 FILLER          PIC X.
03 VAL0D           PIC X.
*
                                     (LEFTLINE & OVERLINE
*                                     & UNDERLINE)

```

Figure 46. Various Ways to Specify Field Outlining (Part 14 of 16)

```

02 VAL000E          PIC S999 COMP  VALUE  +14.
02 VAL000EX        REDEFINES  VAL000E.
03 FILLER          PIC X.
03 VAL0E           PIC X.
*
                                     (LEFTLINE & OVERLINE
*                                     & RIGHTLINE)

```

Figure 46. Various Ways to Specify Field Outlining (Part 15 of 16)

Output Message Formats

```

02 VAL000F          PIC S999 COMP  VALUE +15.
02 VAL000FX        REDEFINES  VAL000F.
03 FILLER          PIC X.
03 VAL0F           PIC X.
*                  (BOX)

```

Figure 46. Various Ways to Specify Field Outlining (Part 16 of 16)

Examples: The following examples show the use of the EATTR= and ATTR=(,nn) operands:

```

AX   DFLD  EATTR=(VMFILL,HUL),ATTR=(NUM,HI)
AY   MFLD  AX,ATTR=(,2)

```

The EATTR= operand of the DFLD statement requests that the specified field must be completely filled with data, high intensity, and underlined. The ATTR= operand of the DFLD statement requests that the specified field be numeric and high intensity.

Specifying the ATTR=(,2) operand indicates the application program can dynamically modify the two extended attributes specified in the EATTR= operand. If this is specified, the LTH= value on the MFLD statement must be increased by 4 bytes for the modified attribute bytes. The application program can dynamically modify the validation and the extended highlighting attributes. The extended attributes of color and programmed symbols cannot be dynamically modified, because they were not specified in the EATTR= operand. The existing 3270 attributes cannot be dynamically modified, because ATTR=YES was not specified on the MFLD statement.

To dynamically modify the extended highlighting to blinking, and add mandatory field validation when data is entered into the field, the extended attribute types and values shown in Table 59 must be placed in the field referenced by the MFLD “AY” in the preceding example.

Table 59. Extended Attribute Types and Values for COBOL

ATTR 1 type	ATTR 1 value	ATTR 2 type	ATTR 2 value	Field data
C1	F1	02	02	data
0	1	2	3	4–n

Specification of color and programmed symbols, if present, is ignored. Regardless of the number of attribute modification bytes specified, MFS sends the number of extended attributes specified in the EATTR=operand of the DFLD.

Because the validation addition type (X'02') is specified, rather than the validation replacement type (X'01'), the change to the validation attribute byte is an addition rather than a replacement.

```

BX   DFLD  EATTR=(CD,HD,PC'Z'),ATTR=(PROT)
BY   MFLD  BX,ATTR=(YES,3)

```

The EATTR= operand of the DFLD statement requests a field with a programmed symbol buffer local ID of “Z” and the protected attribute. If no dynamic modification by an IMS application program occurs, the color and highlighting device defaults are used. Because of the specification of ATTR=(YES,3) in this example, the color, extended highlighting, programmed symbol buffer local ID, and existing 3270 attributes can be dynamically modified.

You can dynamically modify the color, extended highlighting, and the 3270 attribute bytes, while keeping the programmed symbol local ID (PC'Z') as specified on the DFLD statement. For example, to dynamically modify the color to pink, the extended highlighting to reverse video, and the 3270 attribute bytes to numeric and unprotected, use the attribute modification bytes for fields referenced by MFLD "BY" as shown in Table 60.

Table 60. Example of Dynamically Modified Attribute Bytes

Existing 3270 ATTR mods	ATTR 1 type	ATTR 1 value	ATTR 2 type	ATTR 2 value	ATTR 3 type	ATTR 3 value	Field data
00 D0	C2	F3	C1	F2	40	40	data
0 1	2	3	4	5	6	7	8–n

With byte 1, bit 1 of the existing 3270 attribute modification bytes on, IMS replaces the existing 3270 attribute byte rather than adding to it. This changes the field to unprotected and specifies the numeric attribute. The third attribute has a type of X'40' (an invalid type) specified, which causes IMS to use the DFLD specification for programmed symbols.

Dynamic Modification of EGCS Data

EGCS data can also be dynamically modified to permit EBCDIC or EGCS data to be mapped to a particular field on the 3270 display. With this function:

- You can enter EBCDIC or EGCS data.
- The application program can receive EBCDIC or EGCS data.
- EBCDIC or EGCS data can be passed to an SLU P remote program or to an ISC subsystem.

If ATTR=(,nn) is specified in the MFLD statement and a programmed symbol attribute is specified in the corresponding DFLD statement, the application program can modify the field programmed symbol attribute. Dynamic modification of the programmed symbol attribute for EGCS requires two additional bytes. These additional bytes precede the MFLD data and must be included in the MFLD LTH= specification.

The IMS application program can modify the DFLD programmed symbol attribute if all the following conditions are met:

- The DFLD specifies EATTR=PX'hh', PC'c', EGCS'hh' or EGCS.
- The corresponding MFLD statement specifies ATTR=(,nn), where nn is a value from 1 through 4.
- The application program includes $2 \times nn$ additional bytes preceding the data field.
- One set of two attribute bytes has an X'C3' as its first byte and a valid value (X'00' or X'40'—X'FE') as its second byte.

Table 61 on page 238 illustrates what the MFS transmits in the value byte of the programmed symbol attribute type, if the DFLD statement does or does not specify a programmed symbol attribute, and the IMS application program does or does not modify it.

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Table 61. Attribute Type Value Byte Contents

Application Program Programmed Symbol Attribute Bytes of X and:	C3 EATTR=	ATTR=	EATTR=
	Programmed symbol specified	Programmed symbol default	Not specified
X'40_FE' ¹	Send X'40_FE'	Send X'40_FE'	Send no attribute
Default X'00' ¹	Send X'00'	Send X'00'	Send no attribute
Not specified ²	Send programmed symbol DFLD specification	Send no attribute	N/A
Omitted or Invalid ³	Send programmed symbol DFLD specification	Send X'00'	Send no attribute

Notes:

1. ATTR=*nn* is specified on at least one MFLD statement that maps to this DFLD statement. The IMS application program specifies a programmed symbol attribute of X'40' to X'FE'.
2. ATTR=*nn* is not specified on any MFLD statement that maps to this DFLD statement.
3. ATTR=*nn* is specified on at least one MFLD statement that maps to this DFLD statement. The application program omits specifying this attribute, or the specified attribute is not X'00' or X'40' to X'FE'.

Dynamic Modification of DBCS/EBCDIC Mixed Data

Programmed symbols and input control attribute bytes can be dynamically modified to permit EBCDIC or EGCS data to be mapped to a particular field on the 3270 display. DBCS/EBCDIC mixed data can also be dynamically modified. DBCS is a subset of EGCS, so the EGCS field can contain DBCS data, as shown in Figure 47.

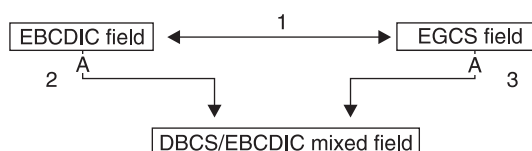


Figure 47. Dynamic Modification of a DBCS/EBCDIC Mixed Field

The IMS application program can make a field EBCDIC, EGCS, or DBCS/EBCDIC mixed when all of the following conditions are satisfied:

- One of the following is specified on the DFLD statement:

```
EATTR=(EGCS,MIXD)
EATTR=(EGCS'00',MIX)
EATTR=(EGCS'00',MIXD)
```

A DBCS keyword does not exist; DBCS fields are specified using the EGCS keyword. The initial attribute must specify an EGCS field, a DBCS/EBCDIC mixed field, or an EBCDIC field.

- The corresponding MFLD statement specifies ATTR=(,*nn*) where *nn* is 2 or greater.
- The application program contains $2 \times nn$ additional bytes preceding the data field.

When $nn=2$, the initial attribute is changed as shown in Table 62 according to the value of the two attribute byte sets (4 bytes) specified in front of the data field by the application program.

Table 62. Dynamic Modification of a DBCS/EBCDIC Mixed Field

Attribute Byte	EBCDIC	EGCS	Mixed
40404040	EBCDIC	EGCS	Mixed
05014040	Mixed	Mixed	Mixed
0501C3F8	EGCS	EGCS	EGCS
C3F84040	EGCS	EGCS	EGCS
C3F80501	Mixed	Mixed	Mixed
0500C3F8	EGCS	EGCS	EGCS
C3000501	Mixed	Mixed	Mixed
C3000500	EBCDIC	EBCDIC	EBCDIC

When the initial attribute specifies an EGCS field and the application program specifies dynamic modification of the input control attribute to a DBCS/EBCDIC mixed field, MFS replaces the value of the programmed symbol for which the EGCS field is specified with the device default. For more information, refer to “Dynamic Modification of Extended Field Attributes” on page 231.

Specification of Message Output Descriptor Name

Output messages destined for MFS terminals are formatted using a message output descriptor (MOD). Which MOD IMS uses can be specified within the output call, either insert (ISRT) or purge (PURG). Both ISRT and PURG allow you to specify an output MOD name parameter on the call that provides a segment of an output message.

When the output MOD name parameter is specified, IMS uses the name supplied to select the message output descriptor. If the call is directed to the TP PCB or alternate response PCB, IMS updates the MESSAGE OUTPUT DESCRIPTOR NAME field of the TP PCB with the name supplied in the output call. The MOD name of all output messages inserted on an alternate PCB that did not explicitly specify a MOD name is set to the previous MOD name.

Which MOD IMS uses to format the message depends on the name specified:

Name Specified	Descriptor Used
Valid output MOD name	Message output descriptor named by output MOD name
Eight blanks	IMS default message output descriptor (3270 or SLU 2 only—other devices use IMS basic edit for output)
Invalid output MOD name	IMS error default message output descriptor

If the output MOD name parameter is not specified, IMS formats the message using the MOD named in the MESSAGE OUTPUT DESCRIPTOR NAME field of the I/O PCB.

MFS Bypass for the 3270 or SLU 2

IMS MFS allows the IMS application program to bypass MFS formatting of input and output messages. With this option, the IMS application program can load programmed symbol buffers, or send a device-dependent data stream to format and update the 3270 display, or write a message to a 3270 printer. The bypass can be used only on the SLU 2, and 3270 devices (except the 3275 dial-up BTAM terminal). Optionally, the IMS application program can examine an input message with the attention identification (AID) byte, cursor address, SBA orders, and buffer addresses as received from the display. For BTAM and non-SNA VTAM transmissions, the data to be sent must be equal to or less than the value specified in the system definition OUTBUF parameter. Data sent to a printer using the MFS bypass is restricted to 4 KB.

MFS recognizes two special message output descriptor (MOD) names: DFS.EDT and DFS.EDTN.

Output messages bypass MFS formatting only if DFS.EDT or DFS.EDTN is supplied as the MOD name parameter of the application program CALL statement (for more information, see “Specifying Input Forms for MFS Bypass”). IMS system messages, IMS error messages, application program messages with no MOD name, and message switches are always formatted by MFS (using the IMS-supplied formats).

When MFS is bypassed on output, the application program is responsible for constructing the entire 3270 data stream, beginning with the command code and ending with the last data byte. An exception to this could be 3270 output using the MFS bypass and destined to a printer. The hexadecimal EBCDIC command codes for use with the 3271/3274 controllers are:

Command	3271/3274
Erase All Unprotected	6F
Erase/Write	F5
Erase/Write Alternate	7E
Read Buffer	F2
Read Modified	F6
Read Modified All	6E
Write	F1
Write Structured Field	F3

The user-written application program has two ways to send output to printers:

- By providing the command code and WCC character in the application program and by setting bit 0 to 1 (X'80') in the Z2 field of the message segment to show that the appropriate command is provided.
- By allowing IMS to provide the command code and other characters. However, to print less than the maximum line length, insert new line (NL) characters at the appropriate places in the data stream. This method is the default.

Specifying Input Forms for MFS Bypass

After using the MFS bypass, the IMS application program must accept the input in one of two forms depending on the MOD name specified for the output message:

- MODNAME=DFS.EDT edits the input data.

- MODNAME=DFS.EDTN performs no editing on the input data.

MODNAME=DFS.EDT: The AID and the cursor address are removed from the data stream and any SBA or start field sequences are replaced with blanks. In addition, the basic input edit routine performs the editing. If the AID code received is a CLEAR, PA2, PA3, PFK12, or selector pen attention, existing IMS functions are performed. If a PA1 is received, IMS performs the same function as for PA2 (that is, the next output message is sent if one is available).

MODNAME=DFS.EDTN: If the transaction is in conversational mode, all input is passed to the application as received from the terminal. If the transaction is not in conversational mode, the transaction code must be positioned to precede the AID character of the data stream received from the terminal.

The password should never be passed to the IMS application program. The basic editing functions are performed on the destination and password fields only. If the password appears within parentheses immediately after the transaction code, basic edit removes the password. No editing is performed on the remainder of the data. Existing IMS functions are bypassed for AID codes resulting from a CLEAR, PA1, PA2, PA3, or selector pen attention. PFK12 causes a copy to be performed if it is allowed.

Position the transaction code using the physical terminal input edit exit, or cause IMS to supply it using the conversational or preset destination mode.

If the terminal is in conversational mode, the message is sent to the application program in the conversation. If the terminal is in preset mode, the transaction code is added to the beginning of the message and the message is sent to the destination established by the /SET command. Therefore, while in preset mode, a slash (/) as the first character of the input data is not considered an IMS command. To be recognized as a command, /RESET must immediately follow the cursor address in the input data stream. To do this, enter the /RESET command from an unformatted screen (no fields defined for the screen). If the screen is formatted (fields defined for the screen), press the clear key to unformat the screen. However, an application program must receive the clear AID byte and write a data stream that does not format the screen.

Example:

```
Data stream = F5C3, erases the 3270 buffer.  
Data stream = F5C3114040, erases the 3275 buffer.  
    Entering: The /RESET command  
              resets preset mode.
```

If /RESET is received from an unformatted screen, while bypassing MFS and basic edit (MOD name is DFS.EDTN) and in preset mode, the input is treated as a command, and the terminal is taken out of preset mode. You are responsible for sending a data stream that leaves the screen unformatted.

If the transaction code and password (if required) are entered with the input message and the terminal is not in conversational or preset mode, your physical terminal input edit exit routine must be included in the IMS system definition. The physical terminal input edit routine gains control before IMS destination and security checking and must modify the input to place the transaction code and password (if required) in front of the AID code.

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If the **OPTIONS** keyword of the IMS system definition **TERMINAL** or **TYPE** macro specifies that the keyboard is to remain locked, and the MFS bypass with MOD name **DFS.EDTN** is used, the application program must assume responsibility for unlocking the 3270 keyboard and resetting the MDT flags.

After use of the MFS bypass, the next output message is formatted by MFS if the MOD name is not supplied or the MOD name supplied is not **DFS.EDT** or **DFS.EDTN**.

MFS bypass is intended primarily for subsystems executing under IMS and is not recommended for normal application usage. If IMS application programs deal with 3270 data streams, they become device-dependent, which complicates the application development process.

When a read command is executing in the MFS bypass, the output message containing the read command is dequeued or re-enqueued when the input is received, depending on the option (**PAGDEL/NPGDEL**) specified on the **TERMINAL** macro during system definition.

MFS Bypass for the SLU 2 (3290) with Partitioning

When the MOD specified in an application is either **DFS.EDT** or **DFS.EDTN**, the output message generated can cause an SLU 2 terminal to function in partitioned mode. Using **DFS.EDTN**, a conversational application can send a Query and receive a Query reply.

For output, the application program must supply the Create Partition data stream within the output message, along with the data for the partitions. Also, the SLU 2 Device-Dependent Module sets Change Direction (CD) on non-last conversational output messages. This allows Reads and Queries to be sent in Write Structured Fields data streams.

A Query Reply input can be processed only if the previous MOD specified is **DFS.EDTN**. A Query Reply input can be received but does not have a transaction code in the data stream.

For partitions 01 through 0F, the X'88' byte is followed by a 2-byte field that is not used. If a X'80' byte follows this field, then the next byte is the PID byte (X'01' through X'0F'). For partition 00, the input will have the same format as input data from a non-partitioned SLU 2.

For input with **DFS.EDT** or **DFS.EDTN**, the first AID byte, X'88', causes the proper decoding of the second AID byte. Depending on the second AID byte, one of the following occurs:

- If the second AID byte decoded is X'80', a third AID byte is decoded. The data stream following that AID byte is passed to the application program as follows:
 - Using basic edit, if **DFS.EDT** is specified
 - As a complete data stream, if **DFS.EDTN** is specified
- If the second AID byte is not X'80', input is passed only if the MOD specified in the application is **DFS.EDTN**. When **DFS.EDTN** is specified, the complete data stream starting with the X'88' AID byte is passed to the application program.

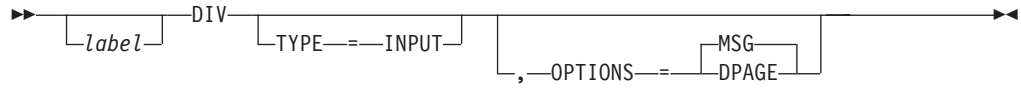
DIV Statement

The **DIV** statement defines device formats within a **DIF** or **DOF**. The formats are identified as input, output, or both input and output, and can consist of multiple physical pages. For **DEV TYPE=274X**, **SCS1**, **SCS2**, or **DPM-AN**, two **DIV**

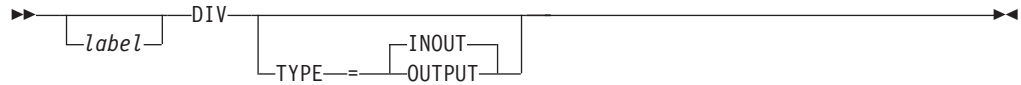
Output Message Formats

statements can be defined: DIV TYPE=OUTPUT and DIV TYPE=INPUT. For all other device types, only one DIV statement per DEV is allowed.

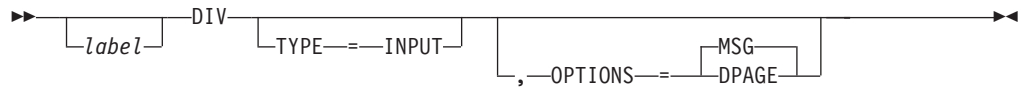
Format for DEV TYPE=274X, SCS1, or SCS2 and DIV TYPE=INPUT:



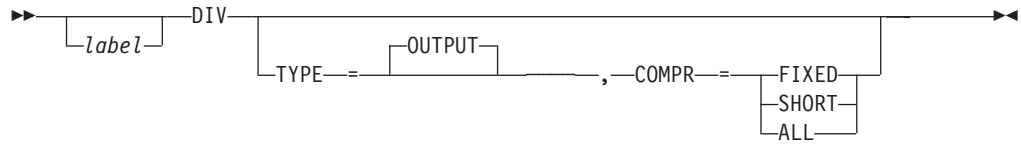
Format for DEV TYPE=3270 or 3270-An:



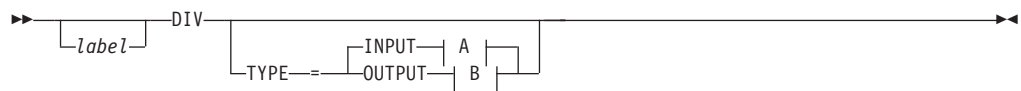
Format for DEV TYPE=FIN:



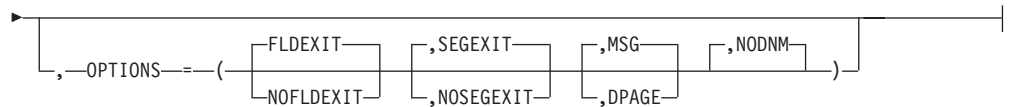
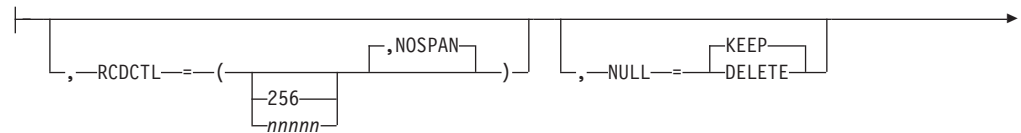
Format for DEV TYPE=274X, SCS1, SCS2, 3270P, FIDS, FIDS3, FIDS4, FIDS7, FIJP, FIPB, or FIFP and DIV TYPE=OUTPUT:



Format for DEV TYPE=DPM-An:

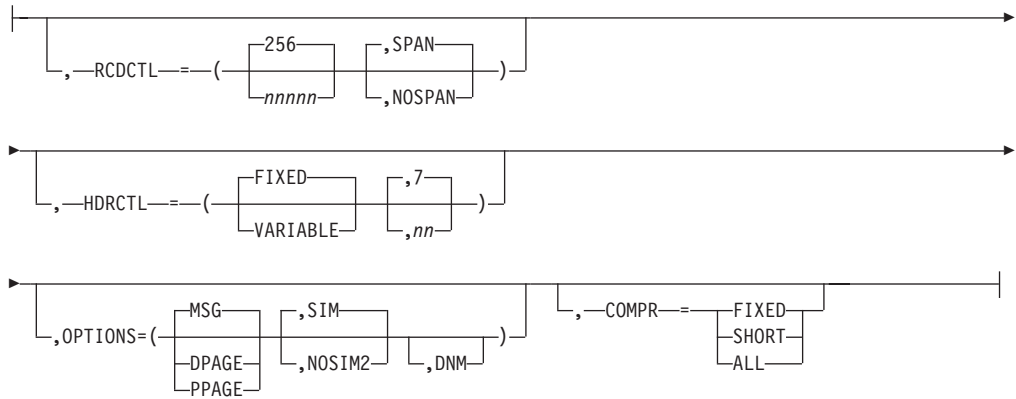


A:

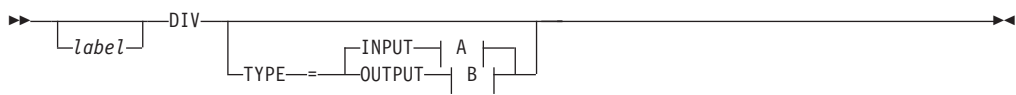


B:

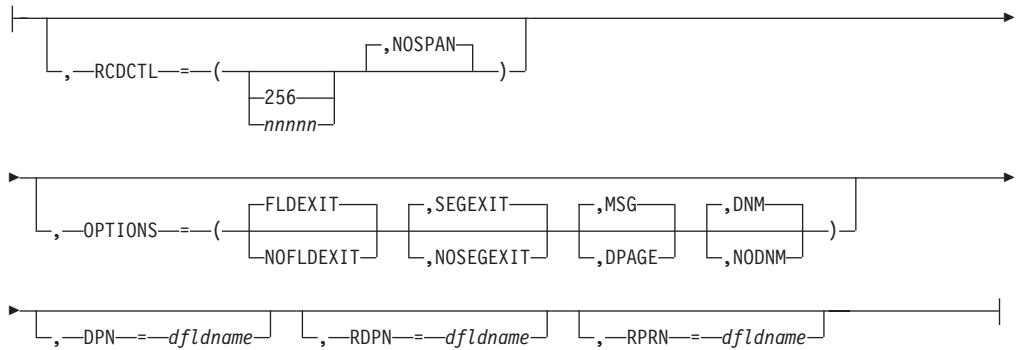
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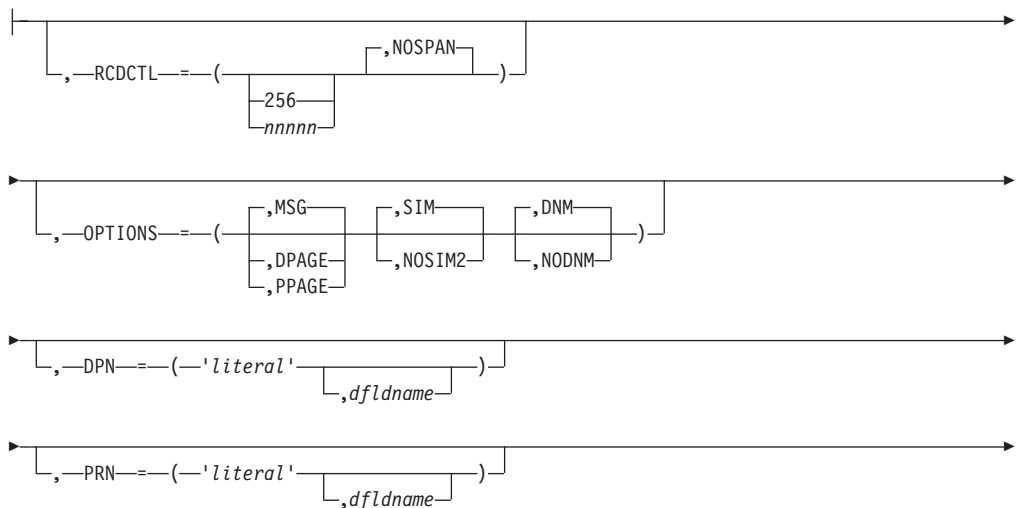
Format for DEV TYPE=DPM-Bn:

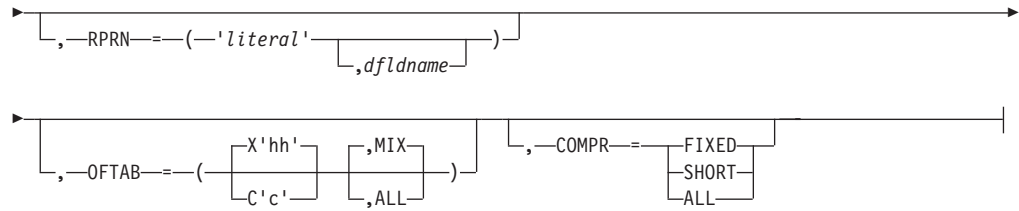


A:



:





Parameters:

label

A one- to eight-character alphanumeric name that is specified to uniquely identify this statement.

TYPE=

This describes the format as input, output, or both.

INOUT

Describes an input and output format.

INPUTOUTPUT

Describes an input-only format (INPUT) or an output-only format (OUTPUT). Certain DEV statement keywords can be used. For example:

- Specifying WIDTH=80 for DEV TYPE=SCS1 indicates that fields can be printed in columns 1 through 80 on output and received from columns 1 through 80 on input.
- Specifying WIDTH=80 for DEV TYPE=SCS2 indicates that both the card reader and card punch have the same number of punch positions.
- Specifying WIDTH=80 and HTAB=(SET,5) for DEV TYPE=SCS1 indicates that fields can be printed in columns 5 through 80 on output and received from columns 5 through 80 on input. In this case DFLD POS=(1,5) or POS=5 on input is the same as if you specified column 1 and a left margin position at 1.

You enter data the same way, regardless of where the left margin is currently set.

RCDCTL=

Creates record definitions even if RCD statements are used in the same format definition. RCDCTL is valid only if MODE=RECORD is specified on the DEV statement.

The first data field is the first field of the message for OPTIONS=MSG. The first data field is the first field of the DPAGE or PPAGE for OPTIONS=DPAGE and PPAGE, respectively. If the first data field does not fit in the same record as the output message header, and if OPTIONS=DPAGE or PPAGE has been specified, the first data record will be sent in the next transmission. The output message header will be transmitted by itself (as is always the case for OPTIONS=MSG).

256

The maximum length of an input or output transmission. The value 256 is valid only for DEV TYPE=DPM-An or DPM-Bn.

nnnnn

The maximum length of an input or output transmission. A value is valid only for DEV TYPE=DPM-An or DPM-Bn. The length cannot be greater

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than 32000 or less than the length of the message output header. For information about the DPM-An message output header, see the “HDRCTL parameter” on page 249.

When TYPE=OUTPUT is specified, *nnnn* is less than or equal to the output buffer size specified in the OUTBUF= macro at IMS system definition. If *nnnn* is greater than the OUTBUF= value specified, one record can require multiple output transmissions and can produce undesirable results in the remote program. If fields do not exactly fit in the defined records, and NOSPAN has been specified, records might not be completely filled.

SPAN

Specifies that fields can span records.

When TYPE=OUTPUT is specified you can specify SPAN only with DEV TYPE=DPM-An. Fields can span a record boundary but not a PPAGE boundary. The remote program must include logic to associate the partial fields or deal with them separately.

NOSPAN

Specifies that fields cannot span records. Every field is contained within a record and no field has a length greater than the value specified. NOSPAN is the default.

NULL=

Specifies how MFS is to handle trailing nulls. NULL= is valid only for DEV TYPE=DPM-An and TYPE=INPUT.

KEEP

Directs MFS to ignore trailing nulls.

DELETE

Directs MFS to search for and replace trailing nulls. MFS searches input message fields for trailing nulls or for fields that are all nulls, and replaces the nulls with the fill character specified in the message definition. See “Optional Deletion of Null Characters for DPM-An” on page 138 for a discussion of the effects of NULL=DELETE.

OPTIONS=

Specifies formatting and mapping of data.

DNM

Specifies the data name.

- For TYPE=INPUT:

DNM can be specified only for DEV TYPE=DPM-Bn. A specific DPAGE is selected to map the current or only data transmission when the DPAGE data name is supplied as the DSN parameter in the message header, and the DPAGE data name matches a defined DPAGE data name. If these conditions are not met, the last defined DPAGE name is used to map the data, unless the DPAGE is defined as conditional.

- For TYPE=OUTPUT:

DNM can be specified for DEV TYPE=DPM-An or DPM-Bn.

For DEV TYPE=DPM-An, use DNM with the FORS keyword on the DEV statement to specify a literal in the message header. See the discussion of the FORS= keyword and output message headers with

the forms literal in “Output Message Header” on page 166 and Chapter 3, “Message Processing,” on page 41. This parameter is optional.

For DEV TYPE=DPM-Bn, MFS includes the following in the DD header:

- The FMT name if OPTIONS=MSG
- The DPAGE name if OPTIONS=DPAGE
- The PPAGE name if OPTIONS=PPAGE

NODNM

Specifies that there is no data name.

- For TYPE=INPUT:

NODNM can be specified for either DEV TYPE=DPM-An or DPM-Bn. MFS selects a specific DPAGE by performing a conditional test on the data received and the COND= parameter.

- For TYPE=OUTPUT:

NODNM can be specified only for DEV TYPE=DPM-Bn. If NODNM is specified, no data structure name (DSN) is supplied in the DD header.

DPAGE

Specifies different ways of receiving and transmitting data, depending on the device type and whether TYPE=INPUT or TYPE=OUTPUT:

- For TYPE=INPUT:

For 274x, SCS1, SCS2, or FIN, or for DEV TYPE=DPM-An or DPM-Bn, DPAGE specifies that an input message can be created from multiple DPAGES.

If multiple DPAGE input is not requested in MFS definitions, messages cannot be created from more than one DPAGE.

If a single DPAGE is transmitted and contains more data than defined for the DPAGE selected, or multiple pages are transmitted, the input message is rejected and an error message is sent to the other subsystem.

- For TYPE=OUTPUT:

For DEV TYPE=DPM-An or DPM-Bn, DPAGE specifies that IMS transmits all DFLDs that are grouped in one page together. The logical page is transmitted in one or more records. If PPAGE statements are defined with the DPAGE, each PPAGE statement begins a new record. An additional logical page is sent when a paging request is received from the remote program. Each logical page is preceded by an output message header, and the label on the DPAGE is placed in the header. For DEV TYPE=DPM-Bn, the data structure name is optional in the DD header and depends on the specification of DNM or NODNM.

FLDEXIT

Specifies that the exit routine in the MSG definition MFLD is to be called for DEV TYPE=DPM-An or DPM-Bn and TYPE=INPUT.

FLDEXIT is the default.

This parameter is valid only when DEV TYPE=DPM-An or DPM-Bn and TYPE=INPUT.

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NOFLDEXIT

Specifies that the exit routine in the MSG definition MFLD is to be bypassed.

MSG

Specifies different ways of creating and transmitting messages, depending on the device and whether TYPE=INPUT or TYPE=OUTPUT:

- For TYPE=INPUT:

For DEV TYPE=274x, SCS1, SCS2, or FIN, or for DEV TYPE=DPM-An or DPM-Bn, MSG specifies that an input message can be created from a single DPAGE.

- For TYPE=OUTPUT:

For DEV TYPE=DPM-An or DPM-Bn and TYPE=OUTPUT, MSG is the default and specifies that IMS transmits all the DFLDs within a message together as a single message group. The message is preceded by an output message header. All DFLDs are transmitted. For DEV TYPE=DPM-Bn, the data structure name is optional in the header.

PPAGE

Specifies that IMS transmits the DFLDs that are grouped in one presentation page (PPAGE) together in one chain. PPAGE is valid only when DEV TYPE=DPM-An or DPM-Bn and TYPE=OUTPUT. The presentation page is transmitted in a group of one or more records. An additional presentation page is sent when a paging request is sent to IMS from the remote program. Each presentation page is preceded by an output message header, and the label on the PPAGE statement is placed in the header. For DEV TYPE=DPM-Bn, the data structure name is optional in the DD header and depends on the specification of DNM or NODNM.

SEGEXIT

Specifies that the exit routine in the MSG definition SEG is to be called for DEV TYPE=DPM-An or DPM-Bn and TYPE=INPUT. SEGEXIT is the default.

This parameter is valid only when DEV TYPE=DPM-An or DPM-Bn and TYPE=INPUT.

NOSEGEXIT

Specifies that the exit routine in the MSG definition SEG is to be bypassed.

SIM

Specifies that MFS is to simulate attributes. This is valid only when DEV TYPE=DPM-An or DPM-Bn and TYPE=OUTPUT. SIM indicates that MFS is to simulate the attributes specified by the IMS application program and place the simulated attributes in corresponding DFLDs that are defined with ATTR=YES or YES,*nn*. The first byte of the field is used for the simulated attributes.

If the MFLD does not supply 3270 attribute information (by means of the ATTR=YES or YES,*nn* operand) for the corresponding DFLD specifying ATTR=YES or YES,*nn*, a blank is sent in the first byte of the field. The application designer of the remote program or ISC subsystem is responsible for interpreting the simulated attribute within the remote program or ISC subsystem.

SIM is the default of SIM/NOSIM2.

NOSIM2

Specifies that MFS sends a bit string that is 2 bytes long to the remote program or subsystem. This bit string is sent exactly as received from the IMS application program. 3270 extended bytes, if any (ATTR=YES,*nn*), are always sent as received from the application program and follow the 2-byte string of 3270 attributes.

If the MFLD does not supply attribute information, binary zeros are sent in the 2 bytes preceding the data for the field.

For more information on the ATTR parameter on the MFLD statement, see “MFS Language Utility” in the *IMS Version 9: Utilities Reference: Database and Transaction Manager*.

HDRCTL=

Specifies, for DEV TYPE=DPM-An and DIV TYPE=OUTPUT only, the characteristics of the output message header.

FIXED

Specifies that a fully padded output message header is to be sent to the remote program. The structure of the fixed output message header is the same for all DPM output messages that are built using this FMT definition. The content of the output message header is shown in an example under “Output Format Control for SLU P DPM-An” on page 165. The base DPM output message header has a length of 7, and includes the version ID.

VARIABLE

Specifies that MIDNAME and DATANAME have trailing blanks omitted and their length fields adjusted accordingly. If MIDNAME is not used, neither the MIDNAME field nor its length is present.

nn Specifies the minimum length of the header, that is, the base header without MFS fields, as shown in the example under “Output Format Control for SLU P DPM-An” on page 165. The default is 7, which is the length of the base message header for DPM. Specifying other than 7 can cause erroneous results in the remote program.

The parameters RDPN=, DPN=, PRN=, and RPRN= refer to both the ISC ATTACH function management header and the equivalent ISC SCHEDULER function management header.

RDPN=

For DIV TYPE=INPUT, the *dflname* specification permits the suggested return destination process name (RDPN) to be supplied in the input message MFLD referencing this *dflname*. If *dflname* is not specified, no RDPN is supplied in the input message.

DPN=

For DIV TYPE=OUTPUT, the *literal* specification requests MFS to use this literal as the DPN in the output ATTACH message header. *literal* cannot exceed eight characters, and must be enclosed in single quotes. If the *dflname* is also specified, the data supplied in the MFLD referencing this *dflname* is used as the DPN in the output ATTACH message header. If no output message MFLD reference to the *dflname* exists, *literal* is used. If the data in the MFLD referencing the *dflname* is greater than eight characters, the first eight characters are used.

PRN=

For DIV TYPE=INPUT, the *dflname* specification permits the suggested primary resource name (PRN) to be supplied in the input message MFLD

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referencing this *dflename*. If the *dflename* is not specified, no PRN is supplied in the input message to the application program.

For DIV TYPE=OUTPUT, the '*literal*' specification requests MFS to use *literal* as the PRN in the output ATTACH message header. *literal* cannot exceed eight characters and must be enclosed in single quotes. If the *dflename* is also specified, the data supplied in the MFLD referencing this *dflename* is used as the PRN in the output ATTACH message header. If no output message MFLD reference to the *dflename* exists, '*literal*' is used. If the data in the MFLD referencing the *dflename* is greater than eight characters, the first eight characters are used.

RPRN=

For DIV TYPE=INPUT, the *dflename* specification permits the suggested return primary resource name (RPRN) to be supplied in the input message MFLD referencing this *dflename*. If *dflename* is not specified, no RPRN is supplied in the input message to the application program.

For DIV TYPE=OUTPUT, '*literal*' specification requests MFS to use *literal* as the suggested return primary resource name (RPRN) in the output ATTACH message header. *literal* cannot exceed 8 characters and must be enclosed in single quotes. If the *dflename* is also specified, the data supplied in the MFLD referencing this *dflename* is used as the RPRN in the output ATTACH message header. If no output message MFLD reference to the *dflename* exists, '*literal*' is used. If the data in the MFLD referencing the *dflename* is greater than 8 characters, the first 8 characters are used.

OFTAB=

Directs MFS to insert output field tab separator characters in the output data stream for the message. If OPTIONS=DNM and OFTAB, then the OFTAB character is placed in the DD header and an indicator is set to MIX or ALL. If OPTIONS=NODNM, then no DD header is sent.

X'*hh*'

Specifies a hexadecimal character (*hh*) to be used as the output field tab separator character. X'3F' and X'40' are invalid.

C'*c*'

Specifies a character (*c*) to be used as the output field tab separator character. You cannot specify a blank for the character (C' ').

The character specified cannot be present in the data stream from the IMS application program. If it is present, it is changed to a blank (X'40').

If an output field tab separator character is defined, either MIX or ALL can also be specified. The default is MIX.

MIX

Specifies that the output field tab separator character is inserted into each individual field with no data or with data that is less than the defined DFLD length.

ALL

Specifies that the output field tab separator character is inserted into all fields, regardless of data length.

COMPR=

Directs MFS to remove trailing blanks from short fields, fixed-length fields, or all fields presented by the application program.

For DPM-An devices, trailing blanks are removed from the end of a segment if all of the following are specified:

- FILL=NULL or FILL=PT
- GRAPHIC=YES for the current segment being mapped
- OPT=1 or OPT=2, in the MSG segment

If these conditions are met, trailing blanks are replaced as follows:

FIXED

Specifies that trailing blanks from fixed-length fields are replaced by nulls.

SHORT

Specifies that trailing blanks from fields shortened by the application are replaced by nulls.

ALL

Specifies that trailing blanks from all fields are replaced by nulls.

The trailing nulls are compressed at the end of the record. For more information on the FILL= operand of the MFLD statement, see “MFS Language Utility” in the *IMS Version 9: Utilities Reference: Database and Transaction Manager*.

For DPM-Bn devices, trailing blanks are removed if all of the following are specified:

- OFTAB (on the current DIV statement), FILL=NULL, or FILL=PT
- GRAPHIC=YES for the current segment being mapped
- OPT=1 or OPT=2 in the MSG segment

If these conditions are met, trailing blanks are removed as follows:

FIXED

Specifies that trailing blanks are to be removed from fixed-length fields.

SHORT

Specifies that trailing blanks are to be removed from fields shortened by the application.

ALL

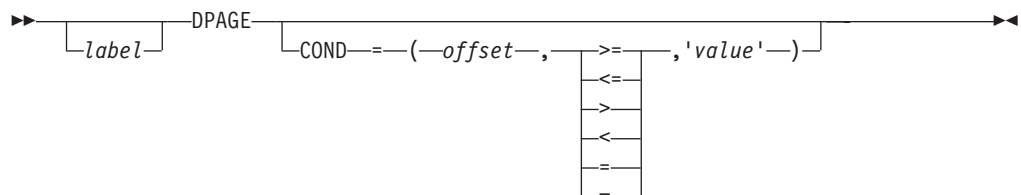
Specifies that trailing blanks are to be removed from all fields.

For additional information on blank compression for DPN-BN devices, see “Trailing Blank Compression” on page 173.

DPAGE Statement

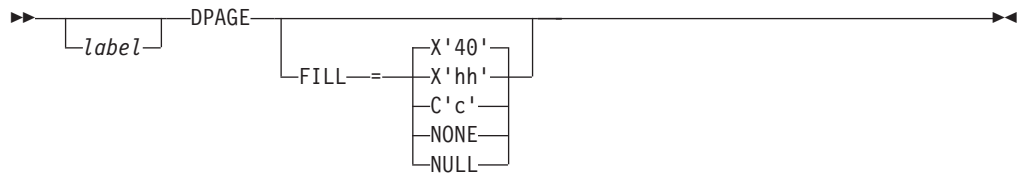
The DPAGE statement defines a logical page of a device format. This statement can be omitted if none of the message descriptors referring to this device format (FMT) contain LPAGE statements and no specific device option is required.

Format for DEV TYPE=274X, DPM-An, or DPM-Bn AND DIV TYPE=INPUT:

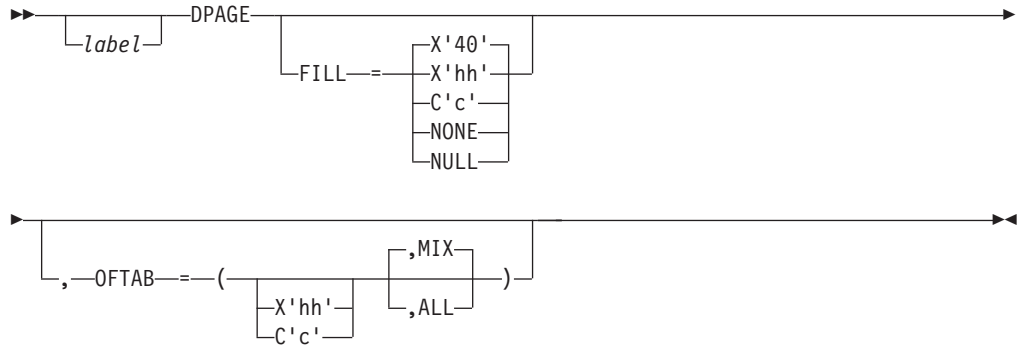


Format for DEV TYPE=274X or DPM-An AND DIV TYPE=OUTPUT:

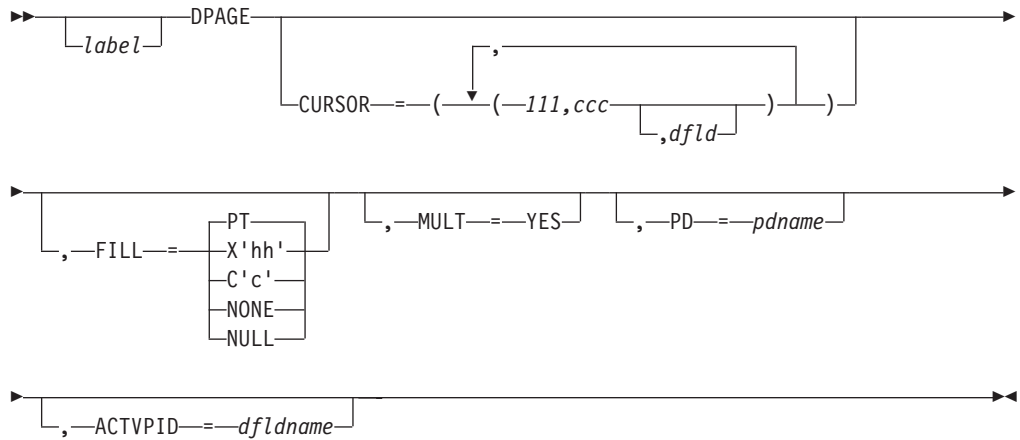
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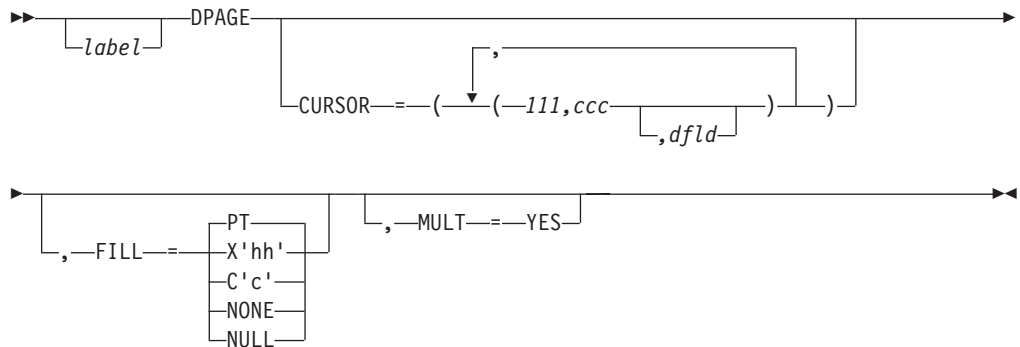
Format for DEV TYPE=DPM-Bn AND DIV TYPE=OUTPUT:



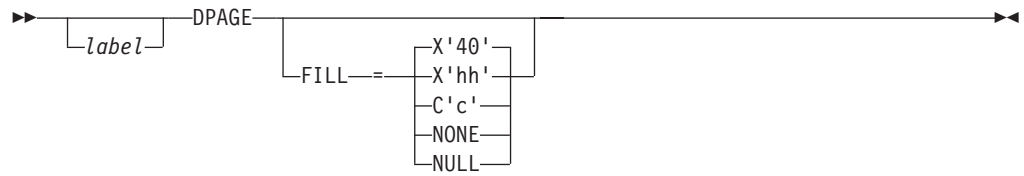
Format for DEV TYPE=3270-An:



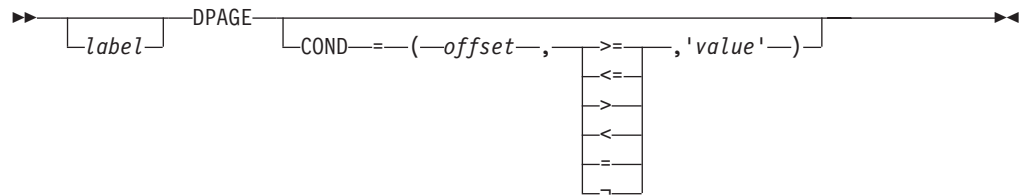
Format for DEV TYPE=3270:



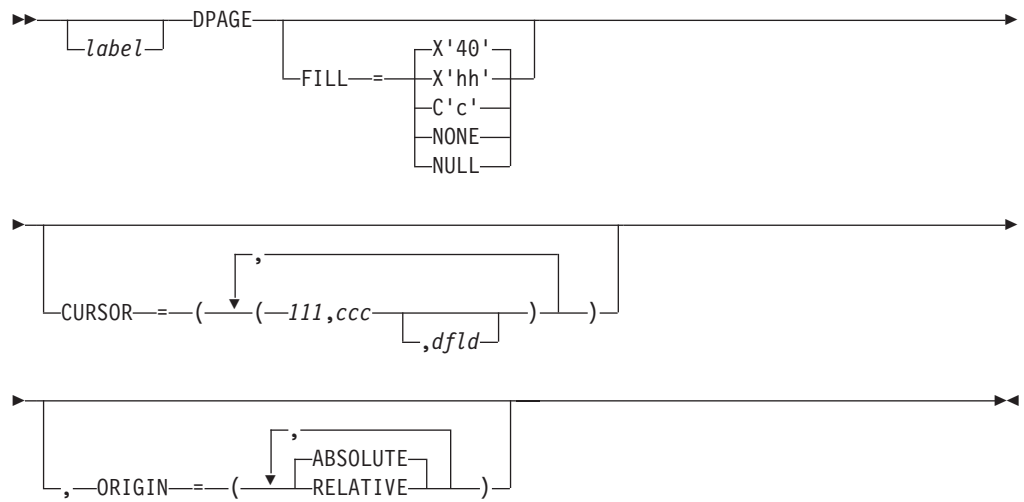
Format for DEV TYPE=3270P:



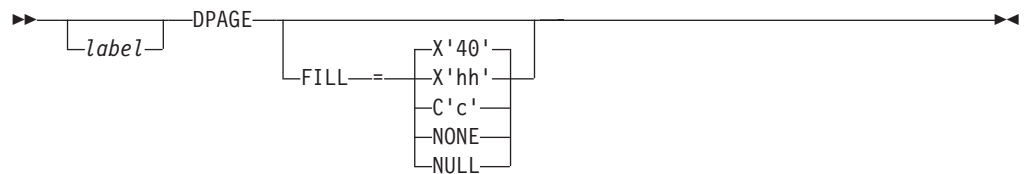
Format for DEV TYPE=FIN:



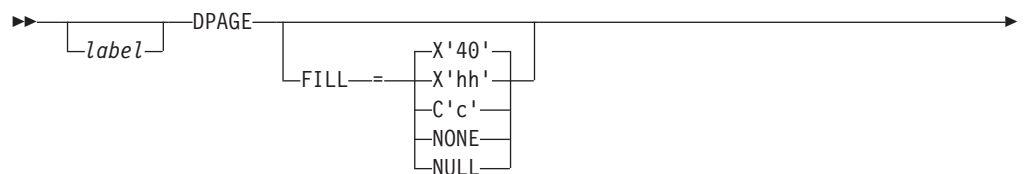
Format for DEV TYPE=FIDS, FIDS3, FIDS4, or FIDS7:



Format for DEV TYPE=FIJP or FIPB:



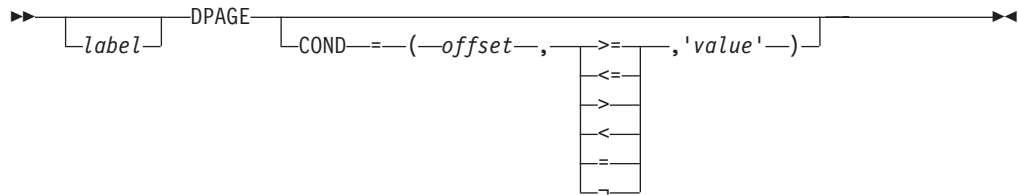
Format for DEV TYPE=FIFP:



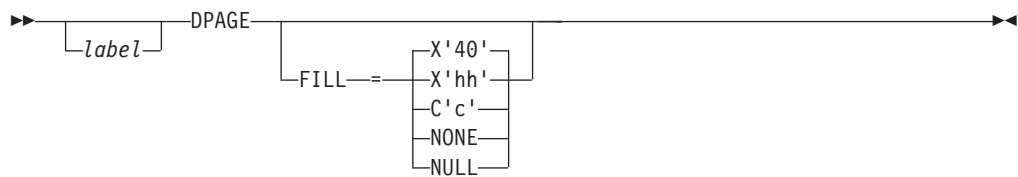
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Format for DEV TYPE=SCS1 or SCS2 AND DIV TYPE=INPUT:



Format for DEV TYPE=SCS1 or SCS2 AND DIV TYPE=OUTPUT:



Parameters:

label

A 1- to 8-byte alphanumeric name can be specified for this device format that contains LPAGE SOR= references, or if only one DPAGE statement is defined for the device. If multiple DEV statements are defined in the same FMT definition, each must contain DPAGE statements with the same label.

For device type DPM-An and DIV statement OPTIONS=DPAGE, this name is sent to the remote program as the data name in the output message header. If *label* is omitted, MFS generates a diagnostic name and sends it to the remote program in the header. If the DPAGE statement is omitted, the label on the FMT statement is sent in the output message header. If OPTIONS=DNM, the label on the FMT statement is sent as the DSN in the DD header.

COND=

Specifies a conditional test to be performed on the first input record. The offset specified is relative to zero. The specification of the offset must allow for the LLZZ field of the input record (for example, the first data byte is at offset 4). If the condition is satisfied, the DFLDs defined following this DPAGE are used to format the input. When no conditions are satisfied, the last defined DPAGE will be used only if the last defined DPAGE does not specify COND=. If the COND= parameter is specified for the last DPAGE defined and the last defined DPAGE condition is not satisfied, the input message will be rejected. Multiple LPAGE definitions are allowed in message input definitions.

If this keyword is specified, and OPTIONS=NODNM is specified on the DIV statement, this specification is used for DPAGE selection. If this keyword is specified and OPTIONS=DNM is specified on the DIV statement, the COND= specification is ignored and the data structure name from the DD header is used for DPAGE selection.

Lowercase data entered from 274X, Finance, SCS1, or SCS2 keyboards is not translated to uppercase when the COND= comparison is made. Therefore, the literal operand must also be in lowercase.

FILL=

Specifies a fill character for output device fields. Default value for all device types except the 3270 display is X'40'; default for the 3270 display is PT. For 3270 output when EGCS fields are present, only FILL=PT or FILL=NULL should be specified. A FILL=PT erases an output field (either a 1- or 2-byte field) only when data is sent to the field, and thus does not erase the DFLD if the application program message omits the MFLD. For DPM-Bn, if OFTAB is specified, FILL= is ignored and FILL=NULL is assumed.

NONE

Must be specified if the fill character from the message output descriptor is to be used to fill the device fields.

X'hh'

Specifies a hexadecimal character (*hh*) that is used to fill the device fields.

C'c'

Specifies a character (*c*) that is used to fill the device fields.

NULL

Specifies that fields are not to be filled. For devices other than the 3270 display, *compacted lines* are produced when message data does not fill the device fields.

For DPM-An devices, trailing nulls (X'3F') are removed from all records transmitted to the remote program or subsystem. Trailing nulls are removed up to the first non-null character. Null characters between non-null characters are transmitted. If the entire record is null, but more data records follow, a record containing a single null is transmitted to the remote program. If the entire record is null and more records follow, if OPTIONS=MSG or DPAGE, or in a PPAGE, if OPTIONS=PPAGE, then all null records are deleted to the end of that DPAGE or PPAGE.

PT

Is identical to NULL except for the 3270 display. For the 3270 display, specifies that output fields that do not fill the device field (DFLD) are followed by a program tab character to erase data previously in the field; otherwise, this operation is identical to FILL=NULL.

For 3270 display devices, any specification with a value less than X'3F' is changed to X'00' for control characters or to X'40' for other nongraphic characters. For all other devices, any FILL=X'hh' or FILL=C'c' specification with a value less than X'3F' is ignored and defaulted to X'3F' (which is equivalent to a specification of FILL=NULL).

MULT=YES

Specifies that multiple physical page input messages are allowed for this DPAGE.

CURSOR=

Specifies the position of the cursor on a physical page. Multiple cursor positions might be required if a logical page or message consists of multiple physical pages. The value *lll* specifies line number and *ccc* specifies column. Both *lll* and *ccc* must be greater than or equal to 1. The cursor position must either be on a defined field or defaulted. The default *lll,ccc* value for 3270 displays is 1,2. For Finance display components, if no cursor position is specified, MFS does not

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position the cursor—the cursor is normally placed at the end of the output data on the device. For Finance display components, all cursor positioning is absolute, regardless of the `ORIGIN=` parameter specified.

The `dfld` parameter provides a method for supplying the application program with cursor information on input and allowing the application program to specify cursor position on output.

Recommendation: Use the cursor attribute facility (specify `ATTR=YES` in the `MFLD` statement) for output cursor positioning.

The `dfld` parameter specifies the name of a field containing the cursor position. This name can be referenced by an `MFLD` statement and must *not* be used as the label of a `DFLD` statement in this `DEV` definition. The format of this field is two binary halfwords containing line and column number, respectively. When this field is referred to by a message input descriptor, it contains the cursor position at message entry. If referred to by a message output descriptor, the application program places the desired cursor position into this field as two binary halfwords containing line and column, respectively. Binary zeros in the named field cause the values specified for `///,ccc` to be used for cursor positioning during output. During input, binary zeros in this field indicate that the cursor position is not defined. The input `MFLD` referring to this `dfld` should be defined within a segment with `GRAPHIC=NO` specified or should use `EXIT=(0,2)` to convert the binary numbers to decimal.

ORIGIN=

Specifies page positioning on the Finance display for each physical page defined. Default value is `ABSOLUTE`.

ABSOLUTE

Erases the previous screen and positions the page at line 1 column 1. The line and column specified in the `DFLD` statement become the actual line and column of the data on the screen.

RELATIVE

Positions the page starting on column 1 of the line following the line where the cursor is positioned at time of output. Results might be undesirable unless all output to the device is planned in a consistent manner.

OFTAB=

Directs `MFS` to insert the output field tab separator character specified on this `DPAGE` statement for the output data stream of the `DPAGE` being described.

X'hh'

Specifies a hexadecimal character (`hh`) to be used as the output field tab separator character. `X'3F'` and `X'40'` are invalid.

C'c'

Specifies a character (`c`) to be used as the output field tab separator character. You cannot specify a blank for the character (`C' '`).

The character specified cannot be present in data streams from the `IMS` application program. If it is present, it is changed to a blank (`X'40'`).

If the output field tab separator character is defined, either `MIX` or `ALL` can also be specified. Default value is `MIX`.

MIX

Specifies that an output field tab separator character is to be inserted into each individual field with no data or with data less than the defined `DFLD` length.

ALL

Specifies that an output field tab separator character is to be inserted into all fields, regardless of data length.

SELECT=

Specifies carriage selection for a FIFP device with FEAT=DUAL specified in the previous DEV statement. It is your responsibility to ensure that proper forms are mounted and that left margins are set properly. Default value is LEFT.

LEFT

Causes the corresponding physical page defined in this DPAGE to be directed to the left platen.

RIGHT

Causes the corresponding physical page defined in this DPAGE to be directed to the right platen.

DUAL

Causes the corresponding physical page defined in this DPAGE to be directed to both the left and right platens.

PD=

(for the 3180 and 3290 in partition formatted mode) Specifies the name of the partition descriptor of the partition associated with the DPAGE statement. This is the parameter that maps a logical page of a message to or from the appropriate partition. The name of the PD must be contained within the PDB statement specified in the DEV statement.

ACTVPID=

(for the 3290 in partition formatted mode) Specifies the name of an output field in the message containing the partition identification number (PID) of the partition to be activated. This *dfldname* must be referenced by an MFLD statement and must not be used as the label of a DFLD statement in the DEV definition. The application program places the PID of the partition to be activated in this field. The PID must be in the format of a two byte binary number ranging from X'0000' to X'000F'.

Restriction: Do not specify this operand for the 3180. Because only one partition is allowed for this device, you do not need to specify an active partition.

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Chapter 9. DL/I Calls for Transaction Management

This chapter describes the format for DL/I calls you can use with IMS TM to perform transaction management functions in your application program. Transaction management calls must use either *i/o pcb* or *aib* parameters.

Each call description contains:

- A syntax diagram
- A definition for each parameter that can be used in the call
- Details on how to use the call in your application program
- Restrictions on the use of the call

Each parameter is described as an input or output parameter. “Input” refers to input to IMS from the application program. “Output” refers to output from IMS to the application program.

The syntax diagrams for the transaction management calls do not contain the complete call structure. Instead, the calls begin with the *function* parameter. The call, the call interface (xxxTDLI), and *parmcount* (if it is required) are not included in the syntax diagrams. See language-specific information (for COBOL, C language, Pascal, PL/I, and assembler language) in Chapter 2, “Defining Application Program Elements,” on page 11 for the complete structure.

The following topics provide additional information:

- “Transaction Management Call Summary”
- “AUTH Call” on page 266
- “CHNG Call” on page 271
- “CMD Call” on page 279
- “GCMD Call” on page 281
- “GN Call” on page 282
- “GU Call” on page 283
- “ISRT Call” on page 285
- “PURG Call” on page 288
- “SETO Call” on page 290

| **Related Reading:** For more information about DL/I calls used for database
| management, see *IMS Version 9: Application Programming: Database Manager*.
| EXEC DL/I commands used in CICS are described in *IMS Version 9: Application*
| *Programming: EXEC DLI Commands for CICS and IMS*. DCCTL users can issue
| calls using GSAM database PCBs, which are described in *IMS Version 9:*
| *Application Programming: Database Manager*.

Transaction Management Call Summary

Table 63 on page 266 summarizes the parameters that are valid for each of the transaction management message calls. Table 63 on page 266 lists the function code, its meaning, use, parameters, and in which regions it is valid. Optional parameters are enclosed in brackets, [].

Exception: Language-dependent parameters are not shown here. The variable *parmcount* is required for all PLITDLI calls. Either *parmcount* or **VL** is required for

Transaction Management Call Summary

assembler language calls. Parmcount is optional in COBOL, C, and Pascal programs. See “Formatting DL/I Calls for Language Interfaces” on page 11 for language-specific information.

Related Reading: For detailed information on each call, its parameters, usage, and restrictions, see Chapter 9, “DL/I Calls for Transaction Management,” on page 265. For information on writing calls with programming language interfaces, see Chapter 2, “Defining Application Program Elements,” on page 11.

Table 63. Summary of TM Message Calls

Function Code	Meaning	Use	Parameters	Valid for
AUTH	Authorization	Verifies user's security authorization.	function, i/o pcb or aib, i/o area	DB/DC, DCCTL
CHNG	Change	Sets destination on modifiable alternate PCB	function, alt pcb or aib, destination name[, options list, feedback area]	DB/DC, DCCTL
CMD	Command	Used by a program to issue IMS commands	function, i/o pcb or aib, i/o area	DB/DC, DCCTL
GCMD	Get Command	Retrieves second and any subsequent responses to a command	function, i/o pcb or aib, i/o area	DB/DC, DCCTL
GN	Get Next	Retrieves second and any subsequent message segments	function, i/o pcb or aib, i/o area	DB/DC, DCCTL
GU	Get Unique	Retrieves the first segment of a message	function, i/o pcb or aib, i/o area	DB/DC, DCCTL
ISRT	Insert	Builds an output message in a program's I/O area	function, i/o or alt pcb or aib, i/o area [,mod name.]	DB/DC, DCCTL
PURG	Purge	Enqueues messages from a PCB to destinations	function, i/o or alt pcb or aib[, i/o area, mod name.]	DB/DC, DCCTL
SETO	Set options. Sets processing options for advanced print functions and APPC/IMS message processing.	Feedback area returns information about errors in the options list.	function, i/o pcb or alternate pcb or aib, i/o area, options list[, feedback area]	BMP, MPP, IFP DB/DC, DCCTL

AUTH Call

An Authorization (AUTH) call verifies each user's security authorization. It determines whether a user is authorized to access the resources specified on the AUTH call.

Format



Call Name	DB/DC	DBCTL	DCCTL	DB Batch	TM Batch
AUTH	X		X		

Parameters

i/o pcb

Specifies the I/O PCB, the first PCB address in the list that is passed to the program. This parameter is an input and output parameter.

aib

Specifies the application interface block (AIB) that is used for the call. This parameter is an input and output parameter.

The following fields must be initialized in the AIB:

AIBID

Eyecatcher. This 8-byte field must contain DFSAIBbb.

AIBLEN

AIB lengths. This field must contain the actual length of the AIB that the application program obtained.

AIBRSNM1

Resource name. This 8-byte, left-justified field must contain the PCB name IOPCBbbb.

AIBOALEN

I/O area length. This field must contain the length of the I/O area that is specified in the call list.

i/o area

Specifies the I/O area used for the call. This parameter is an input and output parameter.

I/O Area

Table 64 and Table 65 show the format of the parameter list in the I/O area before the AUTH call is issued. Table 66 on page 268 and Table 67 on page 269 show the I/O area after the AUTH call.

I/O area before the AUTH call

Table 64. I/O Area before the AUTH Call is Issued for AIBTDLI, ASMTDLI, CBLTDLI, CEETDLI, CTDLI, and PASTDLI interfaces

Field Name	Field Length
LL	2
ZZ	2
CLASSNAME	8
RESOURCE	8
USERDATA	8

Table 65. I/O Area before the AUTH Call is Issued for the PLITDLI interface

Field Name	Field Length
LLLL	4
ZZ	2

TM Message Call: AUTH

Table 65. I/O Area before the AUTH Call is Issued for the PLITDLI interface (continued)

Field Name	Field Length
CLASSNAME	8
RESOURCE	8
USERDATA	8

LL or LLLL

specifies a 2-byte field that contains the length of the parameter list, including two bytes for LL. For the PLITDLI interface, use the 4-byte field LLLL. However, if you use the AIBTDLI interface, PL/I programs require only a 2-byte field.

ZZ specifies a 2-byte field that contains binary zeros.

CLASSNAME

specifies an 8-byte field that contains one of the following values:

TRANbbbb
DATABASE
SEGMENTb
FIELDbbb
OTHERbbb

All parameters are 8 bytes in length, left-justified, and must be padded to the right with blanks.

The use of a generic class name in the call parameter list eliminates the need for the application to be sensitive to the actual Resource Access Control Facility (RACF) class names being used. Since transaction authorization must be active, only the RACF class associated with the generic class name identifier for the transaction class must be defined. The generic class name in the call parameter list causes the authorization function to select the proper RACF class and request access checking for that class.

RESOURCE

specifies the 8-byte field that contains the name of the resource to be checked. Except for the generic class TRAN, the resource name can be whatever the application designates because the name has no meaning for IMS TM.

IMS TM performs no validity checking of the resource name.

USERDATA

specifies the 8-byte keyword constant USERDATA is the only value supported. Its presence in the parameter list means that the application program wants any RACF installation data that exists in the RACF Accessor Environment Element (ACEE).

I/O area after the AUTH call

Table 66. I/O Area after the AUTH Call is Issued for AIBTDLI, ASMTDLI, CBLTDLI, CEETDLI, CTDLI, and PASTDLI interfaces

Field Name	Field Length
LL	2
ZZ	2
FEEDBACK	2
EXITRC	2
STATUS	2

Table 66. I/O Area after the AUTH Call is Issued for AIBTDLI, ASMTDLI, CBLTDLI, CEETDLI, CTDLI, and PASTDLI interfaces (continued)

Field Name	Field Length
RESERVED	16
UL	2
USERDATA	Variable

Table 67. I/O Area after the AUTH Call is Issued for the PLITDLI interface

Field Name	Field Length
LLLL	4
ZZ	2
FEEDBACK	2
EXITRC	2
STATUS	2
RESERVED	16
UL	2
USERDATA	Variable

LL or LLLL

A 2-byte field that contains the length of the character string, plus 2 bytes for LL. For the PLITDLI interface, use the 4-byte field LLLL. However, if you use the AIBTDLI interface, PL/I programs require only a 2-byte field.

ZZ specifies a 2-byte field that contains binary zeros.

FEEDBACK

specifies a 2-byte field that contains one of the following RACF return codes:

- 0000** User is authorized.
- 0004** Resource or class not defined.
- 0008** User is not authorized.
- 000C** RACF is not active.
- 0010** Invalid installation exit return code.

EXITRC

specifies a 2-byte field that contains the return code from the user exits if they were used. The EXITRC field contains the return code from the last user exit that was entered. If none of the user exits are present or invoked, the field contains binary zeros. If installation data is returned from the exit, the EXITRC field is set to zero to indicate an authorized return code from the exit.

STATUS

specifies a 2-byte field that contains the hexadecimal status code indicating installation data status:

- 0000** RACF installation data is present in the I/O area.
- 0004** Security exit installation data present in then I/O area.
- 0008** User is not currently signed on.
- 000C** User is not authorized, so installation data is not made available, or user is authorized, but no installation data has been defined.

TM Message Call: AUTH

0010 User was authorized, but installation data was not requested.

0014 USERDATA exceeds PSBWORK area length.

0018 RACF not active and TRN=N defined.

RESERVED

Binary zeros (reserved)

UL

specifies a 2-byte field that specifies the length of the installation data, including the length of the UL parameter.

USERDATA

specifies a variable-length field that contains installation data from ACEE or a user security exit. The length of the installation data is limited to 1026 bytes, including the length (UL) field. If a security exit returns a value greater than 1026, IMS truncates the installation data and adjusts the length field to represent the amount of installation data actually returned to the application program. If security exit installation data is returned, IMS passes it to the application program even if the parameter list did not contain the USERDATA parameter.

Any available installation data is returned if the return code from RACF indicates that the user is authorized to the resource named in the call parameter list. No installation data is returned if the user who originated the transaction is no longer signed on to the terminal associated with the transaction. Installation data might or might not be provided by the security exits when they are involved in the security decision. However, when either of the exits returns installation data, IMS passes it on to the application program.

If provided, installation data is returned from a security exit to the application even when the call parameter list does not specify the USERDATA parameter. In that case, the STATUS field of the I/O area contains the code X'0004' indicating the presence of the installation data.

Usage

The AUTH call determines whether a user is authorized to access the resources specified on the AUTH call. AUTH is issued with an I/O PCB and its function depends on the application program. Authorization checking depends on the dependent region type and whether a GU call has been issued. The call functions are as follows:

- In BMPs, AUTH uses the user ID of the IMS control region or installation specific user exits to determine the status of the call.
- For BMPs that have issued a successful GU call to the I/O PCB, AUTH functions as it does in an MPP.
- In MPPs, AUTH verifies user authorization with RACF for the specified resource classes of those resources used by the application program.

Because the call can request RACF user data to be passed back in the I/O area as installation data, the processing of the call always results in changes to the STATUS field in the I/O area. This STATUS field notifies the application of the status of installation data in the I/O area: available or not available. It might not be available because the installation data is not defined or the originating user is no longer signed on to the IMS system.

Either of the supported security exits for transaction authorization (DFSCTRN0 or DFSCTSE0) can present installation data upon return to IMS. If an exit returns

installation data, the data is returned to the application even if the parameter list did not contain the USERDATA parameter. The STATUS field is set to indicate the origination of the installation data. The STATUS field indicates the presence of either RACF installation data or security exit installation data.

The application program also receives notification of the actual RACF return code. This return code, presented as FEEDBACK in the I/O area, can be used by the application program to detect inconsistent operational modes and take alternate action. Examples of inconsistent operational modes are the proper RACF classes not being defined or the requested resource not properly defined to RACF.

By checking the FEEDBACK, EXITRC, and STATUS in the I/O area, the application program can be sensitive to issues such as the proper RACF definitions and resources not being defined. If RACF is being used, and the AUTH call references any resources that are not defined, the PCB status code is set to blanks and the FEEDBACK field of the I/O area is set to indicate that the resource is not protected.

Because the value for EXITRC is provided by a user security exit, use of this field must be made with an understanding of exit operation and the knowledge that any changes to the exit can result in application errors. If due to operational errors, the proper resources are not protected, the application can deal with the error in any way. This feedback can make operational control simpler and give the application more flexibility.

Related Reading: RACF terms and concepts are discussed in more detail in other information units. For additional information, see *IMS Version 9: Administration Guide: System* and *IMS Version 9: Customization Guide*.

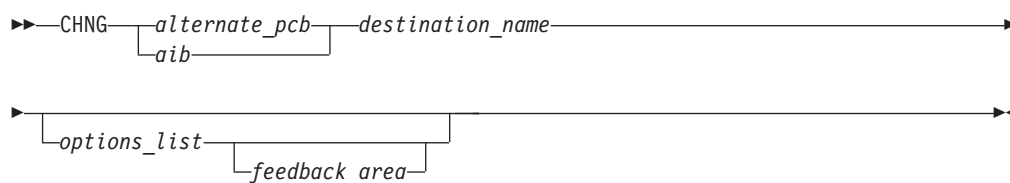
Restrictions

The AUTH call must not be issued before a successful GU call to the I/O PCB.

CHNG Call

The Change (CHNG) call sets the destination of a modifiable alternate PCB to the logical terminal, LU 6.2 descriptor, or transaction code that you specify. You can also use the CHNG call with the Spool Application Program Interface (Spool API) to specify print data set characteristics.

Format



Call Name	DB/DC	DBCTL	DCCTL	DB Batch	TM Batch
CHNG	X		X		

Parameters

alternate pcb

Specifies the modifiable alternate PCB to use for this call. This parameter is an input and output parameter.

aib

Specifies the application interface block (AIB) that is used for the call. This parameter is an input and output parameter.

The following fields must be initialized in the AIB:

AIBID

Eyecatcher. This 8-byte field must contain DFSAIBbb.

AIBLEN

AIB lengths. This field must contain the actual length of the AIB that the application program obtained.

AIBRSNM1

Resource name. This 8-byte, left-justified field must contain the name of a modifiable alternate PCB.

AIBOALEN

I/O area length. This field must contain the length of the I/O area that is specified in the call list.

destination name

Specifies an 8-byte field containing the destination name (the logical terminal or transaction code) to which you want messages sent. This parameter is an input parameter. The destination name can be up to 8 bytes. When you specify LU 6.2 options, IMS TM sets the destination name in the alternate PCB to DFSLU62b. If an LU 6.2 options list is specified the destination name parameter is ignored.

For more information on LU 6.2, see *IMS Version 9: Administration Guide: Transaction Manager*.

Restriction: Some destination names are invalid. For more information on resource naming rules, see *IMS Version 9: Installation Volume 2: System Definition and Tailoring*.

options list

Specifies one of several option keywords. This parameter is an input parameter. The options in the list are separated by commas and cannot contain embedded blanks. Processing for the options list terminates when the first blank in the list is reached or when the specified options list length has been processed. You can specify options for advanced print functions or for APPC (see “Advanced Print Function Options” on page 274 and “APPC Options” on page 276).

For more information on APPC, see *IMS Version 9: Administration Guide: Transaction Manager*.

The format for the options list is shown here:

LL or LLLL ^{1, 2, 3}	ZZ	keyword1=variable1
Halfword length of the options string, including the 4-byte length of LLZZ or LLLLZZ.	Halfword of zero.	CHNG options separated by commas.

LL or LLLL ^{1, 2, 3}	ZZ	keyword1=variable1
--------------------------------------	-----------	---------------------------

Notes:

1. For application programs that use the PLITDLI interface, the length field is a fullword (LLLL). However, the length of the LLLLZZ field is still considered four bytes.
2. If the length field is set to zero, the options list is ignored. IMS TM processes the CHNG call as if the *options list* parameter was not specified.
3. A keyword must be separated from the following variable by an equal sign (=). A keyword with no variable must be delimited by a comma or blank.

feedback area

Specifies an optional parameter used to return error information about the options list to the application program. This parameter is an output parameter. The amount of information that the application program receives is based on the size of the feedback area. If no feedback area is specified, the status code returned is the only indication of an options list error. If you specify a feedback area 1½ to 2 times the size of the specified options list (a minimum of eight words), IMS TM returns more specific information about errors in the options list.

The format for the feedback area passed to IMS in the call list is as follows:

LL or LLLL ^{1, 2}	ZZ
Halfword length of the feedback area, including the 4-byte length of the LLZZ fields.	Halfword of zero.

Notes:

1. For application programs that use the PLITDLI interface, the length field is a fullword (LLLL). However, the length of the LLLLZZ field is still considered 4 bytes.
2. If the length field is set to zero, the feedback area is ignored. IMS TM processes the CHNG call as if the *feedback area* parameter was not specified.

The output format returned to the application program from IMS for the feedback area is as follows:

LLZZ or LLLLZZ	LL	<i>feedback data</i>
The length field as specified in the input format for the feedback area.	Halfword length of the feedback data returned by IMS TM, including the 2-byte LL field.	Data returned by IMS TM. The feedback data generally includes the option keyword found to be in error and a 4-byte EBCDIC code in parentheses that indicates the reason for the error. Multiple errors are separated by commas.

Usage

Use the CHNG call to send an output message to an alternate destination in your system or in another system. When you issue the CHNG call, you supply the name of the destination to which you want to send the message. The alternate PCB you name then remains set to that destination until you do one of the following:

- Issue another CHNG call to reset the destination.
- Issue a Get Unique (GU) call to the message queue to start processing a new message. In this case, the name of the PCB you specify with the CHNG call still appears in the alternate PCB, even though it is no longer valid.

TM Message Call: CHNG

- Terminate the application program. When you terminate the application, IMS TM resets the destination to blanks.

For more information on sending messages to alternate terminals, see “ISRT Call” on page 285 and “PURG Call” on page 288.

You can use the CHNG call to perform Spool API functions.

For Spool API functions, each CHNG call to a nonexpress, alternate PCB, creates a separate JES spool data set. (PURG calls have no effect when issued against a nonexpress, alternate PCB.) If the destination of the PCB is the JES spool, it cannot be CHNGed to a non-JES spool destination until the data set(s) have been released by a sync point. Keywords that can be specified on the CHNG call are discussed in “Advanced Print Function Options” and “APPC Options” on page 276.

In the OTMA Environment

If an IMS application program issues a CHNG call to an alternate PCB and specifies an options list, then the output destination cannot be an IMS Open Transaction Manager client.

An IMS application program that issues a CHNG call to an alternate PCB (specifying an options list) does not cause IMS to call the OTMA Prerouting and Destination Resolution exit routines to determine the destination. But an IMS application program that issues a CHNG call to an alternate PCB (specifying an APPC descriptor) does cause IMS to call the OTMA exit routines to determine the destination. For information on these exit routines, see *IMS Version 9: Customization Guide*.

The application program can still issue ISRT calls to the I/O PCB to send data to an OTMA destination.

OTMA application programs can use CHNG and ISRT calls for APPC destinations. For more information, see *IMS Version 9: Application Programming: Design Guide*.

Advanced Print Function Options

The IAFP keyword identifies the CHNG call as a request for Spool API functions. The parameters of the IAFP keyword are:

Keyword	Description
IAFP=abc	a — specifies carriage control options
	b — specifies integrity options
	c — specifies message processing options

These options specify advanced print functions for the CHNG call.

Carriage Control Options: The 1-character carriage control options indicate the type of carriage control that is present in the message data when the ISRT or PURG call is issued. Your application program must insert the proper carriage control characters in the data stream. You can specify one of the following values for the IAFP keyword:

- A** The data stream contains ASA carriage control characters.
- M** The data stream contains machine carriage control characters.
- N** The data stream does not contain carriage control characters.

Integrity Options: The 1-character integrity options indicate the method IMS TM uses in allocating the IMS Spool data set that contains the IAFP message. You can specify one of the following options for the IAFP keyword:

- 0** IMS TM attempts no data set protection. Your application program must provide any disposition or hold status by using the appropriate OUTPUT descriptor options. IMS TM does attempt to prevent a partial message from printing and to deallocate data sets that contain messages that have already reached a sync point. To control whether error messages about the IMS Spool data set are issued, use the message processing options for the IAFP keyword.
- 1** The IMS Spool data set is placed on the SYSOUT HOLD queue when it is allocated. If IMS TM issues message DFS00121 or DFS00141, the operator must query the SYSOUT HOLD queue to locate the appropriate data sets. IMS TM releases the data set and deallocates it to be printed at sync point.
When you specify 1 for the integrity option, you must specify *M* for the message processing option of the IAFP keyword.
- 2** A remote destination is specified in the *destination name* parameter on the CHNG call. The IMS Spool data set, when allocated, is placed on a SYSOUT remote workstation, IMSTEMP. This destination must be included in the definitions as nonselectable so that the data set is not automatically selected to be printed. If IMS TM issues message DFS00121 or DFS00141, the operator must query IMSTEMP to locate the appropriate data sets. At sync point, IMS TM releases the data set and deallocates it to the remote workstation ID specified in the *destination name* parameter. The value 2 overrides any destination specified in the IAFP OUTPUT options.

Message Processing Options: The 1-character message processing options indicate whether IMS TM issues message DFS00141 during restart and message DFS00121 for dynamic allocation failures. You can specify one of the following options:

- 0** DFS00121 and DFS00141 are not issued. Your application program controls IAFP message integrity.
- M** DFS00121 and DFS00141 are issued if necessary. IMS TM controls IAFP message integrity.

The CHNG call can provide the data set characteristics by:

- Directly, using the PRTO= option
- Referencing prebuilt text units, using the TXTU= option
- Referencing an OUTPUT JCL statement in the dependent region's JCL, using the OUTN= option

When you use the IAFP keyword, you must also specify the PRTO, TXTU, or OUTN option. (The options PRTO, TXTU, and OUTN are mutually exclusive.) If you do not specify one of these additional options, or if you specify more than one of these options, or if you specify IAFP with an invalid value, IMS TM returns an AR status code to your application program.

Keyword	Description
PRTO= <i>outdes options</i>	Describes the data set processing options as they are specified on the TSO OUTDES statement.

TM Message Call: CHNG

The format for the PRTO= keyword is as follows:

LL	outdes options
Halfword length of the total OUTDES printer options, including the 2-byte length of LL.	Any valid combination of OUTDES printer options.

Note: For information on TSO OUTDES options, see *MVS Application Development Guide: Authorized Assembler Language Programs*. Some options depend on the release level of MVS.

TXTU=*address*

specifies the address of a list of text-unit pointers. The list (with the associated text units) can be created by a previous SET0 call, or it can be created by your application program. The LLZZ or LLLLZZ prefix must be included on the buffer that contains the list. TXTU allows your application program to issue a SET0 call to build the text units for the OUTDES options before the CHNG call is issued.

If your application program issues several CHNG calls with the same OUTDES printer options, the TXTU option means you do not need to build OUTDES options for each CHNG call.

OUTN=*name*

specifies a character string up to eight characters long that contains the name of an OUTPUT JCL statement that identifies the printer processing options to be used. If the specified OUTPUT DD statement is not included in the JCL for the region in which the application program runs, a dynamic allocation error occurs when the application attempts to insert data to the data set.

APPC Options

The following APPC options are available for the CHNG call:

Keyword	Description
---------	-------------

LU=*logical unit name*

Specifies the logical unit (LU) name of a partner for an LU 6.2 conversation with a partner application program. It is used in conjunction with the MODE and TPN options to establish the conversation. The LU name can be any alphanumeric string including national characters, but the first character cannot be a number. If the LU name is a network-qualified name, it can be up to seventeen characters long and consist of the network ID of the originating system, followed by '.', then the LU name. (for example, netwrkid.luname). The LU name and the network ID are both one to eight characters long. The default for this option is DFSLU.

Related Reading: For more information on LU 6.2, see *IMS Version 9: Administration Guide: Transaction Manager*.

MODE=*mode name*

Specifies the mode of the partner for an LU 6.2 conversation with a partner application program. It is used in conjunction with the LU and TPN options to establish the conversation. The mode name can be any alphanumeric string up to eight characters long, including national characters, but the first character cannot be a number. If both MODE and SIDE options are specified, the mode name specified in the SIDE entry is ignored but is not changed. The default for this option is DFSMODE.

Related Reading: For more information on LU 6.2, see *IMS Version 9: Administration Guide: Transaction Manager*.

TPN=*transaction program name*

Specifies the transaction program (TP) name of the partner application program in an LU 6.2 conversation. The option is used in conjunction with the LU and MODE keywords to establish the conversation.

Related Reading: For more information on LU 6.2, see *IMS Version 9: Administration Guide: Transaction Manager*.

TP names can be up to 64 characters long and can contain any character from the 00640 character set except a blank. The 00640 character set includes the letters A-Z, the digits 0-9, and 20 special characters. The default for this option is DFSASYNC. For more information on the 00640 character set, see *Common Programming Interface Communications Reference*. The format for the TPN option is as follows:

LL	<i>tpn</i>
Halfword length of the TP name, including the 2-byte length of LL.	The TP name, which can be up to 64 characters long.

TP names that are processed with the IMS command processor must contain characters that are valid to IMS. For example, names that contain lower case letters cannot be processed and are rejected if they are used as operands for IMS commands.

SIDE=*side information entry name*

Specifies the side information entry name that can be used to establish an LU 6.2 conversation with a partner application program. For more information on LU 6.2, see *IMS Version 9: Administration Guide: Transaction Manager*. The SIDE name can contain up to eight characters, including the uppercase alphabet (A-Z), and the digits 0-9. If the LU, MODE, or TPN keywords are specified, they override the SIDE keyword, but they do not change the side information entry name. This option has no default.

SYNC=NC Overrides the APPC/IMS conversation synchronization level. N sets the synchronization level to NONE. C sets the synchronization level to CONFIRM. The default for this option is C.

TYPE=BM Overrides the APPC/IMS conversation type. B sets the conversation type to BASIC. M sets the conversation type to MAPPED. The default for this option is M.

Related Reading: For more information on APPC and the default options, see *IMS Version 9: Administration Guide: Transaction Manager*.

Options List Feedback Area

When errors are encountered in the options list, the options list feedback area is used to return error information to the application.

IMS attempts to parse the entire options list and return information on as many errors as possible. If the feedback area is not large enough to contain all the error information, only as much information is returned as space permits. The status code is the only indication of an option list error if you do not specify the area.

TM Message Call: CHNG

The feedback area must be initialized by the application with a length field indicating the length of the area. A feedback area approximately 1½ to 2 times the length of the options list or a minimum of 8 words should be sufficient.

Error Codes

This section contains information on error codes that your application can receive.

Error Code	Reason
(0002)	Unrecognized option keyword. Possible reasons for this error are: <ul style="list-style-type: none">• The keyword is misspelled.• The keyword is spelled correctly but is followed by an invalid delimiter.• The length specified field representing the PRTO is shorter than the actual length of the options.• A keyword is not valid for the indicated call.
(0004)	Either too few or too many characters were specified in the option variable. An option variable following a keyword in the options list for the call is not within the length limits for the option.
(0006)	The length field (LL) in the option variable is too large to be contained in the options list. The options list length field (LL) indicates that the options list ends before the end of the specified option variable.
(0008)	The option variable contains an invalid character or does not begin with an alphabetic character.
(000A)	A required option keyword was not specified. Possible reasons for this error are: <ul style="list-style-type: none">• One or more additional keywords are required because one or more keywords were specified in the options list.• The specified length of the options list is more than zero but the list does not contain any options.
(000C)	The specified combination of option keywords is invalid. Possible causes for this error are: <ul style="list-style-type: none">• The keyword is not allowed because of other keywords specified in the options list.• The option keyword is specified more than once.
(000E)	IMS found an error in one or more operands while it was parsing the print data set descriptors. IMS usually uses z/OS services (SJF) to validate the print descriptors (PRTO= option variable). When IMS calls SJF, it requests the same validation as for the TSO OUTDES command. Therefore, IMS is insensitive to changes in output descriptors. Valid descriptors for your system are a function of the MVS release level. For a list of valid descriptors and proper syntax, use the TSO HELP OUTDES command. IMS must first establish that the format of the PRTO options is in a format that allows the use of SJF services. If it is not, IMS returns the status code AS , the error code (000E), and a descriptive error message. If the error is detected during the SJF process, the error

message from SJF will include information of the form (R.C.=xxxx,REAS.=yyyyyyyy), and an error message indicating the error.

Related Reading: For more information on SJF return and reason codes, see *MVS Application Development Guide: Authorized Assembler Language Programs*.

The range of some variables is controlled by the initialization parameters. Values for the maximum number of copies, allowable remote destination, classes, and form names are examples of variables influenced by the initialization parameters.

Restrictions

Before you can use the CHNG call to set or alter the destination of an alternate PCB, you must issue the PURG call to indicate to IMS that the message that you have been building with that PCB is finished.

LU 6.2 architecture prohibits the use of the ALTRESP PCB on a CHNG call in an LU 6.2 conversation. The LU 6.2 conversation can only be associated with the IOPCB. The application sends a message on the existing LU 6.2 conversation (synchronous) or has IMS create a new conversation (asynchronous) using the IOPCB. Since there is no LTERM associated with an LU 6.2 conversation, only the IOPCB represents the original LU 6.2 conversation.

For Spool API functions, each CHNG call to a nonexpress, alternate PCB, creates a separate JES spool data set. (PURG calls have no effect when issued against a nonexpress, alternate PCB.) If the destination of the PCB is the JES spool, it cannot be CHNGed to a non-JES spool destination until the data set(s) have been released by a sync point.

CMD Call

The Command (CMD) call enables an application program to issue IMS commands.

Format



Call Name	DB/DC	DBCTL	DCCTL	DB Batch	TM Batch
CMD	X		X		

Parameters

| *i/o pcb*
 | Specifies the I/O PCB, the first PCB address in the list that is passed to the
 | program. This parameter is an input and output parameter.

aib
 Specifies the application interface block (AIB) that is used for the call. This parameter is an input and output parameter.

The following fields must be initialized in the AIB:

TM Message Call: CMD

AIBID

Eyecatcher. This 8-byte field must contain DFSAIBbb.

AIBLEN

AIB lengths. This field must contain the actual length of the AIB that the application program obtained.

AIBRSNM1

Resource name. This 8-byte, left-justified field must contain the PCB name IOPCBbbb.

AIBOALEN

I/O area length. This field must contain the length of the I/O area that is specified in the call list.

i/o area

Specifies the I/O area to use for this call. This parameter is an input and output parameter. The I/O area must be large enough to hold the largest segment passed between the program and IMS TM.

Usage

Use the CMD call with the GCMD call to send commands to and receive responses from IMS TM. After the CMD call issues the command to IMS TM, IMS TM processes the command and returns the first segment of the response message to the application program's I/O area, but only if a CC status code is returned on the CMD call. Your application program must then issue GCMD calls to retrieve all subsequent message segments one segment at a time. For more information, see "GCMD Call" on page 281. The CMD and GCMD command calls are typically used to perform functions that are usually handled by someone at a terminal. These programs are called automated operator (AO) applications.

Related Reading: For more information on the automated operator interface (AOI), see *IMS Version 9: Customization Guide*.

Before you issue a CMD call, the IMS command that you want to execute must be in the I/O area that you refer to in the call. When you issue a CMD call, IMS TM passes the command from the I/O area to the IMS control region for processing. IMS TM places your application program in a wait state until the command is processed. The application program remains in a wait state until IMS TM returns a response. (*Response* means that IMS TM has received and processed the command.) For asynchronous commands, you receive a response when the command is processing, but not when it is complete.

You can also issue DB2 commands from your IMS TM application program. Issue the command call and use the /SSR command, followed by the DB2 command. IMS TM routes the command to DB2. DB2 issues a response to the command, and IMS TM routes the DB2 response to the master terminal operator (MTO).

Restrictions

The AIB must specify the I/O PCB for this call.

Any application program that uses this call must be authorized by the security administrator.

You cannot issue a CMD call from a CPI-C driven application program.

This call is not supported in an IFP or non-message-driven BMP.

GCMD Call

The Get Command (GCMD) call retrieves the response segments from IMS TM when your application program processes IMS commands using the CMD call.

Format



Call Name	DB/DC	DBCTL	DCCTL	DB Batch	TM Batch
GCMD	X		X		

Parameters

i/o pcb

Specifies the I/O PCB, the first PCB address in the list that is passed to the program. This parameter is an input and output parameter.

aib

Specifies the application interface block (AIB) that is used for the call. This parameter is an input and output parameter.

The following fields must be initialized in the AIB:

AIBID

Eyecatcher. This 8-byte field must contain DFSAIBbb.

AIBLEN

AIB lengths. This field must contain the actual length of the AIB that the application program obtained.

AIBRSNM1

Resource name. This 8-byte, left-justified field must contain the PCB name IOPCBbbb.

AIBOALEN

I/O area length. This field must contain the length of the I/O area that is specified in the call list.

i/o area

Specifies the I/O area to use for this call. This parameter is an output parameter. The I/O area must be large enough to hold the largest segment passed between the program and IMS TM.

Usage

When you issue a CMD call (see “CMD Call” on page 279), IMS TM returns the first command response segment to the application program’s I/O area. If you are processing commands that return more than one command response segment, use the GCMD call to retrieve the second and subsequent command response segments. IMS TM returns one command response segment to the I/O area of your application program each time the application program issues a GCMD call. The I/O area must be large enough to hold the longest message segment expected by your application program. IMS allows a maximum segment size of 132 bytes (including the 4-byte LLZZ field).

TM Message Call: GCMD

The CMD and GCMD calls are typically used to perform functions that are usually performed by someone at a terminal. These programs are called automated operator (AO) applications.

Related Reading: For more information on the automated operator (AO) interface, see *IMS Version 9: Customization Guide*.

PCB status codes indicate the results of a GCMD call. The status codes are similar to those that result from a message GN call. A QD status indicates that there are no more segments in the response. A QE status indicates that a GCMD call was issued after a CMD call that did not produce response segments. A blank status ('bb') indicates that a segment was retrieved successfully.

Restrictions

The AIB must specify the I/O PCB for this call.

Any AO application that uses this call must be authorized by the security administrator.

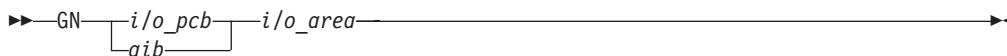
You cannot issue a GCMD call from a CPI-C driven application program.

This call is not supported in an IFP, or non-message driven BMP.

GN Call

If an input message contains more than one segment, a Get Unique (GU) call retrieves the first segment of the message and Get Next (GN) calls retrieve the remaining segments (see "GU Call" on page 283).

Format



Call Name	DB/DC	DBCTL	DCCTL	DB Batch	TM Batch
GN	X		X		

Parameters

| *i/o pcb*
| Specifies the I/O PCB, the first PCB address in the list that is passed to the
| program. This parameter is an input and output parameter.

aib
Specifies the application interface block (AIB) that is used for the call. This parameter is an input and output parameter.

The following fields must be initialized in the AIB:

AIBID

Eyecatcher. This 8-byte field must contain DFSAIBbb.

AIBLEN

AIB lengths. This field must contain the actual length of the AIB that the application program obtained.

AIBRSNM1

Resource name. This 8-byte, left-justified field must contain the PCB name IOPCBbbb.

AIBOALEN

I/O area length. This field must contain the length of the I/O area that is specified in the call list.

i/o area

Specifies the I/O area to use for this call. This parameter is an output parameter. The I/O area must be large enough to hold the largest segment passed between the program and IMS TM.

Usage

If you are processing messages that contain more than one segment, you use the GN call to retrieve the second and subsequent segments of the message. IMS TM returns one message segment to the I/O area of your application program each time the application program issues a GN call.

You can issue a GN call from a BMP program.

Restrictions

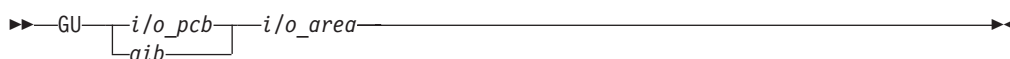
The AIB must specify the I/O PCB for this call.

You cannot issue a GN call from a CPI-C driven application program.

GU Call

The Get Unique (GU) call retrieves the first segment of a message.

Format



Call Name	DB/DC	DBCTL	DCCTL	DB Batch	TM Batch
GU	X		X		

Parameters

|
|
|

i/o pcb

Specifies the I/O PCB, the first PCB address in the list that is passed to the program. This parameter is an input and output parameter.

aib

Specifies the application interface block (AIB) that is used for the call. This parameter is an input and output parameter.

The following fields must be initialized in the AIB:

AIBID

Eyecatcher. This 8-byte field must contain DFSAIBbb.

AIBLEN

AIB lengths. This field must contain the actual length of the AIB that the application program obtained.

TM Message Call: GU

AIBRSNM1

Resource name. This 8-byte, left-justified field must contain the PCB name IOPCBbbb.

AIBOALEN

I/O area length. This field must contain the length of the I/O area that is specified in the call list.

i/o area

Specifies the I/O area to use for this call. This parameter is an output parameter. The I/O area must be large enough to hold the largest segment passed between the program and IMS TM.

Usage

An MPP or message-driven BMP uses two calls to retrieve input message from the host: GN and GU. A GU call retrieves the first segment of a message. The Get Next (GN) call retrieves subsequent segments. See “GN Call” on page 282.

When you issue a successful GU or GN, IMS TM returns the message segment to the I/O area that you specify in the call. Message segments are not all the same length. Because the segment length varies, your I/O area must be long enough to hold the longest segment that your program can receive. The first two bytes of the segment contain the length of the segment.

Your application program must issue a GU call to the message queue before issuing other DL/I calls. When IMS TM schedules an MPP, the Transaction Manager transfers the first segment of the first message to the message processing region. When the MPP issues the GU for the first message, IMS TM already has the message waiting. If the application program does not issue a GU message call as the first call of the program, IMS TM has to transfer the message again, and the efficiency provided by message priming is lost.

If an MPP responds to more than one transaction code, the MPP has to examine the text of the input message to determine what processing the message requires.

After a successful GU call, IMS TM places the following information in the I/O PCB mask:

- The name of the logical terminal that sent the message.
- The status code for this call. (See “System Service Call Summary” on page 298)
- The input prefix, giving the date, time, and sequence number of the message at the time it was first queued. IMS returns both an 8-byte local date containing a 2-digit year and a 12-byte time stamp (local or UTC time) containing a 4-digit year.
- The MOD name (if you are using MFS).
- The user ID of the person at the terminal, or if user IDs are not used in the system, the logical terminal name. If the message is from a BMP, IMS TM places the PSB name of the BMP in this field.
- Group name, used by DB2 to provide security for SQL calls.

Related Reading: For more information on the format of the I/O PCB mask, see “Specifying the I/O PCB Mask” on page 26.

Restrictions

The AIB must specify the I/O PCB for this call.

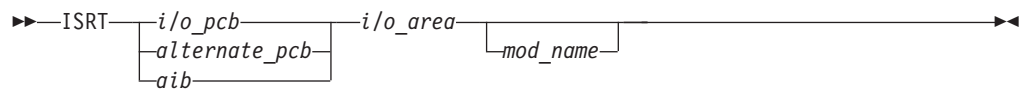
You cannot issue a GU call from a CPI-C driven application program.

ISRT Call

The Insert (ISRT) call sends one message segment to the destination that you specify in the call. The destination is represented by the I/O PCB, alternate PCB, or AIB you specify in the call parameters.

For Spool API functions, the ISRT call is also used to write data to the JES Spool.

Format



Call Name	DB/DC	DBCTL	DCCTL	DB Batch	TM Batch
ISRT	X		X		

Parameters

i/o pcb

Specifies the I/O PCB, the first PCB address in the list that is passed to the program. This parameter is an input and output parameter.

alternate pcb

Specifies the PCB to use for this call. These parameters are input and output parameters.

aib

Specifies the application interface block (AIB) that is used for the call. This parameter is an input and output parameter.

The following fields must be initialized in the AIB:

AIBID

Eyecatcher. This 8-byte field must contain DFSAIBbb.

AIBLEN

AIB lengths. This field must contain the actual length of the AIB that the application program obtained.

AIBRSNM1

Resource name. This 8-byte, left-justified field must contain the PCB name IOPCBbbb (if the TP PCB is used), or the name of an alternate PCB (if an alternate PCB is used).

AIBOALEN

I/O area length. This field must contain the length of the I/O area that is specified in the call list.

i/o area

Specifies the I/O area to be used for the call. This parameter is an input

TM Message Call: ISRT

parameter. The I/O area must be large enough to hold the largest segment passed between the application program and IMS TM.

mod name

Specifies the MOD you want used for this output message. This parameter is an input parameter. The 8-byte MOD name must be left-justified and padded with blanks as necessary. If the terminal receiving the output does not use MFS, this parameter is ignored. If you specify a valid MOD name, IMS TM uses that MOD to format the screen for the output message you are sending.

Usage

To issue the ISRT call successfully, your application program must first build the message you want to send in the application program's I/O area. The ISRT uses the destination name in the I/O PCB or alternate PCB, and the I/O area that you specify in the call, to locate the message to be sent. The ISRT call then sends the output message from your application program to another terminal. ISRT sends one message segment per issue, so your application program must issue one ISRT call for each segment of the message in the I/O area.

You can also specify a MOD name if you want to change the screen format. For example, if the application program detects an error and must notify the person at the terminal, you can specify a MOD name that formats the screen to receive the error message. ISRT and PURG are the only DL/I calls that allow you to specify a MOD name on the first segment of an output message.

When your application program issues one or more ISRT calls, IMS TM groups the message segments to be sent in the message queue. IMS TM sends the message segments to the destination when the application program does one of the following:

- Issues a GU call to retrieve the first segment of the next message
- Reaches a commit point
- Issues a PURG call on an express alternate PCB

Your application must also use the ISRT call to issue replies to other terminals in conversational programs and to pass a conversation between application programs.

Related Reading: For more information on ISRT in conversational programs see "Sending Messages to Other Terminals and Programs" on page 56 and "Passing the Conversation to another Conversational Program" on page 69.

In the Shared Queues Environment

A STATUSQF can be received on an ISRT call in a shared queues environment if the MSGQ structure is full. If the MSGQ structure is full, one of the following can happen:

- If the ISRT is for a multi-segment message, STATUSQF will be received.
- If the ISRT for a multi-segment message still completes correctly (enough space) but not enough space is found to be available at PURG or CHKP time, the application will abend with ABENDU0370.
- If the ISRT is for a single segment message, STATUSQF can be received. If the program continues to insert further messages that cause all available DRRN to be exhausted, IMS will fail with ABENDU0758. If the program issues a checkpoint before exhausting all available DRRN, queue buffers will be freed and the messages will be written on the log as "unresolved UOWEs." Logs containing the original type01 and type03 log records are needed to later insert the

messages in the structure if space becomes available and must not be reused. IMS will issue message DFS1994I to remind the user at every check point time.

Spool API Functions

You can use the ISRT call to write data to the JES Spool. These writes are done using BSAM and, if possible, each BSAM “write” is done directly from the application program’s buffer area.

Restriction: BSAM does not support the I/O area for sysout data sets above the 16-MB line. If IMS finds an I/O area above the 16-MB line, it moves the application data to a work area below the line before it performs the BSAM write. If the I/O area is already below the line, the write is done directly from the I/O area. Do not take unusual steps to place the I/O area below the line unless performance indicates a need to do so.

When you issue the ISRT call for an alternate PCB set up for IAFF processing, prefix the I/O area with a BSAM block descriptor word for variable length records.

Related Reading: For more information on BSAM block descriptor words, see *MVS Data Administration Guide for Data Facility Product*.

LL or LLLL ^{1,2}	ZZ ²	ll ³	zz ³
Halfword length of the I/O area or block, including the 4-byte length of the LLZZ fields.	Halfword of zero	Halfword length of the logical record or segment, including the 4-byte length of the llzz fields.	Halfword of zero

Notes:

1. For application programs that use the PLITDLI interface, the length field is a fullword (LLLL). However, the length of the LLLLZZ field is still considered 4 bytes.
2. LLZZ is the equivalent of the BSAM Block Descriptor Word (BDW).
3. llzz is the equivalent of the BSAM Record Descriptor Word (RDW).

For more information on Spool API, see *IMS Version 9: Application Programming: Design Guide*.

Restrictions

A CPI-C driven application program can only issue the ISRT call to an alternate PCB.

If you want to send message segments before retrieving the next message or issuing a commit point, you must use the PURG call. For a description of the PURG call, see “PURG Call” on page 288.

MOD name can be specified only once per message, on the first ISRT or PURG call that begins the message.

BSAM does not support the I/O area for sysout data above the 16 MB line.

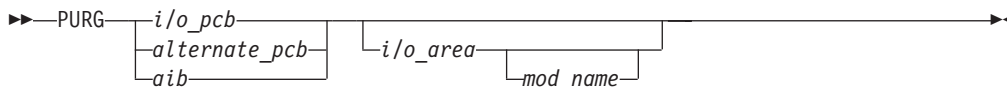
For more information on LU 6.2, see *IMS Version 9: Administration Guide: Transaction Manager*.

PURG Call

The Purge (PURG) call allows your application program to send one or more output message segments (specified with the ISRT call) to the specified destination before the application program retrieves the next input message or issues a commit point.

For Spool API functions, the PURG call can also be used to release a print data set for immediate printing.

Format



Call Name	DB/DC	DBCTL	DCCTL	DB Batch	TM Batch
PURG	X		X		

Parameters

- | *i/o pcb*
| Specifies the I/O PCB, the first PCB address in the list that is passed to the
| program. This parameter is an input and output parameter.
- | *alternate pcb*
| Specifies the PCB to use for the call. These parameters are input and output
| parameters.
- | *aib*
| Specifies the application interface block (AIB) that is used for the call. This
| parameter is an input and output parameter.
| The following fields must be initialized in the AIB:
| **AIBID**
| Eyecatcher. This 8-byte field must contain DFSAIBbb.
| **AIBLEN**
| AIB lengths. This field must contain the actual length of the AIB that the
| application program obtained.
| **AIBRSNM1**
| Resource name. This 8-byte, left-justified field must contain the PCB name
| IOPCBbbb (if the TP PCB is used), or the name of an alternate PCB (if an
| alternate PCB is used).
| **AIBOALEN**
| I/O area length. This field must contain the length of the I/O area that is
| specified in the call list.
- | *i/o area*
| Specifies the I/O area to use for this call. This parameter is an input parameter.
| The I/O area must be large enough to hold the largest segment passed
| between the program and IMS TM.
- | *mod name*
| Specifies the MOD you want used for this output message. This parameter is
| an input parameter. The 8-byte MOD name must be left justified and padded

with blanks as necessary. PURG can specify the MOD name for the first message segment for an output message. If the terminal receiving the output does not use MFS, this parameter is ignored. If you specify a valid MOD name, IMS TM uses that MOD to format the screen for the output message you are sending.

Usage

Use the PURG call to send output messages to several different terminals. A PURG call tells IMS TM that the message built against the specified I/O PCB, or alternate PCB (with the ISRT call) is complete. IMS TM collects the message segments that have been inserted into one PCB as one message and sends the message to the destination specified by the destination name of the alternate PCB listed in the PURG call.

If you specify an I/O area in the PURG call parameters, PURG acts as an ISRT call to insert the first segment of the next message. When you identify the I/O area, you can also specify a MOD name to change the screen format.

Related Reading: For more information on sending messages to several terminals see “Sending Messages to Other Terminals and Programs” on page 56.

In the OTMA environment

An IMS application program that issues a PURG call causes IMS to call the Open Transaction Manager Access (OTMA) Prerouting and Destination Resolution exit routines to determine the destination. For information on these exit routines, see *IMS Version 9: Customization Guide*.

In the Shared Queues environment

A STATUSQF can be received on a PURG call in a shared queues environment if the MSGQ structure is full. If the MSGQ structure is full, one of the following can happen:

- If the PURG is for a multi-segment message, STATUSQF will be received.
- If the PURG for a multi-segment message still completes correctly (enough space) but not enough space is found to be available at PURG or CHKP time, the application will abend with ABENDU0370.

Spool API Functions

You can use the PURG call with an express alternate PCB to release a print data set for immediate printing. When you issue the PURG call with an I/O area, IMS treats the call as two functions: the purge request, and the insertion of data provided by the I/O area.

If you issue the PURG call:

- Against an express alternate PCB, the data set is closed, unallocated, and released for printing. The destination is reset.
- With an I/O area against a non-express alternate PCB, the purge function is ignored and the data in the insert portion of the call is put into the print data set. This means that the call behaves like an ISRT call.
- With no I/O area against an express alternate PCB, the data set is closed, unallocated, and released for printing. IMS returns a status code of blanks.
- With no I/O area against a non-express alternate PCB, no action is taken.

Restrictions

CPI-C driven application programs can only issue the PURG call to alternate PCBs.

TM Message Call: PURG

MOD name can be specified only once per message, in the first ISRT or PURG call that begins the message.

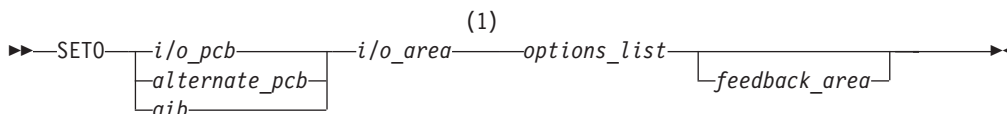
This call is not supported in an IFP.

For synchronized APPC/OTMA conversations, PURG calls on the TP PCB are ignored. The next ISRT call is processed for the next segment of the current message.

SETO Call

The SET Options (SETO) call allows IMS application programs to set processing options. The SETO call can also be used to set processing options for Spool API functions.

Format



Notes:

- 1 The I/O area parameter is not used for calls that specify APPC options.

Call Name	DB/DC	DBCTL	DCCTL	DB Batch	TM Batch
SETO	X		X		

Parameters

- | *i/o pcb*
| Specifies the I/O PCB, the first PCB address in the list that is passed to the
| program. This parameter is an input and output parameter.
- | *alternate pcb*
| Specifies the TP or alternate PCB to be used for the call. These parameters are
| input and output parameters.
- | *aib*
| Specifies the application interface block (AIB) that is used for the call. This
| parameter is an input and output parameter.
| The following fields must be initialized in the AIB:
| **AIBID**
| Eyecatcher. This 8-byte field must contain DFSAIBbb.
| **AIBLEN**
| AIB lengths. This field must contain the actual length of the AIB that the
| application program obtained.
| **AIBRSNM1**
| Resource name. This 8-byte, left-justified field must contain the PCB name
| IOPCBbbb (if the TP PCB is used), or the name of an alternate PCB (if an
| alternate PCB is used).

AIBOALEN

I/O area length. This field must contain the length of the I/O area that is specified in the call list.

i/o area

Specifies the I/O area to be used for the call. This parameter is an output parameter. If you specify an options list that contains advanced print functions, you must specify an I/O area. If you use APPC options, the I/O area parameter is optional.

For advanced print function options the I/O area must be at least 4 KB. If the I/O area including the LLZZ or LLLLZZ prefix is less than 4096 bytes in length, an AJ status code is returned. Once the text units area built in the I/O area, the area must not be copied to a new area. The I/O area passed on the SETO call must contain a LLZZ or, if PL/I, a LLLLZZ prefix.

LLLL applies only to DL/I call interface.

options list

Specifies several option keywords. This input parameter is required. The options in the list are separated by commas and cannot contain embedded blanks. Processing for the options list terminates when the first blank in the list is reached or when the specified options list length has been processed. You can specify options for advanced print functions or for APPC. The options you can specify are described in “Advanced Print Function Options” on page 293 and “APPC Options” on page 293.

The format for the options list is as follows:

LL or LLLL^{1,2}	ZZ	keyword=variable1
Halfword length of the options string, including the 4-byte length of LLZZ or LLLLZZ.	Halfword of zero.	SETO options separated by commas.

Note:

1. For application programs that use the PLITDLI interface, the length field is a fullword (LLLL). However, the length of the LLLLZZ field is still considered 4 bytes.
2. If the length field is set to zero, the options list is ignored. IMS TM processes the SETO call as if the *options list* parameter was not specified.

feedback area

Specifies an optional parameter used to return error information about the options list to the application program. This parameter is an output parameter. The amount of information that the application program receives is based on the size of the feedback area. If no feedback area is specified, the status code returned is the only indication of an options list area. If you specify a feedback area 1½ to 2 times the size of the specified options list (a minimum of eight words), IMS TM returns more specific information about errors in the options list.

The format for the feedback area passed to IMS TM in the call list is as follows:

LL or LLLL^{1,2}	ZZ
Halfword length of the feedback area, including the 4-byte length of the LLZZ fields.	Halfword of zero.

TM Message Call: SETO

LL or LLLL ^{1, 2}	ZZ
-----------------------------------	-----------

Note:

1. For application programs that use the PLITDLI interface, the length field is a fullword (LLLL). However, the length of the LLLLZZ field is still considered four bytes.
2. If the length field is set to zero, the feedback area is ignored. IMS TM processes the SETO call as if the *feedback area* parameter was not specified.

The output format returned to the application program from IMS TM for the feedback area is as follows:

LLZZ or LLLLZZ	LL	<i>feedback data</i>
The length field as specified in the input format for the feedback area.	Halfword length of the feedback data returned by IMS TM, including the 2-byte LL field.	Data returned by IMS TM. The feedback data generally includes the option keyword found to be in error and a 4-byte EBCDIC code in parentheses that indicates the reason for the error. Multiple errors are separated by commas.

Usage

The SETO call allows you to set processing options.

You can use the SETO call to reduce the overhead necessary to perform parsing and text construction of the OUTPUT descriptors for a data set. If your application program can use a set of descriptors more than once during an installation, the application can use the SETO call to provide print data set characteristics to the Spool API. When the SETO call is processed, it parses the OUTPUT options and constructs the dynamic OUTPUT text units in the work area provided by the application. After the application has received the prebuilt text units, you can use the CHNG call and TXTU= option to provide the print characteristics for the data set without incurring the overhead of parsing and text unit build.

It is not necessary to use the SETO call to prebuild the text units if they can be prebuilt with another programming technique.

Keywords that can be specified on the SETO call are described in “Advanced Print Function Options” on page 293 and “APPC Options” on page 293.

Related Reading: For more information about Spool API, see *IMS Version 9: Application Programming: Design Guide*.

In the OTMA environment

An IMS application program that issues a SETO call does not cause IMS to call the Open Transaction Manager Access (OTMA) Prerouting and Destination Resolution exit routines to determine the destination. For information on these exit routines, see *IMS Version 9: Customization Guide*.

Existing IMS application programs that issue SETO calls might not run as expected because a return code is returned to the program if it is processing an OTMA-originated transaction. Also, APPC/IMS application programs that issue SETO calls might not need modification if they require implicit OTMA support.

A solution to this problem is to use an INQY call before issuing the SET0 call. The application program can use the output from the INQY call to determine if a transaction is an OTMA-originated one, to bypass the SET0 call.

Advanced Print Function Options

The PRTO= keyword identifies the SET0 call as a Spool API request:

Keyword	Description
PRTO= <i>outdes options</i>	Describes the data set processing options as they are specified on the TSO OUTDES statement. The format for the PRTO keyword is as follows:

LL	<i>outdes options</i>
Halfword length of the total OUTDES printer options, including the 2-byte length of LL .	Any valid combination of OUTDES printer options, separated by commas.
Note: For information about TSO OUTDES options, see <i>MVS Application Development Guide: Authorized Assembler Language Programs</i> . Some options depend on the release level of MVS.	

If z/OS detects an error in the OUTDES printer options, an AS status code is returned to the application program.

APPC Options

The following options are available for the SET0 call:

SEND_ERROR

causes the IMS LU Manager to issue SEND_ERROR on the conversation associated with the I/O or alternate PCB when a message is sent. Messages for express PCBs are sent during the PURG call or sync point processing, whichever comes first. Messages for nonexpress PCBs are sent during sync point processing.

This option is only used by LU 6.2 devices, and it is ignored if specified for a non-LU 6.2 device.

The option is mutually exclusive with the DEALLOCATE_ABEND option. If both options are coded in the options list, an AR status code is returned to the application.

DEALLOCATE_ABEND

deallocates a conversation by issuing a SEND_ERROR followed by a DEALLOCATE_ABEND at the time the message is sent. Once a SET0 call with the DEALLOCATE_ABEND option is issued, any subsequent ISRT calls made to the PCB are rejected with a QH status code.

This option is applicable only to LU 6.2 devices. If specified for a non-LU 6.2 device, any subsequent ISRT calls made to the PCB are rejected with a QH status code.

When the SET0 call is issued on a TP PCB in an IFP region, the DEALLOCATE_ABEND option is not valid. If you attempt to use the option under these conditions, an AD status code is returned to the application.

The option is mutually exclusive with the SEND_ERROR option. If both options are coded in the options list, an AR status code is returned to the application.

Related Reading: For more information about APPC and LU 6.2, see *IMS Version 9: Administration Guide: Transaction Manager*.

Options List Feedback Area

When errors are encountered in the options list, the options list feedback area is used to return error information to the application.

IMS attempts to parse the entire options list and return information on as many errors as possible. If the feedback area is not large enough to contain all the error information, only as much information is returned as space permits. The status code is the only indication of an option list error if you do not specify the area.

The feedback area must be initialized by the application with a length field indicating the length of the area. A feedback area approximately 1½ to 2 times the length of the options list or a minimum of 8 words should be sufficient.

Error Codes

This section contains information on error codes that your application can receive.

Error Code	Reason
(0002)	Unrecognized option keyword. Possible reasons for this error are: <ul style="list-style-type: none">• The keyword is misspelled.• The keyword is spelled correctly but is followed by an invalid delimiter.• The length specified field representing the PRTO is shorter than the actual length of the options.• A keyword is not valid for the indicated call.
(0004)	Either too few or too many characters were specified in the option variable. An option variable following a keyword in the options list for the call is not within the length limits for the option.
(0006)	The length field (LL) in the option variable is too large to be contained in the options list. The options list length field (LL) indicates that the options list ends before the end of the specified option variable.
(0008)	The option variable contains an invalid character or does not begin with an alphabetic character.
(000A)	A required option keyword was not specified. Possible reasons for this error are: <ul style="list-style-type: none">• One or more additional keywords are required because one or more keywords were specified in the options list.• The specified length of the options list is more than zero but the list does not contain any options.
(000C)	The specified combination of option keywords is invalid. Possible causes for this error are: <ul style="list-style-type: none">• The keyword is not allowed because of other keywords specified in the options list.• The option keyword is specified more than once.
(000E)	IMS found an error in one or more operands while it was parsing the print data set descriptors. IMS usually uses z/OS services (SJF) to validate the print descriptors (PRTO= option variable). When IMS calls SJF, it requests the same validation as for the TSO OUTDES

command. Therefore, IMS is insensitive to changes in output descriptors. Valid descriptors for your system are a function of the MVS release level. For a list of valid descriptors and proper syntax, use the TSO HELP OUTDES command.

IMS must first establish that the format of the PRTO options is in a format that allows the use of SJF services. If it is not, IMS returns the status code **AS**, the error code (000E), and a descriptive error message. If the error is detected during the SJF process, the error message from SJF will include information of the form (R.C.=xxxx,REAS.=yyyyyyyy), and an error message indicating the error. For more information on SJF return and reason codes, see *MVS Application Development Guide: Authorized Assembler Language Programs*.

The range of some variables is controlled by the initialization parameters. Values for the maximum number of copies, allowable remote destination, classes, and form names are examples of variables influenced by the initialization parameters.

Restrictions

A CPI-C driven application program can issue SET0 calls only to an alternate PCB.

Chapter 10. DL/I Calls for System Services

This chapter describes the system service calls you can use with IMS TM in each type of IMS application program and the parameters for each call. The calls are listed in alphabetical order.

Each call description contains:

- A syntax diagram
- A definition for each parameter that can be used in the call
- Details on how to use the call in your application program
- Restrictions on the use of the call

Each parameter is described as an input or output parameter. “Input” refers to input to IMS from the application program. “Output” refers to output from IMS to the application program.

System service calls must refer only to TP PCBs. The system service calls are described only as they pertain to IMS TM functions.

Syntax diagrams for these calls begin with the *function* parameter. The call, the call interface, (xxxTDLI), and *parmcount* (if it is required) are not included in the following syntax diagrams. See specific information for assembler language, COBOL, Pascal, and PL/I in Chapter 2, “Defining Application Program Elements,” on page 11 for the complete structure.

The following topics provide additional information:

- “System Service Call Summary” on page 298
- “APSB Call” on page 299
- “CHKP (Basic) Call” on page 300
- “CHKP (Symbolic) Call” on page 301
- “DPSB Call” on page 303
- “GMSG Call” on page 304
- “GSCD Call” on page 306
- “ICMD Call” on page 307
- “INIT Call” on page 309
- “INQY Call” on page 311
- “LOG Call” on page 321
- “RCMD Call” on page 323
- “ROLB Call” on page 324
- “ROLL Call” on page 326
- “ROLS Call” on page 327
- “SETS/SETU Call” on page 328
- “SYNC Call” on page 330
- “XRST Call” on page 331

Related Reading: The DL/I calls used for database management are described in *IMS Version 9: Application Programming: Database Manager*. EXEC DL/I commands used in CICS are described in *IMS Version 9: Application Programming: EXEC DLI Commands for CICS and IMS*. DCCTL users can issue calls using

GSAM database PCBs. GSAM databases are described in *IMS Version 9: Application Programming: Database Manager*.

System Service Call Summary

Table 68 is a summary of which system service calls you can use in each type of IMS TM application program, and the parameters for each call. Table 68 lists the function code, its meaning, use, parameters, and in which regions it is valid. Optional parameters are shown in brackets ([]).

System service calls issued in a DCCTL environment must refer only to I/O PCBs or GSAM database PCBs. Calls that cannot be used in a DCCTL environment are noted.

Language-dependent parameters are not shown here. For language-specific information, see “Formatting DL/I Calls for Language Interfaces” on page 11.

For detailed information on each call, its parameters, usage, and restrictions see Chapter 10, “DL/I Calls for System Services,” on page 297. For information on writing calls with programming language interfaces see Chapter 2, “Defining Application Program Elements,” on page 11.

Table 68. Summary of System Service Calls

Function Code	Meaning and Use	Options	Parameters	Valid for
APSB	Allocate PSB. Allocates a PSB for use in CPI-C driven application programs.	None	function, aib	MPP
CHKP (Basic)	Basic checkpoint. For recovery purposes.	None	function, i/o pcb or aib, i/o area	batch, BMP, MPP
CHKP (Symbolic)	Symbolic checkpoint. For recovery purposes.	Can specify seven program areas to be saved.	function, i/o pcb or aib, i/o area length, i/o area[, area length, area]	batch, BMP
DPSB	Deallocate PSB. Frees a PSB in use by a CPI-C driven application program.	None	function, aib	MPP
GMSG	Retrieve a message from the AO exit routine.	Can wait for an AOI message when none is available.	function, aib, i/o area	DB/DC and DCCTL(BMP, MPP, IFP), DB/DC and DBCTL(DRA thread), DBCTL(BMP non-message driven)
GSCD ¹	Get the address of the system contents directory.	None	function, i/o pcb or aib, i/o area	batch
ICMD	Issue an IMS command and retrieve the first command response segment.	None	function, aib, i/o area	DB/DC and DCCTL(BMP, MPP, IFP), DB/DC and DBCTL(DRA thread), DBCTL(BMP non-message driven)

Table 68. Summary of System Service Calls (continued)

Function Code	Meaning and Use	Options	Parameters	Valid for
INIT	Application receives data availability status codes.	Checks each PCB for data availability.	function, i/o pcb or aib, i/o area	batch, BMP, MPP, IFP
INQY	Inquiry. Retrieves information about output destinations, session status, execution environment, and the PCB address.	None	function, aib, i/o area	batch, BMP, MPP, IFP
LOGb	Log. Write a message to the system log.	None	function, i/o pcb or aib, i/o area	batch, BMP, MPP, IFP
RCMD	Retrieve the second and subsequent command response segments resulting from an ICMD call.	None	function, aib, i/o area	DB/DC and DCCTL(BMP, MPP, IFP), DB/DC and DBCTL(DRA thread), DBCTL(BMP non-message driven)
ROLB	Rollback. Backs out messages sent by the application program.	Call returns last message to i/o area.	function, i/o pcb or aib[, i/o area]	batch, BMP, MPP, IFP
ROLL	Roll. Backs out output messages and terminates the conversation.	None	function	batch, BMP, MPP
ROLS	Returns message queue positions to sync points set by the SETS or SETU call.	Issues call with i/o PCB or aib	function, i/o pcb or aib i/o area, token	batch, BMP, MPP, IFP
SETS	Sets intermediate sync (backout) points.	Cancels all existing backout points. Can establish up to 9 backout points.	function, i/o pcb or aib, i/o area, token	batch, BMP, MPP, IFP
SETU	Sets intermediate sync (backout) points.	Cancels all existing backout points. Can establish up to 9 backout points.	function, i/o pcb or aib, i/o area, token	batch, BMP, MPP, IFP
SYNC	Synchronization	Request commit point processing.	function, i/o pcb or aib	BMP
XRST	Restart. Works with symbolic CHKP to restart application program failure.	Can specify up to 7 areas to be saved.	function, i/o pcb or aib, i/o area length, i/o area[, area length, area]	batch, BMP

Note:

1. GSCD is a Product-sensitive programming interface.

APSB Call

The Allocate PSB (APSB) call is used to allocate a PSB for a CPI Communications driven application program. These types of application programs are used for conversations that include LU 6.2 devices.

System Service Call: APSB

Format

▶▶ APSB *aib* ◀◀

Call Name	DB/DC	DBCTL	DCCTL	DB Batch	TM Batch
APSB	X		X		

Parameters

aib

Specifies the application interface block (AIB) that is used for the call. This parameter is an input and output parameter.

The following fields must be initialized in the AIB:

AIBID

Eyecatcher. This 8-byte field must contain DFSAIBbb.

AIBLEN

AIB lengths. This field must contain the actual length of the AIB that the application program obtained.

AIBRSNM1

Resource name. This 8-byte, left-justified field must contain the PSB name.

Usage

CPI-C driven application programs must be link edited with the IMS language interface module and must indicate the PSB to be used before the application program can issue DL/I calls. The APSB call uses the AIB to allocate a PSB for these types of application programs.

When you issue the APSB call, IMS TM returns a list of PCB addresses contained in the specified PSB to the application program. The PCB list is returned in the AIBRSA1 field in the AIB.

IMS TM allows the APSB call to complete even if the databases that the PSB points to are not available. You can issue the INIT call to inform IMS TM of the application program's capabilities to accept additional status codes regarding data availability.

Related Reading: For more information on CPI Communications driven application programs, see *IMS Version 9: Application Programming: Design Guide*.

Restrictions

An application program that uses APSB can allocate only one PSB at a time. If your application requires more than one PSB, you must first release the PSB in use by issuing the deallocate PSB (DPSB) call.

CPI Communications driven application programs must issue the APSB call before issuing any other DL/I calls. If your application program attempts to issue DL/I calls before a PSB has been allocated with the APSB call, the application program receives error return and reason codes in the AIB.

CHKP (Basic) Call

A basic Checkpoint (CHKP) call is used for recovery purposes.

Format



Call Name	DB/DC	DBCTL	DCCTL	DB Batch	TM Batch
CHKP	X	X	X	X	X

Parameters

i/o pcb

Specifies the I/O PCB, the first PCB address in the list passed to the program, to use for this call. It is an input and output parameter.

aib

Specifies the application interface block (AIB) that is used for the call. This parameter is an input and output parameter.

The following fields must be initialized in the AIB:

AIBID

Eyecatcher. This 8-byte field must contain DFSAIBbb.

AIBLEN

AIB lengths. This field must contain the actual length of the AIB that the application program obtained.

AIBRSNM1

Resource name. This 8-byte, left-justified field must contain the PCB name IOPCBbbb.

AIBOALEN

I/O area length. This field must contain the length of the I/O area that is specified in the call list.

i/o area

Specifies the I/O area to use for the call. This parameter is an input and output parameter. For the CHKP call, the I/O area that contains the 8-character checkpoint ID. If the program is an MPP or a message-driven BMP, the CHKP call implicitly returns the next input message into this I/O area. Therefore, the area must be long enough to hold the longest message that can be returned.

Usage

In transaction management application programs, the basic CHKP call can be used to retrieve the conversational SPA or the initial message segment that was queued before the application was scheduled. The CHKP call commits all changes made by the program and, if your application program abends, establishes the point at which the program can be restarted.

Restrictions

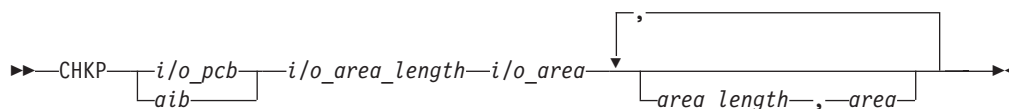
CPI Communications driven application programs cannot issue a basic CHKP call.

CHKP (Symbolic) Call

A symbolic Checkpoint (CHKP) call is used for recovery purposes.

System Service Call: CHKP (Symbolic)

Format



Call Name	DB/DC	DBCTL	DCCTL	DB Batch	TM Batch
CHKP	X	X	X	X	X

Parameters

i/o pcb

Specifies the I/O PCB to use for the call, the first PCB address in the list passed to the program, to use for this call. This parameter is an input and output parameter.

aib

Specifies the application interface block (AIB) that is used for the call. This parameter is an input and output parameter.

The following fields must be initialized in the AIB:

AIBID

Eyecatcher. This 8-byte field must contain DFSAIBbbb.

AIBLEN

AIB lengths. This field must contain the actual length of the AIB that the application program obtained.

AIBRSNM1

Resource name. This 8-byte, left-justified field must contain the PCB name IOPCBbbb.

AIBOALEN

I/O area length. This field must contain the length of the I/O area that is specified in the call list.

i/o area length

Is no longer used by IMS. For compatibility reasons, this parameter must still be included in the call, and it must contain a valid address. You can get a valid address by specifying the name of any area in your program.

i/o area

Specifies the I/O area to be used for your call. This parameter is an input and output parameter. For the CHKP call, the I/O area contains the 8-character checkpoint ID. If the program is a message-driven BMP, the CHKP call implicitly returns the next input message into this I/O area. Therefore, the area must be long enough to hold the longest message that can be returned.

area length

Specifies a 4-byte field in your program that contains the length in binary of the first area to checkpoint. This parameter is an input parameter. Up to seven area lengths can be specified. For each area length, you must also specify an area parameter.

area

Specifies the area in your program that you want IMS to checkpoint. This parameter is an input parameter. You can specify up to seven areas in your

program that you want IMS to checkpoint. Always specify the area length parameter first, followed by the area parameter. The number of areas you specify on a XRST call must be less than or equal to the number of areas you specify on the CHKP calls the program issues. When you restart the program, IMS restores only the areas you specified in the CHKP call.

Usage

In transaction management application programs, the symbolic CHKP call can be used to retrieve the conversational SPA or the initial message segment that was queued before the application was scheduled. The CHKP call commits all changes made by the program and, if your application program abends, establishes the point at which the program can be restarted. In addition, the symbolic CHKP call can:

- Work with the extended restart (XRST) call to restart your program if your program abends.
- Enables you to save as many as seven data areas in your program, which are restored when your program is restarted.

Restrictions

A CPI Communications driven application program cannot issue the symbolic CHKP call. The symbolic CHKP call is only allowed from batch and BMP applications.

You must issue an XRST call before the symbolic CHKP call.

DPSB Call

The Deallocate PSB (DPSB) call frees a PSB that was allocated with the APSB call.

Format

▶▶—DPSB—*aib*—◀◀

Call Name	DB/DC	DBCTL	DCCTL	DB Batch	TM Batch
DPSB	X		X		

Parameters

aib

Specifies the application interface block (AIB) that is used for the call. This parameter is an input and output parameter.

The following fields must be initialized in the AIB:

AIBID

Eyecatcher. This 8-byte field must contain DFSAIBbb.

AIBLEN

AIB lengths. This field must contain the actual length of the AIB that the application program obtained.

AIBRSNM1

Resource name. This 8-byte, left-justified field must contain the PSB name.

System Service Call: DPSB

Usage

The DPSB call must be used in a CPI Communications driven application program to release a PSB after a commit point occurs and before another PSB can be allocated. In a CPI Communications driven application program, the commit point is achieved with the COMMIT verb. For more information on CPI Communications driven application programs, see “CPI-C Driven Application Programs” on page 76.

Restrictions

You can issue the DPSB call only after a commit point occurs, and it is valid only after a successful APSB call.

GMSG Call

A Get Message (GMSG) call is used in an automated operator (AO) application program to retrieve a message from AO exit routine DFSAOE00.

Format

▶▶ GMSG *aib* *i/o_area* ◀◀

Parameters

aib

Specifies the application interface block (AIB) to be used for this call. This parameter is an input and output parameter.

You must initialize the following fields in the AIB:

AIBID

Eyecatcher. This 8-byte field must contain DFSAIBbb.

AIBLEN

AIB lengths. This field must contain the actual length of the AIB that the application program obtained.

AIBSFUNC

Subfunction code. This field must contain one of the listed 8-byte subfunction codes:

8-blanks (null)

When coded with an AOI token in the AIBRSNM1 field, indicates IMS is to return when no AOI message is available for the application.

WAITAOI

When coded with an AOI token in the AIBRSNM1 field, indicates IMS is to wait for an AOI message when none is currently available for the application. This subfunction value is invalid if an AOI token is not coded in AIBRSNM1. In this case, error return and reason codes are returned in the AIB.

The value WAITAOI must be left justified and padded with a blank character.

AIBRSNM1

Resource name. This field must contain the AOI token or blanks. The AOI token identifies the message the AO application is to retrieve. The token is supplied for the first segment of a message. If the message is a

multisegment message, set this field to blanks to retrieve the second through the last segment. AIBRSNM1 is an 8-byte alphanumeric left-justified field padded with blanks.

AIBOALEN

I/O area length. This field must contain the length of the I/O area that is specified in the call list. This field is not changed by IMS.

AIBOAUSE

Length of the data returned in the I/O area. This parameter is an output parameter.

When partial data is returned because the I/O area is not large enough, AIBOAUSE contains the length required to receive all of the data, and AIBOALEN contains the actual length of the data.

i/o area

Specifies the I/O area to use for this call. This parameter is an output parameter. The I/O area should be large enough to hold the largest segment passed from IMS to the AO application. If the I/O area is not large enough to contain all of the data, IMS returns partial data.

Usage

GMSG is used in an AO application to retrieve a message associated with an AOI token. The AO application must pass an 8-byte AOI token to IMS to retrieve the first segment of the message. IMS uses the AOI token to associate messages from AO exit routine DFSAOE00 with the GMSG call from an AO application. IMS returns to the application only those messages associated with the AOI token. By using different AOI tokens, DFSAOE00 can direct messages to different AO applications. Note that your installation defines the AOI token.

Related Reading: For more information on the AOI exits, see *IMS Version 9: Customization Guide*.

To retrieve the second through the last segments of a multisegment message, issue GMSG calls with no token specified (set the token to blanks). If you want to retrieve all segments of a message, you must issue GMSG calls until all segments are retrieved. IMS discards all non-retrieved segments of a multisegment message when a new GMSG call specifying an AOI token is issued.

Your AO application can specify a wait on the GMSG call. If no messages are currently available for the associated AOI token, your AO application waits until a message is available. The decision to wait is specified by the AO application, unlike a WFI transaction where the wait is specified in the transaction definition. The wait is done on a call basis; that is, within a single AO application some GMSG calls might specify waits while others do not.

Table 69 shows, by IMS environment, the types of application programs that can issue GMSG. GMSG is also supported from a CPI-C driven application program.

Table 69. GMSG Support by Application Region Type

Application Region Type	IMS Environment		
	DBCTL	DB/DC	DCCTL
DRA thread	Yes	Yes	N/A
BMP (nonmessage-driven)	Yes	Yes	Yes
BMP (message-driven)	N/A	Yes	Yes

System Service Call: GMSG

Table 69. GMSG Support by Application Region Type (continued)

Application Region Type	IMS Environment		
	DBCTL	DB/DC	DCCTL
MPP	N/A	Yes	Yes
IFP	N/A	Yes	Yes

Restrictions

A CPI-C driven program must issue an APSB (allocate PSB) call before issuing GMSG.

GSCD Call

This section contains programming interface information.

The Get System Contents Directory (GSCD) call retrieves the address of the IMS system contents directory (SCD) for batch programs.

Format



Call Name	DB/DC	DBCTL	DCCTL	DB Batch	TM Batch
GSCD				X	X

Parameters

i/o pcb

Specifies the PCB, the first PCB address in the list passed to the program, to use for this call. This parameter is an input and output parameter.

aib

Specifies the address of the application interface block (AIB) that is used for the call. This parameter is an input and output parameter.

The following fields must be initialized in the AIB:

AIBID

Eyecatcher. This 8-byte field must contain DFSAIBbb.

AIBLEN

AIB lengths. This field must contain the actual length of the AIB that the application program obtained.

AIBRSNM1

Resource name. This 8-byte, left-justified field must contain the PCB name IOPCBbbb.

AIBOALEN

I/O area length. This field must contain the length of the I/O area that is specified in the call list.

i/o area

Specifies the I/O area to be used for the call. This parameter is an output parameter. For the GSCD call, the I/O area must be 8 bytes in length. IMS TM

places the address of the SCD in the first 4 bytes and the address of the program specification table (PST) in the second 4 bytes.

Usage

IMS does not return a status code to a program after it issues a successful GSCD call. The status code from the previous call that used the same PCB remains unchanged in the PCB.

Restrictions

The GSCD call can be issued only from DLI or DBB batch application programs.

For more information on GSCD, see *IMS Version 9: Application Programming: Design Guide*.

ICMD Call

An Issue Command (ICMD) call lets an automated operator (AO) application program issue an IMS command and retrieve the first command response segment.

Format

►►—ICMD—*aib*—*i/o_area*—►►

Parameters

aib

Specifies the application interface block (AIB) used for this call. This parameter is an input and output parameter.

The following fields must be initialized in the AIB:

AIBID

Eyecatcher. This 8-byte field must contain DFSAIBbb.

AIBLEN

AIB lengths. This field must contain the actual length of the AIB that the application program obtained.

AIBOALEN

I/O area length. This field must contain the length of the I/O area that is specified in the call list. This field is not changed by IMS.

AIBOAUSE

Length of data returned in the I/O area. This parameter is an output parameter.

Your program must check this field to determine whether the ICMD call returned data to the I/O area. When the only response to the command is a DFS058 message indicating either COMMAND IN PROGRESS or COMMAND COMPLETE, the response is not returned.

When partial data is returned because the I/O area is not large enough, AIBOAUSE contains the length required to receive all of the data, and AIBOALEN contains the actual length of the data.

i/o area

Specifies the I/O area to use for this call. This parameter is an input and output parameter. The I/O area should be large enough to hold the largest command

System Service Call: ICMD

passed from the AO application to IMS, or command response segment passed from IMS to the AO application. If the I/O area is not large enough to contain all of the data, IMS returns partial data.

The general format of your I/O work area on an ICMD call is:

LLZZ/VERB KEYWORD1 P1 KEYWORD2 P2, P3.

LL	Two-byte field containing the length of the command text, including LLZZ.
ZZ	Two-byte field reserved for IMS.
/ or CRC	Indicates an IMS command follows. CRC (Command Recognition Character) rather than a slash (/) is used in the DBCTL environment.
VERB	The IMS command you are issuing.
KEYWORDX	Keywords that apply to the command being issued.
PX	Parameters for the keywords you are specifying.
. (Period)	End of the command.

The length of a command is limited by the size of the I/O area; the size is specified in the IOASIZE parameter in the PSBGEN macro during PCB generation. LL is the length of the command text. The size of the I/O area is the length of the actual command text, plus 4 bytes for LLZZ. The minimum size of the I/O work area is 132 bytes.

The fifth byte must be a "/" (or CRC for DBCTL), and the verb must follow immediately. The /BROADCAST and /LOOPTEST commands must have a period between the command segment and text segment, and must be preceded by an LLZZ field that includes the size of the text. Comments can be added by placing a period (.) after the last parameter.

Restriction: When issuing the /SSR command, do not code an end-of-command indicator (period) as shown in the *IMS Version 9: Command Reference*. If a period is used, it is considered part of the text.

Usage

ICMD enables an AO application to issue an IMS command and retrieve the first command response segment.

When using ICMD, put the IMS command that is to be issued in your application's I/O area. After IMS has processed the command, it returns the first segment of the response message to your AO application's I/O area to retrieve subsequent segments (one segment at a time), using the RCMD call.

Some IMS commands that complete successfully result in a DFS058 COMMAND COMPLETE message. Some IMS commands that are processed asynchronously result in a DFS058 COMMAND IN PROGRESS message. For a command entered on an ICMD call, neither DFS058 message is returned to the AO application. The AIBOAUSE field is set to zero to indicate no segment was returned. So, your AO application must check the AIBOAUSE field along with the return and reason codes to determine if a response was returned.

Related Reading: For more information on the AOI exits, see *IMS Version 9: Customization Guide*.

Table 70 shows, by IMS environment, the types of application programs that can issue ICMD. ICMD is also supported from a CPI-C driven application.

Table 70. ICMD Support by Application Region Type

Application Region Type	IMS Environment		
	DBCTL	DB/DC	DCCTL
DRA thread	Yes	Yes	N/A
BMP (nonmessage-driven)	Yes	Yes	Yes
BMP (message-driven)	N/A	Yes	Yes
MPP	N/A	Yes	Yes
IFP	N/A	Yes	Yes

See the *IMS Version 9: Command Reference* for a list of commands that can be issued using the ICMD call.

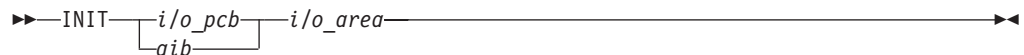
Restrictions

A CPI-C driven program must issue an APSB (allocate PSB) call before issuing ICMD.

INIT Call

An Initialize (INIT) call allows the application to receive data availability status codes by checking each DB PCB for data availability.

Format



Call Name	DB/DC	DBCTL	DCCTL	DB Batch	TM Batch
INIT	X	X	X	X	X

Parameters

i/o pcb

Specifies the I/O PCB, the first PCB address in the list passed to the program. This parameter is an input and output parameter.

aib

Specifies the address of the application interface block (AIB) that is used for the call. This parameter is an input and output parameter.

The following fields must be initialized in the AIB:

AIBID

Eyecatcher. This 8-byte field must contain DFSAIBbbb.

AIBLEN

AIB lengths. This field must contain the actual length of the AIB that the application program obtained.

AIBRSNM1

Resource name. This 8-byte, left-justified field must contain the PCB name IOPCBbbb.

System Service Call: INIT

AIBOALEN

I/O area length. This field must contain the length of the I/O area that is specified in the call list.

i/o area

Specifies the I/O area to be used for the call. This parameter is an input parameter. For the INIT call, the I/O area contains the character string "DBQUERY".

Usage

The INIT call is valid for all IMS TM application programs.

To specify the database query subfunction in your application program, specify the character string "DBQUERY" in the I/O area.

Determining Database Availability: INIT DBQUERY

When the INIT call is issued with the DBQUERY character string in the I/O area, the application program can obtain information regarding the availability of data for each PCB. Table 71 and Table 72 contain sample I/O areas for the INIT call with DBQUERY.

Table 71. INIT I/O Area Examples for All xxxTDLI Interfaces Except PLITDLI

L	L	Z	Z	Character String
00	0B	00	00	DBQUERY

Note: The LL and ZZ fields are binary. The LL value X'0B' is a hexadecimal representation of decimal 11.

Table 72. INIT I/O Area Examples for the PLITDLI Interface

L	L	L	L	Z	Z	Character String
00	00	00	0B	00	00	DBQUERY

Note: The LLLL and ZZ fields are binary. The L value X'0B' is a hexadecimal representation of decimal 11.

LL or LLLL

A 2-byte field that contains the length of the character string, plus 2 bytes for LL. For the PLITDLI interface, use the 4-byte field LLLL. When you use the AIBTDLI interface, PL/I programs require only a 2-byte field.

ZZ A 2-byte field of binary zeros.

One of the following status codes is returned for each database PCB:

NA At least one of the databases that can be accessed using this PCB is not available. A call made using this PCB probably results in a BA or BB status code if the INIT STATUS GROUPA call has been issued, or in a DFS3303I message and 3303 pseudo-abend if it has not. An exception is when the database is not available because dynamic allocation failed. In this case, a call results in an AI (unable to open) status code.

In a DCCTL environment, the status code is always NA.

NU At least one of the databases that can be updated using this PCB is unavailable for update. An ISRT, DLET, or REPL call using this PCB might result in a BA status code if the INIT STATUS GROUPA call has been issued, or in a DFS3303I message and 3303 pseudoabend if it has not. The

database that caused the NU status code might be required only for delete processing. In that case, DLET calls fail, but ISRT and REPL calls succeed.

- bb** The data that can be accessed with this PCB can be used for all functions the PCB allows. DEDBs and MSDBs always have the bb status code.

In addition to data availability status, the name of the database organization of the root segment is returned in the segment name field of the PCB. In DCCTL environments, the name of the database organization is UNKNOWN.

Automatic INIT DBQUERY

When the application program is entered initially, the status code in the database PCBs is initialized as if the INIT DBQUERY call was issued. This enables the application program to determine database availability without issuing the INIT call.

In DCCTL environments, the status code is NA.

Performance Considerations for the INIT Call (IMS Online Only)

For performance reasons, the INIT call should not be issued in online application programs before the first GU call to the I/O PCB. If the INIT call is issued first, the GU call to the I/O PCB is not processed as efficiently.

INQY Call

The Inquiry (INQY) call is used to request information regarding execution environment, destination type and status, and session status. INQY is valid only when using the AIBTDLI interface.

Format

▶▶—INQY—*aib*—*i/o_area*—————▶▶

Call Name	DB/DC	DBCTL	DCCTL	DB Batch	TM Batch
INQY	X	X	X	X	X

Parameters

aib

Specifies the address of the application interface block (AIB) that is used for the call. This parameter is an input and output parameter. The following fields must be initialized in the AIB:

AIBID

Eyecatcher. This 8-byte field must contain DFSAIBbb.

AIBLEN

AIB lengths. This field must contain the actual length of the AIB that the application program obtained.

AIBSFUNC

Subfunction code. This field must contain one of the 8-byte subfunction codes as follows:

- bbbbbbbb (Null)
- DBQUERYb
- ENVIRONb

System Service Call: INQY

FINDbbbb
LERUNOPT
PROGRAMb

Use of the PCB and I/O area with the subfunction is summarized in Table 80 on page 321.

AIBRSNM1

Resource name. This 8-byte, left-justified field must contain the PCB name of any PCB named in the PSB.

AIBOALEN

I/O area length. This field must contain the length of the I/O area that is specified in the call list. This field is not changed by IMS.

i/o area

Specifies the I/O area to be used for the INQY call. This parameter is an output parameter. An I/O area is required for INQY subfunctions ENVIRON, PROGRAM, and null. It is not required for subfunctions DBQUERY and FIND.

Usage

The INQY operates in both batch and online IMS TM environments. IMS TM application programs can use the INQY call to request information regarding output destination, session status, the current execution environment, the availability of databases, and the PCB address, which is based on the PCB name. Before you can issue an INQY call, you must initialize the fields of the AIB. See “AIBTDLI Interface” on page 33 for more information.

When you use the INQY call, specify an 8-byte subfunction code, which is passed in the AIB. The INQY subfunction determines the information that the application receives. For a summary of PCB type and I/O area use for each subfunction, see Table 80 on page 321.

The INQY call returns information to the caller's I/O area. The length of the data returned from the INQY call is passed back to the application in the AIB field AIBOAUUSE.

Specify the size of the I/O area in the AIB field AIBOALEN. The INQY call returns only as much data as the area can hold in one call. If the area is not large enough for all the data, an AG status code is returned, and partial data is returned in the I/O area. In this case, the AIB field AIBOALEN contains the actual length of the data returned to the I/O area, and the AIBOAUUSE field contains the output area length that would be required to receive all the data.

Querying Information from the PCB: INQY Null

When the INQY call is issued with the null subfunction, the application program obtains information related to the PCB, including output destination type and location, and session status. The INQY call can use the I/O PCB or the alternate PCB. The information you receive regarding destination location and session status is based on the destination type. The destination types are APPC, OTMA, TERMINAL, TRANSACT, and UNKNOWN.

Related Reading: For more information about APPC and LU 6.2, see *IMS Version 9: Administration Guide: Transaction Manager*.

The INQY null subfunction returns character string data in the I/O area. The output that is returned for the destination types APPC, OTMA, TERMINAL, and

TRANSACT is left justified and padded with blanks. The UNKNOWN destination type does not return any information. Table 73 through Table 77 on page 316 list the output returned from the INQY null call. Refer to the notes associated with the table for further information about some of the entries.

Table 73. INQY Null Data Output for Terminal -Type Destinations

Information Returned	Length in Bytes	Actual Value	Explanation
Destination Type	8	Terminal	The destination of the I/O PCB or alternate PCB is a terminal.
Terminal Location	8	Local	The terminal is defined as local.
		Remote	The terminal is defined as remote.
Queue Status	8	Started	The queue is started and can accept work.
		Stopped	The queue is stopped and cannot accept work.
Session Status	8	b	The status is not available.
		ACTIVE	The session is active.
		INACTIVE	The session is inactive.

Table 74. INQY Null Data Output for Transaction -Type Destinations

Information Returned	Length in Bytes	Actual Value	Explanation
Destination Type	8	TRANSACT	The destination of the alternate PCB is a program.
Transaction Location	8	Local	The transaction is defined as local.
		Remote	The transaction is defined as remote.
		DYNAMIC	The transaction is defined as dynamic. ¹
		b	The Program Routing exit routine has defined the destination as a transaction not on this system.
Transaction Status	8	STARTED	The transaction can be scheduled.
		STOPPED	The transaction cannot be scheduled.
		b	The Program Routing exit routine has defined the destination as a transaction not on this system. The transaction status is not available.
Destination PSB Name	8		This field gives the name of the destination PSB.
		b	The Program Routing exit routine has defined the destination as a transaction not on this system or the transaction is dynamic. The transaction destination is not available.
Destination Program or Session Status	8	b	The status is not available.
		ACTIVE	The session is active (remote transaction).
		INACTIVE	The session is inactive (remote transaction).
		STARTED	The program can be scheduled (local transaction).
		STOPPED	The program cannot be scheduled (local transaction).

System Service Call: INQY

Table 74. INQY Null Data Output for Transaction -Type Destinations (continued)

Information Returned	Length in Bytes	Actual Value	Explanation
Notes:			
1. A dynamic transaction is only possible in a shared-queues environment. A transaction is dynamic when it is not defined to the IMS system that is sending the message, but rather to another IMS system that is sharing the queues. The dynamic transaction is created when the Output Creation exit routine, DFSINSX0, indicates a transaction whose destination is unknown to IMS. The output fields for the destination PSB name and destination program are set to blanks.			

Table 75. INQY Null Data Output for APPC -Type Destinations

Information Returned	Length in Bytes	Actual Value	Explanation
Destination Type	8	APPC	The destination is an LU 6.2 device.
APPC/MVS Side Information Entry Name ¹	8		This field provides the Side Name.
		b	The Side Name is not available.
Partner Logical Unit Name ²	8		This field provides the partner LU name for the conversation.
		b	The partner LU name is not available.
Partner Mode Table Entry Name ³	8		This field provides the Mode Name for the conversation.
		b	The Mode Name is not available.
User Identifier	8		This field provides the user ID.
		b	The user ID is not available.
Group Name	8		This field provides the Group Name.
		b	The Group Name is not available.
Synchronization Level ⁴	1	C	The synchronization level is defined as CONFIRM.
		N	The synchronization level is defined as NONE.
Conversation Type ⁵	1	B	The conversation is defined as BASIC.
		M	The conversation is defined as MAPPED.
Userid Indicator	1		The value of the Userid Indicator field indicates the contents of the user ID field. The Userid Indicator field has four possible values.
		U	The U value indicates the user's identification from the source terminal during signon.
		L	The L value indicates the LTERM name of the source terminal if signon is not active.
		P	The P value indicates the PSBNAME of the source BMP or transaction.
Address of TPN ⁶	4		The O value indicates some other name.
		0	This is the address of the LL field of the Transaction Program Name. ⁷ The address of the Transaction Program Name is not available.

Table 75. INQY Null Data Output for APPC -Type Destinations (continued)

Information Returned	Length in Bytes	Actual Value	Explanation
-----------------------------	------------------------	---------------------	--------------------

Notes:

1. If the call is issued against a TP PCB, the Side Name cannot be used and b is returned. If the call is issued against an alternate modifiable PCB, the Side Name must be supplied in a CHNG call that is issued before INQY.
2. If the call is issued against an TP PCB, the LU name must be coded. If the call is issued against a modifiable alternate PCB, the LU name must be supplied in a CHNG call that is issued before INQY.
3. If the call is issued against an TP PCB, the Mode Name cannot be used and b is returned. If the call is issued against an alternate modifiable PCB, the Mode Name must be supplied in a CHNG call that is issued before INQY.
4. When the synchronization level is not available, IMS uses the default value of CONFIRM.
5. When the conversation type is not available, IMS uses the default value of MAPPED.
6. The pointer identifies a length field (LL), which contains the length of the TPN in binary, including the 2 bytes required for LL.
7. The TPN can be up to 64 bytes long.

Table 76. INQY Null Data Output for OTMA -Type Destinations

Information Returned	Length in Bytes	Actual Value	Explanation
Destination Type	8	OTMA	The destination is an OTMA client.
Tpipe Name	8		This field provides the OTMA transaction pipe name.
		b	The Tpipe Name is not available.
Member Name	16		This field provides the OTMA client's XCF member name.
		b	The Member Name is not available.
User Identifier	8		This field provides the User ID.
		b	The User ID is not available.
Group Name	8		This field provides the group name.
		b	The Group Name is not available.
Synchronization Level	1	S	The OTMA transaction pipe is synchronized.
		b	The OTMA transaction pipe is not synchronized.
Message Synchronization Level ¹	1	C	The synchronization level is defined as CONFIRM.
		N	The synchronization level is defined as NONE.
Userid Indicator	1		The value of the Userid Indicator field indicates the contents of the user ID field. The Userid Indicator field has four possible values.
		U	The U value indicates the user's identification from the source terminal during signon.
		L	The L value indicates the LTERM name of the source terminal if signon is not active.
		P	The P value indicates the PSBNAME of the source BMP or transaction.
		O	The O value indicates some other name.

System Service Call: INQY

Table 76. INQY Null Data Output for OTMA -Type Destinations (continued)

Information Returned	Length in Bytes	Actual Value	Explanation
Reserved for IMS	1		This field is reserved.

Notes:

1. When the synchronization level is not available, IMS uses the default value of CONFIRM.

Table 77. INQY Null Data Output for Unknown -Type Destinations

Information Returned	Length in Bytes	Actual Value	Explanation
Destination Type	8	UNKNOWN	Unable to find destination.

The contents of the output fields vary depending on the type of PCB used for the INQY call. Table 78 shows how INQY output for APPC destinations varies depending on the PCB type. The PCB can be a TP PCB or an alternate PCB.

Table 78. INQY Output and PCB Type

Output Field	TP PCB	Alternate PCB (Non-modifiable)	Alternate PCB (Modifiable)
Destination Type	APPC	APPC	APPC
Side Name	blanks	Side Name if available or blanks	Side Name if supplied on previous CHNG call or blanks
LU Name	Input LU Name	LU Name if available or blanks	LU Name if supplied on previous CHNG call or blanks
Mode Name	blanks	Mode Name if available or blanks	Mode Name if supplied on previous CHNG call or blanks
User Identifier	USERID if available or blanks	USERID if available or blanks	USERID if available or blanks
Group Name	Group Name if available or blanks	Group Name if available or blanks	Group Name if available or blanks
Sync Level	C or N	C or N	C or N
Conversation Type	B or M	B or M	B or M
Userid Indicator	U or L or P or O	U or L or P or O	U or L or P or O
TPN Address	Address of the TPN character string	Address of the TPN character string or zero	Address of the TPN character string or zero
TPN character string Note: If your TPN name is DFSASYNC, the destination represents an asynchronous conversation.	Inbound name of IMS Transaction that is executing.	Partner TPN, if available. If not available, address field is zero.	TP Name if it is supplied on the previous CHNG call. If not supplied, the address field is zero.

Related Reading: For more information on APPC and LU 6.2, see *IMS Version 9: Administration Guide: Transaction Manager*.

Querying Data Availability: INQY DBQUERY

When the INQY call is issued with the DBQUERY subfunction, the application program obtains information regarding the data for each PCB. The only valid PCB name that can be passed in AIBRSNM1 is "IOPCBbbb". The INQY DBQUERY call is

similar to the INIT DBQUERY call. It updates status codes in the database PCBs, but it does not return information in the I/O area.

In addition to the INIT DBQUERY status codes, the INQY DBQUERY call returns the following status codes in the I/O PCB:

- bb** The call is successful and all databases are available.
- BJ** None of the databases in the PSB are available, or no PCBs exist in the PSB. All database PCBs (excluding GSAM) contain an NA status code as the result of processing the INQY DBQUERY call.
- BK** At least one of the databases in the PSB is not available or availability is limited. At least one database PCB contains an NA or NU status code as the result of processing the INQY DBQUERY call.

The INQY call returns the following status codes in each DB PCB:

- NA** At least one of the databases that can be accessed using this PCB is not available. A call made using this PCB probably results in a BA or BB status code if the INIT STATUS GROUPA call has been issued, or in a DFS3303I message and 3303 pseudoabend if it has not. An exception is when the database is not available because dynamic allocation failed. In this case, a call results in an AI (unable to open) status code.

In a DCCTL environment, the status code is always NA.
- NU** At least one of the databases that can be updated using this PCB is unavailable for update. An ISRT, DLET, or REPL call using this PCB might result in a BA status code if the INIT STATUS GROUPA call has been issued, or in a DFS3303I message and 3303 pseudoabend if it has not. The database that caused the NU status code might be required only for delete processing. In that case, DLET calls fail, but ISRT and REPL calls succeed.
- bb** The data that can be accessed with this PCB can be used for all functions the PCB allows. DEDBs and MSDBs always have the bb status code.

Querying the Environment: INQY ENVIRON

When the INQY call is issued with the ENVIRON subfunction, the application program obtains information regarding the current execution environment. The only valid PCB name that can be passed in AIBRSNM1 is "IOPCBbbb". This includes the IMS identifier, release, region, and region type. The INQY ENVIRON call returns character string data in the I/O area. The output is left justified and padded with blanks on the right. Table 79 on page 318 lists the output returned from the INQY ENVIRON call.

Recommendation: To receive the data listed in Table 79 on page 318 and to account for future expansion, define the I/O area length to be larger than 152 bytes (the total of all the fields listed). If you define the I/O area length to be exactly 152 bytes and the I/O area is expanded in future releases, you will receive an AG status code. The following list describes the length of the fields and their contents.

Length	Content Definition
100 bytes	INQY ENVIRON data
2 bytes	Length field for Recovery Token section (18 bytes)
16 bytes	Recovery Token
2 bytes	Length field for APARM section (maximum of 34 bytes)
32 bytes	APARM data

System Service Call: INQY

Table 79. INQY ENVIRON Data Output

Information Returned	Length in Bytes	Actual Value	Explanation
IMS Identifier	8		Provides the identifier from the execute parameters.
IMS Release Level	4		Provides the release level for IMS. For example, X'00000410'
IMS Control Region Type	8	BATCH	Indicates that an IMS Batch region is active.
		DB	Indicates that only the IMS Database Manager is active (DBCTL system).
		TM	Indicates that only the IMS Transaction Manager is active (DCCTL system).
		DB/DC	Indicates that both the IMS Database and Transaction managers are active (DB/DC system).
IMS Application Region Type	8	BATCH	Indicates that the IMS Batch region is active.
		BMP	Indicates that the Batch Message Processing region is active.
		DRA	Indicates that the Database Resource Adapter Thread region is active.
		IFP	Indicates that the IMS Fast Path region is active.
		MPP	Indicates that the Message Processing region is active.
Region Identifier	4		Provides the region identifier. For example, X'00000001'
Application Program Name	8		Provides the name of the application program being run.
PSB Name (currently allocated)	8		Provides the name of the PSB currently allocated.
Transaction Name	8		Provides the name of the transaction.
		b	Indicates that there is no transaction.
User Identifier ¹	8		Provides the user ID.
		b	Indicates that the user ID is unavailable.
Group Name	8		Provides the group name.
		b	Indicates that the group name is unavailable.
Status Group Indicator	4	A	Indicates an INIT STATUS GROUPA call is issued.
		B	Indicates an INIT STATUS GROUPB call is issued.
		b	Indicates that a status group is not initialized.
Address of Recovery Token ²	4		Provides the address of the LL field, followed by the Recovery Token.
Address of the Application Parameter String ²	4		Provides the address of the LL field, followed by the application parameter string.
		0	Indicates that the APARM=parameter is not coded in the EXEC (execute) parameters of the dependent region JCL.
Shared Queues Indicator	4		Indicates IMS is not using Shared Queues.
		SHRQ	Indicates IMS is using Shared Queues.
Userid of Address Space	8		Userid of dependent address space.

Table 79. INQY ENVIRON Data Output (continued)

Information Returned	Length in Bytes	Actual Value	Explanation
Userid Indicator	1		The Userid Indicator field has one of four possible values. This value indicates the contents of the user ID field. <ul style="list-style-type: none"> • U: Indicates the user's identification from the source terminal during signon. • L: Indicates the LTERM name of the source terminal. • P: Indicates the PSBNAME of the source BMP or transaction. • O: Indicates some other name.
RRS Indicator	3	b	Indicates IMS has not expressed interest in the UR with RRS. Therefore, the application should refrain from performing any work that causes RRS to become the syncpoint manager for the UR because IMS will not be involved in the commit scope. For example, the application should not issue any outbound protected conversations.
		RRS	Indicates IMS has expressed interest in the UR with RRS. Therefore, IMS will be involved in the commit scope if RRS is the syncpoint manager for the UR.

Note:

- The user ID is derived from the PSTUSID field of the PST that represents the region making the INQY ENVIRON call. The PSTUSID field is one of the following:
 - For message-driven BMP regions that have not completed successful GU calls to the IMS message queue and for non-message-driven BMP regions, the PSTUSID field is derived from the name of the PSB currently scheduled into the BMP region.
 - For message-driven BMP regions that have completed a successful GU call and for any MPP region, the PSTUSID field is derived from the last message retrieved from the message queue, which is usually the input terminal's RACF ID. If the terminal has not signed onto RACF, the ID is the input terminal's LTERM.
- The pointer identifies a length field (LL) that contains the length of the recovery token and user parameter in binary, including the 2 bytes required for LL.

Related Reading: For more information on authorizing resource use in a dependent region, see *IMS Version 9: Administration Guide: System*.

Querying the PCB Address: INQY FIND

When the INQY call is issued with the FIND subfunction, the application program is returned with the PCB address of the requested PCB name. The valid PCB names that can be passed in AIBRSNM1 are either "IOPCBbbb" or the name of the alternate PCB (TP PCB) or database PCB as it is defined in the PSB.

On a FIND subfunction, the requested PCB remains unmodified, and no information is returned in an I/O area.

The FIND subfunction is used to get a PCB address following an INQY DBQUERY call. This process allows the application to analyze the PCB status code to determine if an NA or NU status code is set in the PCB.

Querying for LE Overrides: INQY LERUNOPT

When the LERUNOPT call is issued with the LERUNOPT subfunction, IMS determines if LE overrides are allowed based on the LEOPT system parameter. The LE override parameters are defined to IMS through the UPDATE LE command. IMS checks to see if there are any overrides applicable to the caller based on the specific combinations of transaction name, lterm name, user ID, or program name

System Service Call: INQY

in the caller's environment. IMS will return the address of the string to the caller if an override parameter is found. The LE overrides are used by the IMS supplied CEEBXITA exit, DFSBXITA, to allow dynamic overrides for LE runtime parameters.

Related Reading:

- For more information about the UPDATE LE command, see *IMS Version 9: Command Reference*.
- For more information about the IMS supplied CEEBXITA, DFSBXITA, see *IMS Version 9: Customization Guide*.

The call string must contain the function code and the AIB address. The I/O area is not a required parameter and will be ignored if specified. The only valid PCB name that can be passed in AIBRSNM1 is IOPCB. The AIBOALEN and AIBOAUSE fields are not used.

The rules for matching an entry, which results in it being returned on a DL/I INQY LERUNOPT call, are:

- An MPP or JMP region uses transaction name, lterm, user ID, and program to match with each entry.
- An IFB, JBP, or non-message driven BMP uses program name to match with each entry. If an entry has a defined filter for transaction name, lterm, or user ID, it does not match. Message driven BMPs also use transaction name.
- The entries are scanned to find the entry with the most filter matches. The first entry in the list with the most exact filter matches is selected. The scan stops with an entry found with all of the filters matching the entry.

Note: Searching table entries can be confusing because of the way entries are built and searched.

For example, assume there are two entries in the table that match on the filters specified on the DL/I INQY call. The first transaction matches on transaction name and lterm name. The second entry matches on transaction name and program name. IMS chooses the first entry because it was the first entry encountered with highest number of filter matches. If the second entry is now updated with a longer parameter string, which causes a new entry to be built, it will be added to the head of the queue.

The next search would result in the entry with transaction name and program name to be selected. This could result in the selection of a set of runtime options not expected by the user.

Environments: The LERUNOPT subfunction can be specified from DB/DC, DBCTL, and DCCTL environments. Overrides are based on a combination of transaction name, lterm name, user ID, and program name in MPP and JMP regions. IFP, BMP, and JBP regions will have overrides based on program name. Message driven BMP regions can also use transaction name.

Return and Reason Codes: AIB return and reason codes must be checked to determine if the call has been successfully completed. AIBRSA2 is used to return the address of the parameter string if override parameters are available for the caller.

Related Reading: For more information, see *IMS Version 9: Messages and Codes, Volume 1*.

Querying the Program Name: INQY PROGRAM

When you issue the INQY call with the PROGRAM subfunction, the application program name is returned in the first 8 bytes of the I/O area. The only valid PCB name that can be passed in AIBRSNM1 is "IOPCBbbb".

INQY Return Codes and Reason Codes

When you issue the INQY call, return and reason codes are returned to the AIB. Status codes can be returned to the PCB. If return and reason codes other than those apply to INQY are returned, your application should examine the PCB to see what status codes are found.

Related Reading: For more information about the return and reason codes that apply to INQY, see *IMS Version 9: Messages and Codes, Volume 1*.

Map of INQY Subfunction to PCB Type

Table 80 describes the subfunction, PCB, and I/O area combinations for the INQY call.

Table 80. Subfunction, PCB, and I/O Area Combinations for the INQY Call

Subfunction	TP PCB	Alternate PCB	DB PCB	I/O Area Required
DBQUERY	OK	NO	NO	NO
ENVIRON	OK	NO	NO	YES
FIND	OK	OK	OK	OK
LERUNOPT	OK	NO	NO	NO
Null	OK	OK	NO	YES
PROGRAM	OK	NO	NO	YES

Restrictions

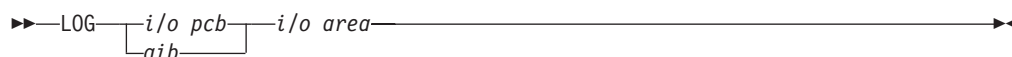
A CPI Communications driven application program cannot issue an INQY call with the null subfunction against an I/O PCB.

A batch program cannot issue an INQY call with a null subfunction.

LOG Call

The Log (LOG) call is used to send and write information to the IMS system log.

Format



Call Name	DB/DC	DBCTL	DCCTL	DB Batch	TM Batch
LOG	X	X	X	X	X

Parameters

i/o pcb

Specifies the address of the PCB, the first PCB address in the list passed to the program, to use for this call. This parameter is an input and output parameter.

aib

Specifies the application interface block (AIB) that is used for the call. This parameter is an input and output parameter.

The following fields must be initialized in the AIB:

AIBID

Eyecatcher. This 8-byte field must contain DFSAIBbb.

AIBLEN

AIB lengths. This field must contain the actual length of the AIB that the application program obtained.

AIBRSNM1

Resource name. This 8-byte, left-justified field must contain the PCB name IOPCBbbb.

AIBOALEN

I/O area length. This field must contain the length of the I/O area that is specified in the call list.

i/o area

Specifies the area in your program that contains the record that you want to write to the system log. This parameter is an input parameter. This record must be in the format shown in Table 81 and Table 82.

Table 81. Log Record Formats for COBOL, PL/I, C Language, Pascal, and Assembler for AIBTDLI, ASMTDLI, CBLTDLI, CEETDLI, CTDLI, and PASTDLI interfaces

Field Name	Field Length
LL	2
ZZ	2
C	1
Text	Variable

Table 82. Log Record Formats for COBOL, PL/I, C Language, Pascal, and Assembler for PLITDLI interface

Field Name	Field Length
LLLL	4
ZZ	2
C	1
Text	Variable

The fields must be as follows:

LL or LLLL Specifies a 2-byte field that contains the length of the record. When you use the AIBTDLI interface, the length of the record is equal to LL + ZZ + C + text of the record. For the PLITDLI interface, the length of the record is equal to LLLL + ZZ + C +

the text of the record. When you calculate the length of the log record, you must account for all of the fields. The total length you specify includes:

- 2 bytes for LL or LLLL. (For PL/I, include the length as 2, even though LLLL is a 4-byte field.)
- 2 bytes for the ZZ field.
- 1 byte for the C field.
- n bytes for the length of the record itself.

If you are using the PLITDLI interface, your program must define the length field as a binary fullword.

ZZ	Specifies a 2-byte field of binary zeros.
C	Specifies a 1-byte field containing a log code, which must be equal to or greater than X'A0'.
Text	Specifies any data to be logged.

Usage

An application program can write a record to the system log by issuing the LOG call. When you issue the LOG call, you specify the I/O area that contains the record you want written to the system log. You can write any information to the log, and you can use log codes to distinguish among various types of information. You can issue the LOG:

- In the IMS DB/DC environment, and the record is written to the IMS log.
- In the DCCTL environment, and the record is written to the DCCTL log.

Restrictions

The length of the I/O area (including all fields) cannot be larger than the logical record length (LRECL) for the system log data set minus 4 bytes and the length of logrec prefix (which is x'4A' bytes in length), or the I/O area specified in the IOASIZE keyword of the PSBGEN statement of the PSB.

RCMD Call

A Retrieve Command (RCMD) call lets an automated operator (AO) application program retrieve the second and subsequent command response segments after an ICMD call.

Format

►►—RCMD—*aib*—*i/o area*—◄◄

Parameters

aib

Specifies the application interface block (AIB) used for this call. This parameter is an input and output parameter.

The following fields must be initialized in the AIB:

AIBID

Eyecatcher. This 8-byte field must contain DFSAIBbb.

System Service Call: RCMD

AIBLEN

AIB lengths. This field must contain the actual length of the AIB that the application program obtained.

AIBOALEN

I/O area length. This field must contain the length of the I/O area that is specified in the call list. This field is not changed by IMS.

AIBOAUSE

Length of data returned in the I/O area. This parameter is an output parameter.

When partial data is returned because the I/O area is not large enough, AIBOAUSE contains the length required to receive all of the data and AIBOALEN contains the actual length of the data.

i/o area

Specifies the I/O area to use for this call. This parameter is an output parameter. The I/O area should be large enough to hold the largest command response segment passed from IMS to the AO application. If the I/O area is not large enough for all of the information, partial data is returned in the I/O area.

Usage

RCMD lets an AO application retrieve the second and subsequent command response segments resulting from an ICMD call.

Related Reading: For more information on the AOI exits, see *IMS Version 9: Customization Guide*.

Table 83 shows, by IMS environment, the types of application programs that can issue RCMD. RCMD is also supported from a CPI-C driven application program.

Table 83. RCMD Support by Application Region Type

Application Region Type	IMS Environment		
	DBCTL	DB/DC	DCCTL
DRA thread	Yes	Yes	N/A
BMP (nonmessage-driven)	Yes	Yes	Yes
BMP (message-driven)	N/A	Yes	Yes
MPP	N/A	Yes	Yes
IFP	N/A	Yes	Yes

RCMD retrieves only one response segment at a time. If you need additional response segments, you must issue RCMD once for each response segment issued by IMS.

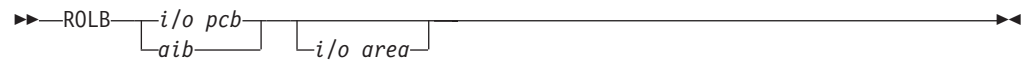
Restrictions

An ICMD call must be issued before an RCMD call.

ROLB Call

The Rollback (ROLB) call backs out messages sent by the application program. For more information on the ROLB call, see “Backing out to a Prior Commit Point: ROLL, ROLB, and ROLS Calls” on page 77.

Format



Call Name	DB/DC	DBCTL	DCCTL	DB Batch	TM Batch
ROLB	X	X	X	X	X

Parameters

i/o pcb

Specifies the I/O PCB, the first PCB address in the list passed to the program. This parameter is an input and output parameter.

aib

Specifies the application interface block (AIB) that is used for the call. This parameter is an input and output parameter.

The following fields must be initialized in the AIB:

AIBID

Eyecatcher. This 8-byte field must contain DFSAIBbb.

AIBLEN

AIB lengths. This field must contain the actual length of the AIB that the application program obtained.

AIBRSNM1

Resource name. This 8-byte, left-justified field must contain the PCB name IOPCBbbb.

AIBOALEN

I/O area length. This field must contain the length of the I/O area that is specified in the call list.

i/o area

An output parameter that specifies the area in your program to which IMS TM returns the first message segment. For conversational transactions the SPA will be the first item returned to the application. Your next GN call will then return the first user segment of the message.

Usage

Issuing a ROLB in a conversational program causes IMS TM to back out the messages that the application program has sent. If the program issues a ROLB call and then reaches a commit point without sending the required response to the originating terminal, IMS TM terminates the conversation and sends the message DFS2171I NO RESPONSE CONVERSATION TERMINATED to the originating terminal.

If your application program has allocated resources that IMS TM cannot roll back, the resources are ignored. For example, if your application program issues CPI-C verbs to allocate resources (for modified DL/I or CPI-C driven programs), ROLB only affects those resources allocated by IMS. Your application must notify any CPI-C conversations that a ROLB call was issued.

System Service Call: ROLB

For CPI-C driven application programs, all messages inserted to nonexpress alternate PCBs are discarded. Messages inserted to express alternate PCBs are discarded if the PURG call was not issued against the PCB before the ROLB call was issued.

Any application program that uses Spool API functions and creates print data sets can issue the ROLB call. This backs out any print data sets that have not been released to JES.

If the application program has processed input as a result of a protected conversation with RRS/MVS, the ROLB will result in IMS abnormally terminating the application program with an ABENDU0711, Reason Code X'20'. IMS will discard the input message.

Restrictions

The AIB must specify the I/O PCB for this call.

ROLL Call

The Roll (ROLL) call backs out output messages sent by a conversational application program and terminates the conversation. For more information on the ROLL call, see “Backing out to a Prior Commit Point: ROLL, ROLB, and ROLS Calls” on page 77.

Format

▶▶—ROLL—◀◀

Call Name	DB/DC	DBCTL	DCCTL	DB Batch	TM Batch
ROLL	X	X	X	X	X

Parameters

The only parameter required for the ROLL call is the call function.

Usage

IMS terminates the application with a U0778 abend.

If you issue a ROLL call during a conversation, IMS TM backs out the update and cancels output messages. IMS TM also terminates the conversation with a U0778 abend code.

For applications that use the CPI Communications interface, the original transaction is discarded if it is classified by IMS as a discardable transaction.

Any remote LU 6.2 conversation transactions generated by a modified DL/I or CPI-C driven application program are deallocated with TYPE (ABEND_SVC).

Any application program that uses Spool API functions and creates print data sets can issue the ROLL call. This backs out any print data sets that have not been released to JES.

Related Reading:

- For information on discardable and non-discardable transactions see *IMS Version 9: Application Programming: Design Guide*.
- For more information on LU 6.2, see *IMS Version 9: Administration Guide: Transaction Manager*.

Restrictions

The ROLL call cannot use the AIBTDLI interface.

ROLS Call

The Roll Back to SETS/SETU (ROLS) call returns message queue positions to sync points established by the SETS/ SETU call. For more information on the ROLS and SETS/SETU calls, see “Backing out to a Prior Commit Point: ROLL, ROLB, and ROLS Calls” on page 77, and “SETS/SETU Call” on page 328).

Format



Call Name	DB/DC	DBCTL	DCCTL	DB Batch	TM Batch
ROLS	X	X	X	X	X

Parameters

i/o pcb

Specifies the I/O PCB, the first PCB address in the list passed to the program. This parameter is an input and output parameter.

aib

Specifies the application interface block (AIB) that is used for the call. This parameter is an input and output parameter.

The following fields must be initialized in the AIB:

AIBID

Eyecatcher. This 8-byte field must contain DFSAIBbb.

AIBLEN

AIB lengths. This field must contain the actual length of the AIB that the application program obtained.

AIBRSNM1

Resource name. This 8-byte, left-justified field must contain the PCB name IOPCBbbb.

AIBOALEN

I/O area length. This field must contain the length of the I/O area that is specified in the call list.

i/o area

Specifies the I/O area. It has the same format as the I/O area supplied on the SETS/SETU call. This parameter is an output parameter.

token

Specifies the name of the area in your program that contains a 4-byte identifier. This parameter is an input parameter.

System Service Call: ROLS

Usage

Issuing a ROLS in a conversational program causes IMS TM to back out the messages that the application program has sent. For conversation transactions, this means that if the program issues a ROLS call and then reaches a commit point without sending the required response to the originating terminal, IMS TM terminates the conversation and sends the message DFS21711 NO RESPONSE, CONVERSATION TERMINATED to the originating terminal.

When you issue a ROLS call with a token and the messages to be rolled back include nonexpress messages that are processed by IMS TM, message queue repositioning might occur. The repositioning can include the initial message segment, and the original input transaction can be presented again to the IMS TM application program.

Input and output positioning is determined by the SETS/SETU call in standard and modified DL/I application programs. Input and output positioning does not apply to CPI-C driven application programs.

The application program must notify any remote transaction programs of the ROLS.

On a ROLS without a token, IMS issues the APPC/MVS verb, ATBCMTP TYPE(ABEND), specifying the transaction program instance (TPI). This causes all conversations associated with the application program to be DEALLOCATED TYPE(ABEND_SVC). If the original transaction was entered from an LU 6.2 device and IMS TM received the message from APPC/MVS, a discardable transaction is discarded. Nondiscardable transactions are placed on the suspend queue.

Related Reading: For more information on LU 6.2, see *IMS Version 9: Administration Guide: Transaction Manager*.

Restrictions

When ROLS is issued during a conversational application program that includes resources outside of IMS TM (for example, a CPI-C driven application program), only the IMS TM resources are rolled back. The application program notifies the remote transactions of the ROLS call.

The Spool API functions do not restrict the use of the SETS/SETU and ROLS calls because these calls can be used by the application program outside the processing of print data sets. When these commands are issued, the Spool API takes no action because these commands cannot be used for the partial backout of print data sets. No special status codes are returned to the application program to indicate that the SETS/SETU or ROLS call was issued by an application that is using Spool API.

The ROLS call is not valid when the PSB contains a DEDB or MSDB PCB, or when the call is made to a DB2 database.

SETS/SETU Call

The Set Backout Point (SETS) call is used to set an intermediate backout point or to cancel all existing backout points. The Set Unconditional (SETU) call operates like the SETS call except that the SETU call isn't rejected if unsupported PCBs are in the PSB or if the program uses an external subsystem.

Format



Call Name	DB/DC	DBCTL	DCCTL	DB Batch	TM Batch
SETS/SETU	X	X	X	X	X

Parameters

i/o pcb

Specifies the I/O PCB, the first PCB address in the list passed to the program. This parameter is an input and output parameter.

aib

Specifies the application interface block (AIB) that is used for the call. This parameter is an input and output parameter.

The following fields must be initialized in the AIB:

AIBID

Eyecatcher. This 8-byte field must contain DFSAIBbb.

AIBLEN

AIB lengths. This field must contain the actual length of the AIB that the application program obtained.

AIBRSNM1

Resource name. This 8-byte, left-justified field must contain the PCB name IOPCBbbb.

AIBOALEN

I/O area length. This field must contain the length of the I/O area that is specified in the call list.

i/o area

Specifies the area in your program that contains the data that is to be kept by IMS and returned on the corresponding ROLS call. This parameter is an input parameter.

token

Specifies the name of the area in your program that contains a 4-byte identifier. This parameter is an input parameter.

Usage

Except for the call names themselves, the SETS and SETU format and parameters are the same.

The SETS and SETU calls provide the backout points that IMS uses in the ROLS call. The ROLS call operates consistent with the SETS and SETU call backout points.

The meaning of the SC status code for SETS or SETU is as follows:

SETS The SETS call is rejected. The SC status code in the I/O PCB indicates that either the PSB contains unsupported options or the application program made calls to an external subsystem.

System Service Call: SETS/SETU

SETU The SETU call is not rejected. The SC status code indicates that unsupported PCBs exist in the PSB or the application made calls to an external subsystem.

Restrictions

The SETS call is not valid when the PSB contains a DEDB or MSDB PCB, or when the call is made to a DB2 database.

CPI-C driven transaction programs cannot issue the SETS/SETU call.

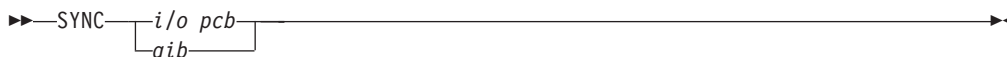
The Spool API functions do not restrict the use of the SETS/SETU and ROLS calls. This is so, because these calls can be used by the application outside the processing of print data sets. When these commands are issued, the Spool API takes no action because these commands cannot be used for the partial backout of print data sets.

Before a ROLS call, you can specify a maximum of 255 SETS calls with the same token and still back out to the correct message level. After 255 SETS calls, the messages continue to back out, but only to the same message level as at 255th SETS call. The SETS token count resets to zero during sync point processing.

SYNC Call

The Synchronization Point (SYNC) call is used to request commit point processing.

Format



Call Name	DB/DC	DBCTL	DCCTL	DB Batch	TM Batch
SYNC	X	X	X		

Parameters

i/o pcb

Specifies the I/O PCB, the first PCB address in the list passed to the program. This parameter is an input and output parameter.

aib

Specifies the application interface block (AIB) that is used for the call. This parameter is an input and output parameter.

The following fields must be initialized in the AIB:

AIBID

Eyecatcher. This 8-byte field must contain DFSAIBbb.

AIBLEN

AIB lengths. This field must contain the actual length of the AIB that the application program obtained.

AIBRSNM1

Resource name. This 8-byte, left-justified field must contain the PCB name IOPCBbbb.

Usage

Issue the SYNC call to request that IMS TM process the application program with commit points for the application program.

Restrictions

The SYNC call is valid only in batch-oriented BMPs.

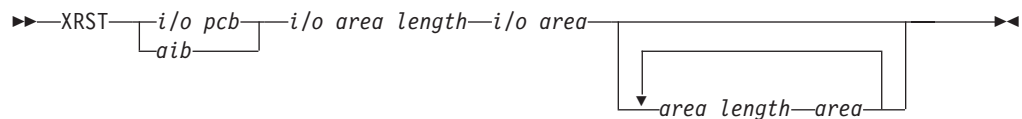
You cannot issue a SYNC call from a CPI Communications driven application program.

For important considerations about the use of the SYNC call, see *IMS Version 9: Administration Guide: Database Manager*.

XRST Call

The Extended Restart (XRST) call is used to restart your program. If you use the symbolic Checkpoint call in your program, you must use the XRST call. For a description of the symbolic CHKP call see “CHKP (Symbolic) Call” on page 301.

Format



Call Name	DB/DC	DBCTL	DCCTL	DB Batch	TM Batch
XRST	X	X	X	X	X

Parameters

i/o pcb

Specifies the I/O PCB, the first PCB address in the list passed to the program. This parameter is an input and output parameter.

aib

Specifies the application interface block (AIB) that is used for the call. This parameter is an input and output parameter.

The following fields must be initialized in the AIB:

AIBID

Eyecatcher. This 8-byte field must contain DFSAIBbb.

AIBLEN

AIB lengths. This field must contain the actual length of the AIB that the application program obtained.

AIBRSNM1

Resource name. This 8-byte, left-justified field must contain the PCB name IOPCBbbb.

AIBOALEN

I/O area length. This field must contain the length of the I/O area that is specified in the call list. This parameter is not used during the XRST call. For compatibility reasons, this parameter must still be coded.

System Service Call: XRST

i/o area length

This parameter is no longer used by IMS. For compatibility reasons, this parameter must still be included in the call, and it must contain a valid address. You can get a valid address by specifying the name of any area in your program.

i/o area

Specifies a 14-byte area in your program. This area must be either set to blanks if starting your program normally or, if performing an extended restart, have a checkpoint ID.

area length

Specifies a 4-byte field in your program containing the length (in binary) of an area to restore. This input parameter is optional. You can specify up to seven area lengths. For each area length, you must also specify the area parameter. The number of areas you specify on a XRST call must be less than or equal to the number of areas you specify on the CHKP calls the program issues. When you restart the program, IMS TM restores only the areas you specified in the CHKP call.

area

Specifies the area in your program that you want IMS TM to restore. You can specify up to seven areas. Each area specified must be preceded by an *area length* value. This parameter is an input parameter.

Usage

Programs that wish to issue Symbolic Checkpoint calls (CHKP) must also issue the Extended Restart call (XRST). The XRST call must be issued only once and should be issued early in the execution of the program. It does not need to be the first call in the program. However, it must precede any CHKP call. Any Database calls issued before the XRST call are not within the scope of a restart.

IMS determines whether to perform a normal start or a restart based on the I/O area provided by the XRST call or CKPTID= value in the PARM field on the EXEC statement in your program's JCL.

Starting Your Program Normally

When you are starting your program normally, the I/O area pointed to in the XRST call must contain blanks and the CKPTID= value in the PARM field must be nulls. This indicates to IMS that subsequent CHKP calls are symbolic checkpoints rather than basic checkpoints. Your program should test the I/O area after issuing the XRST call. IMS does not change the area when you are starting the program normally.

Restarting Your Program

You can restart the program from a symbolic checkpoint taken during a previous execution of the program. The checkpoint used to perform the restart can be identified by entering the checkpoint ID either in the I/O area pointed to by the XRST call (leftmost justified, with the rest of the area containing blanks) or by specifying the ID in the CKPTID= field of the PARM= parameter on the EXEC statement in your program's JCL. (If you supply both, IMS uses the CKPTID= value specified in the parm field of the EXEC statement.)

The ID specified can be:

- A 1 to 8-character extended checkpoint ID
- A 14-character "time stamp" ID from message DFS05401, where:
 IIII is the region ID

DDD is the day of the year

HHMMSST is the time in hours, minutes, seconds, and tenth of a second

- The 4-character constant "LAST". (BMPs only: this indicates to IMS that the last completed checkpoint issued by the BMP will be used for restarting the program)

The system message DFS05401 supplies the checkpoint ID and the time stamp.

The system message DFS6821 supplies the checkpoint ID of the last completed checkpoint which can be used to restart a batch program or batch message processing program (BMP) that was abnormally terminated.

If the program being restarted is in either a batch region or a BMP region, and the checkpoint log records no longer reside on the Online Log Data Set (OLDS) or System Log Data Set (SLDS), the //IMSLOGR DD defining the log data set must be supplied in the JCL for the BATCH or BMP region. IMS reads these data sets and searches for the checkpoint records with the ID that was specified.

At the completion of the XRST call, the I/O area always contains the 8-character checkpoint ID used for the restart. An exception exists when the checkpoint ID is equal to 8 blank characters; the I/O area then contains a 14-character time stamp (IIIIDDHHMMSST).

Also check the status code in the I/O PCB. The only successful status code for an XRST call are blanks.

Restrictions

If your program is being started normally, the first 5 bytes of the I/O area must be set to blanks.

If your program is restarted and the CKPTID= value in the PARM field of the EXEC statement is not used, then the rightmost bytes beyond the checkpoint ID being used in the I/O area must be set to blanks.

The XRST call is allowed only from Batch and BMP applications.

Chapter 11. IMS Adapter for REXX

The IMS adapter for REXX (REXXTDLI) provides an environment in which IMS users can interactively develop REXX EXECs under TSO/E (time-sharing option extensions) and execute them in IMS MPPs, BMPs, IFPs, or Batch regions.

This product does not compete with DFSDDLTO but is used as an adjunct. The IMS adapter for REXX provides an application programming environment for prototyping or writing low-volume transaction programs.

The REXX environment executing under IMS has the same abilities and restrictions as those documented in the *TSO/E Version 2 Procedures Language MVS/REXX Reference*. These few restrictions pertain to the absence of the TSO, ISPEXEC, and ISREDIT environments, and to the absence of TSO-specific functions such as LISTDS. You can add your own external functions to the environment as documented in the *TSO/E Version 2 Procedures Language MVS/REXX Reference*.

IMS calls the REXX EXEC using IRXJCL. When this method is used, Return Code 20 (RC20) is a restricted return code. Return Code 20 is returned to the caller of IRXJCL when processing was not successful, and the EXEC was not processed.

A REXX EXEC runs as an IMS application and has characteristics similar to other IMS-supported programming languages, such as COBOL. Programming language usage (REXX and other supported languages) can be mixed in MPP regions. For example, a COBOL transaction can be executed after a REXX transaction is completed, or vice versa.

The advantages of REXX are:

- REXX is an easy-to-use interpretive language.
- REXX does not require a special PSB generation to add an EXEC and run it because EXECs can run under a standard PSB (IVPREXX or one that is established by the user).
- The REXX interface supports DL/I calls and provides these functions:
 - Call tracing of DL/I calls, status, and parameters
 - Inquiry of last DL/I call
 - Extensive data mapping
 - PCB specification by name or offset
 - Obtaining and releasing storage
 - Messaging through WTO, WTP, WTL, and WTOR

The following system environment conditions are necessary to run REXX EXECs:

- DFSREXX0 and DFSREXX1 must be in a load library accessible to your IMS dependent or batch region; for example, STEPLIB.
- DFSREXX0 is stand-alone and must have the RENT option specified.
- DFSREXX1 must be link-edited with DFSLI000 and DFSCPIR0 (for SRRCMIT and SRRBACK) and optionally, DFSREXXU. The options must be REUS, not RENT.
- IVPREXX (copy of DFSREXX0 program) must be installed as an IMS transaction program. IVP (Installation Verification Program) installs the program. For more information, see “REXX Transaction Programs” on page 337.
- The PSB must be defined as assembler language or COBOL.

IMS Adapter for REXX

- SYSEXEC DD points to a list of data sets containing the REXX EXECs that will be run in IMS. You must put this DD in your IMS dependent or batch region JCL.
- SYSTSPRT DD is used for REXX output, for example tracing, errors, and SAY instructions. SYSTSPRT DD is usually allocated as SYSOUT=A or another class, depending on installation, and must be put in the IMS dependent or batch region JCL.
- SYSTSIN DD is used for REXX input because no console exists in an IMS dependent region, as under TSO. The REXX PULL statement is the most common use of SYSTSIN.

The following topics provide additional information:

- “Sample Exit Routine (DFSREXXU)”
- “Addressing Other Environments”
- “REXX Transaction Programs” on page 337
- “REXXTDLI Commands” on page 341
- “REXXTDLI Calls” on page 341
- “REXXIMS Extended Commands” on page 344
- “Sample Execs Using REXXTDLI” on page 356

Related Reading: For more information on SYSTSPRT and SYSTSIN, see *TSO/E Version 2 Procedures Language MVS/REXX Reference*.

Sample Exit Routine (DFSREXXU)

IMS provides a sample user exit routine that is used with the IMS Adapter for REXX. For a description of how to write the user exit routine see *IMS Version 9: Customization Guide*. The sample user exit routine checks to see if it is being called on entry. If so, the user exit routine sets the parameter list to the transaction code with no arguments and sets the start-up IMSRXTRC level to 2. The return code is set to 0. For the latest version of the DFSREXXU source code, see the IMS.SDFSSRC distribution library; the member name is DFSREXXU.

Addressing Other Environments

Use the REXX ADDRESS instruction to change the destination of commands. The IMS Adapter for REXX functions through two host command environments: REXXTDLI and REXXIMS. Other host command environments can be accessed with an IMS EXEC as well.

The z/OS environment is provided by TSO in both TSO and non-TSO address spaces. It is used to run other programs such as EXECIO for file I/O. IMS does not manage the z/OS EXECIO resources. An IMS COMMIT or BACKOUT, therefore, has no effect on these resources. Because EXECIO is not an IMS-controlled resource, no integrity is maintained. If integrity is an issue for flat file I/O, use IMS GSAM, which ensures IMS-provided integrity.

If APPC/MVS is available (MVS 4.2 or higher), other environments can be used. The environments are:

APPCMVS	Used for z/OS-specific APPC interfacing
CPICOMM	Used for CPI Communications
LU62	Used for z/OS-specific APPC interfacing

Related Reading: For more information on addressing environments, see *TSO/E Version 2 Procedures Language MVS/REXX Reference*.

REXX Transaction Programs

A REXX transaction program can use any PSB definition. The definition set up by the IVP for testing is named IVPREXX. A section of the IMS stage 1 definition is shown in the following example:

```
*****
*   IVP APPLICATIONS DEFINITION FOR DB/DC, DCCTL   *
*****
          APPLCTN GPSB=IVPREXX,PGMTYPE=TP,LANG=ASSEM  REXXTDLI SAMPLE
          TRANACT CODE=IVPREXX,MODE=SNGL,           X
          MSGTYPE=(SNGLSEG,NONRESPONSE,1)
```

This example uses a GPSB, but you could use any PSB that you have defined. The GPSB provides a generic PSB that has an TP PCB and a modifiable alternate PCB. It does not have any database PCBs. The language type of ASSEM is specified because no specific language type exists for a REXX application.

Recommendation: For a REXX application, specify either assembler language or COBOL.

IMS schedules transactions using a load module name that is the same as the PSB name being used for MPP regions or the PGM name for other region types. You must use this load module even though your application program consists of the REXX EXEC. The IMS adapter for REXX provides a load module for you to use. This module is called DFSREXX0. You can:

- Copy to a steplib data set with the same name as the application PSB name. Use either a standard utility intended for copying load modules (such as IEBCOPY or SAS), or the Linkage Editor.
- Use the Linkage Editor to define an alias for DFSREXX0 that is the same as the application PGM name.

Example: Figure 48 shows is section from the PGM setup job that uses the binder to perform the copy function to the name IVPREXX. The example uses the IVP.

```
/* REXXTDLI SAMPLE - GENERIC APPLICATION DRIVER
/*
//LINK      EXEC PGM=IEWL,
//          PARM='XREF,LIST,LET,SIZE=(192K,64K)'
//SYSPRINT  DD SYSOUT=*
//SDFSRESL  DD DISP=SHR,DSN=IMS.SDFSRESL
//SYSMOD    DD DISP=SHR,DSN=IMS1.PGMLIB
//SYSUT1    DD UNIT=(SYSALLDA,SEP=(SYSMOD,SYSLIN)),
//          DISP=(,DELETE,DELETE),SPACE=(CYL,(1,1))
//SYSLIN    DD *
           INCLUDE  SDFSRESL(DFSREXX0)
           ENTRY   DFSREXX0
           NAME    IVPREXX(R)
/*
```

Figure 48. Using the Binder to Copy the Name IVPREXX

When IMS schedules an application transaction, the load module is loaded and given control. The load module establishes the REXX EXEC name as the PGM name with an argument of the Transaction Code (if applicable). The module calls a

REXX Transaction Programs

user exit routine (DFSREXXU) if it is available. The user exit routine selects the REXX EXEC (or a different EXEC to run) and can change the EXEC arguments, or do any other desired processing.

Related Reading: For more information on the IMS adapter for REXX exit routine, see *IMS Version 9: Customization Guide*.

Upon return from the user exit routine, the action requested by the routine is performed. This action normally involves calling the REXX EXEC. The EXEC load occurs using the SYSEXEC DD allocation. This allocation must point to one or more partitioned data sets containing the IMS REXX application programs that will be run as well as any functions written in REXX that are used by the programs.

Standard REXX output, such as SAY statements and tracing, is sent to SYSTSPRT. This DD is required and can be set to SYSOUT=A.

When the stack is empty, the REXX PULL statement reads from the SYSTSIN DD. In this way, you can conveniently provide batch input data to a BMP or batch region. SYSTSIN is optional; however, you will receive an error message if you issue a PULL from an empty stack and SYSTSIN is not allocated. Figure 49 shows the JCL necessary for MPP region that runs the IVPREXX sample EXEC.

```
//IVP32M11 EXEC PROC=DFSMPR,TIME=(1440),
//      AGN=IVP,          AGN NAME
//      NBA=6,
//      OBA=5,
//      SOUT='*',          SYSOUT CLASS
//      CL1=001,          TRANSACTION CLASS 1
//      CL2=000,          TRANSACTION CLASS 2
//      CL3=000,          TRANSACTION CLASS 3
//      CL4=000,          TRANSACTION CLASS 4
//      TLIM=10,         MPR TERMINATION LIMIT
//      SOD=,            SPIN-OFF DUMP CLASS
//      IMSID=IVP1,      IMSID OF IMS CONTROL REGION
//      PREINIT=DC,     PROCLIB DFSINTXX MEMBER
//      PWFY=Y          PSEUDO=WFI
//*
//* ADDITIONAL DD STATEMENTS
//*
//DFSCCTL DD DISP=SHR,
//      DSN=IVPSYS32.PROCLIB(DFSSBPRM)
//DFSSTAT DD SYSOUT=*
//* REXX EXEC SOURCE LOCATION
//SYSEXEC DD DISP=SHR,
//      DSN=IVPIVP32.INSTALIB
//      DD DISP=SHR,
//      DSN=IVPSYS32.SDFSEXEC
//* REXX INPUT LOCATION WHEN STACK IS EMPTY
//SYSTSIN DD *
//*
//* REXX OUTPUT LOCATION
//SYSTSPRT DD SYSOUT=*
//* COBOL OUTPUT LOCATION
//SYSOUT DD SYSOUT=*
```

Figure 49. JCL Code Used to Run the IVPREXX Sample Exec

IMS Adapter for REXX Overview Diagram

Figure 50 on page 339 shows the IMS adapter for REXX environment at a high level. This figure shows how the environment is structured under the IMS program

controller, and some of the paths of interaction between the components of the environment.

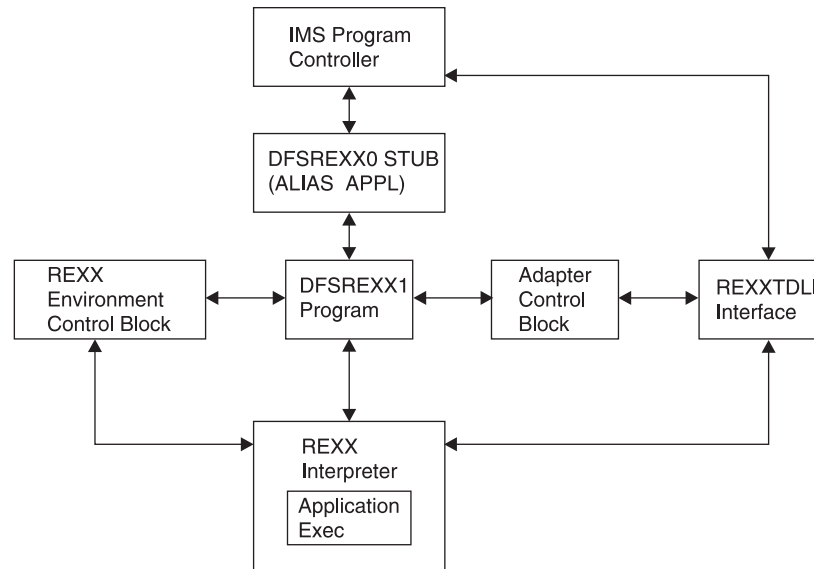


Figure 50. IMS Adapter for REXX Logical Overview Diagram

IVPREXX Sample Application

Figure 49 on page 338 shows the JCL needed to use IVPREXX from an MPP region. This EXEC can also be run from message-driven BMPs or IFP regions.

To use the IVPREXX driver sample program in a message-driven BMP or IFP environment, specify IVPREXX as the program name and PSB name in the IMS region program's parameter list. Specifying IVPREXX loads the IVPREXX load module, which is a copy of the DFSREXX0 front-end program. The IVPREXX program loads and runs an EXEC named IVPREXX that uses message segments sent to the transaction as arguments to derive the EXEC to call or the function to perform.

Interactions with IVPREXX from an IMS terminal are shown in the following examples:

- "IVPREXX Example 1"
- "IVPREXX Example 2" on page 340
- "IVPREXX Example 3" on page 340
- "IVPREXX Example 4" on page 340

IVPREXX Example 1

Entry:

```
IVPREXX execname
```

or

```
IVPREXX execname arguments
```

Response:

```
EXEC execname ended with RC= x
```

REXX Transaction Programs

IVPREXX Example 2

Entry:

```
IVPREXX LEAVE
```

Response:

```
Transaction IVPREXX leaving dependent region.
```

IVPREXX Example 3

Entry:

```
IVPREXX HELLOHELLO
```

Response:

```
One-to-eight character EXEC name must be specified.
```

IVPREXX Example 4

Entry:

```
IVPREXX
```

or

```
IVPREXX ?
```

Response:

```
TRANCODE EXECNAME <Arguments> Run specified EXEC
TRANCODE LEAVE Leave Dependent Region
TRANCODE TRACE level 0=None,1=Some,2=More,3=Full
TRANCODE ROLL Issue ROLL call
```

When an EXEC name is supplied, all of the segments it inserts to the I/O PCB are returned before the completion message is returned.

REXX return codes (RC) in the range of 20000 to 20999 are usually syntax or other REXX errors, and you should check the z/OS system console or region output for more details.

Related Reading: For more information on REXX errors and messages, see *TSO/E Version 2 Procedures Language MVS/REXX Reference*.

Stopping an Infinite Loop: To stop an EXEC that is in an infinite loop, you can enter either of the following IMS commands from the master terminal or system console:

```
/STO REGION p1 ABDUMP p2
/STO REGION p1 CANCEL
```

In these examples, *p1* is the region number and *p2* is the TRANCODE that the EXEC is running under. Use the /DISPLAY ACTIVE command to find the region number. This technique is not specific to REXX EXECs and can be used on any transaction that is caught in an infinite loop.

Related Reading: For more information about these commands and others to help in this situation, see *IMS Version 9: Command Reference*.

REXXTDLI Commands

If you do not use the AIBTDLI interface, a simulated return code is returned. This simulated return code is set to zero if the PCB status code was GA, GK, or bbbb. If the status code had any other value, the simulated return code is X'900' or decimal 2304.

Parameter Handling

The IMS adapter for REXX performs some parameter setup for application programs in a REXX environment. This setup occurs when the application program uses variables or maps as the parameters. When the application uses storage tokens, REXX does not perform this setup. The application program must provide the token and parse the results just as a non-REXX application would. For a list of parameter types and definitions, see Table 84 on page 343.

The REXXTDLI interface performs the following setup:

- The I/O area retrieval for the I/O PCB is parsed. The LL field is removed, and the ZZ field is removed and made available by means of the REXXIMS('ZZ') function call. The rest of the data is placed in the specified variable or map. Use the REXX LENGTH() function to find the length of the returned data.
- The I/O area building for the TP PCB or alternate PCB is done as follows:
 - The appropriate LL field.
 - The ZZ field from a preceding SET ZZ command or X'0000' if the command was not used.
 - The data specified in the passed variable or map.
- The I/O area processing for the SPA is similar to the first two items, except that the ZZ field is 4 bytes long.
- The feedback area on the CHNG and SET0 calls is parsed. The LLZZLL fields are removed, and the remaining data is returned with the appropriate length.
- The parameters that have the LLZZ as part of their format receive special treatment. These parameters occur on the AUTH, CHNG, INIT, ROLS, SET0, and SETS calls. The LLZZ fields are removed when IMS returns data to you and added (ZZ is always X'0000') when IMS retrieves data from you. In effect, your application ignores the LLZZ field and works only with the data following it.
- The numeric parameters on XRST and symbolic CHKP are converted between decimal and a 32-bit number (fullword) as required.

Table 84. IMS Adapter for REXX Parameter Types and Definitions

Type ¹	Parameter Definition
PCB	<p>PCB Identifier specified as a variable containing one of the following:</p> <ul style="list-style-type: none"> • PCB name as defined in the PSB generation on the PCBNAME= parameter. See <i>IMS Version 9: Utilities Reference: System</i> for more information on defining PCB names. The name can be from 1 to 8 characters long and does not have to be padded with blanks. If this name is given, the AIBTDLI interface is used, and the return codes and reason codes are acquired from that interface. • An AIB block formatted to DFSAIB specifications. This variable is returned with an updated AIB. • A # followed by PCB offset number (#1=first PCB). Example settings are: <ul style="list-style-type: none"> – IOPCB=:#1" – ALTPCB=:#2" – DBPCB=:#3" <p>The IOAREA length returned by a database DL/I call defaults to 4096 if this notation is used. The correct length is available only when the AIBTDLI interface is used.</p>
In	Input variable. It can be specified as a constant, variable, *mapname ² , or !token ³ .
SSA	Input variable with an SSA (segment search argument). It can be specified as a constant, variable, *mapname ² , or !token ³ .
Out	Output variable to store a result after a successful command. It can be specified as a variable, *mapname ² , or !token ³ .
In/Out	Variable that contains input on entry and contains a result after a successful command. It can be specified as a variable, *mapname ² , or !token ³ .
Const	Input constant. This command argument must be the actual value, not a variable containing the value.

Note:

1. The parameter types listed in Table 84 correspond to the types shown in Table 63 on page 266 and Table 68 on page 298, as well as to those shown in Table 85 on page 345. All parameters specified on DL/I calls are case independent except for the values associated with the STEM portion of the compound variable (REXX terminology for an array-like structure). A period (.) can be used in place of any parameter and is read as a NULL (zero length string) and written as a void (place holder). Using a period in place of a parameter is useful when you want to skip optional parameters.
2. For more information on *mapname, see "MAPGET" on page 349 and "MAPPUT" on page 350.
3. For more information on !token, see "STORAGE" on page 352.

Example DL/I Calls

The following example shows an ISRT call issued against the I/O PCB. It writes the message "Hello World".

REXXTDLI Commands

```
IO = "IOPCB"          /* IMS Name for I/O PCB */
OutMsg="Hello World"
Address REXXTDLI "ISRT IO OutMsg"
If RC=0 Then Exit 12
```

In this example, *IO* is a variable that contains the PCB name, which is the constant "IOPCB" for the I/O PCB. If a non-zero return code (RC) is received, the EXEC ends (Exit) with a return code of 12. You can do other processing here.

The next example gets a part from the IMS sample parts database. The part number is "250239". The actual part keys have a "02" prefix and the key length defined in the DBD is 17 bytes.

The following example puts the segment into the variable called *Part_Segment*.

```
PartNum = "250239"
DB      = "DBPCB01"
SSA     = 'PARTROOT(PARTKEY = '||Left('02'||PartNum,17)||')'
Address REXXTDLI "GU DB Part_Segment SSA"
```

Notes:

- In a real EXEC, you would probably find the value for PartNum from an argument and would have to check the return code after the call.
- The LEFT function used here is a built-in REXX function. These built-in functions are available to any IMS REXX EXEC. For more information on functions, see *TSO/E Version 2 Procedures Language MVS/REXX Reference*.
- The single quote (') and double quote (") are interchangeable in REXX, as long as they are matched.

The IMS.SDFSISRC library includes the DFSSUT04 EXEC. You can use this EXEC to process any unexpected return codes or status codes. To acquire the status code from the last DL/I call issued, you must execute the IMSQUERY('STATUS') function. It returns the two character status code.

If you use an EXEC that runs in both IMS and non-IMS environments, check to see if the IMS environment is available. You can check to see if the IMS environment is available in two ways:

- Use the z/OS SUBCOM command and specify either the REXXTDLI or REXXIMS environments. The code looks like this:

```
Address MVS 'SUBCOM REXXTDLI'
If RC=0 Then Say "IMS Environment is Available."
Else Say "Sorry, no IMS Environment here."
```

- Use the PARSE SOURCE instruction of REXX to examine the address space name (the 8th word). If it is running in an IMS environment, the token will have the value IMS. The code looks like this:

```
Parse Source . . . . . Token .
If Token='IMS' Then Say "IMS Environment is Available."
Else Say "Sorry, no IMS Environment here."
```

Environment Determination

REXXIMS Extended Commands

The IMS adapter for REXX gives access to the standard DL/I calls and it supplies a set of extended commands for the REXX environment. These commands are listed in Table 85 and are available when you ADDRESS REXXIMS. DL/I calls are also available when you address the REXXIMS environment.

The following topics include additional information about REXX commands:

- “DLIINFO”
- “IMSRXTRC” on page 346
- “MAPDEF” on page 347
- “MAPGET” on page 349
- “MAPPUT” on page 350
- “SET” on page 351
- “SRRBACK and SRRCMIT” on page 352
- “STORAGE” on page 352
- “WTO, WTP, and WTL” on page 354
- “WTOR” on page 354
- “IMSQUERY Extended Functions” on page 355

Table 85. REXXIMS Extended Commands

Command	Parameter Types ¹
DLIINFO	Out [PCB]
IMSRXTRC	In
MAPDEF	Const In [Const]
MAPGET	Const In
MAPPUT	Const Out
SET	Const In
SRRBACK	Out
SRRCMIT	Out
STORAGE	Const Const [In [Const]]
WTO	In
WTP	In
WTL	In
WTOR	In Out

Note:

1. The parameter types listed correspond to the types shown in Table 84 on page 343. All parameters specified on DL/I calls are case-independent except for the values associated with the STEM portion of the compound variable (REXX terminology for an array-like structure). A period (.) can be used in place of any parameter and has the effect of a NULL (zero length string) if read and a void (place holder) if written. Use a period in place of a parameter to skip optional parameters.

DLIINFO

The DLIINFO call requests information from the last DL/I call or on a specific PCB.

The following topics contain additional information:

- “Format” on page 346
- “Usage” on page 346
- “Example” on page 346
-

REXXIMS Extended Commands

Format

►►—DLIINFO—*infoout*—pcb*id*—►►

Call Name	DB/DC	DBCTL	DCCTL	DB Batch	TM Batch
DLIINFO	X	X	X	X	X

Usage

The *infoout* variable name is a REXX variable that is assigned the DL/I information. The *pcb* variable name, when specified as described in “Parameter Handling” on page 342, returns the addresses associated with the specified PCB and its last status code.

The format of the returned information is as follows:

Word Description

- 1 Last DL/I call ('.' if N/A)
- 2 Last DL/I PCB name (name or #number, '.' if N/A)
- 3 Last DL/I AIB address in hexadecimal (00000000 if N/A)
- 4 Last DL/I PCB address in hexadecimal (00000000 if N/A)
- 5 Last DL/I return code (0 if N/A)
- 6 Last DL/I reason code (0 if N/A)
- 7 Last DL/I call status ('.' if blank or N/A)

Example

```
Address REXXIMS 'DLIINFO MyInfo'          /* Get Info          */
Parse Var MyInfo DLI_Cmd DLI_PCB DLI_AIB_Addr DLI_PCB_Addr,
          DLI_RC DLI_Reason DLI_Status .
```

Always code a period after the status code (seventh word returned) when parsing to allow for transparent additions in the future if needed. Words 3, 4, and 7 can be used when a *pcb* is specified on the DLIINFO call.

IMSRXTRC

The IMSRXTRC command is used primarily for debugging. It controls the tracing action taken (that is, how much trace output through SYSTSPRT is sent to the user) while running a REXX program.

- “Format”
- “Usage” on page 347
- “Example” on page 347

Format

►►—IMSRXTRC—*level*—►►

Call Name	DB/DC	DBCTL	DCCTL	DB Batch	TM Batch
IMSRXTRC	X	X	X	X	X

Usage

The *level* variable name can be a REXX variable or a digit, and valid values are from 0 to 9. The initial value at EXEC start-up is 1 unless it is overridden by the user Exit. Traced output is sent to the DDNAME SYSTSPRT. See *IMS Version 9: Customization Guide* for more information on the IMS adapter for REXX exit routine.

The IMSRXTRC command can be used in conjunction with or as a replacement for normal REXX tracing (TRACE).

Level Description

- 0** Trace errors only.
- 1** The previous level and trace DL/I calls, their return codes, and environment status (useful for flow analysis).
- 2** All the previous levels and variable sets.
- 3** All the previous levels and variable fetches (useful when diagnosing problems).
- 4-7** All previous levels.
- 8** All previous levels and parameter list to/from standard IMS language interface. See message DFS3179 in *IMS Version 9: Messages and Codes, Volume 1*.
- 9** All previous levels.

Example

Address REXXIMS 'IMSRXTRC 3'

IMSRXTRC is independent of the REXX TRACE instruction.

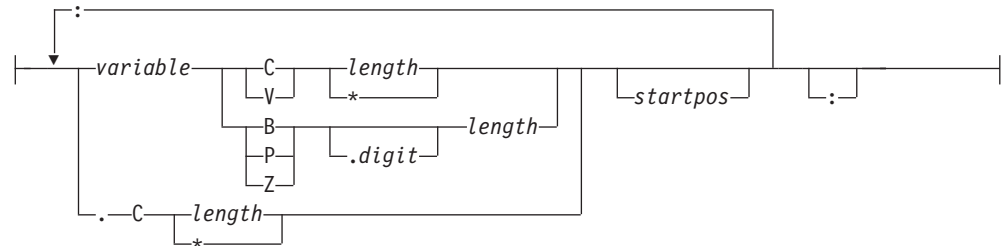
MAPDEF

The MAPDEF command makes a request to define a data mapping.

Format



A:



Call Name	DB/DC	DBCTL	DCCTL	DB Batch	TM Batch
MAPDEF	X	X	X	X	X

Usage

Data mapping is an enhancement added to the REXXIMS interface. Because REXX does not offer variable structures, parsing the fields from your database segments or MFS output maps can be time consuming, especially when data conversion is necessary. The MAPDEF, MAPGET, and MAPPUT commands allow simple extraction of most formatted data.

- *mapname* is a 1- to 16-character case-independent name.
- *definition* (**A**) is a variable containing the map definition.
- REPLACE, if specified, indicates that a replacement of an existing map name is allowed. If not specified and the map name is already defined, an error occurs and message DFS3171E is sent to the SYSTPRT.

The map *definition* has a format similar to data declarations in other languages, with simplifications for REXX. In this definition, you must declare all variables that you want to be parsed with their appropriate data types. The format is shown in **A** in the syntax diagram.

Variable name: The variable name *variable* is a REXX variable used to contain the parsed information. Variable names are case-independent. If you use a STEM (REXX terminology for an array-like structure) variable, it is resolved at the time of use (at the explicit or implicit MAPGET or MAPPUT call time), and this can be very powerful. If you use an index type variable as the STEM portion of a compound variable, you can load many records into an array simply by changing the index variable. Map names or tokens cannot be substituted for variable names inside a map definition.

Repositioning the internal cursor: A period (.) can be used as a variable place holder for repositioning the internal cursor position. In this case, the data type must be C, and the length can be negative, positive, or zero. Use positive values to skip over fields of no interest. Use negative lengths to redefine fields in the middle of a map without using absolute positioning.

The data type values are:

- C** Character
- V** Variable
- B** Binary (numeric)
- Z** Zoned Decimal (numeric)
- P** Packed Decimal (numeric)

All numeric data types can have a period and a number next to them. The number indicates the number of digits to the right of a decimal point when converting the number.

Length value: The *length* value can be a number or an asterisk (*), which indicates that the rest of the buffer will be used. You can only specify the *length* value for data types C and V. Data type V maps a 2-byte length field preceding the data string, such that a when the declared length is 2, it takes 4 bytes.

Valid lengths for data types are:

- C** 1 to 32767 bytes or *
- V** 1 to 32765 bytes or *

- B** 1 to 4 bytes
- Z** 1 to 12 bytes
- P** 1 to 6 bytes

If a value other than asterisk (*) is given, the cursor position is moved by that value.

The *startpos* value resets the parsing position to a fixed location. If *startpos* is omitted, the column to the right of the previous map variable definition (cursor position) is used. If it is the first variable definition, column 1 is used.

Note: A length of asterisk (*) does not move the cursor position, so a variable declared after one with a length of asterisk (*) without specifying a start column overlays the same definition.

Example

This example defines a map named DBMAP, which is used implicitly on a GU call by placing an asterisk (*) in front of the map name.

```
DBMapDef = 'RECORD      C   *  :', /* Pick up entire record */
          'NAME        C  10  :', /* Cols 1-10 hold the name */
          'PRICE       Z.2  6  :', /* Cols 11-16 hold the price */
          'CODE        C   2  :', /* Cols 11-16 hold the code */
          '            C  25  :', /* Skip 25 columns */
          'CATEGORY    B   1  ', /* Col 42 holds category */
Address REXXIMS 'MAPDEF DBMAP DBMapDef'

:
:
Address REXXTDLI 'GU DBPCB *DBMAP' /* Read and decode a segment */
If RC=0 Then Signal BadCall /* Check for failure */
Say CODE /* Can now access any Map Variable*/
```

The entire segment retrieved on the GU call is placed in RECORD. The first 10 characters are placed in NAME, and the next 6 are converted from zoned decimal to EBCDIC with two digits to the right of the decimal place and placed in PRICE. The next 2 characters are placed in CODE, the next 25 are skipped, and the next character is converted from binary to EBCDIC and placed in CATEGORY. The 25 characters that are skipped are present in the RECORD variable.

MAPGET

The MAPGET command is a request to parse or convert a buffer into a specified data mapping previously defined with the MAPDEF command.

Format

►►—MAPGET—*mapname*—*buffer*—◄◄

Call Name	DB/DC	DBCTL	DCCTL	DB Batch	TM Batch
MAPGET	X	X	X	X	X

Usage

The *mapname* variable name specifies the data mapping to use. It is a 1- to 16-character case-independent name. The *buffer* variable name is the REXX variable containing the data to parse.

REXXIMS Extended Commands

Map names can also be specified in the REXXTDLI calls in place of variable names to be set or written. This step is called an implicit MAPGET. Thus, the explicit (or variable dependent) MAPGET call can be avoided. To indicate that a Map name is being passed in place of a variable in the DL/I call, precede the name with an asterisk (*), for example, 'GU IOPCB *INMAP'.

Examples

This example uses explicit support.

```
Address REXXTDLI 'GU DBPCB SegVar'
If RC=0 Then Signal BadCall          /* Check for failure          */
Address REXXIMS 'MAPGET DBMAP SegVar' /* Decode Segment            */
Say VAR_CODE                          /*Can now access any Map Variable */
```

This example uses implicit support.

```
Address REXXTDLI 'GU DBPCB *DBMAP'    /* Read and decode segment if read*/
If RC=0 Then Signal BadCall          /* Check for failure          */
Say VAR_CODE                          /* Can now access any Map Variable*/
```

If an error occurs during a MAPGET, message DFS3172I is issued. An error could occur when a Map is defined that is larger than the input segment to be decoded or during a data conversion error from packed or zoned decimal format. The program continues, and an explicit MAPGET receives a return code 4. However, an implicit MAPGET (on a REXXTDLI call, for example) does not have its return code affected. Either way, the failing variable's value is dropped by REXX.

MAPPUT

This MAPPUT command makes a request to pack or concatenate variables from a specified Data Mapping, defined by the MAPDEF command, into a single variable.

Format

►►—MAPPUT—*mapname*—*buffer*—◄◄

Call Name	DB/DC	DBCTL	DCCTL	DB Batch	TM Batch
MAPPUT	X	X	X	X	X

Usage

The *mapname* variable name specifies the data mapping to use, a 1- to 16-character case-independent name. The *buffer* variable name is the REXX variable that will contain the resulting value.

Map names can also be specified in the REXXTDLI call in place of variable names to be fetched or read. This step is called an implicit MAPPUT and lets you avoid the explicit MAPPUT call. To indicate that a Map name is being passed in the DL/I call, precede the name with an asterisk (*), for example, 'ISRT IOPCB *OUTMAP'.

Note: If the data mapping is only partial and some fields in the record are not mapped to REXX variables, then the first field in the mapping should be a character type of length asterisk (*), as shown in the “Example” on page 349. This step is the only way to ensure that non-mapped (skipped) fields are not lost between the MAPGET and MAPPUT calls, whether they be explicit or implicit.

Examples

This example uses explicit support.

```

Address REXXTDLI
'GHU DBPCB SegVar SSA1'           /* Read segment          */
If RC=0 Then Signal BadCall        /* Check for failure     */
Address REXXIMS 'MAPGET DBMAP SegVar' /* Decode Segment       */
DBM_Total = DBM_Total + Deposit_Amount /* Adjust Mapped Variable */
Address REXXIMS 'MAPPUT DBMAP SegVar' /* Encode Segment       */
'REPL DBPCB SegVar'               /* Update Database      */
If RC=0 Then Signal BadCall        /* Check for failure     */
    
```

This example uses implicit support.

```

Address REXXTDLI
'GHU DBPCB *DBMAP SSA1'           /* Read and decode segment if read */
If RC=0 Then Signal BadCall        /* Check for failure     */
DBM_Total = DBM_Total + Deposit_Amount /* Adjust Mapped Variable */
'REPL DBPCB *DBMAP'               /* Update Database      */
If RC=0 Then Signal BadCall        /* Check for failure     */
    
```

If an error occurs during a MAPPUT, such as a Map field defined larger than the variable's contents, then the field is truncated. If the variable's contents are shorter than the field, the variable is padded:

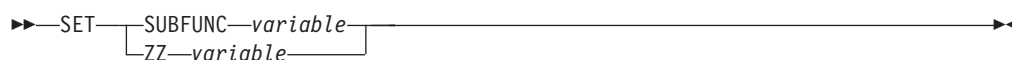
- Character (C)** Padded on right with blanks
- Character (V)** Padded on right with zeros
- Numeric (B,Z,P)** Padded on the left with zeros

If a MAP variable does not exist when a MAPPUT is processed, the variable and its position are skipped. All undefined and skipped fields default to binary zeros. A null parameter is parsed normally. Conversion of non-numeric or null fields to numeric field results in a value of 0 being used and no error.

SET

The SET command resets AIB subfunction values and ZZ values before you issue a DL/I call.

Format



Call Name	DB/DC	DBCTL	DCCTL	DB Batch	TM Batch
SET	X	X	X	X	X

Usage

The SET SUBFUNC command sets the AIB subfunction used on the next DL/I call. This value is used only if the next REXXTDLI call passes a PCB name. If the call does pass a PCB name, the IMS adapter for REXX places the subfunction name (1 to 8 characters or blank) in the AIB before the call is issued. This value initially defaults to blanks and is reset to blanks on completion of any REXXTDLI DL/I call.

The SET ZZ command is used to set the ZZ value used on a subsequent DL/I call. This command is most commonly used in IMS conversational transactions and terminal dependent applications to set the ZZ field to something other than the default of binary zeros. Use the SET command before an ISRT call that requires other than the default ZZ value. For more explanation on ZZ processing, see "Parameter Handling" on page 342.

REXXIMS Extended Commands

Examples

This example shows the SET SUBFUNC command used with the INQY call to get environment information.

```
IO="IOPCB"
Func = "ENVIRON"                /* Sub-Function Value */
Address REXXIMS "SET SUBFUNC Func" /* Set the value */
Address REXXTDLI "INQY IO EnviData" /* Make the DL/I Call */
IMS_Identifier = Substr(EnviData,1,8) /* Get IMS System Name*/
```

This example shows the SET ZZ command used with a conversational transaction for SPA processing.

```
Address REXXTDLI 'GU IOPCB SPA'      /* Get first Segment */
Hold_ZZ = IMSQUERY('ZZ')           /* Get ZZ Field (4 bytes) */
:
:
Address REXXIMS 'SET ZZ Hold_ZZ'     /* Set ZZ for SPA ISRT */
Address REXXTDLI 'ISRT IOPCB SPA'    /* ISRT the SPA */
```

This example shows the SET ZZ command used for setting 3270 Device Characteristics Flags.

```
Bell_ZZ = '0040'X                /* ZZ to Ring Bell on Term */
Address REXXIMS 'SET ZZ Bell_ZZ'    /* Set ZZ for SPA ISRT */
Address REXXTDLI 'ISRT IOPCB Msg'   /* ISRT the Message */
```

SRRBACK and SRRCMIT

The Common Programming Interface Resource Recovery (CPI-RR) commands allow an interface to use the SAA[®] resource recovery interface facilities for back-out and commit processing.

Format

► [SRRBACK—*return_code*] —————►
 [SRRCMIT—*return_code*]

Call Name	DB/DC	DBCTL	DCCTL	DB Batch	TM Batch
SRRBACK, SRRCMIT	X		X		

Usage

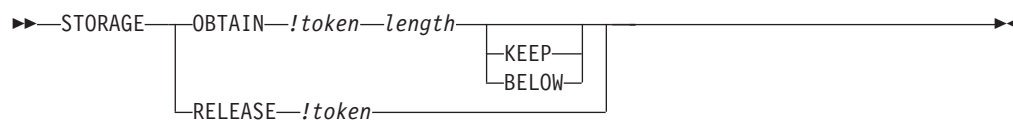
The return code from the SRR command is returned and placed in the *return_code* variable name as well as the REXX variable RC.

For more information on SRRBACK and SRRCMIT, see *IMS Version 9: Administration Guide: Transaction Manager and System Application Architecture Common Programming Interface: Resource Recovery Reference*.

STORAGE

The STORAGE command allows the acquisition of system storage that can be used in place of variables for parameters to REXXTDLI and REXXIMS calls.

Format



Call Name	DB/DC	DBCTL	DCCTL	DB Batch	TM Batch
STORAGE	X	X	X	X	X

Usage

Although REXX allows variables to start with characters (!) and (#), these characters have special meanings on some commands. When using the REXXTDLI interface, you must not use these characters as the starting characters of variables.

The *!token* variable name identifies the storage, and it consists of an exclamation mark followed by a 1- to 16-character case-independent token name. The *length* variable name is a number or variable containing size in decimal to OBTAIN in the range 4 to 16777216 bytes (16 MB). The storage class has two possible override values, BELOW and KEEP, of which only one can be specified for any particular token. The BELOW function acquires the private storage below the 16 MB line. The KEEP function marks the token to be kept after this EXEC is terminated. The default action gets the storage in any location and frees the token when the EXEC is terminated.

Use the STORAGE command to get storage to use on DL/I calls when the I/O area must remain in a fixed location (for example, Spool API) or when it is not desirable to have the LLZZ processing. For more information on LLZZ processing, see "Parameter Handling" on page 342. Once a token is allocated, you can use it in REXXTDLI DL/I calls or on the STORAGE RELEASE command.

When using STORAGE:

- When used on DL/I calls, none of the setup for LLZZ fields takes place. You must fill the token in and parse the results from it just as required by a non-REXX application.
- You cannot specify both KEEP and BELOW on a single STORAGE command.
- The RELEASE function is only necessary for tokens marked KEEP. All tokens not marked KEEP and not explicitly released by the time the EXEC ends are released automatically by the IMS adapter for REXX.
- When you use OBTAIN, the entire storage block is initialized to 0.
- The starting address of the storage received is always on the boundary of a double word.
- You cannot re-obtain a token until RELEASE is used or the EXEC that obtained it, non-KEEP, terminates. If you try, a return code of -9 is given and the error message DFS3169 is issued.
- When KEEP is specified for the storage token, it can be accessed again when this EXEC or another EXEC knowing the token's name is started in the same IMS region.
- Tokens marked KEEP are not retained when an ABEND occurs or some other incident occurs that causes region storage to be cleared. It is simple to check if the block exists on entry with the IMSQUERY(!token) function. For more information, see "IMSQUERY Extended Functions" on page 355.

REXXIMS Extended Commands

Example

This example shows how to use the `STORAGE` command with Spool API.

```
/* Get 4K Buffer below the line for Spool API Usage */
Address REXXIMS 'STORAGE OBTAIN !MYTOKEN 4096 BELOW'
/* Get Address and length (if curious) */
Parse Value IMSQUERY(!MYTOKEN) With My_Token_Addr My_Token_Len.
Address REXXIMS 'SETO ALTPCB !MYTOKEN SETOPARMS SETOFB'

:
:
Address REXXIMS 'STORAGE RELEASE !MYTOKEN'
```

WTO, WTP, and WTL

The `WTO` command is used to write a message to the operator. The `WTP` command is used to write a message to the program (`WTO ROUTCODE=11`). The `WTL` command is used to write a message to the console log.

Format



Call Name	DB/DC	DBCTL	DCCTL	DB Batch	TM Batch
WTO, WTP, WTL	X	X	X	X	X

Usage

The *message* variable name is a REXX variable containing the text that is stored displayed in the appropriate place.

Example

This example shows how to write a simple message stored the REXX variable `MSG`.

```
Msg = 'Sample output message.'          /* Build Message          */
Address REXXIMS 'WTO Msg'                /* Tell Operator          */
Address REXXIMS 'WTP Msg'                /* Tell Programmer        */
Address REXXIMS 'WTL Msg'                /* Log It                 */
```

WTOR

The `WTOR` command requests input or response from the z/OS system operator.

Format



Call Name	DB/DC	DBCTL	DCCTL	DB Batch	TM Batch
WTOR	X	X	X	X	X

Usage

The *message* variable name is a REXX variable containing the text that will be displayed on the z/OS console. The operator's response is placed in the REXX variable signified by the *response* variable name.

Attention: This command hangs the IMS region in which it is running until the operator responds.

Example

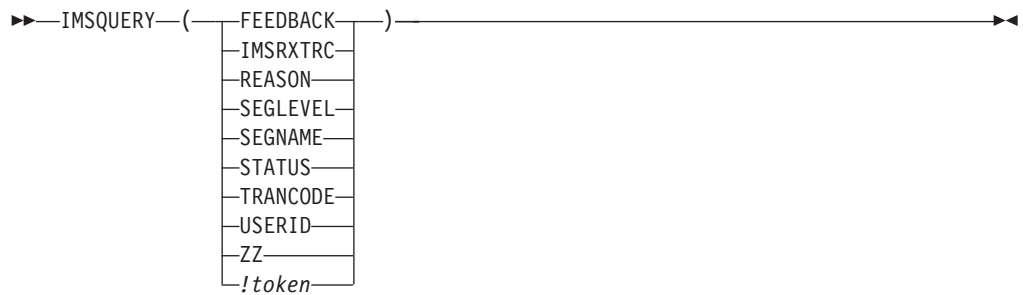
This example prompts the operator to enter ROLL or CONT on the z/OS master or alternate console. Once the WTOR is answered, the response is placed in the REXX variable name *response*, and the EXEC will continue and process the IF statement appropriately.

```
Msg = 'Should I ROLL or Continue. Reply "ROLL" or "CONT"'
Address REXXIMS 'WTOR Msg Resp'          /* Ask Operator */
If Resp = 'ROLL' Then                    /* Tell Programmer */
  Address REXXTDLI 'ROLL'                /* Roll Out of this */
```

IMSQUERY Extended Functions

The IMSQUERY function is available to query certain IMS information either on the environment or on the prior DL/I call.

Format



Call Name	DB/DC	DBCTL	DCCTL	DB Batch	TM Batch
IMSQUERY	X	X	X	X	X

Usage

The format of the function call is: IMSQUERY('Argument') where Argument is one of the following values:

Argument	Description of Data Returned
FEEDBACK	FEEDBACK area from current PCB.
IMSRXTRC	Current IMSRXTRC trace level #.
REASON	Reason code from last call (from AIB if used on last REXXTDLI type call).
SEGLEVEL	Segment level from current PCB (Last REXXTDLI call must be against a DB PCB, or null is returned).
SEGNAME	Segment name from current PCB (Last REXXTDLI call must be against a DB PCB, or null is returned).
STATUS	IMS status code from last executed REXXTDLI call (DL/I call). This argument is the two character status code from the PCB.
TRANCODE	Current transaction code being processed, if available.

REXXIMS Extended Commands

USERID	Input terminal's user ID, if available. If running in a non-message-driven region, the value is dependent on the specification of the BMPUSID= keyword in the DFSDCxxx PROCLIB member: <ul style="list-style-type: none">• If BMPUSID=USERID is specified, the value from the USER= keyword on the JOB statement is used.• If USER= is not specified on the JOB statement, the program's PSB name is used.• If BMPUSID=PSBNAME is specified, or if BMPUSID= is not specified at all, the program's PSB name is used.
ZZ	ZZ (of LLZZ) from last REXXTDLI command. This argument can be used to save the ZZ value after you issue a GU call to the I/O PCB when the transaction is conversational.
!token	Address (in hexadecimal) and length of specified token (in decimal), separated by a blank.

This value can be placed in a variable or resolved from an expression. In these cases, the quotation marks should be omitted as shown below:

```
Token_Name="!MY_TOKEN"  
AddrInfo=IMSQUERY(Token_Name)  
          /* or */  
AddrInfo=IMSQUERY("!MY_TOKEN")
```

Although the function argument is case-independent, no blanks are allowed within the function argument. You can use the REXX STRIP function on the argument, if necessary. IMSQUERY is the preferred syntax, however REXXIMS is supported and can be used, as well.

Example

```
If REXXIMS('STATUS')='GB' Then Signal End_Of_DB  
:  
:  
Hold_ZZ = IMSQUERY('ZZ')          /* Get current ZZ field*/  
:  
:  
Parse Value IMSQUERY('!MYTOKEN') With My-Token_Addr My-Token_Len .
```

Related Reading: For information on the IMS adapter for REXX exit routine, see *IMS Version 9: Customization Guide*.

Sample Execs Using REXXTDLI

| This chapter shows samples of REXX execs that use REXXTDLI to access IMS
| services.

The example sets are designed to highlight various features of writing IMS applications in REXX. The samples are simplified and might not reflect actual usage (for example, they do not use databases).

The PART exec database access example is a set of three execs that access the PART database, which is built by the IMS installation verification program (IVP). The first two execs in this example, PARTNUM and PARTNAME, are extensions of the PART transaction that runs the program DFSSAM02, which is supplied with IMS as

part of IVP. The third exec is the DFSSAM01 exec supplied with IMS and is an example of the use of EXECIO within an exec.

SAY Exec: For Expression Evaluation

Figure 51 is a listing of the SAY exec. SAY evaluates an expression supplied as an argument and displays the results. The REXX command INTERPRET is used to evaluate the supplied expression and assign it to a variable. Then that variable is used in a formatted reply message.

```

/* EXEC TO DO CALCULATIONS */
Address REXXTDLI
Arg Args
If Args='' Then
  Msg='SUPPLY EXPRESSION AFTER EXEC NAME.'
Else Do
  Interpret 'X='Args          /* Evaluate Expression */
  Msg='EXPRESSION:' Arg '=' X
End
'ISRT IOPCB MSG'
Exit RC

```

Figure 51. Exec To Do Calculations

This exec shows an example of developing applications with IMS Adapter for REXX. It also shows the advantages of REXX, such as dynamic interpretation, which is the ability to evaluate a mathematical expression at run-time.

A PDF EDIT session is shown in Figure 52. This figure shows how you can enter a new exec to be executed under IMS.

```

EDIT ---- USER.PRIVATE.PROCLIB(SAY) - 01.03 ----- COLUMNS 001 072
COMMAND ==>                                     SCROLL ==> PAGE
***** ***** TOP OF DATA *****
000001 /* EXEC TO DO CALCULATIONS */
000002 Address REXXTDLI
000003 Arg Args
000004 If Args='' Then
000005   Msg='SUPPLY EXPRESSION AFTER EXEC NAME.'
000006 Else Do
000007   Interpret 'X='Args          /* Evaluate Expression */
000008   Msg='EXPRESSION:' Arg '=' X
000009 End
000010
000011 'ISRT IOPCB MSG'
000012 Exit RC
***** ***** BOTTOM OF DATA *****

```

Figure 52. PDF EDIT Session on the SAY Exec

To execute the SAY exec, use IVPREXX and supply an expression such as:
IVPREXX SAY 5*5+7

This expression produces the output shown in Figure 53.

```

EXPRESSION: 5*5+7 = 32
EXEC SAY ended with RC= 0

```

Figure 53. Example Output from the SAY Exec

PCBINFO Exec: Display Available PCBs in Current PSB

The PCB exec maps the PCBs available to the exec, which are the PCBs for the executing PSB. The mapping consists of displaying the type of PCB (IO, TP, or DB), the LTERM or DBD name that is associated, and other useful information. Mapping displays this information by using the PCB function described in “DLIINFO” on page 345. Example output screens are shown in Figure 54 and Figure 55. The listing is shown in Figure 56 on page 359. PCB mappings are created by placing DFSREXX0 in an early concatenation library and renaming it to an existing application with a PSB/DBD generation.

```
IMS PCB System Information Exec: PCBINFO
System Date: 09/26/92   Time: 15:52:15

PCB # 1: Type=IO, LTERM=T3270LC Status=   UserID=           OutDesc=DFSM02
          Date=91269 Time=1552155
PCB # 2: Type=TP, LTERM=* NONE * Status=AD
PCB # 3: Type=TP, LTERM=* NONE * Status=
PCB # 4: Type=TP, LTERM=CTRL   Status=
PCB # 5: Type=TP, LTERM=T3275   Status=
EXEC PCBINFO ended with RC= 0
```

Figure 54. Example Output of PCBINFO Exec on a PSB without Database PCBs.

```
IMS PCB System Information Exec: PCBINFO
System Date: 09/26/92   Time: 15:53:34

PCB # 1: Type=IO, LTERM=T3270LC Status=   UserID=           OutDesc=DFSM02
          Date=89320 Time=1553243
PCB # 2: Type=DB, DBD =DI21PART Status=   Level=00 Opt=G
EXEC PCBINFO ended with RC= 0
```

Figure 55. Example Output of PCBINFO Exec on a PSB with a Database PCB.

```

/* REXX EXEC TO SHOW SYSTEM LEVEL INFO */
Address REXXTDLI
Arg Dest .
WTO=(Dest='WTO')
Call SayIt 'IMS PCB System Information Exec: PCBINFO'
Call SayIt 'System Date:' Date('U') ' Time:' Time()
Call SayIt ' '
/* A DFS3162 message is given when this exec is run because it does */
/* not know how many PCBs are in the list and it runs until it gets */
/* an error return code. Note this does not show PCBs that are */
/* available to the PSB by name only, in other words, not in the PCB list. */
Msg='PCBINFO: Error message normal on DLIINFO.'
'WTP MSG'
Do i=1 by 1 until Result='LAST'
  Call SayPCB i
End
Exit 0

SayPCB: Procedure Expose WTO
  Arg PCB
  'DLIINFO DLIINFO #'PCB /* Get PCB Address */
  If rc<0 Then Return 'LAST' /* Invalid PCB Number */
  Parse Var DLIInfo . . AIBAddr PCBAddr .
  PCBINFO=Storage(PCBAddr,255) /* Read PCB */
  DCPCB=(Substr(PCBInfo,13,1)='00'x) /* Date Field, must be DC PCB */
  If DCPCB then Do
    Parse Value PCBInfo with,
      LTERM 9 . 11 StatCode 13 CurrDate 17 CurrTime 21,
      InputSeq 25 OutDesc 33 UserID 41
    If LTERM='' then LTERM='* NONE *'
    CurrDate=Substr(c2x(CurrDate),3,5)
    CurrTime=Substr(c2x(CurrTime),1,7)
    If CurrDate~='000000' then Do
      Call SayIt 'PCB #'Right(PCB,2)': Type=IO, LTERM=LTERM,
        'Status=StatCode 'UserID=UserID 'OutDesc=OutDesc
      Call SayIt ' Date=CurrDate 'Time=CurrTime
    End
  Else
    Call SayIt 'PCB #'Right(PCB,2)': Type=TP, LTERM=LTERM,
      'Status=StatCode
  End
Else Do
  Parse Value PCBInfo with,
    DBDName 9 SEGLev 11 StatCode 13 ProcOpt 17 . 21 Segname . 29,
    KeyLen 33 NumSens 37
  KeyLen = c2d(KeyLen)
  NumSens= c2d(NumSens)

  Call SayIt 'PCB #'Right(PCB,2)': Type=DB, DBD =DBDName,
    'Status=StatCode 'Level=SegLev 'Opt=ProcOpt
End
Return '

SayIt: Procedure Expose WTO
  Parse Arg Msg
  If WTO Then
    'WTO MSG'
  Else
    'ISRT IOPCB MSG'
Return

```

Figure 56. PCBINFO Exec Listing

PART Execs

PART Execs: Database Access Examples

This set of execs accesses the PART database shipped with IMS. These execs demonstrate fixed-record database reading, SSAs, and many REXX functions. The PART database execs (PARTNUM, PARTNAME, and DFSSAM01) are described in this section.

The PARTNUM exec is used to show part numbers that begin with a number equal to or greater than the number you specify. An example output screen is shown in Figure 57.

To list part numbers beginning with the number “300” or greater, enter the command:

```
PARTNUM 300
```

All part numbers that begin with a 300 or larger numbers are listed. The listing is shown in Figure 59 on page 361.

```
IMS Parts DATABASE Transaction
System Date: 02/16/92   Time: 23:28:41

Request: Display 5 Parts with Part_Number >= 300
 1 Part=3003802         Desc=CHASSIS
 2 Part=3003806         Desc=SWITCH
 3 Part=3007228         Desc=HOUSING
 4 Part=3008027         Desc=CARD FRONT
 5 Part=3009228         Desc=CAPACITOR

EXEC PARTNUM ended with RC= 0
```

Figure 57. Example Output of PARTNUM Exec

PARTNAME is used to show part names that begin with a specific string of characters.

To list part names beginning with “TRAN”, enter the command:

```
PARTNAME TRAN
```

All part names that begin with “TRAN” are listed on the screen. The screen is shown in Figure 58. The listing is shown in Figure 60 on page 362.

```
IMS Parts DATABASE Transaction
System Date: 02/16/92   Time: 23:30:09

Request: Display 5 Parts with Part Name like TRAN
 1 Part=250239         Desc=TRANSISTOR
 2 Part=7736847P001    Desc=TRANSFORMER
 3 Part=975105-001     Desc=TRANSFORMER
 4 Part=989036-001     Desc=TRANSFORMER
End of DataBase reached before 5 records shown.

EXEC PARTNAME ended with RC= 0
```

Figure 58. Example Output of PARTNAME Exec

The DFSSAM01 exec is used to load the parts database. This exec is executed in batch, is part of the IVP, and provides an example of EXECIO usage in an exec.

Related Reading: For details, see *IMS Version 9: Installation Volume 1: Installation Verification*.

PARTNUM Exec: Show Set of Parts Near a Specified Number

Requirement: Figure 59 is designed to be run by the IVPREXX exec with PSB=DFSSAM02.

```

/* REXX EXEC TO SHOW A SET OF PARTS NEAR A SPECIFIED NUMBER */
/* Designed to be run by the IVPREXX exec with PSB=DFSSAM02 */
/* Syntax: IVPREXX PARTNUM string <start#> */

Address REXXTDLI
IOPCB='IOPCB' /* PCB Name */
DataBase='#2' /* PCB # */
RootSeg_Map = 'PNUM C 15 3 : DESCRIPTION C 20 27'
'MAPDEF ROOTSEG ROOTSEG_MAP'
Call SayIt 'IMS Parts DATABASE Transaction'
Call SayIt 'System Date:' Date('U') ' Time:' Time()
Call Sayit ' '

Arg PartNum Segs .
If ~DataType(Segs,'W') then Segs=5 /* default view amount */

PartNum=Left(PartNum,15) /* Pad to 15 with Blanks */
If PartNum='' then
  Call Sayit 'Request: Display first' Segs 'Parts in the DataBase'
Else
  Call Sayit 'Request: Display' Segs 'Parts with Part_Number >=' PartNum
SSA1='PARTROOT(PARTKEY >=02'PartNum')'
'GU DATABASE *ROOTSEG SSA1'
Status=IMSQUERY('STATUS')
If Status='GE' then Do /* Segment Not Found */
  Call Sayit 'No parts found with larger Part_Number'
  Exit 0
End
Do i=1 to Segs While Status=' '
  Call Sayit Right(i,2) 'Part='PNum ' Desc='Description
  'GN DATABASE *ROOTSEG SSA1'
  Status=IMSQUERY('STATUS')
End
If Status='GB' then
  Call SayIt 'End of DataBase reached before' Segs 'records shown.'
Else If Status~=' ' then Signal BadCall
Call Sayit ' '
Exit 0

SayIt: Procedure Expose IOPCB
Parse Arg Msg
'ISRT IOPCB MSG'
If RC~=0 then Signal BadCall
Return

BadCall:
'DLIINFO INFO'
Parse Var Info Call PCB . . . . Status .
Msg = 'Unresolved Status Code' Status,
'on' Call 'on PCB' PCB
'ISRT IOPCB MSG'
Exit 99

```

Figure 59. PARTNUM Exec: Show Set of Parts Near a Specified Number

PARTNAME Exec: Show a Set of Parts with a Similar Name

Requirement: The REXX exec shown in Figure 60 on page 362 is designed to be run by the IVPREXX exec with PSB=DFSSAM02.

PART Execs

```
/* REXX EXEC TO SHOW ALL PARTS WITH A NAME CONTAINING A STRING */
/* Designed to be run by the IVPREXX exec with PSB=DFSSAM02 */
/* Syntax:  IVPREXX PARTNAME string <#parts> */

Arg PartName Segs .
Address REXXIMS
Term    ='IOPCB'      /* PCB Name */
DataBase='DBPCB01'   /* PCB Name for Parts Database */

Call SayIt 'IMS Parts DATABASE Transaction'
Call SayIt 'System Date:' Date('U') ' Time:' Time()
Call Sayit ' '

If ~DataType(Segs,'W') & Segs~='*' then Segs=5
If PartName='' then Do
    Call Sayit 'Please supply the first few characters of the part name'
    Exit 0
End

Call Sayit 'Request: Display' Segs 'Parts with Part Name like' PartName
SSA1='PARTRoot '
'GU DATABASE ROOT_SEG SSA1'
Status=REXXIMS('STATUS')
i=0
Do While RC=0 & (i<Segs | Segs~='*')
    Parse Var Root_Seg 3 PNum 18 27 Description 47
    'GN DATABASE ROOT_SEG SSA1'
    Status=REXXIMS('STATUS')
    If RC~=0 & Status~='GB' Then Leave
    If Index(Description,PartName)=0 then Iterate
    i=i+1
    Call Sayit Right(i,2)' Part='PNum ' Desc='Description'
End
If RC~=0 & Status~='GB' Then Signal BadCall
If i<Segs & Segs~='*' then
    Call SayIt 'End of DataBase reached before' Segs 'records shown.'
Call Sayit ' '
Exit 0

SayIt: Procedure Expose Term
    Parse Arg Msg
    'ISRT Term MSG'
    If RC~=0 then Signal BadCall
Return

BadCall:
    Call "DFSSUT04" Term
Exit 99
```

Figure 60. PARTNAME Exec: Show Parts with Similar Names

DFSSAM01 Exec: Load the Parts Database

For the latest version of the DFSSAM01 source code, see the IMS.ADFSEXEC distribution library; member name is DFSSAM01.

DOCMD: IMS Commands Front End

DOCMD is an automatic operator interface (AOI) transaction program that issues IMS commands and allows dynamic filtering of their output. The term “dynamic” means that you use the headers for the command as the selectors (variable names) in the filter expression (Boolean expression resulting in 1 if line is to be displayed and 0 if it is not). This listing is shown in Figure 67 on page 365.

Not all commands are allowed through transaction AOI, and some setup needs to be done to use this AOI.

Related Reading: See “Security Considerations for Automated Operator Commands” in *IMS Version 9: Administration Guide: System* for more information.

Some examples of DOCMD are given in Figure 61, Figure 62, Figure 63, Figure 64 on page 364, Figure 65 on page 364, and Figure 66 on page 364.

```
Please supply an IMS Command to execute.
EXEC DOCMD ended with RC= 0
```

Figure 61. Output from => DOCMD

```
Headers being shown for command: /DIS NODE ALL
Variable (header) #1 = RECTYPE
Variable (header) #2 = NODE_SUB
Variable (header) #3 = TYPE
Variable (header) #4 = CID
Variable (header) #5 = RECD
Variable (header) #6 = ENQCT
Variable (header) #7 = DEQCT
Variable (header) #8 = QCT
Variable (header) #9 = SENT
EXEC DOCMD ended with RC= 0
```

Figure 62. Output from => DOCMD /DIS NODE ALL;?

```
Selection criteria =>CID>0<= Command: /DIS NODE ALL
NODE_SUB TYPE CID RECD ENQCT DEQCT QCT SENT
L3270A 3277 01000004 5 19 19 0 26 IDLE CON
L3270C 3277 01000005 116 115 115 0 122 CON
Selected 2 lines from 396 lines.
DOCMD Executed 402 DL/I calls in 2.096787 seconds.
EXEC DOCMD ended with RC= 0
```

Figure 63. Output from => DOCMD /DIS NODE ALL;CID>0

```

Selection criteria =>TYPE=SLU2<= Command: /DIS NODE ALL
NODE_SUB TYPE CID RECD ENQCT DEQCT QCT SENT
WRIGHT SLU2 00000000 0 0 0 0 0 IDLE
Q3290A SLU2 00000000 0 0 0 0 0 IDLE
Q3290B SLU2 00000000 0 0 0 0 0 IDLE
Q3290C SLU2 00000000 0 0 0 0 0 IDLE
Q3290D SLU2 00000000 0 0 0 0 0 IDLE
V3290A SLU2 00000000 0 0 0 0 0 IDLE
V3290B SLU2 00000000 0 0 0 0 0 IDLE
H3290A SLU2 00000000 0 0 0 0 0 IDLE
H3290B SLU2 00000000 0 0 0 0 0 IDLE
E32701 SLU2 00000000 0 0 0 0 0 IDLE
E32702 SLU2 00000000 0 0 0 0 0 IDLE
E32703 SLU2 00000000 0 0 0 0 0 IDLE
E32704 SLU2 00000000 0 0 0 0 0 IDLE
E32705 SLU2 00000000 0 0 0 0 0 IDLE
ADLU2A SLU2 00000000 0 0 0 0 0 IDLE
ADLU2B SLU2 00000000 0 0 0 0 0 IDLE
ADLU2C SLU2 00000000 0 0 0 0 0 IDLE
ADLU2D SLU2 00000000 0 0 0 0 0 IDLE
ADLU2E SLU2 00000000 0 0 0 0 0 IDLE
ADLU2F SLU2 00000000 0 0 0 0 0 IDLE
ADLU2X SLU2 00000000 0 0 0 0 0 IDLE
ENDS01 SLU2 00000000 0 0 0 0 0 IDLE
ENDS02 SLU2 00000000 0 0 0 0 0 IDLE
ENDS03 SLU2 00000000 0 0 0 0 0 IDLE
ENDS04 SLU2 00000000 0 0 0 0 0 IDLE
ENDS05 SLU2 00000000 0 0 0 0 0 IDLE
ENDS06 SLU2 00000000 0 0 0 0 0 IDLE
NDSL2A1 SLU2 00000000 0 0 0 0 0 ASR IDLE
NDSL2A2 SLU2 00000000 0 0 0 0 0 ASR IDLE
NDSL2A3 SLU2 00000000 0 0 0 0 0 ASR IDLE
NDSL2A4 SLU2 00000000 0 0 0 0 0 ASR IDLE
NDSL2A5 SLU2 00000000 0 0 0 0 0 IDLE
NDSL2A6 SLU2 00000000 0 0 0 0 0 ASR IDLE
OMSSLU2A SLU2 00000000 0 0 0 0 0 IDLE
Selected 34 lines from 396 lines.
DOCMD Executed 435 DL/I calls in 1.602206 seconds.
EXEC DOCMD ended with RC= 0

```

Figure 64. Output from => DOCMD /DIS NODE ALL;TYPE=SLU2

```

Selection criteria =>ENQCT>0 & RECTYPE='T02'<= Command: /DIS TRAN ALL
TRAN CLS ENQCT QCT LCT PLCT CP NP LP SEGSZ SEGNO PARLM RC
TACP18 1 119 0 65535 65535 1 1 1 0 0 NONE 1
Selected 1 lines from 1104 lines.
DOCMD Executed 1152 DL/I calls in 5.780977 seconds.
EXEC DOCMD ended with RC= 0

```

Figure 65. Output from => DOCMD /DIS TRAN ALL;ENQCT>0 & RECTYPE='T02'

```

Selection criteria =>ENQCT>0<= Command: /DIS LTERM ALL
LTERM ENQCT DEQCT QCT
CTRL 19 19 0
T3270LC 119 119 0
Selected 2 lines from 678 lines.
DOCMD Executed 681 DL/I calls in 1.967670 seconds.
EXEC DOCMD ended with RC= 0

```

Figure 66. Output from => DOCMD /DIS LTERM ALL;ENQCT>0

The source code for the DOCMD exec is shown in Figure 67 on page 365.


```

/*****/
/* A REXX exec that executes an IMS command and parses the      */
/* output by a user supplied criteria.                          */
/*                                                              */
/*****/
/* Format:  tranname DOCMD IMS-Command;Expression              */
/* Where:   */
/*   tranname is the tranname of a command capable transaction that */
/*           will run the IVPREXX program.                       */
/*   IMS-Command is any valid IMS command that generates a table of */
/*           output like /DIS NODE ALL or /DIS TRAN ALL          */
/*   Expression is any valid REXX expression, using the header names*/
/*           as the variables, like CID>0 or SEND=0 or more     */
/*           complex like CID>0 & TYPE=SLU2                    */
/* Example: TACP18 DOCMD DIS A          Display active          */
/*           TACP18 DOCMD DIS NODE ALL;?   See headers of DIS NODE */
/*           TACP18 DOCMD DIS NODE ALL;CID>0 Show active Nodes  */
/*           TACP18 DOCMD DIS NODE ALL;CID>0 & TYPE='SLU2'      */
/*****/
Address REXXTDLI
Parse Upper Arg Cmd ';' Expression
Cmd=Strip(Cmd);
Expression=Strip(Expression)
If Cmd='' Then Do
  Call SayIt 'Please supply an IMS Command to execute.'
  Exit 0
End
AllOpt= (Expression='ALL')
If AllOpt then Expression='
If Left(Cmd,1)~='/' then Cmd='/'Cmd /* Add a slash if necessary */
If Expression='' Then
  Call SayIt 'No Expression supplied, all output shown',
  'from:' Cmd
Else If Expression='?' Then
  Call SayIt 'Headers being shown for command:' Cmd
Else
  Call SayIt 'Selection criteria =>'Expression'<=',
  'Command:' Cmd
x=Time('R'); Calls=0
ExitRC= ParseHeader(Cmd,Expression)
If ExitRC~=0 then Exit ExitRC
If Expression='?' Then Do
  Do i=1 to Vars.0
    Call SayIt 'Variable (header) #'i '=' Vars.i
    Calls=Calls+1
  End
End
End

```

Figure 67. DOCMD Exec: Process an IMS Command (Part 1 of 3)

```

Else Do
  Call ParseCmd Expression
  Do i=1 to Line.0
    If AllOpt then Line=Line.i
    Else Line=Substr(Line.i,5)
    Call SayIt Line
    Calls=Calls+1
  End
  If Expression=' ' then
    Call SayIt 'Selected' Line.0-1 'lines from',
      LinesAvail 'lines.'
  Else
    Call SayIt 'Total lines of output:' Line.0-1
    Call SayIt 'DOCMD Executed' Calls 'DL/I calls in',
      Time('E') 'seconds.'
  End
  Exit 0
ParseHeader:
  CurrCmd=Arg(1)
  CmdCnt=0
  'CMD IOPCB CURRCMD'
  CmdS= IMSQUERY('STATUS')
  Calls=Calls+1
  If CmdS=' ' then Do
    Call SayIt 'Command Executed, No output available.'
    Return 4
  End
  Else If CmdS='CC' then Do
    Call SayIt 'Error Executing Command, Status='CmdS
    Return 16
  End
  CurrCmd=Translate(CurrCmd,' ','15'x) /* Drop special characters */
  CurrCmd=Translate(CurrCmd,'_','-/') /* Drop special characters */
  CmdCnt=CmdCnt+1
  Interpret 'LINE.'||CmdCnt '= Strip(CurrCmd)'
  Parse Var CurrCmd RecType Header
  If Expression=' ' then Nop
  Else If Right(RecType,2)='70' then Do
    Vars.0=Words(Header)+1
    Vars.1 = "RECTYPE"
    Do i= 2 to Vars.0
      Interpret 'VARS.'i '= "'Word(CurrCmd,i)'"'
    End
  End
  Else Do
    Call SayIt 'Command did not produce a header',
      'record, first record's type='RecType
  End
  Return 12
End
Return 0

```

Figure 67. DOCMD Exec: Process an IMS Command (Part 2 of 3)

```

ParseCmd:
  LinesAvail=0
  CurrExp=Arg(1)
  Do Forever
    'GCMD IOPCB CURRCMD'
    CmdS= IMSQUERY('STATUS')
    Calls=Calls+1
    If CmdS=' ' then Leave
    /* Skip Time Stamps      */
    If Word(CurrCmd,1)='X99' & Expression=' ' then Iterate
    LinesAvail=LinesAvail+1
    CurrCmd=Translate(CurrCmd,' ','15'x)/* Drop special characters */
    If Expression=' ' then OK=1
    Else Do
      Do i= 1 to Vars.0
        Interpret Vars.i '= "'Word(CurrCmd,i)'"'
      End
      Interpret 'OK='Expression
    End
    If OK then Do
      CmdCnt=CmdCnt+1
      Interpret 'LINE.'||CmdCnt '= Strip(CurrCmd)'
    End
  End
  Line.0 = CmdCnt
  If CmdS='QD' Then
    Call SayIt 'Error Executing Command:',
              Arg(1) 'Stat='CmdS
Return

SayIt: Procedure
  Parse Arg Line
  'ISRT IOPCB LINE'
Return RC

```

Figure 67. DOCMD Exec: Process an IMS Command (Part 3 of 3)

IVPREXX: MPP/IFP Front End for General Exec Execution

The IVPREXX exec is a front-end generic exec that is shipped with IMS as part of the IVP. It runs other execs by passing the exec name to execute after the TRANCODE (IVPREXX). For further details on IVPREXX, see “IVPREXX Sample Application” on page 339. For the latest version of the IVPREXX source code, see the IMS.ADFSEXEC distribution library; member name is IVPREXX.

Chapter 12. DL/I Test Program (DFSDDLTO)

DFSDDLTO is an IMS application program test tool that issues calls to IMS based on control statement information. You can use it to verify and debug DL/I calls independently of application programs. You can run DFSDDLTO using any PSB, including those that use an IMS-supported language. You can also use DFSDDLTO as a general-purpose database utility program.

The functions that DFSDDLTO provides include:

- Issuing any valid DL/I call against any database using:
 - Any segment search argument (SSA) or PCB, or both
 - Any SSA or AIB, or both
- Comparing the results of a call to expected results. This includes the contents of selected PCB fields, the data returned in the I/O area, or both.
- Printing the control statements, the results of calls, and the results of comparisons only when the output is useful, such as after an unequal compare.
- Dumping DL/I control blocks, the I/O buffer pool, or the entire batch region.
- Punching selected control statements into an output file to create new test data sets. This simplifies the construction of new test cases.
- Merging multiple input data sets into a single input data set using a SYSIN2 DD statement in the JCL. You can specify the final order of the merged statements in columns 73 to 80 of the DFSDDLTO control statements.
- Sending messages to the z/OS system console (with or without a reply).
- Repeating each call up to 9,999 times.

The following topics provide additional information:

- “Control Statements” on page 370
- “Planning the Control Statement Order” on page 371
- “ABEND Statement” on page 372
- “CALL Statement” on page 372
- “COMMENT Statement” on page 393
- “COMPARE Statement” on page 394
- “IGNORE Statement” on page 400
- “OPTION Statement” on page 400
- “PUNCH CTL Statement” on page 401
- “STATUS Statement” on page 404
- “WTO Statement” on page 407
- “WTOR Statement” on page 407
- “JCL Requirements” on page 408
- “Execution of DFSDDLTO in IMS Regions” on page 411
- “Explanation of DFSDDLTO Return Codes” on page 412
- “DFSDDLTO Hints” on page 412

Control Statements

DFSDDLTO processes control statements to control the test environment. DFSDDLTO can issue calls to IMS full-function databases and Fast Path databases, as well as DC calls. Table 86 gives an alphabetical summary of the types of control statements DFSDDLTO uses. A detailed description of each type of statement follows.

Table 86. Summary of DFSDDLTO Control Statements

Control Statement	Code	Description
ABEND ¹	ABEND	Causes user abend 252.
CALL		There are two types of CALL statements:
	L	CALL FUNCTION identifies the type of IMS call function to be made and supplies information to be used by the call.
		CALL DATA provides IMS with additional information.
COMMENT		There are two types of COMMENT statements:
	T	Conditional allows a limited number of comments that are printed or not depending on how the STATUS statement is coded and the results of the PCB or DATA COMPARE.
	U ¹	Unconditional allows an unlimited number of comments, all of which are printed.
COMPARE		There are three types of COMPARE statements:
	E	COMPARE DATA verifies that the correct segment was retrieved by comparing the segment returned by IMS with data in this statement.
		COMPARE AIB compares values that IMS returns to the AIB.
		COMPARE PCB checks fields in the PCB and calls for a snap dump of the DL/I blocks, the I/O buffer pool, or the batch region if the compare is unequal.
IGNORE	N or .	The program ignores statements that contain an N or . (period) in column 1.
OPTION ¹	O	Shows which control blocks are to be dumped, the number of unequal comparisons allowed, whether dumps are produced, number of lines printed per page, and the SPA size.
PUNCH ¹	CTL	PUNCH CTL produces an output data set consisting of the COMPARE PCB statements, the COMPARE AIB statements, the DATA statements, and all other control statements read.
STATUS ¹	S	Establishes print options and selects the PCB or AIB against which subsequent calls are to be issued.
WTO ¹	WTO	Sends a message to the z/OS console without waiting for reply.
WTOR ¹	WTOR	Sends a message to the z/OS console and waits for a reply before proceeding.

Note:

1. These control statements are acted on immediately when encountered in an input stream. Do not code them where they will interrupt call sequences. (See "Planning the Control Statement Order" on page 371.)

The control statements from Table 86 are described below:

- The CALL statement is the central DFSDDLTO statement. The CALL statement has two parts: CALL FUNCTION and CALL DATA. CALL FUNCTION identifies

the type of IMS call function and supplies information about segment search arguments (SSAs). CALL DATA provides more information required for the type of call identified by CALL FUNCTION.

- The STATUS statement controls the PCB, AIB, and handling of output.
- The three types of COMPARE statements, DATA, PCB, and AIB, compare different values:
 - If you want specific data from a call, use COMPARE DATA to check the segment data for mismatches when the call is made.
 - Use COMPARE PCB to check status codes, segment levels, and feedback keys. It also indicates mismatches when you specify output.
 - Use COMPARE AIB to compare values that IMS returns to the AIB.
- The two COMMENT statements, Conditional and Unconditional, allow you to set limits on the number of comments on the DFSDDLTO job stream and to specify whether you want the comments printed.
- The OPTION statement controls several overall functions such as the number of unequal comparisons allowed and the number of lines printed per page.
- The remaining statements, ABEND, IGNORE, CTL, WTO and WTOR, are not as important as the others at first. Read the sections describing these statements so that you can become familiar with the functions they offer.

When you are coding the DFSDDLTO control statements, keep these items in mind:

- If you need to temporarily override certain control statements in the DFSDDLTO streams, go to the JCL requirements section and read about SYSIN/SYSIN2 processing under “SYSIN2 DD Statement” on page 409.
- You must fill in column 1 of each control statement. If column 1 is blank, the statement type defaults to the prior statement type. DFSDDLTO attempts to use any remaining characters as it would for the prior statement type.
- Use of reserved fields can produce invalid output and unpredictable results.
- Statement continuations are important, especially for the CALL statement.
- Sequence numbers are not required, but they can be very useful for some DFSDDLTO functions. To understand how to use sequence numbers, see “PUNCH CTL Statement” on page 401, “SYSIN DD Statement” on page 409 and “SYSIN2 DD Statement” on page 409.
- All codes and fields in the DFSDDLTO statements must be left justified followed by blanks, unless otherwise specified.

Planning the Control Statement Order

The order of control statements is *critical* in constructing a successful call. To avoid unpredictable results, follow these guidelines:

1. If you are using STATUS and OPTION statements, place them somewhere before the calls that are to use them.
2. Both types of COMMENT statements are optional but, if present, must appear before the call they document.
3. You must code CALL FUNCTION statements and any required SSAs consecutively without interruption.
4. CALL DATA statements must immediately follow the last continuation, if any, of the CALL FUNCTION statements.
5. COMPARE statements are optional but must follow the last CALL (FUNCTION or DATA) statement.

Planning the Control Statement Order

- When CALL FUNCTION statements, CALL DATA statements, COMPARE DATA statements, COMPARE PCB statements, and COMPARE AIB statements are coded together, they form a call sequence. *Do not* interrupt call sequences with other DFSDDLTO control statements.

Exception: IGNORE statements are the only exception to this rule.

- Use IGNORE statements (N or .) to override any statement, regardless of its position in the input stream. You can use IGNORE statements in either SYSIN or SYSIN2 input streams.

ABEND Statement

The ABEND statement causes IMS to issue an abend and terminate DFSDDLTO. Table 87 shows the format of the ABEND statement.

Table 87. ABEND Statement

Column	Function	Code	Description
1-5	Identifies control statement	ABEND	Issues abend U252. (No dump is produced unless you code DUMP on the OPTION statement.)
6-72	Reserved	b	
73-80	Sequence indication	nnnnnnnn	For SYSIN2 statement override.

Examples of ABEND Statement

If you use ABEND in the input stream and want a dump, you must specify DUMP on the OPTION statement. The default on the OPTION statement is NODUMP.

```
|-----1-----2-----3-----4-----5-----6-----7-----<
ABEND                                                    22100010
```

Dump will be produced; OPTION statement provided requests dump.

```
|-----1-----2-----3-----4-----5-----6-----7-----<
0 DUMP                                                    22100010
```

No dump will be produced; OPTION statement provided requests NODUMP.

```
|-----1-----2-----3-----4-----5-----6-----7-----<
0 NODUMP                                                  22100010
```

CALL Statement

The CALL control statement has two parts: CALL FUNCTION and CALL DATA.

- The CALL FUNCTION statement supplies the DL/I call function, the segment search arguments (SSAs), and the number of times to repeat the call. SSAs are coded according to IMS standards.
- With the CALL DATA statement you provide any data (database segments, z/OS commands, checkpoint IDs) required by the DL/I call specified in the CALL FUNCTION statement. See “CALL DATA Statement” on page 376.

CALL FUNCTION Statement

Table 88 on page 373 gives the format for CALL FUNCTION statements, including the column number, function, code, and description. This is the preferred format when you are not working with column-specific SSAs.

Table 88. CALL FUNCTION Statement

Column	Function	Code	Description
1	Identifies control statement	L	Issues an IMS call
2	Reserved	b	
3	SSA level	b	SSA level (optional)
		n	Range of hexadecimal characters allowed is 1-F
4	Reserved	b	
5-8	Repeat count	bbbb	If blank, repeat count defaults to 1.
		nnnn	'nnnn' is the number of times to repeat this call. Range is 1 to 9999, right-justified, with or without leading zeros.
9	Reserved	b	
10-13	Identifies DL/I call function	bbbb	If blank, use function from previous CALL statement.
		xxxx	'xxxx' is a DL/I call function.
	Continue SSA	CONT	Continuation indicator for SSAs too long for a single CALL FUNCTION statement. Column 72 of the preceding CALL FUNCTION statement must have an entry. The next CALL statement should have CONT in columns 10 - 13 and the SSA should continue in column 16.
14-15	Reserved	b	
16-23 or	SSA name	xxxxxxxx	Must be left-justified.
16-23 or	Token	xxxxxxxx	Token name (SETS/ROLS).
16-23 or	MOD name	xxxxxxxx	Modname (PURG+ISRT).
16-23 or	Subfunction	xxxxxxxx	nulls, DBQUERY, FIND, ENVIRON, PROGRAM (INQY).

CALL Statement

Table 88. CALL FUNCTION Statement (continued)

Column	Function	Code	Description
16-19 and	Statistics type	xxxx	DBAS/DBES-OSAM or VBAS/VBES-VSAM (STAT). ²
20 or	Statistics format	x	F - Formatted U- Unformatted S - Summary.
16-19	SETO ID ¹	SETx	Where x is 1, 2, or 3. Specified on SETO and CHNG calls as defined in Note.
21-24	SETO IOAREA SIZE	nnnn	Value of 0000 to 8192. If a value greater than 8192 is specified, it defaults to 8192. If no value is specified, the call is made with no SETO size specified.
24-71	Remainder of SSA		Unqualified SSAs must be blank. Qualified search arguments should have either an '*' or a '(' in column 24 and follow IMS SSA coding conventions.
72	Continuation column	b x	No continuations for this statement. Alone, it indicates multiple SSAs each beginning in column 16 of successive statements. With CONT in columns 10-13 of the next statement, indicates a single SSA that is continued beginning in column 16 of the following statement.
73-80	Sequence indication	nnnnnnnn	For SYSIN2 statement override.

Table 88. CALL FUNCTION Statement (continued)

Column	Function	Code	Description
Note:			
1.	SETO CALL:		
			The SETO ID (SET1, SET2, or SET3) is required on the SETO call if DFSDDLTO is to keep track of the text unit address returned on the SETO call that would be passed on the CHNG call for option parameter TXTU.
			If the SETO ID is omitted on the SETO call, DFSDDLTO does not keep track of the data returned and is unable to reference it on a CHNG call.
	CHNG CALL:		
			The SETO ID (SET1, SET2, or SET3) is required on the CHNG call if DFSDDLTO is to place the address of the SETO ID I/O area returned on the SETO call. This is the SETO call of the text unit returned on the SETO call with a matching SETO ID for this CHNG call into the "TXTU=ADDR" field of the option parameter in the CHNG call.
			When the SETO ID is specified on the CHNG call, DFSDDLTO moves the address of that text unit returned on the SETO call using the same SETO ID.
			Code the OPTION statement parameter TXTU as follows: TXTU=xxxx where xxxx is any valid non-blank character. It cannot be a single quote character.
			Suggested value for xxxx could be SET1, SET2, or SET3. This value is not used by DFSDDLTO.
2.	STAT is a Product-sensitive programming interface.		

This information applies to different types of continuations:

- Column 3, the SSA level, is usually blank. If it is blank, the first CALL FUNCTION statement fills SSA 1, and each following CALL FUNCTION statement fills the next lower SSA. If column 3 is not blank, the statement fills the SSA at that level, and the following CALL FUNCTION statement fills the next lower one.
 - Columns 5 through 8 are usually blank, but if used, must be right justified. The same call is repeated as specified by the repeat call function.
 - Columns 10 through 13 contain the DL/I call function. The call function is required only for the first CALL FUNCTION statement when multiple SSAs are in a call. If left blank, the call function from the previous CALL FUNCTION statement is used.
 - Columns 16 through 23 contain the segment name if the call uses a SSA.
 - If the DL/I call contains multiple SSAs, the statement must have a nonblank character in column 72, and the next SSA must start in column 16 of the next statement. The data in columns 1 and 10 through 13 are blank for the second through last SSAs.
- Restriction:** On ISRT calls, the last SSA can have only the segment name with no qualification or continuation.
- If a field value extends past column 71, put a nonblank character in column 72. (This character is not read as part of the field value, only as a continuation character.) In the next statement insert the keyword CONT in columns 10 through 13 and continue the field value starting at column 16.
 - Maximum length for the field value is 256 bytes, maximum size for a SSA is 290 bytes, and the maximum number of SSAs for this program is 15, which is the same as the IMS limit.
 - If columns 5 through 8 in the CALL FUNCTION statement contain a repeat count for the call, the call will terminate when reaching that count, unless it first encounters a GB status code.

Related Reading: See "CALL FUNCTION Statement with Column-Specific SSAs" on page 390 for another format supported by DFSDDLTO.

CALL Statement

CALL DATA Statement

CALL DATA statements provide IMS with information normally supplied in the I/O area for that type of call function.

CALL DATA statements must follow the last CALL FUNCTION statement. You must enter an L in column 1, the keyword DATA in columns 10 through 13, and code the necessary data in columns 16 through 71. You can continue data by entering a nonblank character in column 72. On the continuation statement, columns 1 through 15 are blank and the data resumes in column 16. Table 89 shows the format for a CALL DATA statement.

Table 89. CALL DATA Statement

Column	Function	Code	Description
1	Identifies control statement	L	CALL DATA statement.
2	Increase segment length	K	Adds 2500 bytes to the length of data defined in columns 5 through 8.
3	Propagate remaining I/O indicator	P	Causes 50 bytes (columns 16 through 65) to be propagated through remaining I/O area. Note: This must be the last data statement and cannot be continued.
4	Format options	b	Not a variable-length segment.
		V	For the first statement describing the only variable-length segment or the first variable-length segment of multiple variable-length segments, LL field is added before the segment data.
		M	For statements describing the second through the last variable-length segments, LL field is added before the segment data.
		P	For the first statement describing a fixed-length segment in a path call.
		Z	For message segment, LLZZ field is added before the data.
		U	Undefined record format for GSAM records. The length of segment for an ISRT is placed in the DB PCB key feedback area.
5-8	Length of data in segment	nnnn	This value must be right justified but need not contain leading zeros. If you do not specify a length, DFSDDLTO will use the number of DATA statements read multiplied by 56 to derive the length.
9	Reserved	b	
10-13	Identifies CALL DATA statement	DATA	Identifies this as a DATA statement.
14-15	Reserved	b	
16-71	Data area	xxxx	Data that goes in the I/O area.
or			
16-23	Checkpoint ID		Checkpoint ID (SYNC).
or			

Table 89. CALL DATA Statement (continued)

Column	Function	Code	Description
16-23	Destination name		Destination name (CHNG).
or			
16	DEQ option		DEQ options (A,B,C,D,E,F,G,H,I, or J).
72	Continuation column	b	If no more continuations for this segment.
		x	If more data for this segment or more segments.
73-80	Sequence indication	nnnnnnnn	For SYSIN2 statement override.

When inserting variable-length segments or including variable-length data for a CHKP or LOG call:

- You must use a V or M in column 4 of the CALL DATA statement.
- Use V if only one variable-length segment is being processed.
- You must enter the length of the data with leading zeros, right justified, in columns 5 through 8. The value is converted to binary and becomes the first 2 bytes of the segment data.
- You can continue a CALL DATA statement into the next CALL DATA statement by entering a nonblank character in column 72. For subsequent statements, leave columns 1 through 15 blank, and start the data in column 16.

If multiple variable-length segments are required (that is, concatenation of logical child and logical parent segments, both of which are variable-length) for the first segment:

- You must enter a V in column 4.
- You must enter the length of the first segment in columns 5 through 8.
- If the first segment is longer than 56 bytes, continue the data as described for inserting variable-length segments.

Exceptions:

- The last CALL DATA statement to contain data for this segment must have a nonblank character in column 72.
- The next CALL DATA statement applies to the next variable-length statement and must contain an M in column 4 and the length of the segment in columns 5 through 8.

You can concatenate any number of variable-length segments in this manner. Enter M or V and the length (only in CALL DATA statements that begin data for a variable-length segment).

When a program is inserting or replacing through path calls:

- Enter a P in column 4 to specify that the length field is to be used as the length the segment will occupy in the user I/O area.
- You only need to use P in the first statement of fixed-length-segment CALL DATA statements in path calls that contain both variable- and fixed-length segments.
- You can use V, M, and P in successive CALL DATA statements.

For INIT, SETS, ROLS, and LOG calls:

- The format of the I/O area is
LLZuser-data

CALL Statement

where LL is the length of the data in the I/O area, including the length of the LLZZ portion.

- If you want the program to use this format for the I/O area, enter a Z in column 4 and the length of the data in columns 5 through 8. The length in columns 5 through 8 is the length of the data, not including the 4-byte length of LLZZ.

OPTION DATA Statement

The OPTION DATA statement contains options as required for SETO and CHNG calls.

Table 90 shows the format for an OPTION DATA statement, including the column number, function, code, and description.

Table 90. OPTION DATA Statement

Column	Function	Code	Description
1	Identifies control statement	L	OPTION statement.
2-9	Reserved	b	
10-13	Identifies	OPT	Identifies this as OPTION statement.
		CONT	Identifies this as a continuation of an option input.
14-15	Reserved	b	
16-71	Option area	xxxx	Options as defined for SETO and CHNG call.
72	Continuation column	b	If no more continuations for options.
		x	If more option data exists in following statement.
73-80	Sequence number	nnnnnnnn	For SYSIN2 statement override.

FEEDBACK DATA Statement

The FEEDBACK DATA statement defines an area to contain feedback data.

The FEEDBACK DATA statement is optional. However, if the FEEDBACK DATA statement is used, an OPTION DATA statement is required.

Table 91 shows the format for a FEEDBACK DATA statement, including the column number, function, code, and description.

Table 91. FEEDBACK DATA Statement

Column	Function	Code	Description
1	Identifies control statement	L	FEEDBACK statement.
2-3	Reserved	b	
4	Format option	b	Feedback area contains LLZZ.
		Z	Length of feedback area will be computed and the LLZZ will be added to the feedback area.
5-8	Length of feedback area	nnnn	This value must be right justified but need not contain leading zeros. If you do not specify a length, DFSDDLTO uses the number of FDBK inputs read multiplied by 56 to derive the length.
2-9	Reserved	b	

Table 91. FEEDBACK DATA Statement (continued)

Column	Function	Code	Description
10-13	Identifies	FDBK	Identifies this as feedback statement and continuation of feedback statement.
14-15	Reserved	b	
16-71	Feedback area	xxxx	Contains user pre-defined initialized area.
72	Continuation column	b	If no more continuations for feedback.
		x	If more feedback data exists in following statement.
73-80	Sequence number	nnnnnnnn	For SYSIN2 statement override.

DL/I Call Functions

Table 92 shows the DL/I call functions supported in DFSDDLTO and which ones require data statements.

Table 92. DL/I Call Functions

Call	AIB Support	PCB Support	Data Stmt ¹	Description
CHKP	yes	yes	R	Checkpoint.
CHNG	yes	yes	R	Change alternate PCB.
			R	Contains the alternate PCB name option statement and feedback statement optional.
CMD	yes	yes	R	Issue IMS command. This call defaults to I/O PCB.
DEQ	yes	yes	R	Dequeue segments locked with the Q command code. For full function, this call defaults to the I/O PCB, provided a DATA statement containing the class to dequeue immediately follows the call. For Fast Path, the call is issued against a DEDB PCB. Do not include a DATA statement immediately following the DEQ call.
DLET	yes	yes	O	Delete. If the data statement is present, it is used. If not, the call uses the data from the previous Get Hold Unique (GHU).
FLD	yes	yes	R	Field—for Fast Path MSDB calls using FSAs. This call references MSDBs only. If there is more than one FSA, put a nonblank character in column 34, and put the next FSA in columns 16-34 of the next statement. A DATA statement containing FSA is required.
GCMD	yes	yes	N	Get command response. This call defaults to I/O PCB.
GHN	yes	yes	O ²	Get Hold Next.
GHNP	yes	yes	O ²	Get Hold Next in Parent.
GHU	yes	yes	O ²	Get Hold Unique.
GMSG³	yes	no	R	Get Message is used in an automated operator (AO) application program to retrieve a message from AO exit routine DFSAOE00. The DATA statement is required to allow for area in which to return data. The area must be large enough to hold this returned data.
GN	yes	yes	O ²	Get Next segment.
GNP	yes	yes	O ²	Get Next in Parent.
GU	yes	yes	O ²	Get Unique segment.

CALL Statement

Table 92. DL/I Call Functions (continued)

Call	AIB Support	PCB Support	Data Stmt ¹	Description
ICMD³	yes	no	R	Issue Command enables an automated operator (AO) application program to issue an IMS command and retrieve the first command response segment. The DATA statement is required to contain the input command and to allow for area in which to return data. The area must be large enough to hold this returned data.
INIT	yes	yes	R	Initialization This call defaults to I/O PCB. A DATA statement is required. Use the LLZZ format.
INQY³	yes	no	R	Request environment information using the AIB and the ENVIRON subfunction. The DATA statement is required to allow for area in which to return data. The area must be large enough to hold this returned data.
			R	Request database information using the AIB and the DBQUERY subfunction, which is equivalent to the INIT DBQUERY call. The DATA statement is required to allow for area in which to return data. The area must be large enough to hold this returned data.
ISRT	yes	yes		Insert.
			R	DB PCB, DATA statement required.
			O	I/O PCB using I/O area with MOD name, if any, in columns 16-23.
			R	Alt PCB.
LOG	yes	yes	R	Log system request. This call defaults to I/O PCB. DATA statement is required and can be specified in one of two ways.
POS	yes	yes	N	Position - for DEDBs to determine a segment location. This call references DEDBs only.
PURG	yes	yes		Purge.
			R	This call defaults to use I/O PCB. If column 16 is not blank, MOD (message output descriptor) name is used and a DATA statement is required.
			O	If column 16 is blank, the DATA statement is optional.
RCMD³	yes	no	R	Retrieve Command enables an automated operator (AO) application program to retrieve the second and subsequent command response segments after an ICMD call. The DATA statement is required to allow for area in which to return data. The area must be large enough to hold this returned data.
REPL	yes	yes	R	Replace—This call references DB PCBs only. The DATA statement is required.
ROLB	yes	yes	O	Roll Back call.
ROLL	no	yes	O	Roll Back call and issue U778 abend.
ROLS	yes	yes	O	Back out updates and issue 3303 abend. Uses the I/O PCB. Can be used with the SETS call function. To issue a ROLS with an I/O area and token as the fourth parameter, specify the 4-byte token in column 16 of the CALL statement. Leaving columns 16-19 blank will cause the call to be made without the I/O area and the token. (To issue a ROLS using the current DB PCB, use ROLX.)

Table 92. DL/I Call Functions (continued)

Call	AIB Support	PCB Support	Data Stmt ¹	Description
ROLX	yes	yes	O	Roll call against the DB PCB (DFSDDLTO call function). This call is used to request a Roll Back call to DB PCB, and is changed to ROLS call when making the DL/I call.
SETO	yes	yes	N	Set options. OPTION statement required. FEEDBACK statement optional.
SETS/SETU	yes	yes	O	Create or cancel intermediate backout points. Uses I/O PCB. To issue a SETS with an I/O area and token as the fourth parameter, specify the four-byte token in column 16 of the CALL statement and include a DATA statement. Leaving columns 16-19 blank will cause the call to be made without the I/O area and the token.
SNAP⁴	yes	yes	O	Sets the identification and destination for snap dumps. If a SNAP call is issued without a CALL DATA statement, a snap of the I/O buffer pools and control blocks will be taken and sent to LOG if online and to PRINTDD DCB if batch. The SNAP ID will default to SNAPxxxx where xxxx starts at 0000 and is incremented by 1 for every SNAP call without a DATA statement. The SNAP options default to YYYYN. If a CALL DATA statement is used, columns 16-23 specify the SNAP destination, columns 24-31 specify the SNAP identification, and columns 32-35 specify the SNAP options. SNAP options are coded using 'Y' to request a snap dump and 'N' to prevent it. Column 32 snaps the I/O buffer pools, columns 33 and 34 snap the IMS control blocks and column 35 snaps the entire region. The SNAP call function is only supported for full-function database PCB.
STAT⁵	yes	yes	O	<p>The STAT call retrieves statistics on the IMS system. This call must reference only full-function DB PCBs. See the examples on 389. Statistics type is coded in columns 16-19 of the CALL FUNCTION statement.</p> <p>DBAS For OSAM database buffer pool statistics.</p> <p>VBAS For VSAM database subpool statistics. Statistics format is coded in column 20 of the CALL FUNCTION statement.</p> <p>F For the full statistics to be formatted if F is specified, the I/O area must be at least 360 bytes.</p> <p>U For the full statistics to be unformatted if U is specified, the I/O area must be at least 72 bytes.</p> <p>S For a summary of the statistics to be formatted if S is specified, the I/O area must be at least 120 bytes.</p>
SYNC	yes	yes	R	Synchronization.
XRST	yes	yes	R	Restart.

Notes:

1. R = required; O = optional; N = none
2. The data statement is required on the AIB interface.
3. Valid only on the AIB interface.
4. SNAP is a Product-sensitive programming interface.
5. STAT is a Product-sensitive programming interface.

CALL Statement

Examples of DL/I Call Functions

Basic CHKP Call: Use a CALL FUNCTION statement to contain the CHKP function and a CALL DATA statement to contain the checkpoint ID.

```
|-----1-----2-----3-----4-----5-----6-----7-----<
L          CHKP                                     10101400
L          DATA TESTCKPT
```

Symbolic CHKP Call with Two Data Areas to Checkpoint: Use a CALL FUNCTION statement to contain the CHKP function, a CALL DATA statement to contain the checkpoint ID data, and two CALL DATA statements to contain the data that you want to checkpoint.

You also need to use an XRST call when you use the symbolic CHKP call. Prior usage of an XRST call is required when using the symbolic CHKP call, as the CHKP call keys on the XRST call for symbolic CHKP.

Recommendation: Issue an XRST call as the first call in the application program.

```
|-----1-----2-----3-----4-----5-----6-----7-----<
L          XRST
L          .
L          .
L          .
L          CHKP
L          DATA TSTCHKP2                               X
L          8 DATA STRING2-                             X
L          16 DATA STRING2-STRING2-
U EIGHT BYTES OF DATA (STRING2-) IS CHECKPOINTED AND
U SIXTEEN BYTES OF DATA (STRING2-STRING2-) IS CHECKPOINTED ALSO
```

CHNG Call: Use a CALL FUNCTION statement to contain the CHNG function and a CALL DATA statement to contain the new logical terminal name.

```
|-----1-----2-----3-----4-----5-----6-----7-----<
L          CHNG SET1
L          OPT IAFP=A1M,PRTO=LLOPTION1,OPTION2,
L          CONT OPTION4
L Z0023 DATA DESTNAME
```

LL is the hex value of the length of LLOPTION,.....OPTION4.

The following is an example of a CHNG statement using SETO ID SET2, OPTION statement, DATA statement with MODNAME, and FDBK statement.

```
|-----1-----2-----3-----4-----5-----6-----7-----<
L          CHNG SET2
L          OPT IAFP=A1M,XTTU=SET2
L Z0023 DATA DESTNAME
L Z0095 FDBK FEEDBACK AREA
```

CMD Call: Use a CALL FUNCTION statement to contain the CMD function and a CALL DATA statement to contain the Command data.

```
|-----1-----2-----3-----4-----5-----6-----7-----<
L          CMD
L ZXXXX DATA COMMAND DATA
```

WHERE XXXX = THE LENGTH OF THE COMMAND DATA

CALL Statement

```
|---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---<
L      MSG  TOKEN111 WAITAOI
L Z0132 DATA
L      MSG
L Z0132 DATA
```

GN Call: Use a CALL FUNCTION statement to contain the GN function; no CALL DATA statement is required.

```
|---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---<
L      GN                                     10103210
```

GNP Call: Use a CALL FUNCTION statement to contain the GNP function; no CALL DATA statement is required.

```
|---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---<
L      GNP                                    10103210
```

GU Call with a Single SSA and a Relational Operator: Use a CALL FUNCTION statement to contain the GU function; no CALL DATA statement is required. The qualified SSA begins in column 24 and is contained in parentheses.

```
|---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---<
L      GU  SEGF  (KEYF > F131*KEYF < F400)
```

GU Call with a Single SSA and a Relational Operator Extended Across Multiple Inputs with Boolean Operators: Use a CALL FUNCTION statement to contain the GU function and three additional continuation of CALL FUNCTION input to continue with Boolean operators. No CALL DATA statement is required. The qualified SSA begins in column 24 and is contained in parentheses. This type of SSA can continue over several statements.

```
|---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---<
L      GU  SEGG  (FILLRG > G131G131G131G131G131G131G131G131G131G*
CONT 131G131G131G131G131G131G131G131G131G131G131G131G131G131G131G131G131G131G*
CONT 00G400G400G400G400G400G400G400G400G400G400G400G400G400G400G400G400G400G400G400G400G400G*
CONT )
```

GU Path Call: Use a CALL FUNCTION statement to contain the GU function and three additional continuation of CALL function input to continue with two additional SSAs. No CALL DATA statement is required. The call uses command codes in columns 24 and 25 to construct the path call. This type of call cannot be made with the column-specific SSA format.

```
|---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---<
L      GU  SEGA  *D(KEYA = A200)
      SEGF  *D(KEYF = F250)
      SEGG  *D(KEYG = G251)
```

ICMD Call: Use a CALL FUNCTION statement to contain the ICMD function. Use a CALL DATA statement to contain the command.

```
|---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---<
L      ICMD
L Z0132 DATA /DIS ACTIVE
```

INIT Call: Use a CALL FUNCTION statement to contain the INIT call and a CALL DATA statement to contain the INIT function DBQUERY, STATUS GROUPA, or STATUS GROUPB.

```
|-----1-----2-----3-----4-----5-----6-----7-----<
L      INIT                                     10103210
L  Z0011 DATA  DBQUERY
```

INQY Call: Use a CALL FUNCTION statement to contain the INQY call and either the DBQUERY or ENVIRON subfunction. The subfunctions are in the call input rather than the data input as in the INIT call.

```
|-----1-----2-----3-----4-----5-----6-----7-----<
L      INQY  ENVIRON                           10103210
L  V0256 DATA                                     10103211
L                                                    10103212
```

```
|-----1-----2-----3-----4-----5-----6-----7-----<
L      INQY  DBQUERY                           10103210
L  V0088 DATA                                     10103211
L                                                    10103212
```

ISRT Call: Use two CALL FUNCTION statements to contain the multiple SSAs and a CALL DATA statement to contain the segment data.

```
|-----1-----2-----3-----4-----5-----6-----7-----<
L      ISRT  STOCKSEG(NUMFIELD =20011)         X10103210
L           ITEMSSEG                           10103211
L  V0018 DATA 3002222222222222                10103212
```

ISRT Containing Only One Fixed-Length Segment: Use a CALL FUNCTION statement to contain the ISRT function and segment name, and two CALL DATA statements to contain the fixed-length segment. When inserting only one fixed-length segment, leave columns 4 through 8 blank and put data in columns 16 through 71. To continue data, put a nonblank character in column 72, and the continued data in columns 16 through 71 of the next statement.

```
|-----1-----2-----3-----4-----5-----6-----7-----<
L      ISRT  JOKESSEG                           10103210
L      DATA THEQUICKBLACKDOGJUMPEDONTOTHECRAZYFOXOOPSTHEQUICKBROWNFO*10103211
L           XJUMPEDOVERTHELAZYDOGSIR          10103212
```

ISRT Containing Only One Variable-Length Segment: Use a CALL FUNCTION statement to contain the ISRT function and segment name, and two CALL DATA statements to contain the variable-length segment. When only one segment of variable-length is being processed, you must enter a V in column 4, and columns 5 through 8 must contain the length of the segment data. The length in columns 5 through 8 is converted to binary and becomes the first two bytes of the segment data. To continue data, put a nonblank character in column 72, and the continued data in columns 16 through 71 of the next statement.

```
|-----1-----2-----3-----4-----5-----6-----7-----<
L      ISRT  JOKESSEG                           10103210
L  V0080 DATA THEQUICKBLACKDOGJUMPEDONTOTHECRAZYFOXOOPSTHEQUICKBROWNFO*10103211
L           XJUMPEDOVERTHELAZYDOGSIR          10103212
```

ISRT Containing Multiple Variable-Length Segments: Use a CALL FUNCTION statement to contain the ISRT function and segment name, and four CALL DATA statements to contain the variable-length segments. For the first segment, you must enter a V in column 4 and the length of the segment data in columns 5 through 8. If

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the segment is longer than 56 bytes, put a nonblank character in column 72, and continue data on the next statement. The last statement to contain data for this segment must have a nonblank character in column 72.

The next DATA statement applies to the next variable-length segment and it must contain an M in column 4, the length of the new segment in columns 5 through 8, and data starting in column 16. Any number of variable-length segments can be concatenated in this manner. If column 72 is blank, the next statement must have the following:

- An L in column 1
- An M in column 4
- The length of the new segment in columns 5 through 8
- The keyword DATA in columns 10 through 13
- Data starting in column 16

```
|---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---<
L      ISRT  AAAASEG                                10103210
L  V0080 DATA THEQUICKBLACKDOGJUMPEDONTOTHECRAZYFOXOOPSTHEQUICKBROWNFO*10103211
      XJUMPEDOVERTHELAZYDOGSIR                    *10103212
      M0107 DATA NOWISTHETIMEFORALLGOODMENTOCOMETOTHEAIDOFTHEIRCOUNTRYNOW*10103213
      ISTHETIMEFORALLGOODMENTOCOMETOTHEAIDOFTHEIRCOUNTRY 10103214
```

ISRT Containing Multiple Segments in a PATH CALL: Use a CALL FUNCTION statement to contain the ISRT function and segment name, and seven CALL DATA statements to contain the multiple segments in the PATH CALL.

When DFSDDLTO is inserting or replacing segments through path calls, you can use V and P in successive statements. The same rules apply for coding multiple variable-length segments, but fixed-length segments must have a P in column 4 of the DATA statement. This causes the length field in columns 5 through 8 to be used as the length of the segment, and causes the data to be concatenated in the I/O area without including the LL field.

Rules for continuing data in the same segment or starting a new segment in the next statement are the same as those applied to the variable-length segment.

```
|---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---<
L      ISRT  LEV01SEG*D                             *10103210
      LEV02SEG                                     *10103211
      LEV03SEG                                     *10103212
      LEV04SEG                                     10103213
L  V0080 DATA THEQUICKBLACKDOGJUMPEDONTOTHECRAZYFOXOOPSTHEQUICKBROWNFO*10103214
      XJUMPEDOVERTHELAZYDOGSIR                    *10103215
      M0107 DATA NOWISTHETIMEFORALLGOODMENTOCOMETOTHEAIDOFTHEIRCOUNTRYNOW*10103216
      ISTHETIMEFORALLGOODMENTOCOMETOTHEAIDOFTHEIRCOUNTRY *10103217
L  P0039 DATA THEQUICKBROWNFOXJUMPEDOVERTHELAZYDOGSIR *10103218
L  M0107 DATA NOWISTHETIMEFORALLGOODMENTOCOMETOTHEAIDOFTHEIRCOUNTRYNOW*10103219
      ISTHETIMEFORALLGOODMENTOCOMETOTHEAIDOFTHEIRCOUNTRY 10103220
```

LOG Call Using an LLZZ Format: Use a CALL FUNCTION statement to contain the LOG function and a CALL DATA statement to contain the LLZZ format of data to be logged.

When you put a Z in column 4, the first word of the record is not coded in the DATA statement. The length specified in columns 5 through 8 must include the 4 bytes for the LLZZ field that is not in the DATA statement.

```
|-----1-----2-----3-----4-----5-----6-----7-----<
L          LOG                                     10103210
L  Z0016 DATA  ASEGMENT ONE                       10103211
```

The A in column 16 becomes the log record ID.

POS Call: Use a CALL FUNCTION statement to contain the POS function and SSA; CALL DATA statement is optional.

```
|-----1-----2-----3-----4-----5-----6-----7-----<
L          POS  SEGA  (KEYA  =A300)
```

PURG Call with MODNAME and Data: Use a CALL FUNCTION statement to contain the PURG function and MOD name. Use the CALL DATA statement to contain the message data. If MOD name is provided, a DATA statement is required.

```
|-----1-----2-----3-----4-----5-----6-----7-----<
L          PURG  MODNAME1
L          DATA  FIRST SEGMENT OF NEW MESSAGE
```

PURG Call with Data and no MODNAME: Use a CALL FUNCTION statement to contain the PURG function; a DATA statement is optional.

```
|-----1-----2-----3-----4-----5-----6-----7-----<
L          PURG
L          DATA  FIRST SEGMENT OF NEW MESSAGE
```

PURG Call without MODNAME or Data: Use a CALL FUNCTION statement to contain the PURG function; CALL DATA statement is optional.

```
|-----1-----2-----3-----4-----5-----6-----7-----<
L          PURG
```

RCMD Call: Use a CALL FUNCTION statement to contain the RCMD function. Use a CALL DATA statement to retrieve second and subsequent command response segments resulting from an ICMD call.

```
|-----1-----2-----3-----4-----5-----6-----7-----<
L          RCMD
L  Z0132 DATA
```

REPL Call: Use a CALL FUNCTION statement to contain the REPL function. Use a CALL DATA statement to contain the replacement data.

```
|-----1-----2-----3-----4-----5-----6-----7-----<
L          REPL
L  V0028 DATA  THIS IS THE REPLACEMENT DATA
```

ROLB Call Requesting Return of First Segment of Current Message: Use a CALL FUNCTION statement to contain the ROLB function. Use the CALL DATA statement to request first segment of current message.

```
|-----1-----2-----3-----4-----5-----6-----7-----<
L          ROLB
L          DATA  THIS WILL BE OVERLAID WITH FIRST SEGMENT OF MESSAGE
```

CALL Statement

ROLB Call Not Requesting Return of First Segment of Current Message: Use a CALL FUNCTION statement to contain the ROLB function. The CALL DATA statement is optional.

```
|---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---<
L      ROLB
```

ROLL Call: Use a CALL FUNCTION statement to contain the ROLL function. The CALL DATA statement is optional.

```
|---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---<
L      ROLL
```

ROLS Call with a Token: Use a CALL FUNCTION statement to contain the ROLS function and token, and the CALL DATA statement to provide the data area that will be overlaid by the data from the SETS call.

```
|---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---<
L      ROLS TOKEN1
```

```
L Z0046 DATA THIS WILL BE OVERLAID WITH DATA FROM SETS
```

ROLS Call without a Token: Use a CALL FUNCTION statement to contain the ROLS function. The CALL DATA statement is optional.

```
|---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---<
L      ROLS
```

ROLX Call: Use a CALL FUNCTION statement to contain the ROLX function. The CALL DATA statement is optional. The ROLX function is treated as a ROLS call with no token.

```
|---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---<
L      ROLX
```

SETO Call: Use a CALL FUNCTION statement to contain the SETO function. The DATA statement is optional; however, if an OPTION statement is passed on the call, the DATA statement is required. Also, if a FEEDBACK statement is passed on the call, then both the DATA and OPTION statements are required. The following is an example of a SETO statement using the OPTION statement and SETO token of SET1.

```
|---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---<
L      SETO SET1 5000
L      OPT  PRT0=11OPTION1,OPTION2,
L      CONT OPTION3,
L      CONT OPTION4
```

11 is the hex value of the length of 11OPTION,.....OPTION4.

The following is an example of a SETO statement using the OPTION statement and SETO token of SET1.

```
|---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---<
L      SETO SET1 7000
L      OPT  PRT0=11OPTION1,OPTION2,OPTION3,OPTION4
```

11 is the hex value of the length of 11OPTION,.....OPTION4.

The following is an example of a SETO statement using the OPTION statement and SETO token of SET2 and FDBK statement.

```
|---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---<
L      SETO  SET2 5500
L      OPT  PRT0=11OPTION1,OPTION2,OPTION3,OPTION4
L Z0099  FDBK OPTION ERROR FEEDBACK AREA
```

11 is the hex value of the length of 11OPTION,.....OPTION4.

SETS Call with a Token: Use a CALL FUNCTION statement to contain the SETS function and token; use the CALL DATA statement to provide the data that is to be returned to ROLS call.

```
|---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---<
L      SETS  TOKEN1

L  Z0033 DATA  RETURN THIS DATA ON THE ROLS CALL
```

SETS Call without a Token: Use a CALL FUNCTION statement to contain the SETS function; CALL DATA statement is optional.

```
|---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---<
L      SETS
```

This section (SNAP call) contains product-sensitive programming interface information.

SNAP Call: Use a CALL FUNCTION statement to contain the SNAP function and a CALL DATA statement to contain the SNAP data.

```
|---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---<
L      SNAP                                     10103210
L  V0022 DATA  PRINTDD 22222222                10103212
```

This section (STAT call) contains product-sensitive programming interface information.

STAT Call: OSAM statistics require only one STAT call. STAT calls for VSAM statistics retrieve only one subpool at a time, starting with the smallest. See *IMS Version 9: Application Programming: Design Guide* for further information about the statistics returned by STAT.

```
|---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---<
L      STAT  DBASF
L      STAT  VBASS
L      STAT  VBASS
L      STAT  VBASS
L      STAT  VBASS
```

SYNC Call: Use a CALL FUNCTION statement to contain the SYNC function. The CALL DATA statement is optional.

```
|---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---<
L      SYNC
```

CALL Statement

Initial XRST Call: Use a CALL FUNCTION statement to contain the XRST FUNCTION and a CALL DATA statement that contains a checkpoint ID of blanks to indicate that you are normally starting a program that uses symbolic checkpoints.

```
|---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---<
L      XRST                                     10101400
L      DATA
L      CKPT
L      DATA YOURID01
```

Basic XRST Call: Use a CALL FUNCTION statement to contain the XRST function and a CALL DATA statement to contain the checkpoint ID.

```
|---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---<
L      XRST                                     10101400
L      DATA TESTCKPT
```

Symbolic XRST Call: Use a CALL FUNCTION statement to contain the XRST function, a CALL DATA statement to contain the checkpoint ID data, and one or more CALL DATA statements where the data is to be returned.

The XRST call is used with the symbolic CHKP call.

```
|---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---<
L      XRST
L      DATA TSTCHKP2                           X
L      8 DATA OVERLAY2                          X
L      16 DATA OVERLAY2OVERLAY2
U EIGHT BYTES OF DATA (OVERLAY2) SHOULD BE OVERLAID WITH CHECKPOINTED DATA
U SIXTEEN BYTES OF DATA (OVERLAY2OVERLAY2) IS OVERLAID ALSO
```

CALL FUNCTION Statement with Column-Specific SSAs

In this format, the SSA has intervening blanks between fields. Columns 24, 34, and 37 must contain blanks. Command codes are not permitted. Table 93 gives the format for the CALL FUNCTION statement with column-specific SSAs.

Table 93. CALL FUNCTION Statement (Column-Specific SSAs)

Column	Function	Code	Description
1	Identifies control statement	L	Call statement (see columns 10-13).
2	Reserved	b	
3	Reserved	b	
4	Reserved	b	
5-8	Repeat Count	b nnnn	If blank, repeat count defaults to 1. 'nnnn' is the number of times to repeat this call. Range 1 to 9999, right-justified but need not contain leading zeros.
10-13	Identifies DL/I call function	b xxxx	If blank, use function from previous CALL statement. 'xxxx' is a DL/I call function.

Table 93. CALL FUNCTION Statement (Column-Specific SSAs) (continued)

Column	Function	Code	Description
		CONT	Continuation indicator for SSAs too long for a single CALL FUNCTION statement. Column 72 of preceding CALL FUNCTION statement must contain a nonblank character. The next CALL statement should have CONT in columns 10 through 13 and the SSA should continue in column 16.
14-15	Reserved	b	
16-23	SSA name	s-name	Required if call contains SSA.
24	Reserved	b	Separator field.
25	Start character for SSA	(Required if segment is qualified.
26-33	SSA field name	f-name	Required if segment is qualified.
34	Reserved	b	Separator field.
35-36	DL/I call operator(s)	name	Required if segment is qualified.
37	Reserved	b	Separator field.
38-nn	Field value	nnnnn	Required if segment is qualified. Note: Do not use '5D' or ')' in field value.
nn+1	End character for SSA)	Required if segment is qualified.
72	Continuation column	b	No continuations for this statement.
		x	Alone, it indicates multiple SSAs each beginning in column 16 of successive statements. With CONT in columns 10-13 of the next statement, indicates a single SSA that is continued beginning in column 16 of the following statement
73-80	Sequence indication	nnnnnnnn	For SYSIN2 statement override.

If a CALL FUNCTION statement contains multiple SSAs, the statement must have a nonblank character in column 72 and the next SSA must start in column 16 of the next statement. If a field value extends past column 71, put a nonblank character in column 72. In the next statement insert the keyword CONT in columns 10 through 13 and continue the field value starting at column 16. Maximum length for field value is 256 bytes, maximum size for a SSA is 290 bytes, and the maximum number of SSAs for this program is 15, which is the same as the IMS limit.

DFSDDLTO Call Functions

The DFSDDLTO call functions were created for DFSDDLTO. They do not represent "valid" IMS calls and are not punched as output if DFSDDLTO encounters them while a CTL (PUNCH) statement is active. Table 94 shows the special call functions of the CALL FUNCTION statement. Descriptions and examples of these special functions follow.

Table 94. CALL FUNCTION Statement with DFSDDLTO Call Functions

Column	Function	Code	Description
1	Identifies control statement	L	Call statement.
2-4	Reserved	b	
5-8	Repeat count	b	If blank, repeat count defaults to 1.

CALL Statement

Table 94. CALL FUNCTION Statement with DFSDDLTO Call Functions (continued)

Column	Function	Code	Description
		nnnn	'nnnn' is the number of times to repeat this call. Range is 1 to 9999, right-justified but need not contain leading zeros.
9	Reserved	b	
10-15	Special call function	STAKb	Stack control statements for later execution.
		ENDbb	Stop stacking and begin execution.
		SKIPb	Skip statements until START function is encountered.
		START	Start processing statements again.
73-80	Sequence indication	nnnnnnnn	For SYSIN2 statement override.

STAK/END (stacking) Control Statements

With the STAK statement, you repeat a series of statements that were read from SYSIN and held in memory. All control statements between the STAK statement and the END statement are read and saved. When DFSDDLTO encounters the END statement, it executes the series of calls as many times as specified in columns 5 through 8 of the STAK statement. STAK calls imbedded within another STAK cause the outer STAK call to be abnormally terminated.

SKIP/START (skipping) Control Statements

With the SKIP and START statements, you identify groups of statements that you do not want DFSDDLTO to process. These functions are normally read from SYSIN2 and provide a temporary override to an established SYSIN input stream. DFSDDLTO reads all control statements occurring between the SKIP and START statements, but takes no action. When DFSDDLTO encounters the START statement, it reads and processes the next statement normally.

Examples of DFSDDLTO Call Functions

STAK/END Call: The following example shows the STAK and END call functions.

```
//BATCH.SYSIN DD *                                10000700
|---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---<
O SNAP= ,ABORT=0                                  10000800
S 1 1 1 1 1                                       10001000
L    GU    SEGA    (KEYA    =A300)                10001100
L    0003 STAK                                     10001150
WTO THIS IS PART OF THE STAK                      10001200
T THIS COMMENT IS PART OF THE STAK                10001300
L    GN                                           10001400
L    END                                          10001450
U THIS COMMENT SHOULD GET PRINTED AFTER THE STAK IS DONE 3 TIMES 10001500
L    0020 GN                                       10001600
/*
```

SKIP/START Call: The following example demonstrates the use of the SKIP and START call functions in SYSIN2 to override and stop the processing of the STAK and END call functions in SYSIN. DFSDDLTO executes the GU call function in SYSIN, skips the processing of STAK, WTO, T comment, GN, and END in SYSIN, and goes to the COMMENT.

```

//BATCH.SYSIN DD *
|-----1-----2-----3-----4-----5-----6-----7-----<
O SNAP= ,ABORT=0
S 1 1 1 1 1
L GU SEGA (KEYA =A300)
L 0003 STAK
WTO THIS IS PART OF THE STAK
T THIS COMMENT IS PART OF THE STAK
L GN
L END
U THIS COMMENT SHOULD GET PRINTED AFTER THE STAK IS DONE 3 TIMES
L 0020 GN
/*
//BATCH.SYSIN2 DD *
|-----1-----2-----3-----4-----5-----6-----7-----<
L SKIP
L START
U THIS COMMENT SHOULD REPLACE THE STAK COMMENT
U *****THIS COMMENT SHOULD GET PRINTED BECAUSE OF SYSIN2*****
/*

```

COMMENT Statement

Use the COMMENT statement to print comments in the output data. The two types of COMMENT statements, conditional and unconditional are described. Table 95 shows the format of the COMMENT statement.

Conditional COMMENT Statement

You can use up to five conditional COMMENT statements per call; no continuation mark is required in column 72. Code the statements in the DFSDDLTO stream before the call they are to document. Conditional COMMENTS are read and held until a CALL is read and executed. (If a COMPARE statement follows the CALL, conditional COMMENTS are held until after the comparison is completed.) You control whether the conditional comments are printed with column 3 of the STATUS statement. DFSDDLTO prints the statements according to the STATUS statement in the following order: conditional COMMENTS, the CALL, and the COMPARE(s). The time and date are also printed with each conditional COMMENT statement.

Unconditional COMMENT Statement

You can use any number of unconditional COMMENT statements. Code them in the DFSDDLTO stream before the call they are to document. The time and date are printed with each unconditional COMMENT statement. Table 95 lists the column number, function, code, and description

Table 95. COMMENT Statement

Column	Function	Code	Description
1	Identifies control statement	T	Conditional comment statement.
		U	Unconditional comment statement.
2-72	Comment data		Any relevant comment.
73-80	Sequence indication	nnnnnnnn	For SYSIN2 statement override.

Example of COMMENT Statement

T/U Comment Calls: The following example shows the T and U comment calls.

COMPARE Statement

```

//BATCH.SYSIN DD *
|---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---<
O SNAP= ,ABORT=0
S 1 1 1 1 1
L GU SEGB (KEYA =A400)
T THIS COMMENT IS A CONDITIONAL COMMENT FOR THE FIRST GN
L GN
U THIS COMMENT IS AN UNCONDITIONAL COMMENT FOR THE SECOND GN
L 0020 GN
/*

```

COMPARE Statement

The COMPARE statement compares the actual results of a call with the expected results. The three types of COMPARE statements are the COMPARE PCB, COMPARE DATA, and COMPARE AIB.

When you use the COMPARE PCB, COMPARE DATA, and COMPARE AIB statements you must:

- Code COMPARE statements in the DFSDDLTO stream immediately after either the last continuation, if any, of the CALL DATA statement or another COMPARE statement.
- Specify the print option for the COMPARE statements in column 7 of the STATUS statement.

For all three COMPARE statements:

- The condition code returned for a COMPARE gives the total number of unequal comparisons.
- For single fixed-length segments, DFSDDLTO uses the comparison length to perform comparisons if you provide a length. The length comparison option (column 3) is not applicable.

Product-sensitive programming interface

When you use the COMPARE PCB statement and you want a snap dump when there is an unequal comparison, request it on the COMPARE PCB statement. A snap dump to a log with SNAP ID COMPxxxx is issued along with the snap dump options specified in column 3 of the COMPARE PCB statement.

The numeric part of the SNAP ID is initially set to 0000 and is incremented by 1 for each SNAP resulting from an unequal comparison.

End of Product-sensitive programming interface

COMPARE DATA Statement

The COMPARE DATA statement is optional. It compares the segment returned by IMS to the data in the statement to verify that the correct segment was retrieved. Table 96 gives the format of the COMPARE DATA statement.

Table 96. COMPARE DATA Statement

Column	Function	Code	Description
1	Identifies control statement	E	COMPARE statement.
2	Reserved	b	

Table 96. COMPARE DATA Statement (continued)

Column	Function	Code	Description
3	Length comparison option	b	For fixed-length segments or if the LL field of the segment is not included in the comparison; only the data is compared.
		L	The length in columns 5-8 is converted to binary and compared against the LL field of the segment.
4	Segment length option	b	
		V	For a variable-length segment only, or for the first variable-length segment of multiple variable-length segments in a path call, or for a concatenated logical-child-logical-parent segment.
		M	For the second or subsequent variable-length segment of a path call, or for a concatenated logical-child-logical-parent segment.
		P	For fixed-length segments in path calls.
5-8	Comparison length	Z	For message segment.
		nnnn	Length to be used for comparison. (Required for length options V, M, and P if L is coded in column 3.)
9	Reserved	b	
10-13	Identifies type of statement	DATA	Required for the first I/O COMPARE statement and the first statement of a new segment if data from previous I/O COMPARE statement is not continued.
14-15	Reserved	b	
16-71	String of data		Data against which the segment in the I/O area is to be compared.
72	Continuation column	b	If blank, data is NOT continued.
		x	If not blank, data will be continued, starting in columns 16-71 of the subsequent statements for a maximum of 3840 bytes.
73-80	Sequence indication	nnnnnnnn	For SYSIN2 statement override.

Notes:

- If you code an L in column 3, the value in columns 5 through 8 is converted to binary and compared against the LL field of the returned segment. If you leave column 3 blank and the segment is not in a path call, then the value in columns 5 through 8 is used as the length of the comparison.
- If you code column 4 with a V, P, or M, you must enter a value in columns 5 through 8.
- If this is a path call comparison, code a P in column 4. The value in columns 5 through 8 must be the exact length of the fixed segment used in the path call.
- If you specify the length of the segment, this length is used in the COMPARE and in the display. If you do not specify a length, DFSDDL0 uses the shorter value for the length of the comparison and display of:
 - The length of data supplied in the I/O area by IMS
 - The number of DATA statements read times 56

COMPARE Statement

COMPARE AIB Statement

The COMPARE AIB statement is optional. You can use it to compare values returned to the AIB by IMS. Table 97 shows the format of the COMPARE AIB statement.

Table 97. COMPARE AIB Statement

Column	Function	Code	Description
1	Identifies control statement	E	COMPARE statement.
2	Hold compare option	H	Hold COMPARE statement. See note for COMPARE AIB Statement.
		b	Reset hold condition for a single COMPARE statement.
3	Reserved	b	
4-6	AIB compare	AIB	Identifies an AIB compare.
7	Reserved	b	
8-11	Return code	xxxx	Allow specified return code only.
12	Reserved		
13-16	Reason code	xxxx	Allow specified reason code only.
17-72	Reserved	b	b
73-80	Sequence indication	nnnnnnnn	For SYSIN2 statement override.

Note for COMPARE AIB Statement: To execute the same COMPARE AIB after a series of calls, put an H in column 2. When you specify an H, the COMPARE statement executes after each call. The H COMPARE statement is particularly useful when comparing with the same status code on repeated calls. The H COMPARE statement stays in effect until another COMPARE AIB statement is read.

COMPARE PCB Statement

The COMPARE PCB statement is optional. You can use it to compare values returned to the PCB by IMS or to print blocks or buffer pool. Table 98 shows the format of the COMPARE PCB statement.

Table 98. COMPARE PCB Statement

Column	Function	Code	Description
1	Identifies control statement	E	COMPARE statement.
2	Hold compare option	H	Hold compare statement.
		b	Reset hold condition for a single COMPARE statement.
3	Snap dump options (if compare was unequal)	b	Use default value. (You can change the default value or turn off the option by coding the value in an OPTION statement.)
		1	The complete I/O buffer pool.
		2	The entire region (batch regions only).
		4	The DL/I blocks.

Table 98. COMPARE PCB Statement (continued)

Column	Function	Code	Description
		8	Terminate the job step on miscompare of DATA or PCB.
		S	To SNAP subpools 0 through 127. Requests for multiple SNAP dump options can be obtained by summing their respective hexadecimal values. If anything other than a blank, 1-9, A-F, or S is coded in column 3, the SNAP dump option is ignored.
4	Extended SNAP ¹ options	b	Ignore extended option.
		P	SNAP the complete buffer pool (batch).
		S	SNAP subpools 0 through 127 (batch). An area is never snapped twice. The SNAP option is a combination of columns 3 (SNAP dump option) and 4 (extended SNAP option).
5-6	Segment level	nn	'nn' is the segment level for COMPARE PCB. A leading zero is required.
7	Reserved	b	
8-9	Status code	b	Allow blank status code only.
		xx	Allow specified status code only.
		XX	Do not check status code.
		OK	blank, GA, GC, or GK allowed.
10	Reserved	b	
11-18	Segment name User Identification	xxxxxxxx	Segment name for DB PCB compare.
			Logical terminal for I/O.
			Destination for ALT PCB.
19	Reserved	b	
20-23	Length of key	nnnn	'nnnn' is length of the feedback key.
24-71 or	Concatenated key		Concatenated key feedback for DB PCB compare.
24-31	User ID		User identification for TP PCB.
72	Continuation column	b	If blank, key feedback is <i>not</i> continued.
		x	If not blank, key feedback is continued, starting in columns 16-71 of subsequent statements.
73-80	Sequence indication	nnnnnnnn	For SYSIN2 statement override.

Note:

1. SNAP is a Product-sensitive programming interface.

Blank fields are not compared to the corresponding field in the PCB, except for the status code field. (Blanks represent a valid status code.) To accept the status codes blank, GA, GC, or GK as a group, put OK in columns 8 and 9. To stop comparisons of status codes, put XX in columns 8 and 9.

To execute the same compare after a series of calls, put an H in column 2. This executes the COMPARE statement after each call. This is particularly useful to compare to a blank status code only when loading a database. The H COMPARE statement stays in effect until another COMPARE PCB statement is read.

COMPARE Statement

Examples of COMPARE DATA and COMPARE PCB Statements

COMPARE PCB Statement for Blank Status Code: The COMPARE PCB statement is coded blank. It checks a blank status code for the GU.

```
|-----1-----2-----3-----4-----5-----6-----7-----<
L          GU                                     10101100
E                                               10101200
```

COMPARE PCB Statement for SSA Level, Status Code, Segment Name, Concatenated Key Length, and Concatenated Key: The COMPARE PCB statement is a request to compare the SSA level, a status code of OK (which includes blank, GA, GC, and GK), segment name of SEGA, concatenated key length of 0004, and a concatenated key of A100.

```
|-----1-----2-----3-----4-----5-----6-----7-----<
L          GU
E 01 OK SEGA    0004A100
```

COMPARE PCB Statement for SSA Level, Status Code, Segment Name, Concatenated Key Length, and Concatenated Key: The COMPARE PCB statement causes the job step to terminate based on the 8 in column 3 when any of the fields in the COMPARE PCB statement are not equal to the corresponding field in the PCB.

```
|-----1-----2-----3-----4-----5-----6-----7-----<
L          GU                                     10105100
E 8 01 OK SEGK    0004A100                       10105200
```

COMPARE PCB Statement for Status Code with Hold Compare: The COMPARE PCB statement is a request to compare the status code of OK (which includes blank, GA, GC, and GK) and hold that compare until the next COMPARE PCB statement. The compare of OK is used on GN following GU and is also used on a GN that has a request to be repeated six times.

```
|-----1-----2-----3-----4-----5-----6-----7-----<
L          GU   SEGA   (KEYA   = A300)           20201100
L          GN                                     20201300
EH        OK                                     20201400
L    0006 GN                                     20201500
```

COMPARE DATA Statement for Fixed-Length Segment: The COMPARE DATA statement is a request to compare the data returned. 72 bytes of data are compared.

```
|-----1-----2-----3-----4-----5-----6-----7-----<
L          GU
E          DATA A100A100A100A100A100A100A100A100A100A100A100A100A100A100X10102200
E          A100A100A100A100                                     10102300
```

COMPARE DATA Statement for Fixed-Length Data for 64 Bytes: The COMPARE DATA statement is a request to compare 64 bytes of the data against the data returned.

```
|-----1-----2-----3-----4-----5-----6-----7-----<
L          GU                                     10101600
E 0064 DATA A100A100A100A100A100A100A100A100A100A100A100A100A100A100X10101700
E          A100A100B111B111                             10101800
```

COMPARE DATA Statement for Fixed-Length Data for 72 Bytes: The COMPARE DATA statement is a request to compare 72 bytes of the data against the data returned.

```
|---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---<
L          GU                                     10103900
E LP0072 DATA A100A100A100A100A100A100A100A100A100A100A100A100A100A100X10104000
E          A100A100A100A100                                     10104100
```

COMPARE DATA Statement for Variable-Length Data of Multiple-Segments Data and Length Fields: The COMPARE DATA statement is a request to compare 36 bytes of the data against the data returned for segment 1 and 16 bytes of data for segment 2. It compares the length fields of both segments.

```
|---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---<
L          ISRT D          (DSS      = DSS01)          X38005500
L          DJ          (DJSS     = DJSS01)          X38005600
L          QAJAXQAJ          38005700
L V0036 DATA QSS02QASS02QAJSS01QAJASS97*IQAJA**    *38005800
L M0016 DATA QAJSS01*IQAJ**          38005850
L          GHU D          (DSS      = DSS01)          X38006000
L          DJ          (DJSS     = DJSS01)          X38006100
L          QAJAXQAJ (QAJASS = QAJASS97)          38006200
E LV0036 DATA QSS02QASS02QAJSS01QAJASS97*IQAJA**    *38006300
E LM0016 DATA QAJSS01*2QAJ**          38006350
```

COMPARE DATA Statement for Variable-Length Data of Multiple Segments with no Length Field COMPARE: The COMPARE DATA statement is a request to compare 36 bytes of the data against the data returned for segment 1 and 16 bytes of data for segment 2 with no length field compares of either segment.

```
|---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---<
L          ISRT D          (DSS      = DSS01)          X38005500
L          DJ          (DJSS     = DJSS01)          X38005600
L          QAJAXQAJ          38005700
L V0036 DATA QSS02QASS02QAJSS01QAJASS97*IQAJA**    *38005800
L M0016 DATA QAJSS01*IQAJ**          38005850
L          GHU D          (DSS      = DSS01)          X38006000
L          DJ          (DJSS     = DJSS01)          X38006100
L          QAJAXQAJ (QAJASS = QAJASS97)          38006200
E V0036 DATA QSS02QASS02QAJSS01QAJASS97*IQAJA**    *38006300
M0016 DATA QAJSS01*2QAJ**          38006350
```

COMPARE DATA Statement for Variable-Length Data of Multiple Segments and One Length Field COMPARE: The COMPARE DATA statement is a request to compare 36 bytes of the data against the data returned for segment 1 and 16 bytes of data for segment 2. It compares the length field of segment 1 only.

```
|---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---<
L          ISRT D          (DSS      = DSS01)          X38005500
L          DJ          (DJSS     = DJSS01)          X38005600
L          QAJAXQAJ          38005700
L V0036 DATA QSS02QASS02QAJSS01QAJASS97*IQAJA**    *38005800
L M0016 DATA QAJSS01*IQAJ**          38005850
L          GHU D          (DSS      = DSS01)          X38006000
L          DJ          (DJSS     = DJSS01)          X38006100
L          QAJAXQAJ (QAJASS = QAJASS97)          38006200
E LV0036 DATA QSS02QASS02QAJSS01QAJASS97*IQAJA**    *38006300
M0016 DATA QAJSS01*2QAJ**          38006350
```

IGNORE Statement

DFSDDLTO ignores any statement with an N or a period (.) in column 1. You can use the N or . (period) to comment out a statement in either the SYSIN or SYSIN2 input streams. Using N or . (period) in a SYSIN2 input stream causes the SYSIN input stream to be ignored as well. See “SYSIN2 DD Statement” on page 409 for information on how to override SYSIN input. Table 99 gives the format of the IGNORE statement. An example of the statement follows.

Table 99. IGNORE Statement

Column	Function	Code	Description
1	Identifies control statement	N or .	IGNORE statement.
2-72	Ignored		
73-80	Sequence indication	nnnnnnnn	For SYSIN2 statement override.

Example of IGNORE Statement Using N or .

```
|---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---<
. NOTHING IN THIS AREA WILL BE PROCESSED. ONLY THE SEQUENCE NUMBER 67101010
N WILL BE USED IF READ FROM SYSIN2 OR SYSIN. 67101020
```

OPTION Statement

Use the OPTION statement to override various default options. Use multiple OPTION statements if you cannot fit all the options you want in one statement. No continuation character is necessary. Once you set an option, it remains in effect until you specify another OPTION statement to change the first parameter. Table 100 shows the format of the OPTION statement. An example follows.

Table 100. OPTION Statement

Column	Function	Code	Description
1	Identifies control statement	O	OPTION statement (free-form parameter fields).
2	Reserved	b	b
3-72	Keyword parameters:		
	ABORT=	<ul style="list-style-type: none"> • 0 • 1 to 9999 	<ul style="list-style-type: none"> • Turns the ABORT parameter off. • Number of unequal compares before aborting job. Initial default is 5.
	LINECNT=	10 to 99	Number of lines printed per page. Must be filled with zeros. Initial default 54.
	SNAP ¹	x	SNAP option default, when results of compare are unequal. To turn the SNAP option off, code 'SNAP='. See “COMPARE PCB Statement” on page 396 for the appropriate values for this parameter. (Initial default is 5 if this option is not coded. This causes the I/O buffer pool and the DL/I blocks to be dumped with a SNAP call.)
	DUMP/NODUMP		Produce/do not produce dump if job abends. Default is NODUMP.

Table 100. OPTION Statement (continued)

Column	Function	Code	Description
	LCASE=	<ul style="list-style-type: none"> • H • C 	<ul style="list-style-type: none"> • Hexadecimal representation for lower case characters. This is the initial default. • Character representation for lower case characters.
	STATCD/NOSTATCD		Issue/do not issue an error message for the internal, end-of-job stat call that does not receive a blank or GA status code. NOSTATCD is the default.
	ABU249/NOABU249		Issue/do not issue a DFSDDLT0 ABENDU0249 when an invalid status code is returned for any of the internal end-of-job stat calls in a batch environment. NOABU249 is the default.
73 - 80	Sequence indication	nnnnnnnn	For SYSIN2 statement override.

Note:

1. SNAP is a Product-sensitive programming interface.

OPTION statement parameters can be separated by commas.

Example of OPTION Control Statement

```
|-----1-----2-----3-----4-----5-----6-----7-----<
0 ABORT=5,DUMP,LINECNT=54,SPA=4096,SNAP=5                               67101010
```

PUNCH CTL Statement

The PUNCH CTL statement allows you to produce an output data set consisting of COMPARE PCB statements, COMPARE DATA statements, COMPARE AIB statements, other control statements (with the exceptions noted in Table 101), or combinations of these statements. Table 101 shows the format and keyword parameters for the PUNCH CTL statement.

Table 101. PUNCH CTL Statement

Column	Function	Code	Description
1-3	Identifies control statement	CTL	PUNCH statement.
4-9	Reserved	b	
10-13	Punch control	PUNC	Begin punching (no default values).
		NPUN	Stop punching (default value).
14-15	Reserved	b	
16-72	Keyword parameters:		

PUNCH Statement

Table 101. PUNCH CTL Statement (continued)

Column	Function	Code	Description
	OTHER		<p>Reproduces all input control statements except:</p> <ul style="list-style-type: none"> • CTL (PUNCH) statements. • N or . (IGNORE) statements. • COMPARE statements. • CALL statements with functions of SKIP and START. Any control statements that appear between SKIP and START CALLs are not punched. (See "SKIP/START (skipping) Control Statements" on page 392). • CALL statements with functions of STAK and END. Control statements that appear between STAK and END CALLs are saved and then punched the number of times indicated in the STAK CALL. (See "STAK/END (stacking) Control Statements" on page 392).
	DATAL		Create a full data COMPARE using all of the data returned to the I/O area. Multiple COMPARE statements and continuations are produced as needed.
	DATAS		Create a single data COMPARE statement using only the first 56 bytes of data returned to the I/O area.
	PCBL		Create a full PCB COMPARE using the complete key feedback area returned in the PCB. Multiple COMPARE statements and continuations are produced as needed.
	PCBS		Create a single PCB COMPARE statement using only the first 48 bytes of the key feedback area returned in the PCB.
	SYNC/NOSYNC		If a GB status code is returned on a Fast Path call while in STAK, but prior to exiting STAK, this function issues or does not issue SYNC.

Table 101. PUNCH CTL Statement (continued)

Column	Function	Code	Description
	START=		00000001 to 99999999. This is the starting sequence number to be used for the punched statements. Eight numeric bytes must be coded.
	INCR=		1 to 9999. Increment the sequence number of each punched statement by this value. Leading zeros are not required.
	AIB		Create an AIB COMPARE statement.
73-80	Sequence indication	nnnnnnnn	For SYSIN2 statement override.

To change the punch control options while processing a single DFSDDLTO input stream, always use PUNCH CTL statements in pairs of PUNC and NPUN.

One way to use the PUNCH CTL statement is as follows:

1. Code only the CALL statements for a new test. Do not code the COMPARE statements.
2. Verify that each call was executed correctly.
3. Make another run using the PUNCH CTL statement to have DFSDDLTO merge the proper COMPARE statements and produce a new output data set that can be used as input for subsequent regression tests.

You can also use PUNCH CTL if segments in an existing database are changed. The control statement causes DFSDDLTO to produce a new test data set that has the correct COMPARE statements rather than you having to manually change the COMPARE statements.

Parameters in the CTL statement must be the same length as described in Table 101, and they must be separated by commas.

Example of PUNCH CTL Statement

```

|---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---<
CTL   PUNC  PCBS,DATAS,OTHER,START=00000010,INCR=0010      33212010
CTL   NPUN                                     33212020
    
```

The DD statement for the output data set is labeled PUNCHDD. The data sets are fixed block with LRECL=80. Block size as specified on the DD statement is used. If not specified, the block size is set to 80. If the program is unable to open PUNCHDD, DFSDDLTO issues abend 251.

PUNCH Statement

Example of PUNCH CTL Statement for All Parameters

```
|-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----<
CTL          PUNC  OTHER,DATAL,PCBL,START=00000001,INCR=1000,AIB          33212010
```

STATUS Statement

With the STATUS statement, you establish print options and name the PCB that you want subsequent calls to be issued against. Table 102 shows the format of the STATUS statement.

Table 102. STATUS Statement

Column	Function	Code	Description
1	Identifies control statement	S	STATUS statement.
2	Output device option	b	Use PRINTDD when in a DL/I region; use I/O PCB in MPP region.
		1	Use PRINTDD in MPP region if DD statement is provided; otherwise, use I/O PCB.
		A	Same as if 1, and disregard all other fields in this STATUS statement.
3	Print comment option	b	Do not print.
		1	Print for each call.
		2	Print only if compare done and unequal.
4	Print AIB option	b	Do not print.
		1	Print for each call.
		2	Print only if compare done and unequal.
5	Print call option	b	Do not print.
		1	Print for each call.
		2	Print only if compare done and unequal.
6	Reserved	b	
7	Print compare option	b	Do not print.
		1	Print for each call.
		2	Print only if compare done and unequal.
8	Reserved	b	
9	Print PCB option	b	Do not print.
		1	Print for each call.
		2	Print only if compare done and unequal.
10	Reserved	b	
11	Print segment option	b	Do not print.
		1	Print for each call.
		2	Print only if compare done and unequal.
12	Set task and real time	b	Do not time
		1	Time each call.
		2	Time each call if compare done and unequal.
13-14	Reserved	b	

Table 102. STATUS Statement (continued)

Column	Function	Code	Description
15	PCB selection option	1	PCB name passed in columns 16-23 (use option 1).
		2	DBD name passed in columns 16-23 (use option 2).
		3	Relative DB PCB passed in columns 16-23 (use option 3).
		4	Relative PCB passed in columns 16-23 (use option 4).
		5	\$LISTALL passed in columns 16-23 (use option 5).
		b	If column 15 is blank, DFSDDLTO selects options 2 through 5 based on content of columns 16-23.
Opt. 1 16-23	PCB selection PCB name	alpha	These columns must contain the name of the label on the PCB at PSBGEN, or the name specified on the PCBNAME= operand for the PCB at PSBGEN time.
Opt. 2 16-23	PCB selection DBD name	b alpha	The default PCB is the first database PCB in the PSB. If columns 16-23 are blank, current PCB is used. If DBD name is specified, this must be the name of a database DBD in the PSB.
Opt. 3 16-18 19-23	PCB selection Relative position of PCB in PSB	b numeric	When columns 16 through 18 are blank, columns (19-23) of this field are interpreted as the relative number of the DB PCB in the PSB. This number must be right-justified to column 23, but need not contain leading zeros.
Opt. 4 16-18 19-23	PCB selection I/O PCB Relative position of PCB in PSB	TPb numeric	When columns 16 through 18 = 'TPb', columns (19-23) of this field are interpreted as the relative number of the PCB from the start of the PCB list. This number must be right-justified to column 23, but need not contain leading zeros. I/O PCB is always the first PCB in the PCB list in this program.
Opt. 5 16-23	List all PCBs in the PSB	\$LISTALL	Prints out all PCBs in the PSB for test script.
24	Print status option	b	Use print options to print this STATUS statement.
		1	Do not use print options in this statement; print this STATUS statement.
		2	Do not print this STATUS statement but use print options in this statement.
		3	Do not print this STATUS statement and do not use print options in this statement.
25-28	PCB processing option	xxxx	This is optional and is only used when two PCBs have the same name but different processing options. If not blank, it is used in addition to the PCB name in columns 16 through 23 to select which PCB in the PSB to use.

STATUS Statement

Table 102. STATUS Statement (continued)

Column	Function	Code	Description
29	Reserved	b	
30-32	AIB interface	AIB	Indicates that the AIB interface is used and the AIB is passed rather than passing the PCB. (Passing the PCB is the default.) Note: When the AIB interface is used, the PCB must be defined at PSBGEN with PCBNAME=name. IOPCB is the PCB name used for all I/O PCBs. DFSDDLTO recognizes that name when column 15 contains a 1 and columns 16 through 23 contain IOPCB.
33	Reserved		
37-72	Reserved		
73-80	Sequence indication	nnnnnnnn	For SYSIN2 statement override.

If DFSDDLTO does not encounter a STATUS statement, all default print options (columns 3 through 12) are 2 and the default output device option (column 2) is 1. You can code a STATUS statement before any call sequence in the input stream, changing either the PCB to be referenced or the print options.

The referenced PCB stays in effect until a subsequent STATUS statement selects another PCB. However, a call that must be issued against an I/O PCB (such as LOG) uses the I/O PCB for that call. After the call, the PCB changes back to the original PCB.

Examples of STATUS Statement

To Print Each CALL Statement: The following STATUS statement tells DFSDDLTO to print these options: COMMENTS, CALL, COMPARE, PCB, and SEGMENT DATA for all calls.

```
|-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----<
S 1 1 1 1 1
```

To Print Each CALL Statement, Select a PCB: The following STATUS statements tell DFSDDLTO to print the COMMENTS, CALL, COMPARE, PCB, and SEGMENT DATA options for all calls, and select a PCB.

The 1 in column 15 is required for PCBNAME. If omitted, the PCBNAME is treated as a DBDNAME.

```
|-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----<
S 1 1 1 1 1 1PCBNAME
```

```
|-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----<
S 1 1 1 1 1 1PCBNAME AIBb
```

To print each CALL statement, select PCB based on a DBD name: The following STATUS statements tell DFSDDLTO to print the COMMENTS, CALL, COMPARE, PCB, and SEGMENT DATA options for all calls, and select a PCB by a DBD name.

The 2 in column 15 is optional.

```
|-----1-----2-----3-----4-----5-----6-----7-----<
S 1 1 1 1 1 2DBDNAME
```

```
|-----1-----2-----3-----4-----5-----6-----7-----<
S 1 1 1 1 1 2DBDNAME AIBb
```

If you do not use the AIB interface, you do not need to change STATUS statement input to existing streams; existing call functions will work just as they have in the past. However, if you want to use the AIB interface, you must change the STATUS statement input to existing streams to include AIB in columns 30 through 32. The existing DBD name, Relative DB PCB, and Relative PCB will work if columns 30 through 32 contain AIB and the PCB has been defined at PSBGEN with PCBNAME=name.

WTO Statement

The WTO (Write to Operator) statement sends a message to the z/OS console without waiting for a reply. Table 103 shows the format for the WTO statement.

Table 103. WTO Statement

Column	Function	Code	Description
1-3	Identifies control statement	WTO	WTO statement.
4	Reserved	b	
5-72	Message to send		Message to be written to the system console.
73-80	Sequence indication	nnnnnnnn	For SYSIN2 statement override.

Example of WTO Statement

This WTO statement sends a message to the z/OS console and continues the test stream.

```
|-----1-----2-----3-----4-----5-----6-----7-----<
WTO AT A "WTO" WITHIN TEST STREAM --WTO NUMBER 1-- TEST STARTED
```

WTOR Statement

The WTOR (Write to Operator with Reply) statement sends a message to the z/OS system console and waits for a reply. Table 104 shows the format of the WTOR statement.

Table 104. WTOR Statement

Column	Function	Code	Description
1-4	Identifies control statement	WTOR	WTOR statement.
5	Reserved	b	
6-72	Message to send		Message to be written to the system console.
73-80	Sequence indication	nnnnnnnn	For SYSIN2 statement override.

WTOR Statement

Example of WTOR Statement

This WTOR statement causes the test stream to hole until DFSDDLT0 receives a response from the z/OS console operator. Any response is valid.

```
|---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---<  
WTOR AT A "WTOR" WITHIN TEST STREAM - ANY RESPONSE WILL CONTINUE
```

JCL Requirements

This section defines the DD statements that DFSDDLT0 uses. Execution JCL depends on the installation data set naming standards as well as the IMS environment (batch or online). See Figure 68.

```
//SAMPLE JOB ACCOUNTING,NAME,MSGLEVEL=(1,1),MSGCLASS=3,PRTY=8          33001100  
//GET EXEC PGM=DFSRR00,PARM='DLI,DFSDDLT0,PSBNAME'                    33001200  
//STEPLIB DD DSN=IMS.SDFSRESL,DISP=SHR                                33001300  
//IMS DD DSN=IMS2.PSBLIB,DISP=(SHR,PASS)                            33001400  
// DD DSN=IMS2.DBDLIB,DISP=(SHR,PASS)                              33001500  
//DDCARD DD DSN=DATASET,DISP=(OLD,KEEP)                            33001600  
//IEFRDR DD DUMMY                                                  33001700  
//PRINTDD DD SYSOUT=A                                              33001800  
//SYSUDUMP DD SYSOUT=A                                             33001900  
//SYSIN DD *                                                       33002000  
|---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---<  
U THIS IS PART OF AN EXAMPLE                                        33002100  
S 1 1 1 1 1 PCB-NAME                                             33002200  
L GU                                                                33002300  
/*  
//SYSIN2 DD *  
|---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---<  
ABEND                                                            33002300  
/*
```

Figure 68. Example JCL Code for DD Statement Definition

Figure 69 is an example of coding JCL for DFSDDLT0 in a BMP. Use of a procedure is optional and is only shown here as an example.

```
//SAMPLE JOB ACCOUNTING,NAME,MSGLEVEL=(1,1),MSGCLASS=A              00010047  
//*****  
/* BATCH DL/I JOB TO RUN FOR RSR TESTING *  
//*****  
//BMP EXEC IMSBATCH,MBR=DFSDDLT0,PSB=PSBNAME  
//BMP.PRINTDD DD SYSOUT=A  
//BMP.PUNCHDD DD SYSOUT=B  
//BMP.SYSIN DD *  
U ***THIS IS PART OF AN EXAMPLE OF SYSIN DATA                    00010000  
S 1 1 1 1 1 1                                                    00030000  
L GU                                                                00040000  
L 0099 GN                                                            00050000  
/*  
|---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---<  
//BMP.SYSIN2 DD *  
U ***THIS IS PART OF AN EXAMPLE OF SYSIN2 DATA *****          00020000  
ABEND                                                            00050000  
/*
```

Figure 69. Example JCL Code for DFSDDLT0 in a BMP

SYSIN DD Statement

The data set specified by the SYSIN DD statement is the normal input data set for DFSDDLTO. When processing input data that is on direct-access or tape, you may want to override certain control statements in the SYSIN input stream or to add other control statements to it. You do this with a SYSIN2 DD statement and the control statement sequence numbers.

Sequence numbers in columns 73 to 80 for SYSIN data are optional unless a SYSIN2 override is used. If a SYSIN2 override is used, follow the directions for using sequence numbers as described in “SYSIN2 DD Statement.”

SYSIN2 DD Statement

DFSDDLTO does not require the SYSIN2 DD statement, but if it is present in the JCL, DFSDDLTO will read and process the specified data sets. When using SYSIN2:

- The SYSIN DD data set is the primary input. DFSDDLTO attempts to insert the SYSIN2 control statements into the SYSIN DD data set.
- You must code the control groups and sequence numbers properly in columns 73 to 80 or the merging process will not work.
- Columns 73 and 74 indicate the control group of the statement.
- Columns 75 to 80 indicate the sequence number of the statement.
- Sequence numbers *must* be in numeric order within their control group.
- Control groups in SYSIN2 must match the SYSIN control groups, although SYSIN2 does not have to use all the control groups used in SYSIN. DFSDDLTO does not require that control groups be in numerical order, but the control groups in SYSIN2 must be in the same order as those in SYSIN.
- When DFSDDLTO matches a control group in SYSIN and SYSIN2, it processes the statements by sequence number. SYSIN2 statements falling before or after a SYSIN statement are merged accordingly.
- If the sequence number of a SYSIN2 statement matches the sequence number of a SYSIN statement in its control group, the SYSIN2 overrides the SYSIN.
- If the program reaches the end of SYSIN before it reaches the end of SYSIN2, it processes the records of SYSIN2 as if they were an extension of SYSIN.
- Replacement or merging occurs only during the current run. The original SYSIN data is not changed.
- During merge, if one of the control statements contains blanks in columns 73 through 80, DFSDDLTO discards the statement containing blanks, sends a message to PRINTDD, and continues the merge until end-of-file is reached.

PRINTDD DD Statement

The PRINTDD DD statement defines output data set for DFSDDLTO, including displays of control blocks using the SNAP call. It must conform to the z/OS SNAP data set requirements.

PUNCHDD DD Statement

The DD statement for the output data set is labeled PUNCHDD. The data sets are fixed block with LRECL=80. Block size as specified on the DD statement is used; if not specified, the block size is set to 80. If the program is unable to open PUNCHDD, DFSDDLTO issues abend 251. Here is an example of the PUNCHDD DD statement.

Execution of DFSDDLT0 in IMS Regions

I/O PCB. DFSDDLT0 issues GU and GN calls until it receives the “No More Messages” status code, QC. If there is a SYSIN DD statement and a PRINTDD DD statement in the dependent region, DFSDDLT0 reads input from SYSIN and SYSIN2, if present, and sends output to the PRINTDD. If the dependent region is an MPP region and the input stream does not cause a GU to be issued to the I/O PCB before encountering end-of-file from SYSIN, the program will implicitly do a GU to the I/O PCB to get the message that caused the program to be scheduled. If the input stream causes a GU to the I/O PCB and a “No More Messages” status code is received, this is treated as the end of file. When input is from the I/O PCB, you can send output to PRINTDD by coding a 1 or an A in column 2 of the STATUS statement.

Because the input is in fixed form, it is difficult to key it from a terminal. To use DFSDDLT0 to test DL/I in a message region, execute another message program that reads control statements stored as a member of a partitioned set. Insert these control statements to an input transaction queue. IMS then schedules the program to process the transactions. This method allows you to use the same control statements to execute in any region type.

Explanation of DFSDDLT0 Return Codes

A non-zero return code from DFSDDLT0 indicates the number of unequal comparisons that occurred during that time.

A return code of 0 (zero) from DFSDDLT0 does not necessarily mean that DFSDDLT0 executed without errors. There are several messages issued by DFSDDLT0 that do not change the return code, but do indicate some sort of error condition. This preserves the return code field for the unequal comparison count.

If an error message was issued during the run, a message `ERRORS WERE DETECTED WITHIN THE INPUT STREAM. REVIEW OUTPUT TO DETERMINE ERRORS.` appears at the end of the DFSDDLT0 output. You must examine the output to ensure DFSDDLT0 executed as expected.

DFSDDLT0 Hints

This section describes loading a database, printing, retrieving, replacing, and deleting segments, regression testing, using a debugging aid, and verifying how a call is executed.

Load a Database

Use DFSDDLT0 for loading only very small databases because you must provide all the calls and data rather than have them generated. The following example shows `CALL FUNCTION` and `CALL DATA` statements that are used to load a database.


```

|---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---<
0 SNAP= ,ABORT=0
S 1 2 2 1 1
L      ISRT COURSE
L      DATA FRENCH
L      ISRT COURSE
L      DATA COBOL
L      ISRT CLASS
L      DATA 12
L      ISRT CLASS
L      DATA 27
L      ISRT STUDENT
L      DATA SMITH      THERESE
L      ISRT STUDENT
L      DATA GRABOWSKY  MARION

```

Print the Segments in a Database

Use either of the following sequences of control statements to print the segments in a database.

```

|---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---<
.* Use PRINTDD, print call, compare, and PCB if compare unequal
.* Do 1 Get Unique call
.* Hold PCB compare, End step if status code is not blank, GA, GC, GK
.* Do 9,999 Get Next calls
S  2 2 2 1  DBDNAME
L      GU
EH8    OK
L  9999 GN

|---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---<
.* Use PRINTDD, print call, compare, and PCB if compare unequal
.* Do 1 Get Unique call
.* Hold PCB compare, Halt GN calls when status code is GB.
.* Do 9,999 Get Next calls
S  2 2 2 1  DBDNAME
L      GU
EH     OK
L  9999 GN

```

Both examples request the GN to be repeated 9999 times. Note that the first example uses a COMPARE PCB of EH8 while the second uses a COMPARE PCB of EH.

The difference between these two examples is that the first halts the job step the first time the status code is not blank, GA, GC, or GK. The second example halts repeating the GN and goes on to process any remaining DFSDDLT0 control statements when a GB status code is returned or the GN has been repeated 9999 times.

Retrieve and Replace a Segment

Use the following sequence of control statements to retrieve and replace a segment.

DFSDDLTO Hints

```
|-----1-----2-----3-----4-----5-----6-----7-----8-----  
S 1 1 1 1 1 COURSEDB  
L      GHU  COURSE (TYPE   =FRENCH)           X  
          CLASS (WEEK   =27)           X  
          STUDENT (NAME  =SMITH)  
  
L      REPL  
L      DATA SMITH      THERESE
```

Delete a Segment

Use the following sequence of control statements to delete a segment.

```
|-----1-----2-----3-----4-----5-----6-----7-----8-----  
S 1 1 1 1 1 4  
L      GHU  COURSE (TYPE   =FRENCH)           X  
          CLASS *L           X  
          INSTRUC (NUMBER =444)  
  
L      DLET
```

Do Regression Testing

DFSDDLTO is ideal for doing regression testing. By using a known database, DFSDDLTO can issue calls and then compare the results of the call to expected results using COMPARE statements. The program then can determine if DL/I calls are executed correctly. If you code all the print options as 2's (print only if comparisons done and unequal), only the calls not properly satisfied are displayed.

Use as a Debugging Aid

When debugging a program, you usually need a print of the DL/I blocks. You can snap the blocks to a log data set at appropriate times by using a COMPARE statement that has an unequal compare in it. You can then print the blocks from the log. If you need the blocks even though the call executed correctly, such as for the call before the failing call, insert a SNAP function in the CALL statement in the input stream.

Verify How a Call Is Executed

Because it is very easy to execute a particular call, you can use DFSDDLTO to verify how a particular call is handled. This can be of value if you suspect DL/I is not operating correctly in a specific situation. You can issue the calls suspected of not executing properly and examine the results.

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