UNISYS

System 80 OS/3 Information Management System (IMS) COBOL/Assembler Action Programs

Programming Guide

OS/3 Release 13.0

March 1990

Printed in U S America

Priced Item

UP-9207 Rev. 2 - Update A

Correspondence regarding this publication should be forwarded to Unisys Corporation either by using the Business Reply Mail form at the back of this manual or by addressing remarks directly to Unisys Corporation, OS/3 Systems Product Information Development, P.O. Box 500, Mail Station E5-114, Blue Bell, Pennsylvania, 19424, U.S.A.

PAGE STATUS SUMMARY
ISSUE: Update A - UP-9207 Rev. 2

Part/Section	Page Number	Update Level
Cover		Orig.
Title Page/Disclaimer		A
PSS	iii	A
Acknowledgment	v	Orig.
About This Guide	Tab Breaker vii thru xi	Orig. Orig.
Contents	xiii thru xxviii	Orig.
1	Tab Breaker 1 thru 11	Orig. Orig.
2	Tab Breaker 1 thru 13	Orig. Orig.
3	Tab Breaker 1 thru 38	Orig. Orig.
4	Tab Breaker 1 thru 19	Orig. Orig.
5	Tab Breaker 1 thru 60	Orig. Orig.
6	Tab Breaker 1 thru 52	Orig. Orig.
7	Tab Breaker 1 thru 28	Orig. Orig.
8	Tab Breaker 1 thru 8	Orig. Orig.
9	Tab Breaker 1 thru 17	Orig. Orig.
10	Tab Breaker 1 thru 27	Orig. Orig.

Part/Section	Page Number	Update Level
11	Tab Breaker 1 thru 11	Orig. Orig.
12	Tab Breaker 1 thru 60	Orig. Orig.
Appendix A	Tab Breaker 1 thru 2	Orig. Orig.
Appendix B	Tab Breaker 1 thru 69	Orig. Orig.
Appendix C	Tab Breaker 1 thru 71	Orig. Orig.
Appendix D	Tab Breaker 1 thru 13	Orig. Orig.
Appendix E	Tab Breaker 1 thru 22	Orig. Orig.
Appendix F	Tab Breaker 1 thru 21	Orig. Orig.
Appendix G	Tab Breaker 1 thru 8	Orig. Orig.
Appendix H	Tab Breaker 1	Orig. Orig.
Index	Tab Breaker 1 thru 19	Orig. A*
User Comments Form		
Back Cover		

Part/Section	Page Number	Update Level

*New pages

PAGE STATUS SUMMARY
ISSUE: UP-9207 Rev. 2

Part/Section	Page Number	Update Level
Cover		
Title Page/Disclaimer		
PSS	iii	
Acknowledgment	v	
About This Guide	Tab Breaker vii thru xi	
Contents	xiii thru xxviii	
1	Tab Breaker 1 thru 11	
2	Tab Breaker 1 thru 13	
3	Tab Breaker 1 thru 38	
4	Tab Breaker 1 thru 19	
5	Tab Breaker 1 thru 60	
6	Tab Breaker 1 thru 52	
7	Tab Breaker 1 thru 28	
8	Tab Breaker 1 thru 8	
9	Tab Breaker 1 thru 17	
10	Tab Breaker 1 thru 27	
11	Tab Breaker 1 thru 11	
12	Tab Breaker 1 thru 60	
Appendix A	Tab Breaker 1 thru 2	
Appendix B	Tab Breaker 1 thru 69	
Appendix C	Tab Breaker 1 thru 71	
Appendix D	Tab Breaker 1 thru 13	
Appendix E	Tab Breaker 1 thru 22	
Appendix F	Tab Breaker 1 thru 21	
Appendix G	Tab Breaker 1 thru 8	
Appendix H	Tab Breaker 1	
Index	Tab Breaker (To be supplied)	
User Comments Form		
Back Cover		

Part/Section	Page Number	Update Level

Acknowledgment

We are indebted to the many systems analysts and staff members of Unisys branch offices and customer organizations who helped us develop the OS/3 IMS library. They gave us suggestions, answered numerous questions, reviewed the manuals, and provided us with "real-life" programming examples. The customer organizations assisting us include:

- Gay and Taylor Insurance Adjustors, Winston-Salem, NC
- Penn Ventilator Company, Philadelphia, PA
- Victor Valley Community College District, Victorville, CA

The Unisys organizations assisting us include:

- Los Angeles Access Center, Customer Support Services, Los Angeles, CA
- Charlotte Commercial Branch, Greensboro Office, Greensboro, NC
- Minneapolis Marketing Branch, Minneapolis, MN
- Wellesley General Branch, Wellesley, MA
- Philadelphia Manufacturing Branch, Wayne, PA
- Des Moines Marketing Branch, West Des Moines, IA
- System 80 Benchmark and Demonstration Services, Blue Bell, PA

About This Guide

Purpose

This guide is one of a series designed to instruct you in using the Information Management System (IMS) for Operating System/3 (OS/3). It describes all aspects of writing action programs in COBOL and basic assembly language (BAL).

Scope

This guide provides detailed information on coding and implementing IMS action programs using COBOL and the basic assembly language. IMS action programs may be written in COBOL 74, COBOL 85, or Extended COBOL. Thus, the single term "COBOL" is used in this document unless it is necessary to refer to a specific version of the language.

The major topics in this guide include the basics of IMS action programming, rules and guidelines for coding action programs, using the special features of OS/3 such as screen format services and distributed data processing capabilities, preparing action programs for execution, and action program problem analysis using SNAP dumps. Numerous examples are provided to illustrate the principles and guidelines contained in this document.

Audience

The intended audience for this document are programmers who have knowledge and experience in software development using COBOL and/or BAL, and who wish to use these languages to develop programs for use in the IMS environment.

Prerequisites

The programmer planning to develop IMS action programs should be experienced in the use of COBOL and/or BAL, and have a general understanding of IMS, how it operates, and what is needed to do to make it operational. This information is contained in the *IMS Technical Overview,* UP-9205.

Organization

Information in this guide is divided into twelve sections and eight appendices:

Section 1. Transaction Processing in the IMS Environment

Introduces COBOL and BAL programmers to action programs and their interface with IMS. Also previews actions, transaction structures, action program termination, succession, and single-thread and multithread environments.

Section 2. General Rules for Coding Action Programs

Discusses COBOL and BAL action program structures and compares them to regular COBOL and BAL program structures. Describes the activation record, its contents, structure, and use.

Section 3. Communicating with IMS

Provides a more detailed description of the COBOL and BAL program information blocks, including formats, contents, and use.

Section 4. Receiving Input Messages

Describes the input message area, including the formats, contents, and use of the input message control header format for COBOL and BAL programs and the description of input message text. Explains how an IMS action program can clear ICAM queues.

Section 5. Processing Data Files

Tells how to access and update data files.

Section 6. Sending Output Messages

Covers all aspects of output messages, including the formats, contents, and use of the output message control header for COBOL and BAL programs; the use of the SEND function for multiple output or message switching; the use of a work area for output messages; continuous output; and output-for-input queueing.

Section 7. Using Screen Format Services to Format Messages

Discusses and shows examples of how to display a screen format and a replenish screen or error format; handle error returns; receive formatted input in a successor program; display a screen format on an auxiliary device; and use screen formats in a distributed data processing environment.

Section 8. Calling Subprograms from Action Programs

Describes how to call subprograms from COBOL or BAL action programs, and illustrates the use of a subprogram.

Section 9. Action Programming in a Distributed Data Processing Environment

Presents basic distributed data processing terminology; defines and illustrates directory, operator, and action program routing of transactions; and describes how to initiate a remote transaction and how to process a transaction initiated by a remote system.

Section 10. Additional Special Features

Describes the downline load feature and how to write your own downline load program. Also describes how to disconnect a single-station dial-in line from an action program, how to initiate batch jobs from your action program using the RUN function, and how to perform a SETIME WAIT within an action program. Explains the use of transaction buffers by BAL and COBOL programs to acquire and release blocks of main storage.

Section 11. Compiling, Linking, and Storing Action Programs

Provides control streams that are needed to compile and link your action programs, and describes how to store them in load libraries.

Section 12. Debugging Action Programs

Discusses all portions of termination and the CALL SNAP dump, and provides examples and a step-by-step explanation of how to interpret them.

Appendix A. Statement Conventions

Describes the format conventions used in this guide.

Appendix B. COBOL Action Programming Examples

Contains complete compiler listings with accompanying flowcharts of sample COBOL action programs discussed throughout this guide. Examples include simple and dialog transactions, external and immediate internal succession, screen format services, sending a message to another terminal, output-for-input queueing, and continuous output.

Appendix C. Basic Assembly Language (BAL) Action Programming Examples

Contains complete compiler listing with accompanying flowcharts of sample BAL action programs discussed throughout this guide.

Appendix D. Status and Detailed Status Codes

Provides status codes and detailed status codes returned after execution of function calls issued by action programs.

Appendix E. Generating Edit Tables

Discusses the edit table generator, including coding rules, parameter values that describe the edit table, edit table execution, and error processing. Shows how input messages entered at the terminal are edited. Includes a sample action program that uses an edit table.

Appendix F. Using Device-Independent Control Expressions and Field Control Characters

Explains device-independent control expressions (DICE), their values, interpretation, how to create them via the DICE macroinstructions, and when to use them.

Appendix G. Differences between Extended COBOL and 1974 ANS COBOL

Describes the minor differences between using the extended COBOL and 1974 American National Standard (ANS) COBOL compilers to compile action programs.

Appendix H. Listing IMS DSECTs

Related Product Information

As one of a series, this document is designed to guide you in programming and using the OS/3 Information Management System. Depending on your need, you should also refer to the current versions of other documents in the series. Complete document names, their ordering numbers, and a general description of their contents and use are as follows:

Note: *Throughout this manual, when we refer you to another manual, use the version that applies to the software level in use at your site.*

***Information Management System (IMS) Technical Overview,* UP-9205**

Describes the basic concepts of IMS and the facilities that IMS offers.

***Information Management System (IMS) System Support Functions Programming Guide,* UP-11907**

Describes the procedures to generate, initiate, and recover an online IMS system.

Information Management System (IMS) Action Programming in RPG II Programming Guide, UP-9206

Describes how to write action programs in RPG II with extensive examples.

Information Management System (IMS) Data Definition and UNIQUE Programming Guide, UP-9209

Describes data definitions for use with the uniform inquiry update element (UNIQUE) and explains how to use UNIQUE.

Information Management System (IMS) Operations Guide, UP-12027

Describes terminal operating procedures, standard and master terminal commands, and special-purpose IMS transaction codes. Also includes UNIQUE command formats with brief descriptions.

Information Management System (IMS) to DMS Interface Programming Guide, UP-8748

Describes how to access a data base management system (DMS) data base from IMS.

Extended COBOL Programming Reference Manual, UP-8059

1974 American Standard COBOL Programming Reference Manual, UP-8613

COBOL 85 Technical Overview, 7002 3982

COBOL 85 Programming Reference Manual, 7002 3940

Assembler Programming Reference Manual, UP-8914

If your action programs access a DMS data base, consult the following documents:

IMS to DMS Interface Programming Guide, UP-8748

DMS Data Description Language Programming Reference Manual, UP-8022

DMS Data Manipulation Language Programming Guide, UP-12013

DMS System Support Functions Programming Guide, UP-10870.

Notation Conventions

Information on statement conventions used in this document is contained in Appendix A.

Contents

Section 4. Receiving Input Messages

Section 5. Processing Data Files

Section 6. Sending Output Messages

Section 10. Additional Special Features

Section 11. Compiling, Linking, and Storing Action Programs

Figures

Tables

Section 1
Transaction Processing in the IMS Environment

1.1. Introducing IMS

The Unisys Information Management System (IMS) is an interactive, transaction-oriented file processing system. It is interactive because it carries on a conversation with the terminal operator; it is transaction-oriented because, for each input message, the terminal operator receives a response or output message. In this way, operators are constantly informed of the results of their inquiries.

1.2. Interacting with IMS

Application programs, called action programs, interact with IMS to process input messages from terminals, perform file retrieval or updating functions, and create output messages.

You can write action programs in RPG II, COBOL, or basic assembly language (BAL). IMS also provides a set of action programs called the uniform inquiry update element (UNIQUE) that performs file retrieval and updating functions through commands from the terminal.

This guide tells you how to write action programs in COBOL and BAL. Action programs are similar to standard COBOL and BAL programs, but they must follow specific rules because they operate under the control of IMS.

Throughout this guide, it is assumed you have read and understood the *IMS Technical Overview* and the appropriate language manual. However, as required, terms and concepts that are directly related to RPG II action programming will be briefly described and defined.

1.3. Basic IMS Terms

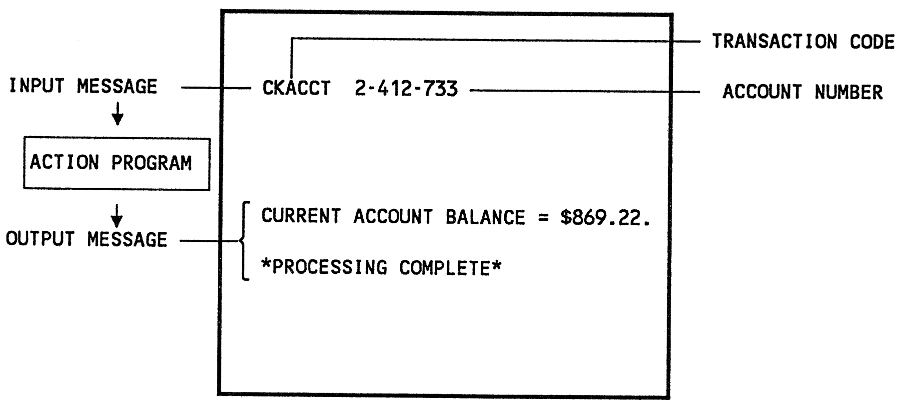
The term **action programming** comes from the fact that the unit of work in IMS is the action. An action begins when an operator enters a message at a terminal and ends when a response to that message is returned. This is an important point to remember, since the action programs you write are involved primarily with this activity - processing input messages, performing file retrieval or updating, and creating output messages.

An action always consists of three activities:

1. Input
2. Processing
3. Output

A **transaction** is one action or a series of actions.

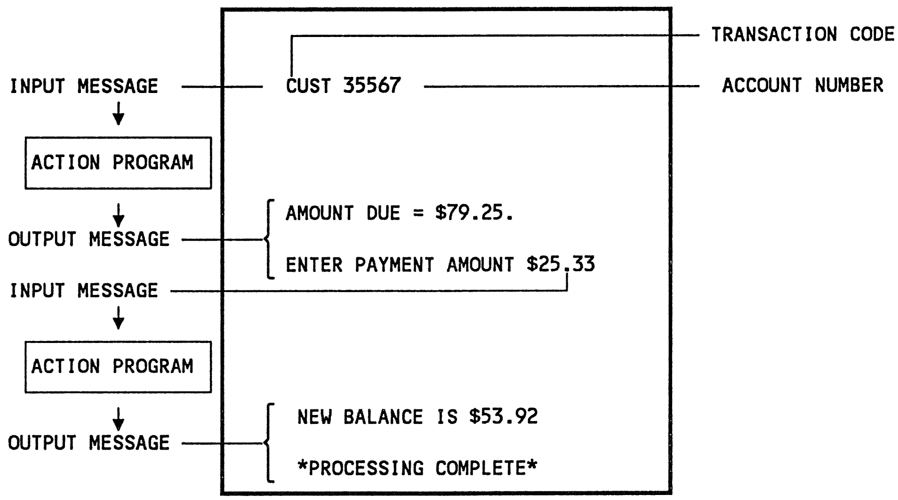
A **simple** transaction (Figure 1-1) consists of a single action.



In this example, one action program processes the input message and produces an output message - the checking account balance for the account specified and a PROCESSING COMPLETE notice.

Figure 1-1. A Simple Transaction

A **dialog** transaction (Figure 1-2) consists of two or more related actions.



In this example, two action programs are sequenced to produce amount due information, allow data entry, and compute a new balance for a specific customer account.

Figure 1-2. A Dialog Transaction

To begin a transaction, the operator enters a 1- to 8-character transaction code. (In single-thread IMS, the transaction code is from 1 to 5 characters long.) This code tells IMS the name of the action program that will process the input message.

Transaction codes are either the entire input message or a part of it. Transaction codes are defined to IMS at configuration time.

1.4. Structuring Transactions

Sometimes a single action program can process the function required. But more often, a series of action programs is needed. In either case, a transaction structure is created.

Transaction structure depends on how you terminate action programs. There are four major types of termination:

- Normal
- External succession
- Delayed internal succession
- Immediate internal succession

From here on, the termination types will be referred to as normal termination, and external, delayed, and immediate succession.

Using the words termination and succession in the same context can be somewhat confusing. In IMS, termination means that an action program is finished processing. Whether you specify normal termination, or external, delayed, or immediate succession, you are telling IMS that the current action program is finished processing and is now terminating.

Succession means that, although the action program is terminating, the transaction is not complete. A successor action program will continue processing the transaction.

Normal termination means that the transaction itself is complete. No more processing occurs.

However, external, delayed, or immediate succession means that another action program follows and processing should continue.

Figures 1-3 through 1-6 illustrate these concepts.

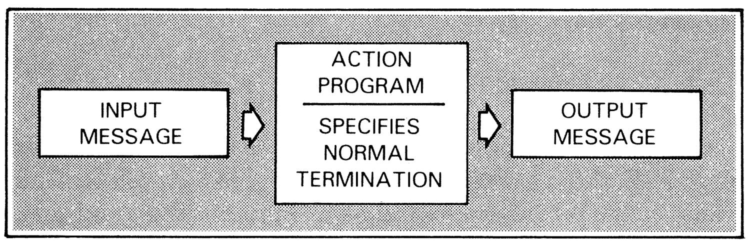


Figure 1-3. Normal Termination

Use normal termination to tell IMS that once your program creates an output message, the transaction is complete. When you don't specify the type of termination, IMS terminates normally. The last action program in a transaction always ends with normal termination.

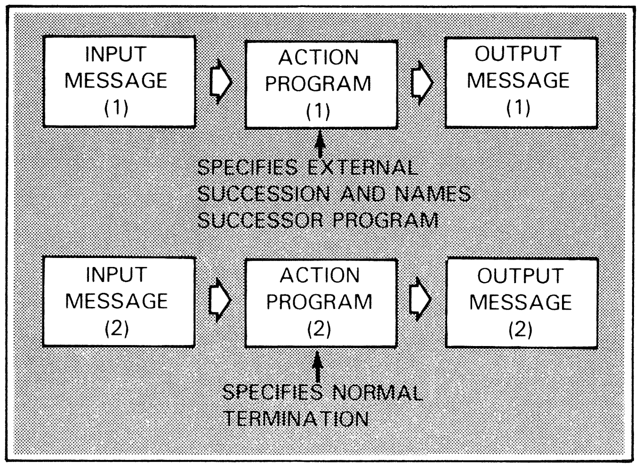


Figure 1-4. External Succession

Use external succession to tell IMS that the current action program is sending an output message and terminating; however, the transaction is not complete. When the terminal operator enters a second input message, the action program you named as external successor processes the second action, produces an output message, and terminates.

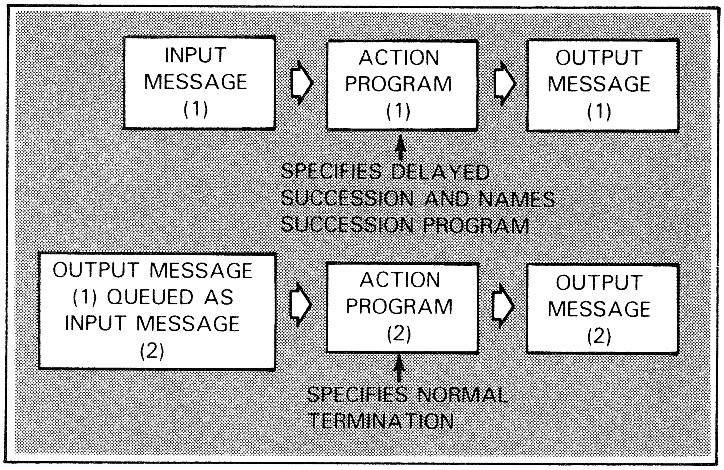


Figure 1-5. Delayed Succession

Use delayed succession to tell IMS that the current action program has processed an input message and produced an output message; however, that message isn't going to the terminal. Instead, it becomes the input message to the action program you named as successor. The successor program produces an output message that does go to the terminal and terminates. With delayed succession, the second action program uses the output message of the predecessor as its input message. Even though only one input message and one output message are seen at the terminal, internally there are two separate actions, each with an input and output message.

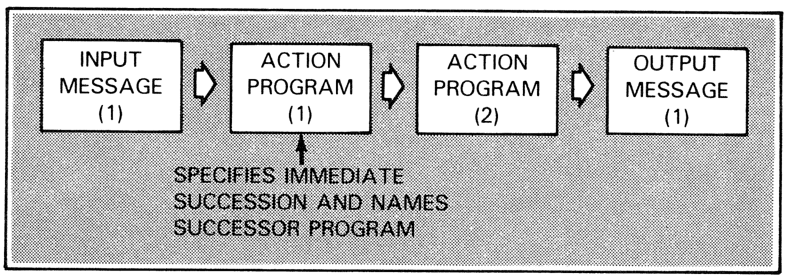


Figure 1-6. Immediate Succession

Use immediate succession to tell IMS that the current action program processed an input message but is not producing an output message. When it terminates, its successor action program immediately takes up where processing left off, produces an output message, and terminates. In immediate succession, there is only one input message and one output message. Thus, two action programs are processing a single action.

With these four types of termination or transaction structures, there is a good deal of flexibility in structuring transactions. There are basically no limitations on how you can combine them. For example, you can specify immediate succession, delayed succession, external succession, and finally normal termination, all in turn (Figure 1-7).

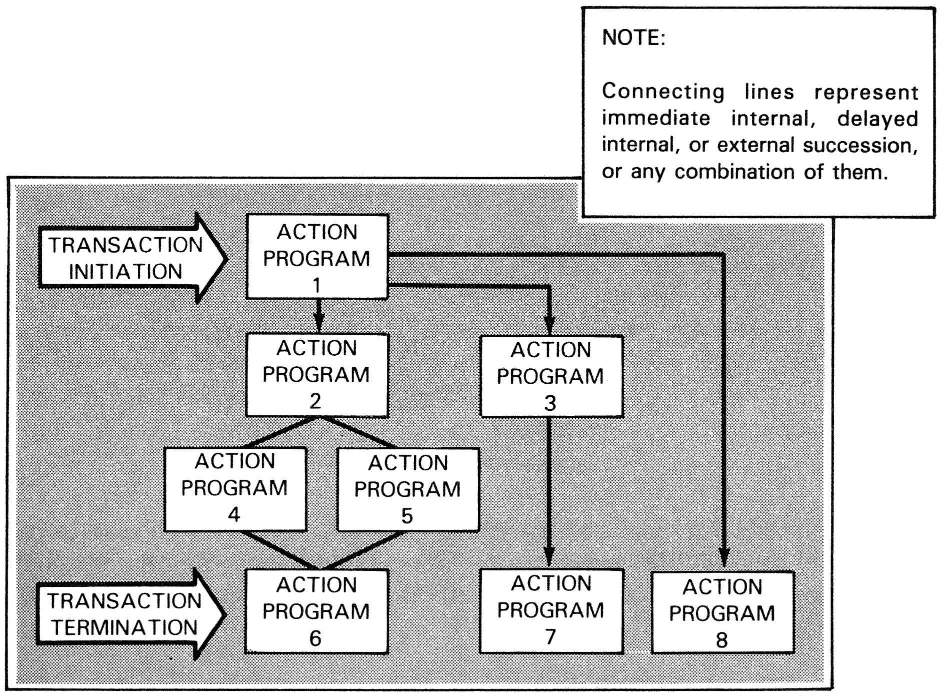
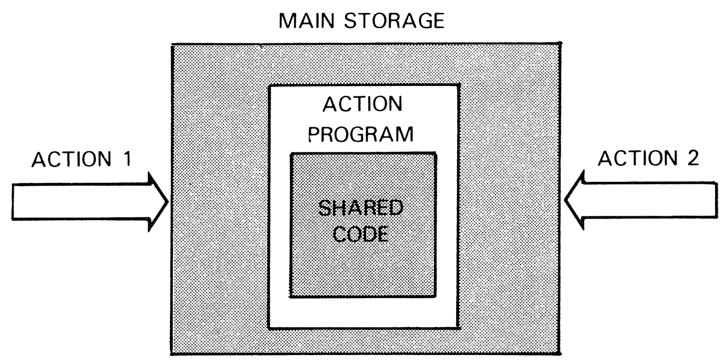


Figure 1-7. Dynamic Transaction Structure

1.5. Writing Efficient Action Programs

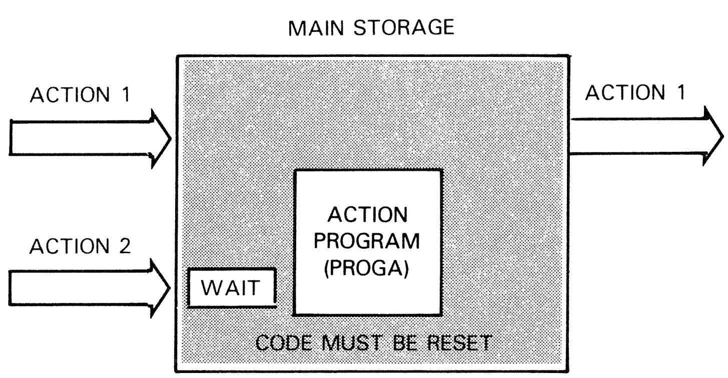
In part, the coding you use in your action program determines the efficiency of your message processing. The most efficient way to code an action program is to make the code reentrant or sharable. Action programs can be shared only in a multithread IMS environment. However, even in a single-thread environment, you should write reentrant or sharable code because you may later wish to use multithread IMS.

A reentrant program is completely sharable, and none of the code is self-modifying. BAL and COBOL action programs can be reentrant. This can mean great performance improvement because it prevents waiting when several actions require the same action program.



Shared code is a means of executing a COBOL program as if it were reentrant. Shared-code COBOL programs are sharable in the procedure division and working-storage section but not in IMS control regions. Don't use shared code in 1974 COBOL programs.

A third type of coding that is used for action programs is serially reusable code. Serially reusable action programs can process only one action at a time. You can modify the action program code, but you must reset or restore it because the same copy of the program sometimes remains in storage to process the next action.



Remember that your action programs should serve the best interests of terminal operators who request information from your file. For this reason, messages you receive or create should be simple and understandable with a minimum of operator-entered codes or other data required at the terminal.

1.6. How IMS Action Programs Interface with IMS

To communicate with IMS, an action program must link itself to IMS. This link is the activation record, which handles the control and communication of data between IMS and your action program. The activation record can contain up to six interface areas:

- Input message area
- Output message area (OMA)
- Program information block (PIB)
- Continuity data area (CDA)
- Work area (WA)
- Defined record area (DRA)

Whether or not you use all six interface areas depends on the needs of your action program. All the interface areas are optional except the input message area and program information block.

Even if you don't access the program information block, IMS automatically returns values there to the status code fields after each I/O request.

Figure 1-8 shows how main storage looks when the action program PROG01 is loaded in a multithread IMS system. The layout of the activation record is slightly different in single-thread IMS.

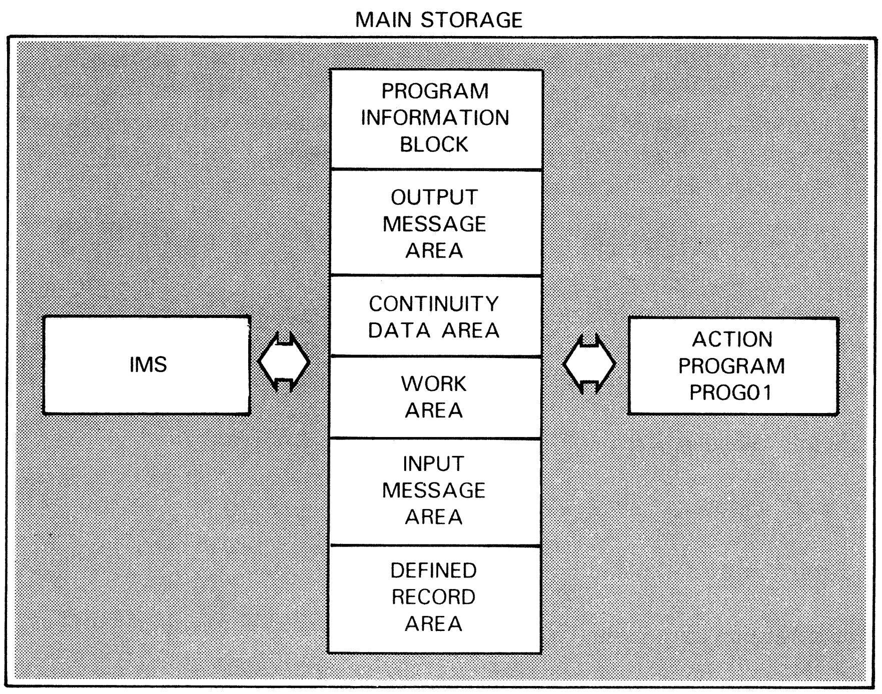


Figure 1-8. Activation Record in Main Storage

Figure 1-9 shows the relationship between an action program and its interface areas.

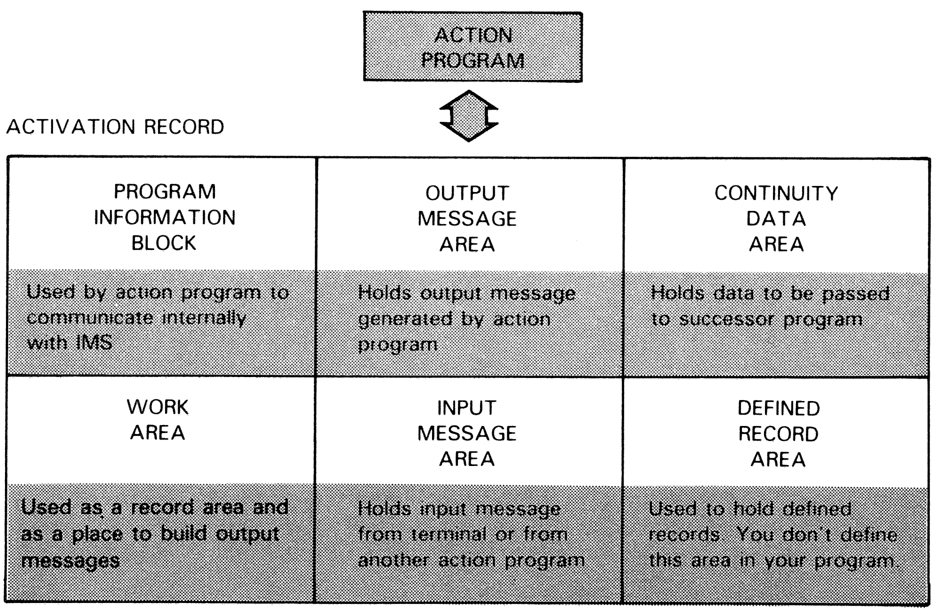


Figure 1-9. The Action Program and Its Interface Areas

Your action program must define the formats of the interface areas that make up the activation record.

For COBOL action programs, you use COPY statements to copy the program information block and the input and output message area headers into the linkage section of your action program. You have to code the descriptions of the continuity data area and work area according to the action program application.

In BAL action programs, you assign registers to receive the addresses of interface areas. The formats for the program information block and the input and output message area headers are in the form of DSECTs in the system macro library, YMAC. You issue macroinstructions to copy these formats into your program.

Action programs also interface with IMS through the COBOL CALL statement or the BAL CALL or ZG#CALL macroinstruction. You use these CALL functions to issue requests to IMS for file access and other operations.

Section 2
General Rules for Coding Action Programs

2.1. COBOL Action Program Structure

Though COBOL action programs are similar to conventional COBOL programs, certain differences characterize them.

2.1.1. Identification Division

The identification division is the same as any COBOL identification division.

2.1.2. Environment Division

The first important difference is in the environment division.

You must omit the input-output section in the environment division. It is not needed because you supply a file description in the file section of the IMS configuration. You also name your files, give file types, and give any additional information concerning file processing as part of IMS configuration.

2.1.3. Data Division

Instead of using an FD statement to name the file you are accessing, omit the file section and place the file name in the working-storage section.

When you use a function CALL statement for a particular file later in your program, IMS associates the file name you specified at configuration time with the file you name in the working-storage section.

In a sharable or reentrant COBOL action program, the working-storage section in an action program may contain constants only. Describe each elementary item in the working-storage section with a VALUE clause.

Figure 2-1 shows an example of correct and incorrect working-storage section coding for an action program.

INCORRECT	CORRECT
DATA DIVISION. WORKING-STORAGE SECTION. 77 ERR-INDICATOR PIC X(19). 01 ERR-MSG-LITS. 02 ERR-1 PIC X(19). 02 ERR-2 PIC X(19). 02 ERR-3 PIC X(19). 0 ERR-4 PIC X(19). NO VALUE CLAUSES	DATA DIVISION. WORKING-STORAGE SECTION. 77 DMOALT PIC X(6) VALUE 'DMOALT'. 01 ERR-MSG-LITS. 02 ERR-1 PIC X(19) VALUE '**INVALID KEY**'. 02 ERR-2 PIC X(19) VALUE '**END OF FILE**'. 02 ERR-3 PIC X(19) VALUE '**INVALID REQUEST**'. 02 ERR-4 PIC X(19) VALUE '**I/O ERROR'.

Figure 2-1. Describing Working-Storage Items in a Sharable COBOL Action Program

Every COBOL action program requires a linkage section. This section is optional in a conventional COBOL program.

Your action program's linkage section defines the areas your program uses to interface with IMS. The names of these areas must correspond with the interface areas in the activation record and also with the names in the USING clause parameter list in the procedure division (Figure 2-2).

```
DATA DIVISION.
.
.
.
LINKAGE SECTION.
01  P-I-B.  COPY PIB74.
01  I-M-A.  COPY IMA74.
01  W-A.
01  O-M-A.  COPY OMA74.
01  C-D-A.
PROCEDURE DIVISION USING P-I-B I-M-A W-A
    O-M-A C-D-A.
```

Figure 2-2. Describing Interface Areas in a COBOL Action Program

2.1.4. Procedure Division

An action program always contains a USING clause in the procedure division statement. This is for naming the interface areas your program uses in processing messages.

Because parameters in the USING list are positional, you must code them in the prescribed order shown in Figure 2-2.

If, for example, your COBOL action program does not need the work area and continuity data area, you must still code a dummy parameter to indicate their omission from the USING list as follows:

```
PROCEDURE DIVISION USING PROGRAM-INFORMATION-BLOCK
  INPUT-MESSAGE-AREA D OUTPUT-MESSAGE-AREA.
```

In this case, you are choosing the letter D as a dummy parameter name. Because continuity data area is the last parameter of the list, you can omit the dummy parameter.

Action programs do not use standard I/O COBOL verbs in the procedure division. Instead, they issue CALL function statements to IMS. (See Section 5.)

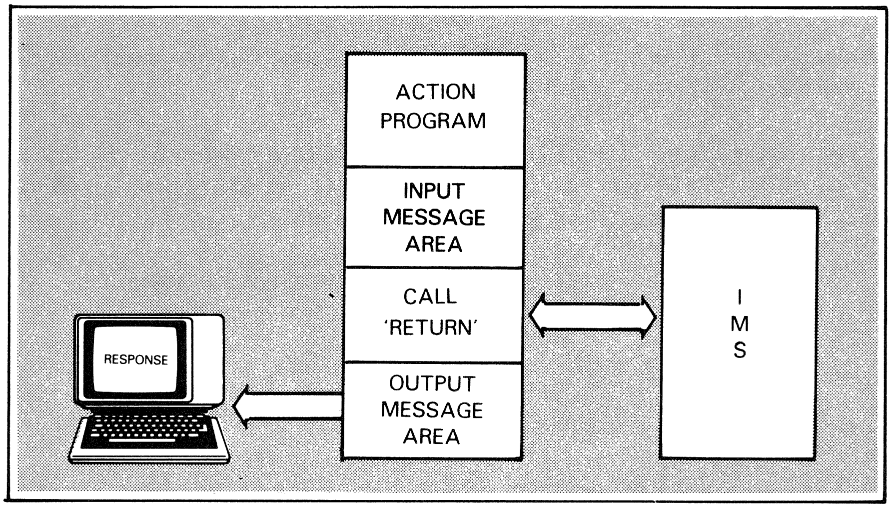
Figure 2-3 shows the correct and incorrect way to access data files from a COBOL action program.

INCORRECT	CORRECT

PROCEDURE DIVISION USING
PROGRAM-INFORMATION-BLOCK
INPUT-MESSAGE-AREA D
OUTPUT-MESSAGE-AREA
BEGIN-ROUT.
      OPEN MYFIL.
      READ MYFIL.
 	
MUST BE CALL FUNCTION,
NOT COBOL VERB
	PROCEDURE DIVISION USING
	PROGRAM-INFORMATION-BLOCK
	INPUT-MESSAGE-AREA D
	OUTPUT-MESSAGE-AREA.
	BEGIN-ROUT.
	      CALL 'GET' USING MYFIL MYREC
	                  MYKEY.

Figure 2-3. Accessing a Data File

When you want to end an action program, use the CALL 'RETURN' function. It returns control to IMS, and if you've built an output message in the output message area, the CALL 'RETURN' sends the output message to the destination terminal.



2.2. COBOL Program Structure Comparison

COBOL action programs are distinguished from conventional COBOL programs by the:

- Absence of an input-output section
- Absence of a file section
- Linkage section containing a 77- or 01-level data description corresponding to each parameter on the procedure division USING clause
- CALL functions to access and manipulate files
- CALL 'RETURN' function that ends the action program

Figure 2-4 shows the similarities and differences between conventional COBOL programs and COBOL action programs.

CONVENTIONAL PROGRAM STRUCTURE	ACTION PROGRAM STRUCTURE
IDENTIFICATION DIVISION. PROGRAM-ID. program-name. (Any optional entry) ENVIRONMENT DIVISION. CONFIGURATION SECTION. SOURCE-COMPUTER. UNISYS OS3. OBJECT-COMPUTER. UNISYS OS3. SPECIAL-NAMES. (Any OS/3 implementor-names) INPUT-OUTPUT SECTION. FILE-CONTROL SELECT filename ASSIGN TO DISK-lfdname-V ORGANIZATION file-type.	IDENTIFICATION DIVISION. PROGRAM-ID. program-name. (Any optional entry) ENVIRONMENT DIVISION. CONFIGURATION SECTION. SOURCE-COMPUTER. UNISYS OS/3. OBJECT-COMPUTER. UNISYS OS/3. SPECIAL-NAMES. (No special names) (No input-output section)
DATA DIVISION. FILE SECTION. FD filename LABEL RECORD STANDARD. 01 data-name-2 02 data-name-2 02 data-name-3	DATA DIVISION. (No file section)
[WORKING-STORAGE SECTION. 77 data-name. 01 record-name.]	[WORKING-STORAGE SECTION. 77 data-name. . . .]
[LINKAGE SECTION.]	LINKAGE SECTION. 01 PROGRAM-INFORMATION-BLOCK . . .
(No control area description)	01 INPUT-MESSAGE-AREA . . . [01 WORK-AREA] . . . [01 OUTPUT-MESSAGE-AREA] . . .

Figure 2-4. Conventional COBOL Structure versus COBOL Action Program Structure
(Part 1 of 2)

CONVENTIONAL PROGRAM STRUCTURE	ACTION PROGRAM STRUCTURE
PROCEDURE DIVISION.	[01 CONTINUITY-DATA-AREA] PROCEDURE DIVISION USING program-information-block input-message-area [work-area][output-message-area] [continuity-data-area]. Para-1. . . . Para-2. . . . CALL'RETURN'.

Figure 2-4. Conventional COBOL Structure versus COBOL Action Program Structure
(Part 2 of 2)

2.3. COBOL Language Restrictions

In addition to omitting input-output and file sections, there are several restrictions to observe when you write a COBOL action program.

Some programmers like to use a function key to identify the action program load module. If you do this, don't use a function key (F#nn) as the program-id name because the COBOL compiler treats the # symbol as invalid. Instead, supply a valid program-id name in the identification division and then include a LOADM statement with F#nn as the load module name at link-edit time.

For example, you can identify your action program as follows:

```
IDENTIFICATION DIVISION.
PROGRAM-ID. CREDIT.
```

CREDIT is your program name. You then associate your program-id with a function key at link-edit time in the following job control stream:

```
// EXEC LNKEDT
/$
   LOADM F#01
   INCLUDE CREDIT
/*
```

Some COBOL verbs, clauses, and sections are illegal in action programs. If you compile them with the shared code parameter, PARAM IMSCOD=YES, or with the reentrant parameter, PARAM IMSCOD=REN, the compiler locates and deletes them from your program. (See Section 11.)

The following reserved words are illegal in COBOL action programs. For language restrictions on extended COBOL programs, refer to G.7.

ACCEPT MESSAGE COUNT	SEGMENT-LIMIT
ALTER	SEND
CALL identifier	SORT
CANCEL	START
CLOSE	STOP
COMMUNICATION SECTION	SYSCHAN-n
DECLARATIVES	SYSCONSOLE
DELETE	SYSFORMAT
DISABLE	SYSIN
ENABLE	SYSIPT
EXHIBIT	SYSLOG
FILE SECTION	SYSLST
INPUT-OUTPUT SECTION	SYSOPT
MERGE	SYSOUT
OPEN	SYSSCOPE
READ	SYSTERMINAL
RECEIVE	SYSWORK
RELEASE	TRACE
RETURN	WRITE
REWRITE	

Other COBOL verbs must not have working-storage items as receiving operands. These verbs are:

ACCEPT	PERFORM (varying)
ADD	SEARCH (varying)
COMPUTE	SET
DIVIDE	STRING
INSPECT	SUBTRACT
MOVE	TRANSFORM
MULTIPLY	UNSTRING

When you compile your action program with the shared code parameter, the compiler flags the erroneous statement and issues a precautionary diagnostic.

When you compile your COBOL action program with the IMSCOD=REN parameter, the compiler deletes the erroneous statement and issues a serious diagnostic.

Do not use these subroutine names in reentrant COBOL action programs:

- TIPDXC
- TIPJUMP
- TIPRTN
- TIPXCTL

The compiler generates special object code for these names, which deallocates the object program reentrancy control area for the calling program, and the action program may be abnormally terminated.

For extended COBOL language restrictions on action programs, refer to G.7.

2.4. BAL Action Program Structure

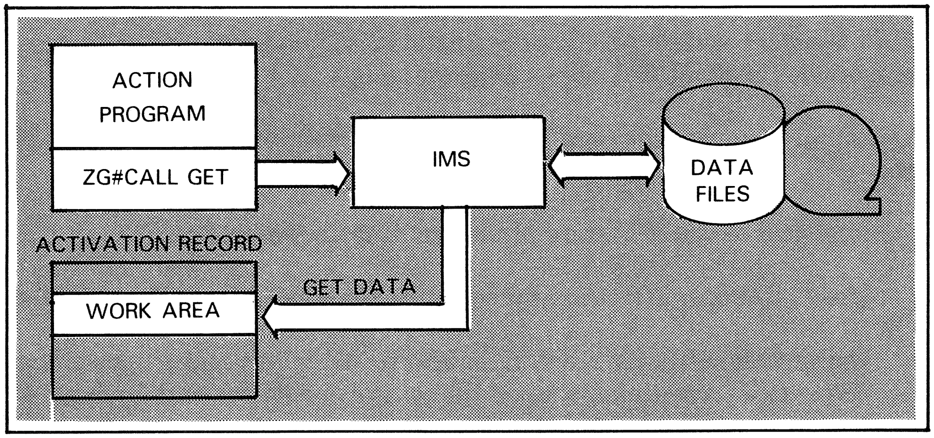
Similar to COBOL action programs, BAL action programs must provide a receiving area for the IMS activation record interface areas. You handle this by assigning registers to receive the addresses of the interface areas.

There are macroinstruction calls for the program information block and input and output message header formats. When you issue one of these macroinstructions, it calls a corresponding DSECT that generates the interface area format into your action program.

```
USING ZA#DPIB,R9
ZM#DPIB
.
.
.
USING ZA#IMH,R12
ZM#DIMH
.
.
.
USING WA,R6
.
.
.
USING ZA#DOMH
.
.
USING CDA,R4
```

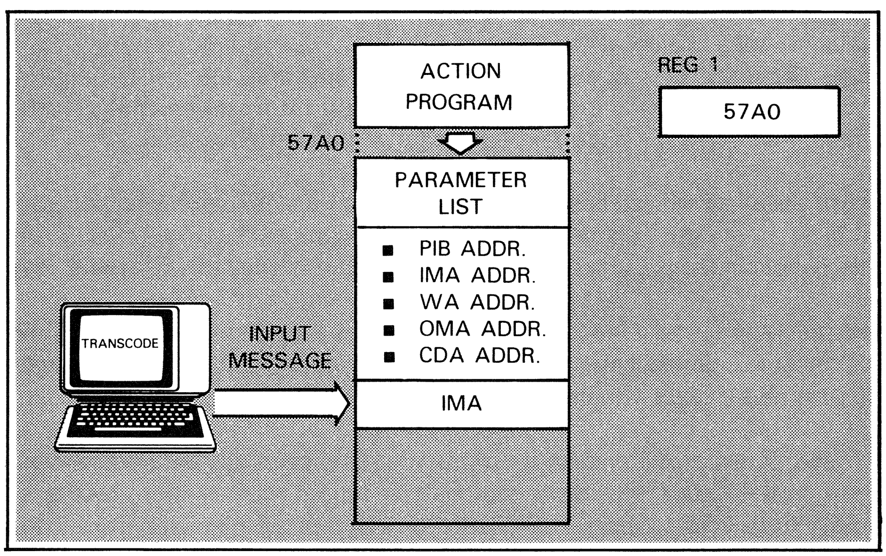
Figure 2-5. Describing Interface Areas in a BAL Action Program

A BAL action program, like COBOL, uses function calls to access files. There are two forms of function calls, the CALL or the ZG#CALL macroinstruction.



When you enter a message at the terminal and IMS transfers control to your BAL action program entry point, register 1 always points to a parameter list containing, in order:

1. Program information block address
2. Input message area address
3. Work area address
4. Output message area address
5. Continuity data area address



The work area, output message area, and continuity data area are optional. If you don't need them in your program, IMS assigns a binary 0 to their place in the parameter list.

Other registers contain save area and action program entry point addresses. (See 6.5 for more detail about BAL action programming.)

Several ways you can distinguish a BAL action program from other BAL programs are:

- Registers assigned to the addresses of interface area DSECTs
- Use of CALL or ZG#CALL macroinstructions to access and manipulate files
- Use of ZM#DPIB, ZM#DOMH, or ZM#DIMH macroinstructions to transfer the program information block and the control header formats from the IMS activation record to the BAL program
- Use of ZG#CALL RETURN function to end the action program

2.5. The Activation Record

Each time IMS initiates an action, it constructs an activation record in main storage.

Each activation record has a program information block and an input message area. It may also have an output message area, work area, continuity data area, and a defined record area.

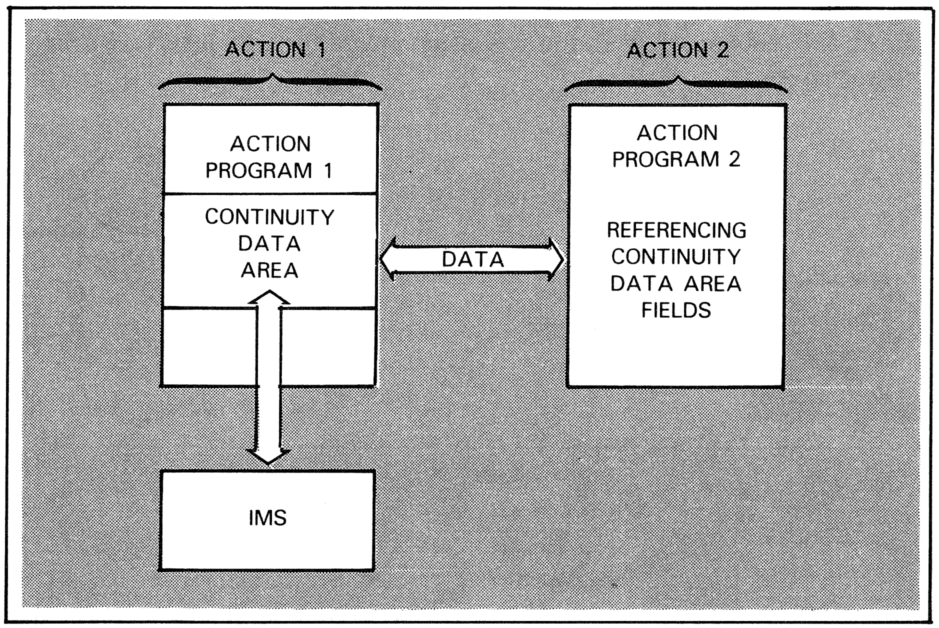
The program information block contains information that IMS uses to communicate with your action program. By testing fields in the program information block for the status of IMS functions, your program can control the processing of files and the succession of action programs.

IMS uses the input message area to exchange input message processing information with your program. Fields in the IMA hold control information that identifies input terminals, and gives message text length as well as message text.

The work area is an interface area that you often use when your action programs are sharable or reentrant. It is modifiable working storage that your action program uses to build output messages (see 6.1) or as a record area for file input and output.

Output message area fields notify IMS of output message control information, such as output terminal identification, special output options, and output message text length. It also provides a place where IMS can interface with output message text.

When used, the continuity data area provides the interface area where your action program passes data from action to action in a dialog transaction. IMS uses the continuity data area to interface with your action program's transfer of data from one action to another.



IMS uses the defined record area to reference defined records. Your action program can't access a defined record area (DRA) or write into the DRA. You do not define this area in your program.

When you enter a message at a terminal, IMS:

- Dynamically allocates the activation record interface areas that your program needs to converse with IMS

- Schedules and loads the action program needed to process the action

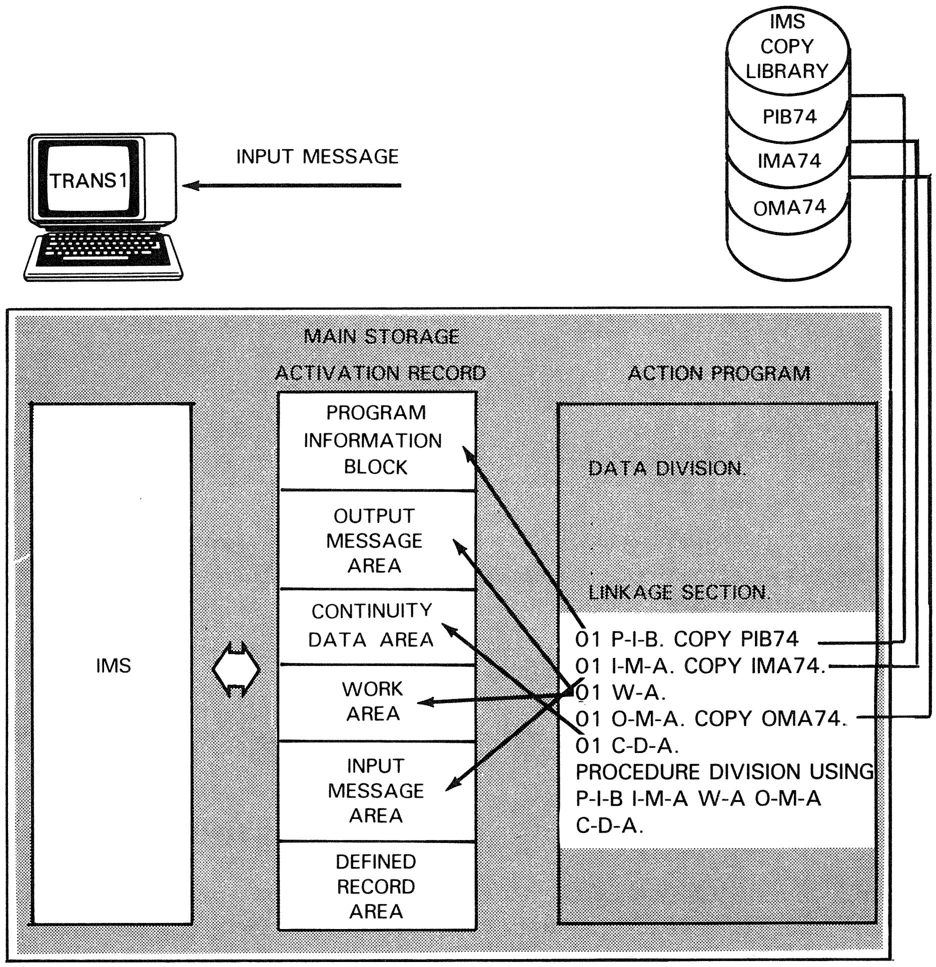
When IMS schedules a COBOL action program, that program must contain a linkage section where it can exchange data with IMS. Part of the linkage section must be formatted in a certain way. The IMS copy library provides this formatted source code.

You use a COPY statement to transfer the formats of the program information block area, input message area header, and output message area header from the IMS copy library areas to the linkage section of your COBOL action program.

When you compile your COBOL action program using the extended COBOL compiler, the IMS copy library makes the program information block format and the output message area and input message area control headers available under the names PIB, OMA, and IMA, respectively.

When you use the 1974 American National Standard COBOL compiler, your COPY statement must use the names PIB74, OMA74, and IMA74 to transfer the interface area formats needed by your program.

Figure 2-6 shows how a COBOL action program converses with IMS via the activation record. IMS sets up space in the activation record for each interface area your action program uses.

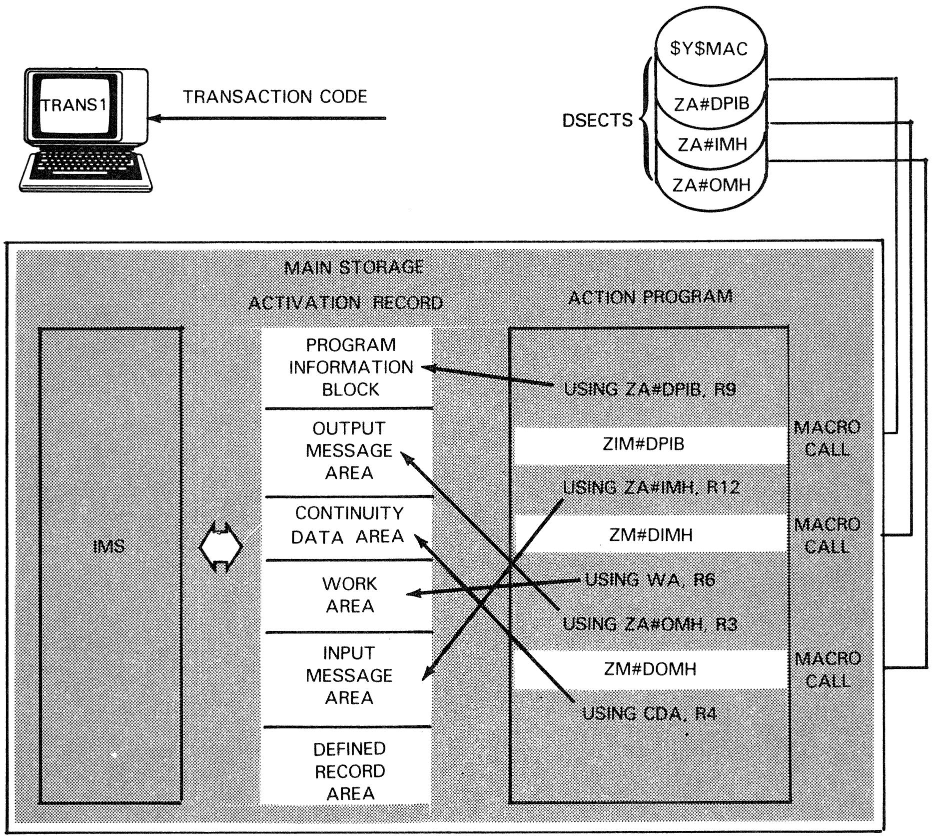


The COPY verb moves interface area formats from the IMS copy library to your action program's linkage section and your program converses with the IMS interface areas in the activation record. Note that your action program cannot access or write into the defined record area.

Figure 2-6. IMS/COBOL Action Program Interface

A BAL action program accesses the activation record interface areas via macroinstructions that call DSECTs from the YMAC system macro library or a user macro library. The ZM#DPIB macroinstruction calls the ZA#DPIB DSECT, the ZM#DOMH macroinstruction calls the ZA#OMH DSECT, and the ZM#DIMH macroinstruction calls the ZA#IMH DSECT. (See Appendix H.)

Figure 2-7 shows IMS communicating with a BAL action program via the activation record. Again, IMS sets up an interface area in the activation record for each interface area used by your BAL action program.



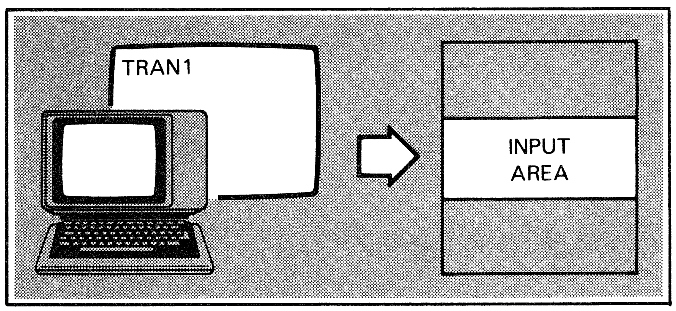
The ZM#DPIB, ZM#DOMH, and ZM#DIMH macroinstructions call the format headers from the YMAC system macro library. If you use a work area or continuity data area, you must define and cover them in your action program. Note that your action program cannot access or write into the defined record area.

Figure 2-7. IMS/BAL Action Program Interface

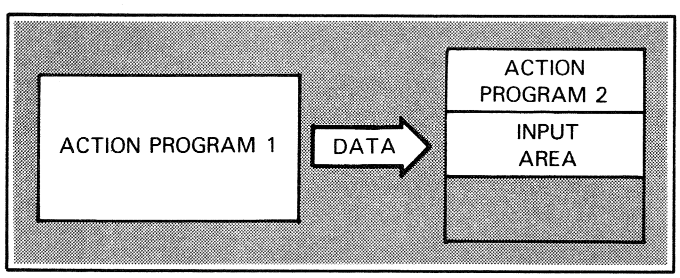
Section 4
Receiving Input Messages

4.1. Need for Input Message Area

When a terminal operator enters a transaction code, your action program must define an input area to receive it. The same is true when the terminal operator enters an input message in response to an output message.



When you use internal succession and pass data as input to the next action program, you must define an input area in the successor program to receive the data.

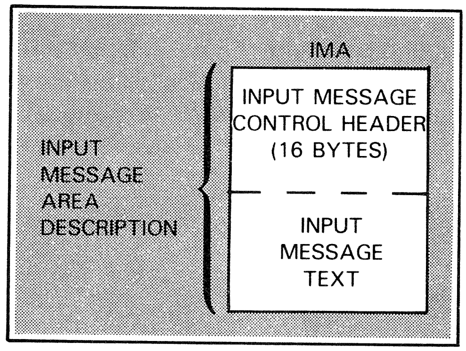


An input message area is always required in your action program because each action program must receive an input message, either via the terminal or action program succession, to produce an output response. Without an input message, no message processing is possible.

4.2. Input Message Area Contents

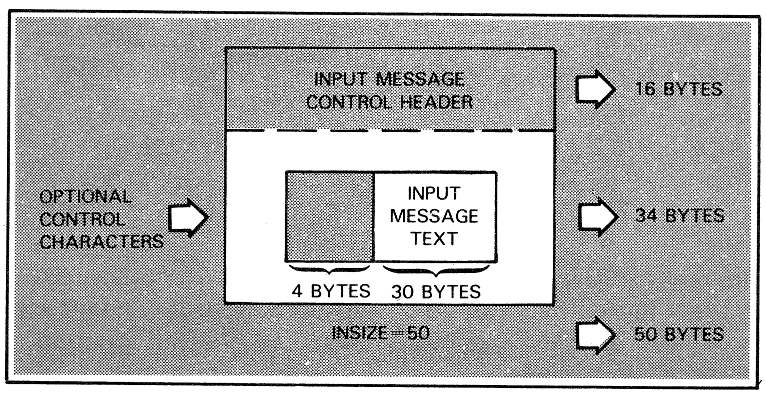
The first part of any input message area description is the 16-byte control header. Your program obtains the appropriate COBOL or BAL input message control header format from the copy library or macro library.

The second part of the input message area description is the text of the message itself. The input message text consists of the input fields your program expects to receive either from the terminal operator or by succession from a previous action program.



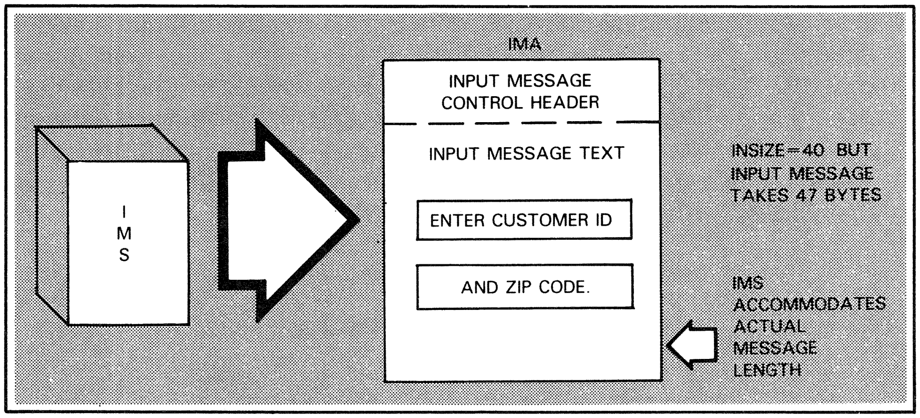
4.3. Size of Input Message Area

You tell IMS the size of your input message area at configuration time when you specify the INSIZE parameter in the ACTION section. The value given for the INSIZE parameter is the number of bytes in the input message header plus the message text length, including any control characters you expect to receive in your program. You receive control characters in your action program only when you specify EDIT=NONE in the configurator ACTION section.



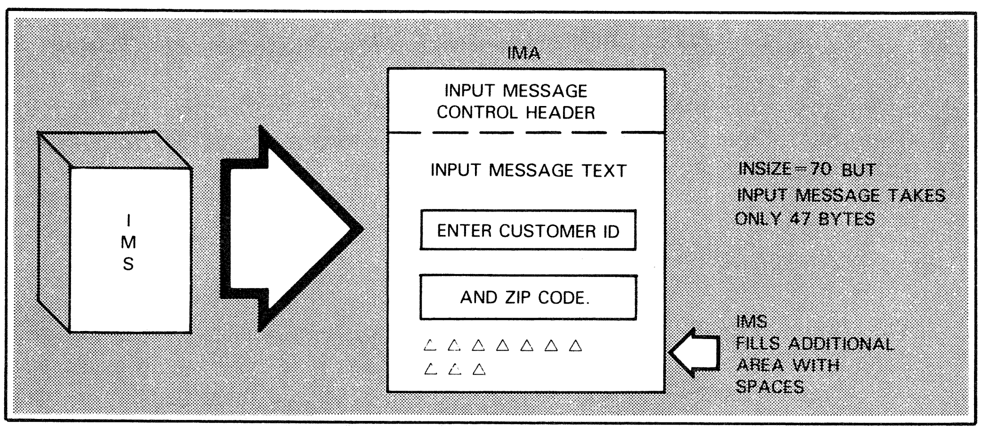
Instead of specifying an input message area length on the INSIZE parameter, you can specify a standard message size (INSIZE=STAN); IMS allocates an area based on your CHRS/LIN and LNS/MSG parameter values in the GENERAL section.

When you omit the INSIZE parameter or specify an inadequate amount of space for the input message area, IMS automatically allocates an area large enough to contain the actual input message.



Automatic space allocation doesn't occur if you use an edit table (EDIT=tablename), so you must specify the number of bytes for the input message area on the INSIZE parameter.

On the other hand, if you specify more space than is needed, IMS fills the balance of the area with blanks.



Note that you're wasting storage when you overestimate input message area size. If you're not using the edit table generator and you aren't sure of the input message area size, omit the INSIZE parameter and let IMS determine the input message area length.

4.4. COBOL Action Program Input Message Area

4.4.1. Input Message Header Format

IMS supplies input message control header formats for extended COBOL and 1974 American National Standard COBOL. There is only a slight difference in their content. The COBOL input message header format is available in the IMS copy library under the name IMA for extended COBOL, or under the name IMA74 for 1974 American National Standard COBOL. Figure 4-1 shows the format of the 1974 COBOL input message area control header. Note the different data names of TODAY and HR-MIN-SEC fields for extended COBOL.

```
01  INPUT-MESSAGE-AREA.
    02  SOURCE-TERMINAL-ID              PIC X(4).
    02  DATE-TIME-STAMP.
        03  YEAR                        PIC 9(4)   COMP-4.
        03  TODAY                       PIC 9(4)   COMP-4.   ①
        03  HR-MIN-SEC                  PIC 9(9)   COMP-4.   ②
    02  TEXT-LENGTH                     PIC 9(4)   COMP-4.
    02  AUXILIARY-DEVICE-ID.
        03  FILLER                      PIC X.
        03  AUX-DEVICE-NO               PIC X.
```

Notes:

① The name of this field in extended COBOL is DAY.

② The name of this field in extended COBOL is TIME.

Figure 4-1. 1974 COBOL Format for Input Message Area Control Header

When you code your COBOL action program's linkage section, copy the input message area control header format into your action program from the copy library by using a COPY verb.

4.4.2. Input Message Text Description

The input message text description immediately follows the input message control header format. You describe the input message text expected by your program from the terminal or previous action program. In COBOL, describe the input message text as data items subordinate to the 01-level input message area description. The shaded area in Figure 4-2 shows the input message area control header formats generated by the COPY verb. Fields immediately following the shaded area represent the input text expected by the program.

Note: *An action program's input message must not begin with the characters ZZ in the first two positions. These characters are reserved to indicate master terminal commands.*

Refer to the CSCAN action program example, PAYMT-3, in Appendix B for an example of this input text. When you copy the input message control header format from the copy library, all its fields are accessible to the CSCAN action program and can be referenced in the procedure division.

```
LINKAGE SECTION.
01  P-I-B                     COPY PIB74.
01  I-M-A.                    COPY IMA74.
    02  SOURCE-TERMINAL-ID     PIC X(4).
    02  DATE-TIME-STAMP.
        03  YEAR               PIC 9(4)    COMP-4.         IMA
        03  TODAY              PIC 9(4)    COMP-4.         CONTROL
        03  HR-MIN-SEC         PIC 9(9)    COMP-4.         HEADER
    02  TEXT-LENGTH            PIC 9(4)      COMP-4.       DESCRIPTION
    02  AUXILIARY-DEVICE-ID.
        03  FILLER             PIC X.
        03  AUX-DEVICE-NO      PIC X.
    02 FILLER                  PIC X(6).
    02 CUSTID                  PIC X(6).
    02 FILLER                  PIC X.                      INPUT
    02 MSG-PAY.                                            MESSAGE
       03  MSG-CHAR            PIC X  OCCURS 7 INDEXED by 1.   TEXT
    02 FILLER                  PIC X.                      DESCRIPTION
```

Figure 4-2. Sample COBOL Input Message Area Description

4.5. BAL Action Program Input Message Area

4.5.1. Input Message Header Format

IMS supplies an input message area control header format for BAL action programs. It is in the form of a DSECT called by a macroinstruction in your action program. Figure 4-3 shows the format of the BAL input message area control header.

```
155            ZA#DIMH
156+ZA#IMH     DSECT
157+*
158+*  INPUT MESSAGE HEADER
159+*
160+ZA#ISTID   DS  CL4 SOURCE TERMINAL ID
161+ZA#IDTS    DS  XL8 DATE/TIME STAMP
162+ZA#ITRID   EQU ZA#IDTS,L'ZA#IDTS UNIQUE TRANSACTION ID
163+ZA#IMHL    EQU *-ZA#IMH INPUT MESSAGE AREA HEADER LENGTH
164+ZA#ITL     DS  H TEXT LENGTH
165+          DS  CL1 RESERVED FOR SYSTEM USE
166+ZA#IDEV    DS  CL1 AUX DEVICE ID
167+*
168+*          EQUATES FOR ZA#IDEV
169+*
170+ZA#IDID1   EQU  C'1' DEVICE = AUX 1
171+ZA#IDID2   EQU  C'2' DEVICE = AUX 2
172+ZA#IDID3   EQU  C'3' DEVICE = AUX 3
173+ZA#IDID4   EQU  C'4' DEVICE = AUX 4
174+ZA#IDID5   EQU  C'5' DEVICE = AUX 5
175+ZA#IDID6   EQU  C'6' DEVICE = AUX 6
176+ZA#IDID7   EQU  C'7' DEVICE = AUX 7
177+ZA#IDID8   EQU  C'8' DEVICE = AUX 8
178+ZA#IDID9   EQU  C'9' DEVICE = AUX 9
179+IMSDSECT   CSECT
180 IMSDSECT   CSECT
```

Figure 4-3. BAL Format for Input Message Area Control Header (ZA#IMH DSECT)

You issue the ZM#DIMH macroinstruction in your BAL action program to generate inline the input message control header (ZA#IMH DSECT). If you don't want to see the ZM#DIMH macro expansion inline, use the PRINT NOGEN instruction before you issue the ZM#DIMH macroinstruction. Even though the input message control header fields are not seen in your program coding, they are still available and you can reference them in your program.

Immediately following the ZM#DIMH macroinstruction, you describe the input message text fields. Using define-storage (DS) statements, you describe each field of your input message text. Figure 4-4 illustrates the macroinstruction to generate the input message control header format followed by the description of input message text expected from the terminal (transaction code and state name key). Refer to Appendix B for this example in the full context of the IMS state capital action program. Note that PRINT NOGEN is specified and the ZM#DIMH macroinstruction is not expanded inline. Nevertheless, this action program can still access any fields in the control header for values placed there by IMS.

```
1        10    16
--------------------------------------------
         PRINT NOGEN  <-------------------------  Suppresses inline
 .                                                macro expansion.
 .
 .
*ACTIVATION RECORD DEFINITION
         ZM#DIMH  <-----------------------------  Makes IMA control header
                                                  fields available.
TCODE    DS    X                TRANSACTION CODE ]
         DS    X                SPACE            } Input Message Text
SNKEY    DS    XL4              STATE NAME KEY   ]
```

Figure 4-4. Sample BAL Input Message Area Description

4.6. Contents of Input Message Area Control Header

The header format identifies the terminal that sent the input message, the date and time when the message was sent, the length of the input text, and whether or not an auxiliary device transmitted input to the action program. Figure 4-5 shows some of the questions about input messages that the input message control header answers when IMS sets values in the control header fields. Subsections 4.7 through 4.10 describe input message header fields.

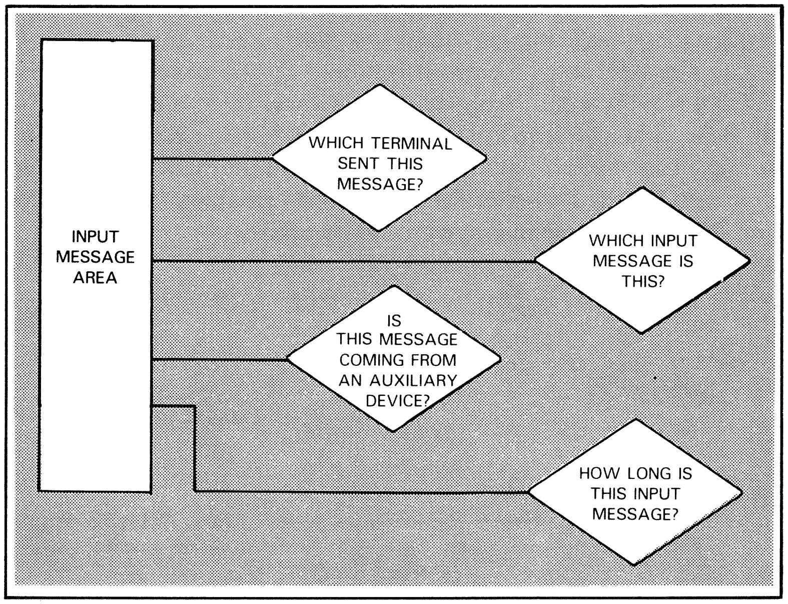


Figure 4-5. Answers to Input Message Processing Questions

4.7. Identifying the Source Terminal (SOURCE-TERMINAL-ID)

The SOURCE-TERMINAL-ID (ZA#ISTID) field specifies a 1- to 4-byte name of the terminal that originated the input message. Your action program may need to check this field to determine which terminal sent a particular input message. This terminal name is the same name specified for the terminal in the ICAM network definition and in a TERMINAL section of the configuration (Figure 4-6).

```
                    ICAM NETWORK DEFINITION

IMS1      CCA   TYPE=(GBL,,S),GAWAKE=YES,SAVE=YES,                         X
                FEATURES=(OPCOM,OUTDELV)
          BUFFERS 10,512,2,ARP=20
WOLO      LOCAP TYPE=(TCI),LOW=MAIN,MEDIUM=MAIN,HIGH=MAIN
LNE1      LINE  DEVICE=(LWS)
WS1       TERM  ADDR=(312),FEATURES=(LWS),LOW=MAIN,INPUT=(YES),            X
                MEDIUM=MAIN,HIGH=MAIN,TCTUPD=YES
LNE2      LINE  DEVICE=(LWS)
WS2       TERM  ADDR=(313),FEATURES=(LWS),LOW=MAIN,INPUT=(YES),            X
                MEDIUM=MAIN,HIGH=MAIN,TCTUPD=YES
LNE3      LINE  DEVICE=(LWS)
WS3       TERM  ADDR=(314),FEATURES=(LWS),LOW=MAIN,INPUT=(YES),            X
                MEDIUM=MAIN,HIGH=MAIN,TCTUPD=YES
LNE4      LINE  DEVICE=(LWS)
WS4       TERM  ADDR=(315),FEATURES=(LWS),LOW=MAIN,INPUT=(YES),            X
                MEDIUM=MAIN,HIGH=MAIN,TCTUPD=YES
PRC1      PRCS  LOW=MAIN
          ENDCCA
                         IMS CONFIGURATION

NETWORK
   .
   .
   .
TERMINAL WS1    UNSOL=ACTION
TERMINAL WS2    UNSOL=ACTION
TERMINAL WS3    UNSOL=ACTION
TERMINAL WS4    UNSOL=ACTION
TRANSACT MENU   ACTION=JAMENU
TRANSACT SIGN   ACTION=JASIGN
ACTION    JAMENU CDASIZE=1024  EDIT=NONE   MAXSIZE=12000
                 OUTSIZE=4096  WORKSIZE=1024
                 FILES=SYSCTL,CUSTMST,XREF1,XREF2
ACTION    JASIGN CDASIZE=1024  EDIT=NONE   MAXSIZE=12000
```

Figure 4-6. Identifying the Source Terminal to ICAM and the Configurator

Suppose your action program processes input messages differently, depending on which terminal sent the message. Before it can decide how to process the message, your program needs to check the name of the source terminal that sent the input message.

Let's say that if your program receives a message from source terminals T100 through T300, it performs routine A. On the other hand, if your program receives a message from source terminals T400 through T600, it performs routine B. Your program simply interrogates the SOURCE-TERMINAL-ID field of the input message header as shown in Figure 4-7 and processes the input message according to the values placed in the SOURCE-TERMINAL-ID field.

```
100-TERM-TEST.
    IF SOURCE-TERMINAL-ID GREATER THAN OR EQUAL TO 'T100'
              AND LESS THAN OR EQUAL TO 'T300'
          PERFORM ROUT-A
    ELSE IF SOURCE-TERMINAL-ID GREATER THAN OR EQUAL TO 'T400' AND
              LESS THAN OR EQUAL TO 'T600'
          PERFORM ROUT-B.
    GO TO ERR-ROUT.
ROUT-A.
    .
    .
    .
ROUT-B.
    .
    .
    .
ERR-ROUT.
```

Figure 4-7. Interrogating the SOURCE-TERMINAL-ID Field

4.8. Identifying the Action (DATE-TIME-STAMP)

When IMS receives an input message, it places the date and time as a binary value in the DATE-TIME-STAMP field (ZA#IDTS) of your input message header. The first half-word of the field contains the year; the second half-word of the field contains the Julian day. The second word contains a sequence number unique to this input message. The date/time stamp is used for recovery purposes and not for determining the time of day.

IMS uses this field to distinguish actions. Each time IMS receives an input message, it identifies the action via this date/time stamp. If you need the accurate date or time in your action program, you should interrogate the TRANSACTION-DATE and TIME-OF-DAY under SUCCESS-UNIT-ID in the program information block.

4.9. Obtaining Input Message Text Length (TEXT-LENGTH)

Once the terminal operator enters an input message, or a previous action program passes input data to a successor action program, IMS places a binary half-word value indicating the input message length plus 4 bytes for the TEXT-LENGTH (ZA#ITL) field itself into the TEXT-LENGTH field.

Your action program may want to print out all input messages for a day's transactions. Suppose the input messages received by your action program can vary in length and you plan to write them as variable-length unblocked records to a sequential file.

The value IMS places in the TEXT-LENGTH field contains the length of the input message text your action program receives plus 4 bytes for the TEXT-LENGTH field. Each time your program receives an input message, it must first subtract 4 bytes from the value in TEXT-LENGTH. Your program then compares the resulting value with the different input message lengths that the program expects. When the program determines which size message was received, it moves TEXT-LENGTH minus 4 bytes to the record length field of your record area description in the work area. Finally, it moves the appropriate input message to the work area and writes it to the sequential file. Figure 4-8 shows the coding to test the TEXT-LENGTH field in the input message area. Note that you must subtract a binary 4 from the COMP-4 TEXT-LENGTH field, and the RECORD-LENGTH field in the work area must also be a binary value.

When you access the TEXT-LENGTH field in the input message area, your COBOL program must qualify the TEXT-LENGTH field by identifying it as a part of the input message area header; that is, TEXT-LENGTH IN INPUT-MESSAGE-AREA.

```
WORKING-STORAGE SECTION.
77   FOUR                    PIC 9    COMP-4     VALUE 4.
77   FORTY                   PIC 99   COMP-4     VALUE 40.
LINKAGE SECTION.
01   INPUT-MESSAGE-AREA.        COPY IMA74.
     05  MSG-IN-1.
         10  TRANS-CODE-1        PIC X(5).
         10  IN-MSG-TEXT-1       PIC X(35).
     05  MSG-IN-2   REDEFINES MSG-IN-1.
         10  IN-MSG-TEXT-2.
             20  TRANS-CODE-2        PIC X(5).
             20  TEXT-2              PIC X(20).
         10  FILLER                  PIC X(15).
01   WORK-AREA.
     05  IN-MSG-REC.
         10  REC-LEN                 PIC 9(4)    COMP-4.
         10  MSG-TEXT.
             20  MSG-1               PIC X(25).
             20  FILLER              PIC X(15).
01   OUTPUT-MESSAGE-AREA.       COPY OMA74.
       .
       .
       .
PROCEDURE DIVISION              USING PROGRAM-INFORMATION-BLOCK
                                INPUT-MESSAGE-AREA
                                WORK-AREA
                                OUTPUT-MESSAGE-AREA.
       .
       .
       .
IN-MSG-MOVE
     MOVE TEXT-LENGTH IN INPUT-MESSAGE-AREA TO REC-LEN.
     SUBTRACT FOUR FROM TEXT-LENGTH IN INPUT-MESSAGE-AREA.
     MOVE SPACES TO MSG-TEXT.
      IF TEXT-LENGTH IN INPUT-MESSAGE-AREA EQUAL FORTY
          MOVE MSG-IN-1 TO MSG-TEXT
     ELSE MOVE IN-MSG-TEXT-2 TO MSG-1.
     CALL 'PUT'  USING IN-MSG-FIL     IN-MSG-REC.
     IF STATUS-CODE  > 0  GO TO ERR-ROUT.
       .
       .
       .
ERROR-ROUT.
```

Figure 4-8. Testing the TEXT-LENGTH Field

4.10. Identifying Auxiliary Devices (AUXILIARY-DEVICE-NO)

When an input message is received from an auxiliary device, IMS places the number of the auxiliary device in the second byte of the AUXILIARY-DEVICE-ID (ZA#IDEV) field, AUX-DEVICE-NO. Auxiliary device values range from 1 to 9. The first byte is reserved for system use.

Just as your action program can check the source terminal identification, it can also check auxiliary device identification. To determine which auxiliary device sent the input message, your action program interrogates the AUX-DEVICE-NO field.

Suppose your action program logic depends upon which auxiliary device transmitted a particular input message. If your input message came from auxiliary device 1, your program performs one routine. If device 2 transmitted the message, your program performs another routine. Figure 4-9 shows the procedure division coding used to check the number of the auxiliary device that sent the input message to your action program.

```
AUX-DEV-TEXT.
      IF AUX-DEVICE-NO EQUAL 1
             PERFORM ROUT-A.
      ELSE IF AUX-DEVICE-NO EQUAL 2
             PERFORM ROUT-B.
      GO TO ERR-ROUT.
ROUT-A.
   .
   .
   .
ROUT-B.
   .
   .
   .
ERR-ROUT.
```

Figure 4-9. Testing the AUX-DEVICE-NO Field in a COBOL Action Program

The same test can be performed in a BAL action program by using the CLI instruction and branching to the appropriate routine to handle the processing of a message from either auxiliary device 1 or 2. Figure 4-10 shows this coding for a BAL action program.

```
1        10     16
         CLI    ZA#IDEV+1, C'1'
         BE     ROUTA
         CLI    ZA#IDEV+1, C'2'
         BE     ROUTB
ROUTA
         .
         .
         .
ROUTB
         .
         .
         .
```

Figure 4-10. Testing the AUX-DEVICE-NO Field in a BAL Action Program

4.11. Input Message Text

Though input message texts vary according to individual applications, you must consider three important options before defining your input message area in your action program:

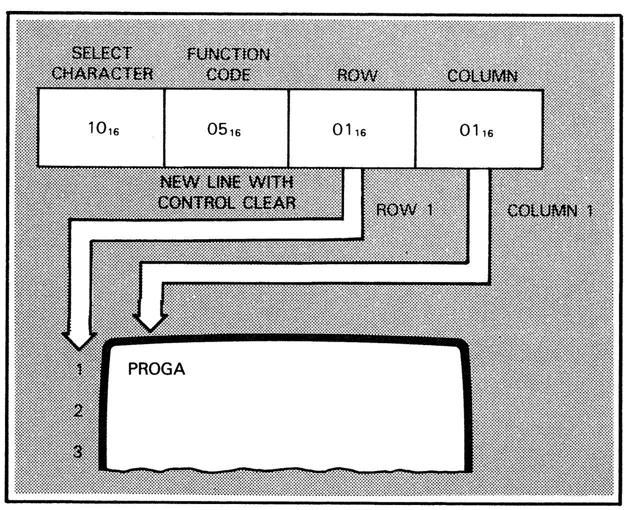
- Receiving control character sequences
- Use of the edit table generator to edit input messages
- Use of screen format services to receive input on formatted screens

4.11.1. Control Character Sequences

Two input message control character sequences are used on input messages: device-independent control expressions (DICE) and field control character sequences (FCC). Field control characters apply only to UTS devices and workstations.

4.11.2. Device-Independent Control Expressions

ICAM automatically inserts DICE sequences into input messages. DICE sequences show the format of input messages. A DICE sequence consists of the select character (10_{16}), a hexadecimal function code, and two hexadecimal coordinates: the first representing a row, and the second representing a column on the terminal. Function codes position the cursor, control carriage return, control forms, control line, feed line, and erase the screen. (See Table F-1 for further details.) The following diagram shows the relationship between the DICE sequences received in your program and their appearance on the screen.



In most cases, you configure the removal of DICE codes from input messages by specifying EDIT=tablename or EDIT=c in the configurator ACTION section, or by omitting the EDIT parameter.

If you wish to receive DICE sequences on input messages, you configure EDIT=NONE, which indicates no input message editing. You may want to receive DICE sequences on input in order to:

- Obtain cursor positioning control values for an input message and use this data in screen positioning output messages

- Switch a message to another terminal via the SEND function

Configuring EDIT=NONE also means that all blanks entered at the terminal, including leading blanks, are received in your input message area. However, in the case of an input message from the system console, leading blanks are removed.

Suppose you receive an input message from a terminal and want to send that message to another terminal; you want that message to arrive at the destination terminal in the same screen position as when it was entered on input.

First, define an area in the first 4 bytes of your input message area to receive the DICE control sequence. In the procedure division, move the DICE sequence from the input message area to the output message area before moving the destination terminal identification and output message text to the output message area and issuing the SEND function (Figure 4-11).

```
 WORKING-STORAGE SECTION.
 77   ELEVEN               PIC 99        COMP-4       VALUE 11.
 LINKAGE SECTION.
      .
      .
      .
01    INPUT-MESSAGE-AREA.     COPY IMA.
      05    DICE-SEQ         PIC X(4). <-------- RECEIVE DICE CONTROL SEQUENCES
      05    TRANS-CODE       PIC X(5).
      05    FILLER           PIC X.
      05    DEST-TERM        PIC X(4).
      05    FILLER           PIC X.
      05    IN-TEXT          PIC X(28).
01    OUTPUT-MESSAGE-AREA.    COPY OMA74.
      05    CURSOR-POS       PIC X(4). <--------- RECEIVE DICE CONTROL SEQUENCES
      05    OUT-TEXT         PIC X(28).
PROCEDURE DIVISION           USING    PROGRAM-INFORMATION-BLOCK
                                      INPUT-MESSAGE-AREA  D
                                      OUTPUT-MESSAGE-AREA.
      .
      .
      .
MOVE-MESSAGE.
     MOVE DEST-TERM TO DESTINATION-TERMINAL-ID.
     SUBTRACT ELEVEN FROM TEXT-LENGTH IN INPUT-MESSAGE-AREA
              GIVING TEXT-LENGTH IN OUTPUT-MESSAGE-AREA.
     MOVE DICE-SEQ TO CURSOR-POS.
     MOVE IN-TEXT TO OUT-TEXT.
     CALL 'SEND' USING OUTPUT-MESSAGE-AREA.
     IF STATUS-CODE NOT EQUAL  0  GO TO ERROR-PROC.
      .
      .
      .
ERROR-PROC.
```

Figure 4-11. Receiving DICE Sequence on Input Message

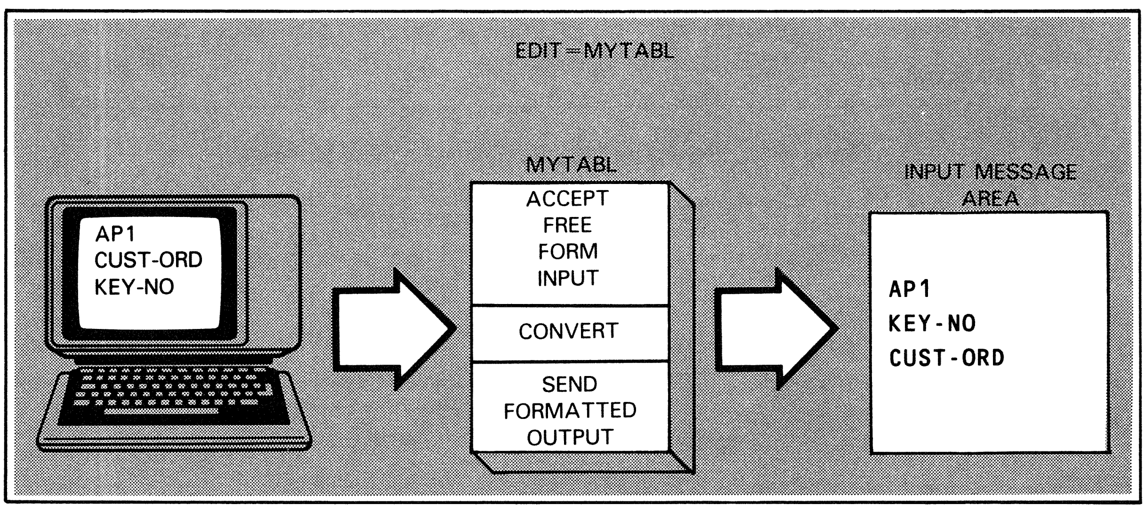
4.11.3. Field Control Character Sequences

To receive FCC sequences in your input from a UTS terminal or workstation, specify EDIT=NONE or FCCEDIT=NO in the configurator ACTION section. Leave 5 bytes in your input message text wherever you expect to receive the sequences. You describe the input message text including the FCC sequences much the same as you do for DICE sequences. Both FCC and DICE sequences can be interspersed in the message text instead of just at the beginning.

4.11.4. Receiving Free-Form Input

Let's consider the use of an edit table (EDIT=tablename) to edit input messages. You create an edit table by executing an offline IMS utility, the edit table generator, and configuring EDIT=tablename. This allows the operator to enter input messages in free form at the terminal. IMS uses the edit table to convert the free-form input message into the format your program requires.

You describe the input message text in your action program to reflect the formatted input message you want to receive. IMS receives free-form input from the terminal, formats and validates this input as you specify on edit table parameters, and sends it to your program's input message text in the format described there. For a description of how to use the edit table generator and a sample program that uses an edit table, see Appendix E.



4.11.5. Receiving Screen-Formatted Input

Your action program can receive input entered on screen formats, using screen format services. Your action program displays the screen format by issuing a BUILD function. In your input message area, you describe all input or input/output fields entered by the operator. For more details about receiving screen-formatted input, see Section 7.

Section 5
Processing Data Files

5.1. Accessing Files

Most IMS applications require access to data files. Your action programs exist to process messages that depend on data obtained from files. Though your action programs don't directly access data files, they do issue I/O function calls that tell IMS to retrieve, insert, update, or delete records.

When IMS receives a function call from your action program, it makes records available for processing. Data management access methods, SAM, DAM, ISAM, or MIRAM, perform the functions your action program requests. To access IRAM files, you must configure them as MIRAM files.

IMS supports sequential, relative, and indexed files as well as defined files that are in indexed organization. Table 5-1 summarizes the files supported by IMS.

Table 5-1. Summary of File Types Supported by IMS

File Organization	Access Mode	Data Management Access Method	Functions Available through IMS File Management
Sequential	Sequential	SAM/dedicated MIRAM (tape and disk)	Retrieve, Append (write unblocked output)
Relative (nonindexed)	Random	DAM/MIRAM	Retrieve*, Update, Insert, Delete
	Sequential	MIRAM	Retrieve
Indexed	Random	ISAM/MIRAM	Retrieve*, Update, Insert, Delete
	Sequential	ISAM/MIRAM	Retrieve
Indexed (defined file	Random	ISAM/DAM/ MIRAM	Retrieve*, Update, Insert, Delete
	Sequential	ISAM/DAM/ MIRAM	Retrieve

*Both retrieve and retrieve-with-the-intent-to-update can be requested.

Your action programs may issue random and sequential I/O functions to indexed and relative files but only sequential I/O functions to sequential files. Table 5-2 lists the file I/O functions allowed with each file organization and the CALL function parameters.

Table 5-2. Summary of File I/O Function Calls

File Organization	Random Functions		Sequential Functions	
	CALL	Parameters	CALL	Parameters
Sequential			GET	filename record-area
			PUT	filename record-area
Relative (nonindexed)	GET	filename record-area record number ①	SETL	filename position [record-number]
	GETUP	filename record-area record number		
	PUT	filename record-area [record-number] ②	GET	filename record-area
	INSERT	filename record-name record-number	ESETL	filename
	DELETE	filename record-area record-number	SETK	filename [key-of-ref]
Indexed	GET GETUP	filename record-area key [key-of-ref [dup-key-ct]] ③	SETL	filename position [key[partial-key-count]] ③
	PUT	filename record-area	GET	filename record-area
	INSERT	filename record-name	ESETL	filename
	DELETE	filename record-area	SETK	filename [key-of-ref] ③
Indexed (defined file)	GET	filename record-area key	SETL	filename position [key]
	GETUP	filename record-area key	GET	filename record-area
	PUT	filename record-area	ESETL	filename
	INSERT	filename record-area key		
	DELETE	filename record-area		

Notes:

① Sequential functions available with MIRAM, not DAM.

② Record-number required for DAM files.

③ Optional parameters available for MIRAM only.

5.2. I/O Function Calls

Function calls are your program's means of accessing data on files. You can issue an I/O function call in either COBOL or BAL action programs; their formats differ slightly.

The COBOL CALL function statement format is:

```
CALL 'function' USING filename, param-1,...param-n.
```

The BAL CALL function is in the format of a macroinstruction. BAL action programs use either the CALL or ZG#CALL macroinstruction:

```
1        10       16
---------------------------------------------------------------
         {CALL   }  function,(filename,param-1,...param-n)
         {ZG#CALL}
```

where:

`function`
: Is the name of the I/O function requested by your action program.

`filename`
: Is the name of the file on which the function is performed.

`param-1,...param-n`
: Indicates the record-area, record-number, key, partial-key-count, key-of-reference, duplicate-key-count, or position relative to the record being processed.

After processing an I/O function call, IMS sets a status code value in the STATUS-CODE field (COBOL action program) or ZA#PSC location (BAL action program) of the program information block. The status codes returned by IMS are explained in more detail in Table D-1.

IMS returns detailed status codes after processing certain I/O functions. These detailed status codes give more description of the error that occurred. For detailed status codes and their descriptions, see 3.6, 3.7, and Appendix D.

For advisory status codes, see 5.12 and Appendix D.

5.2.1. Function Call Positional Parameters

Both COBOL and BAL function CALL statements contain positional parameters that refer to data names in the data division of a COBOL action program or labels of storage locations in a BAL action program. Positional parameters include *filename, record-area, record-number, key, partial-key-count, key-of-reference, duplicate-key-count, position, record-size, control-character-area,* and *lock-disposition.*

Filename is a field containing the 7-character name of the file on which the specified function is performed. This name is left-justified and blank-filled.

In a COBOL action program, the file name can be defined in the working-storage section:

```
WORKING-STORAGE SECTION.
77  CUST-FILENAME      PIC X(7)    VALUE 'CUSTMST'.
```

To call the file, issue a function call using the data name for the file:

```
CALL 'GET' USING CUST-FILENAME IMS-RECORD-AREA IMS-KEY.
```

In a BAL action program, the file name can be defined as a constant in storage:

```
1        10    16
-----------------------------------------------------------------------
STATE    DC    CL7'STATE'
```

and called in the macro:

```
1        10    16
-----------------------------------------------------------------------
         CALL  GET,(STATE,IMS-RECORD-AREA,IMS-KEY)
```

Record-area is the area to or from which IMS moves a logical or defined record. You define the record area within an 01-level item of the linkage section, usually the work area.

Record-area is the data name or storage location that designates the area into which a detailed record is moved by IMS on an input function, or from which a defined record is passed to IMS on an output function call. The area must be large enough to include the entire defined record along with the item status bytes.

```
01   WORK-AREA.
     05   PARAMETER-LIST.
          10   IMS-FILENAME      PIC X(7).
          10   IMS-RECORD-AREA   PIC X(256).
```

In a BAL action program, you define the record area in a defined storage statement:

```
1        10    16
-----------------------------------------------------------------------
WORK     DSECT                 WORK AREA
RECORD   EQU   *
SNAME    DS    XL14            STATE NAME
SPOP     DS    XL8             STATE POPULATION
SCAPITAL DS    XL25            STATE CAPITAL
```

Record-area-size must be equal to or greater than the largest logical record it will contain. If your records are ISAM variable length, your record description must begin with a 2-byte binary field describing the length of the record. Other file types need a 4-byte binary field describing length. In a COBOL action program, describing MIRAM or SAM variable-length records, the description might be:

```
02   DATA-RECORD.
     10   IMS-REC-LENGTH             PIC 99     COMP-4.
     10   FILLER                     PIC XX.
     10   FIXED-PORTION.
          20   MAIN-INFO             PIC X(25).
          20   NR-OF-TRAILERS        PIC 99     COMP-4.
     10   VARIABLE-PORTION     OCCURS 0 TO 10 TIMES
                 DEPENDING ON NR-OF-TRAILERS.
          20   TRAILER               PIC X(15).
          20   TRAILER-2             PIC X(5).
```

The description for an ISAM variable-length record would not need the FILLER statement after the record length field. For DAM files, the record area should be a multiple of 256 bytes and larger than or equal to the record size.

In a BAL action program, the statement might be:

```
1        10    16
------------------------------------------------------------
VARLN    DS    CL4
```

Record-number is an 8-byte field containing a right-justified binary number that specifies the position of the record relative to the beginning of a relative file. The first number is 1. The COBOL description of this field might be:

```
10   IMS-REC-NUMBER   PIC 9(10)   USAGE   COMP-4.
```

A BAL action program might describe the record number as:

```
1        10    16
------------------------------------------------------------
RECNO    DS    XL8
```

Before issuing function calls containing the *record-number* parameter, move a record-number value to this field.

Key contains the value that identifies the record to be retrieved from or inserted into a file. You describe it in a COBOL action program's linkage section. A record key description in your COBOL action program might be:

```
10   IMS-KEY    PIC X(14).
```

In a BAL action program, the equivalent statement might be:

```
RECKEY   DS    CL14
```

Again, before issuing function calls containing the key parameter, you must place a key value in this field.

Partial-key-count is used in the SETL function call for indexed MIRAM files when the *position* parameter is G, K, or H. It is the symbolic address of a 4-byte field containing a right-justified binary number. This binary number indicates the number of leading bytes in the key used to locate the record.

The partial key count can be defined in the linkage section or the working-storage section of a COBOL action program. If defined in working storage, it must have a VALUE clause. For example,

```
WORKING-STORAGE SECTION.
77   STPT             PIC 9(4)     USAGE   COMP-4   VALUE 3.
```

defines your partial key count before you issue the SETL function call using STPT as your partial-key-count parameter.

The following data item has a binary value of 3 referring to the first three characters (279) of the specified key:

```
CALL 'SETL' USING MYFIL  POS  IMS-KEY  STPT.
```

The partial-key-count should be defined in a BAL action program using a DC statement:

```
1       10     16
----------------------------------------------------------
STPT    DC     X'00000003'
```

before being referenced in the macroinstruction:

```
1       10     16
----------------------------------------------------------
        ZG#CALL  SETL,(MYFIL,POS,IMS-KEY,STPT)
```

Key-of-reference is the symbolic address of a 4-byte field containing a right-justified binary number. This binary number indicates which key of multiple keys is used for retrieving the record. Use the same type working-storage (COBOL) or defined storage (BAL) statements as in the partial-key-count example to define the key-of-reference, and assign a value to it before issuing the SETK function call. The value of key-of-reference must be between 1 and 5.

Duplicate-key-count is the symbolic address of a 4-byte field containing a right-justified binary number. This binary number indicates the number of the record for retrieval within a duplicate key set. The duplicate-key-count value must be defined before you reference it in your I/O function call. See examples of how this is done in the previous description of *partial-key-count*.

Position is a symbolic address of a storage location containing a 1-byte value. This value designates the position of the file at completion of the SETL function. Values are listed in the SETL function descriptions.

Record-size is a symbolic address of a 2-byte binary field indicating the number of printable characters to be moved to the I/O area.

Control-character-area is a symbolic address of a 1-byte field containing a device-independent control character (DICE) used for printer control.

Lock-disposition is a symbolic address of a 1-byte field containing the EBCDIC character H. This specifies the retention of the current printer file assignment after the printer file is breakpointed.

5.3. Accessing Indexed Files

The indexed-sequential and multiple-indexed random access methods (ISAM and MIRAM) process function calls issued by your action program to indexed files. With several exceptions, a key specification characterizes most file functions issued to indexed files. Although IMS supports multiple-key MIRAM files, you must use only the primary key identified in the configurator FILE section (PKEY=n parameter) to insert or update records. Changes or duplicates of alternate keys are allowed, except for primary keys.

Note: *You must specify MODE=RAN in the FILE section of the configuration to access MIRAM files randomly. If a file is configured as MODE=SEQ, you can use only the sequential functions GET and PUT (5.9).*

5.4. Random Functions for Indexed Files

The random function calls GET, GETUP, PUT, INSERT, and DELETE:

- Retrieve records with or without updating
- Write records back to a file
- Logically or physically delete records
- Overwrite an existing record or add a new record to a file

For error status codes resulting from the execution of each of the random I/O function calls, see Table D-1.

5.4.1. Reading Records Randomly (GET)

The random GET function retrieves the record designated by the key value from the named file and places it into the specified record area. IMS does not perform the GET function if the requested record is currently locked by a different transaction. You cannot update a record retrieved by the GET function; use GETUP to retrieve a record for updating.

The COBOL and BAL formats for the random GET function calls are:

- COBOL format 1 (ISAM files)

```
CALL 'GET' USING filename record-area key.
```

- COBOL format 2 (MIRAM files)

```
CALL 'GET' USING filename record-area key
         [key-of-reference [duplicate-key-count]].
```

- BAL format 1 (ISAM files)

```
{CALL    }  GET,(filename,record-area,key)
{ZG#CALL }
```

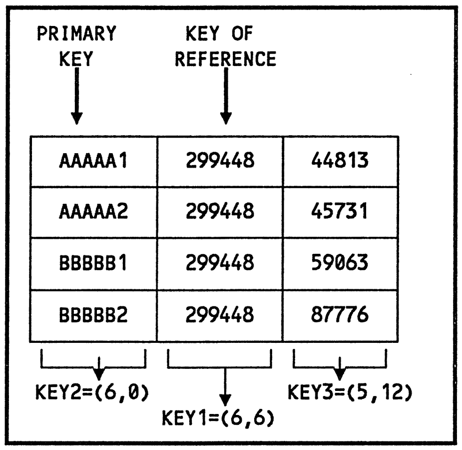
- BAL format 2 (MIRAM files)

```
{CALL    }  GET,(filename,record-area,key
{ZG#CALL }    [,key-of-reference[,duplicate-key-count]])
```

For MIRAM files (format 2), the *key-of-reference* value indicates which key of multiple keys is used for retrieving the record. This key level number must coincide with one of the data management KEY*n* specifications designated at configuration time.

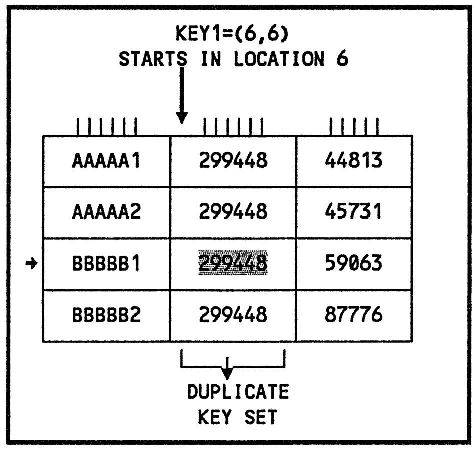
For example, your configurator FILE section might have KEY*n* designations of KEY1=(6,6), KEY2=(6,0), and KEY3=(5,12). (Key 1 starts in position 6 of the file, key 2 starts in position 0, and key 3 starts in position 12.) Key 2 is configured as the primary key (PKEY=2 specification), so key 1 and key 3 are alternate keys. You want to access the file using key 1, so you use the key-of-reference value 1. When the key-of-reference value is omitted, IMS uses the primary key, in this case, key 2.

```
WORKING-STORAGE SECTION.
77  ONE      PIC 9(5)   COMP-4  VALUE 1.
77  TWO      PIC 9(5)   COMP-4  VALUE 2.
77  THREE    PIC 9(5)   COMP-4  VALUE 3.
     .
     .
     .
PROCEDURE DIVISION.
     .
     .
     .
CALL 'GET' USING FIL-A  REC-A  KEY-A  ONE.
```



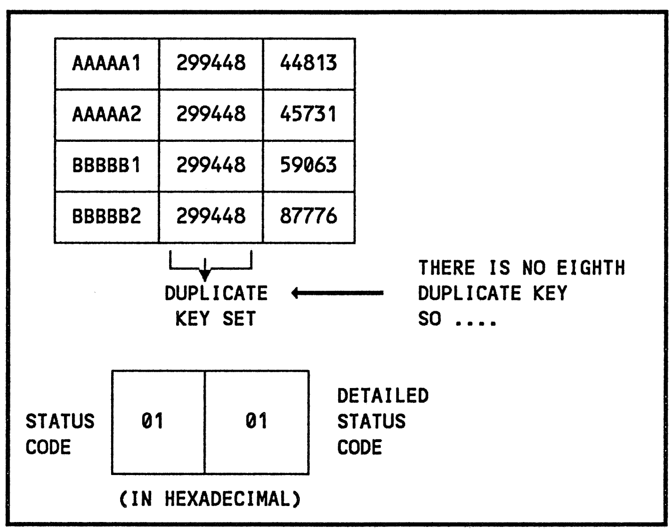
Also, on function calls to MIRAM files, you can specify a duplicate-key-count value to indicate which record within a duplicate key set to retrieve. Retrieving a record with a large number of duplicate key values can be time-consuming. An alternative would be to use the undedicated sequential retrieval method (see 5.5).

```
WORKING-STORAGE SECTION.
77  DUP-KEY-CT       PIC 9(5) COMP-4  VALUE 3.
PROCEDURE DIVISION.
     .
     .
     .
CALL 'GET' USING FIL-A  REC-A  KEY-A  ONE  DUP-KEY-CT.
```



If you omit this parameter or if it equals 1, IMS retrieves the first record within the duplicate key set. If the value is zero or exceeds the number of records within the duplicate key set, IMS sets status code and detailed status code to 1.

```
WORKING-STORAGE SECTION.
77   DUP-KEY-CT     PIC 9(5) USAGE COMP-4  VALUE 8.
```



Note that the sequence of records in a duplicate key set changes when one of the records in the set is deleted. If the deleted record is later restored by online or offline recovery, it is placed at the end of the duplicate key set instead of in its original position.

If you configure physical deletion of records (DELETP=YES) in the FILE section, you can retrieve any logically deleted records on MIRAM files as normal data. You must configure physical deletion of records when files are multikeyed.

The logical sequence of MIRAM records, containing duplicate secondary keys, is not maintained when one of these records is deleted and either online or offline recovery is performed for that file.

5.4.2. Reading Records for Update (GETUP)

The GETUP function retrieves the record for updating and temporarily locks the requested record from access by other transactions. IMS does not perform the GETUP function if the requested record is currently locked by a different transaction. As with the GET function, IMS uses the key you specify on the GETUP function to locate the required record. Unlike the GET function, you can access a record for update only by the primary key.

The COBOL and BAL formats for the GETUP function call to all indexed files are:

- COBOL format

```
CALL 'GETUP' USING filename record-area key.
```

- BAL format

```
{CALL   }  GETUP,(filename,record-area,key)
{ZG#CALL}
```

To update or delete the record requested, issue a PUT or DELETE function call following the GETUP function. Other function calls to the same file may not intervene. Otherwise, the record must be retrieved again with a GETUP function before a PUT or DELETE can be performed. You may, however, issue other instructions and function calls to other files between the GETUP and PUT or DELETE functions.

Incorrect	Correct

CALL 'GETUP' USING MYFIL
    IMS-REC-AREA MYKEY.
CALL 'GET' USING MYFIL
    IMS-REC-AREA MYKEY.
MOVE CUST-NAME TO NAME-FIELD.
CALL 'PUT' USING MYFIL
    IMS-REC-AREA.
	CALL 'GETUP' USING MYFIL
	    IMS-REC-AREA MYKEY.
	MOVE CUST-NAME TO NAME-FIELD.
	CALL 'PUT' USING MYFIL
	    IMS-REC-AREA.

For ISAM files, you must not change the key value in the record area between the GETUP and succeeding PUT or DELETE function calls. IMS does not return an error, but you may damage your data file.

For MIRAM files, do not change the value of the primary key in the record area between the GETUP and succeeding PUT or DELETE function calls. You may, however, change the value of alternate keys.

For ISAM files, do not change the value of the key field used for the key parameter between the GETUP and succeeding PUT or DELETE function calls. This value may be changed when you use MIRAM files.

```
                       01  WORK-AREA.
                           05  REC-AREA
Primary key.           ------> 10  ACCTNO              PIC X(6)
Do not change                  10  NAME                PIC X(20)

Alternate key          ------> 10  ADDRESS             PIC X(20)

Key parameter                  10  OTHER-DATA          PIC X(50).
field. Do not      ------> 05  MYKEY                   PIC X(6).
change for ISAM        .
                       .
                       .
                       PROCEDURE DIVISION.
                       MOVE INPUT-KEY TO MYKEY.
                       CALL 'GETUP' USING MYFIL REC-AREA MYKEY.
                       MOVE INPUT-NAME TO NAME.
                       CALL 'PUT' USING MYFIL REC-AREA.
```

If you configure physical deletion of records, you can retrieve any logically deleted records on MIRAM files as normal data.

5.4.3. Writing Updated Records (PUT)

The random PUT function writes an updated record back to the file. It must be preceded by a GETUP function that retrieves the record for update. The first byte of nonkey data must not contain X'FF', unless you have configured physical deletion for MIRAM files (DELETP=YES).

No key is required on a PUT function because the key is in the specified key location in the record area. If you specify a key parameter, IMS returns a status code of 3 and a detailed status code of 1.

The COBOL and BAL formats for the PUT function call are:

- COBOL format

```
CALL 'PUT' USING filename record-area.
```

- BAL format

```
CALL      PUT,(filename,record-area)
ZG#CALL
```

5.4.4. Deleting Records (DELETE)

The DELETE function deletes a record that was retrieved for updating. The DELETE function must be preceded by a GETUP function. If other function calls to the same file intervene, you must reissue the GETUP function before the record can be deleted.

The COBOL and BAL formats for the DELETE function call are:

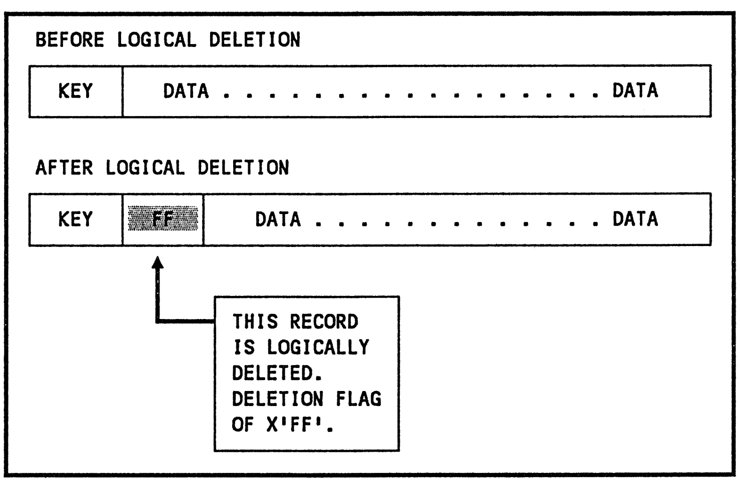
- COBOL format

```
CALL 'DELETE' USING filename record-area.
```

- BAL format

```
CALL      DELETE,(filename,record-area)
ZG#CALL
```

The DELETE function for ISAM files is a logical deletion. A logical record deletion changes the first byte of nonkey data to X'FF' before the record is written back to the file.



The DELETE function for single-keyed MIRAM files can be a logical or a physical deletion. A physical deletion is always performed for multikeyed MIRAM files.

To logically delete single-keyed MIRAM records, configure DELETP=NO or default to this value. The results of this logical deletion are the same as for ISAM records on logical deletion (for example, X'FF' in first byte of nonkey data).

To physically delete a single-keyed MIRAM record, create the file with the data management keyword RCB=YES and configure IMS with the DELETP=YES parameter. (DELETP=YES is assumed for multikeyed MIRAM.) The DELETE function then physically deletes the record from the file.

```
                DELETP=YES
                SPECIFIED
                IN
                CONFIGURATOR
                FILE SECTION
                     .
                     .
                     .
CALL 'GETUP' USING FIL-A REC-A KEY-A.
CALL 'DELETE' USING FILE-A REC-A.

BEFORE PHYSICAL DELETION

| KEY | DATA . . . . . . . . . . . . . . . . DATA |

AFTER PHYSICAL DELETION
 - - - - - - - - - - - - - - - - - - - - - -
|                                            |
 - - - - - - - - - - - - - - - - - - - - - -
```

Suppose the record you call for deletion is previously flagged as logically deleted. If you configure physical deletion, the GETUP function retrieves the requested record. If you configure logical deletion, the GETUP function returns a *record not found* status.

Note: *When IMS logically deletes a record (X'FF' in the first byte of nonkey data) and you later access the file from a non-IMS program, the record will not be recognized as deleted. You must check for HIGH-VALUES or X'FF' in the first byte of nonkey data.*

5.4.5. Adding Records (INSERT)

The INSERT function places a new record into the file or overwrites a previously deleted record. This function is not preceded by a GETUP function. The first byte of nonkey data in the record being inserted must not contain a deleted record value of X'FF', unless you have configured physical deletion for MIRAM files. The COBOL and BAL formats for the random INSERT function calls are:

- COBOL format

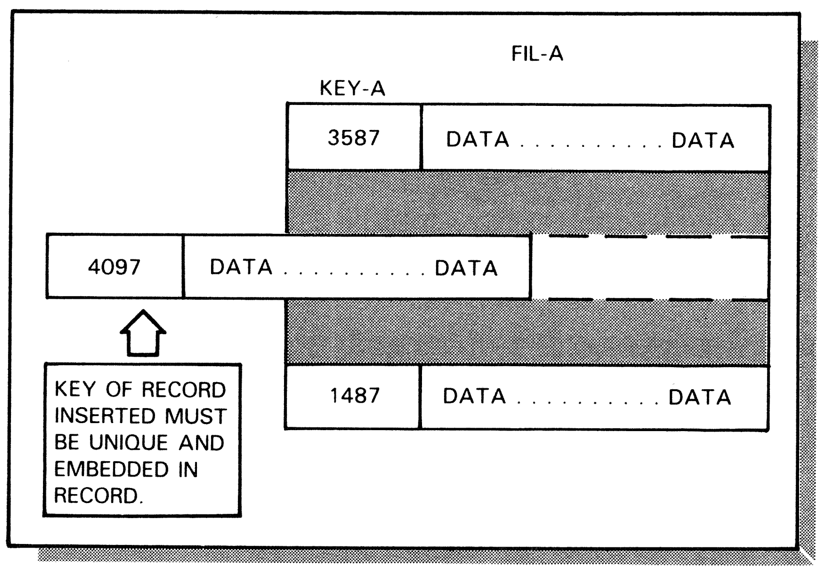
```
CALL 'INSERT' USING filename record-area.
```

- BAL format

```
{CALL  }   INSERT,(filename,record-area)
{ZG#CALL}
```

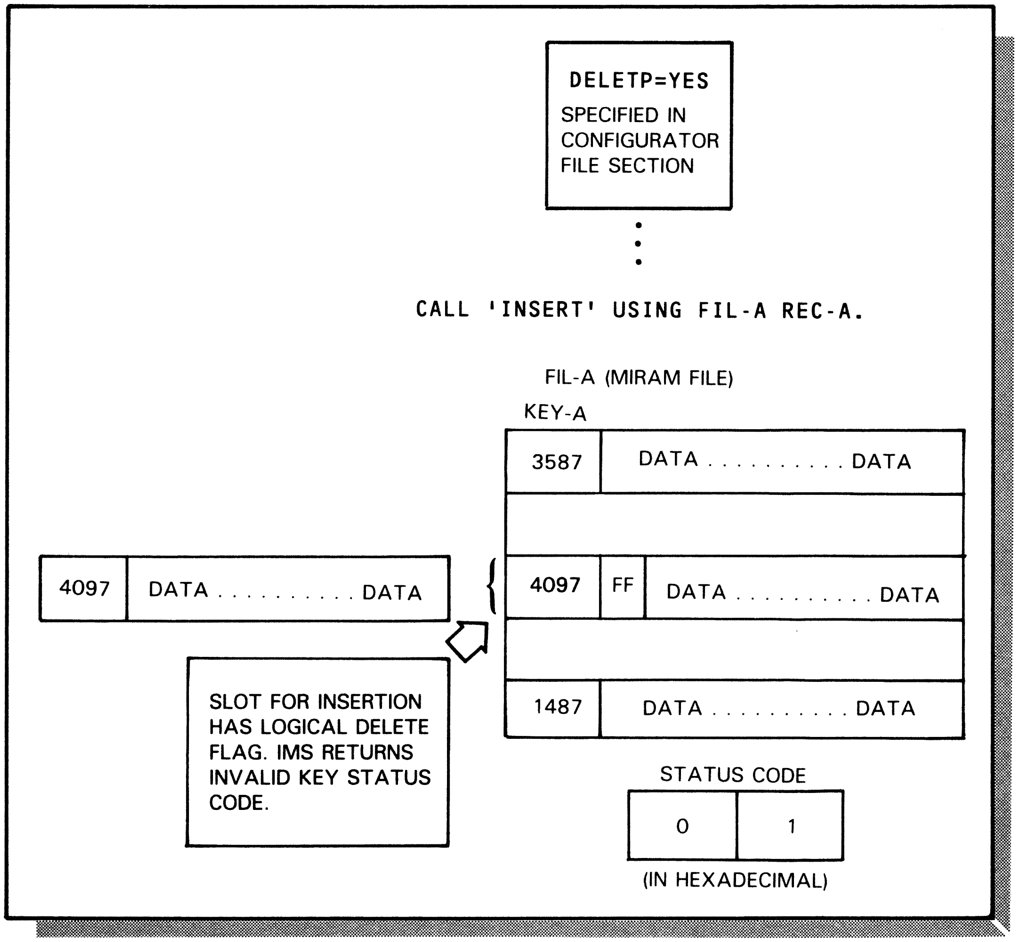
Indexed files do not require a key parameter in the INSERT function. Their keys must be embedded in the record. The key of the new record must have a value that is different from any already existing in the file.

```
CALL 'INSERT' USING FIL-A REC-A.
```



An INSERT function using a previously deleted record slot removes the delete control character. You can change the length field for variable-length records in MIRAM files, but not in ISAM files.

For MIRAM files, you cannot overwrite a logically deleted record, when physical deletion is configured. An attempt to do this results in a status code of 1, invalid key.



5.5. Sequential Functions for Indexed Files

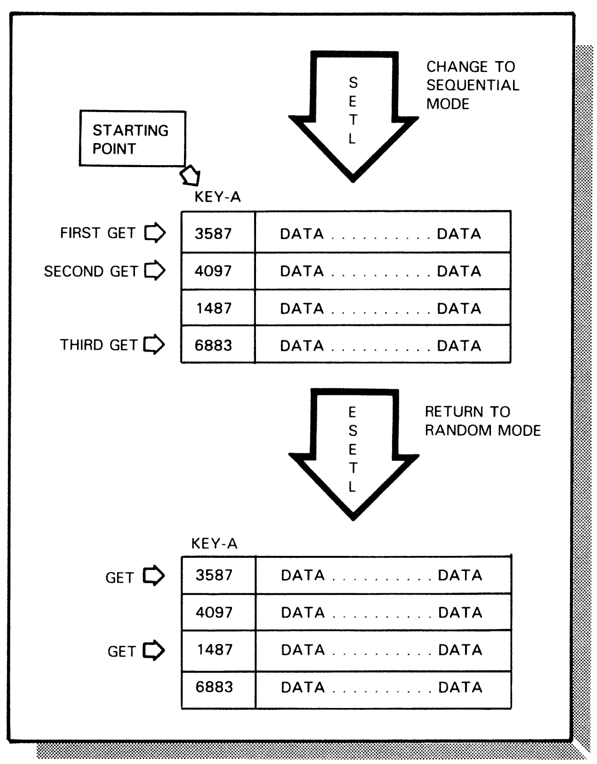
Sequential function calls SETK, SETL, GET, and ESETL:

- Set a key of reference for sequential processing
- Set an indexed file into sequential mode and position it to a selected location in the file
- Retrieve records sequentially
- Reset the indexed file from sequential mode to random mode

For error status codes resulting from the execution of each of the sequential I/O function calls, see Table D-1.

When accessing an indexed file sequentially, your action program must first set the file into sequential mode via the SETL function. During this time, the file is accessed exclusively by the transaction that sets the mode. Requests by other transactions for sequential or random mode functions are queued for later processing.

Sequential mode exists until your program requests an ESETL function or until the current action terminates. In either case, the indexed file returns to random mode. The file also returns to random mode if an error occurs on a SETK or SETL function or an invalid request (status code 3) occurs on a GET function.



Note: *Shared file access among transactions is done only in random mode. The use of sequential mode by one transaction can significantly degrade the response time for other transactions accessing the same file.*

5.5.1. Setting the Key of Reference for Sequential Processing (SETK)

The SETK function establishes the key-of-reference for subsequent indexed file positioning and retrieval. This function is used exclusively with multikeyed MIRAM files.

The COBOL and BAL function call formats for the SETK function are:

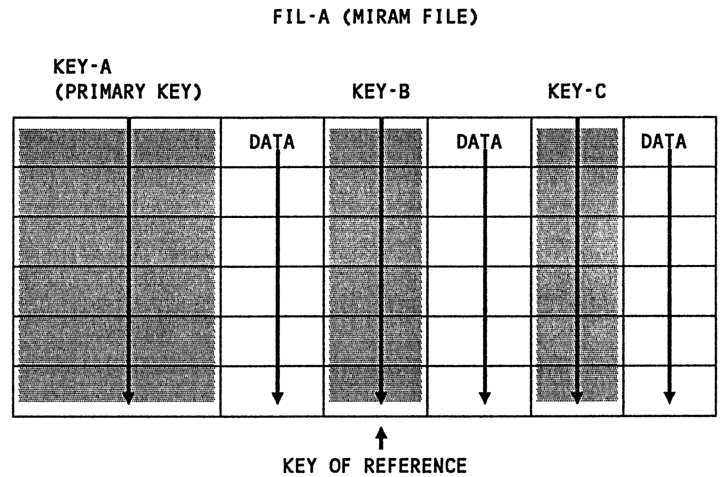
- COBOL format

```
CALL 'SETK' USING filename [key-of-reference].
```

- BAL format

```
{CALL   }  SETK,(filename[key-of-reference])
{ZG#CALL}
```

The *key-of-reference* is the symbolic address of a 4-byte field containing a right-justified binary number. This value indicates which of the multiple keys to use on the succeeding SETL and GET functions. If the key-of-reference parameter is omitted, IMS uses the primary key for the search.




```
CONFIGURE:   FILE    FIL-A   FILETYPE=DMRAM
                             PKEY=1
                             KEY1=(6,0)
                             KEY2=(1,50)
                             KEY3=(2,80)

WORKING-STORAGE SECTION.
77   KEY-A       PIC 9(5)   COMP-4   VALUE 1.
77   KEY-B       PIC 9(5)   COMP-4   VALUE 2.
77   KEY-C       PIC 9(5)   COMP-4   VALUE 3.
.
.
.
PROCEDURE DIVISION.
PARA-1.
  CALL 'SETK' USING FIL-A KEY-B.
  .
  .
  .
  CALL 'ESETL' USING FIL-A.
```

A GET function cannot directly follow a SETK function; you must position the file with the SETL function before retrieving records. It can be issued many times to change the key of reference. Once established, however, the specified key of reference remains in effect until another SETK, ESETL, or action termination.

When any error occurs on a SETK function, the file is reset to random mode and any file locks in effect are released. For further sequential processing, you must issue another SETL and SETK function to reestablish the sequential mode and the key of reference.

5.5.2. Setting Indexed Files from Random to Sequential Mode (SETL)

The SETL function sets an indexed file into sequential mode and logically positions the file as follows:

Value	Meaning
B	Beginning of file
G	Greater than or equal to the key supplied
K	Equal to key supplied
H	Greater than key supplied

The value of the position parameter determines the logical position of the file at completion of the SETL function. Indexed files start at position 0. You can reissue the SETL function any time to change the sequential position of the file. For ISAM files, however, you must issue an ESETL function before reissuing another SETL function.

The COBOL and BAL formats for the SETL function call are:

- COBOL format

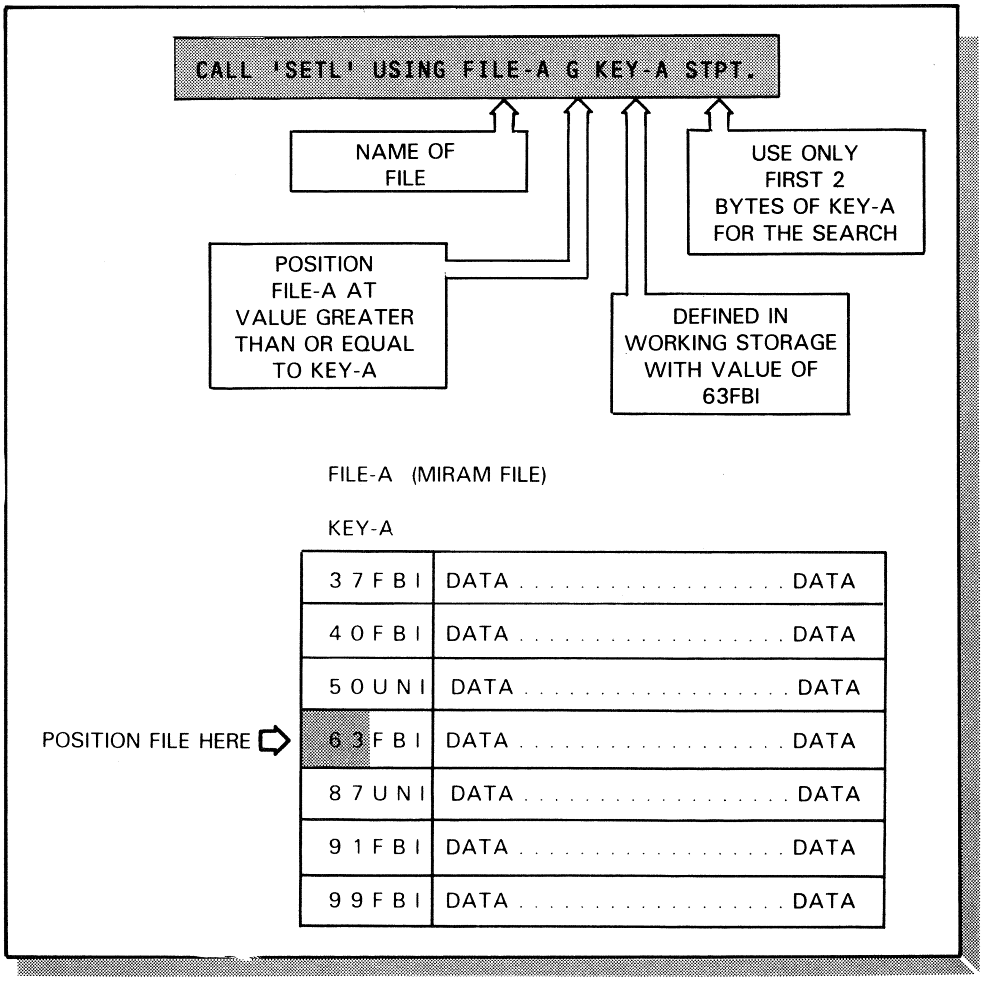
```
CALL 'SETL' USING filename position [key[partial-key-count]].
```

- BAL format

```
{CALL   }    SETL,(filename,position[,key[,partial-key-count]])
{ZG#CALL}
```

You must supply a file name and choose a position value. Depending upon the position chosen, you also supply a *key* parameter.

In addition, the SETL function allows for partial key search of indexed MIRAM files. To do this, use the optional *partial-key-count* parameter. It is the symbolic address of a 4-byte field containing a right-justified binary number. This binary number indicates the number of leading bytes used from the key to locate the record. If you omit the *partial-key-count* parameter, data management uses the entire key to locate the record.



When any error occurs on a SETL function, the file is reset to random mode and any file locks in effect are released. For further sequential processing, you must issue another SETL function call.

Table 5-3 lists the SETL parameter choices for ISAM and MIRAM files.

Table 5-3. SETL Parameter Choices for Indexed Files

File Type	Parameters						
	Filename	Position					
		B	G	K	H	Key	Partial
ISAM	X	X	X	X		X	
Indexed MIRAM	X	X	X	X	X	X	X

5.5.3. Reading Records Sequentially (GET)

The sequential GET function retrieves the next logical record in sequential order unless the record is marked logically deleted (that is, X'FF' in the first byte). If the record is marked logically deleted, the GET function retrieves the following record. For MIRAM files, if DELETP=YES is configured or assumed, data management retrieves logically deleted records as normal data.

Filename and *record-area* parameters are required on sequential GET functions for indexed files.

The COBOL and BAL formats for the sequential GET function call are:

- COBOL format

```
CALL 'GET' USING filename record-area.
```

- BAL format

```
{CALL   }  GET,(filename,record-area)
{ZG#CALL}
```

When an invalid request error occurs on a sequential GET function, after a SETL function, the file is reset to random mode and any file locks in effect are released.

5.5.4. Setting Indexed Files from Sequential to Random Mode (ESETL)

The ESETL function changes the mode of indexed files from sequential to random. If a file is in the sequential mode for a transaction and you do not issue an ESETL function before termination of the current action, IMS resets the file to random mode. The ESETL function always requires a filename parameter.

The COBOL and BAL formats for the ESETL function call are:

- COBOL format

```
CALL 'ESETL' USING filename.
```

- BAL format

```
⎧CALL    ⎫ ESETL,(filename)
⎩ZG#CALL ⎭
```

5.6. Accessing Relative Files

The direct and multiple-indexed random access methods (DAM and MIRAM) process function calls issued by your action program to relative files. A record-number parameter characterizes most file functions to relative files although record numbers are not required on sequential functions. Random and sequential functions are supported for MIRAM files but only random functions for DAM files.

Note: *You must specify MODE=RAN in the FILE section of the configuration to access MIRAM files randomly. If a file is configured as MODE=SEQ, you can use only the sequential functions GET and PUT (5.9).*

5.7. Random Functions for Relative Files

The random function calls GET, GETUP, PUT, INSERT, and DELETE:

- Retrieve records with or without updating
- Write records back to a file
- Logically or physically delete records
- Overwrite an existing record or add a new record to a file

For error status codes resulting from the execution of each of the random I/O functions, see Table D-1.

You must preformat DAM files offline before their initial use, and they must contain the maximum number of physical records to be referenced online under IMS.

5.7.1. Reading Records Randomly (GET)

The random GET function retrieves the record you request by record number and places it into the specified record area. All record number fields must be 8 bytes long and binary. You cannot update a record retrieved by the GET function; use GETUP to retrieve a record for updating.

If the requested record is currently locked by a different transaction, IMS does not perform the GET function.

The COBOL and BAL formats for the random GET function call are:

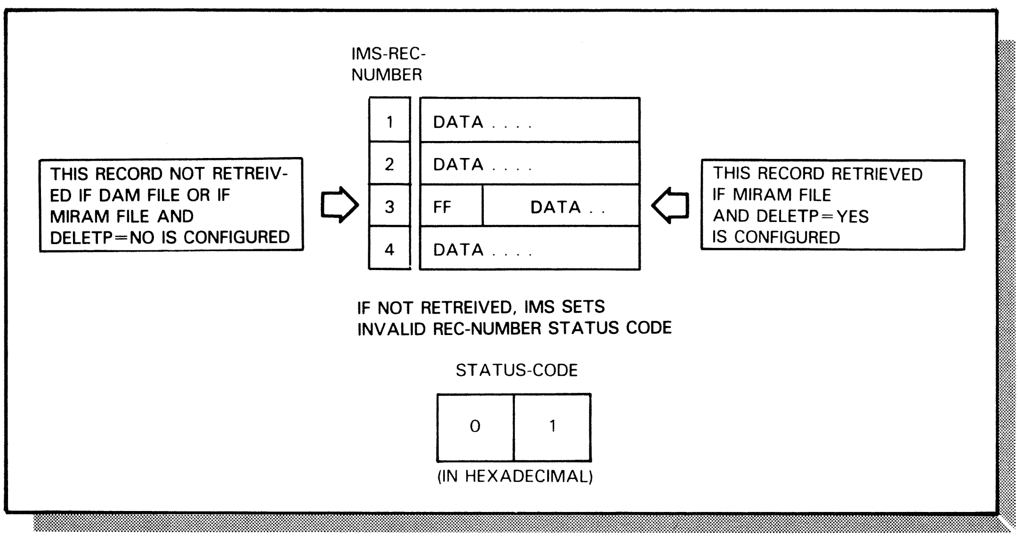
- COBOL format

```
CALL 'GET' USING filename record-area record-number.
```

- BAL format

```
{CALL   }    GET,(filename,record-area,record-number)
{ZG#CALL}
```

If a transaction requests a logically deleted record (X'FF' in the first byte), IMS returns an invalid record number status code of 1. However, if DELETP=YES is configured for a MIRAM file, logically deleted records are retrieved as normal data.



5.7.2. Reading Records for Update (GETUP)

The random GETUP function uses a record number to retrieve a requested record for updating and temporarily locks that record from access by other transactions. IMS does not perform a random GETUP function if the requested record is currently locked by a different transaction. All record number fields must be 8 bytes long and binary.

The COBOL and BAL formats for the random GETUP function call are:

- COBOL format

```
CALL 'GETUP' USING filename record-area record-number.
```

- BAL format

```
{CALL   }  GET,(filename,record-area,record-number)
{ZG#CALL}
```

A GETUP function can be followed by a PUT function to update the record, or a DELETE function to mark the record as logically deleted or to physically delete it.

If the record-number parameter is omitted from the PUT or DELETE function that follows a GETUP function (MIRAM files only), the record field in your program must remain unaltered until IMS completes the PUT or DELETE function.

If the DELETP=YES parameter is configured and you issue a GETUP function call for a logically deleted record, IMS returns the logically deleted record as normal data. For DAM files, and for MIRAM files with DELETP=NO configured, IMS returns an invalid record number status of 1.

5.7.3. Writing Updated Records (PUT)

The random PUT function is used with the GETUP function to write an updated record back to the file. A PUT function must be preceded by a GETUP function that retrieves the requested record for update. The first byte of data in a record must not contain an X'FF' unless you have configured physical deletion for MIRAM files.

The COBOL and BAL formats for the PUT function call are:

- COBOL format

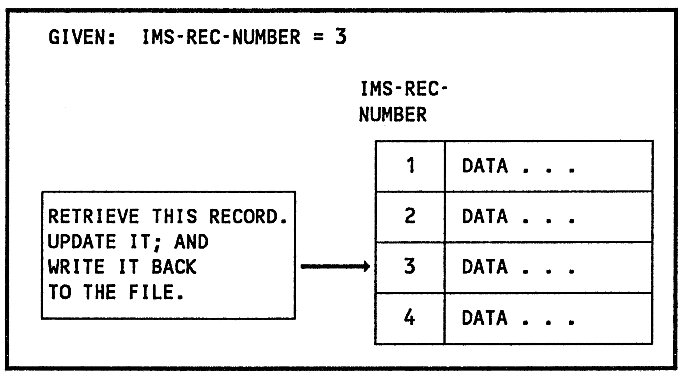
```
CALL 'PUT' USING filename record-area [record-number].
```

- BAL format

```
{CALL  }   PUT,(filename,record-area[,record-number])
{ZG#CALL}
```

A record-number parameter is required on the PUT function for DAM files, but is optional for MIRAM relative files. When you omit the record-number parameter for MIRAM files, no function call for the same file may be between the GETUP and PUT function.

```
CALL 'GETUP' USING FIL-A REC-AREA IMS-REC-NUMBER.
MOVE NEW-AMT TO AMT-A.
CALL 'PUT' USING FIL-A REC-AREA.
```



5.7.4. Deleting Records (DELETE)

The DELETE function for DAM files logically deletes a record that was retrieved for updating.

For MIRAM files, this function physically deletes a record if the file was created with the data management keyword RCB=YES and configured with the DELETP=YES parameter. For MIRAM files configured with DELETP=NO, the deletion is logical.

For an effective logical or physical deletion, this function must be immediately preceded by a GETUP function. If other functions intervene, the GETUP function must be reissued before the record can be deleted.

The COBOL and BAL formats for the DELETE function call are:

- COBOL format

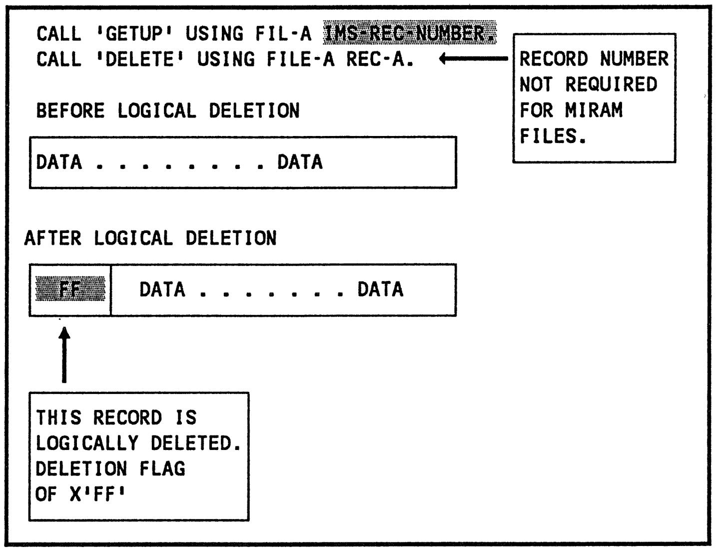
```
CALL 'DELETE' USING filename record-area [record-number].
```

- BAL format

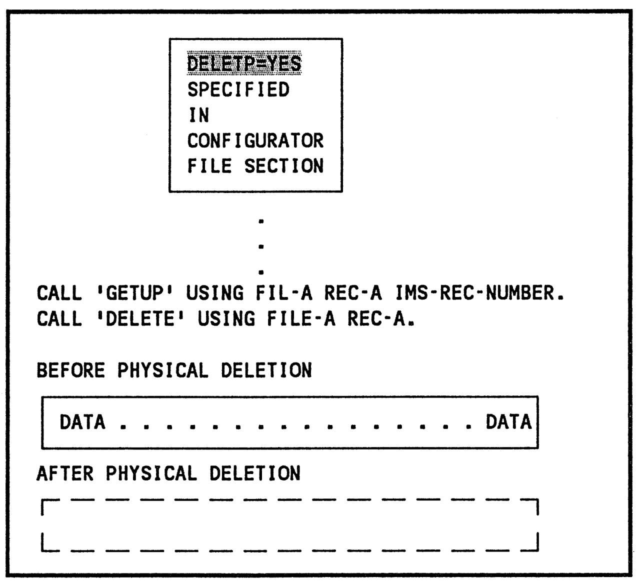
```
{CALL   }   DELETE,(filename,record-area[,record-number])
{ZG#CALL}
```

You must supply a record-number parameter on the DELETE function for DAM files; it is optional for MIRAM files.

The logical DELETE function changes the first byte of data in a record retrieved for update to X'FF' before the record is written to the file.



On the other hand, a physical DELETE actually removes the record from the file.



Note: *When IMS logically deletes a record (X'FF' in the first byte) and you later access the file from a non-IMS program, the record will not be recognized as deleted. You must check for HIGH-VALUES or X'FF' in the first byte.*

5.7.5. Adding Records (INSERT)

The INSERT function places a new record into the file or overwrites a previously deleted record. This function is not preceded by a GETUP function. The first byte of data in the record being inserted must not contain a deleted record value of X'FF'.

An INSERT function using a previously deleted record slot removes the delete control character. You can change the RECORD-LENGTH field for variable-length records in MIRAM files only. The INSERT function for MIRAM files can also overwrite nondeleted records.

The COBOL and BAL formats for the INSERT function call are:

- COBOL format

```
CALL 'INSERT' USING filename record-area record-number.
```

- BAL format

```
{CALL   }    INSERT,(filename,record-area[,record-number])
{ZG#CALL}
```

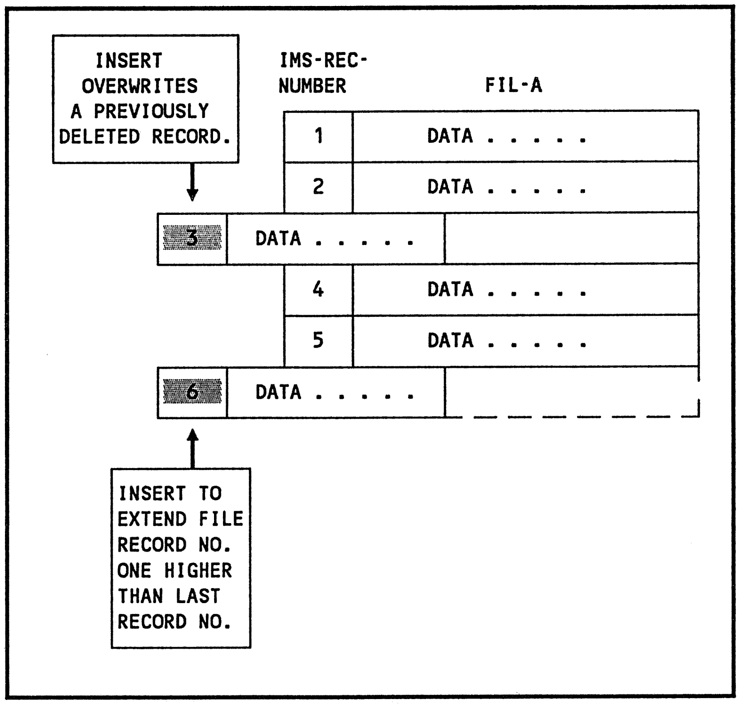
INSERT functions issued to a relative file must supply a record-number parameter. If you configure MIRAM files with RCB=NO, any record you add to a relative file must be assigned a relative record number *one higher than the last record in the file.* This prevents the occurrence of erroneous data between the last record and the new inserted record. You may insert records within or beyond the limits of nonindexed MIRAM files; file extension is permitted.

```
CALL 'INSERT' USING FIL-A REC-A REC-NO.
```

Given: REC-NO = 3

```
CALL 'INSERT' USING FIL-A REC-A REC-NO.
```

Given: REC-NO = 6



5.8. Sequential Functions for Relative Files

Sequential function calls SETL, GET, and ESETL:

- Set a nonindexed MIRAM file into sequential mode and position it to a selected a location in the file
- Retrieve records sequentially
- Reset the file from sequential mode to random mode

Sequential functions cannot be processed by the direct access method (DAM).

For error status codes resulting from the execution of each of the sequential I/O functions, see Table D-1.

When accessing a relative file sequentially, action programs must first set the file into sequential mode via the SETL function. During this time, files are accessed exclusively by the transaction that set the mode. Requests by other transactions for sequential or random mode functions are queued for later processing.

Sequential mode exists until your program requests an ESETL function or until the current action terminates. In either case, the indexed file returns to random mode.

Note: *Shared file access among transactions is done only in random mode. The use of sequential mode by one transaction can significantly degrade the response time for other transactions accessing the same file.*

5.8.1. Setting Relative Files from Random to Sequential Mode (SETL)

The SETL function sets a relative file into sequential mode and logically positions the file as follows:

Value	Meaning
B	Beginning of file
G	Greater than or equal to the record number supplied
K	Equal to record number supplied
H	Greater than record number supplied

The value of the *position* parameter determines the logical position of the file at completion of the SETL function. Relative files start at position 1. You can reissue the SETL function any time you wish to change the sequential position of the file.

The COBOL and BAL formats for the SETL function call are:

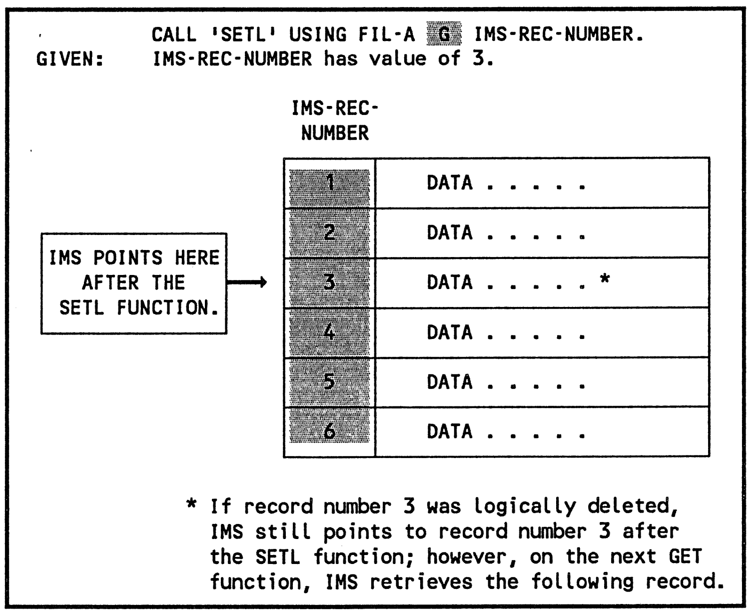
- COBOL format

```
CALL 'SETL' USING filename position[record-number].
```

- BAL format

```
{CALL   }    SETL,(filename,position[,record-number])
{ZG#CALL}
```

You must supply a file name and choose a position value on the SETL function for relative files. The *record-number* parameter is not used with the B position value. When G, K, or H is specified for position, *record-number* must be specified.



When any error occurs on a SETL function, the file is reset to random mode and any file locks in effect are released. For further sequential processing, you must issue another SETL function call.

5.8.2. Reading Records Sequentially (GET)

The sequential GET function retrieves the next logical record in sequential order unless the record is marked logically deleted (that is, X'FF' in the first byte). If the record is marked logically deleted, the GET function retrieves the following record. If DELETP=YES is configured, IMS retrieves logically deleted records as normal data.

The COBOL and BAL formats for the sequential GET function call are:

- COBOL format

```
CALL 'GET' USING filename record-area.
```

- BAL format

```
{CALL   }   GET,(filename,record-area)
{ZG#CALL}
```

Filename and *record-area* parameters are required.

When an invalid request error occurs on a sequential GET function, the file is reset to random mode and any file locks in effect are released.

5.8.3. Setting Files from Sequential to Random Mode (ESETL)

The ESETL function changes the mode of relative files from sequential to random. If a file is in the sequential mode for a transaction and you do not issue an ESETL function before termination of the current action, IMS resets the file to random mode. The ESETL function always requires a *filename* parameter.

The COBOL and BAL formats for the ESETL function call are:

- COBOL format

```
CALL 'ESETL' USING filename.
```

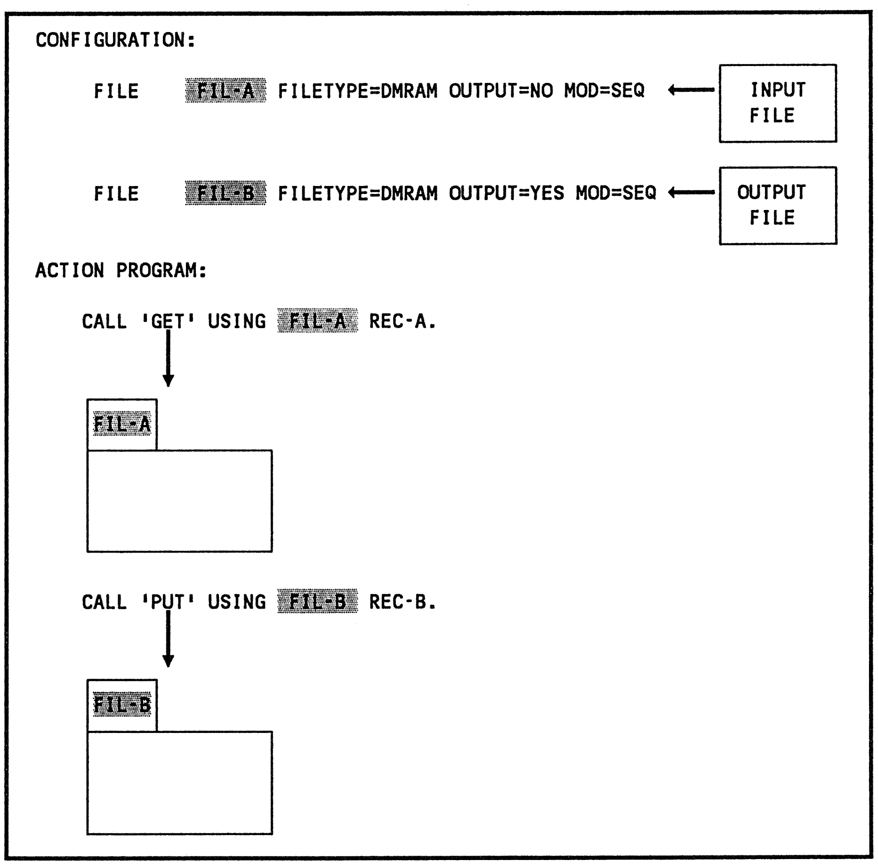
- BAL format

```
{CALL   }  ESETL,(filename)
{ZG#CALL}
```

5.9. Accessing Sequential Disk and Tape Files

The sequential and multiple-indexed random access methods (SAM and MIRAM) process function calls issued by your action program to sequential disk or magnetic tape files. A sequential MIRAM disk file is defined in the configurator FILE section as MODE=SEQ.

Only two functions, GET and PUT, are issued to sequential files. You can't use the same SAM or the same sequential MIRAM file for both input and output. (These files are defined individually in the configurator FILE section as input files or output files.) Input files may only be accessed by the sequential GET function. For output files, only the sequential PUT function is used.



For error status codes resulting from the execution of each of the following sequential I/O functions, see Table D-1.

5.9.1. Reading Records (GET)

The sequential GET function retrieves the next logical record in sequential order. Every record in the file is accessible regardless of contents. The first record of a sequential file retrieved in an IMS session is always the first record of the file.

The COBOL and BAL formats for the sequential GET function call are:

- COBOL format

```
CALL 'GET' USING filename record-area.
```

- BAL format

```
{CALL   }    GET,(filename,record-area)
{ZG#CALL}
```

Filename and *record-area* parameters are required on the GET function.

5.9.2. Writing Records (PUT)

The sequential PUT function writes fixed- or variable-length logical records to sequential files on tape or disk. *Filename* and *record-area* parameters are always required on this function.

When writing to a MIRAM sequential file, the records are appended to the end of the file, thus extending it. If you plan to write a new file, use the INIT parameter on the LFD statement for this file.

The COBOL and BAL formats for the sequential PUT function call are:

- COBOL format

```
CALL 'PUT' USING filename record-area.
```

- BAL format

```
{CALL   }    PUT,(filename,record-area)
{ZG#CALL}
```

5.10. Accessing Defined Files

Defined record management services requests from action programs to retrieve and update the records of defined files. An action program can call upon the random access functions GET, GETUP, PUT, DELETE, and INSERT and also the sequential access functions SETL, GET, and ESETL. In response, IMS places defined records into (and takes them from) the record area named in the I/O function call.

A transaction can access only one defined file during a given action -- the file that was allocated before the beginning of the action. One action of a transaction can select a defined file not allocated to it and designate that the selected file be allocated to the succeeding action. (See the description of the DEFINED-FILE-NAME field in 3.13.)

During a given action, a transaction can access only one defined file but can also access ISAM, SAM, DAM, or MIRAM conventional files if they are not referenced by the defined file. Access standard files by using the I/O function call formats pertaining to them.

5.11. Constructing Function Calls to Defined Files

Certain rules apply to defined files and to the parameters accompanying the function calls for them.

5.11.1. Function Call Positional Parameters

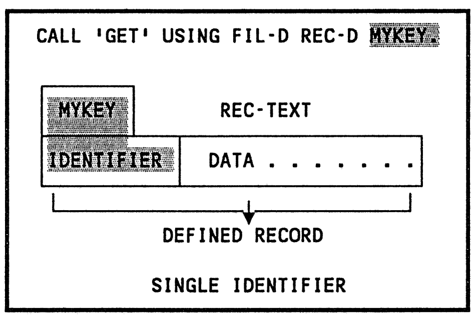
I/O function calls to IMS defined record management use *filename, position, key,* and *record-area* parameters.

Filename is a data name (COBOL) or storage location (BAL) that contains the 7-byte defined file name or subfile name assigned to this action.

Position is a data name or storage location containing the value B, G, or H that determines which defined record is returned by the first execution of the GET call following the SETL function call.

Key is a data name or storage location that contains the identifier of a defined record. An identifier consists of one or more segments.

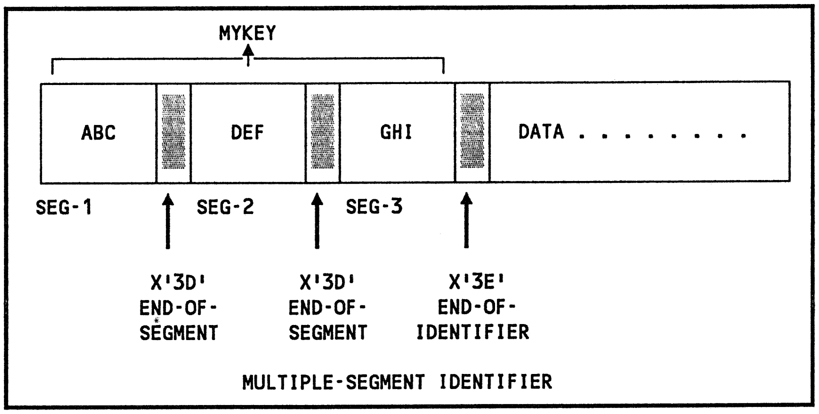
Generally, action programs access a defined record via a single identifier.



There are instances when your program needs to access a defined record that contains an identifier with multiple segments.

A segment must be delimited by an end-of-segment character ($3D_{16}$), unless the segment contains the maximum number of characters defined for it, in which case this character is optional. Every segment must contain at least one character.

The entire identifier must be delimited by an end-of-identifier character ($3E_{16}$). The ignore character ($3F_{16}$) can appear any number of times within the identifier and is always ignored. It is used for editing input messages that contain characters not needed by your action program.



When this happens, define the identifier with all its segments and separators in your action program linkage section. Define your key (identifier) as a group item in COBOL followed by the segments and separators as follows:

```
01  MYKEY.
    05  SEG-1         PIC XXX.
    05  SEP-1         PIC X.
    05  SEG-2         PIC XXX.
    05  SEP-2         PIC X.
    05  SEG-3         PIC XXX.
    05  SEP-3         PIC X.
```

Before issuing a function call using the *key* value, move the identifier segment values to SEG-1, SEG-2, and SEG-3, and the values '3D', '3D', and '3E' to SEP-1, SEP-2, and SEP-3.

To define an identifier with multiple segments in a BAL action program, use define-storage and define-constant statements.

```
1       10     16
-----------------------------------------------------------------
MYKEY   DS     CL12
        ORG
SEG-1   DS     CL3
SEP-1   DS     XL1
SEG-2   DS     CL3
SEP-2   DS     XL1
SEG-3   DS     CL3
SEP-3   DS     XL1
```

Record-area is a data name or storage location that designates the area into which a defined record is moved by IMS on an input function, or from which a defined record is passed to IMS on an output function call. This area must be big enough to contain the entire defined record, including item status bytes.

5.12. Processing Defined Records

In response to a function call, IMS uses the TYPE statement of the data definition to determine the type of defined record involved in the call. IMS returns the record type to the action program in the program information block's DETAILED-STATUS-CODE field (ZG#PDSC) redefined in COBOL as the RECORD-TYPE field. IMS returns the requested record type in the DELIVERED-RECORD-TYPE portion of the RECORD-TYPE field (byte 2 of the ZA#PDSC in the BAL program information block).

COBOL

DETAILED-STATUS-CODE

PREDICTED-RECORD-TYPE	DELIVERED-RECORD-TYPE

REDEFINED AS RECORD-TYPE

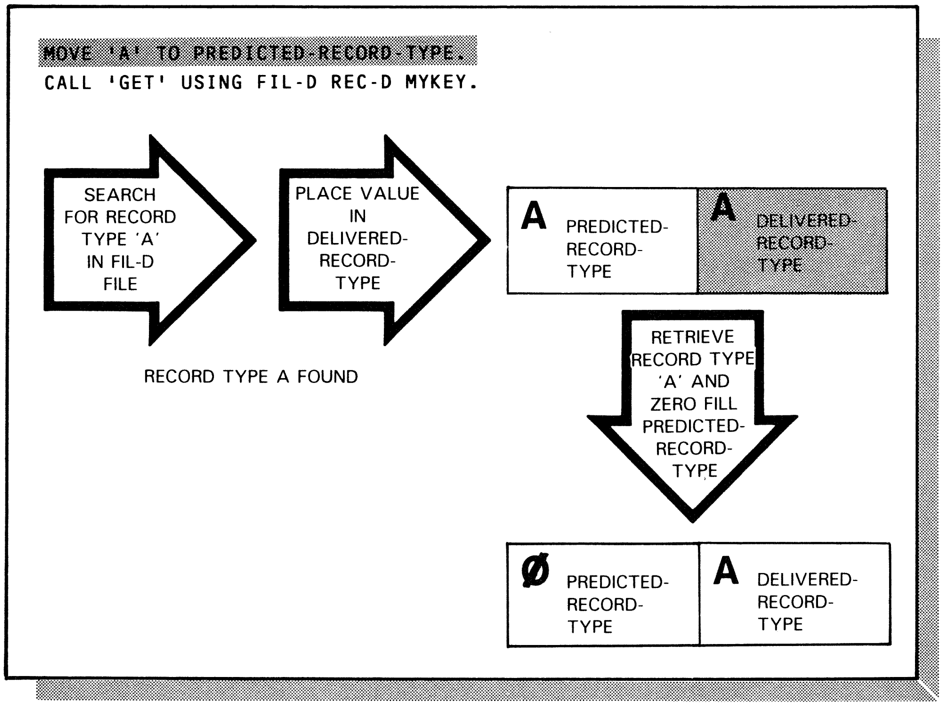
BAL

ZA#PDSC (DETAILED STATUS CODE)

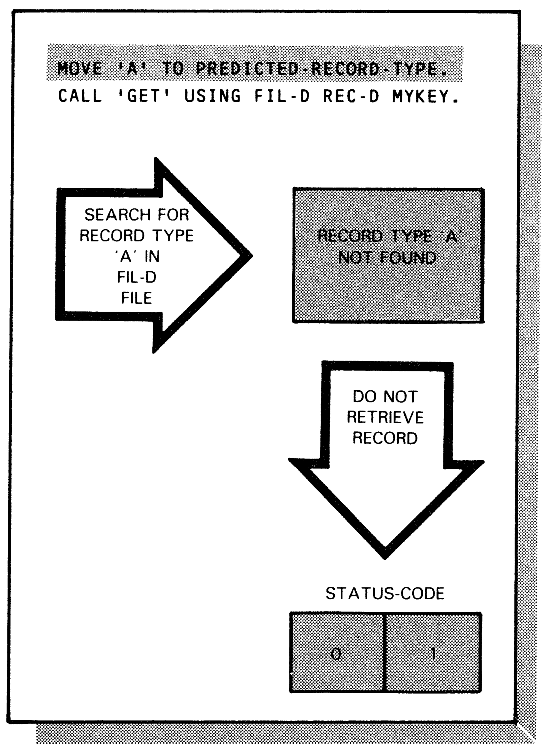
BYTE 1 (PREDICTED-RECORD-TYPE)	BYTE 2 (DELIVERED-RECORD-TYPE)

5.12.1. Handling Record Types

Before issuing any random GET, GETUP, or INSERT function call, the action program can indicate to IMS the record type it expects to receive by placing the desired record type in the PREDICTED-RECORD-TYPE byte of the RECORD-TYPE field (byte 1 of the ZA#PDSC). If IMS finds a value other than zero, it verifies the prediction before carrying out the retrieval or insertion.



If the predicted type is not correct, IMS does not move the requested record; instead, it returns a status code of 1 to the calling program.



If the predicted type is correct, IMS performs the function and the PREDICTED-RECORD-TYPE byte reverts to zero. The action program, therefore, can use the PREDICTED-RECORD-TYPE byte before the request to prevent an unexpected type of defined record from being moved to (or from) the record area. If the defined file contains more than one type of defined record, you are strongly advised to use this feature. This assures that further processing applies the correct defined record definition.

When you issue the sequential function calls SETL and GET, IMS returns the record type of the next sequential record to the PREDICTED-RECORD-TYPE byte in the program information block. If the delivered record type is the parent of the predicted record type and you wish to skip over the current record type to the next record type, you can change the contents of the predicted record byte in your action program to equal the DELIVERED-RECORD-TYPE byte. The result is that IMS skips all sets subordinate to the current delivered record type. When one or more records in a set have already been delivered, you cannot change the PREDICTED-RECORD-TYPE byte to skip over the remaining records of that set.

SEQUENTIAL CALLS TO DEFINED FILES

PREDICTED RECORD-TYPE	DELIVERED RECORD-TYPE
B	A

```
CALL 'SETL' USING FILE-D B.
MOVE 'A' TO PREDICTED-RECORD-TYPE.
CALL 'GET' FIL-D MYKEY.
IF AMT EQUAL 5000 AND PREDICTED-RECORD-TYPE
       NOT EQUAL DELIVERED-RECORD-TYPE
       MOVE DELIVERED-RECORD-TYPE TO
       PREDICTED-RECORD-TYPE.
ELSE GO TO NEXT-ROUT.
```

THIS SKIPS FROM SET-A TO SET-C

DEFINED FILE
PARENT-REC-A
CHILD-REC-1B
CHILD-REC-2B
CHILD-REC-3B
CHILD-REC-4B
CHILD-REC-5B
PARENT-REC-C
CHILD-REC-1D
CHILD-REC-2D
CHILD-REC-3D
CHILD-REC-4D
CHILD-REC-5D
CHILD-REC-6D
PARENT-REC-E
CHILD-REC-1F
CHILD-REC-2F
CHILD-REC-3F
CHILD-REC-4F

5.12.2. Interpreting Status Byte Returns

When IMS responds to a GET, GETUP, PUT, or INSERT function request, it also places a value in the status byte associated with each item of the defined record. (Status bytes are allocated by the data definition processor and have data names in the format *S-item-name.* For sample data definition processor output listings showing status bytes, see the *IMS Data Definition and UNIQUE Programming Guide,* UP-9209.) You can test these values (in COBOL programs for fixed-length records but not variable-length records) to check the validity of individual items in the defined record.

IMS returns the value X'80' in the status byte for all functions to indicate that the item was successfully delivered.

For GET and GETUP functions, IMS returns a value of X'40' to indicate that the item cannot be retrieved because it is null (nonexistent). Null items contain blanks if alphanumeric, zeros if numeric. If IMS returns X'40' for one or more items along with a value of zero in the status code, it means a supplement cannot be found via the value in the pointer item. If returned along with a value of 1 in the status code, it means the key parameter points to a nonexistent primary part. See Table D-2 for detailed status codes when the status code is 1.

For PUT and INSERT functions, IMS returns a value of X'20' in the item status byte, along with a value of 5 in the status code to indicate that the item being changed or added does not conform to conditions specified in the data definition. This error can be caused by any of the following:

- The new item value does not meet VALUE statement conditions.
- The new item value is inconsistent with the PICTURE clause in the data division.
- A change was not permitted for this item (PUT only).
- No new value was entered for a MUST ADD item (INSERT only).

If an error occurs while IMS is accessing a file, before returning control to your action program, IMS changes the LOCK-ROLLBACK-INDICATOR in the program information block to "O". This causes a rollback of any updates since the last rollback point.

Table 5-4 shows status byte returns and status codes for the GET, GETUP, PUT, and INSERT function calls to defined files.

Table 5-4. Status Byte Returns for Defined File Functions

Functions	Status Byte Values	Status Codes	Meaning
All	X'80'	X'0000'	Item successfully delivered
GET or GETUP	X'40'	X'0000'	Supplement can't be found using specified pointer
		X'0001'	Key points to nonexistent primary part
PUT or INSERT	X'20'	X'0005'	• Incorrect VALUE statement • Inconsistent PIC clause • Change not permitted • Value missing for a MUST ADD item.

5.13. Random Functions for Defined Files

I/O function calls to access defined files randomly are GET, GETUP, PUT, DELETE, and INSERT. During random access to defined files, IMS locks logical records involved in the GETUP and INSERT functions. For error status codes resulting from the execution of each of the following random I/O function calls, see Table D-1.

5.13.1. Reading Defined Records Randomly (GET)

Using a *key* parameter, the GET function retrieves a record from the named file and places the record into the record area of your action program. You cannot update or delete a record retrieved by a GET function.

The COBOL and BAL formats for the GET function call are:

- COBOL format

```
CALL 'GET' USING filename record-area key.
```

- BAL format

```
{CALL   }  GET,(filename,record-area,key)
{ZG#CALL}
```

5.13.2. Reading Defined Records for Update (GETUP)

Using a *key* parameter, the GETUP function retrieves a record for update from the named file and places the record into the record area of your action program. A GETUP is followed by a PUT or DELETE function. No other function calls to the defined file can intervene.

The COBOL and BAL formats for the GETUP function call are:

- COBOL format

```
CALL 'GETUP' USING filename record-area key.
```

- BAL format

```
{CALL   }  GETUP,(filename,record-area,key)
{ZG#CALL}
```

5.13.3. Writing Defined Records (PUT)

The PUT function writes a record that was retrieved for update back to the file. For the record to be effectively updated, the PUT function must immediately follow the GETUP function. The COBOL and BAL formats for the PUT function call are:

- COBOL format

```
CALL 'PUT' USING filename record-area.
```

- BAL format

```
{CALL   }  PUT,(filename,record-area)
{ZG#CALL}
```

5.13.4. Deleting Defined Records (DELETE)

The DELETE function logically deletes a record that was retrieved for update. The DELETE function must immediately follow the GETUP function to effectively delete the record. COBOL and BAL formats for the DELETE function call are:

- COBOL format

```
CALL 'DELETE' USING filename record-area.
```

- BAL format

```
{CALL   }  DELETE,(filename,record-area)
{ZG#CALL}
```

5.13.5. Adding Defined Records (INSERT)

The INSERT function enters a new record into a file. The identifier value in the key parameter must not already exist in the file. COBOL and BAL formats for the INSERT function call are:

- COBOL format

```
CALL 'INSERT' USING filename record-area key.
```

- BAL format

```
{CALL   }  INSERT,(filename,record-area,key)
{ZG#CALL}
```

5.14. Sequential Functions for Defined Files

I/O function calls to access defined files sequentially include the SETL, sequential GET, and ESETL function calls. For error status codes resulting from the execution of each of the following sequential function calls, see Table D-1.

5.14.1. Setting Defined Files from Random to Sequential Mode (SETL)

The SETL function sets a defined file into the sequential mode and logically positions the file. The position parameter is a data name or storage location that contains one of the following values:

Value	Meaning
B	Beginning of file
G	Greater than or equal to key
H	Greater than key

The COBOL and BAL formats for the SETL function call are:

- COBOL format

```
CALL 'SETL' USING filename position [key].
```

- BAL format

```
⎧CALL   ⎫  SETL,(filename,position[,key])
⎩ZG#CALL⎭
```

When the value of the position parameter is B, the *key* parameter is omitted. The SETL function always returns successful completion (status code of 0).

5.14.2. Reading Defined Files Sequentially (GET)

The GET function retrieves the next defined record in the file in sequential order.

The COBOL and BAL formats for the sequential GET function are:

- COBOL format

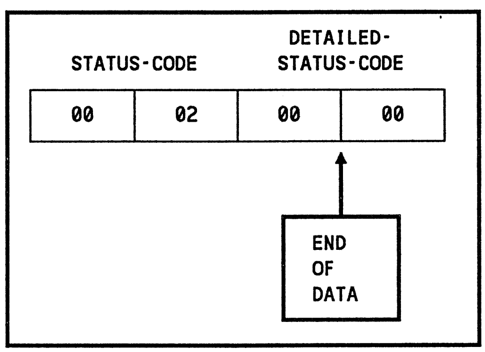
```
CALL 'GET' USING filename record-area.
```

- BAL format

```
{CALL   } GET,(filename,record-area)
{ZG#CALL}
```

If IMS returns a status code of 0 (detail cycle), IMS returns a new defined record to your action program. The DELIVERED-RECORD-TYPE byte identifies the record type.

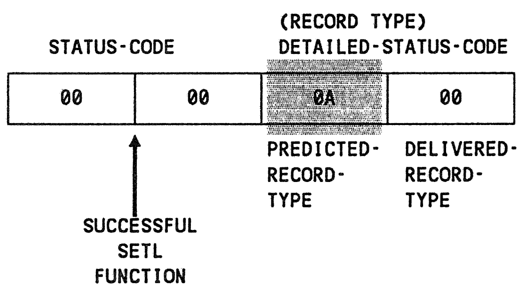
A status code of 2 (total cycle) means that there are no more records in the current set. IMS returns no new defined record. The detailed status code (RECORD-TYPE) indicates the record type of the completed set. A status code of 2 with a detailed status code of 0 indicates end of all data; there are no more sets in this defined file.



After IMS delivers a detail record, it also delivers all subordinate records in response to subsequent GET function calls. When a set of subordinate records is empty, the response to the GET function that requests the first record of the set is a status code of 2 and a detailed status code (DELIVERED-RECORD-TYPE) equal to the record type of the empty set.

Your action program selects the appropriate record area by interrogating the value in the first byte of the DETAILED-STATUS-CODE (PREDICTED-RECORD-TYPE byte) returned by the preceding GET or SETL function.

```
CALL 'SETL' USING FIL-A B.
```




```
IF PREDICTED-RECORD-TYPE EQUALS 'A'
   CALL 'GET' USING FIL-A REC-A
ELSE
   CALL 'GET' USING FIL-A REC-B.
```

5.14.3. Setting Defined Files from Sequential to Random Mode (ESETL)

The ESETL function changes the mode of a defined file from sequential to random. If a file is in the sequential mode and an ESETL function is not performed before termination of the current action, IMS changes the file to random mode at action termination. COBOL and BAL formats for the ESETL function call follow.

- COBOL format

```
CALL 'ESETL' USING filename.
```

- BAL format

```
{CALL   }  ESETL,(filename)
{ZG#CALL}
```

5.15. Unlocking Records (UNLOCK)

The UNLOCK function releases record locks not released as a result of normal transaction termination or file updating. It also makes available for processing ISAM and MIRAM files held for a transaction pending an update.

The COBOL and BAL formats for the UNLOCK function are:

- COBOL format

```
CALL 'UNLOCK' USING filename.
```

- BAL format

```
{CALL   }    UNLOCK,(filename)
{ZG#CALL}
```

The UNLOCK function applies to both the lock-for-update and lock-for-transaction instructions imposed on DAM, MIRAM, or ISAM files. When you configure either type lock for these files and an update of a record is currently pending for a transaction, the UNLOCK function aborts the update by releasing the record lock. The following lines of COBOL code demonstrate:

```
CALL 'GETUP' USING MYFIL IMS-REC-AREA MYKEY.
MOVE CUST-NAME TO NAME-FIELD.
**********************************************
*    UPDATE PENDING / AWAITING PUT OR DELETE *
**********************************************
CALL 'UNLOCK' USING MYFIL.
```

Releases Lock on MYFIL

For ISAM files, the UNLOCK function makes the file, as well as the individual record, accessible for processing requests from other transactions. For DAM files, the UNLOCK function unlocks only the individual record. The rest of the file remains accessible to other transactions.

The UNLOCK function cannot be used against a file in undedicated sequential mode. This applies to any ISAM, IRAM, or MIRAM file placed in sequential mode following a SETL or SETK function. Any attempt to issue the UNLOCK function while a file is in undedicated sequential mode results in an INVALID FUNCTION error (0307) being posted in the PIB status bytes.

5.16. Processing User-Defined Printer Files

You need printer files when you have no terminal printers and want to obtain logging information or a listing of data on your files.

To define printer files, specify the FILETYPE=PRNT parameter in the configurator FILE section. You must define them after all other user-defined files at configuration time.

Three special function calls, issued by your action program, are used only for processing user-defined printer files:

1. PRINT assigns printer files to terminals.

2. UNLOCK releases assigned printer files.

3. BRKPT controls spooler output printing.

All printer files are assigned by terminal. You may assign any number of printer files to the same terminal.

The first time an action program successfully executes a PRINT function call, IMS assigns a printer file to the terminal where that action program originated. Once printer files are assigned to a terminal, any attempts to access those files from another terminal cause IMS to return an invalid request status code in the program information block.

All printer files assigned to a particular terminal remain effective until:

- Your action program issues an UNLOCK or BRKPT function while executing from that terminal.

- A BRKPT transaction code causes IMS to execute the breakpoint (refer to the *IMS Operations Guide*, UP-12027).

- A transaction that uses assigned printer files is executing at a terminal and terminates abnormally (see the description of BRKPT function call).

- The terminal is signed off ($$SOFF).

- The file lock is released at normal transaction termination, when the printer file was assigned to a spool file at a remote location (DDP environment).

For error status codes resulting from the execution of the PRINT, UNLOCK, and BRKPT function calls, see Table D-1.

5.16.1. Printing User Data and Controlling Forms (PRINT)

The PRINT function prints your data and controls forms positioning. It also associates the file you name on the PRINT function with the printer file that IMS assigns to a terminal the first time your action program executes that PRINT function.

- COBOL format

```
CALL 'PRINT' USING file-name rec-area
           [rec-size [cntrl-char-area]].
```

- BAL format

```
{CALL   }  PRINT,(file-name,rec-area
{ZG#CALL}       [,rec-size [,cntrl-char-area]])
```

The file name you specify on your PRINT function call must be the same name you configured in the FILE section on the filename positional parameter. For more details, see the *IMS System Support Functions Programming Guide*, UP-11907. If the file name is not one of those you configured as a printer file, IMS returns a status code of 3 (invalid request) and a detailed status code 7 (invalid function) in the program information block.

The record area may contain only printable data. Control characters are not permitted in this area.

The record size parameter is the symbolic address of a 2-byte binary field indicating the number of printable characters moved to the I/O area.

IMS allows up to 160 characters for record size; however, the record size cannot exceed the maximum print positions of the printer selected. If it does, the record is truncated.

If you specify a record size less than the configured block size, IMS fills the remaining bytes with spaces (X'40').

If you want to control forms movement without printing, specify a record size of zero.

When you omit the record size parameter, IMS assumes a record size of 120 bytes.

The control-character-area parameter is a symbolic address of a 1-byte field containing a printer device-independent control character.

IMS supplies a control character code of X'01' when you omit this parameter. This prints one line and then spaces to the next line.

When you specify PRINTOV=SKIP, automatic advance to the home paper position occurs when an overflow condition is detected. Use this configurator specification for most normal printing requirements.

Specifying PRINTOV=filename (DTF mode) allows you to print either footnotes at the bottom of a page or advance to the home paper position to print special page headers.

IMS returns status code 1 on a forms overflow condition. This occurs when you don't specify PRINTOV=SKIP but configure instead PRINTOV=filename (DTF mode) or PRINTOV=REPORT (CDM mode).

See B.7 for a programming example of PRINT function.

5.16.2. Releasing Assigned Printer Files (UNLOCK)

The UNLOCK function releases the printer file assignment from the current terminal. This means the printer file can now be extended by action programs initiated from other terminals.

- COBOL format

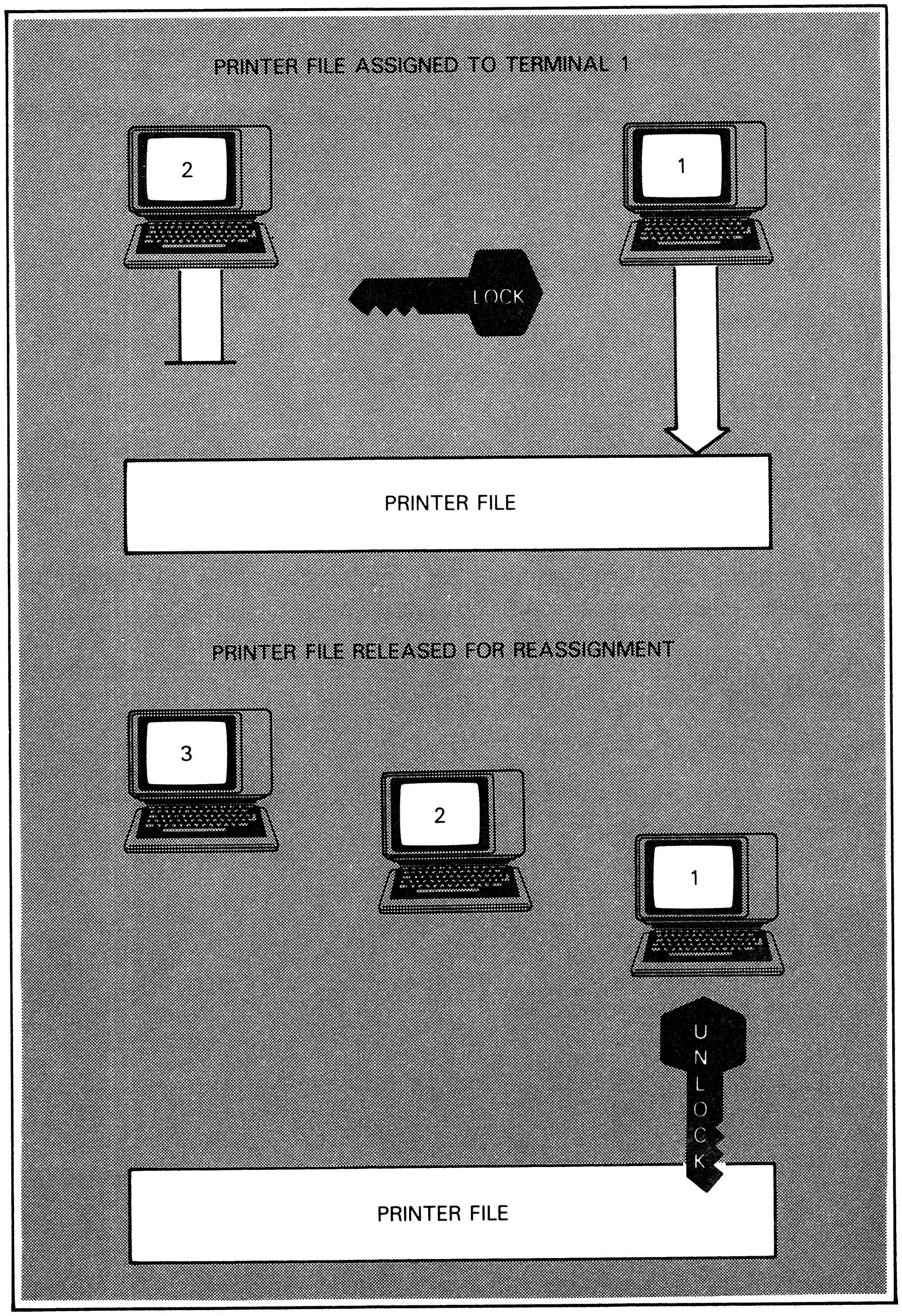
```
CALL 'UNLOCK' USING filename
```

- BAL format

```
{CALL   }   UNLOCK,(filename)
{ZG#CALL}
```

As soon as your action program issues a successful PRINT function call, IMS assigns the printer file and initiates a file lock. Locking prevents output from several terminals from being sent to the same printer file concurrently.

You can unlock a printer file only if the action program issuing the UNLOCK function is initiated at the terminal to which that file is assigned. Otherwise, IMS returns a status code of 3 (invalid request) and a detailed status code of 7 (invalid function). The following diagram illustrates locking and unlocking of printer files.



5.16.3. Starting Spooled Printer Files before Job Termination (BRKPT)

The BRKPT function allows you to unlock and start printing a spooled printer file before the IMS job terminates. This makes the printer file available for reassignment.

During the breakpoint process, the current action program may continue to issue PRINT functions to assign and extend the current spooled printer file.

Avoid sending output directly to printer devices. Spooling output to printer files is faster.

- COBOL format

```
CALL 'BRKPT' USING filename [lock-disposition].
```

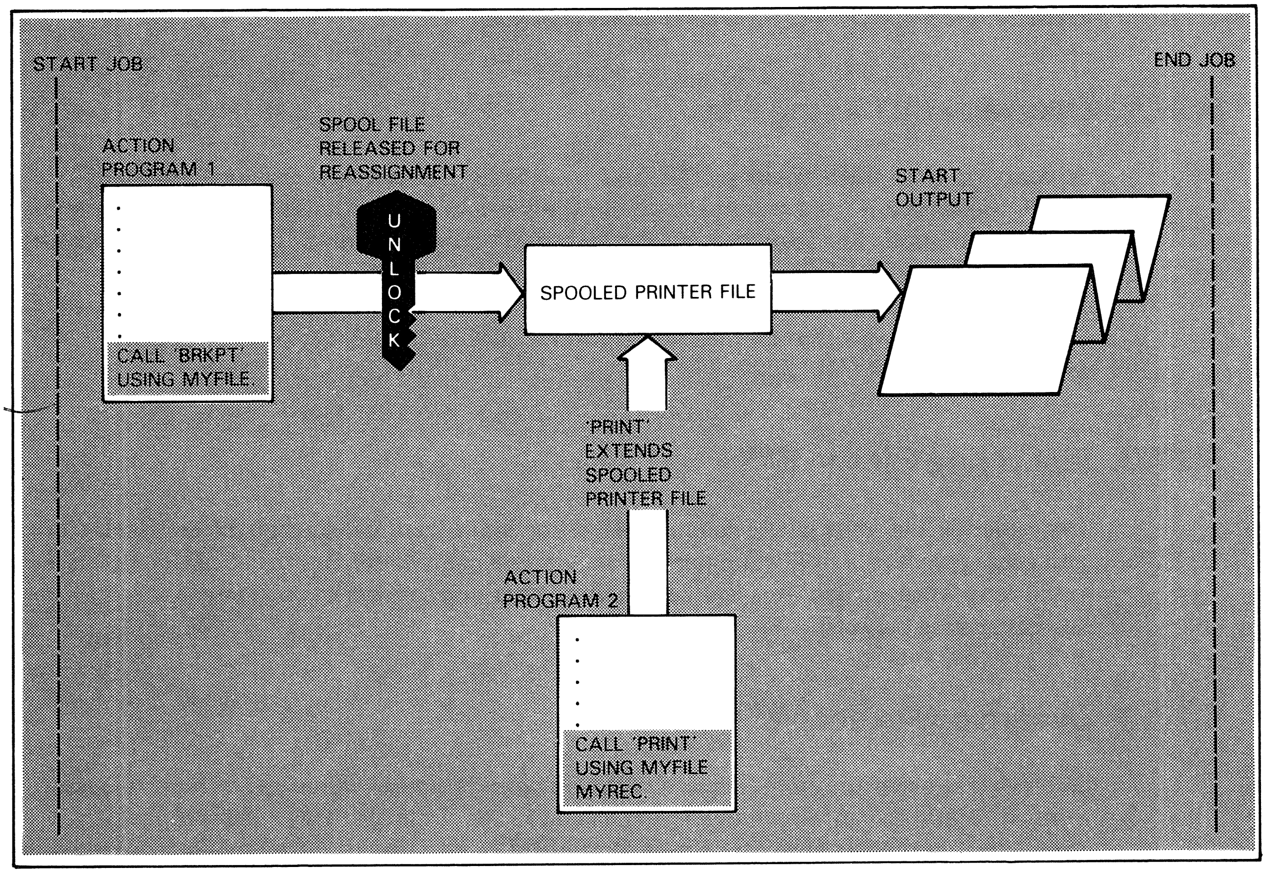
- BAL format

```
{CALL   }    BRKPT,(filename[,lock-disposition])
{ZG#CALL}
```

The lock-disposition parameter is a symbolic address of a 1-byte field containing EBCDIC character H. This value indicates that, after the printer file is breakpointed, IMS retains the file assigned to the current terminal.

If your printer file is not spooled, the breakpoint request is ignored and, if you specified the lock-disposition parameter, the file lock is held.

The following diagram illustrates the BRKPT execution for a spooled printer file when the lock-disposition parameter is not specified.



If you omit the lock-disposition parameter, IMS releases the current printer file after it is breakpointed.

When your printer files are nonspooled, a BRKPT function issued without the lock-disposition parameter results in an unlock operation.

The action program that issues your BRKPT function must be initiated from the terminal assigned to the printer file being breakpointed. If the printer file is not assigned to that terminal, IMS ignores the BRKPT request and returns a status code 3 (invalid request) and a detailed status code of 7 (invalid function) in the program information block.

See B.7 for a programming example of BRKPT function.

5.17. File Processing Considerations

5.17.1. Opening and Closing Files

At start-up time, IMS opens all the files you configure and, at shutdown time, IMS closes them. You must assign each file in the job control stream at start-up. You can close and reopen files from the master terminal using the master terminal commands ZZCLS and ZZOPN. When IMS receives these commands, it issues calls to data management to perform close and reopen functions. You cannot open and close files from your action program. For a description of ZZCLS and ZZOPN, see the *IMS Operations Guide,* UP-12027.

5.17.2. Identifying Files to IMS

Describe each of your data files in a FILE section of the IMS configuration. Each file you configure has a single file descriptor entry in the file control table. IMS uses this table to reference files that you access and to queue requests to each file while servicing each request.

5.17.3. Dynamic Allocation of I/O Areas

In a normal programming environment, you would allocate I/O areas to receive data from files and to contain changes sent back to files. In multithread IMS, these I/O areas are preallocated. And in single-thread IMS, they are allocated when required. No more than one I/O area is allocated to a file at a given time. Once allocated, an I/O area can be used to support multiple-file functions for a number of different transactions. When no function calls to a file are outstanding, IMS releases the I/O area to main storage management.

5.17.4. File Sharing

More than one transaction can share access to a file. Locking procedures for ISAM and MIRAM file updates make it more efficient to program more than one function call in one action (for example, GETUP and its corresponding function call, PUT or DELETE, in the same action).

The lock on a record being updated can be held from one action to another. However, another GETUP must be issued. It is, therefore, more efficient to update ISAM or MIRAM files in a single action.

5.17.5. Work and Record Area Considerations

If your DAM file resides on a fixed-sector disk, OS/3 data management requires that the length of the I/O area be some multiple of 256 bytes and half-word aligned. To achieve device independence across disk subsystems, so that your program can access a DAM file on any disk used under OS/3, the same is true -- I/O areas should be multiples of 256 bytes in length.

To ensure device independence in a BAL or COBOL action program that accesses DAM files, you should ensure that the record-area parameter of any IMS function call (GET, GETUP, PUT, DELETE, or INSERT) refers to an area whose reserved length is some multiple of 256 bytes on a half-word boundary.

There are other considerations (such as record or block length, and the track capacity of the disk subsystem in use) to keep in mind in establishing work-area and record-area lengths for your action programs. For further details, refer to the *Consolidated Data Management Macroinstructions Programming Guide,* UP-9979.

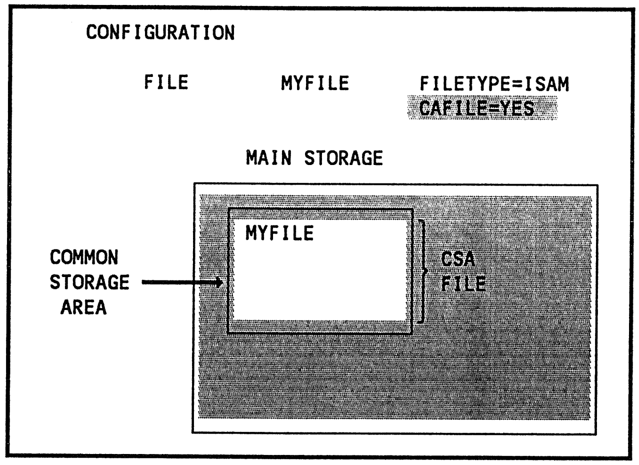
5.17.6. Test Mode Effects on File I/O

When you enter a ZZTMD terminal command to place that terminal in the test mode, any request to IMS to change the contents of a file are only simulated. No UPDATE, DELETE, or INSERT functions are performed. Control returns to the requesting transaction with a successful completion status code.

You can put a terminal in the test mode after completing a transaction; that is, when not in an interactive mode. To revert to normal mode, use the ZZNRM terminal command. Test mode is used to train new terminal operators to handle update transactions. All terminal entries made by the operator are the same in test mode as in the normal mode except that no file modifications actually occur. Test mode also is useful in testing newly written or modified action programs that perform file modifications. For more details about the ZZTMD and ZZNRM terminal commands, see the *IMS Operations Guide,* UP-12027.

5.17.7. Common Storage Area Files

You can increase file processing efficiency by making frequently accessed ISAM or MIRAM files resident in a special common storage area (CSA). This feature is especially useful for maintaining vital information used by many action programs. You must have adequate main storage to use this feature.



You can index and access CSA files only in indexed random mode. You use GET, GETUP, and PUT function calls the same way as for any ISAM or MIRAM file, but INSERT and DELETE functions are not valid. CSA files are not accessible through UNIQUE.

If you specify CUPDATE=YES to the configurator, IMS updates the disk as well as the resident file. This saves disk accesses on reads but not on writes. However, if you've configured CSA files and omit CUPDATE or specify CUPDATE=NO, IMS updates the resident file but does not update the disk file until shutdown, when the entire CSA file is written to disk. File locking and recovery functions are the same for the CSA file as for a disk file.

Section 6
Sending Output Messages

6.1. Purpose of Output Message Area

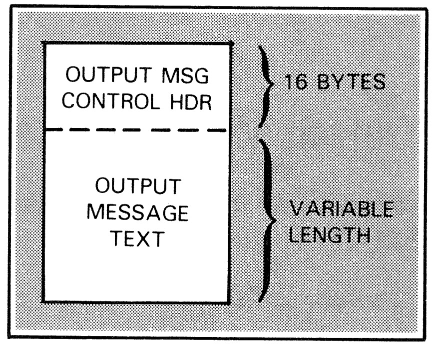
When an action program issues an output message, the message is normally sent from the output message area.

According to application requirements, action programs can issue output messages:

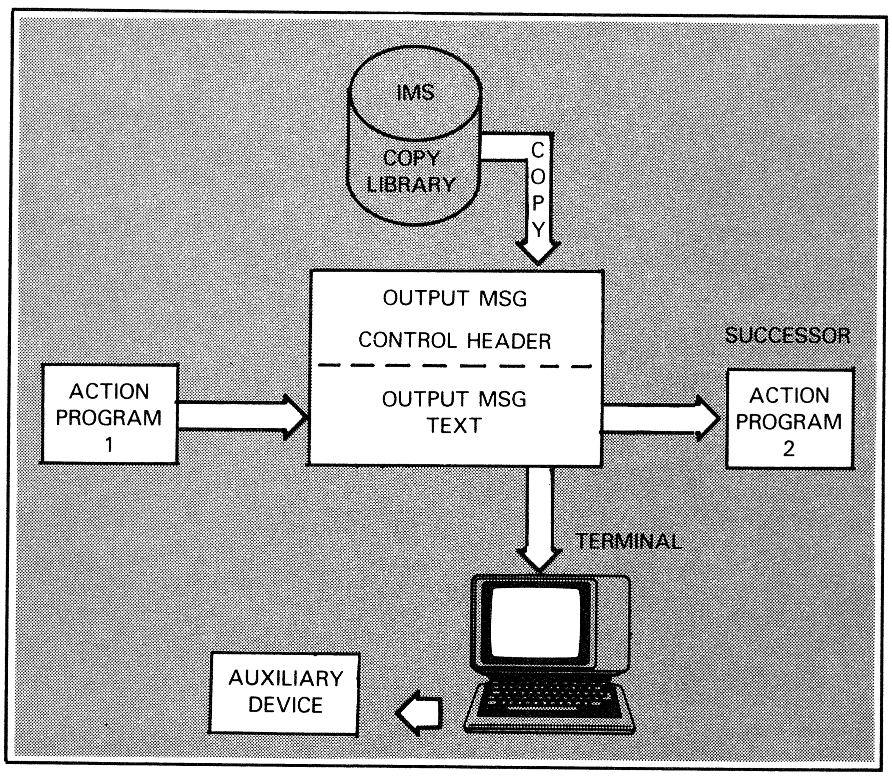
- To the source terminal, auxiliary device, or successor action program at the end of an action via the CALL RETURN function
- To the source or other terminal or auxiliary device via the CALL SEND function.

6.2. Your Action Program's Output Message Area Contents

The output message area you describe has two parts: a 16-byte control header and a variable-length message text.



Your program copies the appropriate COBOL or BAL message control header format from the IMS copy library. The second part of the output message area contains the output message text your program sends to a terminal, auxiliary device, or successor action program.



At action initiation, IMS sets the message text portion of the output message area to blanks.

When an action terminates normally, IMS sends the output message to the source terminal unless otherwise specified.

6.3. Size of Output Message Area

The OUTSIZE parameter in the ACTION section of the configurator specifies the length of the output message area. The size you specify depends on whether you use screen format services for the action and whether you build your screen format in the output message area or in dynamic main storage.

If you build a screen format in the output message area, the OUTSIZE value must be large enough to accommodate the screen format buffer contents including variable output data buffer contents, display constants, and device control characters.

Instead of specifying an output message area length on the OUTSIZE parameter, you can specify a standard output message size (OUTSIZE=STAN). IMS allocates an output area based on your CHRS/LIN and LNS/MSG parameter values in the GENERAL section of the configuration.

For formulas to calculate output message area length, see the IMS *System Support Functions Programming Guide,* UP-11907.

6.4. COBOL Action Program Output Message Area

6.4.1. Output Message Header Format

The COBOL output message header format is available in the IMS copy library under the name OMA for extended COBOL or under the name OMA74 for 1974 American National Standard COBOL. Figure 6-1 shows the output message area control header format.

```
01  OUTPUT-MESSAGE-AREA.
    02 DESTINATION-TERMINAL-ID      PIC X(4).
    02 SFS-OPTIONS
       03 SFS-TYPE                  PIC X.
       03 SFS-LOCATION              PIC X.
    02 FILLER                       PIC X(2).
    02 CONTINUOUS-OUTPUT-CODE       PIC X(4).
    02 TEXT-LENGTH                  PIC 9(4) COMP-4.
    02 AUXILIARY-DEVICE-ID.
       03 AUX-FUNCTION              PIC X.
       03 AUX-DEVICE-NO             PIC X.
```

Figure 6-1. COBOL Format for Output Message Area Control Header

When you code your COBOL action program's linkage section, copy the output message area control header format into your action program from the IMS copy library using a COPY verb. Once you copy the output message control header from the IMS copy library, your program can access any of these control fields by referencing them in the procedure division.

6.4.2. Output Message Text Description

The output message text description immediately follows the output message control header format copied from the IMS copy library. Describe the output message text fields your program issues to a terminal, auxiliary device, or succeeding action program. Define the output message text as those data items subordinate to the 01-level output message area description. The shaded area in Figure 6-2 shows the output message area control header fields generated by the COPY verb. Fields immediately following the control header represent output text sent by your program.

Note that the first 02-level item describes the device-independent control expression (DICE sequence) that formats the output message. (Appendix F explains this use in detail.) DICE control sequences are needed to position output messages unless you use screen format services (see Section 7).

```
                        OUTPUT MESSAGE AREA
                          CONTROL HEADER

                  02 DESTINATION-TERMINAL-ID      PIC X(4).
                  02 SFS-OPTIONS
                     03 SFS-TYPE                  PIC X.
                     03 SFS-LOCATION              PIC X.
                  02 FILLER                       PIC X(2).
                  02 CONTINUOUS-OUTPUT-CODE       PIC X(4).
                  02 TEXT-LENGTH     PIC 9(4)     COMP-4.
                  02 AUXILIARY-DEVICE-ID.
                     03  AUX-FUNCTION             PIC X.
                     03  AUX-DEVICE-NO            PIC X.

              LINKAGE SECTION.
              .
              .
              .
              01  O-M-A.          COPY OMA74.
                  02  DICE-OUT.
CONTROL               03  FILLER      PIC XX.
CHARACTER             03  DICE-Y      PIC X.
SEQUENCE              03  FILLER      PIC X.
                  02  OUT-MSG.
                      03  PAY-OUT     PIC $$$9.99.
OUTPUT                03  LIT-OUT.
MESSAGE                   04  FILLER      PIC X(32).
TEXT                      04  CUST-OUT    PIC X(6).
DESCRIPTION               04  FILLER      PIC X(18).
                      03  NEW-BAL         PIC $$$9.99
```

Figure 6-2. Sample COBOL Output Message Area Description

6.5. BAL Action Program Output Message Area

6.5.1. Output Message Header Format

IMS also supplies an output message area control header format for BAL action programs. It is in the form of a DSECT called by a macroinstruction (ZM#DOMH) in your action program. Figure 6-3 shows the format of the BAL output message area control header. (To list the current DSECTs on your system, see Appendix H.)

```
ZA#OMH    DSECT
*
*  OUTPUT MESSAGE HEADER
*
ZA#ODTID DS    CL4              DESTINATION TERMINAL ID
ZA#OSFSO DS    0CL2             SFS OPTIONS
*
ZA#SFTYP DS    CL1              FORMAT TYPE
ZA#SFLOC DS    CL1              FORMAT LOCATION
*  EQUATES FOR ZA#SFTYP & ZA#SFLOC
ZA#OSFSI EQU   C'I'             INPUT FORMAT
ZA#SFDYN EQU   C'D'             DYNAMIC MEMORY
         DS    CL2              RESERVED FOR SYSTEM USE
ZA#CONT  DS    XL4              CONTINUOUS OUTPUT CODE
ZA#OMHL  EQU   *-ZA#OMH         OUTPUT MSG AREA HEADER LENGTH
ZA#OTL   DS    H                MESSAGE LENGTH
ZA#OAUX  DS    CL2              AUXILIARY-DEVICE-ID
*
*  EQUATES FOR ZA#OAUX
*
ZA#ONCOP EQU   X'00'            NO COP SUPPORT REQUESTED
ZA#OCO   EQU   X'C3'            CONTINUOUS OUTPUT REQ
ZA#OOIQ  EQU   X'C9'            QUEUE AS INPUT FOR DEST: TCT
ZA#OHANG EQU   X'D0'            RESERVED FOR IMS/90 SYSTEM USE
ZA#OCOP  EQU   X'F0'            COP OUTPUT REQUESTED
ZA#OCOCP EQU   X'F3'            CONTINUOUS OUTPUT TO COP
ZA#OPTCP EQU   X'F4'            PRINT TRANSPARENT TO COP
ZA#OPCOC EQU   X'F7'            CONTINUOUS OUTPUT TO COP WITH
*                               PRINT TRANSPARENT

*        SS: SPACE SUPRESSION     ISS:     INHIBIT SPACE SUPPRESSION
*        C:     CONTINUOUS OUTPUT     NC:  NOT CONTINUOUS OUTPUT
*
ZA#OCSPM EQU   X'F3'               3: C,SS,PRINT MODE
ZA#ONSPM EQU   X'F0'               0: NC,SS,PRINT MODE
ZA#OCSPT EQU   X'F7'               7: C,SS,PRINT TRANSPARENT
ZA#ONSPT EQU   X'F4'               4: NC,SS,PRINT TRANSPARENT
ZA#OCIPM EQU   X'F5'               5: C,ISS,PRINT MODE
```

Figure 6-3. BAL Format for Output Message Area Control Header (ZA#OMH DSECT) (Part 1 of 2)

```
ZA#ONIPM EQU   X'F2'                2: NC,ISS,PRINT MODE
ZA#OCIPT EQU   X'F9'                9: C,ISS,PRINT TRANSPARENT
ZA#ONIPT EQU   X'F6'                6: NC,ISS,PRINT TRANSPARENT
ZA#OCSPF EQU   X'C1'                A: C,SS,PRINT FORM (ESC H)
ZA#ONSPF EQU   X'D1'                J: NC,SS,PRINT FORM (ESC H)
ZA#OCSTA EQU   X'C2'                B: C,SS,TRANSFER ALL (ESC G)
ZA#ONSTA EQU   X'D2'                K: NC,SS,TRANSFER ALL (ESC G)
ZA#OCSTV EQU   X'C4'                D: C,SS,TRANSFER VARIABLE (ESC F)
ZA#ONSTV EQU   X'D4'                M: NC,SS,TRANSFER VARIABLE (ESC F)
ZA#OCSTC EQU   X'C5'                E: C,SS,TRANSFER CHANGED (ESC E)
ZA#ONSTC EQU   X'D5'                N: NC,SS,TRANSFER CHANGED (ESC E)
ZA#OCIPF EQU   X'C6'                F: C,ISS,PRINT FORM (ESC H)
ZA#ONIPF EQU   X'D6'                O: NC,ISS,PRINT FORM (ESC H)
ZA#OCITA EQU   X'C7'                G: C,ISS,TRANSFER ALL (ESC G)
ZA#ONITA EQU   X'D7'                P: NC,ISS,TRANSFER ALL (ESC G)
ZA#OCITV EQU   X'C8'                H: C,ISS,TRANSFER VARIABLE (ESC F)
ZA#ONITV EQU   X'D8'                Q: NC,ISS,TRANSFER VARIABLE (ESC F)
ZA#OCTIC EQU   X'E8'                Y: C,ISS,TRANSFER CHANGED (ESC E)
ZA#ONITC EQU   X'F8'                8: NC,ISS,TRANSFER CHANGED (ESC E)
ZA#ONTRM EQU   X'D9'                R: C,READ MODE
ZA#ONTRT EQU   X'E2'                S: C,READ TRANSPARENT
ZA#ONTSR EQU   X'E3'                T: C,SEARCH AND READ MODE
ZA#ONTST EQU   X'E5'                V: C,SEARCH AND READ TRANSPARENT
ZA#ONTRA EQU   X'E6'                W: C,REPORT ADDRESS
ZA#OCTBB EQU   X'D3'                L: C,BACK ONE BLOCK
ZA#ONTBB EQU   X'E7'                X: NC,BACK ONE BLOCK
ZA#OCTSP EQU   X'E9'                Z: C,SEARCH AND POSITION
ZA#ONTSP EQU   X'E4'                U: NC,SEARCH AND POSITION
ZA#HOD   EQU   X'5B'                $: NC,CLEAR ICAM QUEUE
*
*   EQUATES FOR ZA#OAUX+1
*
ZA#ODID1 EQU   C'1'                 DEVICE = AUX1
ZA#ODID2 EQU   C'2'                 DEVICE = AUX2
ZA#ODID3 EQU   C'3'                 DEVICE = AUX3
ZA#ODID4 EQU   C'4'                 DEVICE = AUX4
ZA#ODID5 EQU   C'5'                 DEVICE = AUX5
ZA#ODID6 EQU   C'6'                 DEVICE = AUX6
ZA#ODID7 EQU   C'7'                 DEVICE = AUX7
ZA#ODID8 EQU   C'8'                 DEVICE = AUX8
ZA#ODID9 EQU   C'9'                 DEVICE = AUX9
ZA#ODQA  EQU   X'70'                ALL ICAM QUEUES (H, M, L)
ZA#ODQH  EQU   X'10'                ICAM HIGH QUEUE
ZA#ODQM  EQU   X'20'                ICAM MEDIUM QUEUE
ZA#ODQL  EQU   X'40'                ICAM LOW QUEUE
```

Figure 6-3. BAL Format for Output Message Area Control Header (ZA#OMH DSECT) (Part 2 of 2)

To generate inline the output message control header (the macro expansion of the ZA#OMH DSECT), you issue the ZM#DOMH macroinstruction in your BAL action program. If you don't want to see the ZM#DOMH macro expansion inline, use the PRINT NOGEN instruction before you issue the ZM#DOMH macroinstruction. Though the output message control header fields are not seen in your program coding, they are still available and you can reference them.

6.5.2. Output Message Text Description

Immediately following the ZM#DOMH macroinstruction, you describe the output message text fields your program wants to send to the terminal, auxiliary device, or successor action program. Using defined-constant (DC) statements, you describe each field of your output message text.

Figure 6-4 illustrates the macroinstruction that generates the output message control header followed by the description of output text being sent to a terminal (in this case, a 42-byte area containing a 4-byte control character field, the word CAPITAL, and space to enter the name of a state capital). Refer to Appendix B for this example in the full context of the IMS state capital action program. Note that PRINT NOGEN is specified and the ZM#DOMH macro is not expanded inline. Nevertheless, this action program can still access any field in the control header.

Note that the first four bytes of OUTTEXT contain the device-independent control expression (DICE sequence) that clears the line and positions the output message on the new line. (Appendix F explains their use in detail.) DICE control sequences are needed to format output messages unless you use screen format services.
(See Section 7.)

```
1         10    16                                                  72
------------------------------------------------------------------------
         PRINT NOGEN
.
.
.
*BUILD OUTPUT MESSAGE
         MVC   OUTTEXT(4),NEWLINE            PUT DEVICE INDEPENDENT CONTROL
*                                            CHARACTERS INTO MESSAGE TO CLEAR
*                                            TO END OF LINE AND POSITION TO
*                                            BEGINNING OF NEXT LINE
         MVC   OUTTEXT+4(L'MSGCON1),MSGCON1  PUT TEXT CONSTANT INTO MESSAGE
         MVC   OUTTEXT+4+L'MSGCON1(L'SCAPITAL),SCAPITAL  PUT CAPITAL NAME INTO
*                                                        MESSAGE
.
.
.
*CONSTANTS
STATE    DC    CL7'STATE'                    ISAM FILENAME
MSGCON1  DC    C'CAPITAL'
NEWLINE ZOPOSC 0,0                            ICAM PROCEDURE TO GENERATE
*                                             DICE SEQUENCE FOR NEW LINE
*                                             CONTROL WITH CLEAR
SCAPITAL DS    XL25                          STATE CAPITAL
.
.
.
         ZM#DOMH                             COPY OMA CONTROL HEADER
OUTTEXT  DS    XL42                          OUTPUT MESSAGE TEXT AREA
.
.
.
```

Figure 6-4. Sample BAL Output Message Area Description

6.6. Contents of Output Message Area Control Header

The header format identifies the terminal that is to receive the output message, screen formatting options (if used), continuous output code (if used), the length of the output message text, auxiliary function code (if used), and auxiliary device number (if used). Figure 6-5 shows some of the questions about output messages that the output message control header answers when the action program sets values in the control header fields. Subsections 6.7 through 6.13 describe output message header fields.

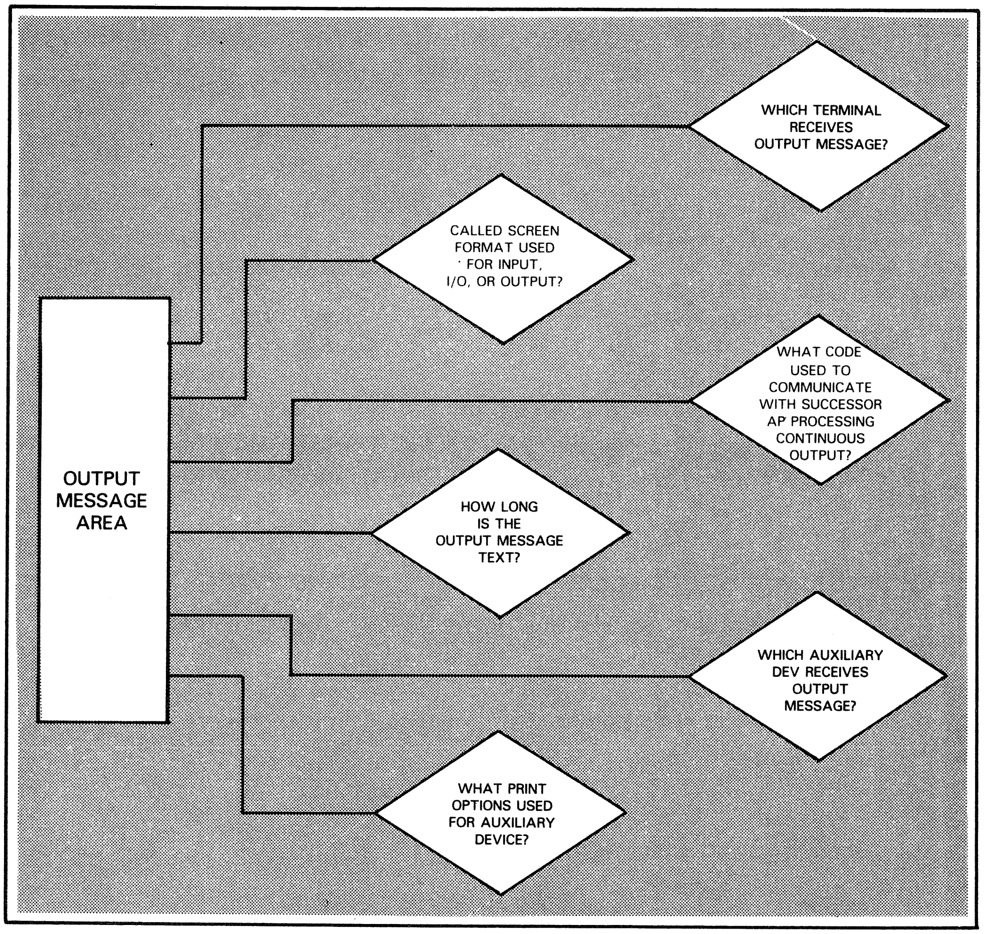


Figure 6-5. Answers to Output Message Processing Questions

6.7. Identifying the Destination Terminal (DESTINATION-TERMINAL-ID)

IMS needs to know the terminal to which it sends the output message your action program builds. The 1- to 4-byte value in the DESTINATION-TERMINAL-ID field (ZA#ODTID) identifies the terminal to which IMS sends the output message.

If you don't move a value to this field before issuing a CALL RETURN or CALL SEND function, IMS assumes the source terminal to be the destination terminal.

The destination terminal name must be left-justified and blank-filled. Also, you must identify this terminal in your ICAM network definition and optionally in a TERMINAL section of the configuration (Figure 6-6).

ICAM Network Definition

```
.
.
.
LNE1     LINE   DEVICE=(LWS)
WS1      TERM   ADDR=(312),FEATURES=(LWS),LOW=MAIN,INPUT=(YES),          X
                MEDIUM=MAIN,HIGH=MAIN
LNE2     LINE   DEVICE=(LWS)
WS2      TERM   ADDR=(313),FEATURES=(LWS),LOW=MAIN,INPUT=(YES),          X
                MEDIUM=MAIN,HIGH=MAIN
LNE3     LINE   DEVICE=(LWS)
WS3      TERM   ADDR=(314),FEATURES=(LWS),LOW=MAIN,INPUT=(YES),          X
                MEDIUM=MAIN,HIGH=MAIN
LNE4     LINE   DEVICE=(LWS)
WS4      TERM   ADDR=(315),FEATURES=(LWS),LOW=MAIN,INPUT=(YES),          X
                MEDIUM=MAIN,HIGH=MAIN
.
.
.
```

IMS Configuration

```
.
.
.
TERMINAL WS1    UNSOL=ACTION
TERMINAL WS2    UNSOL=ACTION
TERMINAL WS3    UNSOL=ACTION
TERMINAL WS4    UNSOL=ACTION
TRANSACT MENU   ACTION=JAMENU
TRANSACT SIGN   ACTION=JASIGN
ACTION   JAMENU CDASIZE=1024  EDIT=NONE  MAXSIZE=12000
                OUTSIZE=4096  WORKSIZE=1024
                FILES=SYSCTL,CUSTMST,XREF1,XREF2
ACTION   JASIGN CDASIZE=1024  EDIT=NONE   MAXSIZE=12000
```

Figure 6-6. Identifying the Destination Terminal to ICAM and the Configurator

The most common use of the DESTINATION-TERMINAL-ID field is to send an output message to a terminal other than the source. Place a value in the DESTINATION-TERMINAL-ID field before issuing the SEND function to transmit the message.

The following COBOL statement moves a terminal identification other than the source terminal to the output message area DESTINATION-TERMINAL-ID field.

```
MOVE DEST-TERM TO DESTINATION-TERMINAL-ID.
```

The terminal operator enters the value of the desired destination terminal from the source terminal. This value is received in the input message area and described as a text field (DEST-TERM) in the input message area of the program's linkage section. For more details, see the sample COBOL action program, BEGIN1, in Appendix B, Figure B-24.

6.8. Specifying Screen Format Services for Output (SFS-OPTIONS)

When you use screen format services for output messages and issue a CALL BUILD function for an input or I/O screen format, IMS places a value of I in the SFS-TYPE field (ZA#SFTYP). This means that IMS is to use the screen format you name on your BUILD function call for the following input. When the screen format is for output only, this field contains hexadecimal zeros.

Each time you issue a BUILD function, IMS resets the SFS-TYPE field. To override an I/O format, set this field to hexadecimal zero before issuing a CALL RETURN. This tells IMS to use the screen format you name on the BUILD function call for output only. (For more information describing input-only, I/O, and output-only screen formats, refer to Section 7.)

To build a formatted output message in dynamic main storage instead of in your output message area, move a character D (C'D') to the SFS-LOCATION field (ZA#SFLOC), the second byte of the SFS-OPTIONS field (ZA#OSFSO). Once you've built the screen format in dynamic main storage, if you want to send a message from the output message area, first clear SFS-LOCATION by filling it with hexadecimal zeros before issuing the SEND or RETURN function. In a COBOL action program, you can do this by coding the statement:

```
MOVE LOW-VALUES TO SFS-LOCATION.
```

In a BAL action program, the statement

```
1       10     16
------------------------------
        MVI    ZA#$SFLOC,X'00'
```

does the same thing.

For a complete description of screen format services, see Section 7.

6.9. Identifying a Continuous Output Message (CONTINUOUS-OUTPUT-CODE)

When you issue a continuous output message, an action program can succeed to itself or to another action program to continue sending output. The CONTINUOUS-OUTPUT-CODE field can be used to communicate between the action program that originated the continuous output and its successor.

If you do not move a value into this field, IMS sets the field to zeros and when the program passes control to its successor, the first four bytes of input message received by the successor action program are zeros. Though the CONTINUOUS-OUTPUT-CODE field can be used, this field is not mandatory in generating continuous output. It can, however, be helpful to indicate the last output message sent. Set this field only when the AUX-FUNCTION field indicates that continuous output is desired. For a complete description of continuous output, see subsections 6.18 through 6.24.

6.10. Supplying Output Message Text Length (TEXT-LENGTH)

The TEXT-LENGTH field (ZA#OTL) is a binary half-word integer that specifies the length of the output message text. IMS sets this value to a predefined output message text length at action initiation, and the action program may reduce the value to reflect the true output message text length. This output message length control is necessary when your action program issues multiple output messages. If the value is set to zero and no output message is sent by the action program, IMS sends a default termination message to the source terminal.

The predefined output message text length is specified at configuration time via the OUTSIZE parameter in the ACTION section. In your action program, the value you place in TEXT-LENGTH must include the length of the actual text plus 4 bytes for the TEXT-LENGTH field itself. Be sure to move this value to the TEXT-LENGTH field before your program sends an output message to a terminal. Figure 6-7 shows the logic involved in moving a message text length to the TEXT-LENGTH field in the output message area.

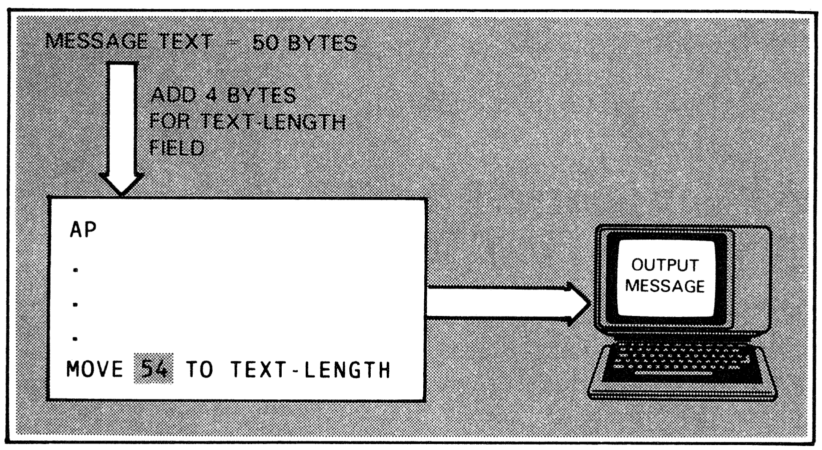


Figure 6-7. Setting Message Text Length for Output Messages

6.11. Identifying Auxiliary Devices (AUXILIARY-DEVICE-ID)

The AUXILIARY-DEVICE-ID field (ZA#OAUX) is a 2-byte field that indicates whether the output message should be sent to an auxiliary device and, if so, it identifies the device. You also use this field to specify printing options.

To list the output message on an auxiliary device attached to the destination terminal, use each byte of the AUXILIARY-DEVICE-ID field - the AUX-FUNCTION byte (ZA#OAUX) and the AUX-DEVICE-NO byte (ZA#OAUX+1).

The AUX-FUNCTION byte describes the print options used for continuous output and to send the output message to an auxiliary device. For AUX-FUNCTION byte settings, refer to Table 6-2. The AUX-DEVICE-NO field specifies the number of the auxiliary device receiving the output message (1 through 9) as defined in the ICAM network definition.

If you don't send the output message to an auxiliary device or want continuous output, set the entire field to binary zeros. This is the original value of the field set by IMS when it generates the output message area control header. Zeroing out this field displays or lists the output message on the primary device - the destination terminal with no special options. The following COBOL coding zeros out the AUXILIARY-DEVICE-ID field in the output message area control header:

```
MOVE LOW-VALUES TO AUXILIARY-DEVICE-ID.
```

6.12. Specifying Special Print Options for Auxiliary Devices (AUX-FUNCTION)

You can choose numerous print options to send output messages to auxiliary devices. For example, to list the output message on the communications output printer (COP) or terminal printer (TP) in print mode, set the AUX-FUNCTION byte to X'F0'; to list it in print transparent mode, set the AUX-FUNCTION byte to X'F4'.

The AUX-FUNCTION field has another use when you send continuous output to a terminal rather than to an auxiliary device. For more detail, see 6.20.

Figure 6-8 shows the coding statements that specify continuous output to an auxiliary device at the primary destination terminal, or continuous output in print transparent mode at a communications output printer attached to the first auxiliary device configured at that terminal.

```
CREATE-CONTINUOUS-OUTPUT.
    IF COP-OUTPUT NOT EQUAL TO 'COP'
          MOVE 'C' TO AUX-FUNCTION
    ELSE MOVE '7' TO AUX-FUNCTION
          MOVE 1 TO AUX-DEVICE-NO.
    MOVE CURRENT-CONT-CODE TO CONTINUOUS-OUTPUT-CODE.
```

Figure 6-8. Specifying Output to an Auxiliary Device

For an explanation of print mode, print transparent mode, space suppression, and other print options, see 6.20; also, refer to Table 6-1 for a summary of the AUX-FUNCTION byte settings.

6.13. Naming Auxiliary Devices (AUX-DEVICE-NO)

When you send an output message to an auxiliary device, you must identify its number in the AUX-DEVICE-NO byte of the AUXILIARY-DEVICE-ID field. The value you place in this byte must be a number from 1 to 9. This number identifies the auxiliary device number appended to the AUX operand of the TERM macroinstruction in your ICAM network definition. (See the *IMS System Support Functions Programming Guide,* UP-11907.

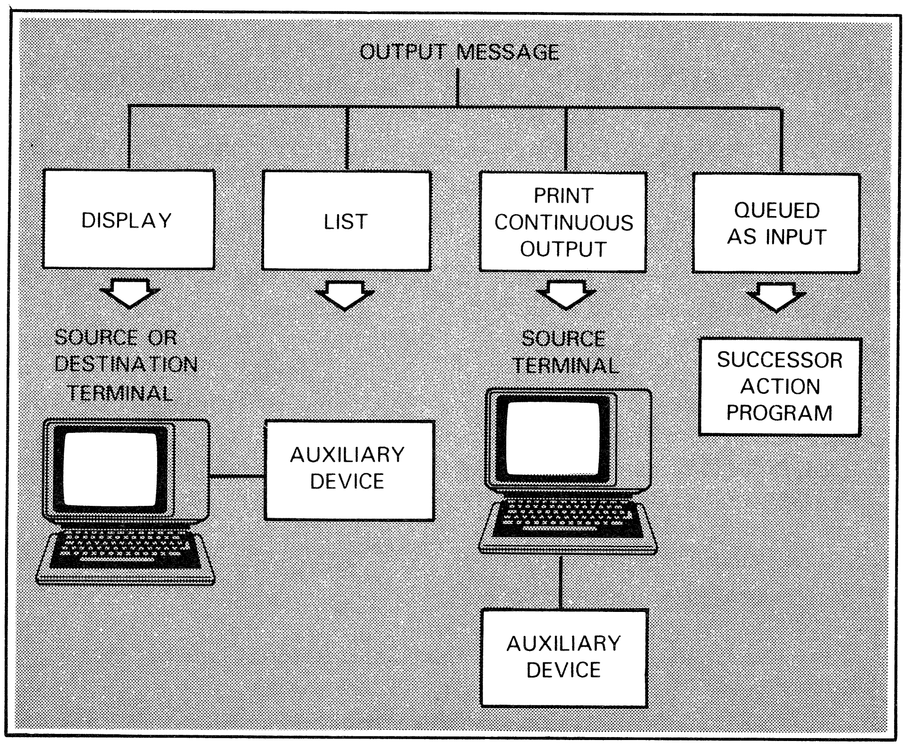
If you send an output message to an auxiliary device attached to the destination terminal as shown in Figure 6-8, the network definition must contain a TERM macroinstruction with an AUX operand appended with the same value placed in the AUX-DEVICE-NO field. The following portion of a network definition shows the AUX operand with the appended number:

```
MOVE  1  TO AUX-DEVICE-NO.
1         10      16                                            72
------------------------------------------------------------------
TRM1      TERM    ADDR=(29,52),                                 X
                  FEATURES=(U400,1920),                         X
                  AUX1=(TP,77),                                 X
                  HIGH=MAIN,                                    X
                  MEDIUM=MAIN,                                  X
                  LOW=DQFILE1
```

6.14. Sending a Message at the End of an Action

Normally, action programs send messages from the output message area to the designated terminal when you issue the RETURN function at action termination. This output can be:

- Displayed on the source terminal or the terminal indicated by the DESTINATION-TERMINAL-ID field
- Listed on an auxiliary device attached to the source terminal or destination terminal
- Printed as continuous output at the source terminal or on an auxiliary device attached to the source terminal (see 6.11)
- Queued as input to a successor action program terminating in delayed internal succession



6.15. Sending Additional Messages (SEND Function)

Sometimes you may want to issue more than one message during an action, or you may want to send a message to a terminal other than a source terminal. This is called switched output. To issue multiple or switched output messages, use the SEND function call.

6.15.1. Transmitting Messages via the SEND Function

The SEND function transmits messages to a terminal other than the source terminal or multiple messages to the source terminal. It can also initiate a transaction at another terminal via output-for-input queueing (described in 6.26); however, when you issue a SEND function for both output-for-input queueing and switched output from the same action program, IMS returns a status code of 6_{16} and a detailed status code of 2_{16} indicating that these two operations are not permitted in the same procedure.

In addition, the SEND function can designate the master terminal as the destination for messages without naming the master terminal in the program. This is useful for sending error messages to the master terminal when the source terminal can't handle the error. In the case where there are multiple master terminals, the message will be sent to the first master terminal in the IMS-MT configuration.

The COBOL and BAL source formats for the SEND function call are:

- COBOL format:

```
CALL 'SEND' USING output-buffer [master].
```

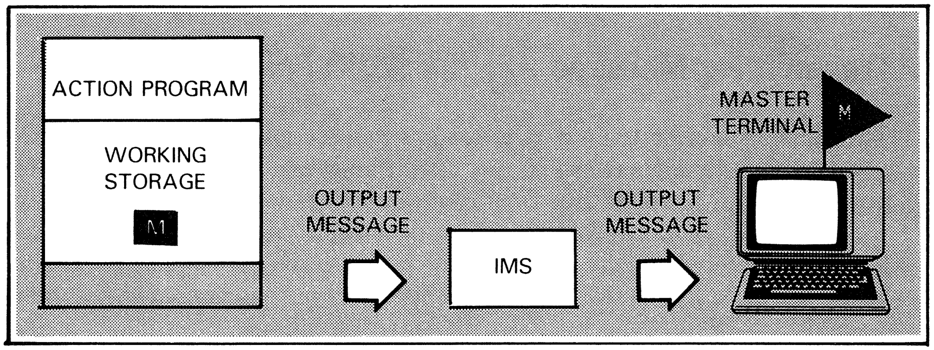
- BAL format

```
{CALL   }    SEND,(output-buffer [,master])
{ZG#CALL}
```

The *output-buffer* parameter refers to a data-name (COBOL) or storage area (BAL) where the output message is built. This area must contain an output message header and text. The output buffer doesn't have to be the output message area described in the linkage section. You can send an output message from the work area or other interface area. This area, however, must be aligned on a full-word boundary. Subsection 6.17 discusses the use of a work area to build output messages and explains how to send output messages from a work area.

The *master* parameter refers to a data-name or storage location that contains the value 'M' indicating that this message is sent to the master terminal.

Figure 6-9 illustrates COBOL coding to send an output message to the master terminal.



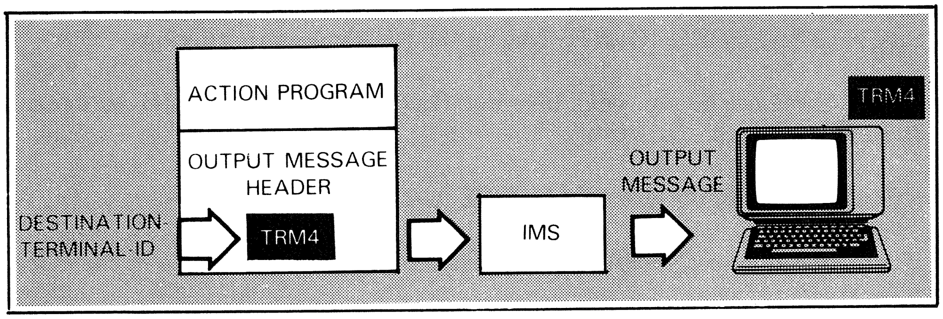

```
WORKING-STORAGE-SECTION.
77 MAST-TERM      PIC X      VALUE 'M'.
.
.
.
PROCEDURE DIVISION.
.
.
.
CALL 'SEND' USING OUTPUT-MESSAGE-AREA MAST-TERM.
```

Figure 6-9. Sending an Output Message to the Master Terminal

When the data-name referenced does not contain the value M, IMS returns a status code of 3 (invalid request) and a detailed status code of 3 (incorrect parameter value) to the program information block of your action program.

When you omit this parameter, IMS sends the message to the terminal specified in the DESTINATION-TERMINAL-ID field of the output message area, or to the source terminal when DESTINATION-TERMINAL-ID is not specified.

Figure 6-10 illustrates the COBOL coding to send an output message to a destination terminal.




```
PROCEDURE DIVISION.
.
.
.
MOVE 'TRM4' TO DESTINATION-TERMINAL-ID.
CALL 'SEND' USING OUTPUT-MESSAGE-AREA.
```

Figure 6-10. Sending an Output Message to a Destination Terminal

You can send a message to the system console or master workstation if console support is configured. To send a message to the console or master workstation, enter the name 1CNS in the DESTINATION-TERMINAL-ID field. When you send a message to the console, your message may not exceed 120 characters. For more information about the system console and master workstation, see 6.29.

IMS does not send an output message to the designated terminal until the successful termination of the current action. After IMS moves the output message from the output message area and writes it to the output message queue, control returns to the statement following the CALL SEND statement.

If the transaction terminates abnormally or is canceled in the current action, IMS deletes from the queue all output messages generated in the action and does not deliver any messages to the terminal. Instead, it sends a message to the source terminal indicating the reason for termination.

To use the SEND function, you must specify the UNSOL=YES parameter in the OPTIONS section of the configurator. In your ICAM network definition, you must:

1. Specify FEATURES=(OUTDELV) on the CCA macroinstruction.

2. Create three queues for each terminal (LOW, MEDIUM, and HIGH operands on the TERM macroinstruction).

3. Create at least one process file (PRCS macroinstruction).

4. If a global network, create a static session for each process file in the SESSION macroinstruction.

If you use the SEND function frequently, you should specify disk queueing. Refer to the *IMS System Support Functions Programming Guide,* UP-11907.

6.15.2. Returns from the SEND Function

After executing a SEND function, IMS notifies the action program whether the request succeeded or failed by placing binary values in the STATUS-CODE and DETAILED-STATUS-CODE fields of the program information block. Table 6-1 shows status and detailed status codes IMS can return after unsuccessful completion of the SEND function.

Table 6-1. Status Codes and Detailed Status Codes Returned after the SEND Function

STATUS-CODE (Decimal)	DETAILED-STATUS-CODE (Decimal)	Description
0		Successful
3	3	Parameter error
3	12	UNSOL=YES or CONTOUT=YES was not configured, or no process files were created in ICAM network definition.
6	2	Returned when output-for-input queueing is requested and: 1. Destination terminal is in interactive mode 2. Destination terminal has an input message on queue 3. ZZHLD or ZZDWN command was entered for destination terminal 4. Destination terminal is marked physically down to ICAM 5. IMS cannot allocate a main storage buffer (multithread only); INBUFSIZ specification inadequate
6	3	Destination terminal physically or logically down; message queued
6	4	Invalid destination terminal, auxiliary device, or auxiliary function specified
6	5	No ICAM network buffer available
6	6	Disk error or recoverable system error on output message to console
6	7	Invalid length specification

IMS returns a status code of 6 and a detailed status code of 2 only when you use the SEND function to initiate a transaction at another terminal (output-for-input queueing). The conditions causing this error are not permanent. The output message header is valid, and you may be able to retransmit the same message successfully at a later time.

Some of the conditions causing a detailed status code of 3 (with status code 6) are the same as those for a detailed status code of 2. However, this error is returned when you use the SEND function for message switching, not output-for-input queueing. In this case, the message sent is queued for the destination terminal and is automatically transmitted when the terminal is operational.

If you configure ERET=YES, the action program regains control at the instruction after the SEND function call and must interrogate these status bytes. If you don't configure ERET=YES, the program does not regain control if the SEND function is unsuccessful and IMS abnormally terminates the program. At this time, IMS also sends a 3-line transaction termination message to the system console. Transaction termination messages are documented in the *System Messages Reference Manual,* UP-8076.

6.16. Clearing IMS Output Messages from ICAM Queues

Due to hardware malfunction or program errors, ICAM queues may contain IMS output messages that are undeliverable. This may utilize excess ICAM resources and ICAM error recovery could occur.

You may delete or clear the IMS output messages from the ICAM queue(s) by using the CALL SEND queue clear option.

To delete the messages from the queue, set the AUX-function byte ZA#OAUX to a C'$' or X'5B' and the AUX-DEVICE-NO ZA#OAUX+1 value for the queue to clear. The following is a list of values to clear the queues:

Values to Clear ICAM Queues

All ICAM Queues	ZA#ODQA	EQU	X'70'
ICAM High Queue	ZA#ODQH	EQU	X'10'
ICAM Medium Queue	ZA#ODQM	EQU	X'20'
ICAM Low Queue	ZA#ODQL	EQU	X'40'

To clear the ICAM low queue for the terminal executing your transaction:

- COBOL example

```
MOVE "$" TO AUX-FUNCTION.
MOVE LOW TO AUX-DEVICE-NO.
CALL 'SEND' USING output-buffer.
```

- BAL example:

```
MVI  ZA#OAUX,ZA#ODEQ
MVI  ZA#OAUX+1,ZA#ODQL

{CALL   }  SEND, (output-buffer)
{ZG#CALL}
```

The *output-buffer* parameter refers to a data-name in COBOL or a storage area in BAL where the output message is built.

6.17. Using a Work Area to Build Output Messages

When you use the SEND function you can use the work area or other interface area in the activation record to build your output message. If you decide to use the work area, you must configure the work area size via the WORKSIZE parameter in the configuration ACTION section. IMS does not generate a work area without this parameter. You describe the work area in your action program's linkage section.

The length of the work area in multithread IMS equals the WORKSIZE length configured, plus the work area increment (WORK-AREA-INC) length specified by the preceding action. In single-thread IMS, the work area length equals the WORKSIZE length configured. The WORK-AREA-INC value is not supported in single-thread IMS.

You can build output messages in four areas in your action program. The output message area is most commonly used. In addition, you have the convenience of building output messages in the work area or continuity data area. If you don't need to save the previous contents of the input message area, you can even build an output message there.

The important difference is that when you build your output message in the output message area, you may use the CALL RETURN function to transmit the message. On the other hand, you must use the SEND function to transmit messages built in any area other than the output message area.

When you issue a SEND function to transmit an output message from the output message area or any other area, you must be sure to use the same name you use for the *output-buffer* parameter in your SEND function call as you use for the output message description in your work area or continuity data area. This tells IMS where to go to find the output message you are sending.

When sending an output message from any area other than the output message area, you must code your own output message header. You can't use the IMS copy library when creating the OMA header in a section other than the output message area. Figure 6-11 shows the COBOL coding to send a message to the master terminal from the work area.

```
WORKING-STORAGE SECTION.
77 MAST-TERM    PIC X    VALUE 'M'.
.
.
.
LINKAGE SECTION.
.
.
.
01 WORK-AREA.
   02 OUTPUT-MSG.
      03  DESTINATION-TERMINAL-ID   PIC X(4).
      03  SFS-OPTIONS               PIC X(2).
           .
           .
           .
      03 OUTPUT-TEXT-1              PIC X(50).
.
.
.
PROCEDURE DIVISION
.
.
.
PARA-X.
    CALL 'SEND' USING OUTPUT-MSG MAST-TERM.
```

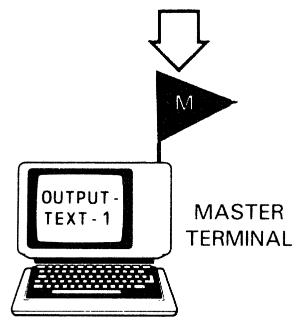


Figure 6-11. Sending an Output Message from the Work Area

6.18. Generating Continuous Output

When you want to print lengthy reports at a terminal or auxiliary device attached to a terminal, the continuous output feature is very useful.

By generating continuous output you can transmit a series of output messages to a terminal, or more commonly to an auxiliary device attached to a terminal, without operator intervention.

To use this feature, you must specify CONTOUT=YES in the OPTIONS section of your configuration.

You also must define an ICAM network that supports unsolicited output. (ICAM requirements are discussed in 6.16.)

Continuous output can be used in batch processing mode -- online for production or offline for listing -- as well as in interactive mode.

6.19. Devices That Can Receive Continuous Output

Action programs can direct continuous output to hard-copy terminals or to auxiliary devices (printer, tape cassette, or diskette) at display terminals. For a complete list of terminals and auxiliary devices supported by IMS, see the *IMS System Support Functions Programming Guide,* UP-11907.

6.20. Coding for Continuous Output

To distinguish continuous output messages from other output messages, an action program must move a specific value to the AUX-FUNCTION field (ZA#OAUX) of the output message area header. When the program terminates, IMS checks this field and recognizes that the program generated a continuous output message.

If that message goes to an auxiliary device rather than a terminal, the program must also move a value to the AUX-DEVICE-NO field (ZA#OAUX+1) of the output message header. This value tells IMS which auxiliary device (1 through 9) receives the continuous output message. Remember to assign a unique number to each auxiliary device when you define your communications network.

Table 6-2 summarizes the settings for the AUX-FUNCTION field when your action program transmits continuous output to a terminal or to an auxiliary device. Note that you can use these print and transfer options to transmit messages to auxiliary devices for normal output as well as continuous output.

Table 6-2. Settings for Auxiliary Function Byte of Output Message Header

Devices		Input/Output Options			Contents of AUX-FUNCTION Field			
					Continuous Output		No Continuous Output	
Primary	Auxiliary	Name	Space Suppression	Inhibit Space Suppression	Hex	Character	Hex	Character
X					C3	C	00	
	X	Print Mode	X		F3	3	F0	0
				X	F5	5	F2	2
		Print Transparent	X		F7	7	F4	4
				X	F9	9	F6	6
		Print Form (ESC H)	X		C1	A	D1	J
				X	C6	F	D6	O
		Transfer All (ESC G)	X		C2	B	D2	K
				X	C7	G	D7	P
		Transfer Variable (ESC F)	X		C4	D	D4	M
				X	C8	H	D8	Q
		Transfer Changed (ESC E)	X		C5	E	D5	N
				X	E8	Y	F8	8
		Read			D9	R		
		Read Transparent			E2	S		
		Search and Read			E3	T		
		Search and Read Transparent			E5	V		
		Report Address			E6	W		
		Backward One Block			D3	L	E7	X
		Search and Position			E9	Z	E4	U
X		Clear ICAM Queue					5B	$

6.20.1. Directing Continuous Output to a Terminal

To send continuous output to the terminal (primary device), move the character C or a hexadecimal C3 to the AUX-FUNCTION field (see Table 6-2). The following COBOL statement will send continuous output to the terminal:

```
MOVE 'C' TO AUX-FUNCTION.
```

In a BAL action program this statement does the same thing:

```
1        10     16
------------------------------------------------
         MVI    ZA#OAUX,ZA#OCO
```

6.20.2. Directing Continuous Output to an Auxiliary Device

When transmitting continuous output to a printer, cassette, or diskette auxiliary device, you must also set the AUX-DEVICE-NO byte. The value you move to the AUX-DEVICE-NO field indicates the number configured for that auxiliary device. Each auxiliary device attached to a terminal has a specific number as defined in the communications network definition.

6.20.3. Print Transparent Mode

The print transparent mode is a commonly used option. In this mode, although the continuous output message generated goes through the logic of the primary device, its format is independent of the terminal format on the screen. The device-independent code (DICE) sequences and field control characters (FCCs) you include to format the continuous output message apply. The cursor return characters normally inserted by the terminal are not transmitted. Thus, the length of a line written to the auxiliary device is independent of the line length of the screen.

When using print transparent mode with a UNISCOPE display terminal, make sure that the output message generated doesn't exceed screen capacity. If it does, the excess lines wrap around and overlay the first few lines originally at the top of the display. The transmitted result is a message beginning with the excess lines instead of the original lines. The same consideration applies to other terminals; however, their larger screen capacity makes wraparound less likely.

6.20.4. Print Mode

In print mode, the continuous output message transmitted to the auxiliary device has the same format as the screen - that is, cursor return characters apply.

When choosing either print or transfer options, you can allow or inhibit space suppression (see Table 6-2). When you specify *allow space suppression,* ICAM suppresses all nonsignificant spaces in the output message. When you specify *inhibit space suppression,* ICAM changes all spaces to DC3 characters, making it necessary to strap the auxiliary device to space when it receives a DC3 character in the output message text.

For instance, let's assume you want to transmit continuous output to a cassette using the transfer all option. You would specify hexadecimal C2 or the character B in the AUX-FUNCTION field. In AUX-DEVICE-NO, you would put the device number configured for the auxiliary device to which you are directing continuous output. The following COBOL coding sets these values:

```
MOVE 'B' TO AUX-FUNCTION.
MOVE 5 TO AUX-DEVICE-NO.
```

To do the same thing in a BAL action program, use the following statements:

```
1        10    16
-------------------------------------
         MVI   ZA#OAUX,ZA#OCSTA
         MVI    ZA#OAUX+1,ZA#ODID5
```

6.20.5. Other Print Options

In addition to print and print transparent options, you can direct the following print options with or without the inhibit space suppression option to the UTS 400 terminal printers, cassettes, or diskettes.

Note: *Unless the inhibit space suppression option is specified with each of these print options, nonsignificant spaces are suppressed.*

- Print form (ESC H) - Sends to the terminal printer, cassette, or diskette all of the unprotected characters and protected characters from the start-of-entry (SOE or home position) to the cursor. Spaces are substituted for protected data. Field control characters (FCCs), are suppressed.
- Transfer all (ESC G) - Sends to the terminal printer, cassette, or diskette all characters from SOE to cursor including FCC sequences.
- Transfer variable (ESC F) - Sends to the terminal printer, cassette, or diskette only the variable (unprotected) characters between the SOE and cursor including FCC sequences.
- Transfer changed (ESC E) - Sends to the terminal printer, cassette, or diskette only the changed characters (or altered fields) between the SOE and the cursor including FCC sequences.

6.21. Writing a Continuous Output Program

Normally when an action program generates multiple output messages in one transaction, the terminal operator must acknowledge each message after the first by pressing the message wait key. However, once you identify an output message to IMS as continuous output, the message is transmitted to the terminal or auxiliary device and the successor program is scheduled to continue generating continuous output. There is no need for operator intervention. This is how very lengthy reports can be printed at an interactive terminal.

You write an action program to generate continuous output as you would any action program. However, there are some special considerations.

First, if you're transmitting continuous output to the terminal, you must move hexadecimal C3 or the character C to the AUX-FUNCTION field of the output message area header. This informs IMS at action program termination that this program generated a continuous output message. It is not common to direct continuous output to a terminal exclusively; however, it is common to direct continuous output to a terminal connected to a hard-copy device such as Teletype® DCT 500.

If you're transmitting the continuous output message to an auxiliary device attached to the terminal, you select the value specifying the print or transfer option you want and move it to the AUX-FUNCTION field. (Refer to Table 6-2 for a summary of these options.) In addition, you must move the number configured for the auxiliary device into the AUX-DEVICE-NO field of the output message area header. The following COBOL coding generates continuous output to a printer using the print transparent option with inhibit space suppression:

```
MOVE 9 TO AUX-FUNCTION.
MOVE 6 TO AUX-DEVICE-NO.
```

To do the same thing in a BAL program you can use these statements:

```
1        10    16
------------------------------
         MVI   ZA#OAUX,ZA#OCIPT
         MVI   ZA#OAUX+1,ZA#ODID6
```

*Teletype is a registered trademark of Teletype Corporation.

An action program can generate only one continuous output message. This message can be as large as the screen capacity of the terminal receiving the message. Of course, screen capacity varies depending on the type of terminal or workstation you're using. Whether the message is destined for the terminal or for an auxiliary device, it always passes through the terminal screen. If the message is larger than the screen, it wraps around and when it is transmitted to the auxiliary device, the beginning of the message is lost.

The term "continuous output" suggests lengthy output messages. If an action program can produce only one continuous output message and the largest message can be only the size of a screen, how do you generate long messages?

The answer is that the first program generates its continuous output message and names a successor program to continue generating the continuous output. In turn, each program names a successor, either itself or another action program until the last screenful of output is processed.

Remember, each action program can generate only one continuous output message. However, it can reschedule itself or another program as successor to continue this process for as long as the application requires.

To continue generating continuous output, an action program must:

- Terminate in external succession by moving an E to the TERMINATION-INDICATOR field in the program information block
- Move its name or another action program's name to the SUCCESSOR-ID field of the program information block when the program terminates
- Pass to the successor program (via the continuity data area) any data required to prepare the next of the continuous series of output messages

This is the same procedure any action program follows for naming a successor.

The reason for specifying external succession (E) rather than other termination indicators is that when continuous output takes place, IMS generates a 5-character message that it sends as input to the successor program. This program must be prepared to accept that input. External succession means that the successor action program is ready to accept an input message. If you use any other IMS termination indicator, IMS abnormally terminates the transaction and does not transmit the generated message.

A final point to remember when generating continuous output is that this message must be the final message the action program creates. This means that a continuous output message must always be transmitted via the RETURN function when the action program terminates. You can't use the SEND function to transmit a continuous output message.

This does not mean, however, that an action program generating continuous output may never use the SEND function. The program can generate as many output messages as it chooses before creating the continuous output message; however, you must transmit all previous messages using the SEND function.

6.22. The IMS Delivery Code

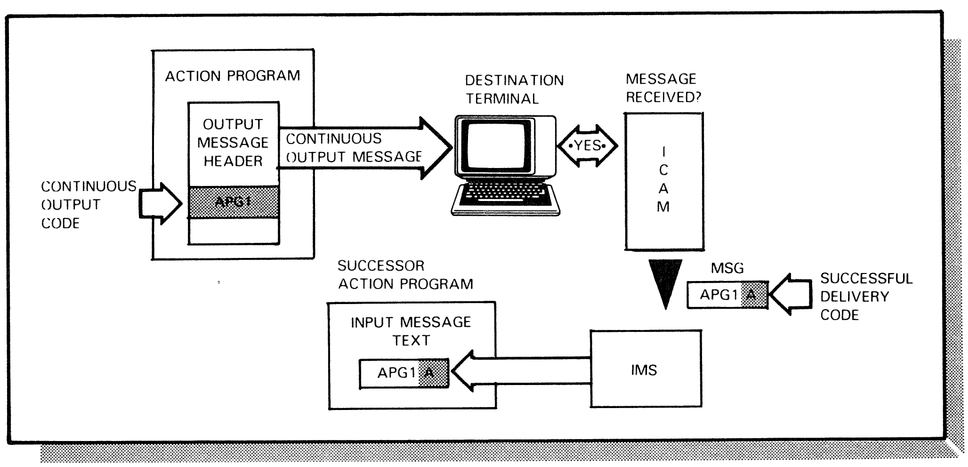
Whenever an action program generates a continuous output message, its successor program receives a 5-character input message from IMS. The first four characters contain the value placed in the CONTINUOUS-OUTPUT-CODE field of the output message area header by the previous program. If the program didn't move a value to this field, it contains binary zeros.

The fifth character of the input message is a delivery code. The delivery code indicates whether ICAM successfully delivered the continuous output message to its destination.

The following COBOL coding moves a value to the CONTINUOUS-OUTPUT-CODE field:

```
MOVE 3 TO AUX-FUNCTION.
MOVE 3 TO AUX-DEVICE-NO.
MOVE APG1 TO CONTINUOUS-OUTPUT-CODE.
```

IMS returns this value plus the delivery code to the successor action program in the first five bytes of its input message text.



Here the value your action program moves to the CONTINUOUS-OUTPUT-CODE field in its output message area is APG1. When the action program terminates, it transmits the continuous output message. When the destination terminal receives and acknowledges it, IMS schedules the successor action program and sends the value APG1 plus the delivery code acknowledgment from ICAM as input to the successor program. The value APG1 comes into the successor program in the first four bytes of the input message text. The delivery code comes into the program in the fifth byte.

The other two output fields in the previous coding (AUX-FUNCTION and AUX-DEVICE-NO, respectively) indicate that the continuous output message generated by this action program goes to an auxiliary device attached to the terminal. IMS sends the message using print mode with space suppression. The configured number for the auxiliary device is 3.

The fifth character of the input message is one of particular interest to the successor action program because it contains a value indicating the status of the continuous output message sent by the predecessor program. IMS returns a hexadecimal value to the successor action program to indicate whether the continuous output message was successfully delivered. Tables 6-3 and 6-4 summarize the output delivery notice status codes that can be returned to an action program.

Table 6-3. Output Delivery Notice Status Codes Returned by IMS

Condition	Primary Devices Addressed				Corresponding Labels in TCS DSECT ①	Hexadecimal Value
	Polled		Nonpolled			
	UNISCOPE, UTS Devices, and Workstations	DCT 1000	DCT 500	TTY		
Successful output completion	Yes	Yes	Yes, regardless of delivery	Yes, regardless of delivery	TM#TDNEM	81 ②
Line down or disconnected. Message deleted by IMS.	Yes	Yes	Yes	Yes	TM#TDLNO	11
Terminal marked down. Message deleted by IMS. ③	Yes	Yes	No	No	TM#TDDNA	12
Auxiliary device down. Message deleted by IMS. Output may be addressed to the primary device.	Yes	No	No	No	TM#TDNAX	40 ④
Missing or invalid destination or auxiliary specification in header.	Yes	Yes	Yes	Yes	TM#TEDST	84 ②
No ICAM network buffer available ⑤	Yes	Yes	Yes	Yes	TM#TENBA	85 ②
Disk error	Yes	Yes	Yes	Yes	TM#TEDER	86 ②
Invalid output buffer length	Yes	Yes	Yes	Yes	TM#TEILG	87 ②

continued

Table 6-3. Output Delivery Notice Status Codes Returned by IMS (cont.)

Notes:

① A BAL action program should access the labels in the TCS DSECT instead of testing the hexadecimal values in the input message directly. The hexadecimal values shown in the table can change in future releases, but the DSECT labels will remain the same.

② The hexadecimal value 81, indicating successful output completion, is translated to the character A if the lowercase-to-uppercase translate option is specified for messages input to the successor action. Similarly, the hexadecimal values 84 through 87, indicating error conditions, are translated to the characters D through G if the translate option is specified.

③ When a terminal is marked down, input solicitation (polling) by ICAM continues automatically. When ICAM receives input from a downed terminal, that terminal is marked up and the input is scheduled for IMS.

④ Refer to Table 6-4 for UNISCOPE and UTS 400 auxiliary device condition codes that are ORed with TM#TDNAX.

⑤ If this condition exists, a user action program can try to resend the last continuous output message.

Table 6-4. UNISCOPE and UTS 400 Auxiliary Device Condition Codes

Auxiliary Device Condition	Label ①	Hexadecimal Value Equated to Label	Hexadecimal Value When ORed with TM#TDNAX ②	UNISCOPE or UTS 400 Auxiliary Status
Ready (good) status but COP/TP write function inoperative	TM#TDDS1	01	41	1
Device out of paper, inoperative, or in test mode	TM#TDDS2	02	42	2
Data error on TCS	TM#TDDS3	03	43	3
Device is not responding; it may be disconnected or a read of unwritten tape may have occurred.	TM#TDDS4	04	44	4

Notes:

① Your action program should access the labels in the DSECT instead of testing the value directly because the equate (EQU) value for each label in the DSECT can vary in future releases. The labels will always remain the same.

② The label TM#TDNAX represents the auxiliary-device-down condition. (Refer to Table 6-3.)

6.23. Recovery Considerations with Continuous Output

Recovery and restart processing are the responsibility of your action program. When the successor action program receives an unsuccessful delivery notice, it can continue processing continuous output or terminate the transaction. When the successor program continues processing, it can send a regular output message to the destination terminal requesting assistance and then terminate with external succession. Note that when a continuous output message is unsuccessfully sent to an auxiliary device, only that device is marked down. You can still send output to the primary device.

After the error condition is corrected, the terminal operator can send an input message to the successor program to reinitiate the continuous output transaction. In this case, the successor program must be prepared to accept input from the destination terminal when necessary, as well as the delivery notice returned by IMS.

Both operator-entered input and delivery notice input can cause attempts to schedule your action program. If operator input exists, IMS processes it and discards the delivery notice. You should, therefore, code your action program to handle keyboard input that can end, temporarily break, and resume a continuous output transaction. The best way to interrupt continuous output is to use function keys as keyboard input. Function keys are faster to use because they are never locked.

When a delivery attempt is unsuccessful, there are a number of recovery options. In planning recovery and handling unsuccessful delivery notices, however, it's important to realize the difference between polled and unpolled devices.

The DCT 1000, UNISCOPE 100 and 200, UTS 10, 20, 40, and 400 terminals, and workstations are polled devices and transmit an acknowledgment to ICAM after receiving a continuous output message. The nonpolled devices, Teletype and DCT 500 terminals, do not. For nonpolled devices, a delivery notice is automatically generated; it always indicates successful delivery regardless of whether or not the output message was successfully delivered. Only a line-down condition returns an unsuccessful delivery notice.

Consequently, IMS almost always receives a successful completion status from ICAM when a message is delivered to a nonpolled device. IMS sends this delivery code to the successor action program which, in turn, generates more continuous output. As you can see, this is a situation to be avoided. So, in critical parts of continuous output applications, avoid using nonpolled devices.

You can use delivery codes to recover continuous output messages when output message errors are detected at queueing time as well as at delivery time. Errors with hexadecimal values 84 through 87 (Table 6-3) are discovered at output queueing time. All others are detected at the time output is delivered to the terminal.

Reasons for output message errors are:

- A missing or invalid destination in the output message header
- An invalid output buffer length in the output message header
- No ICAM network buffer available
- A disk error occurred

If the no-ICAM-network-buffer-available status exists, your action program can try to resend the last continuous output message.

6.23.1. Testing the Delivery Code in a COBOL Action Program

When IMS returns the delivery code in the fifth byte of your action program's input message text, your program must test this byte to see if the continuous output message was delivered successfully. IMS places a hexadecimal 81 or the letter A into this fifth byte when a successful completion occurs. It returns the letter A (hexadecimal C1) when you configure the lowercase-to-uppercase translate option for messages input to a successor action. Otherwise, it returns the hexadecimal value 81. Tables 6-3 and 6-4 list the hexadecimal values for delivery codes returned by IMS.

To test for a successful delivery code, you can set up a 77-level item in working storage to contain the hexadecimal value 81 or the value A (depending on the translate option configured) and compare the value with the value IMS returns in the fifth byte of the input message text. You can also compare the first 5 bytes of input message text with a 5-byte literal containing the value A or 81 (for example, =' A' or =' 81'). Figure 6-12 shows the specific statements needed to test for a successful output delivery code of A. For a complete continuous output program example in COBOL, see the PRINT program in Appendix B.

After the PRINT action program determines from a terminal input value that it will process a continuous output message, it processes this message by succeeding to itself (external succession) and testing for a successful delivery code of A in the fifth byte of the input message text after each screenful of output message. If the delivery code is successful, PRINT terminates in external succession. If it is unsuccessful, PRINT handles the error status code and terminates normally. When continuous output is completed, PRINT terminates normally.

```
DATA DIVISION.
WORKING-STORAGE SECTION.
77  DEL-NOTICE                  PIC X VALUE 'A'.
LINKAGE SECTION.
01  PIB. COPY-PIB74.
01  IMA. COPY IMA74.
    02  TRANS-IN.
        04  CODE                PIC X(5).
        04  DEL-NOTICE-MSG REDEFINES CODE.
            08  DEL-NOTICE-CODE      PIC X(4).
            08  DEL-NOTICE-STATUS    PIC X.
        04  FILLER              PIC X.
        04  TST-NUM             PIC X.
        04  INPUT-TEXT          PIC X(100).
        04  FILLER              PIC X(1813).
01  OMA. COPY OMA74.
     02  PRNT-LINE.
        04  DI-1                PIC 9(4) COMP.
        04  DI-2                PIC 9(4) COMP.
        04  OUTPUT-TEXT         PIC X(1916).
PROCEDURE DIVISION      USING PIB IMA D OMA.
START-HERE.
    IF CODE EQUAL 'PRTPO' GO TO START-IT.
    IF CODE EQUAL 'PPPP' or EQUAL 'TTTT' GO TO TEST-RETURN.
    IF CODE EQUAL 'CCCC' GO TO CONT-CONTINUE.
    IF CODE EQUAL 'STOP' GO TO TERMINATION-EXIT.
START-IT.
    .
    .
    .
CONT-PRINT.
    .
    .
    .
TEST-RETURN.
    IF DEL-NOTICE-STATUS NOT EQUAL DEL-NOTICE GO TO TERMINATION-EXIT.
CONT-CONTINUE.
    MOVE 'E' TO TERMINATION-INDICATOR.
    MOVE 'BUS020' TO SUCCESSOR-ID.
    GO TO ALL-EXITS.
TERMINATION-EXIT.
    MOVE 'N' TO TERMINATION-INDICATOR.
    .
    .
    .
ALL-EXITS.
    CALL 'RETURN'.
```

Figure 6-12. Testing for Successful Delivery Code in a COBOL Action Program

6.23.2. Testing the Delivery Code in a BAL Action Program

BAL action programs processing continuous output should access the ICAM labels in the transaction control section (TCS) DSECT, TM#TCS. Tables 6-3 and 6-4 list these labels that correspond with the hexadecimal values equated to the delivery notice status codes.

BAL action programs should generate the TCS DSECT inline and access the labels instead of testing the hexadecimal value directly in the input message. The reason for this is that these hexadecimal values are equated (EQU) for each DSECT label and can change in future releases; however, the ICAM DSECT labels always remain the same. If you access the labels, you only have to reassemble your BAL action program with each new release to be sure your DSECT is current; otherwise, you must change your code and reassemble.

To generate the TCS DSECT inline when your BAL program is assembled, call the ICAM procedure, TM#DSECT, using the operand TCS. Figure 6-13 shows the TM#DSECT procedure and a portion of the ICAM TCS DSECT showing output delivery notice status codes and their labels. Also shown are the specific BAL statements that test for a successful delivery code in the fifth byte of the input message area. Note that the contents listed with each label in the DSECT indicate that the message is being held by ICAM; however, IMS deletes these messages from the queue.

Note also that if you configure TRANSLAT=YES for the action, you cannot use ICAM DSECTs to evaluate delivery status codes because the codes are changed by the translate routine.

PORTION OF ICAM DSECT SHOWING OUTPUT DELIVERY STATUS CODES

```
1         10     16
          TM#DSECT TCS
          .
          .
          .
TM#TDDNA EQU   X'12'    TERMINAL MARKED DOWN, MESSAGE HELD
TM#TDNAX EQU   X'40'    AUXILIARY DEVICE DOWN, MESSAGE HELD
*                       OUTPUT CAN STILL BE SENT TO PRIMARY
TM#TDDS1 EQU   X'01'    UNISCOPE AUXILIARY STATUS ONE
*                       MESSAGE HELD, GOOD STATUS BUT READ/WRITE
*                       FUNCTION INOPERATIVE
TM#TDDS2 EQU   X'02'    UNISCOPE AUX STATUS TWO
*                       MESSAGE HELD, PRINTER OUT OF PAPER,
*                       INOPERATIVE OR IN TEST MODE
TM#TDDS3 EQU   X'03'    UNISCOPE AUX STATUS THREE
*                       MESSAGE HELD, TAPE CASSETTE END-OF-TAPE
TM#TDDS4 EQU   X'04'    UNISCOPE AUX STATUS FOUR
*                       MESSAGE HELD, NO RESPONSE FROM DEVICE WHEN
*                       ATTEMPTING TO READ BLOCK OF TAPE
TM#TDNEM EQU   X'81'    SUCCESSFUL OUTPUT COMPLETION
*
TM#TDLNO EQU   X'11'    LINE DOWN/DISCONNECTED, MESSAGE HELD
*
TM#TEDST EQU   X'84'    MISSING OR INVALID DESTINATION
TM#TENBA EQU   X'85'    NO ICAM NETWORK BUFFER AVAILABLE
TM#TEDER EQU   X'86'    DISK ERROR OCCURRED SERVICING SVC
TM#TEILG EQU   X'87'    INVALID OUTPUT BUFFER LENGTH
*
* TEST DELIVERY CODE
          CLI    CODE+4,TM#TDNEM
          BE     EXIT
*
*
*
EXIT
*
          ZM#IMH
CODE      DS     CL5
TEXT      DS     CL100
```

Figure 6-13. Testing for Successful Delivery Code in a BAL Action Program

6.24. Continuous Output and Cassette/Diskette Use

You can read and write, search, or position data on cassette and diskette auxiliary devices by using the continuous output feature. To do this, you must move a value to the AUX-FUNCTION and AUX-DEVICE-NO fields of the output message area header just as you do when generating a continuous output message. Table 6-2 summarizes the settings for the AUX-FUNCTION field when reading from or writing data to cassettes or diskettes.

Notice in Table 6-2 that all the options beginning with the read option, except backward-one-block and search-and-position, must be used with the IMS continuous output feature. Backward-one-block and search-and-position can be used with continuous output and regular output by simply moving the appropriate value to the AUX-FUNCTION and AUX-DEVICE-NO fields.

6.24.1. Input Options

There are four input options used with cassette/diskette: read, read-transparent, search-and-read, and search-and-read-transparent. The continuous output feature must be used with any of these input options.

1. The **read** option reads a block of data from the cassette/diskette to the terminal screen. When you specify this option, do not put any message text in the output message area. Also, you must move the value 4 to the TEXT-LENGTH field of the output message area header.

2. The **read-transparent** option reads a block of data from the cassette/diskette and the remote device handler deletes the SOE cursor sequence, carriage return codes, and DICE codes.

3. The **search-and-read** option reads a block of data from the cassette/diskette only if a search argument specified in the message text of the output message area is satisfied. When the argument is satisfied, the block of data is moved to the terminal screen. Your search argument may be in one of three search and read modes. Table 6-5 shows the formats for these modes. When you use the search-and-read option, the only contents of the output message area message text should be the search argument in the mode you choose.

4. The **search-and-read-transparent** option performs the same function as the search-and-read option except the remote device handler removes all DICE sequences, SOE cursor sequences, and carriage return characters from the input message.

Table 6-5. User Message Text for Searching Cassette/Diskette

Search Argument Format	Search Type
Ataaaa or 1taaaa or ataaaa	Mode search to position the tape to a partucilar address and then read one block, where A, 1, or a is constant, and: t Is the track address (1 or 2). aaaa Is the address where the tape is to be positioned.
Btaaaa/c...c or 2taaaa/c...c or btaaaa/c...c	Mode search to position the tape to a particular address, search for a specific character string, and: t Is the track address (1 or 2). aaaa Is the block address. c...c Is the character string. Up to 16 characters can be specified.
Ct/c...c or 3t/c...c or ct/c...c	Mode search to find the specified character string, where C, 3, or c is constant, and: t Is the track address (1 or 2). c...c Is the character string. Up to 16 characters can be specified. The search starts at the present tape position.

The **report-address** option displays the address of the cassette/diskette device on the terminal screen. To use this option, you must also use the continuous output feature and must specify the value 4 in the TEXT-LENGTH field of the output message area header.

The two other options available for cassette/diskette are the search-and-position and backward-one-block options. Only these two input options can be used with either continuous or regular output messages.

- The **search-and-position** option positions the cassette/diskette to the block requested in the search argument that your action program supplies in the output message text. (See Table 6-6 for formats used in describing the search argument.) Your output message text cannot contain any other entries.
- The **backward-one-block** option repositions the cassette/diskette one block in reverse. The AUX-DEVICE-NO field must be set and the TEXT-LENGTH field in the output message area must be 4.

Table 6-6. User Message Text for Search and Positioning

Search Argument Format	Search Type
@tssss or Otssss or 'tssss	Mode search to position the tape, where: @, O, or (apostrophe) is constant, and: t Is the track address (1 or 2). ssss Is the address where the tape is to be positioned. If specified as 0000, the tape is rewound.

In addition to making the required settings in the AUX-FUNCTION and AUX-DEVICE-NO fields of the output message area header, you can also insert into the 4-character CONTINUOUS-OUTPUT-CODE field of the output message area header a code that identifies the continuous output message you generated. This code is returned to the successor program as part of a 5-character input message. If you do not specify a code, the first four characters of the input message generated by IMS for your external successor program contains binary zeros.

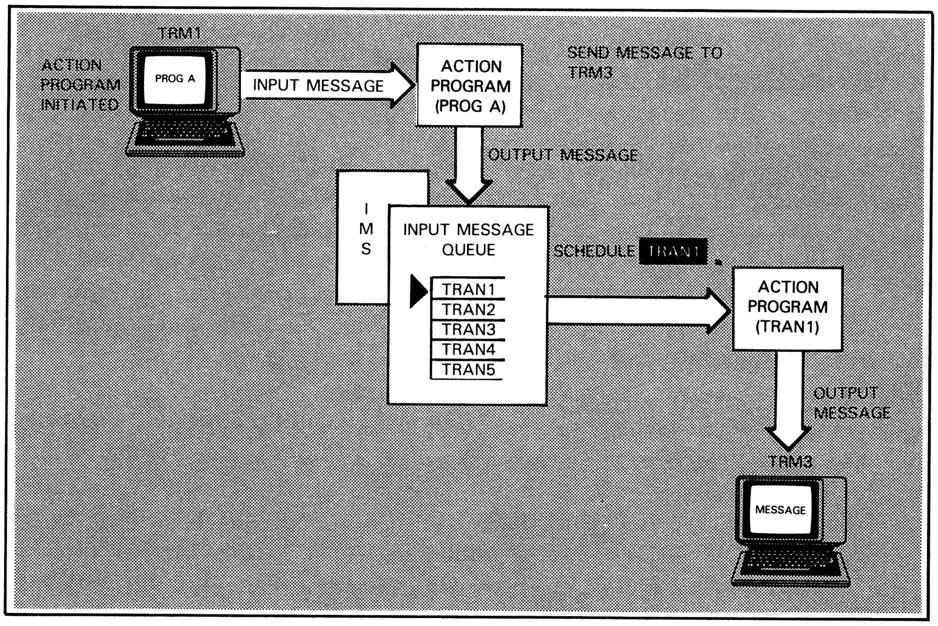
The CONTINUOUS-OUTPUT-CODE field assumes special importance when you use any of the four input options or the report address option for cassettes and diskettes. When you specify one of these options, IMS returns a delivery code to the successor program only if the message wasn't delivered. Otherwise, there is no input to the successor program until a message is transmitted from the cassette/diskette via the terminal screen. For any terminals performing these input options, unless the terminal operator always presses the transmit key, no input is transmitted to the successor program until the AUTO-TRANSMIT feature is set on to allow data to be transmitted from the cassette/diskette.

When using a screen bypass terminal, set the control page for that terminal to take advantage of the autotransmit capability. If this is not done for any of these five input options and a successful delivery notice is returned by the cassette/diskette device, the screen bypass terminal stays in the interactive mode waiting for input it won't receive.

Because a successor action program may receive as input either a delivery notice error or an input message from the cassette or diskette, the CONTINUOUS-OUTPUT-CODE specified by the predecessor action program should be distinguishable from the first four characters of any input message being read from the cassette or diskette. In this way, the successor program determines what type of input message it receives (that is, delivery notice error or input message text) and processes it accordingly. In either case, the successor action program must be capable of handling both unsuccessful delivery notices and standard input messages.

6.25. Initiating a Transaction at Another Terminal

Another special capability of an output message generated by an action program is to initiate a transaction at another terminal. We call this output-for-input queueing. It means that when an action program issues a CALL SEND, the output message generated by that program is queued as input to IMS for the destination terminal in the form of a transaction code that initiates a transaction there.



To use the output-for-input queueing option, specify the CONTOUT=YES parameter in the OPTIONS section of the IMS configuration.

6.26. Coding for Output-for-Input Queueing

You must transmit any output message that initiates a transaction at another terminal using a SEND function. To do this, your action program moves the hexadecimal value C9 or the character I to the AUX-FUNCTION field of the output message area header. This value tells IMS to queue the generated output message as input to IMS from another terminal. You identify the receiving terminal by moving its configured value to the DESTINATION-TERMINAL-ID field. Figure 6-14 shows the coding required to accomplish these functions.

```
LINKAGE SECTION.
01     PROGRAM-INFORMATION-BLOCK  COPY PIB74.
.
.
.
01     INPUT-MESSAGE-AREA     COPY IMA.
       01   TEXT              PIC X(100).
01     OUTPUT-MESSAGE-AREA    COPY OMA.
       02   DESTINATION-TERMINAL-ID     PIC X(4).
       02   SFS-OPTIONS
            03 SFS-TYPE                 PIC X.
            03 SFS-LOCATION             PIC X.
       02   FILLER                      PIC X(4).
       02   CONTINUOUS-OUTPUT-CODE      PIC X(4).
       02   TEXT-LENGTH                 PIC 9(4)  COMP-4.
       02   AUXILIARY-DEVICE-ID.
            03   AUX-FUNCTION           PIC X.
            03   AUX-DEVICE-NO          PIC X.
       02   OUTPUT-TEXT                 PIC X(100).
PROCEDURE DIVISION      USING PROGRAM-INFORMATION-BLOCK
                              INPUT-MESSAGE-AREA  D
                              OUTPUT-MESSAGE-AREA.
.
.
.
GO-CONT-OUTPUT.
      MOVE 'I' TO AUX-FUNCTION.
      MOVE 'TRM3' TO DESTINATION-TERMINAL-ID.
      MOVE TEXT TO OUTPUT-TEXT.
      CALL 'SEND' USING OUTPUT-MESSAGE-AREA.
```

Figure 6-14. Initiating a Transaction at Another Terminal

The only other requirement is that the output message must contain the transaction code that initiates the new transaction at the destination terminal. This code, and any other output generated along with it, is queued immediately as input to IMS for the destination terminal.

If, after issuing the SEND function using output-for-input queuing, the action program terminates abnormally, then the new transaction is still initiated at the destination terminal.

If the destination terminal is in interactive mode when the SEND function is executed (that is, an IMS transaction is already in progress) or if it already has an outstanding input message queued for it, the output message sent using output-for-input queueing cannot cause scheduling of a new transaction. In this case, the action program issuing the SEND function receives an unsuccessful status code in the program information block. (See 6.29.)

When an action program generates an output message and requests that it be queued as input to another terminal, IMS validates the output message area header and the status of the destination terminal. Any errors are indicated to the originating action program by values returned to the STATUS-CODE and DETAILED-STATUS-CODE fields in the program information block. For example, when you issue a SEND function for output-for-input queueing and switched output message from the same action program, IMS returns a status code of 6_{16} and a detailed-status-code of 2_{16} indicating that it does not permit these two operations in the same action program.

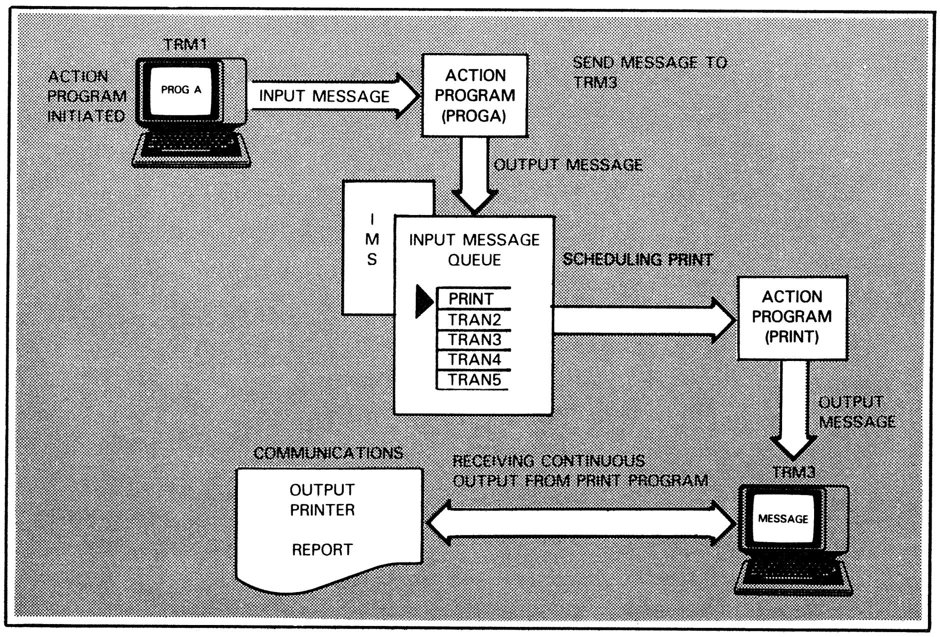
Any errors in the text of the output message (such as invalid transaction code) are not reported to the originating action program but rather to the action program processing the new transaction at the destination terminal. As a result, this program must be prepared to handle such error conditions, and, if necessary, to report these conditions to the originating terminal.

For a complete listing of error codes that IMS returns to the STATUS-CODE and DETAILED-STATUS-CODE fields of your action program following the SEND function, see Table 6-1.

Generally, a program that generates output using the output-for-input queueing option terminates with normal termination; however, it can specify external succession. It cannot terminate with delayed internal succession.

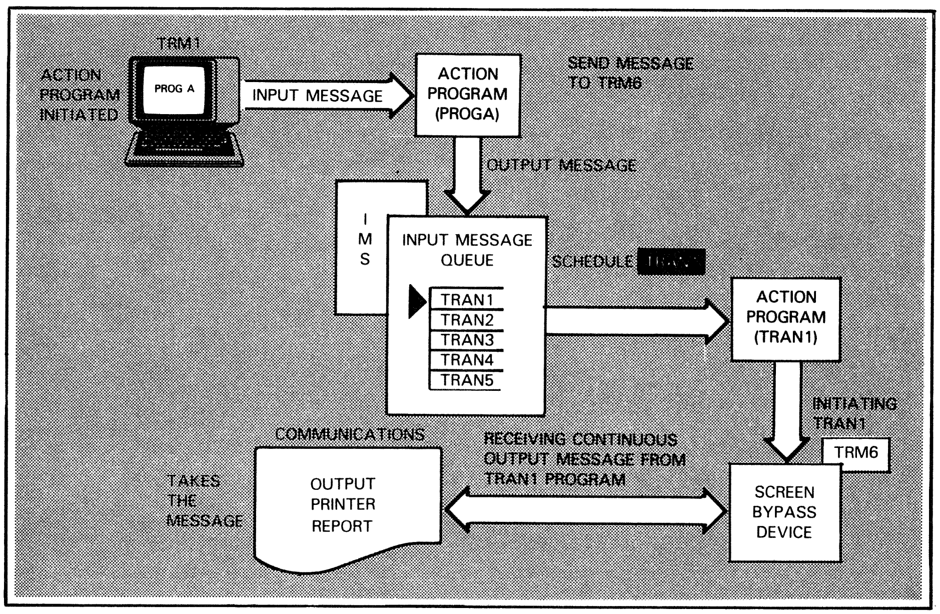
6.27. Output-for-Input Queueing with Continuous Output

It is fairly common to use the output-for-input queueing and continuous output features together. For instance, one transaction could create the records you want printed and write them to a MIRAM file. The last stage of this transaction could then generate an output message using output-for-input queueing for a destination terminal where another transaction actually prints the records. The transaction initiated at the destination terminal reads the MIRAM file and prints the message as continuous output. See Figures B-24 and B-25 for sample COBOL action programs performing output-for-input queueing and continuous output.



6.28. Output-for-Input Queueing with a Screen Bypass Device

Another situation where you can use output-for-input queueing is with the UTS 400 screen bypass device. This device is defined to the communications network as a logical terminal. Nevertheless, because it is physically a separate buffer that can have a telecommunications printer attached to it, it has no way of sending input. Thus, the only way to access a screen bypass device is to use output-for-input queueing. Another terminal in the IMS network calls an action program to generate an output message that initiates a transaction at the screen bypass device. This must be a continuous output transaction and a report could be generated as output on a printer attached to the screen bypass device.



6.29. Sending Messages to the System Console

Your action program can send output messages to the system console if console support is configured. You configure console support by specifying OPCOM=YES in the OPTIONS section of the IMS configuration or by not specifying a master terminal in any TERMINAL section.

To send output to the system console, place the terminal-id 1CNS in the DESTINATION-TERMINAL-ID field of the output message header:

```
MOVE '1CNS' TO DESTINATION-TERMINAL-ID.
```

Sometimes an IMS session has a master workstation associated with it. A master workstation is a workstation from which the IMS start-up job control stream is entered, or it may be defined in the job control stream. When there is a master workstation and you use the destination-terminal-id 1CNS, your output message goes to the master workstation instead of to the console. When the master workstation logs off or is disabled, then the message goes to the console.

You can send normal output, multiple output, switched output, continuous output, and output-for-input queueing messages to the system console. However, there are certain restrictions on output to the console:

- You cannot send output to an auxiliary device at the system console. The only auxiliary function settings you can use are hexadecimal 00, C3 (continuous output), or C9 (output-for-input queueing).
- The maximum length of the output message is 120 characters, not including the output message header. Additional characters are truncated.
- Because of the message length restriction, you cannot output a screen format to the console.
- Output messages are not edited. DICE functions, FCCs, and other control characters appear as blanks, or in a few cases as printable characters.
- There is no message waiting signal. Switched output and multiple output messages are sent immediately.

6.29.1. Error Returns on Output to the Console

IMS returns a status code of 6 and a detailed status code of 4 when you attempt to send output to an auxiliary device at the system console. These are the same codes IMS returns when you have an invalid destination terminal, auxiliary device, or auxiliary function specification on output messages to regular terminals.

When your output message can't be delivered because the console is physically or logically down, the action IMS takes depends on the type of output message it receives:

- With a switched message, IMS returns a status code of 6 and a detailed status code of 6. With a continuous output message, IMS returns a delivery notice status of X'86'. These codes indicate recoverable system errors.

- With other types of output messages (such as normal output in response to input from the console), IMS returns a successful status code of 0. The reason IMS does this is that an error status would cause a "TRANSACTION CANCELLED" message to be sent to the console, and this could cause an abnormal termination of the IMS session.

Section 7
Using Screen Format Services to Format Messages

7.1. Requirements for Using Screen Format Services

The OS/3 screen format services facility lets you display predefined formatted screens at terminals without tedious programming of DICE codes and other control characters. In addition, screen format services does validation checking of input data. As you know, screen formats simplify the task of data entry and are an essential tool in a transaction processing environment.

To display screen formats, issue the BUILD and REBUILD function calls in your action program. The BUILD function places the predefined screen format you request in the action program or in a dynamic main storage area; the REBUILD function replenishes input fields or builds an error formatted screen.

You can direct screen formats to any display terminal supported by IMS except the IBM 3270, and also to auxiliary devices attached to display terminals. You cannot output screen formats to hard-copy terminals.

UNISCOPE 100 and UNISCOPE 200 terminals must have the screen protection feature, and UTS 400 terminals operating in native mode must have the **PROTECT/FCC** switch set to **FCC** and the **control page** set to **XMIT VAR**. For local workstations, specify a line buffer length of at least 900 words on the LBL operand in the ICAM network definition.

You predefine screen formats offline using the screen format generator. (See the *Screen Format Services Technical Overview,* UP-9977.) The screen format generator stores the formats in the system screen format file YFMT or other disk files in MIRAM format. The screen formats for an IMS session may reside in one or two screen format files.

To use screen format services, you must generate a supervisor in consolidated data management (CDM) or mixed mode. However, you can configure IMS in either CDM or DTF mode.

To make screen format services available to action programs, include the SFS parameter in the OPTIONS section at IMS configuration, specifying the maximum number of terminals that may use screen formats at one time. With the RESFMT parameter, also in the OPTIONS section, specify the number of screen formats you want retained in main storage between function calls.

In the job control stream at IMS start-up, include a device assignment set for each screen format file, using the LFD name TC01FMTF for the primary file and TC02FMTF for the secondary file, if there is one.

The *IMS System Support Functions Programming Guide*, UP-11907, describes the configuration and start-up requirements.

Figure 7-1 illustrates the steps you require to create and use screen formats with IMS.

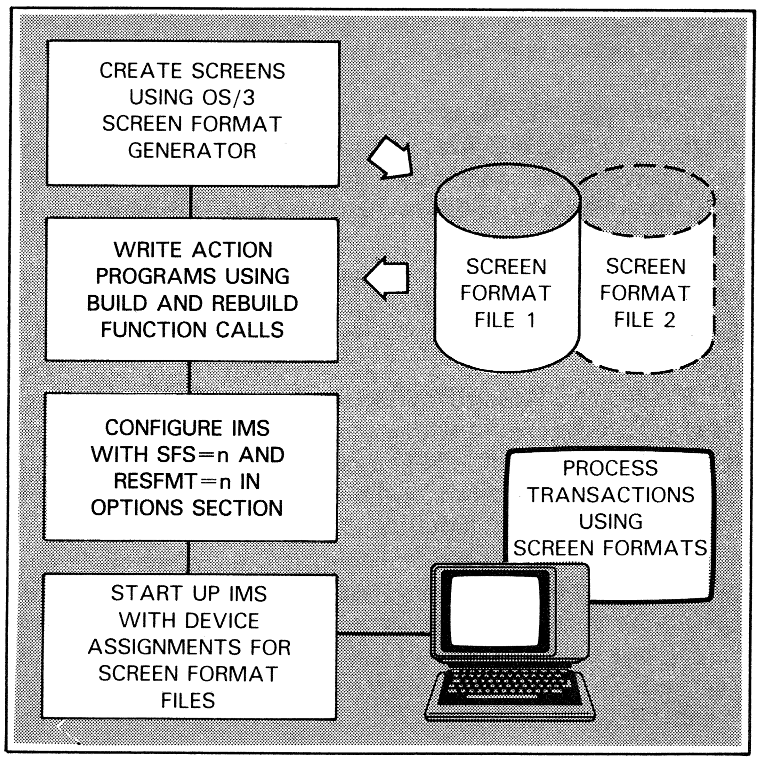


Figure 7-1. Creating and Using Screen Formats

7.2. How Screen-Formatted Messages Are Processed

Your action program requests a screen format by issuing a BUILD function call. IMS retrieves the screen format from the screen format file. (When you assign two screen format files, IMS checks TC01FMTF first, then TC02FMTF.) IMS places the screen format in an output buffer area in your program or in dynamic main storage.

The screen format placed in the buffer area contains the output display constants defined at screen format generation. These constants are always protected; the terminal operator cannot change them.

IMS inserts into the screen buffer any variable data you supply in the action program. Figure 7-2 shows a screen format containing display constants and variable data. Underlines represent input fields.

```
                 PERSONAL CREDIT REPORT
NAME: JOHN DOE
ADDR: 1552 MAIN ST.      STATE:PA         ZIP: 19140
ACCOUNT NO:193-A564
BALANCE:350.00
PAYMENT:_____          DATE:__/__/__
```

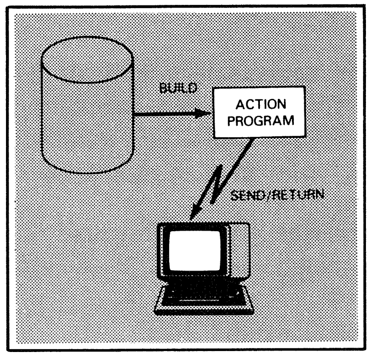
Figure 7-2. Screen Format with Display Constants, Variable Data, and Input Fields

Variable fields defined at screen format generation as input or input/output are unprotected. The terminal operator can enter data in input fields and can make changes to input/output fields. Fields defined as output-only are protected. In Figure 7-3, the terminal operator has changed the address field and entered a payment amount and date.

```
                   PERSONAL CREDIT REPORT

NAME:JOHN DOE
ADDR:224 PINE ST.        STATE:PA      ZIP:19102
ACCOUNT NO:193-A564
BALANCE:350.00
PAYMENT:25.00          DATE 12/23/80
```

Figure 7-3. Screen Format with Input Entries and Changed Address Field

Like any other output message, screen formats are not actually sent to the terminal until a RETURN function call ends the action. You can also output a screen format by issuing a SEND function call. The CALL SEND lets you send a formatted message to a different terminal or multiple formatted messages to the originating terminal.



When you use the SEND function or continuous output to transmit a screen format, the format must be output-only because the terminal operator does not have an opportunity to enter input. Also, when your action program ends in delayed internal succession, you can use only an output format. Instead of going out to the terminal, the screen format is queued as input to the successor action program.

You can transmit an input/output screen format by terminating the action program with external succession or normal termination. The terminal operator enters input on the format, and IMS schedules a successor action program or a new transaction based on this input.

For normal termination, the first input or input/output field in the format must contain a transaction code. IMS verifies the transaction code and if it is invalid, resends the screen format and causes the transaction code to blink. The terminal operator can reenter the input message.

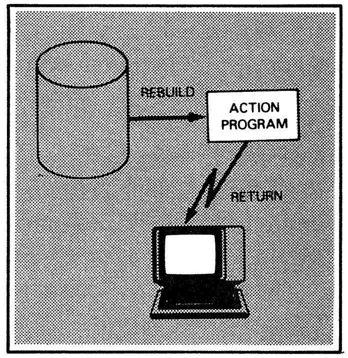
IMS also checks the input for terminal commands. If the input contains a terminal command other than ZZRSD, IMS processes the command and cancels the screen format.

Normally, ZZRSD causes the last output message to be sent again, thus retaining the current screen format. However, if the screen format is built in dynamic main storage instead of in the output message area, it can't be sent again and the screen format is canceled. The terminal operator receives a "NO MSG IN QUEUE" message and can't enter input on the formatted screen.

When the input does not contain a terminal command or invalid transaction code, the screen format coordinator validates the data before IMS passes it to the successor action program. IMS does no additional input editing regardless of the type of editing configured for the action.

If the input contains errors, the screen format coordinator blinks the invalid fields. The terminal operator can correct the input until the retry count specified at screen format generation time is reached. Once the retry count is exhausted, the successor action program receives control.

Your action program can validate input data on a more detailed level than the screen format coordinator. When an action program determines that input data is invalid, you can issue the REBUILD function call to construct an error screen format. IMS replaces fields in which you place hexadecimal Fs with blink characters. Then, when your program issues a RETURN function call, the error fields blink on the screen format at the terminal and all other fields remain unchanged.



You can also use the REBUILD function call to replenish input and input/output fields instead of constructing a new screen format for each input record. After the terminal operator transmits an input screen, the input data is replaced by underlines (or other replenish values defined at screen format creation).

You can make temporary changes to a screen format by defining option indicators at screen format generation time and setting the indicators on before issuing a BUILD function call. Option indicators let you protect fields that are normally unprotected, highlight fields, blink error fields, and replenish input fields. For example, you can build an error screen or replenish screen by using option indicators and issuing a BUILD instead of a REBUILD function call. You cannot use the REBUILD function with a screen format that has option indicators defined.

7.3. Displaying a Screen Format

Do the following in your action program to display a screen format . . .

1. Define an output buffer (usually the output message area). This area must be full-word aligned and begin with a 16-byte output message header. When you use the dynamic main storage option, you still need the output message header.

2. Move the destination terminal-id into the first 4 bytes of the output message header. This step is optional when you want to display the screen format at the source terminal.

3. When you want the screen format built in the output buffer, move the output buffer length into the TEXT-LENGTH field of the output message header. (See the formula described on the OUTSIZE parameter in the configurator ACTION section in the *IMS System Support Functions Programming Guide,* UP-11907.) On return from a successful BUILD function, IMS places the actual length required for the format in this field.

4. When you want the screen format built in dynamic main storage, move C'D' to SFS-LOCATION (COBOL) or set ZA#SFDYN in ZA#SFLOC (BAL).

5. Define an 8-byte field containing the name of the screen format. This area must be left-justified and space-filled.

6. When your screen format uses output option indicators or variable data, define a variable data area and a 2-byte field containing the length of the variable data area. Define option indicator bytes, if any, as the first entries in the variable data area. To set option indicators on, move C'1' to the option indicator byte locations before issuing the BUILD function call.

7. When you want the screen format coordinator to validate output data, define an output status area large enough to contain one status byte for each variable field.

8. Issue the BUILD function call.

9. If you defined an input or input/output screen at screen format generation time and want to use the screen for output-only, move the value X'0' to the SFS-OPTIONS field (COBOL) or ZA#OSFSO field (BAL) of the output message header. Termination of this action with normal succession frees the input capabilities of an input-only or bidirectional screen and redefines it for output-only.

10. Issue the RETURN or SEND function call.

Once an action program issues the BUILD function, do not change the contents of the buffer area. Modifying the area can cause unpredictable results in both the output screen and any input entered on the format.

If you want to send a message from the output message area after building a screen format in dynamic main storage, clear the SFS-LOCATION field to zeros in a COBOL program or move X'00' to the ZA#SFLOC field in a BAL program. This might be necessary, for example, when you output a screen format using the SEND function and then want to output a unformatted message with the CALL RETURN.

7.4. Building a Screen Buffer (BUILD)

The BUILD function call constructs a screen buffer in the output buffer or in dynamic main storage. The screen buffer contains the display constants defined at screen format generation time and any variable data defined in the program.

The COBOL and BAL formats for the BUILD function call are:

- COBOL format

```
CALL 'BUILD' USING output-buffer format-name
  [variable-data data-size [output-status]].
```

- BAL format

```
{CALL   }  BUILD, (output-buffer,format-name[,variable-data,
{ZG#CALL}           data-size [,output-status]])
```

where:

output-buffer
: Identifies the output area where the screen format is built. This area is full-word aligned and begins with a 16-byte output message header. When you use the dynamic main storage option, this area contains only the output message header.

format-name
: Identifies an 8-byte field containing the name of the desired screen format.

variable-data
: Identifies an area containing output option indicator bytes (if any) followed by a string of variable data (if any). Omit this parameter when your screen format does not use either option indicators or variable data.

data-size
: Identifies a 2-byte field containing the length of the variable data area which should be at least as large as the screen size. This parameter is required when you specify a variable data area.

output-status
: Identifies an area where the screen format coordinator places status errors found in the output validation of variable data. If omitted, no output validation is performed.

7.5. Example Coding to Display a Screen Format

Figure 7-4 shows excerpts from a COBOL action program that builds a screen format in the output message area. The program provides two variable data fields (date and time) and a status area for output validation. The complete action program, JAMENU, is illustrated in Appendix B. Figure 7-5 shows the equivalent coding in a BAL action program.

```
DATA DIVISION.
WORKING-STORAGE SECTION.
01  SCREEN-FORMAT-IDS.
    05  SF-MENU                          PIC X(8)  VALUE 'JA$MENU '.
    .
    .
    .
LINKAGE SECTION.
    .
    .
    .
01  WORK-AREA.
    05  IMS-PARAMETER-LIST.
        10  IMS-SCREEN-ID                PIC X(8).
        10  SCREEN-SIZE                  PIC 9(4)  COMP SYNC.
    05  SCREEN-RECORD.
        10  SR-DATE                      PIC 9(6).
        10  SR-TIME                      PIC 9(6).
    05  REFORMAT-DATE.
        10  P-MONTH                      PIC 99.
        10  P-DATE                       PIC 99.
        10  P-YEAR                       PIC 99.
    05  SG-STAT                          PIC X(5).
    .
    .
    .
01  OUTPUT-MESSAGE-AREA.    COPY OMA.
    05  OMA-TEXT                         PIC X(3000).
    .
    .
    .
PROCEDURE DIVISION        USING PROGRAM-INFORMATION-BLOCK
                                INPUT-MESSAGE-AREA
                                WORK-AREA
                                OUTPUT-MESSAGE-AREA
                                CONTINUITY-DATA-AREA.
    .
    .
    .
```

Figure 7-4. Building a Screen Format in a COBOL Action Program (Part 1 of 2)

```
200-BUILD-SCREEN.
    MOVE SOURCE-TERMINAL-ID TO DESTINATION-TERM-ID.
    MOVE SF-MENU                  TO IMS-SCREEN-ID.
    MOVE ALL '0'                  TO SCREEN-RECORD.
    MOVE REFORMAT-DATE            TO SR-DATE.
    MOVE TIME-OF-DAY              TO SR-TIME.
    MOVE 12                       TO SCREEN-SIZE.
    PERFORM 505-BUILD.
    .
    .
    .
505-BUILD.
    CALL 'BUILD'            USING OUTPUT-MESSAGE-AREA
                                  IMS-SCREEN-ID
                                  SCREEN-RECORD
                                  SCREEN-SIZE
                                  SG-STAT.
    IF STATUS-CODE IS GREATER THAN 0
       MOVE '3' TO ERR-FLAG.
    .
    .
    .
507-RETURN.
    CALL 'RETURN'.
```

Figure 7-4. Building a Screen Format in a COBOL Action Program (Part 2 of 2)

```
1         10     16                                                      72
PROG1    START 0
*  ALLOCATE REGISTERS TO COVER ACTIVATION RECORD
         USING *,R2
         USING ZA#DPIB,R3
         USING ZA#IMH,R4
         USING WORK,R5
         USING ZA#OMH,R6
         USING CONT-DTA,R7
*  INITIALIZE REGISTERS
.
.
.
*  BUILD SCREEN
         MVC   ZA#ODTID,ZA#ISTID          MOVE SOURCE-TERMINAL-ID TO
*                                         DESTINATION-TERMINAL-ID
         MVC   SCRNID,SFMENU              MOVE SCREEN NAME TO SCREEN-ID
         MVC   SCRNREC(12),ZEROS          CLEAR DATE/TIME FIELD
         MVC   SRDATE(2),ZA#DTE+2         MOVE PIB DATE TO SCREEN RECORD
         MVC   SRDATE+2(2),ZA#DTE+4       AFTER REFORMATTING DATE
         MVC   SRDATE+4,ZA#DTE
         MVC   SRTIME,ZA#TME              MOVE PIB TIME TO SCREEN RECORD
         MVC   SCRNSIZ,TWELVE             SET SCREEN SIZE
         B     SCRNBLD
.
.
.
SCRNBLD  ZG#CALL BUILD,(OMAREA,SCRNID,SCRNREC,SCRNSIZ,SSGSTAT)
         CLI   ZA#PSC+1,X'00'             ERROR CHECKING
         BNE   BLDERR
         B     TERM
BLDERR
.
.
.
TERM     ZG#CALL RETURN
*  CONSTANTS
SFMENU         CL8'JAMENU '               SCREEN FORMAT NAME
ZEROS    DC    CL12'000000000000'
TWELVE   DC    XL2'OC'
*
*  ACTIVATION RECORD DEFINITION
         ZM#DPIB
         ZM#DIMH
.
.
.
WORK     DSECT                            WORK AREA
PRMLST   EQU   *
SCRNID   DS    CL8                        SCREEN IDENTIFICATION
SCRNSIZ  DS    XL2                        SCREEN SIZE
SCRNREC  EQU   *
SRDATE   DS    CL6
SRTIME   DS    CL6
SGSTAT   DS    CL5
OMAREA   ZM#DOMH
OMATEXT  DS   CL3000                      OUTPUT MESSAGE TEXT AREA
```

Figure 7-5. Building a Screen Format in a BAL Action Program

Note that the COBOL action program moves zeros to the variable data area before entering values. Do not use the LOW-VALUES figurative because it translates to binary zeros.

The example action programs do not move the output buffer length into the TEXT-LENGTH field; but we recommend that you do so when building a screen format in the output buffer. This is not necessary when you want to build a format in dynamic main storage.

To build a format in dynamic main storage, include the following statement in a COBOL action program:

```
MOVE 'D' to SFS-LOCATION.
```

In BAL, code the following instruction:

```
1          10     16
---------------------------------------------------------------
           MVI    ZA#SFLOC,ZA#SFDYN
```

When your screen format uses both output option indicators and variable data, code the option indicator bytes as the first entries in the variable data area. For instance, if you defined option indicators that highlight certain fields on the screen format displayed by the COBOL action program in Figure 7-4, the variable data area might look like this:

```
05  SCREEN-RECORD.
    10  OPTION-INDICATOR-1      PIC X     VALUE '0'
    10  OPTION-INDICATOR-2      PIC X     VALUE '0'
    10  SR-DATE                 PIC 9(6)
    10  SR-TIME                 PIC 9(6)
```

Then, to turn either option indicator on, move '1' to OPTION-INDICATOR-1 or OPTION-INDICATOR-2.

Remember to include the option indicator bytes in the length of the variable data area:

```
MOVE 14 to SCREEN-SIZE.
```

7.6. Error Returns from the BUILD Function

Action programs can receive two types of error returns:

1. Status codes and detailed status codes in the program information block when the BUILD function is unsuccessful.

2. Error codes in the variable data area when the screen format coordinator finds output validation errors.

When the BUILD function call is unsuccessful, no screen buffer is constructed and IMS returns one of the following pairs of status and detailed status codes to the program information block:

Status Code (Decimal)	Detailed Status Code (Decimal)	Explanation
1		Named format cannot be found
3	1	Incorrect number of parameters
3	3	Invalid parameter value
3	12	Screen format services not configured
6	4	Invalid terminal name or type
7	0	Output validation error
7	1	Buffer area not large enough; IMS places the actual length required for the format in the TEXT-LENGTH field
7	2	Variable data area not large enough
7	3	Not enough terminals configured
7	3	Variable-data parameter specified when no variable data area exists
7	5	Format size larger than screen size
7	6	I/O error reading screen format file
7	10	Screen format incorrectly generated
7	11	System error

Status Code (Decimal)	Detailed Status Code (Decimal)	Explanation
7	16	Inadequate main storage available in system; or format contains protected fields and terminal does not have protect feature or is not in protect mode
7	17	Screen format services error
7	18	Action program processing DDP transaction attempted to send screen format to initiating action program

See Appendix D for a complete listing of status and detailed status codes in hexadecimal.

When you define variable data and an output status area in your program, the screen format coordinator validates the variable data. When validation errors occur, the screen format coordinator places X'FF' into each error field in the variable data area and one of the following error codes into the status byte for each invalid field:

Output Validation Error Code	Explanation
1	Nonnumeric value defined for a numeric field
2	Nonalphabetic value defined for an alphabetic field
5	Range check failure
6	Numeric field not in packed decimal format

7.7. Receiving Formatted Input in the Successor Program

You can display an input or input/output screen format only when the action program terminates with external succession or normal termination. The terminal operator enters input on the format, and IMS schedules a successor action program or a new transaction based on this input.

The operator can enter a function key instead of formatted input, if the action program is prepared to accept it. A function key cancels the screen format.

When the action program displaying the screen format terminates with external succession, IMS schedules the action program named in the SUCCESSOR-ID field of the program information block and sends the input data entries to the successor program's input message area.

In the JAMENU action program in Appendix B, the same COBOL action program displays a screen format and also accepts input entered on the format. After building the screen format, JAMENU terminates with external succession, naming itself as successor. Figure 7-6 shows the screen format JAMENU displays, and Figure 7-7 shows the input message fields to receive the formatted input.

```
06/23/81      06:49:28                         JA$MENU      02/09/81

                    ENTITLEMENT ACCOUNTING SYSTEM

     SELECT ONE (1) OF THE FOLLOWING OPTIONS:
        1.  ADD A NEW CUSTOMER RECORD.
       *2.  UPDATE CUSTOMER NAME/ADDRESS INFORMATION.
       *3.  UPDATE BRANCH CUSTOMER INFORMATION.
       *4.  UPDATE CUSTOMER ENTITLEMENTS.
       *5.  DELETE A CUSTOMER RECORD.
       *6.  DISPLAY CUSTOMER INFORMATION.
        7.  LIST ALL ACCOUNTS (ON THE WORKSTATION).
        8.  ENTER WORKSTATION ACTIVITY RECORDS.
        9.  LOGOFF SYSTEM.
                                                          Input
     *ENTER CUSTOMER NUMBER ______                        Message
        MENU SELECTION: __                                Fields
        PLACE CURSOR HERE TO TRANSMIT  [_]
```

Figure 7-6. Screen Format Displayed by JAMENU Action Program

```
01  INPUT-MESSAGE-AREA.    COPY IMA.
    .
    .
    .
    05 IMA-SCREEN-REC REDEFINES IMA-PASS-1.
       10 SR-CUST-NBR                 PIC 9(6).
       10 SR-MENU                     PIC 99.
       10 SR-TRSMIT                   PIC X.
       10 FILLER                      PIC X(4).
```

Figure 7-7. Input Message Area Fields for Formatted Input

In the case of normal termination, the first input field in the format must contain a valid transaction code because IMS must schedule a new transaction to receive the input data. IMS sends the input data, including the transaction code, to the action program named in the configurator TRANSACT section.

A convenient way to ensure that the terminal operator enters the appropriate transaction code in the first input field is to define that field as an input/output variable. Display the transaction code and when the terminal operator transmits the screen, the transaction code is automatically entered as input data.

Figure 7-8 shows an input/output screen format displayed in response to the CSCAN transaction code. Initially, the cursor is positioned after the CSCAN transaction code. To list more names and addresses, the terminal operator simply presses the TRANSMIT key and the CSCAN transaction is rescheduled. To get details about a certain customer, the operator positions the start-of-entry character and cursor on the line for that customer and transmits. This schedules the CDETL transaction. (The CSCAN and CDETL action programs in Appendix B do not use screen format services but could have generated the same screens with screen format services.)

```
CSCAN 07009 RILEY           805238
▶CDETL  181089   FISH                       ROBER   17 CHERRY   07006
▶CDETL  091479   HAFLEIGH                   WILLI   3 HIGHFIEL  07006
▶CDETL  139915   LAMBKA                     IRWIN   DIRECTOR H  07006
▶CDETL  044246   LONGENECKER                R       20 RICHARD  07006
▶CDETL  179363   MAGEDMAN                   DAVID   27 CEDARS   07006
▶CDETL  122399   MCLAUGHLIN                 EDWAR   17 SPRUCE   07006
▶CDETL  805257   ROGERS                     CLESS   51 RAVINE   07006
▶CDETL  152069   WILLIAMS                   GEORG   60 MCKINLE  07006
▶CDETL  181050   ROHRER                     GARRY   219 CARTER  07008
▶CDETL  029997   BOONE                      GEORG   64 BRUNSWI  07009
```

Figure 7-8. Displaying Transaction Codes in Input/Output Fields

Although you can display an input/output screen format using either external succession or normal termination, external succession is more efficient. For a complete example of an action program using a screen format with external succession, see the JAMENU program in Appendix B. JAMENU also uses immediate internal succession to pass control to succeeding action programs that process the menu selection entered by the terminal operator.

Note: *You can define certain input option indicators at screen format generation time. IMS does not support these input option indicators. However, if you defined any input option indicators for this screen format, perhaps for use with another program, you must code option indicator bytes as the first entries in the input message area.*

7.8. Validating Input Data

The screen format coordinator validates the input data entered at the terminal and blinks invalid fields. The terminal operator can correct the invalid entries until the retry count specified at screen format generation time is reached. At that point, IMS schedules the successor program and places a 7 in the STATUS-CODE field and a 0 in the DETAILED-STATUS-CODE field in the program information block.

The input data is followed by one status byte for each input field. You must allow space for these fields in your input message area, but the length field in the input message header includes only the input data items and not their status bytes. When validation errors occur, the screen format coordinator places an error code into the status byte for the invalid fields and replaces the invalid fields with X'FF'. The input validation error codes are:

Input Validation Error Code	Explanation
1	Nonnumeric keyin for a numeric field
2	Nonalphabetic keyin for an alphabetic field
3	Incorrect number of characters entered
4	Decimal point alignment error
5	Range check failure

When your program receives a validation error, you will probably want it to send a message to the terminal operator and terminate the transaction.

7.9. Displaying an Error Format or Replenish Screen

After the terminal operator enters input on a screen format and the screen format coordinator validates the input, you can retain the format at the terminal and make changes to it by issuing a REBUILD function call. You can use the REBUILD function in two different ways:

1. Construct an error screen. Your action program performs additional validation of input fields and fills the input fields that are in error with X'FF' (HIGH-VALUES). When you issue the REBUILD function, the screen format generator blinks any input fields filled with X'FF'.

2. Construct a replenish screen to prompt the terminal operator for the next input. When you issue the REBUILD function call, the screen format generator replaces input and input/output fields with underlines or other replenish value defined at screen format generation.

When you want to build an error screen, identify the area containing the error fields (usually the input message area) with the *variable-data* parameter on the REBUILD function. Omit this parameter when you want to build a replenish screen.

As with the BUILD function, you must define an output buffer, full-word aligned and starting with a 16-byte output message header.

You can request that the error or replenish screen be built in the output buffer or in dynamic main storage. However, because of the smaller size of the message you send with the REBUILD function, you may want to use the output buffer instead of dynamic main storage.

If you want the screen built in the output buffer, move the output buffer length into the TEXT-LENGTH field of the output message header. (To determine the output buffer length, allow approximately 10 bytes per blinking field or replenish field plus 25 bytes for overhead.) To build the screen in dynamic main storage, move C'D' to SFS-LOCATION (set ZA#SFDYN in ZA#FLOC).

After issuing the REBUILD function to construct an error or replenish screen, issue the RETURN function to send the screen to the terminal. Never use the SEND function with a CALL REBUILD function, because the error or replenish screen requests input from the terminal operator. For the same reason, you must terminate the action program with external succession or normal termination.

You can also build an error or replenish screen (or a combination) by using option indicators and issuing a second BUILD function call instead of the REBUILD function. When you build an error screen this way, you do not have to fill the error fields with X'FF'. Set the appropriate indicators on by moving C'1' to the option indicator byte locations before issuing the BUILD function call. You cannot use the REBUILD function with a screen format that has any option indicators defined.

7.10. Building an Error or Replenish Screen (REBUILD)

The REBUILD function call constructs an error or replenish screen in the output buffer or in dynamic main storage. The screen format from the previous BUILD function remains in effect at the terminal, and error fields are blinked or input fields are replenished.

The COBOL and BAL formats for the REBUILD function call are:

- COBOL format

```
CALL 'REBUILD' USING output-buffer [variable-data].
```

- BAL format

```
{CALL   }  REBUILD, (output-buffer[,variable-data])
{ZG#CALL}
```

where:

output-buffer
: Identifies the output area where the error or replenish format is built. This area is full-word aligned and begins with a 16-byte output message header. When you use the dynamic main storage option, this area contains only the output message header.

variable-data
: Identifies an area containing the input message fields including error fields. This is usually the input message area.

When you include the *variable-data* parameter, the screen format coordinator blinks all fields filled with X'FF'. When you omit this parameter, the screen format coordinator replaces all input and input/output fields with the replenish value you defined at screen format generation, which is usually underlines.

7.11. Example Coding to Display an Error or Replenish Screen

Assuming you displayed the screen format shown in Figure 7-6 using the BUILD function, Figure 7-9 shows an example of the COBOL coding to validate the menu selection field and display an error screen using the REBUILD function. Figure 7-10 shows this coding in a BAL action program.

Note in the COBOL coding that the input fields are redefined as alphanumeric. This is necessary because you cannot move HIGH-VALUES to a numeric field.

```
01  INPUT-MESSAGE-AREA.    COPY IMA.
    .
    .
    .
    05  IMA-SCREEN-REC REDEFINES IMA-PASS-1.
        10  SR-CUST-NBR                 PIC 9(6).
        10  SR-CUST-NBR-ERR REDEFINES SR-CUST-NBR  PIC X(6).
        10  SR-MENU                     PIC 99.
        10  SR-MENU-ERR REDEFINES SR-MENU  PIC XX.
        10  SR-TRSMIT                   PIC X.
        10  FILLER                      PIC X(4).
    .
    .
    .
01  OUTPUT-MESSAGE-AREA.    COPY OMA.
    05  OMA-TEXT                        PIC X(3000).
    .
    .
    .
PROCEDURE DIVISION           USING PROGRAM-INFORMATION-BLOCK
                                   INPUT-MESSAGE-AREA
                                   WORK-AREA
                                   OUTPUT-MESSAGE-AREA
                                   CONTINUITY-DATA-AREA.
    .
    .
    .
255-VALIDATE-MENU-SEL.
    IF  SR-MENU  < 1 OR > 9
        MOVE HIGH-VALUES TO SR-MENU-ERR
        PERFORM 506-REBUILD
```

Figure 7-9. Building an Error Screen in a COBOL Action Program (Part 1 of 2)

```
      ELSE
          PERFORM SET-MENU.
      .
      .
      .
 506-REBUILD.
     MOVE 100 TO TEXT-LENGTH.
     CALL 'REBUILD'          USING OUTPUT-MESSAGE-AREA
                                   IMA-SCREEN-REC.
     IF STATUS-CODE IS GREATER THAN 0
        MOVE '3' TO ERR-FLAG.
 507-RETURN.
     CALL 'RETURN'.
```

Figure 7-9. Building an Error Screen in a COBOL Action Program (Part 2 of 2)

```
1        10     16
--------------------------------------------------------------------
*  VALIDATE MENU SELECTION
         CLI    SRMENU,X'F1'
         BL     REBLD
         CLI    SRMENU,X'F9'
         BH     REBLD
         .
         .
         .
*  BUILD ERROR SCREEN
REBLD    MVC    ZA#OTL,MSGSIZE        SET TEXT-LENGTH FIELD
         ZG#CALL REBUILD,(OMAREA,IMAREC)
         CLI    ZA#PSC+1,X'00'        ERROR CHECKING
         BNE    BLDERR
         B      TERM
BLDERR
         .
         .
         .
TERM     ZG#CALL RETURN
*
*  CONSTANTS
MSGSIZE  DC     H'100'
         .
         .
         .
*   ACTIVATION RECORD DEFINITION
         .
         .
         .
         ZM#DIMH
IMAREC   EQU    *
SRCUST   DS     CL6          ]
SRMENU   DS     CL2          }  INPUT MESSAGE FIELDS
SRXMIT   DS     CL5          ]
OMAREA   ZM#DOMH
OMATEXT  DS     CL3000
```

Figure 7-10. Building an Error Screen in a BAL Action Program

To build a replenish screen, you need only move a value to the TEXT-LENGTH field (or move C'D' to SFS-LOCATION to build the screen in dynamic main storage) and issue the REBUILD function call without the *variable-data* parameter:

```
MOVE 100 TO TEXT-LENGTH.
CALL 'REBUILD' USING OUTPUT-MESSAGE-AREA.
```

To build an error or replenish screen using option indicators and the BUILD function, use the same coding used to display the screen format initially, except that you move C'1' to the appropriate option indicator bytes before issuing the BUILD function. (See 7.5.)

7.12. Error Returns from the REBUILD Function

When the REBUILD function call is unsuccessful, no error format or replenish screen is constructed and IMS returns one of the following pairs of status and detailed status codes to the program information block:

Status Code (Decimal)	Detailed Status Code (Decimal)	Explanation
1		Internal error
7	1	Buffer area not large enough; IMS places the actual length required for the format in the TEXT-LENGTH field.
7	5	Internal error
7	6	I/O error reading screen format file
7	7	REBUILD not allowed because screen format has no input fields
7	8	Invalid field in variable data area
7	9	Variable-data parameter specified but no error field detected
7	11	System error

See Appendix D for a complete listing of status codes and detailed status codes in hexadecimal.

7.13. Displaying a Screen Format on an Auxiliary Device

You can use the BUILD function call to output a screen format to an auxiliary device - printer, cassette, or diskette - attached to a display terminal.

To output a screen format to an auxiliary device, you place values in the AUX-FUNCTION and AUX-DEVICE-NO fields in the output message header before issuing the BUILD function call. The AUX-FUNCTION setting tells IMS which print or transfer option to use, and the AUX-DEVICE-NO identifies the auxiliary device.

Table 7-1 lists the print and transfer options IMS supports for the writing of screen formats and the settings for the AUX-FUNCTION field in continuous and noncontinuous output modes. For an explanation of the print and transfer options, see 6.20.

Because the terminal operator cannot enter input at an auxiliary device, the screen format must be output-only. For the same reason, you cannot use the REBUILD function call to write an error or replenish screen to an auxiliary device.

Note: *When you build a screen in dynamic main storage, all values, including auxiliary device numbers and functions, must be present in the output message header before you issue the CALL BUILD. If any header values (except SFS-OPTIONS) are changed after the CALL BUILD, the new values are ignored.*

Table 7-1. Print/Transfer Options for Writing Screen Formats to Auxiliary Devices

Input/Output Options			Contents of aux-function Field				Auxiliary Devices			
Name	Suppression	Inhibit Space Suppression	Continuous Output		No Continuous Output		UTS 400		UNISCOPE 100/200	
			Hex	Character	Hex	Character	Supported	Not Supported	Supported	Not Supported
Print Mode	X		F3	3	F0	0	X (recommended) ① ③		X (recommended) ①	
		X	F5	5	F2	2	X (recommended) ① ③			X (unpredictable output at screen and auxiliary device)
Print Transparent	X		F7	7	F4	4	X② ③		X②	
		X	F9	9	F6	6	X② ③			X (unpredictable output at screen and auxiliary device)
Print Form (ESC H)	X		C1	A	D1	J	X④			X⑥
		X	C6	F	D6	O	X④			X⑥
Transfer All (ESC G)	X		C2	B	D2	K	X (recommended) ⑤			X⑥
		X	C7	G	D7	P	X⑤			X⑥
Transfer Variable (ESC F)	X		C4	D	D4	M	X④			X⑥
		X	C8	H	D8	Q	X④			X⑥
Transfer Changed (ESC E)	X		C5	E	D5	N		X (field control characters not supported)		X⑥
		X	E8	Y	F8	8		X (field control characters not supported)		X⑥

LEGEND:

① Printer – same format as screen

② Printer – same information as screen; no carriage returns

③ Cassette/diskette – same format as screen; no field control characters

④ Cassette/diskette – same format as screen; only records unprotected fields

⑤ Cassette/diskette – same format as screen; records all fields and all field control characters

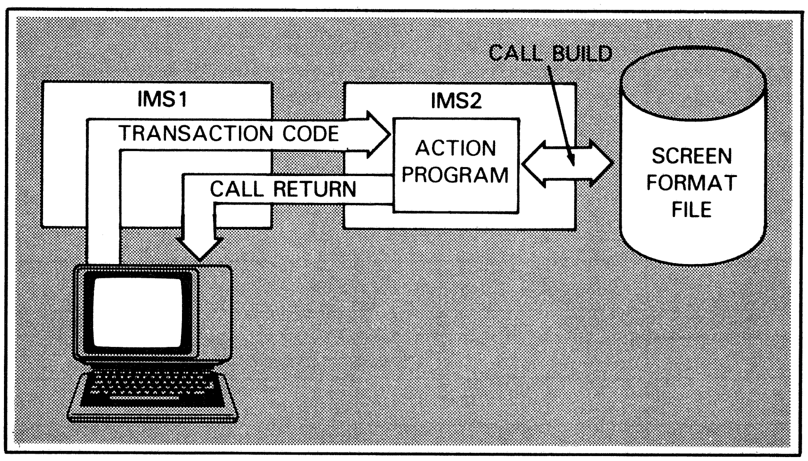
⑥ Cassette/diskette – not available

7.14. Using Screen Formats in a Distributed Data Processing Environment

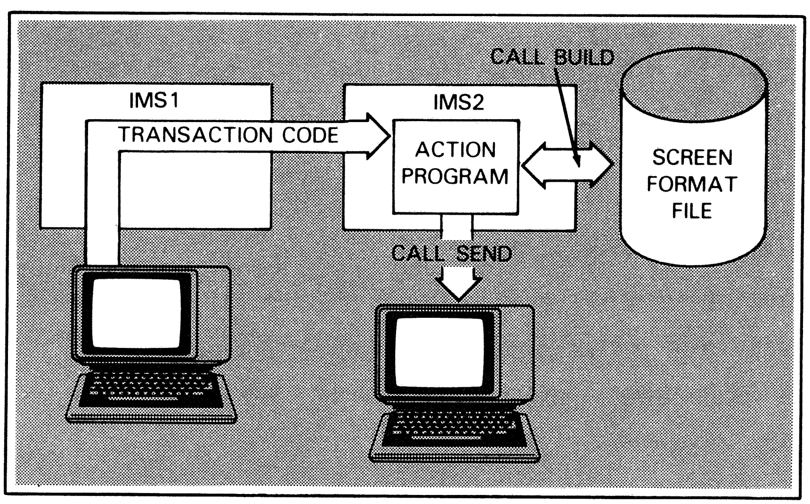
Your action programs can call on screen format services in a distributed data processing environment using the IMS transaction facility. (See Section 9.)

When your action program processes a transaction that is initiated by a terminal operator at a remote system, you can:

1. Issue a CALL BUILD followed by a CALL RETURN to display a screen format at the terminal that initiated the transaction at the remote system. You cannot output a screen format to an auxiliary device at the remote system (primary IMS) or to an action program initiating a remote transaction.



2. Issue a CALL BUILD followed by a CALL SEND to display a screen format at a terminal (or auxiliary device) attached to your local IMS system. You cannot use a CALL SEND to display a screen format at the remote system (primary IMS).

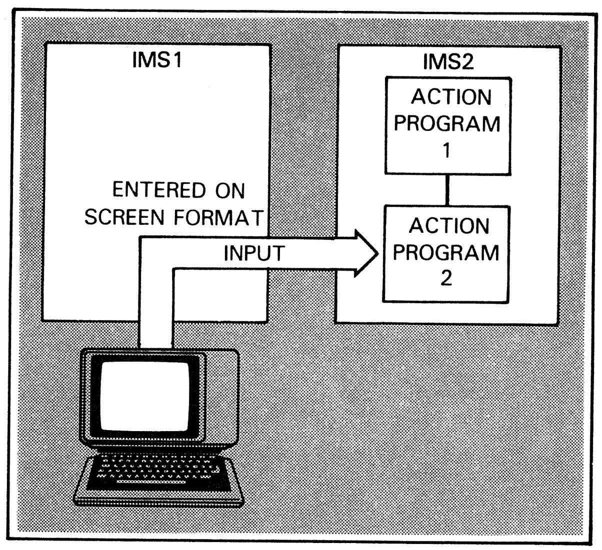


When an action is initiated at a remote system, the SOURCE-TERMINAL-ID field (ZA#ISTID) of the input message area contains the locap-name of the remote system instead of a terminal identification. To display a screen at the source terminal, you can move the locap-name to the DESTINATION-TERMINAL-ID field (ZA#ODTID) of the output message area or leave binary zeros in this field.

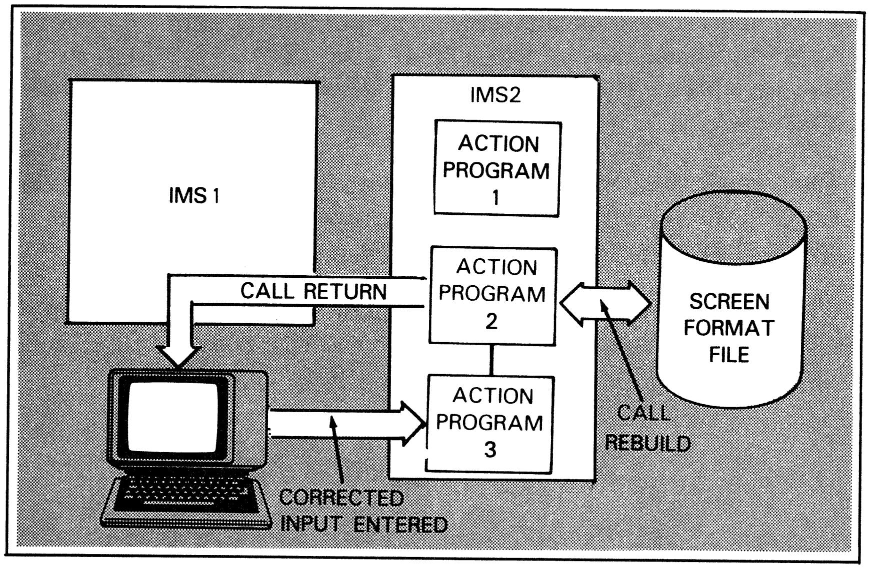
To display a screen at a terminal attached to your local IMS system, move the terminal-id to the DESTINATION-TERMINAL-ID field and issue a SEND function. Remember, you can display only an output format when you use the SEND function. Afterward, clear the DESTINATION-TERMINAL-ID field or move the locap-name to that field before issuing a CALL RETURN to send an output message to the source terminal.

When you display an input/output screen format at the source terminal (at the remote system), you can terminate your program normally or with external succession. External succession is the recommended method.

When the terminal operator at the remote system enters input on the screen format, the successor program you name at your local IMS system (which could be the same action program) takes control and receives the input.



The successor action program can issue a CALL REBUILD, followed by a CALL RETURN, to build an error or replenish screen at the source terminal. Again, you can move the locap-name from the SOURCE-TERMINAL-ID field to the DESTINATION-TERMINAL-ID field or leave binary zeros in that field. This action program should also terminate with external succession and name a successor program to process the corrected input.



Section 8
Calling Subprograms from Action Programs

8.1. When to Use Subprograms

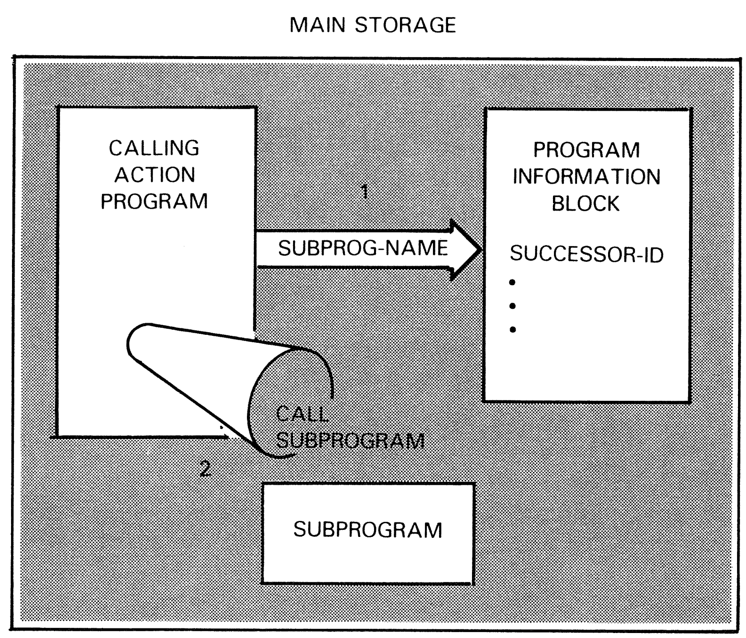
You can call subprograms from action programs to perform common functions or repetitive computations. Subprograms must reside in main storage to be called by an action program. This guarantees their efficient use by not requiring that they be loaded into main storage each time they are called. They are loaded with IMS during start-up.

When a calling action program uses linked subroutines, only the main action program may issue a subprogram call.

8.2. How to Use Subprograms

When you use subprograms, configure SUBPROG=YES in the OPTIONS section. Also, name the subprograms on the *program-name* parameter of the PROGRAM section and specify SUBPROG=YES in the same section.

To use a subprogram, the calling action program must place the subprogram name in the SUCCESSOR-ID field of the program information block before calling the resident subprogram.



Subprograms may be coded as either serially reusable or reentrant modules. If a subprogram is accessed by one action program at a time during a transaction, make it serially reusable. The subprogram code can be modified but must be reset or restored before it is accessed again by another action program. A serially reusable subprogram can read and write into its own area nonreentrant calling action programs and the activation record.

If several action programs access a subprogram concurrently, code the subprogram as a reentrant COBOL or BAL module to increase throughput. Reentrant subprograms are executed as read-only. They may modify only the activation record and nonreentrant calling action programs.

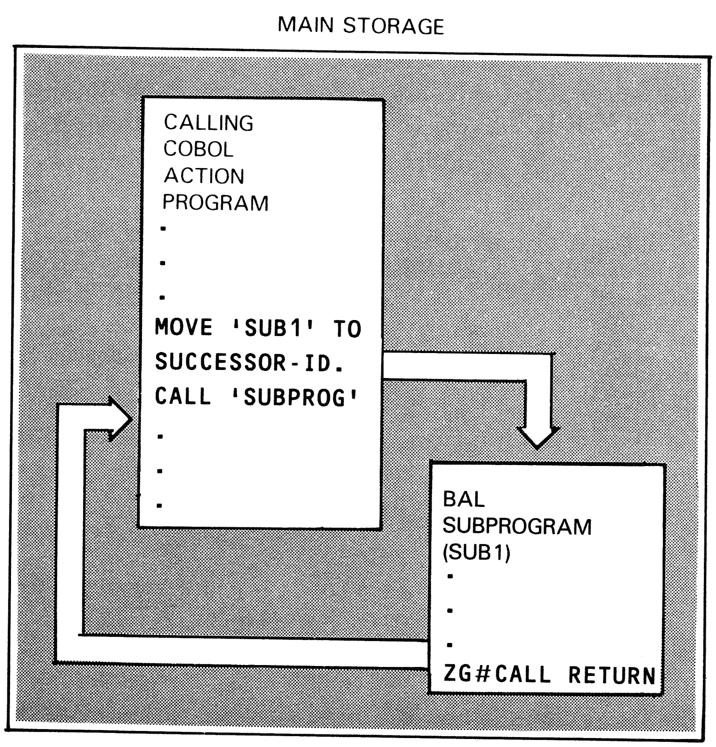
Subprograms can issue all the function calls that regular action programs use.

Subprograms may not call other subprograms.

A parameter list provides the means of transferring information from action program to subprogram.

The called subprogram can access only those files allocated for the calling action program.

Your calling action program may be in COBOL while a subprogram may be in BAL, or both calling program and subprogram may be in the same language.



8.3. COBOL Action Program and Subprogram Interface

A COBOL action program calls a resident subprogram with the following sequence:

```
MOVE subprogram-name TO SUCCESSOR-ID.
CALL 'SUBPROG' [USING data-name-1...data-name-n].
```

where:

`data-name-1...data-name-n`
: Refer to data items in the data division of the calling COBOL action program. No more than 12 data-names can be specified.

A subprogram written in COBOL returns control to the calling action program as follows:

```
CALL 'RETURN'.
```

When the calling action program issues the SUBPROG CALL function, IMS clears the status code and detailed status code fields in the program information block. Be sure to save status codes and detailed status codes in your calling program's work area before issuing a SUBPROG call. Otherwise, you lose the status of the latest function call issued.

When you issue the SUBPROG call, IMS transfers the contents of the calling program's work area to the subprogram's work area and your saved status codes are received in the subprogram's work area.

Also, depending on your application, when returning to the main program, you may want to save the latest status codes and detailed status codes from the subprogram. When the main program needs the status of the latest function call, you move these program information block values to the subprogram work area. When the CALL RETURN function executes, IMS returns these values to the main program work area. Otherwise, IMS clears the status codes and detailed status codes in the program information block and they are lost.

8.4. BAL Action Program and Subprogram Interface

A BAL action program calls a resident subprogram via the following macroinstruction:

```
{CALL   }  SUBPROG,(param-1,...,param-n)
{ZG#CALL}
```

where:

param-1,...,param-n
: Refer to labels of storage locations in the BAL action program. Up to 12 parameters can be specified.

A subprogram written in BAL returns control to the calling action program via the following macroinstruction:

```
{CALL   }  RETURN
{ZG#CALL}
```

Remember to place the name of the called subprogram in the program information block at location ZA#PSID before issuing the CALL function. The subprogram name must be left-justified and zero-filled (X'F0') in a 6-byte area.

When the calling action program transfers control to the called subprogram, register 1 points to the specified parameter list. If the subprogram requires working storage, the calling program can pass the address of the working-storage area to the subprogram either in the parameter list or in a register. Other register contents are as follows:

Registers	Contents
Register 0	Unpredictable
Register 1	Parameter list address
Registers 2-12	Address of calling action program contents
Register 13	72-byte save area supplied by calling action program. Subprogram must save caller's registers using standard linkages.
Register 14	Return address
Register 15	Entry point address of subprogram

Because IMS clears the status codes and detailed status codes after the main program issues the SUBPROG call, your main program must save these codes before issuing the SUBPROG call. Depending on your application, saving these codes may also be necessary before issuing the CALL RETURN from the subprogram.

8.5. Subprogram Sample Application

Consider how often you test the performance of an I/O function call for various error conditions and consequently issue an error message to the terminal. After each function call, you check status. All of the error conditions and error messages could be coded in a subprogram so that each time the calling action program issues a function call, it could call the subprogram to test the status of that function call and move the appropriate error message into an area of the calling action program. After returning to the calling program, that program could issue the error message to the terminal.

In this case, you can handle all the error testing and error message processing in your subprogram instead of duplicating the code in several action programs. Other routines suited to subprograms might be a frequently calculated inventory or payment total or cursor positioning used often in generating output messages to the terminal.

Probably the most common subprogram call application is to a COBOL subprogram. Figure 8-1 is an example of a COBOL action program (GRP4D) that calls the COBOL subprogram (NUMPRG) to determine the status of function calls issued by GRP4D. Figure 8-2 shows the subprogram, NUMPRG.

In Figure 8-1, the calling program (GRP4D) retrieves the customer record of the customer named at the terminal. This customer record is on the file, TEST4, identified on line 9.

Once GRP4D retrieves the customer record (I-REC), it tests the status code for the GET function call. If the GET is successful (line 56), GRP4D processes a customer record (lines 72-82) sending it to the source terminal upon normal termination (lines 83 and 84).

If the GET is unsuccessful, GPR4D saves the status codes and detailed status codes and moves the subprogram name, NUMPRG, to the SUCCESSOR-ID field in the program information block (line 59) and calls the subprogram (line 60). Notice particularly that the USING clause in the procedure division of the subprogram (line 15) must match the USING clause on the CALL 'SUBPROG' statement in the calling program (line 60). This establishes the parameter list.

NUMPRG (Figure 8-2) tests status codes, moves the appropriate error messages to the work area (lines 9-14, Figure 8-2), and returns to GRP4D (line 26, Figure 8-2). Following the SUBPROG call, GRP4D receives the error message returned by NUMPRG, moves it to the output message area (lines 41-52, Figure 8-1), and issues the output message to the terminal (lines 61-70, Figure 8-1). GPR4D terminates normally with the CALL 'RETURN' (line 84, Figure 8-1).

When the status code being tested in NUMPRG is satisfied, NUMPRG returns to GRP4D. GRP4D processes the error message by sending it to the source terminal on normal termination.

Note that the activation record areas described in the subprogram linkage section must correspond in size and layout to their like areas in the main program. (See Figure 8-1, lines 18-26, and Figure 8-2, lines 9-14.)

```
IDENTIFICATION DIVISION.
PROGRAM-ID.  GRP4D.
ENVIRONMENT DIVISION.
CONFIGURATION SECTION.
SOURCE-COMPUTER. UNIVAC-OS3.
OBJECT-COMPUTER. UNIVAC-OS3.
DATA DIVISION.
WORKING-STORAGE SECTION.
77  TEST4    PIC X(7) VALUE 'TEST4  '.
77  DICE1    PIC X(4) VALUE ='1003050A'.
77  DICE2    PIC X(4) VALUE ='10060200'.
77  DICE3    PIC X(4) VALUE ='10060003'.
LINKAGE SECTION.
01  PIB. COPY PIB74.
01  IMA. COPY IMA74.
    02  FILLER  PIC X(11).
    02  PHONE-IN  PIC 999.
01  WORK-AREA.
    02  I-REC.
        03  PHONE-0     PIC 999.
        03  NAME-0   PIC X(15).
        03  ADDRESS-0   PIC X(6).
    02  ERR-DATA.
        03  MSG     PIC X(14).
        03  S-CODE     PIC 9999.
        03  D-CODE     PIC 9999.
01  OMA. COPY OMA74.
    02  DATA-LINE.
        03  DICE-1  PIC X(4).
        03  MSG1    PIC X(4).
        03  DICE-3  PIC X(4).
        03  NAME0   PIC X(15).
        03  DICE-2  PIC X(4).
        03  MSG2    PIC X(7).
        03  DICE-4  PIC X(4).
        03  ADDRESS0   PIC X(6).
        03  DICE-5  PIC X(4).
        03  MSG3    PIC X(3).
        03  DICE-6  PIC X(4).
        03  PHONE0     PIC 999.
    02  ERR-MSG-LINE REDEFINES DATA-LINE.
        03  DICE-7  PIC X(4).
        03  MSG0    PIC X(14).
        03  DICE-8  PIC X(4).
        03  MSG4    PIC X(11).
        03  DICE-9  PIC X(4).
        03  CODE10  PIC 9999.
        03  DICE-10   PIC X(4).
        03  MSG5      PIC X(8).
        03  DICE-11   PIC X(4).
```

Figure 8-1. Sample Action Program (GRP4D) Calling Subprogram (NUMPRG) (Part 1 of 2)

```
               03  CODE20  PIC 9999.
               03  FILLER  PIC X.
       PROCEDURE DIVISION USING PIB IMA WORK-AREA OMA.
       BEGIN.
           CALL 'GET' USING TEST4 I-REC PHONE-IN.
           IF STATUS-CODE EQUAL ZERO GO TO PROCESS-MSG.
           MOVE STATUS-CODE T0 S-CODE.
           MOVE DETAILED-STATUS-CODE TO D-CODE.
           MOVE 'NUMPRG' TO SUCCESSOR-ID.
           CALL 'SUBPROG' USING WORK-AREA.
        PROCESS-ERROR.
           MOVE 80 TO TEXT-LENGTH OF OMA.
           MOVE DICE1 TO DICE-7.
           MOVE DICE2 TO DICE-8, DICE-10.
           MOVE DICE3 TO DICE-9, DICE-11.
           MOVE 'STATUS-CODE' TO MSG4.
           MOVE 'DETAILED' TO MSG5.
           MOVE S-CODE TO CODE10.
           MOVE D-CODE TO CODE20.
           MOVE MSG TO MSG0.
           GO TO E-O-J.
        PROCESS-MSG.
           MOVE 80 TO TEXT-LENGTH OF OMA.
           MOVE DICE1 TO DICE-1.
           MOVE DICE3 TO DICE-3, DICE-4, DICE-6.
           MOVE DICE2 TO DICE-2, DICE-5.
           MOVE 'NAME' TO MSG1.
           MOVE 'ADDRESS' TO MSG2.
           MOVE 'KEY' TO MSG3.
           MOVE NAME-0 TO NAME0.
           MOVE ADDRESS-0 TO ADDRESS0.
           MOVE PHONE-0 TO PHONE0.
        E-O-J.
           CALL 'RETURN'.
```

Figure 8-1. Sample Action Program (GRP4D) Calling Subprogram (NUMPRG) (Part 2 of 2)

```
IDENTIFICATION DIVISION.
PROGRAM-ID.  NUMPRG.
ENVIRONMENT DIVISION.
CONFIGURATION SECTION.
SOURCE-COMPUTER. UNIVAC-OS3.
OBJECT-COMPUTER. UNIVAC-OS3.
DATA DIVISION.
LINKAGE SECTION.
01  WORK-AREA.
    02  FILLER  PIC X(24).
    02  ERR-DATA.
        03  MSG     PIC X(14).
        03  S-CODE      PIC 9999.
        03  D-CODE      PIC 9999.
PROCEDURE DIVISION USING WORK-AREA.
BEGIN.
    IF S-CODE EQUAL 1
        MOVE 'INVALID    KEY' TO MSG ELSE
    IF S-CODE EQUAL 2
        MOVE 'UNALLOCATED FI' TO MSG ELSE
    IF S-CODE EQUAL 3
        MOVE 'INVALID    REQ' TO MSG ELSE
    IF S-CODE EQUAL 4
        MOVE 'I/O      ERROR' TO MSG ELSE
    MOVE 'PROBLEM IN SUB' TO MSG.
    CALL 'RETURN'.
```

Figure 8-2. Sample Subprogram (NUMPRG)

Section 9
Action Programming in a Distributed Data Processing Environment

9.1. Basic DDP Requirements and Terminology

IMS handles distributed data processing (DDP) transactions through the IMS transaction facility. To use distributed data processing with IMS, you must include the IMS transaction facility in your software at each OS/3 system and must configure multithread IMS at each system. Also, you must define a global ICAM network that supports distributed data processing and include a LOCAP section in the IMS configuration for each IMS system where you want to route transactions or which will route transactions to you. Consult the *IMS System Support Functions Programming Guide,* UP-11907, for configuration and network definition requirements.

The following terms are used throughout the discussion of DDP transaction processing:

LOCAL TRANSACTION

Transaction that is processed at the same IMS system where it is initiated.

REMOTE TRANSACTION

Transaction that is initiated at one IMS system and processed at another.

PRIMARY IMS

IMS system where a remote transaction is initiated. In our illustrations, we call this system IMS1.

SECONDARY IMS

IMS system where a remote transaction is processed. The action programs processing the transaction and any files they access are located here. In our illustrations, we call this system IMS2.

LOCAL IMS

Your IMS system, regardless of whether your system is primary or secondary for a particular transaction.

REMOTE IMS

IMS system at another computer.

LOCAP-NAME

The 4-character label of a LOCAP macroinstruction in your ICAM network definition, identifying a local or remote IMS system.

9.2. How IMS Routes Remote Transactions

There are three different ways in which the primary IMS can route a transaction to a secondary system:

1. Directory routing

   The terminal operator enters a transaction code that identifies a transaction at a secondary system. The transaction code is defined in the configurator TRANSACT section.

2. Operator routing

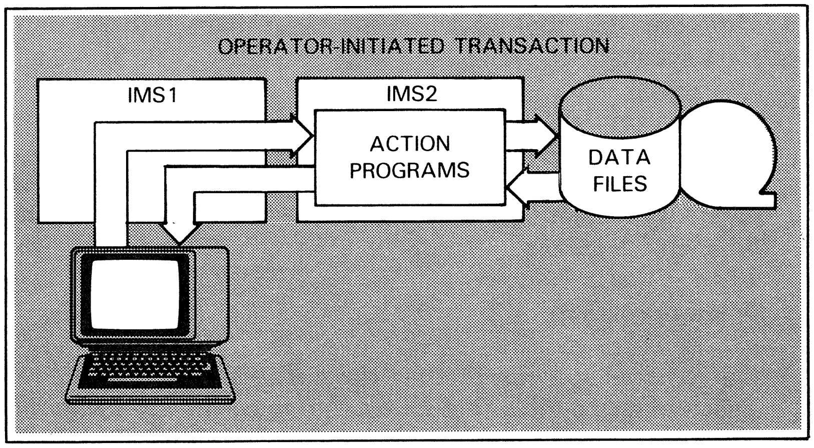
   The terminal operator prefixes the transaction code with a route character (followed by a period) that routes the transaction to a secondary system. This route character is defined in the configurator LOCAP section or in a PARAM job control statement at IMS start-up.

3. Action program routing

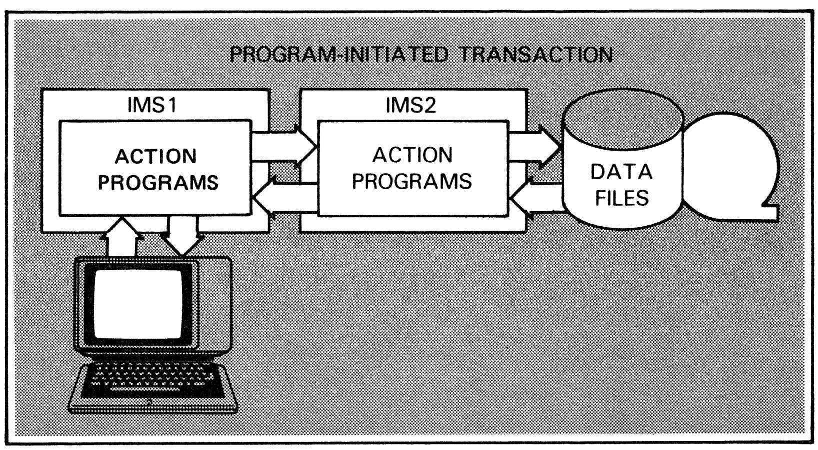
   The terminal operator enters a transaction code that initiates a transaction at the primary system. The action program processing this local transaction issues an ACTIVATE function call to initiate a transaction at a secondary system.

Screen format services cannot be used with transaction program routing.

From the programmer's viewpoint, directory and operator routing are the same because they are both initiated by a terminal operator. Once the transaction is routed to the secondary system, an action program or series of action programs at that system interacts with the terminal operator the same way as in a local transaction. No action programs are involved at the primary system.

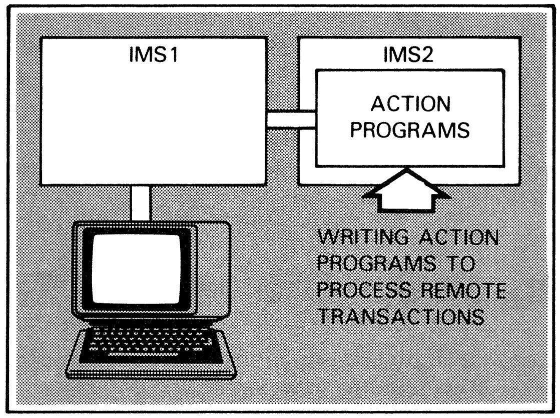


With action program routing, action programs at the secondary system do not interact directly with the terminal operator. They return a message to the initiating action program or its successor, which in turn outputs a message to the terminal operator. As a programmer, you may be writing action programs at either the primary or secondary system.



9.3. Processing a Remote Transaction

First, we'll assume that you are at a secondary IMS, writing action programs to process transactions initiated by an operator or an action program at a primary IMS system.



There is little difference between the way you process a remote transaction and the way you process a local transaction. You can use the same action programs to process both local and remote transactions.

When the transaction begins, you receive an input message starting with a 1- to 8-character transaction code, just as with a local transaction.

You can determine the source of the input message by testing the DDP-MODE field (ZA#DDPMD) of the program information block and the SOURCE-TERMINAL-ID field (ZA#ISTID) of the input message header.

The DDP-MODE field contains the value 'R' (ZA#DTR) when the transaction is operator-initiated (either directory routing or operator routing). It contains the value 'A' (ZA#PTRA) when the transaction is initiated by an action program. When a transaction is local, the DDP-MODE field contains zeros (X'00'). This field has other possible values, but they apply to action programs at the primary IMS system (see 9.8).

When an action is scheduled to process a transaction at a secondary IMS, the SOURCE-TERMINAL-ID field contains the locap-name of the IMS system originating the transaction rather than a terminal-id. You cannot test for the actual terminal initiating a remote transaction.

There are a few general restrictions on processing remote transactions. (There are several additional restrictions for program-initiated remote transactions, which will be discussed a little later in this section.)

1. You cannot use the SEND function to output a message to the originating terminal (or any terminal at the remote IMS). However, you can use the SEND function to output a message to a terminal at your local IMS. Afterward, clear the DESTINATION-TERMINAL-ID field (ZA#OTID) or move the source locap-name to that field before issuing a CALL RETURN to send an output message to the originating terminal.

2. You cannot send continuous output to the originating terminal. Again, you can use the SEND function to initiate continuous output at a local terminal using output-for-input queueing.

3. You cannot send output to an auxiliary device attached to the originating terminal. However, you can output to local auxiliary devices using the SEND function.

9.4. Processing an Operator-Initiated Remote Transaction

With the few exceptions already mentioned, you process an operator-initiated remote transaction the same way as a local transaction.

You can use any type of action program succession with operator-initiated transactions. Once the transaction begins, the IMS transaction facility establishes a communications link, which stays in effect until the transaction ends. When you use external succession, the terminal operator receives and responds to your output messages without entering any additional codes.

Figure 9-1 illustrates a remote dialog transaction, using both internal (either immediate or delayed) and external succession.

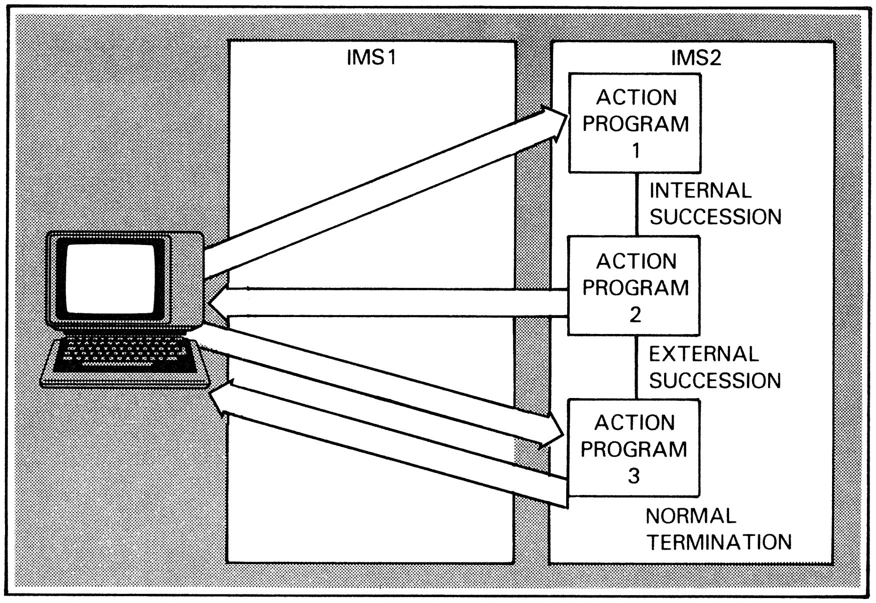


Figure 9-1. Processing an Operator-Initiated Remote Dialog Transaction

You can use screen format services with operator-initiated remote transactions. See 7.14 for details.

9.5. Processing a Program-Initiated Remote Transaction

When a remote transaction is initiated by an action program, you send an output message back to the originating action program's successor. That action program in turn outputs a message to the terminal operator.

Because your output message goes to an action program rather than to a terminal, there are a few additional considerations and restrictions:

1. You may want to format the output message differently; you do not need control characters. Of course, you may want to use the same output message for either operator- or program-initiated transactions. In this case, the action program receiving your message must be prepared to receive your control characters.

2. You cannot use a screen format for the output message you return to the originating action program or its successor (see 7.14). However, you can use the SEND function to display a screen format at a local terminal.

3. You must use normal termination when you return an output message to the originating action program's successor. You cannot use external succession. You can, however, use immediate or delayed internal succession and have your successor program return the output message (Figure 9-2).

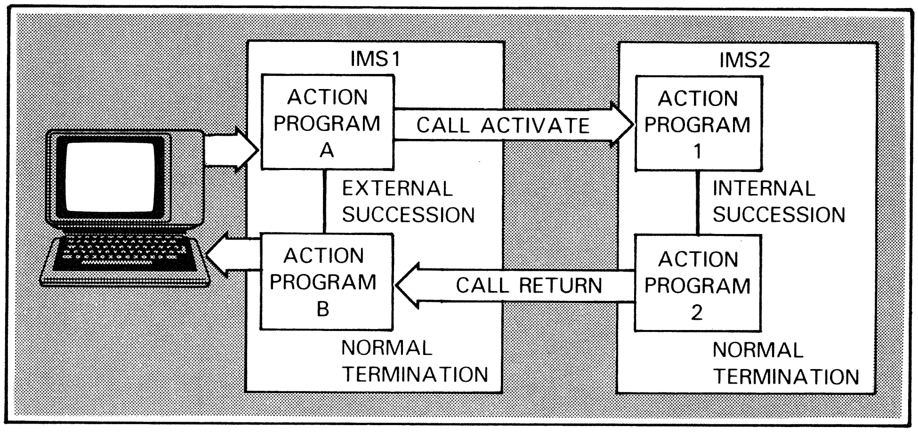


Figure 9-2. Processing a Program-Initiated Remote Transaction

Although a program-initiated remote transaction always has just one input message and one response, a dialog with the terminal operator can still take place. The initiating series of action programs at the primary IMS can use external succession to output messages and receive responses from the terminal and can issue repeated ACTIVATE function calls to communicate with your action programs and access your files. Figure 9-3 shows how you might process successive program-initiated remote transactions while the initiating action programs carry on a dialog with the terminal operator.

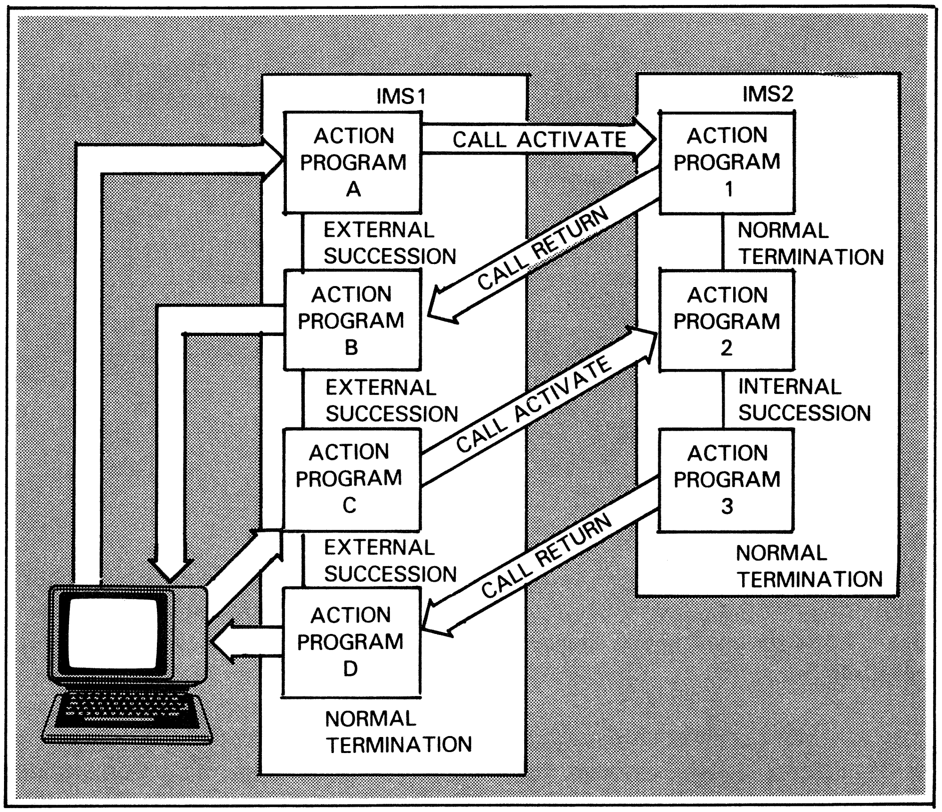
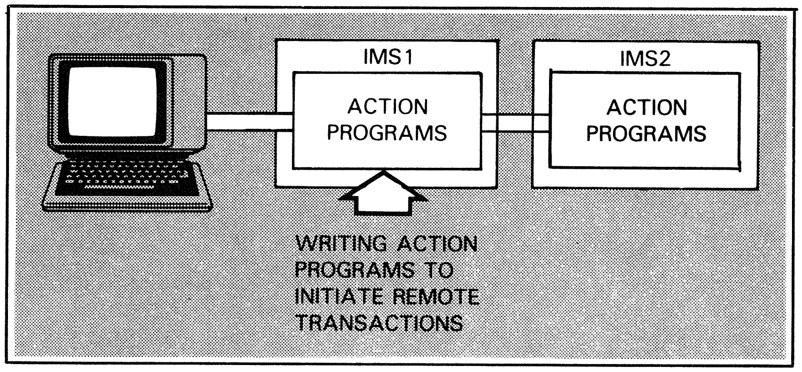


Figure 9-3. Processing Successive Program-Initiated Remote Transactions

9.6. Routing Transactions to a Remote IMS System

Now, assume that you are at a primary IMS writing action programs to initiate remote transactions and receive response messages from a remote system.



In a program-initiated remote transaction, you make the decision whether to route the transaction to a remote system on the basis of some data the terminal operator enters or perhaps something you discover when you access your files or make some computations.

You initiate a remote transaction by identifying the remote IMS system (locap-name) in the output message header, building a message containing a transaction code in your output message area, and issuing an ACTIVATE function call. You must terminate your action program externally, naming a successor program at your local IMS system. Of course, you can reschedule the same action program as the successor.

You cannot use a screen format for the output message you send with the ACTIVATE function call.

Action programs at the remote IMS system process your message and send a response. Your successor program receives the response message in its input message area. You can then send an output message to the originating terminal. (See Figures 9-2 and 9-3.) If you wish, you can issue another ACTIVATE call instead of outputting a message to the terminal (Figure 9-4).

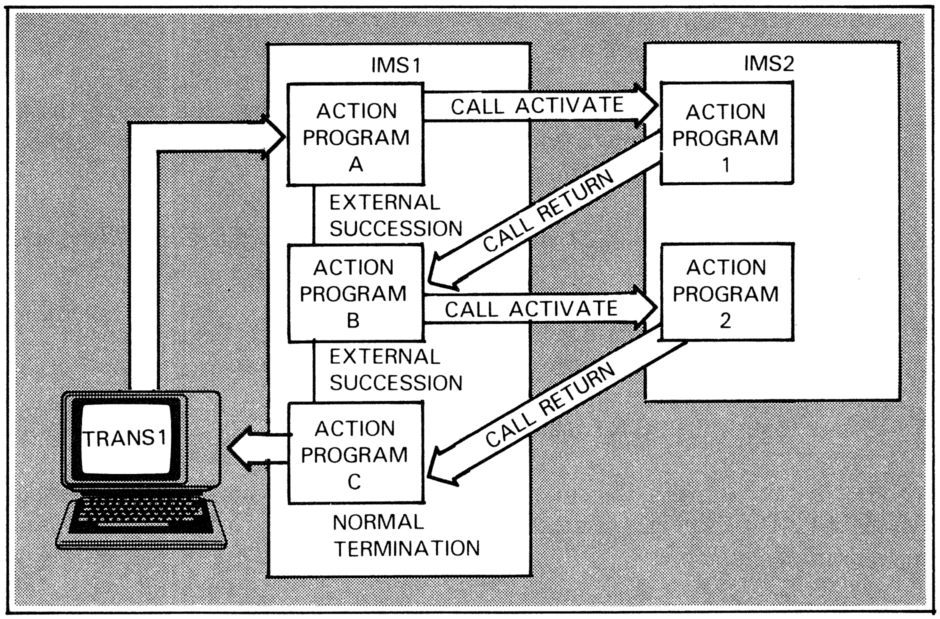


Figure 9-4. Issuing Multiple ACTIVATE Calls without Operator Intervention

9.7. Initiating a Remote Transaction (ACTIVATE)

The ACTIVATE function call initiates a remote transaction and terminates the action program. It has no parameters.

The COBOL and BAL formats for the ACTIVATE function call are:

- COBOL format

```
CALL 'ACTIVATE'
```

- BAL format

```
{CALL   }   ACTIVATE
{ZG#CALL}
```

Here is a step-by-step procedure for initiating a remote transaction:

1. Identify the remote IMS system where you want the transaction processed by placing its locap-name in the DESTINATION-TERMINAL-ID field (ZA#ODTID) of the output message header.

2. Build the output message you want to send to the remote system in the output message area. The message must begin with a transaction code that is acceptable to the remote IMS system.

3. Move the message length to the TEXT-LENGTH field (ZA#OTL) of the output message header.

4. Specify external termination and the name of a successor program at your local IMS system. The successor program can be the same program.

5. Issue the ACTIVATE function call.

You don't issue a RETURN function call when you initiate a remote transaction. The ACTIVATE function call terminates the action program and sends the output message to the remote system.

9.8. Receiving a Response Message in the Successor Action Program

When an action program issues an ACTIVATE function call and terminates in external succession, its successor program receives a message in the input message area regardless of whether the remote transaction is successful. When the remote transaction is successful, the successor program receives a response from the action program processing the transaction at the secondary IMS. When the remote transaction is unsuccessful, the successor program receives error codes in the input message area.

To determine whether the transaction was successful, test the DDP-MODE field (ZA#DDPMD) of the program information block. The DDP-MODE field contains the value 'E' (ZA#PTRE) when the remote transaction ends normally and returns a message to your program. It contains the value 'C' (ZA#PTRC) when the remote transaction is unsuccessful. This field has other possible values, but they apply to action programs processing a remote transaction at a secondary IMS system.

When the remote transaction is successful (value 'E'), you can send a message to the originating terminal or issue another ACTIVATE call to initiate another remote transaction.

IMS sets the DDP-MODE field to 'C' and places an error code in the input message area when:

- Your output message cannot be sent to the remote IMS
- Your output message arrives at the remote IMS but the transaction cannot be scheduled
- The remote transaction is scheduled but terminates abnormally
- The remote transaction terminates normally but your program does not receive the response message

You can continue processing your local transaction, perhaps issuing an error message to the source terminal.

The only errors causing cancellation of the initiating transaction are succession errors. If an action program issuing a CALL ACTIVATE specifies an invalid termination indicator or successor-id, IMS cancels the transaction and sends an error message to the source terminal. Also, if the terminal operator keys in the ZZCNC terminal command, the transaction is canceled.

9.9. Error Returns from an Unsuccessful Remote Transaction

When the remote transaction is unsuccessful, IMS places the value 'C' in the DDP-MODE field and also sets an error code in the input message area. The error code consists of a 2-byte class code and a 2-byte reason code. When the class code is 0081, an error message containing DICE characters follows the error code.

The format of the input message area when IMS returns an error is:

Input Message Header	Error Class Code	Error Reason Code	Message-Text (Optional)
16 bytes	2 bytes	2 bytes	Variable

Table 9-1 describes the error codes and their meanings.

Note: *Class and reason codes are not translated, regardless of the translate option configured for the action receiving the input message.*

Table 9-1. Errors Returned to Input Message Area When Remote Transaction Is Unsuccessful

Class Code (Hexadecimal)	Reason Code (Hexadecimal)	Explanation
0003	000C	Distributed data processing not configured.
0006	0004	Destination locap-name invalid or auxiliary function specified.
0006	0005	No ICAM buffer available for switched message.
0006	0006	Disk error on switched message.
0006	0007	Invalid length specification for switched message.
0006	0009	CALL ACTIVATE requested by action program at remote IMS.
000A	0001	Invalid function code. Submit a User Communication Form (UCF).

continued

Table 9-1. Errors Returned to Input Message Area When Remote Transaction Is Unsuccessful (cont.)

Class Code (Hexadecimal)	Reason Code (Hexadecimal)	Explanation
000A	0002	Invalid name. Submit UCF.
000A	0003	Buffer not available. Retry.
000A	0004	Invalid data type. Submit UCF.
000A	0005	Invalid data length. Submit UCF.
0080	0100	Required header item missing. Submit UCF.
0080	0700	Message sequence error. Submit UCF.
0080	0800	Invalid mode of operation. Submit UCF.
0080	0A00	Protocol procedure error. Submit UCF.
0080	0B00	Invalid header item. Submit UCF.
0080	0C00	Version not supported. Submit UCF.
0080	0D00	Class of procedure not supported. Submit UCF.
0081	0000	Action program or IMS error at remote system. Message text indicates specific error.
008C	0001	Error in transaction presentation control header. Submit UCF.
0400	0001	Invalid transaction code specified.
0400	0002	Shutdown in process at remote IMS.
1000	0051	Invalid destination name. Submit UCF.
1000	0052	Invalid input queue name. Submit UCF.
1000	0056	Destination end user busy. Retry; if problem persists, submit UCF.
1000	0057	Duplicate session request; already active. Submit UCF.
1000	0058	No dynamic main storage available. Retry; if problem persists, submit UCF.
1000	0075	Link not initialized. Check VLINE connection.
1000	0076	Destination terminal down. Submit UCF.
1000	0077	Line down. Check VLINE connection.
1000	0078	Remote IMS not ready. Ensure that secondary IMS has successfully completed start-up.

continued

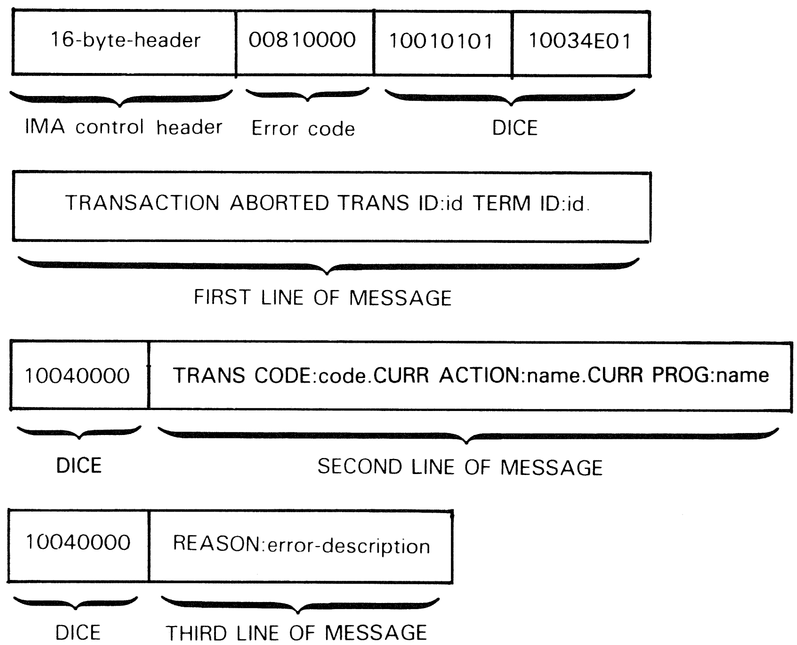
Table 9-1. Errors Returned to Input Message Area When Remote Transaction Is Unsuccessful (cont.)

Class Code (Hexadecimal)	Reason Code (Hexadecimal)	Explanation
1000	0100	No sessions available. Increase DDPSESS specification.
1000	0200	Secondary system rejected session request because: 1. Locap-name of primary IMS is not configured as a valid locap-name at secondary system 2. Secondary system has no more available sessions 3. Secondary system went down while trying to find an available session
1100	1800	No ICAM buffer available. Increase buffers in ICAM network definition.
1100	1900	No session established. Submit UCF.
1200	9900	Invalid request. Submit UCF.
1400	0000	Remote system shutdown. Could be normal or error condition.

The class code 0081 indicates that the remote transaction abnormally terminated because of an IMS or action program error. This class code is always followed by a reason code of 0000 and a message text. The message text is one of the 3-line multithread IMS transaction termination messages documented in the *System Messages Reference Manual,* UP-8076.

The 3-line transaction termination message is formatted for output to the source terminal. You can move this message to your output message area and send it to the source terminal without additional formatting. The message is not edited, regardless of the editing option configured for the action; the message contains DICE codes.

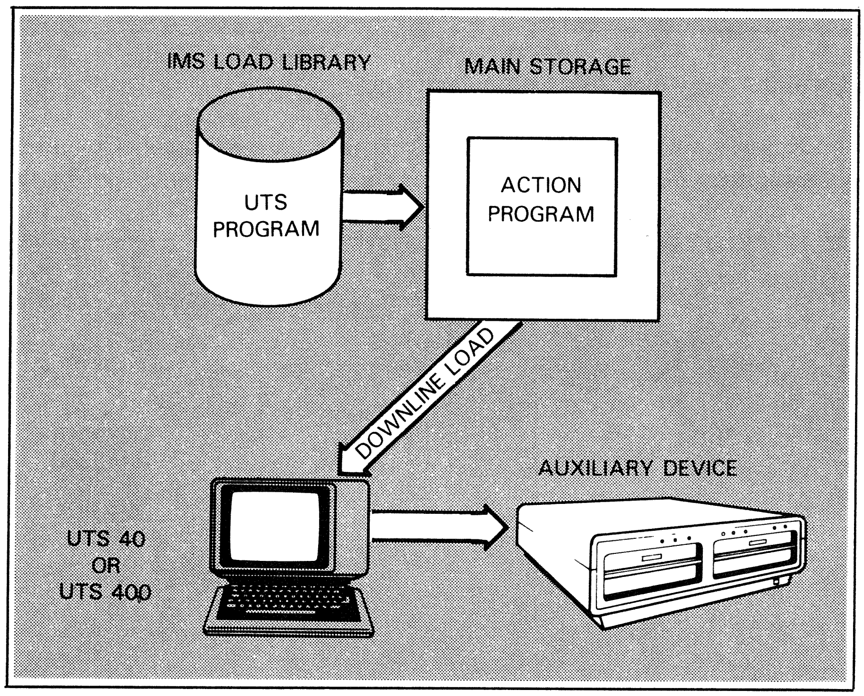
An example of the input message area contents when IMS returns an error code of 0081 is:



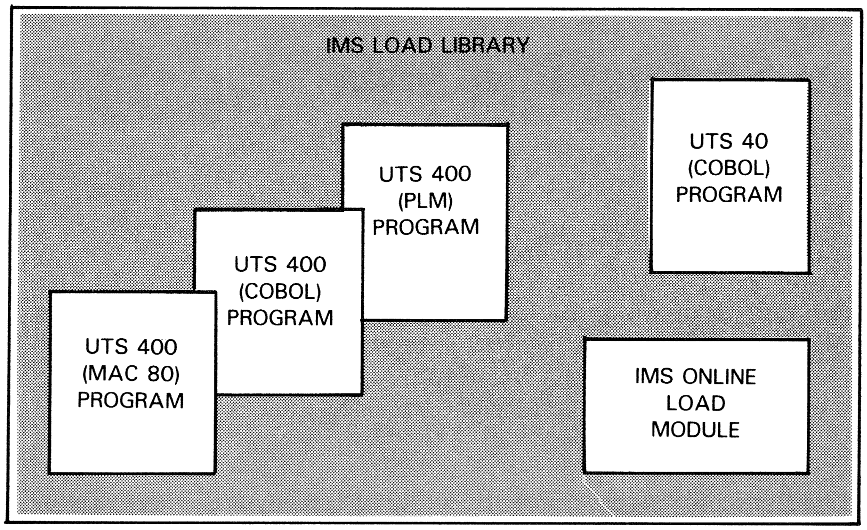
Section 10
Additional Special Features

10.1. Downline Load Feature

Downline load action programs load COBOL, MAC 80, or PLM programs into the storage area of a UTS 400 or COBOL programs into the storage area of a UTS 40 for immediate execution. They can also load these UTS programs to auxiliary storage devices (diskette or cassette) attached to the UTS 40 and UTS 400.

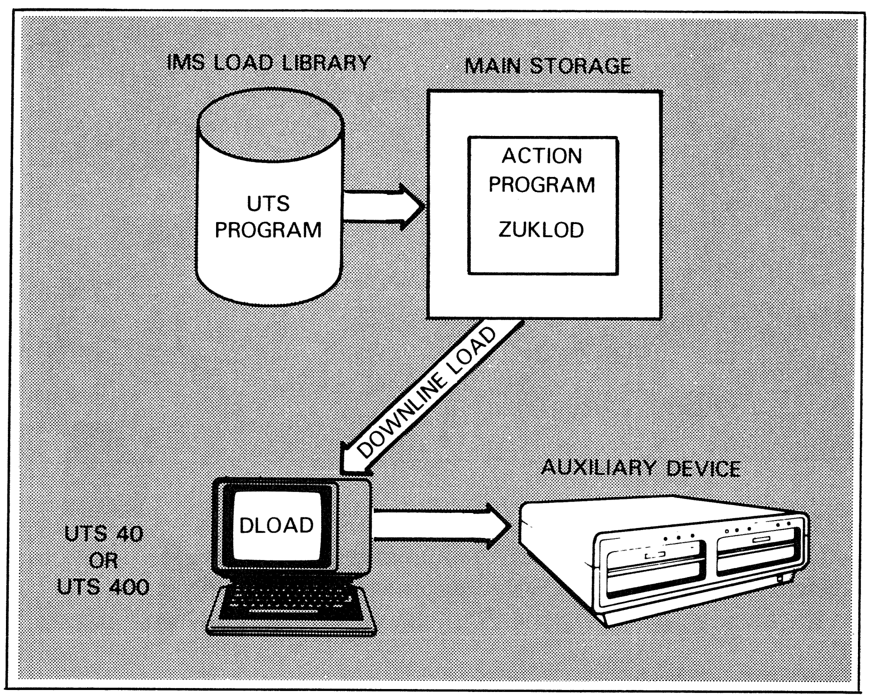


These UTS programs must be stored in the IMS load library -- the same load library that contains your online IMS load module and action programs. If you configure the fastload feature, do not store UTS programs in the action program load library. Store them in the library containing the IMS load module or in the system load library, YLOD.

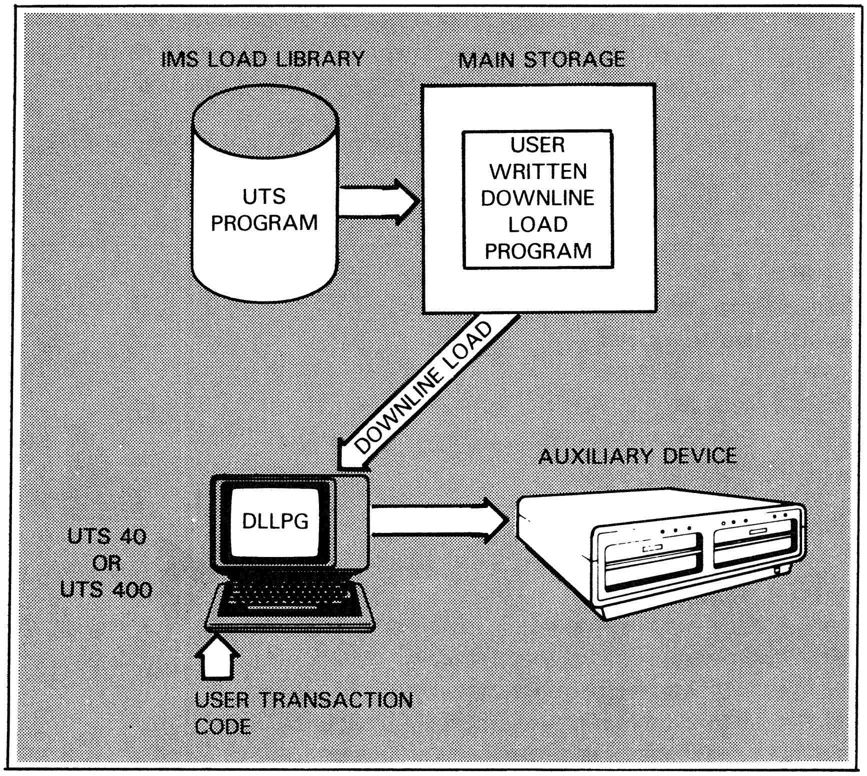


There are two ways of downline loading:

1. Enter the transaction code, DLOAD, to activate the IMS downline load action program, ZUKLOD.



2. Write your own downline load action program.



For details about the DLOAD transaction code, see the *IMS Terminal Operations Guide,* UP-12027.

Downline loading programs can be useful in numerous applications. One use is for editing and validating IMS input messages. If errors occur in input editing and validation, you can handle them directly at the UTS terminal without transmitting the message to the host computer.

To use the downline loading feature, generate a resident ICAM that supports unsolicited output and specify DLLOAD=YES in the OPTIONS section of the configurator input.

The UTS terminal accepting a downline load must be a master or primary station and not a slave station.

Before using the downline loading feature, you should be familiar with the UTS 40, or UTS 400 terminal description found in the *Integrated Communications Access Method (ICAM) Technical Overview*, UP-9744.

10.2. Writing Downline Load Action Programs

Suppose you decide not to call the ZUKLOD action program via the DLOAD transaction code to downline load UTS programs. You can write your own downline load action program to read blocks of UTS program code from the IMS load library to a UTS terminal or auxiliary device. Figure 10-1 is a sketch of a downline load action program that loads a UTS program, stored in the IMS load library, downline to a UTS 400 main storage.

```
IDENTIFICATION DIVISION.
PROGRAM-ID. LODPRG.
ENVIRONMENT DIVISION.
CONFIGURATION SECTION.
SOURCE-COMPUTER. UNIVAC-OS3.
OBJECT-COMPUTER. UNIVAC-OS3.
DATA DIVISION.
WORKING-STORAGE SECTION.
77   LOD-MOD-NAME        PIC X(8)  VALUE  'MACPROG1'.
77   BUF-SIZE            PIC 9999  USAGE COMP  VALUE 10000.
LINKAGE SECTION.
01   PROGRAM-INFORMATION-BLOCK. COPY PIB74.
01   INPUT-MESSAGE-AREA. COPY IMA74.
     02   UTS400-RESPONSE-MESSAGE.
          03   UTS400-RESPONSE-DICE        PIC X(4).
          03   UTS400-RESPONSE             PIC X(4).
     02   DEL-NOTICE-MSG REDEFINES UTS400-RESPONSE-MESSAGE.
          03   CONT-CODE                    PIC X(4).
          03   DEL-NOT-CODE                 PIC X.
          03   FILLER                       PIC XXX.
     02   TRANS-CODE-ENTRY  REDEFINES UTS400-RESPONSE-MESSAGE.
          03   TR-CODE                      PIC X(5).
          03   FILLER                       PIC XXX.
01   OUTPUT-MESSAGE-AREA. COPY OMA74.
     02   DOWNLINE-LOAD-MESSAGE.
          03   DOWNLINE-LOAD-HEADER         PIC X(6).
          03   DOWNLINE-LOAD-TEXT           PIC X(1000).
01   CONTINUITY-DATA-AREA.
     02   GET-SET-AREA                      PIC X(400)  SYNC.
PROCEDURE DIVISION  USING  PROGRAM-INFORMATION-BLOCK
                           INPUT-MESSAGE-AREA
                           OUTPUT-MESSAGE-AREA
                           CONTINUITY-DATA-AREA.
START-PROG.
      IF TRANS-CODE = 'DLLPG' GO TO SET-PARA
```

Figure 10-1. User-Written Downline Load Action Program Sketch (Part 1 of 2)

```
      ELSE
            IF CONT-CODE = 'CONT' GO TO TEST-DEL-NOTICE
            ELSE
                    GO TO LOAD-STATUS-CHECK.
SET-PARA.
      CALL 'SETLOAD' USING LOD-MOD-NAME  GET-SET-AREA.
                (Status code tests)
GET-PROG-CODE.
      CALL 'GETLOAD' USING GET-SET-AREA  DOWNLINE-LOAD-TEXT  BUF-SIZE.
      IF STATUS-CODE > 0  GO TO STAT-TEST
      ELSE MOVE 'C' TO AUX-FUNCTION
           MOVE 'CONT' TO CONTINUOUS-OUTPUT-CODE
      GO TO EXTERNAL-TERMINATION.
STAT-TEST.
      IF STATUS-CODE = 2 GO TO EXTERNAL-TERM
      ELSE
            IF STATUS-CODE = 3 AND DETAILED-STATUS-CODE = 20
                      GO TO INVAL-REQ
     ELSE
          IF STATUS-CODE = 3 AND DETAILED-STATUS-CODE = 21
                 GO TO SMALL-DATA-BUF
          ELSE
                 IF STATUS-CODE = 4 GO TO I/O-ERR.
EXTERNAL-TERM.
      MOVE '1B0E30323130' TO DOWNLINE-LOAD-HEADER.
      MOVE 'E' TO TERMINATION-INDICATOR.
      MOVE 'LODPRG' TO SUCCESSOR-ID.
      CALL 'RETURN'.
AB-TERM.
      MOVE 'S' TO TERMINATION-INDICATOR.
      CALL 'RETURN'.
NORM-TERM.
      (Send message to terminal)
      CALL 'RETURN'.
INVAL-REQ.
      (Send unsuccessful message to terminal)
      CALL 'RETURN'.
TEST-DEL-NOTICE.
      IF DEL-NOT-CODE = '81' GO TO GET-PROG-CODE  ELSE GO TO ERR-ROUT.
LOAD-STATUS-CHECK.
      IF UTS400-RESPONSE = '39303030' GO TO NORM-TERM.
UNSUCCESSFUL-LOD.
      (Generate error message)
      GO TO NORM-TERM.
SMALL-DATA-BUF.
      (Generate error message)
      GO TO NORM-TERM.
I/O-ERR.
      (Generate error message)
      GO TO NORM-TERM.
ERR-ROUT.
      (Generate error message)
      GO TO NORM-TERM.
```

Figure 10-1. User-Written Downline Load Action Program Sketch (Part 2 of 2)

Downline load action programs must contain the following:

- An 8-byte field defined for the UTS load-module-name (line 9 of Figure 10-1). The data-name used to describe this 8-byte field is the same name you must use on the SETLOAD function call.
- One SETLOAD function call for each downline load (line 41). Issue the SETLOAD function before any GETLOAD function call because initialization must occur before you read a block of code from a UTS load module.
- GETLOAD function calls issued to read blocks of code from the UTS load module into the data buffer in the output message area of your calling downline load action program (line 44).
- A 400-byte area defined on the word boundary in the continuity data area (line 29). This area is used as a work area by the SETLOAD and GETLOAD function calls.
- The data-buffer (line 27) and 2-byte field indicating its size (line 10). The data-buffer contains a block of code read from the load module.

Before the downline load program issues the GETLOAD function call, the SIZE field (lines 10 and 44) should have the length of the buffer area in binary format. After the return from the GETLOAD call, the SIZE field has the number of bytes actually moved into the buffer area. This number is also in the binary format.

After issuing the GETLOAD function call, the downline load program must:

- Check for end-of-file (02) in the STATUS-CODE field of the program information block (lines 50 and 59-63)
- Process the status code in the program information block for successful completion of the GETLOAD function call (lines 46-48 and 59-63)

If the GETLOAD function is successful, the downline load program should:

1. Move 'C' to the AUX-FUNCTION field (the first byte of the AUXILIARY-DEVICE-ID field) of the output message header (line 46) if you are sending the block of UTS program code to the terminal (primary device) main storage. Otherwise, see Table 6-1 for the continuous output character needed by your application.

2. Prefix the data block received from the GETLOAD function call with a proper heading to load this block either directly into the UTS main storage or to an auxiliary storage device. This prefixed data block becomes the text in the downline load program's output message area. This text length can be calculated using the length returned in the *size* parameter of the GETLOAD function call. See Figure 10-1, lines 25-27 and 60, for an example of the output message area and the prefixing description required to format the text part of the output message area.

Your downline load action program should move the 6-byte prefix, X'1B0E30323130', into the prefix header (DOWNLINE-LOAD-HEADER) to provide the header information for loading the UTS main storage.

If the downline load is intended for the auxiliary storage device, your action program should instead move X'1313nnnnnnnn' into the prefix header (DOWNLINE-LOAD-HEADER). Here 'nnnnnnnn' is a 4-character ASCII sequence naming the UTS load program.

Figure 10-1, line 60, shows that the UTS MAC 80 program (MACPROG1) is downline loaded into the UTS main storage device.

3. Send the message from the downline load action program output message to the UTS terminal or auxiliary device using the continuous output feature (lines 46 and 47).

4. Terminate the downline load action program with external succession (that is, place 'E' in the TERMINATION-INDICATOR field of the program information block) and name the downline load action program as the successor. The successor action program must then be prepared to handle a delivery notice in the form of an input message (lines 17-20). This includes testing the delivery notice for errors and if an error occurs, moving an error message to the output message area before terminating the program normally (lines 73 and 86-88).

If the SETLOAD or GETLOAD function is unsuccessful and you configured ERET=YES in the PROGRAM section of the configurator, your downline load action program receives control with error indications set in the STATUS-CODE field of the program information block. For status code settings in this case, see status codes 3 and 4 in 10.3. and 10.4. The action program should then send an appropriate error message to the terminal (lines 49-58).

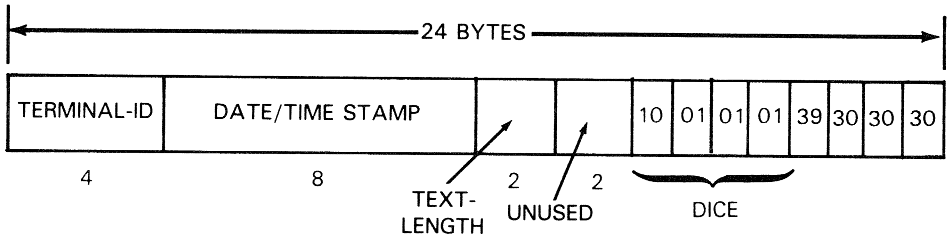
If the SETLOAD or GETLOAD function is unsuccessful and you didn't configure ERET=YES, IMS cancels the transaction and sends the following message to the terminal:

```
DOWN LINE LOAD ERROR.
```

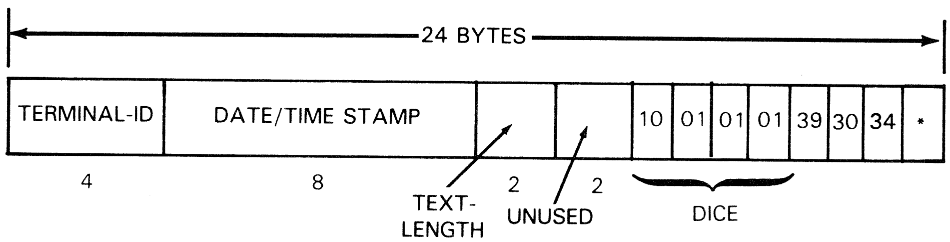
If the GETLOAD function returns an end-of-file condition (STATUS-CODE set to X'02' in the program information block), the buffer area contains the transfer record. This is the last block that should be sent to the UTS terminal; thus, your action program should issue no more GETLOAD functions for this load module.

If the blocks of code are sent to the UTS main storage for immediate execution of the program, then when the UTS terminal receives a transfer record it automatically transmits a response (input message) indicating whether or not the downline load was successful. Therefore, the downline load action program should not use continuous output to send this last block. It should follow the same procedure as for a successful GETLOAD function, except it should not move 'C' into the AUX-FUNCTION field of the output message header. The successor action program then receives in its input message area the 24-byte message header from a UTS in the following formats:

SUCCESSFUL LOAD



UNSUCCESSFUL LOAD



Note: *If you specify EDIT=NONE in the ACTION section, your program receives these DICE characters. If you specify EDIT=c or EDIT=tablename, or if you omit the EDIT parameter, these characters are stripped from the message header before it is sent to the program.*

Table 10-1 defines the various error bit configurations (*) that can be returned in the last byte of the message from the UTS terminal.

Table 10-1. Rejected Load Error Byte Definition

Bit Number*	Error Type	Probable Cause/Recovery
7	Never set	
6	Always set	The UTS operator should initiate a power-on confidence test from the controller or master station and, upon completion of the test, the load should be retried.
4	Load addressed to a UTS slave station instead of a master station	The load should be retried and addressed to the UTS master station.
3	Illegal control code encountered in program	IMS error; submit SUR.
2	Block overflow occurred in available/assigned main storage	If main storage is available, the UTS operator should assign the appropriate storage to the program. The load should be retried. If main storage is not available, the program should be recompiled, addressing available storage.
1	Start address of block is not in available/assigned main storage	Use the control page to assign more main storage, and reenter your transaction code. If insufficient main storage is available, the program must be compiled.
0	Addresses A and B not equal	IMS error; submit SUR.

* Numbered from right to left; that is, bit 7 is the most significant bit; bit 0 is the rightmost or least significant bit.

See Figure 10-1, lines 14-16, for an example of the input message area description to receive the UTS 400 response message after the last block of UTS program code is transferred downline.

After receiving the response message, the downline load action program should:

1. Interrogate the response message (lines 75 and 76) and send an appropriate output message to the terminal indicating the success or failure of the downline load

2. Terminate normally, that is, place 'N' in the TERMINATION-INDICATOR of the program information block

When the action program downline loads a UTS program to an auxiliary device, the UTS terminal does not generate a response message after it receives the last block of code. Therefore, the status of the downline load is not known until the program code is read into the UTS main storage.

10.3. Initializing Downline Load (SETLOAD)

The SETLOAD function call is the first function called by a downline load action program.

The COBOL and BAL formats for the SETLOAD function code are:

- COBOL format

```
CALL 'SETLOAD' USING module-name save-area.
```

- BAL format

```
{CALL   }   SETLOAD,(module-name,save-area)
{ZG#CALL}
```

Module-name is an 8-byte field containing the name of the UTS program load module to be downline loaded.

Save-area is a 400-byte area defined in the continuity data area. IMS uses the save-area to process the SETLOAD and GETLOAD function calls. This area must be word-aligned.

When a SETLOAD function call is issued, IMS returns one of the following status codes with corresponding detailed status codes in the program information block.

Status Codes (Decimal)	Detailed Status Codes (Decimal)	Description
0	0	Successful SETLOAD
3	1	Invalid request; invalid number of parameters
3	7	Invalid request; function invalid for type of request
3	22	Invalid request; after the initial SETLOAD is issued, SETLOAD may not be issued again until the downline load action program receives the transfer record via the GETLOAD call.

10.4. Loading the UTS Program (GETLOAD)

Your downline load action program issues the GETLOAD function call immediately after the SETLOAD function and repeatedly issues the GETLOAD function until end-of-file is reached for the UTS program load module.

The COBOL and BAL formats for the GETLOAD function call are:

- COBOL format

```
CALL 'GETLOAD' USING save-area buffer-area size.
```

- BAL format

```
{CALL   }   GETLOAD,(save-area,buffer-area,size)
{ZG#CALL}
```

where:

`save-area`
: Is the 400-byte word-aligned area previously defined in the SETLOAD function. IMS uses the save-area to process the SETLOAD and GETLOAD function calls.

`buffer-area`
: Is the data buffer in the output message area where your program receives a block of code from the UTS load module.

`size`
: Is a 2-byte field where the length (size) of the buffer-area is stored.

When your downline load action program issues a GETLOAD function call, IMS returns one of the following status codes and corresponding detailed status codes in the program information block:

Status Codes (Decimal)	Detailed Status Codes (Decimal)	Description
0	0	Successful GETLOAD
2	0	End-of-load module (transfer record received). Note that end-of-file is set at the time the last block of data (transfer record) is passed to the action program.
3	20	Invalid request; save-area address invalid or SETLOAD was not issued before GETLOAD.
3	21	Invalid request; data buffer too small (less than 10 bytes).
4	XX	I/O error. XX is the error code (in binary) returned by the OS/3 loader. Note that these error codes are explained in the System Messages Reference Manual, UP-8076.

10.5. Disconnecting a Line from an Action Program

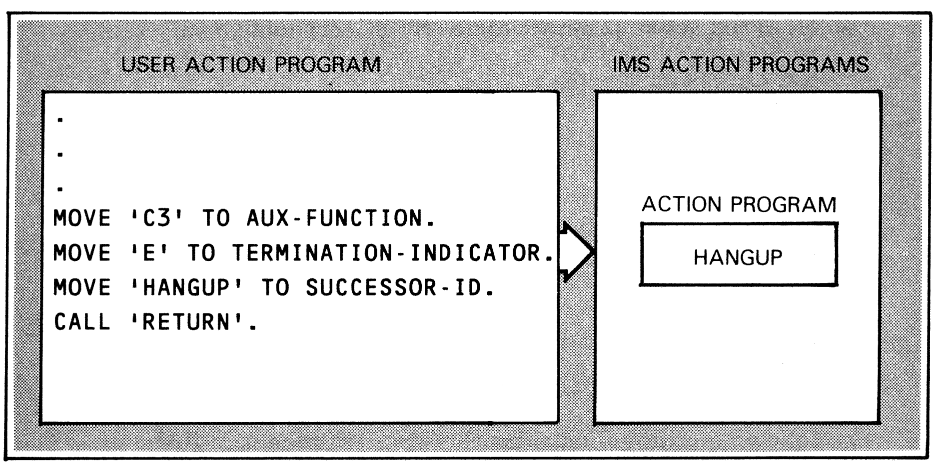
The line disconnect feature allows an action program to disconnect a single-station dial-in line following the delivery of its output message to enable another terminal to dial in on the same line. To use the line disconnect feature, include the continuous output capability in your configuration by specifying CONTOUT=YES in the configurator OPTIONS section. The line disconnect feature is available only in a dedicated ICAM network, not a global network.

To disconnect a line after message transmission, the action program must:

- Place a continuous output flag (X'C3') in the AUX-FUNCTION byte (ZA#OAUX field) of the output message header
- Specify external succession with 'HANGUP' as the successor by setting the TERMINATION-INDICATOR field (ZA#PSIND) in the program information block to E and the SUCCESSOR-ID field (ZA#PSID) to HANGUP

HANGUP is an action program supplied by IMS that terminates with a special code causing IMS to issue a line release/line request sequence to ICAM to disconnect the line.

MAIN STORAGE



After the output message is sent, no further input is required from the terminal operator. IMS waits for ICAM notification of message delivery before scheduling the external successor, HANGUP. In this way, delivery of the message prior to the line disconnect is ensured.

10.6. Initiating an OS/3 Job from an Action Program (RUN)

You can initiate background batch jobs from your action program by issuing the RUN function call. The RUN function initiates a system command that reads a job control stream and schedules that job for execution.

The COBOL and BAL formats for the RUN function call are:

- COBOL format

```
CALL 'RUN' USING command-text.
```

- BAL format

```
{CALL   }  RUN,(command-text)
{ZG#CALL}
```

Command-text is the symbolic address of a character string that consists of a valid command and its associated parameters. Valid commands are RUN, RU, RV, SI, SC, OCL, OC, or OV. The command text is contained in a command text area. This area must be at least 80 characters long. Your command text itself cannot be longer than 64 characters, so in order to get the 80-character minimum you must blank fill (X'40') the area following the text. The following COBOL coding illustrates the statements needed in the action program to use the RUN function call:

```
WORKING-STORAGE SECTION.
01 COMMAND-TEXT.
   02 CMD-TEXT     PIC X(18)    VALUE 'RV JOBN(JOBC),HIGH'.
   02 FILLER       PIC X(62)    VALUE BLANKS.
.
.
.
PROCEDURE DIVISION.
.
.
.
PARA-10.
          CALL 'RUN' USING COMMAND-TEXT.
```

The following coding illustrates the same statement in BAL:

```
1         10     16
-----------------------------------------------------------
          CALL   RUN,(CMDTXT)
          .
          .
          .
CMDTXT    DC     CL80'RV JOBN(JOBC),HIGH'
```

When you use this function in a system with the security feature in force (supervisor-generated with ISLOGONSC=YES), the content of *command-text* changes. The following COBOL coding illustrates the statements needed to use the RUN function call in a security environment:

```
WORKING-STORAGE SECTION.
01  CMD-TXT.
    02 USER-ID.
       03 FILLER   PIC  X    VALUE '('.
       03 USERID   PIC  X(5) VALUE 'USERB'.
       03 FILLER   PIC  X    VALUE BLANK.
       03 PASSWORD PIC  X(6) VALUE 'PASSWD'.
       03 FILLER   PIC  X(2) VALUE ') '.
    02 RUN-CMD PIC X(80) VALUE 'RV JOBN'.
.
.
.
PROCEDURE DIVISION.
.
.
.
PARA-10.
         CALL 'RUN' USING COMMAND-TXT.
```

The user-id field is composed of any alphanumeric characters up to 6 characters in length. No spaces are permitted in the user-id field. For further details, refer to the *Interactive Services Operating Guide,* UP-9972, and the *Security Maintenance Utility Operations Guide,* UP-12028.

The password field is composed of up to 8 alphanumeric characters. This field is optional based on security requirements. No embedded spaces are permitted in the password field.

The RUN-CMD field is any of the job-initiating commands (RUN, RU, RV, etc.) and their associated parameters. This field must be 80 characters in length and blank-filled following the job-initiating command and its parameters.

This security feature is not available in an IMS DDP environment. If a RUN function is attempted in a routed transaction, an IMS SECURITY VIOLATION error will result.

The following coding illustrates an example in BAL:

```
1        10    16
------------------------------------------------------------
CMDTXT   EQU   *
USERID   DC    CL18*(USERID PASSWORD) '
RUNCMD   DC    CL80'RV JOBN'
```

If the password field is specified, a space character (blank) is required between the user-id and password fields.

For example:

```
(USERID psswd)
```

If the password field is omitted, no spaces are required following the user-id field.

```
(USERID)
```

The user-id field requires right and left parentheses and a space must immediately follow the right parenthesis.

For example:

```
(USERID) RV JOBN
```

In a nonsecurity environment, if the user-id and password fields are presented, they will be ignored. In a security environment, the user-id and password fields are optional if the RUN function originated from a transaction entered from a local or remote workstation. The security parameters will default to those at LOGON. However, if the fields are present, they will override the user-id and password values presented when logging on to interactive services. If LOGON is not performed in a security environment, the user-id and optional password must be specified as part of the command-text in the CALL RUN function.

If a format error is detected in the user-id and password fields, a PIB status (subsection 3.25) will be posted. If an invalid user-id or password is detected, the transaction will be canceled with an IMS SECURITY VIOLATION message. Any other system errors will be reported in the following format.

Any preliminary errors encountered by the OS/3 supervisor are passed back to IMS and posted in both the status and detailed status code fields of the program information block.

The format of the errors in these fields is:

Status code:

0	0	0	4

Detailed status code:

0	x	x	x

Values for xxx are listed in Appendix A of the *System Messages Reference Manual,* UP-8076.

10.7. Performing a SETIME WAIT within an Action Program

This feature lets the user action program either suspend or delay action until a specified amount of time elapses. You issue the SCALL function call to use the SETIME WAIT feature. The COBOL and BAL formats for the SCALL function call are:

- COBOL format

```
CALL 'SCALL' USING setime-name time-period
```

- BAL format

```
{CALL    } SCALL,(setime,seconds)
{ZG#CALL }
```

Both COBOL and BAL function CALL statements contain positional parameters. In COBOL, the parameters refer to data names of a COBOL action program. In BAL, the parameters refer to labels of storage locations in a BAL action program. Positional parameters include setime-name and time-period.

Setime-name is a 6-byte field containing the EBCDIC characters 'SETIME'.

Time-period is a 2-byte field, half-word aligned. It contains a binary value indicating the number of seconds the action is to be suspended. The specified time period is the minumum time that action is suspended. However, the actual time varies depending on job priorities, and system load and overhead.

In a COBOL action program, you define the setime-name in the working-storage section:

```
WORKING-STORAGE SECTION.
77 SETIME-NAME      PIC X(6)     VALUE 'SETIME'.
```

You define the time-period in the work-area field of the linkage section:

```
01 WORK-AREA.
   05 PARAMETER-LIST.
      10 TIME-PERIOD     PIC 9999     COMP-4.
```

In a COBOL action program, to suspend the program for 60 seconds:

```
PROCEDURE DIVISION.
    MOVE 60 TO TIME-PERIOD.
    CALL 'SCALL' USING SETIME-NAME TIME-PERIOD.
```

In a BAL action program, you define the setime-name as a constant in storage:

```
1        10    16
------------------------------------------------
SETIME   DC    CL6'SETIME'
```

You define the time-period in seconds in a defined-storage (DS) statement:

```
1        10    16
-----------------------------------------------------------
WORK     DSECT                     WORK AREA
SECONDS  DS    H                   TIME PERIOD
```

to exercise the feature:

```
MVI SECONDS,X'60'
{ CALL    }  SCALL,(SETIME,SECONDS)
{ ZG#CALL }
```

Note: *This feature is available only through the IMS multithread product.*

Care must be exercised when using this feature, as one job task control block (TCB) per transaction is allocated for the period. Also, all transaction resources are retained during this time period.

10.8. Transaction Buffers

Function calls GETMEM and RELMEM allow action programs to acquire and release blocks of main storage on a transaction-by-transaction basis. These buffers can be used to pass information from one action program to a successor in a transaction. This additional memory is assigned to the current transaction and is kept for the duration of the transaction unless returned by RELMEM. A transaction is permitted to hold up to three blocks of transaction buffers at a given time.

The size of a transaction buffer is 4,096 bytes. The maximum number of transaction buffers available to an IMS session is 65,534. The original IMS startup pool can be up to 32,767 transaction buffers. An additional 32,767 transaction buffers may be acquired from the IMS storage pool. In setting up an IMS session in the specification of RESMEM, the size of these transaction buffer pools can be set to this maximum or less.

Another parameter of RESMEM specifies the number of buffers a single transaction can acquire; the default is 4. The maximum any single transaction may be permitted to acquire is 16 of these 4K byte transaction buffers. This limit for the number of buffers is specified in the IMS configuration. These transaction buffers are assigned to a transaction as 1, 2, or 3 blocks in multiples of 4K contiguous bytes.

These blocks of transaction buffers are held for the duration of the transaction unless returned to the IMS buffer pool by a call to RELMEM. After RELMEM is called to release a transaction buffer, the buffer is no longer available to the transaction. At the termination of the transaction, the buffers are automatically returned to the transaction buffer pool.

If data is accessed from a transaction buffer that has been released by RELMEM, the condition of the data is unpredictable.

An attempt to write into a buffer that has been released results in a program check in the action program.

In the PIB status code 0, the detailed status code returns *n*, where *n* is the number of transaction buffers previously held. The *n* is 0, 1, or 2 depending on the number of transaction buffers assigned to the transaction.

An action program acquires this additional main storage by the GETMEM function call to IMS. The additional area of main storage, the transaction buffer, is assigned to the transaction issuing the call.

A COBOL action program can acquire, request the availability of, and release transaction buffers.

10.8.1. COBOL Data Division

Transaction buffers are defined within a COBOL action program as 01 level data-items in the linkage section of the data division. The definition of transaction buffers is similar to the definition of the:

- PIB (program information block)
- IMA (input message)
- WA (work area)
- OMA (output message area)
- CDA (continuity data area)

in a COBOL action program.

A transaction buffer in the linkage section may not be referenced prior to the execution of a call to acquire the buffer, or after a call to release the buffer.

10.8.2. COBOL Procedure Division

Two function calls, GETMEM and RELMEM, provide the transaction buffer interface to IMS.

Using GETMEM, the action program may:

- Request allocation of a transaction buffer or buffers
- Acquire transaction buffers previously allocated to the transaction
- Interrogate for the buffers currently allocated to the transaction

The call to RELMEM releases the transaction buffers and returns them to the buffer pools allocated by RESMEM.

10.8.3. COBOL Action Program Call to Allocate a Transaction Buffer

The COBOL call to allocate a transaction buffer and to make the area addressable by the action program is:

```
CALL 'GETMEM' USING data-name-1 data-name-2
```

where:

`data-name-1`
: Is the data-name of the linkage section 01 data-item for the transaction buffer allocated.

`data-name-2`
: Is the data-name of a full-word binary item containing the number of 4096-byte blocks requested (PIC 9(9) COMP-4 SYNC).

10.8.4. COBOL Call to Get the Address of Previously Allocated Transaction Buffers

The COBOL source code to get the address or addresses of the transaction buffers previously allocated to the transaction is:

```
CALL 'GETMEM' USING data-name-1 [data-name-2 data-name-3] data-name-4
```

where:

`data-name-1 data-name-2 data-name-3`
: Are the data-names of the linkage section 01 items that map the transaction buffers.

`data-name-4`
: Is the data-name of the full-word binary item containing the COBOL low value of zero (PIC 9(9) COMP-4 SYNC).

10.8.5. Determining Buffers Currently Allocated to a Transaction

The COBOL source code to determine the buffers allocated to the transaction is:

```
CALL 'GETMEM' USING data-name-1 data-name-2
```

where:

data-name-1
: Is the name of a 12-byte area in the action program. This area may not be a linkage section 01 item. This area is divided into three 4-byte words.

data-name-2
: Is the data-name of a full-word binary item that contains a value of zero.

Notes: *The action program may interrogate the 12-byte area data-name-1 after the call to determine the address of buffers currently allocated to the transaction.*

The high-order byte contains the size of the transaction buffer.

The three least significant bytes of the data-name-1 words contain the address of a transaction buffer or a zero, when the buffer is not allocated.

When one buffer is allocated, the first word contains the address and the other words contain zero.

When two buffers are allocated, the first two words contain addresses and the third word contains zero.

10.8.6. Releasing from One to Three Transaction Buffers

The COBOL source code to release from one to three transaction buffers is:

```
CALL 'RELMEM' USING data-name-1 [data-name-2 data-name-3]
```

where:

data-name-1 data-name-2 data-name-3
: Are the linkage section data-names of the transaction buffers to be released.

A call to GETMEM can be issued to reacquire buffers previously released by RELMEM. These buffers are reinitialized to 0.

10.8.7. Programming Considerations

The transaction buffer data-names should not be included in the procedure division USING statement.

The diagnostic message 0054, 'Number of records in linkage section not equal to number of arguments in the USING list. USING list accepted' occurs when action programs contain transaction buffers and should be ignored.

Calls to GETMEM for allocating transaction buffers or acquiring the addresses of previously allocated transaction buffers result in the generation of procedure division USING type code following the call. This code updates the table of cover register values used to access the transaction buffers.

Subsection 12.12 illustrates a snap dump of a program containing transaction buffers.

10.8.8. Acquiring a Transaction Buffer

To acquire a transaction buffer, the action program issues the following call to IMS:

```
{ZG#CALL}  SCALL,(string,address,number)
{CALL   }
```

where:

`string`
: Is the address of a field containing the EBCDIC character string GETMEM

`address`
: Upon successful execution of the call, points to a word which contains the address of the first of the contiguous transaction buffers available to the user

`number`
: The address of a word containing a binary number between 1 and 16 (the maximum number of 4K blocks a transaction may use for transaction buffers)

  The sum of the previously acquired buffers plus this current number cannot exceed the number set in RESMEM at IMS configuration or start up.

A maximum of three blocks of transaction buffers can be held by a transaction at any given time.

Note: *The addresses of the transaction buffers should not be kept in the CDA, but they must be requested in each program with a call to GETMEM and* number *set to 0.*

10.8.9. Querying the Number of Transaction Buffers Previously Allocated

To query the number of transaction buffers previously allocated, the call is:

```
{ZG#CALL}  SCALL,(string,address,number)
{CALL   }
```

where:

string
: Is the address of a field containing the EBCDIC character string GETMEM.

address
: Points to a list of three words, in which is returned the address of the transaction buffer in the low-order byte, and the number of contiguous 4K blocks of transaction buffers allocated in the high-order byte of each word.

When the high-order byte of the word contains a 0, then the buffer has not been allocated.

number
: Is the address of a full word of zeros.

10.8.10. Returning Transaction Buffers to Main Storage

To return a transaction buffer or buffers to main storage, an action program issues the following call to IMS:

```
{ZG#CALL} SCALL,(string[,address])
{CALL   }
```

where:

string
: Is the address of a field containing the EBCDIC character string RELMEM.

address
: Contains a list of up to three full words with the addresses of the transaction buffers being returned. The last entry in the list must be an X'80' in the high-order byte to indicate the end of the list.

If RELMEM is issued without an address of a specific list of full words, all transaction buffers previously acquired by the transaction are released.

10.8.11. Returning Status Codes

IMS returns to action programs the status code and detailed status code of the latest function call in the PIB of the action program.

A successful call to RELMEM sets the status code (SC) and the detailed status code (DC) in the PIB to 0.

A successful call to GETMEM sets the status code to 0 and the detailed status code to 0, 1, or 2.

A GETMEM or RELMEM error returns a 3 in the STATUS-CODE field; and in the DETAILED-STATUS-CODE field of the PIB. The detailed status codes are listed along with their meanings in Appendix D.

Table 10-2 lists the GETMEM status codes and detailed status codes, and Table 10-3 lists the RELMEM status codes and detailed status codes. Also, see subsection 3.5, "Obtaining Completion Status (STATUS-CODE)," and subsection 3.6, "Obtaining Additional Status Information (DETAILED-STATUS-CODE)," for information on testing the value of the status codes returned to the PIB for the function called.

The error status codes 03 xx are returned to the user program only if ERET=YES is specified in the PROGRAM section at IMS configuration.

If ERET=NO is specified and a major error occurs, the action program is terminated abnormally according to the IMS specification.

Table 10-2. GETMEM Status Codes and Detailed Status Codes

Status Code (Decimal)	Detailed Status Code (Decimal)	Explanation
0	0	No error
0	n	n = number of blocks of transaction buffers requested. The n is 0, 1, or 2, depending on the number of blocks of transaction buffers previously assigned to the transaction.
3	1	Incorrect number of parameters submitted with the request for the transaction buffer.
3	3	Incorrect parameter value. The address passed to receive the address of a transaction buffer or the field to specify the number of transaction buffers is not full-word aligned.
3	10	Illegal function requested. This error code is returned after three GETMEM calls have been issued. No transaction buffer is made available.
3	12	Required module not included in configuration. The parameter RESMEM was not defined at configuration time. Therefore, the modules supporting the function GETMEM are not available for the current IMS.
3	14	Insufficient space. The transaction buffer pool is depleted and the expansion increment exhausted. This error code is returned if a contiguous block of space is not available. The error code is also returned if, at IMS start up, the RESMEM parameters were overridden with zero.

Table 10-3. RELMEM Status Codes and Detailed Status Codes

Status Code (Decimal)	Detailed Status Code (Decimal)	Explanation
0	0	No error
3	1	Incorrect number of parameters submitted with the request to release the transaction buffer.
3	3	Incorrect parameter value. The address of the list of transaction buffers to be released is not a full-word address.
3	5	Transaction buffer not allocated. One of the addresses submitted in the list of transaction buffers to be released is not pointing to a transaction buffer assigned to the transaction. The value remains unchanged, and the command is terminated with the error code.
3	12	Required module not in configuration. To activate the acquisition of transaction buffers, the keyword RESMEM is specified in the IMS OPTIONS section at configuration time.

10.9. Opening Files from an Action Program

Function calls OPEN and CLOSE allow action programs to open or close data files from within user written action programs. The COBOL and BAL formats for OPEN and CLOSE function calls are:

- COBOL format

```
CALL '{OPEN }' USING filename.
      {CLOSE}
```

- BAL format

```
{CALL   } {OPEN } ,(filename)
{ZG#CALL} {CLOSE}
```

The OPEN and CLOSE function calls are intended to address the operational problems associated with sharing files between IMS and batch applications. These function calls allow the user to construct action programs that open or close related groups of files. The resulting transactions should be limited to use by the IMS administrator.

10.9.1. Action Program Structure

While the OPEN and CLOSE functions may be used in any action program, it is recommended that their use be confined to constructing transactions that just open or close a predetermined list of files.

Because any given file may be in use at the time the OPEN or CLOSE function call is issued, the structure of the action program must include a PIB status check after each function call. If the function could not be completed, the program can be written to either repeat that function call or issue a SETIME WAIT before repeating the call. When the entire list of files has been successfully opened or closed, the program -- and transaction -- terminates.

The following are some guidelines in using the OPEN and CLOSE function calls:

- The files to be opened or closed need not be assigned to the action.
- MIRAM files with sequential views must be addressed using only the filename of the primary view. The status posted will always reflect the state of the primary view of the file regardless of errors encountered on secondary sequential views. This is consistent with the ZZOPN and ZZCLS treatment of sequential views. If an attempt is made to use a secondary view filename which is eight characters in length, the primary filename is defaulted to and used for the OPEN/CLOSE function.
- A test mode environment (ZZTMD) has no effect on OPEN or CLOSE functions.

10.9.2. Error Conditions

OPEN or CLOSE functions must be issued from within action programs originating from a master terminal. They must not address common storage data files or internal IMS files. In case of any of these invalid situations, an invalid function request, 0307, is posted in the PIB.

If a close function is issued to a file in which at least one thread has been marked for rollback, the file is considered *currently in use* and cannot be closed. In this event, a PIB status of 0100 is posted. This can occur when *before image* records have been written to the AUDFILE for a given file and the transaction is still active.

It is recommended that a transaction not attempt to close a file that is marked for rollback by that same transaction.

Section 11
Compiling, Linking, and Storing Action Programs

11.1. Preparing Action Programs for Online Processing

After you write a COBOL or BAL action program or subprogram, you must do the following:

1. Compile or assemble the action program or subprogram (11.1).
2. Link-edit the program to create a load module (11.2).
3. Store the program in the appropriate load library (11.3).
4. Identify the program to IMS in a PROGRAM section of the configuration. (See the *IMS System Support Functions Programming Guide,* UP-11907.)
5. Identify the load library in the job control stream at IMS start-up, unless programs are stored in the system load library, YLOD. (See UP-11907.)

This section tells you how to compile (or assemble) and link your action programs and subprograms and where to store them for use during the online IMS session. For additional information on the job control statements and procedures shown in the examples, refer to the current versions of the *Job Control Programming Guide*, UP-9986, and the appropriate language manual.

11.2. Compiling or Assembling Action Programs

You assemble a basic assembly language action program or subprogram the same way as any other BAL program.

You compile a COBOL action program or subprogram the same way as other COBOL programs, with one exception. That exception is different for 1974 American National Standard COBOL and extended COBOL and also depends on whether the program is sharable, nonsharable (serially reusable), or reentrant.

11.2.1. Sharable, Nonsharable (Serially Reusable), or Reentrant COBOL Programs

To compile a sharable or serially reusable 1974 COBOL program, include the job control statement:

```
// PARAM IMSCOD=YES
```

To compile a sharable or serially reusable extended COBOL program, include the job control statement:

```
// PARAM OUT=(M)
```

To compile a reentrant 1974 COBOL program, include the job control statement:

```
// PARAM IMSCOD=REN
```

The COBOL compiler checks for IMS language restrictions and issues diagnostics when you compile your serially reusable programs with the IMSCOD=YES or OUT=(M) parameters. However, if your program is not written to sharable standards (for instance, the procedure division contains statements that move data to the working-storage section), you cannot compile it with IMSCOD=YES or OUT=(M).

To share COBOL action programs or subprograms, you must specify the TYPE=SHR and SHRDSIZE parameters in your IMS configuration in addition to including the shared code PARAM statement at compilation time. You can share action programs only in multithread IMS.

Specify the TYPE=RNT parameter in your IMS configuration, and compile the program with the IMSCOD=REN parameter when you use 1974 COBOL reentrant action programs or subprograms. (See 2.3 for restrictions.)

Increase the work area size on the WORKSIZE parameter in your IMS configuration to include the compiler's object program reentrancy control size. Include this additional area in your work area size whenever you compile the program with the IMSCOD=REN parameter (even if you specify TYPE=SER or TYPE=SHR in your IMS configuration).

To compile a nonsharable 1974 COBOL program, include the job control statement:

```
// PARAM CALLST=YES
```

to assure the proper linkages to IMS at CALL interrupts. However, the compiler does not check for IMS language restrictions when you use CALLST=YES instead of IMSCOD=YES or IMSCOD=REN.

There is no special PARAM statement for compiling nonsharable extended COBOL action programs. When you omit PARAM OUT=(M), the compiler does not check for IMS language restrictions and you receive the COBOL error message:

```
140  NO EXIT PROGRAM NOR RETURN STATEMENT ASSOCIATED WITH
     ENTRY OR USING STATEMENT
```

You can ignore this message.

Table 11-1 summarizes the use of PARAM statements for sharable, nonsharable (serially reusable), and reentrant COBOL action programs.

Table 11-1. Compiling Sharable, Nonsharable, and Reentrant COBOL Action Programs

	1974 COBOL	Extended COBOL
Sharable Action Program	Include // PARAM IMSCOD=YES. Compiler checks for IMS language restrictions.	Include // PARAM OUT=(M). Compiler checks for IMS language restrictions.
Nonsharable Action Program	Include // PARAM CALLST=YES. Assures proper linkages to IMS at CALL interrupts. Compiler does not check for IMS language restrictions.	No substitute for // PARAM OUT=(M). Compiler does not check for IMS language restrictions. Generates error message which can be ignored.
Reentrant Action Program	Include // PARAM IMSCOD=REN. Compiler checks for IMS language restrictions.	Not supported.

For a shared COBOL action program, the size of the volatile data area is printed in decimal in the compilation summary listing. The format of this message is:

```
SHARED CODE VOLATILE DATA AREA=nnnn BYTES
```

Multithread IMS uses the shared code volatile data area to save and restore data at CALL interrupts. It is not used in single-thread IMS.

Use this size for the SHRDSIZE parameter specification in the ACTION section of your IMS configuration. If the action includes more than one COBOL action program, use the largest shared code volatile data area for this specification.

In the compilation summary listing for reentrant 1974 COBOL action programs, the additional IMS work area needed by the object program is printed in decimal. The format of this message is:

```
REENTRANCY CONTROL=nnnnnn WORKAREA BYTES
(NOT INCLUDING PROGRAM DEFINED DATA AREAS)
```

This additional work area is used by the object program for its control variables.

Add this additional work area to the WORKSIZE parameter specified in the ACTION section of your IMS configuration. The work area size must be large enough to accommodate the maximum program data area size and the sum of all concurrently active object program reentrancy control areas.

If you do not specify a large enough work area, program data areas are destroyed, and the action program may be abnormally terminated.

11.2.2. Job Control for Compiling COBOL Action Programs

To compile a 1974 COBOL action program or subprogram, you can use either the COBL74 job control procedure (jproc) or the EXEC COBL74 job control statement.

Figure 11-1 uses the jproc and assumes that the source program, MYPROG, is filed in the system source library, YSRC. The program is sharable.

```
// JOB PROG1
//MYPROG COBL74 IN=(RES)
// PARAM IMSCOD=YES
/&
// FIN
```

Figure 11-1. Compiling a COBL74 Action Program Using Jproc

When you use the EXEC COBL74 job control statement, you must allocate a printer and three work files for the COBOL compiler. In Figure 11-2, the source program is embedded in the job control stream. The program is not sharable.

```
// JOB PROG2
// DVC 20  // LFD PRNTR
// WORK1
// WORK2
// WORK3
// EXEC COBL74
// PARAM CALLST=YES
/$
    .
    .  source program
    .
/*
/&
// FIN
```

Figure 11-2. Compiling a COBL74 Action Program Using Standard Job Control

To compile an extended COBOL action program or subprogram, you can use either the COBOL jproc or the EXEC COBOL job control statement.

Figure 11-3 executes the extended COBOL compiler using the COBOL jproc. In this example, the source program is embedded in the job control stream, and the program is sharable.

```
// JOB PROG3
// COBOL
// PARAM OUT=(M)
/$
    .
    .  source program
    .
/*
/&
// FIN
```

Figure 11-3. Compiling an Extended COBOL Action Program Using Jproc

Figure 11-4 uses the EXEC COBOL job control statement and assumes that the source program, MYPROG, is filed in a user source library, SRCIN. Notice that a device assignment set is required for the user source library. The program is sharable.

```
// JOB PROG4
// DVC 20  // LFD PRNTR
// DVC 50  // VOL DISK01  // LBL SRCLIB  // LFD SRCIN
// WORK1
// WORK2
// WORK3
// EXEC COBOL
// PARAM IN=MYPROG/SRCIN
// PARAM OUT=(M)
/&
// FIN
```

Figure 11-4. Compiling an Extended COBOL Action Program Using Standard Job Control

11.2.3. Job Control for Assembling BAL Action Programs

You assemble BAL action programs and subprograms the same way as other BAL programs, using the ASM jproc or the EXEC ASM job control statement.

Figure 11-5 uses the ASM jproc and assumes the source program, ASMPRG, is filed in the system source library, YSRC.

```
// JOB PROG5
//ASMPRG ASM IN=(RES)
/&
// FIN
```

Figure 11-5. Assembling a BAL Action Program Using Jproc

Figure 11-6 uses the EXEC ASM job control statement and takes source input from the job control stream. You must allocate a printer and two work files for the assembler.

```
// JOB PROG6
// DVC 20  // LFD PRNTR
// WORK1
// WORK2
// EXEC ASM
/$
    .
    .  source program
    .
/*
/&
// FIN
```

Figure 11-6. Assembling a BAL Action Program Using Standard Job Control

11.3. Link-Editing Action Programs

After you obtain a clean action program compilation or assembly, you must link-edit the program and store it in the appropriate load library. Load libraries are discussed in 11.4.

You can use the LINK job control procedure for a BAL program or for a COBOL program compiled with PARAM IMSCOD=YES, PARAM IMSCOD=REN, or PARAM OUT=(M). You must use the EXEC LNKEDT job control statement for nonsharable COBOL action programs.

On the LINK jproc, you must specify the OUT parameter to store the action program in a load library:

```
// LINK action-program-name, OUT= {(vol-ser-no,label)}
                                  {(RES,$Y$LOD)      }
```

For example:

```
// LINK MYPROG,OUT=(RES,$Y$LOD)
```

If you want to give the action program load module a different name than the object module, use this format:

```
//load-module-name LINK object-module-name,
  OUT= {(vol-ser-no,label)}
       {(RES,$Y$LOD)      }
```

Figure 11-7 uses the jproc to link-edit an object module called MYPROG and create a load module called CREDIT. Output is to LOADLIB. You do not need a device assignment for LOADLIB because the LINK jproc generates it from your OUT specification.

```
// JOB LINK
//CREDIT LINK MYPROG,OUT=(IMSVOL,LOADLIB)
/&
// FIN
```

Figure 11-7. Link-Editing an Action Program Using Jproc

When you execute the linkage editor using standard job control, you need a LOADM statement to name the load module and INCLUDE statements for the action program object module and the IMS link module, ZF#LINK.

A nonsharable extended COBOL action program or subprogram also requires an ENTER statement. The ENTER statement must be the last linkage editor control statement in your job control stream.

Figure 11-8 shows a standard job control stream for the linkage editor. The linkage editor requires a printer file and one work file. You can omit the printer file if you assigned one to the compiler in the same job control stream. Output is to the system load library, YLOD; a device assignment is not needed for this file.

```
// JOB LNKEDT
 // DVC 20  // LFD PRNTR
 // WORK1
 // EXEC LNKEDT
 // PARAM OUT=$Y$LOD
 /$
    LOADM CREDIT
    INCLUDE MYPROG   (1)
    INCLUDE ZF#LINK,$Y$OBJ
    ENTER MYPROG    (2)
 /*
 /&
 // FIN
```

Notes:

(1) For extended COBOL, the object module name is appended with 00.

(2) Required only for nonsharable extended COBOL programs.

Figure 11-8. Link-Editing an Action Program Using Standard Job Control

Figure 11-9 shows a job control stream for compiling and linking a 1974 COBOL action program, using both the COBL74 and LINK jprocs. The action program is stored in the LOAD action program library (see 11.4). The LINK jproc generates a device assignment for the load library.

```
// JOB COBL
//MYPROG COBL74 IN=(RES)
// PARAM IMSCOD=REN
//CREDIT LINK MYPROG,OUT=(IMSVOL,LOAD)
/&
// FIN
```

Figure 11-9. Compiling and Linking a COBOL Action Program Using Jproc

Figure 11-10 shows a job control stream for assembling and linking a BAL action program, using standard job control. A device assignment set is required for the output file, LOADLIB.

```
    // JOB ASML
    // DVC 20  // LFD PRNTR
    // DVC 50  // VOL IMSVOL  // LBL LOADLIB  // LFD LOADLIB
    // WORK1
    // WORK2
    // EXEC ASM
       .
       .  source program
       .
    /*
    // WORK1
    // EXEC LNKEDT
    // PARAM OUT=LOADLIB
    /$
       LOADM PAYROL
       INCLUDE ASMPRG
       INCLUDE ZF#LINK,$Y$OBJ
/*
/&
// FIN
```

Figure 11-10. Assembling and Linking a BAL Action Program Using Standard Job Control

11.4. Storing Action Programs in a Load Library

When you link-edit an action program, you must specify the load library where you want it stored. IMS has specific requirements for storing action programs.

The first requirement is that all your action programs must reside in the same load library.

The load library you choose depends on whether or not you configure the fast load feature by specifying FASTLOAD=YES in the OPTIONS section of your IMS configuration. (See the *IMS System Support Functions Programming Guide,* UP-11907.) The fast load feature improves online performance in applications with large action programs or frequent action program loading.

If you configure fast loading, place all action programs in a separate action program load library in unblocked format. You assign this library at IMS start-up with the LFD-name LOAD. At start-up, you also assign the fast load file, LDPFILE. The first time a transaction calls on a particular action program, IMS copies the program from LOAD to the LDPFILE. After that, action programs are loaded from LDPFILE.

If you do not want fast loading, you can store your action programs in either of two libraries (but all in the same library):

1. The system load library, YLOD

2. The library containing your online IMS load module. This library is identified at configuration time by the LIBL parameter of the IMSCONF jproc.

To improve performance after link editing your action program, put the program module in block format, using the BLK librarian control statement. (Refer to the *System Service Programs (SSP) Programming Reference Manual,* UP-8842.)

Note: *If you use downline loading (10.1), store your universal terminal system (UTS) programs in YLOD or in the library containing the online IMS load module. Do not store UTS programs in the LOAD action program library.*

11.5. Replacing Action Programs in the Load Library during Online Processing

You can replace action programs in the load library while IMS is online, whether or not you use the fast load feature. However, you cannot replace resident subprograms during online processing.

You replace an action program in the YLOD, LOAD, or other load library by recompiling (or reassembling) and relinking, or by applying a patch (COR). For an explanation of the COR function, see the *System Service Programs (SSP) Operating Guide,* UP-8841.

When you use the fast load feature, you must insert the statement

```
// DD ACCESS=EXCR
```

in the device assignment set for the LOAD library in the compile and link or COR job control stream.

The job control stream in Figure 11-11 recompiles and links a 1974 COBOL action program for output to the LOAD file. This example assumes you use the fast load feature.

```
// JOB RECOMP
// DVC 50  // VOL IMSVOL  // DD ACCESS=EXCR  // LBL LOAD  // LFD LOAD
//MYPROG COBL74 IN=(RES)
// PARAM IMSCOD=YES
//CREDIT LINK MYPROG,OUT=(IMSVOL,LOAD)
/&
// FIN
```

Figure 11-11. Recompiling and Linking an Action Program during Online Processing

After replacing the action program in the load library, issue the ZZPCH master terminal command. The next time a transaction calls on the action program, IMS loads the new version from the load library. When you use the fast load feature, IMS copies the new version to the LDPFILE. The ZZPCH master terminal command is described in the *IMS Terminal Users Guide*, UP-9208.

Follow the same procedure to add an action program to the load library that is missing at start-up. Of course, the program must be defined in a PROGRAM section of the IMS configuration.

When you use the fast load feature, do not use ALTER statements in the job control steam at IMS start-up. When you do not use fast loading, you can insert ALTER statements in the start-up job control stream to make temporary changes to action programs.

Section 11
Compiling, Linking, and Storing Action Programs

11.1. Preparing Action Programs for Online Processing

After you write a COBOL or BAL action program or subprogram, you must do the following:

1. Compile or assemble the action program or subprogram (11.1).

2. Link-edit the program to create a load module (11.2).

3. Store the program in the appropriate load library (11.3).

4. Identify the program to IMS in a PROGRAM section of the configuration. (See the *IMS System Support Functions Programming Guide,* UP-11907.)

5. Identify the load library in the job control stream at IMS start-up, unless programs are stored in the system load library, YLOD. (See UP-11907.)

This section tells you how to compile (or assemble) and link your action programs and subprograms and where to store them for use during the online IMS session. For additional information on the job control statements and procedures shown in the examples, refer to the current versions of the *Job Control Programming Guide*, UP-9986, and the appropriate language manual.

11.2. Compiling or Assembling Action Programs

You assemble a basic assembly language action program or subprogram the same way as any other BAL program.

You compile a COBOL action program or subprogram the same way as other COBOL programs, with one exception. That exception is different for 1974 American National Standard COBOL and extended COBOL and also depends on whether the program is sharable, nonsharable (serially reusable), or reentrant.

11.2.1. Sharable, Nonsharable (Serially Reusable), or Reentrant COBOL Programs

To compile a sharable or serially reusable 1974 COBOL program, include the job control statement:

```
// PARAM IMSCOD=YES
```

To compile a sharable or serially reusable extended COBOL program, include the job control statement:

```
// PARAM OUT=(M)
```

To compile a reentrant 1974 COBOL program, include the job control statement:

```
// PARAM IMSCOD=REN
```

The COBOL compiler checks for IMS language restrictions and issues diagnostics when you compile your serially reusable programs with the IMSCOD=YES or OUT=(M) parameters. However, if your program is not written to sharable standards (for instance, the procedure division contains statements that move data to the working-storage section), you cannot compile it with IMSCOD=YES or OUT=(M).

To share COBOL action programs or subprograms, you must specify the TYPE=SHR and SHRDSIZE parameters in your IMS configuration in addition to including the shared code PARAM statement at compilation time. You can share action programs only in multithread IMS.

Specify the TYPE=RNT parameter in your IMS configuration, and compile the program with the IMSCOD=REN parameter when you use 1974 COBOL reentrant action programs or subprograms. (See 2.3 for restrictions.)

Increase the work area size on the WORKSIZE parameter in your IMS configuration to include the compiler's object program reentrancy control size. Include this additional area in your work area size whenever you compile the program with the IMSCOD=REN parameter (even if you specify TYPE=SER or TYPE=SHR in your IMS configuration).

To compile a nonsharable 1974 COBOL program, include the job control statement:

```
// PARAM CALLST=YES
```

to assure the proper linkages to IMS at CALL interrupts. However, the compiler does not check for IMS language restrictions when you use CALLST=YES instead of IMSCOD=YES or IMSCOD=REN.

There is no special PARAM statement for compiling nonsharable extended COBOL action programs. When you omit PARAM OUT=(M), the compiler does not check for IMS language restrictions and you receive the COBOL error message:

```
140  NO EXIT PROGRAM NOR RETURN STATEMENT ASSOCIATED WITH
     ENTRY OR USING STATEMENT
```

You can ignore this message.

Table 11-1 summarizes the use of PARAM statements for sharable, nonsharable (serially reusable), and reentrant COBOL action programs.

Table 11-1. Compiling Sharable, Nonsharable, and Reentrant COBOL Action Programs

	1974 COBOL	Extended COBOL
Sharable Action Program	Include // PARAM IMSCOD=YES. Compiler checks for IMS language restrictions.	Include // PARAM OUT=(M). Compiler checks for IMS language restrictions.
Nonsharable Action Program	Include // PARAM CALLST=YES. Assures proper linkages to IMS at CALL interrupts. Compiler does not check for IMS language restrictions.	No substitute for // PARAM OUT=(M). Compiler does not check for IMS language restrictions. Generates error message which can be ignored.
Reentrant Action Program	Include // PARAM IMSCOD=REN. Compiler checks for IMS language restrictions.	Not supported.

For a shared COBOL action program, the size of the volatile data area is printed in decimal in the compilation summary listing. The format of this message is:

```
SHARED CODE VOLATILE DATA AREA=nnnn BYTES
```

Multithread IMS uses the shared code volatile data area to save and restore data at CALL interrupts. It is not used in single-thread IMS.

Use this size for the SHRDSIZE parameter specification in the ACTION section of your IMS configuration. If the action includes more than one COBOL action program, use the largest shared code volatile data area for this specification.

In the compilation summary listing for reentrant 1974 COBOL action programs, the additional IMS work area needed by the object program is printed in decimal. The format of this message is:

```
REENTRANCY CONTROL=nnnnnn WORKAREA BYTES
(NOT INCLUDING PROGRAM DEFINED DATA AREAS)
```

This additional work area is used by the object program for its control variables.

Add this additional work area to the WORKSIZE parameter specified in the ACTION section of your IMS configuration. The work area size must be large enough to accommodate the maximum program data area size and the sum of all concurrently active object program reentrancy control areas.

If you do not specify a large enough work area, program data areas are destroyed, and the action program may be abnormally terminated.

11.2.2. Job Control for Compiling COBOL Action Programs

To compile a 1974 COBOL action program or subprogram, you can use either the COBL74 job control procedure (jproc) or the EXEC COBL74 job control statement.

Figure 11-1 uses the jproc and assumes that the source program, MYPROG, is filed in the system source library, YSRC. The program is sharable.

```
// JOB PROG1
//MYPROG COBL74 IN=(RES)
// PARAM IMSCOD=YES
/&
// FIN
```

Figure 11-1. Compiling a COBL74 Action Program Using Jproc

When you use the EXEC COBL74 job control statement, you must allocate a printer and three work files for the COBOL compiler. In Figure 11-2, the source program is embedded in the job control stream. The program is not sharable.

```
// JOB PROG2
// DVC 20  // LFD PRNTR
// WORK1
// WORK2
// WORK3
// EXEC COBL74
// PARAM CALLST=YES
/$
   .
   .  source program
   .
/*
/&
// FIN
```

Figure 11-2. Compiling a COBL74 Action Program Using Standard Job Control

To compile an extended COBOL action program or subprogram, you can use either the COBOL jproc or the EXEC COBOL job control statement.

Figure 11-3 executes the extended COBOL compiler using the COBOL jproc. In this example, the source program is embedded in the job control stream, and the program is sharable.

```
// JOB PROG3
// COBOL
// PARAM OUT=(M)
/$
   .
   .  source program
   .
/*
/&
// FIN
```

Figure 11-3. Compiling an Extended COBOL Action Program Using Jproc

Figure 11-4 uses the EXEC COBOL job control statement and assumes that the source program, MYPROG, is filed in a user source library, SRCIN. Notice that a device assignment set is required for the user source library. The program is sharable.

```
// JOB PROG4
// DVC 20  // LFD PRNTR
// DVC 50  // VOL DISK01  // LBL SRCLIB  // LFD SRCIN
// WORK1
// WORK2
// WORK3
// EXEC COBOL
// PARAM IN=MYPROG/SRCIN
// PARAM OUT=(M)
/&
// FIN
```

Figure 11-4. Compiling an Extended COBOL Action Program Using Standard Job Control

11.2.3. Job Control for Assembling BAL Action Programs

You assemble BAL action programs and subprograms the same way as other BAL programs, using the ASM jproc or the EXEC ASM job control statement.

Figure 11-5 uses the ASM jproc and assumes the source program, ASMPRG, is filed in the system source library, YSRC.

```
// JOB PROG5
//ASMPRG ASM IN=(RES)
/&
// FIN
```

Figure 11-5. Assembling a BAL Action Program Using Jproc

Figure 11-6 uses the EXEC ASM job control statement and takes source input from the job control stream. You must allocate a printer and two work files for the assembler.

```
// JOB PROG6
// DVC 20  // LFD PRNTR
// WORK1
// WORK2
// EXEC ASM
/$
    .
    .  source program
    .
/*
/&
// FIN
```

Figure 11-6. Assembling a BAL Action Program Using Standard Job Control

11.3. Link-Editing Action Programs

After you obtain a clean action program compilation or assembly, you must link-edit the program and store it in the appropriate load library. Load libraries are discussed in 11.4.

You can use the LINK job control procedure for a BAL program or for a COBOL program compiled with PARAM IMSCOD=YES, PARAM IMSCOD=REN, or PARAM OUT=(M). You must use the EXEC LNKEDT job control statement for nonsharable COBOL action programs.

On the LINK jproc, you must specify the OUT parameter to store the action program in a load library:

```
// LINK action-program-name, OUT= {(vol-ser-no,label)}
                                  {(RES,$Y$LOD)      }
```

For example:

```
// LINK MYPROG,OUT=(RES,$Y$LOD)
```

If you want to give the action program load module a different name than the object module, use this format:

```
//load-module-name LINK object-module-name,
  OUT= {(vol-ser-no,label)}
       {(RES,$Y$LOD)      }
```

Figure 11-7 uses the jproc to link-edit an object module called MYPROG and create a load module called CREDIT. Output is to LOADLIB. You do not need a device assignment for LOADLIB because the LINK jproc generates it from your OUT specification.

```
// JOB LINK
//CREDIT LINK MYPROG,OUT=(IMSVOL,LOADLIB)
/&
// FIN
```

Figure 11-7. Link-Editing an Action Program Using Jproc

When you execute the linkage editor using standard job control, you need a LOADM statement to name the load module and INCLUDE statements for the action program object module and the IMS link module, ZF#LINK.

A nonsharable extended COBOL action program or subprogram also requires an ENTER statement. The ENTER statement must be the last linkage editor control statement in your job control stream.

Figure 11-8 shows a standard job control stream for the linkage editor. The linkage editor requires a printer file and one work file. You can omit the printer file if you assigned one to the compiler in the same job control stream. Output is to the system load library, YLOD; a device assignment is not needed for this file.

```
// JOB LNKEDT
 // DVC 20  // LFD PRNTR
 // WORK1
 // EXEC LNKEDT
 // PARAM OUT=$Y$LOD
 /$
    LOADM CREDIT
    INCLUDE MYPROG  ①
    INCLUDE ZF#LINK,$Y$OBJ
    ENTER MYPROG   ②
 /*
 /&
 // FIN
```

Notes:

① For extended COBOL, the object module name is appended with 00.

② Required only for nonsharable extended COBOL programs.

Figure 11-8. Link-Editing an Action Program Using Standard Job Control

Figure 11-9 shows a job control stream for compiling and linking a 1974 COBOL action program, using both the COBL74 and LINK jprocs. The action program is stored in the LOAD action program library (see 11.4). The LINK jproc generates a device assignment for the load library.

```
// JOB COBL
//MYPROG COBL74 IN=(RES)
// PARAM IMSCOD=REN
//CREDIT LINK MYPROG,OUT=(IMSVOL,LOAD)
/&
// FIN
```

Figure 11-9. Compiling and Linking a COBOL Action Program Using Jproc

Figure 11-10 shows a job control stream for assembling and linking a BAL action program, using standard job control. A device assignment set is required for the output file, LOADLIB.

```
   // JOB ASML
   // DVC 20  // LFD PRNTR
   // DVC 50  // VOL IMSVOL  // LBL LOADLIB  // LFD LOADLIB
   // WORK1
   // WORK2
   // EXEC ASM
      .
      .  source program
      .
   /*
   // WORK1
   // EXEC LNKEDT
   // PARAM OUT=LOADLIB
   /$
      LOADM PAYROL
      INCLUDE ASMPRG
      INCLUDE ZF#LINK,$Y$OBJ
/*
/&
// FIN
```

Figure 11-10. Assembling and Linking a BAL Action Program Using Standard Job Control

11.4. Storing Action Programs in a Load Library

When you link-edit an action program, you must specify the load library where you want it stored. IMS has specific requirements for storing action programs.

The first requirement is that all your action programs must reside in the same load library.

The load library you choose depends on whether or not you configure the fast load feature by specifying FASTLOAD=YES in the OPTIONS section of your IMS configuration. (See the *IMS System Support Functions Programming Guide,* UP-11907.) The fast load feature improves online performance in applications with large action programs or frequent action program loading.

If you configure fast loading, place all action programs in a separate action program load library in unblocked format. You assign this library at IMS start-up with the LFD-name LOAD. At start-up, you also assign the fast load file, LDPFILE. The first time a transaction calls on a particular action program, IMS copies the program from LOAD to the LDPFILE. After that, action programs are loaded from LDPFILE.

If you do not want fast loading, you can store your action programs in either of two libraries (but all in the same library):

1. The system load library, YLOD

2. The library containing your online IMS load module. This library is identified at configuration time by the LIBL parameter of the IMSCONF jproc.

To improve performance after link editing your action program, put the program module in block format, using the BLK librarian control statement. (Refer to the *System Service Programs (SSP) Programming Reference Manual,* UP-8842.)

Note: *If you use downline loading (10.1), store your universal terminal system (UTS) programs in YLOD or in the library containing the online IMS load module. Do not store UTS programs in the LOAD action program library.*

11.5. Replacing Action Programs in the Load Library during Online Processing

You can replace action programs in the load library while IMS is online, whether or not you use the fast load feature. However, you cannot replace resident subprograms during online processing.

You replace an action program in the YLOD, LOAD, or other load library by recompiling (or reassembling) and relinking, or by applying a patch (COR). For an explanation of the COR function, see the *System Service Programs (SSP) Operating Guide,* UP-8841.

When you use the fast load feature, you must insert the statement

```
// DD ACCESS=EXCR
```

in the device assignment set for the LOAD library in the compile and link or COR job control stream.

The job control stream in Figure 11-11 recompiles and links a 1974 COBOL action program for output to the LOAD file. This example assumes you use the fast load feature.

```
// JOB RECOMP
// DVC 50  // VOL IMSVOL  // DD ACCESS=EXCR  // LBL LOAD  // LFD LOAD
//MYPROG COBL74 IN=(RES)
// PARAM IMSCOD=YES
//CREDIT LINK MYPROG,OUT=(IMSVOL,LOAD)
/&
// FIN
```

Figure 11-11. Recompiling and Linking an Action Program during Online Processing

After replacing the action program in the load library, issue the ZZPCH master terminal command. The next time a transaction calls on the action program, IMS loads the new version from the load library. When you use the fast load feature, IMS copies the new version to the LDPFILE. The ZZPCH master terminal command is described in the *IMS Terminal Users Guide*, UP-9208.

Follow the same procedure to add an action program to the load library that is missing at start-up. Of course, the program must be defined in a PROGRAM section of the IMS configuration.

When you use the fast load feature, do not use ALTER statements in the job control steam at IMS start-up. When you do not use fast loading, you can insert ALTER statements in the start-up job control stream to make temporary changes to action programs.

Section 12
Debugging Action Programs

Though error-free programs are every programmer's dream, in reality they never seem to materialize. After all the explanations are made about how to program applications correctly, probably the most important tool a programmer has is his working knowledge of debugging procedures. Consequently, it's important to know how to debug your action program using the snap dump feature provided by IMS.

12.1. Types of Snap Dumps

You can obtain two types of snap dumps:

1. Termination snap dump

2. CALL SNAP dump

A termination snap is caused by action program termination either by voluntarily moving an S to the termination indicator or by abnormally terminating due to program check or timer-check (time out due to a loop in the action program).

A CALL SNAP dump is caused by your program voluntarily issuing the CALL SNAP statement in a COBOL action program or the ZG#CALL SNAP macroinstruction in a BAL action program. The action program does not terminate to produce this dump.

IMS provides both edited and unedited snap dumps. In single-thread IMS, termination snaps are always edited; however, for CALL SNAP dumps only unedited snap dumps are available. In multithread IMS, users must specify SNAPED=YES in the OPTIONS section of the IMS configuration to obtain edited snap dumps.

12.2. Termination Snap Dumps

Figure 12-1 illustrates the general layout of a termination snap dump caused by S termination indicator or abnormal termination.

This same general layout applies to single-thread and multithread IMS.

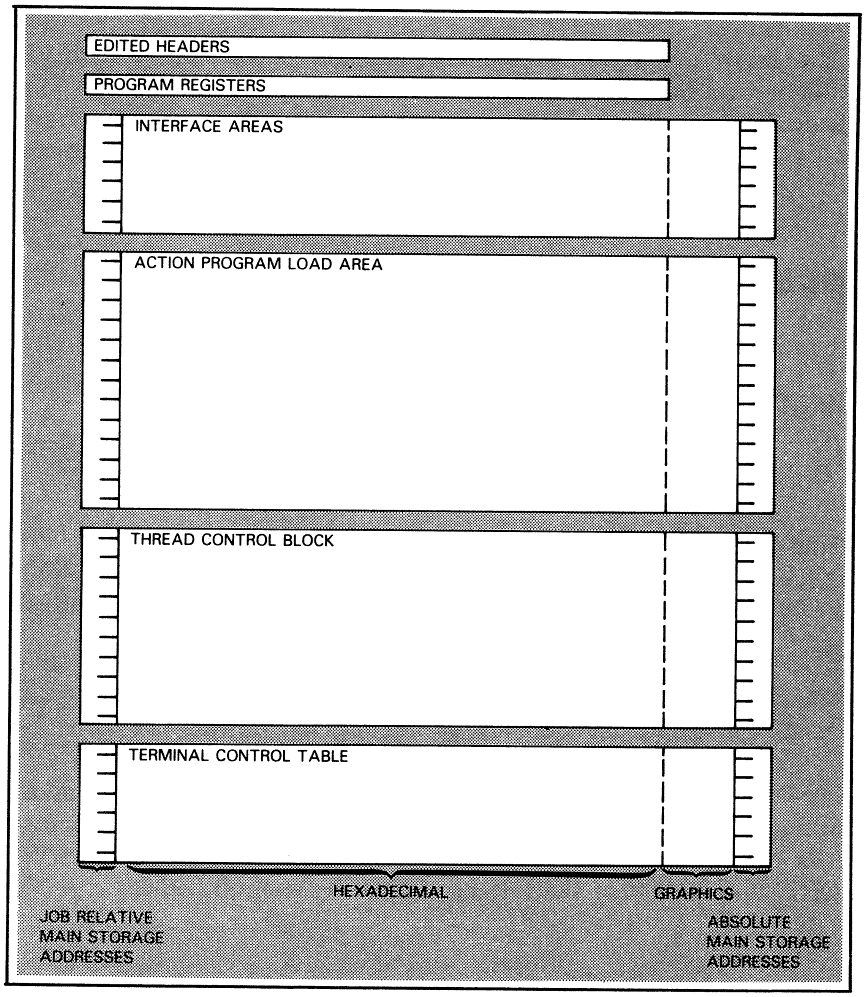


Figure 12-1. Layout of a Termination Snap Dump

There are six sections to each termination snap dump: edited headers, IMS and action program registers, interface areas, action program load area, the thread control block, and the terminal control table.

- Edited headers

  The edited header section contains information about the action program that was running when the snap occurred. Included is the name of the action program load module that was executing, an allocation map that provides the relative addresses of action programs and IMS areas needed in debugging the program, and a general statement of why the snap dump occurred: for example, USER REQUESTED VOLUNTARY TERMINATION.

- IMS and action program registers

  The next section contains registers and their contents. Here, you'll find one or two sets of registers depending on the reason for the snap dump. If your action program voluntarily terminated with a snap, that is, S termination indicator, your snap dump contains one set of registers - IMS registers. These registers are of little use to you.

  When you voluntarily terminate your action program to obtain a snap dump, you're usually checking contents of interface areas that are easily locatable from the allocation map in your snap dump. In this situation, you do not need to obtain a program status word from the save area. Furthermore, no program status word is passed to the save area on a termination snap.

  If, however, your action programs are in BAL and you do need to know your action program's register contents on a termination snap, look in your action program's save area plus C_{16} bytes to find registers 14, 15, and 0-12, in that order.

  To arrive at the save area plus C_{16}, locate the BAL program information block DSECT field, ZA#PSAVE, which contains the address of your action program save area. (See Figure 3-2 for the BAL program information block DSECT.)

  On the other hand, if IMS terminates your action program abnormally, the snap dump contains two sets of registers - user action program registers and IMS registers.

  User registers precede IMS registers and are labeled so they are easily identifiable. Just above the user registers 0-F is the 8-byte program status word indicating in its last three bytes the address of the instruction immediately following the one that caused the abnormal termination. (See Figure 12-11, program status word,
  `E0E60E01 40` $\boxed{\texttt{034C5C}}_{16}$.)

- Interface areas

  Following the register section, you find the interface areas - program information block, output message area, input message area, work area, continuity data area, and defined record area.

- Action program load area

  The next section of the snap dump is the action program load area. It contains the executable load module generated by the linkage editor.

- Thread control block

  Following the action program area is a section used for the action program's thread control block. In the third control block, most pointers and flags required to control the user environment are stored for use by IMS and indirectly by the user action program.

  Figure 12-2 illustrates the relationship between the IMS thread control block and the user interface areas for both single-thread and multithread IMS.

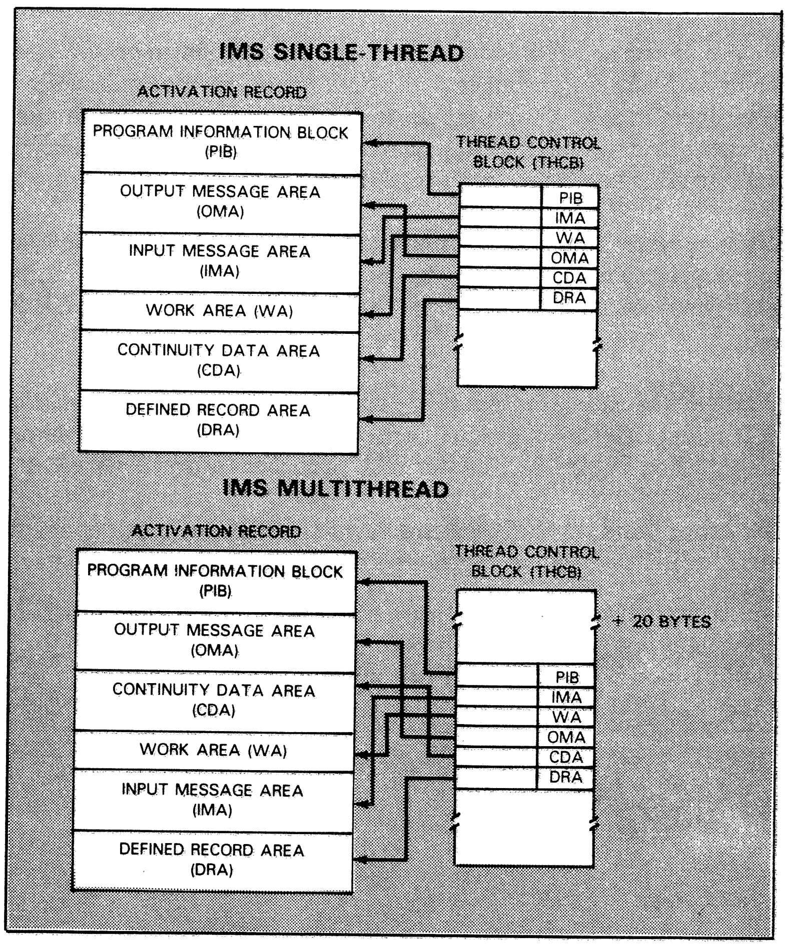


Figure 12-2. Relationship between THCB and Interface Areas

Notice that pointers within the thread control block point to each interface area. Single-thread and multithread IMS differ only in the location of these pointers and in the relative order of the interface areas themselves.

Also, the program information block (first interface area) in the thread control block is located 20 bytes into the thread control block in a multithread termination snap. In a single-thread termination snap, the program information block begins at the first byte of the thread control block.

- Terminal control table

  The last section in the snap dump is the terminal control table. Data in this area is relevant to the terminal that initiated the action and is the least useful section of the dump to the IMS programmer.

12.3. CALL SNAP Dumps

12.3.1. Layout Description

Figure 12-3 illustrates the general layout of CALL SNAP dump. Except for the edited headers, this layout pertains to single and multithread CALL SNAP dumps. All single-thread CALL SNAP dumps are unedited.

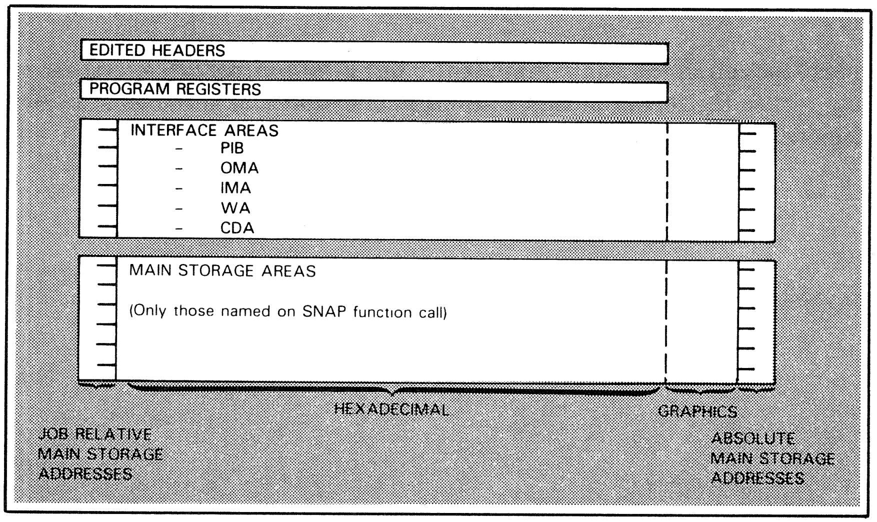


Figure 12-3. Layout of a CALL SNAP Dump

There are three sections in each CALL SNAP dump:

1. Edited headers (for edited dumps)

2. IMS registers

3. Requested main storage areas

The edited Header section contains information about the action program that was running when the CALL SNAP occurred. Included is the name of the action program load module that was executing, an allocation map that provides the relative addresses of action programs and IMS areas needed in debugging the program, and a general statement of why the snap dump occurred; for example, USER INLINE SNAP.

The register section contains IMS registers only. No program registers are shown. These registers are of little use to you.

Following the register section, you find the main storage area. The main storage areas included in the CALL SNAP dump are only those you named on the SNAP function call in your action program. You can dump up to six main storage areas including interface areas.

12.3.2. SNAP Function Call

When you want to debug your action program without terminating the program, use the SNAP function call. The SNAP function dumps up to six noncontiguous main storage areas in hexadecimal. The printer file is breakpointed. Output is to the printer. COBOL and BAL formats for the SNAP function calls are:

- COBOL format

```
CALL 'SNAP' USING start-area-1 end-area-1
                  [...start-area-6 end-area-6].
```

- BAL format

```
ZG#CALL SNAP,(start-addr-1, end-addr-1[,...start-addr-6,
              end-addr-6])
```

The *start-area-1* and *end-area-1* parameters are paired for the COBOL CALL statement just as the *start-addr-1* and *end-addr-1* parameters are paired for the BAL CALL statement. The *start-area-1* is the data name of the beginning of the area to be snapped and the *end-area-1* is the data name of the end of the area to be snapped.

For the BAL CALL macroinstruction, the *start-addr-1* and *end-addr-1* parameters indicate the start and end addresses of the area being snapped.

The SNAP function dumps up to six areas including the program information block, input message area, work area, output message area, continuity data area, working-storage (COBOL), and defined storage area (BAL).

In the FIXSAM action program (Figure 12-8, line 312) the SNAP function call shows how the start areas and end areas are paired and their data names defined elsewhere in the program. Though the beginning and ending identification of these snapped areas may occur on the SNAP function call in any order as long as they are paired, the interface areas take their beginning and ending identification from the single and multithread activation record layouts shown in Figure 12-2.

12.4. Single-Thread and Multithread Snap Dumps

There are three major differences between single-thread and multithread snap dumps. First, the order of the interface areas is different. In a single-thread dump, it is: program information block; output message area; input message area; work area; continuity data area; and defined record area if defined files are used. On a multithread dump, it is: program information block; output message area; continuity data area; work area; input message area; and defined record area if defined files are used. Since the allocation map in an edited dump points directly to these areas, there should be no difficulty in locating them in either single or multithread IMS dumps.

The second major difference concerns the thread control block. The format for single-thread and multithread is totally different. Figures 12-4 and 12-5 provide listings of the thread control block DSECTs for both single-thread and multithread IMS. By examining these figures, notice that although the format is different, the data they contain is basically the same.

The third difference is if the action program is a shared code COBOL program; in multithread, the termination snap dump shows an additional area appended to the end of the program information block. This is the shared code volatile save area used by IMS and COBOL to make COBOL reentrant at CALL interrupt. This portion of the dump is of little use to an action programmer.

The terminal control table for single and multithread IMS is also a valuable debugging aid. Figure 12-6 shows the single-thread terminal control table, and Figure 12-7 shows the multithread terminal control table.

```
 LOC.            LINE    SOURCE STATEMENT

                 A9979+          ZM#DTHCB
000000           B9980+ZT#DTHCB  DSECT
                 B9981+*
                 B9982+*   THREAD CONTROL BLOCK / SYSTEM INFORMATION BLOCK
                 B9983+*
                 B9984+*     THREAD CONTROL SECTION
                 B9985+*
                 B9986+*
                 B9987+*         INSERTED EQU'S TO MATCH OS/7 NAMES
                 B9988+*
000000           B9989+ZT#TPIBA EQU    *
000000           B9990+ZT#HPIBA DS     A PROGRAM INFORMATION BLOCK ADDR
000004           B9991+ZT#TIMA  EQU    *
000004           B9992+ZT#HIMA  DS     A INPUT MESSAGE AREA ADDR
000008           B9993+ZT#TWA   EQU    *
000008           B9994+ZT#HWA   DS     A WORK AREA ADDR
00000C           B9995+ZT#TOMA  EQU    *
00000C           B9996+ZT#HOMA  DS     A OUTPUT MESSAGE AREA ADDR
000010           B9997+ZT#TCDA  EQU    *
000010           B9998+ZT#HCDA  DS     A CONTINUITY DATA AREA ADDR
000014           B9999+ZT#TDRMA EQU    *
000014           B0000+ZT#HDRA  DS     A DEFINED RECORD AREA ADDR
000018           B0001+ZT#DDREC EQU    *
000018           B0002+ZT#HDDRA DS     F DATA DEFINITION RECORD ADDR
00001C           B0003+ZT#SUBFL EQU    *
00001C           B0004+ZT#HDFA  DS     F DEFINED FILE/SUBFILE PKT ADDR
000020           B0005+ZT#TFAM  EQU    *
000020           B0006+ZT#HFAM  DS     4F FILE ALLOCATION MAP
000010           B0007+ZT#HNUMF EQU    *-ZT#HFAM FILE ALLOCATION MAP LENGTH
000030           B0008+ZT#TATA  EQU    *
000030           B0009+ZT#HATA  DS     F ACTION CONTROL REC PTR
000034           B0010+ZT#TPTA  EQU    *
000034           B0011+ZT#HPTA  DS     F PROG CONTROL TABLE REC PTR
000038           B0012+ZT#TPTA1 DS     F
00003C           B0013+ZT#TTTA  EQU    *
00003C           B0014+ZT#HTTA  DS     F TERM CONTROL TAB REC PTR
000040           B0015+ZT#HIOAV DS     F START OF VARIABLE I/O AREA
000044           B0016+ZT#HPLA  DS     F PROGRAM LOAD AREA ADDRESS
000048           B0017+ZT#HBIQP DS     F BYPASS INTERRUPT QUEUE PTR
                 B0018+*
                 B0019+*    EQUATES FOR 1ST BYTE OF ZT#HBIQP
000008           B0020+ZB#SOLSH EQU    X'08' SHUTDOWN IN PROCESS
000004           B0021+ZB#SOLAS EQU    X'04' AUTOMATIC STATUS
000002           B0022+ZB#SOLCO EQU    X'02' ZZUP/ZZDWN COMMAND OUTSTANDING
000001           B0023+ZB#SOLST EQU    X'01' SHUTDOWN TIMER
                 B0024+*
00004C           B0025+ZT#HBIQL DS     XL1 BYPASSED INTERRUPT QUEUE LENGTH
00004D           B0026+ZA#USER  EQU    *
00004D 00        B0027+ZT#USER  DC     X'0' . USER FLAG
                 B0028+*
                 B0029+*               MUST ALWAYS BE ON OWN BYTE BOUNDARY
```

Figure 12-4. Single-Thread Control Block (Part 1 of 4)

```
 LOC.      LINE    SOURCE STATEMENT
           B0030+*
           B0031+*                                              80 - I/O HAS OCCURRED
           B0032+*                                              40 - INITIAL SETTING FOR USER
           B0033+*                                              00 - IMS ACTIVE
           B0034+*                                                 - COUNT FOR TOTAL TIME
00004E     B0035+ZT#TIND   EQU    *
00004E     B0036+ZT#HIND   DS     XL1 CONTROL INDICATORS
           B0037+*
           B0038+*     EQUATES FOR ZT#HIND
           B0039+*
000080     B0040+ZT#HINSP EQU    X'80' SNAP INDICATOR
000040     B0041+ZT#HINER EQU    X'40' ERROR RETURN
000020     B0042+ZT#HINDI EQU    X'20' DELAYED INTERNAL SUCCESSION
000010     B0043+ZT#HINEO EQU    X'10' EXPLICIT OUTPUT
000008     B0044+ZT#HINEX EQU    X'08' EXTERNAL SUCCESSION
000004     B0045+ZT#HINCN EQU    X'04' CANCELLED
000002     B0046+ZT#HINIR EQU    X'02' INTERNAL REQUEST TO FILE MGMT
000001     B0047+ZT#HINUP EQU    X'01' UPDATE PERFORMED BY THIS ACTION
           B0048+*
00004F     B0049+ZT#SYIND DS     XL1 CONTROL INDICATORS
000080     B0050+ZT#ILIST EQU    X'80' INTERRUPT LIST IF SET
000040     B0051+ZT#TOMRD EQU    X'40' . IF ON INDICATES READ FROM TOMFOLE
000020     B0052+ZT#TRSD  EQU    X'20' . RESEND = NO
000010     B0053+ZT#UTOUT EQU    X'10' USER TIME OUT
000008     B0054+ZT#ESETL EQU    X'08'
000004     B0055+ZT#USETX EQU    X'04' USE THE TEXT IN UMA ALTHOUGH TRANS WAS CNC
000002     B0056+ZT#ZZOPN EQU    X'02' INDICATES TO WRITE ZZOPN TERM. RECORD
000050     B0057+ZT#PSSK  DS     9F
           B0058+*
           B0059+*     FILE MANAGEMENT ENTRIES
           B0060+*
000074     B0061+ZT#TFC   EQU    *
000074     B0062+ZT#HFC   DS     F BYTE 0 :# OF PARAMS
           B0063+*                                   BYTE 3 : FUNCTION CODE
000078     B0064+ZT#TUPDA EQU    *
000078     B0065+ZT#HUPDA DS     F UNPROTECTED DTF ADDR
00007C     B0066+ZT#TCR   EQU    *
00007C     B0067+ZT#HRPLA DS     F PARAM LIST ADDR
000080     B0068+ZT#TFWA  EQU    *
000080     B0069+ZT#HFWA  DS     3A FILE MGMT WORK AREA
00008C     B0070+ZT#DMSL  DS     A TCT ADDR OF DMS RUN-UNIT
000090     B0071+ZT#DMCA  DS     A DMS - DMCA ADDRESS
           B0072+*
           B0073+*     SAVE AREAS
           B0074+*
           B0075+*
           B0076+*
000094     B0077+ZT#HSADM DS     18F DATA MANAGEMENT SAVE AREA
0000DC     B0078+ZT#HSAIR DS     18F INTERNAL REQUEST SAVE AREA
           B0079+*
           B0080+*     SYSTEM INFORMATION SECTION
           B0081+*
```

Figure 12-4. Single-Thread Control Block (Part 2 of 4)

```
 LOC.    LINE    SOURCE STATEMENT
000124  B0082+ZB#STIDT DS    F TRANSACTION CODE TABLE
000128  B0083+ZB#SACT  DS    F ACTION CONTROL TABLE
00012C  B0084+ZB#SPCT  DS    F PROGRAM CONTROL TABLE
000130  B0085+ZB#SFCTI DS    F FILE CONTROL TABLE INDEX
000134  B0086+ZB#STERM DS    F TERMINAL CNTL TBL ADDR
000138  B0087+ZB#SDCTI DS    F DEF FILE CONTROL TABLE
00013C  B0088+ZB#SFADR DS    F IMS LOAD ADDRESS
000140  B0089+ZB#SAVAL DS    F AVAILABLE LIST ADDRESS
000144  B0090+ZB#STCS  DS    F TERM. CONTROL SECTION
000148  B0091+ZB#SIMB  DS    F INPUT MESSAGE BUFFER
00014C  B0092+ZB#SIOAE DS    F I/O AREA END ADDR
000150  B0093+ZB#SFSAD DS    A ADDR IMS SESSION STATISTICS
000154  B0094+ZB#LOUTM DS    H LARGEST OUTPUT MSG.
000156  B0095+ZB#LINM  DS    H LARGEST INPUT MSG.
000158  B0096+ZB#LOMTI DS    4C LARGEST OUTPUT MSG.-TERM ID. NAME
00015C  B0097+ZB#LIMTI DS    4C LARGEST INPUT  MSG.-TERM ID. NAME
000160  B0098+ZB#SMLL  DS    H STANDARD MESSAGE LINE LENGTH
000162  B0099+ZB#SMNL  DS    H STANDARD MESSAGE NUMBER OF LINES
000164  B0100+ZB#SIMBL DS    H INPUT MESSAGE BUFFER LENGTH
000166  B0101+ZB#TMCCA DS    H NUMBER OF TERMS IN ICAM CCA
000168  B0102+ZB#STOF  DS    XL1 . USER TIMEOUT FLAG
000169  B0103+ZB#SOLOF DS    XL1 CONTROL INDICATORS FOR AUDIT
        B0104+*
        B0105+*      EQUATES FOR ZB#SOLOF
000080  B0106+ZB#SOLUP EQU   X'80' UPDATING PERMITTED
000040  B0107+ZB#SOLAI EQU   X'40' AUDIT MODULE INCLUDED
        B0108+*                                 (BEF IMAGES, TR FILES)
000020  B0109+ZB#SOLRD EQU   X'20' ROLLBACK PROGRAM / FILE DOWN
000010  B0110+ZB#SOLSU EQU   X'10' SUPPRESS UPDATES
000008  B0111+ZB#SOLTB EQU   X'08' BEFORE IMAGES TRACED
000004  B0112+ZB#SOLTA EQU   X'04' AFTER IMAGES TRACED
000002  B0113+ZB#SOLTI EQU   X'02' INPUT MESSAGES TRACED
000001  B0114+ZB#SOLTE EQU   X'01' I/O ERROR TRACE FILE
        B0115+*
00016C  B0116+         DS    0F
        B0117+*
00016C  B0118+ZB#FLG1  DS    X . FLAG1 OF STARTUP
000080  B0119+ZB#STRIN EQU   X'80' . STARTUP ACTIVE
000040  B0120+ZB#TCRSH EQU   X'40' ..TRCFILE=CRASH
000020  B0121+ZB#TEXT  EQU   X'20' ..TRCFILE=EXT
00016D  B0122+ZB#FLG2  DS    X .FLAG FOR TOMFILE
000080  B0123+ZB#TOMUP EQU   X'80' . TOMFILE CONFIGURED
000001  B0124+ZB#TOMER EQU   X'01' . ERROR ON TOM FILE
000002  B0125+ZB#TOMNT EQU   X'02' . DO NOT TRACE TOMFILE
00016E  B0126+ZB#FLG3  DS    X .FLAG FOR TYPE OF RESTART
000001  B0127+ZB#INDCL EQU   X'01' .START=CLEAN
000002  B0128+ZB#INDWA EQU   X'02' .START=WARM
000004  B0129+ZB#INDCO EQU   X'04' .START=COLD
00016F  B0130+ZB#FLG4  DS    X DMS FLAG BYTE
000080  B0131+ZB#IMSDM EQU   X'80' IMS HAS MADE A REQUEST TO DMS
000040  B0132+ZB#DMSDC EQU   X'40' DMS HAS TERMINATED
000020  B0133+ZB#DMSRU EQU   X'20' DMS RUN-UNIT EXISTS
```

Figure 12-4. Single-Thread Control Block (Part 3 of 4)

```
 LOC.      LINE    SOURCE STATEMENT
000010    B0134+ZB#IMSNA EQU    X'10' IMS NOT ALLOWED ACCESS TO DMS
000008    B0135+ZB#DMSNA EQU    X'08' DMS IS NOT THERE
000173    B0136+ZB#FLGS  DS     XL1
000080    B0137+ZB#KAT   EQU    X'80' KATAKANA CONFIGURED
000040    B0138+ZB#STATS EQU    X'40' STATISTICS AT SHUTDOWN
000020    B0139+ZB#SFSEN EQU    X'20' SFS ENABLED
000008    B0140+ZB#GLB   EQU    X'08' GLOBAL NETWORK
000004    B0141+ZB#DED   EQU    X'04' DEDICATED NETWORK
000171    B0142+         DS     XL3 UNUSED
000174    B0143+ZB#LPCT  DS     F LAST PCT ADDRESS
000178    B0144+ZB#LACT  DS     F LAST ACT ADDRESS
00017C    B0145+ZB#LAD   DS     F LAST LOAD AREA ADDRESS
000180    B0146+ZB#NLST  DS     H INTLIST=N VALUE
000182    B0147+         DS     XL2 UNUSED
000184    B0148+ZC#CCA   DS     F CCA NAME
000188    B0149+ZC#LOCAP DS     F LOCAP NAME
00018C    B0150+ZB#MDICE DS     F DICE-SCREEN CLEAR/MSG POSITION
000190    B0151+ZB#UNDEF DS     A POINTER TO TRIDT TO PROCESS UNDEF.TRANS.CODES
000194    B0152+ZB#DATE  DS     F TODAY'S DATE
000198    B0153+ZB#SESLN DS     F LENGTH-SESSION TABLE-ZSTAT
00019C    B0154+ZQ#THFIN DS     OF . THIS TAG MUST STAY AT END
00019C    B0155+ZT#HLEN  EQU    *-ZT#DTHCB LENGTH OF THCB
00019C    B0156+ZT#TLEN  EQU    ZT#HLEN
000000    B0157+ZC#IIP   CSECT
```

Figure 12-4. Single-Thread Control Block (Part 4 of 4)

```
 LOC.      LINE    SOURCE STATEMENT

            273            ZM#DTHCB
000000    A 274+ZT#DTHCB DSECT  .          ** IMS THREAD CONTRL BLOCK - MULTI THREAD **
000000    A 275+ZT#THQPT DS     F .        NEXT THREAD IN QUEUE POINTER
000004    A 276+ZT#NTHCB DS     F .        NEXT THREAD FOR SCHEDULING
000008    A 277+ZT#THURF DS     X .        URGENT FLAG    0 - ROUTINE
000009    A 278+ZT#THRDF DS     X .        THREAD READY FLAG   1 - READY
00000A    A 279+ZT#DWAIT DS     0X .       BIT 0 INITIAL THREAD WAIT FLAG - WAIT
00000A    A 280+ZT#REGRS DS     X .        BIT 7 RESTORE REGISTER FLAG  0 - YES
00000B    A 281+ZT#IECB3 DS     X .          BIT 0 CANCEL FLAG  1 - CANCEL
          A 282+*                            BIT 2 OUTPUT MESSAGE GENERATED BY ZG#MTMSO
          A 283+*                            BIT 3 INTERNAL CANCEL INITIATED
          A 284+*                            BIT 7 IECB FLAG     1 - 3 WORD
00000C    A 285+ZT#THSVR DS     F .        THREAD SAVE AREA REGISTER
000010    A 286+ZT#THRAD DS     F .        THREAD RETURN ADDRESS
000014    A 287+ZT#TPIBA DS     A .        PROGRAM INFORMATION BLOCK ADDR
000018    A 288+ZT#TIMA  DS     A .        INPUT MESSAGE AREA ADDR
00001C    A 289+ZT#TWA   DS     A .        WORK AREA ADDR
000020    A 290+ZT#TOMA  DS     A .        OUTPUT MESSAGE AREA ADDR
000024    A 291+ZT#TCDA  DS     A .        CONTINUITY DATA AREA ADDR
000028    A 292+ZT#TDRMA DS     A .        DEFINED RECORD AREA ADDR
00002C    A 293+ZT#DDREC DS     A .        DATA DEFINITION RECORD ADDR
000030    A 294+ZT#SUBFL DS     A .        DEFINED FILE SUB-FILE DESC ADDR
000034    A 295+ZT#TFAM  DS     8F .       FILE ALLOCATION MAP
000020    A 296+ZT#TNUMF EQU    *-ZT#TFAM .  FILE ALLOCATION MAP LENGTH
000054    A 297+ZT#TATA  DS     A .        ACTION CONTROL TABLE RECORD ADDR
000058    A 298+ZT#TPTA  DS     A .        PROGRAM CONTROL TABLE RECORD ADDR
00005C    A 299+ZT#TPTA1 DS     F .
000060    A 300+ZT#TTTA  DS     A .        TERMINAL CONTROL TABLE RECORD ADDR
000064    A 301+ZT#TIMB  DS     A .        INPUT MSG BUFFER ADDR
000068    A 302+ZT#TEDIT DS     A .        EDIT TABLE ADDR
00006C    A 303+ZT#TRID  DS     CL8 .      TRANSACTION ID
000074    A 304+ZT#TIND  DS     XL1 .      CONTROL INDICATORS
          A 305+*                            BIT 0  TERMINATION TYPE  0  NORMAL
          A 306+*                                                     1  ABNORMAL
          A 307+*                            BIT 2  ERROR RETURN      0  NO
          A 308+*                                                     1  YES
          A 309+*                            BIT 3-4 INTERNAL MESSAGE CONTROL:
          A 310+*                                   00   END ACTION OR END TRANSACTION
          A 311+*                                   01   EXPLICIT OUTPUT
          A 312+*                                   10   DELAYED INTERNAL SUCCESSION
          A 313+*                                   11   CANCELLED
          A 314+*                            BIT 5  INTERNAL REQUEST INDIC FOR FM
          A 315+*                                                     0  NO
          A 316+*                                                     1  YES
          A 317+*                            BIT 6  OUTPUT IN PROCESS
          A 318+*                            BIT 7  OUTPUT WAITED
000075    A 319+ZT#TER#  DS     X .        ERROR CODE NUMBER
000076    A 320+ZT#SFS14 DS     H .        LENGTH NEEDED BY SFS                        R10
000078    A 321+ZT#TES   DS     F .        ADDR ACTION CNTRL TBL (ACT)
00007C    A 322+ZC#SFSSC DS     H .        INPUT STATUS BYTE COUNT
00007E    A 323+ZC#ITLN  DS     XL1 .      XTION FLD LEN CTR-INVALID TRANSACTION
```

Figure 12-5. Multithread Control Block (Part 1 of 2)

```
 LOC.     LINE   SOURCE STATEMENT
00007F    A 324+ZC#SFSID DS     CL6 .      SUCCESSOR-ID FOR REBUILD
000085    A 325+         DS     XL3 .      --------  UNUSED  --------
          A 326+*                          - FILE MANAGEMENT ENTRIES -
          A 327+*                          - PARAMETER LIST FOR SUBTASK -
000088    A 328+ZT#TBA   DS     A .        BEGIN ADDR
00008C    A 329+ZT#TRPLA DS     A .        REQUEST PARAM LIST ADDR
000090    A 330+ZT#TFC   DS     A .        BYTE 0 - # OF PARAMS IN LIST
          A 331+*                           BYTE 3 - FUNCTION CODE
000094    A 332+ZT#TUPDA DS     A .        UNPROTECTED DTF ADDR
000098    A 333+ZT#TCR   DS     A .        COVER REG
          A 334+*                          - OTHER -
00009C    A 335+ZT#TFWA  DS     3A .       WORK AREA
0000A8   'A 336+ZT#TSAV1 DS     11A .      SAVE AREA 1
0000D4    A 337+ZT#TSAV2 DS     11A .
0000D4    A 338+ZT#SAV5  EQU    ZT#TSAV2 . SAVE AREA 5
0000FC    A 339+ZT#SAVE6 EQU    ZT#SAV5+40 .
000100    A 340+         DS     7F'0' .
00011C    A 341+ZT#TSAV4 DS     18A .      SAVE AREA 4
000164    A 342+ZT#TSAV3 DS     11A .      SAVE AREA 3
000190    A 343+ZA#PSSK  DS     15F .
0001CC    A 344+ZT#TFLA  DS     F .        REQUIRED BY IRAM
0001D0    A 345+ZT#TF1   DS     F .        APPL. MANAG.
0001D4    A 346+ZT#TF2   DS     F .        FLAG BYTE
          A 347+*        ZT#TF2+1            ACTIVATE FUNCTION CODE SAVED
0001D4    A 348+ZT#SYIND EQU    ZT#TF2 .     FLAGS
000040    A 349+ZT#TOMRD EQU    X'40' .      INDICATES TOM READ
000004    A 350+ZT#ZZOPN EQU    X'04' .      INDICATES TO WRITE ZZOPN TERM. RECORD
000001    A 351+ZT#RDF   EQU    X'01' .      MIRAM RE-READ FLAG
0001D8    A 352+ZT#UDMCA DS     A .        USER PROGRAM DMCA ADDRESS
0001DC    A 353+ZT#IDMCA DS     A .        IMS INTERNAL DMCA ADDRESS
0001E0    A 354+ZT#SIBA  DS     F .        SIB ADDRESS
0001E4    A 355+ZT#SCLST DS     4F .       USERID,
          A 356+*                            PROGRAM NAME,
          A 357+*                            TRANSACTION CODE,
          A 358+*                            FILE NAME ADDRESS LIST.
0001F4    A 359+ZT#SCPLA DS     F .        PARAM LIST ADDRESS
0001F8    A 360+ZT#SCSP1 DS     F .        --------  UNUSED  --------
0001FC    A 361+ZT#SCPTR DS     F .        FILE LIST PTR.
000200    A 362+ZT#SCURF DS     F .        CUR.PTR. IN LIST
000204    A 363+ZT#SCFN  DS     F .        ADDRESS OF FILE NAME IN FCTI
000208    A 364+ZT#SCNTF DS     H .        FILE COUNT
00020A    A 365+ZT#SCFG1 DS     H .        SECURITY BIT FLAGS
00020C    A 366+ZT#ATME  DS     F .        ACTION TIME IN MILLISECONDS
000210    A 367+ZT#XTME  DS     F .        EXPIRATION TIME ON MILLISECOND CLOCK
000214    A 368+ZT#STME  DS     F .        STARTING TIME IN MILLISECONDS (SB$CLK)
000218    A 369+ZT#SCPN  DS     3F .       SET TIME ECB (EVENT CONTROL BLOCK)
000224    A 370+ZT#SCSP2 DS     2F .       --------  UNUSED  --------
00022C    A 371+ZT#SCEND EQU    * .
00022C    A 372+         DS     0F .
00022C    A 373+ZT#TLEN  EQU    *-ZT#DTHCB .  LENGTH OF THREAD CONTROL BLOCK
000000    A 374+IMSDSECT CSECT
000000      375 IMSDSECT CSECT
```

Figure 12-5. Multithread Control Block (Part 2 of 2)

```
 LOC.        LINE   SOURCE STATEMENT

              2712           ZM#DTCT
000000       A2713+ZC#DTCT  DSECT   **** TERMINAL CONTROL TABLE RECORD ****
             A2714+*
000000       A2715+ZC#LINK  DS      F ACT LINK TO NEXT TCT IN QUEUE
000004       A2716+ZC#TID   DS      XL4 TERMINAL ID
000008       A2717+ZC#TAL   DS      F REL ADDR SOURCE TCT  (OS/3)
00000C       A2718+ZC#TALT  DS      F REL ADDR ALTERNATE TCT (OS/3)
000010       A2719+ZC#TTTA  DS      F CORRESPONDING TTT ADDRESS
000014       A2720+ZC#TESR  DS      F SUCC ACT REL ADDR - ROLLBACK
000018       A2721+ZC#TCDL  DS      H CONTINUITY DATA LENGTH
00001A       A2722+ZC#TLN   DS      XL1 LINE NUMBER
00001B       A2723+ZC#TTST  DS      XL7 STATUS BYTES
00001B       A2724+ZC#TST   EQU     ZC#TTST
             A2725+*
             A2726+*   EQUATES FOR ZC#TTST/ZC#TST
             A2727+*
000080       A2728+ZC#TTLST EQU     X'80' LAST TCT
000040       A2729+ZC#TTTMD EQU     X'40' TEST MODE
000020       A2730+ZC#TTUM  EQU     X'20' URGENT MESSAGE, ACTION
000010       A2731+ZC#TTDWN EQU     X'10' TERMINAL DOWN
000008       A2732+ZC#TTHLD EQU     X'08' HOLD TERMINAL
000004       A2733+ZC#TTUT  EQU     X'04' URGENT TERMINAL
000002       A2734+ZC#TMWR  EQU     X'02' MSG WAIT (FOR ZZTST) RECEIVED
000001       A2735+ZC#TMTC  EQU     X'01' MWRITE FOR ZZTST (SINLGE THREAD)
000001       A2736+ZC#TOMW  EQU     X'01' OUTSTANDING MWRITE (MULTI THREAD)
             A2737+*
00001C       A2738+ZC#TST1  EQU     ZC#TST+1,1
             A2739+*
             A2740+*   EQUATES FOR ZC#TST1
             A2741+*
000080       A2742+ZC#TTIM  EQU     X'80' INTERACTIVE MODE
000040       A2743+ZC#TTMT  EQU     X'40' MASTER TERMINAL
000020       A2744+ZC#TALTS EQU     X'20' ALTERNATE TERM SPECIFIED
000010       A2745+ZC#TTRC  EQU     X'10' ROLLBACK COMPLETE
000008       A2746+ZC#TTMWS EQU     X'08' IMS SENT MSG WAIT
000004       A2747+ZC#TTBTH EQU     X'04' BATCH TERMINAL
000002       A2748+ZC#TTRP  EQU     X'02' ROLLBACK IN PROCESS
000001       A2749+ZC#TTMS  EQU     X'01' MSG TO ORIG TERM SENT
             A2750+*
00001D       A2751+ZC#TST2  EQU     ZC#TST1+1,1
00001D       A2752+ZC#TPRSF EQU     ZC#TST2
             A2753+*
             A2754+*   EQUATES FOR ZC#TST2
             A2755+*
000080       A2756+ZC#TTUNS EQU     X'80' MWRITE ISSUED FROM ZO#UNSMT MODULE
000040       A2757+ZC#TTREL EQU     X'40' RELEASE BUFFER AT MWRITE COMPL
000020       A2758+ZC#TPRMQ EQU     X'20' MSG IN QUEUE
000010       A2759+ZC#TPRMP EQU     X'10' MSG IN PROCESS
000008       A2760+ZC#TTSTA EQU     X'08' SEND AUTO STATUS MESSAGE
000004       A2761+ZC#TCONT EQU     X'04' CONTINUOUS OUTPUT REQUESTED
000002       A2762+ZC#TDELN EQU     X'02' DEL NOTICE - ACTION TO BE SCHED
```

Figure 12-6. Single-Thread Terminal Control Table (Part 1 of 5)

```
 LOC.        LINE   SOURCE STATEMENT
000001      A2763+ZC#TOIQ  EQU   X'01' OUTPUT GENERATED FOR INPUT QUEUING
            A2764+*
00001E      A2765+ZC#TST3  EQU   ZC#TST2+1,1
            A2766+*
            A2767+*     EQUATES FOR ZC#TST3
            A2768+*
000080      A2769+ZC#TTDR  EQU   X'80' DISCONNECT REQUESTED (S/T)
000040      A2770+ZC#TTQNE EQU   X'40' TERMINAL'S LOW QUEUE NOT EMPTY
000020      A2771+ZC#THDRS EQU   X'20' OUTPUT HEADER SAVED
000010      A2772+ZC#TIDN  EQU   X'10' INTERNAL DELIVERY NOTICE
000008      A2773+ZC#TIGM  EQU   X'08' IMS GENERATED ERROR MSG
000004      A2774+ZC#COIP  EQU   X'04' CONTINUOUS OUTPUT IN PROCESS (M/T)
000002      A2775+ZC#TNRDY EQU   X'02' NO IMS READY MSG TO THIS TERMINAL
000001      A2776+ZC#TUNAC EQU   X'01' SEND UNSOLICITED OUTPUT INDICATOR
            A2777+*                    FOR SWITCHED MESSAGES AT ACTION END
            A2778+*
00001F      A2779+ZC#TST4  EQU   ZC#TST3+1,1
            A2780+*
            A2781+*     EQUATES FOR ZC#TST4
            A2782+*
000080      A2783+ZC#ERMEX EQU   X'80' A/M GENERATED ERROR MSG.
000040      A2784+ZC#SFSRB EQU   X'40' REBUILD ALLOWED BY A/P
000020      A2785+ZC#ABTDY EQU   X'20' ABORT DYNAMIC SESSION
000010      A2786+ZC#DYTWD EQU   X'10' ABORT TERM WINDOW
000008      A2787+ZC#SIGN  EQU   X'08' SIGN ON FOR DYNAMIC SESSION
000004      A2788+ZC#ATTRI EQU   X'04' TERM HAS CONFIG. ATTRIBUTES
000002      A2789+ZC#CONSL EQU   X'02' CONSOLE TERMINAL
000001      A2790+ZC#CNTRD EQU   X'01' OUTSTANDING TCS/DISKETTE READ FUNCTION
            A2791+*
000020      A2792+ZC#TST5  EQU   ZC#TST4+1,1 DMS FLAGS
            A2793+*
            A2794+*     EQUATES FOR ZC#TST5
            A2795+*
000080      A2796+ZC#IMPRT EQU   X'80' ISSUED IMPACT FOR ACTION
000040      A2797+ZC#DEPND EQU   X'40' DEPART PENDING
000040      A2798+ZC#DEPRT EQU   X'40' ACTION ISSUED DEPART
000020      A2799+ZC#DMSUP EQU   X'20' ISSUED DSM OPEN FOR UPDATE
000020      A2800+ZC#BND   EQU   X'20' BOUND/UNBOUND STATE
000010      A2801+ZC#UBPND EQU   X'10' UNBIND PENDING
000008      A2802+ZC#DMSRD EQU   X'08' DMS FORCED DEPART WITH ROLLBACK
000004      A2803+ZC#DMSUB EQU   X'04' DMS RUN UNIT UNBOUND
000008      A2804+ZC#UPDRU EQU   X'08' OPENED FOR UPDATE IN THIS RUN-UNIT
000004      A2805+ZC#UPDTD EQU   X'04' UPDATING RUN-UNIT IN THIS SUCCESS UNIT
000002      A2806+ZC#TCALL EQU   X'02' FUNCTION CALL/TERMINATION CALL
000001      A2807+ZC#DMSDR EQU   X'01' DMS REQUEST VIA D.R.M.
            A2808+*
000021      A2809+ZC#TST6  EQU   ZC#TST5+1,1 DMS FLAGS EXTENSION
            A2810+*
            A2811+*     EQUATES FOR ZC#TST6
            A2812+*
000080      A2813+ZC#DMSER EQU   X'80' DMS ERROR IN RUN-UNIT
000040      A2814+ZC#WRK1  EQU   X'40' TEMPORARY FLAG #1
```

Figure 12-6. Single-Thread Terminal Control Table (Part 2 of 5)

```
 LOC.       LINE    SOURCE STATEMENT
000020     A2815+ZC#WRK2  EQU    X'20' TEMPORARY FLAG #2
000010     A2816+ZC#TTMDF EQU    X'10' MDEFER ISSUED FOR THIS TERMINAL
           A2817+*   THE FOLLOWING STATUS  BYTE TAGS ARE NOT CLEARED WHEN A GLOBAL
           A2818+*   NETWORK DYNAMIC TERMINAL DOES A $$SOFF
           A2819+*         ZC#TTLST
           A2820+*         ZC#TTUT
           A2821+*         ZC#TTMT
           A2822+*         ZC#TNRDY
           A2823+*         ZC#TUNAC
           A2824+*         ZC#ATTRI
           A2825+*
           A2826+*
000022     A2827+ZC#DDPST DS     X DDP STATUS BYTE
           A2828+*
           A2829+*    EQUATES FOR ZC#DDPST
           A2830+*
000080     A2831+ZC#REMTR EQU    X'80' REMOTE TRANS
000040     A2832+ZC#FSOUT EQU    X'40' FIND SESSION OUTSTANDING
000020     A2833+ZC#PSEDO EQU    X'20' PSEUDO TCT
000010     A2834+ZC#DDPOT EQU    X'10' MWRITE FOR DDP
           A2835+*
000023     A2836+ZC#DDPMD DS     X DDP MODE
           A2837+*
           A2838+*    EQUATES FOR ZC#DDP MODE
           A2839+*
0000D9     A2840+ZC#DTR   EQU    C'R' DIRECTORY TRANS. ROUTING
0000C1     A2841+ZC#PTRA  EQU    C'A' PROGRAM   TRANS. ROUTING - ACTIVATE
0000C3     A2842+ZC#PTRC  EQU    C'C' PROGRAM   TRANS. ROUTING - ABORT/CANCEL
0000C5     A2843+ZC#PTRE  EQU    C'E' PROGRAM   TRANS. ROUTING - END
           A2844+*
000024     A2845+ZC#SFLAG DS     XL1 GENERAL SFS FLAG  BYTE
           A2846+*
           A2847+*    EQUATES FOR ZC#SFLAG
           A2848+*
000080     A2849+ZC#INFMT EQU    X'80' INPUT FORMAT
000040     A2850+ZC#DYNM  EQU    X'40' DYNAMIC MEMORY
000020     A2851+ZC#SFBT1 EQU    X'20' SFS FLAG 1
000010     A2852+ZC#ITCF  EQU    X'10' INVALID XTION
000008     A2853+ZC#SFBT2 EQU    X'08' SFS FLAG 2
           A2854+*
000025     A2855+ZC#SFIRC DS     XL1 SFS INPUT RETRY COUNT
           A2856+*
000026     A2857+         DS     XL2 UNUSED
000028     A2858+ZC#TRCTA DS     A TRCT ADDR
00002C     A2859+ZC#TQE   DS     F CANCEL LINK
000030     A2860+ZC#PFFT  DS     F DISPL TO PROCESS FILE TABLE
000034     A2861+ZC#PQCNT DS     H PROCESS QUEUE COUNT
000036     A2862+ZC#MQCNT DS     XL1 LAST ICAM SVC
000037     A2863+ZC#TDELS DS     XL1 DELIVERY NOTICE STATUS
000038     A2864+ZC#LQCNT DS     H LOW QUEUE COUNT
00003A     A2865+ZC#TIN   DS     H TOTAL INPUT COUNT
00003C     A2866+ZC#TINT  DS     H TRANS. INPUT COUNT
```

Figure 12-6. Single-Thread Terminal Control Table (Part 3 of 5)

```
 LOC.       LINE    SOURCE  STATEMENT
C0003E     A2867+ZC#TTCM   DS     H TERM COMMAND COUNT
C0004C     A2868+ZC#TINCH  DS     F TOTAL NO. INPUT  CHARS.
C00044     A2869+ZC#TOTCH  DS     F TOTAL NO. OUTPUT  CHARS.
C00048     A2870+ZC#TOC    DS     H TOTAL OUTPUT COUNT
C0004A     A2871+ZC#TOMSZ  DS     H SOURCE TERM O/P MSG. SIZE
C0004C     A2872+ZC#TON    DS     F TIMER LINK
C00050     A2873+ZC#IML    DS     H INPUT MESSAGE LENGTH
C00052     A2874+ZC#OML    DS     H OUTPUT MESSAGE LENGTH
C00054     A2875+ZC#TML    DS     H TIMER MESSAGE LENGTH (OS/3 M.T.)
           A2876+*    OS/3 S.T. USES ZC#COSEQ INSTEAD OF ZC#TML
C00054     A2877+ZC#COSEQ  EQU    ZC#TML C/O SEQ COUNT (OS/3 S.T. ONLY)
C00056     A2878+ZC#DML    DS     H DDP MSG. LENGTH
C00058     A2879+ZC#IBF    DS     A INPUT  BUFFER ADDR
C0005C     A2880+ZC#OBF    DS     A OUTPUT BUFFER ADDR
C00060     A2881+ZC#TBF    DS     A TIMER  BUFFER ADDR
C00064     A2882+ZC#DBF    DS     A DDP    BUFFER ADDR
C00068     A2883+ZC#DPREL  DS     A DDP BUFFER RELEASE ADDR
C0006C     A2884+ZC#TDELC  DS     XL4 USER CONTINUOUS OUTPUT CODE
C00070     A2885+ZC#SFSTC  DS     A SFS TERMINAL CLASS ENTRY ADDR
C00074     A2886+ZC#SFSFN  DS     CL8 SFS FORMAT NAME
C0007C     A2887+ZC#SESAD  DS     A SESSION STAT TABLE ADDR
C00080     A2888+ZC#SESID  DS     F SESSION ID
C00084     A2889+ZC#TDMEM  DS     F SFS DYNAMIC MEMORY ADDR
C00088     A2890+ZC#TTRID  DS     CL8 TRANS ID (INITIAL DATE/TIME)
C00088     A2891+ZC#TRID   EQU    ZC#TTRID OS/4 TAG
C00090     A2892+ZC#DLCNT  DS     H IMC DEADLOCK DETECTION COUNT
C00092     A2893+          DS     H UNUSED
C00094     A2894+ZC#TCB    DS     A THREAD CONTROL BLOCK ADDR
C00098     A2895+ZC#TLI    DS     8F TRANS LOCK INDICATOR
C000B8     A2896+ZC#TAUM   DS     8F AUDITED UPDATE MAP
           A2897+*** ZC#TLI AND ZC#TAUM MUST AGREE WITH ZT#TNUMF IN THE THCB
C000D8     A2898+ZC#TTEXT  DS     CL8 TRANSLATED TERM CMD/TRANS CODE
C000D8     A2899+ZC#TCODE  EQU    ZC#TTEXT OS/4 TAG
C000E0     A2900+ZC#TDDRC  DS     CL1 DDR NAME ID CHAR (HIGH BYTE = X'FD')
           A2901+*** THE ABOVE FIELD IS DEFINED IN OS/4 BUT NOT TAGGED
C000E1     A2902+ZC#TDDRN  DS     CL7 DATA DEF REC NAME
C000E8     A2903+ZC#TDFN   DS     CL7 DEFINED FILE NAME
C000EF     A2904+          DS     X UNUSED
C000F0     A2905+ZC#TES    DS     F SUCC ACT RECORD RELATIVE ADDR
           A2906+*      MULTI-THREAD SYSTEMS USE ZC#ES & ZC#CDC IN PLACE OF ZC#TES
C000F0     A2907+          ORG    ZC#TES
C000F0     A2908+ZC#ES     DS     H SUCC ACT RECORD RELATIVE ADDR
C000F2     A2909+ZC#CDL    DS     H CONTINUITY DATA LENGTH
           A2910+*
C000F4     A2911+ZC#WAI    DS     H WORK AREA INC
C000F6     A2912+ZC#CDI    DS     H CONTINUITY DATA AREA INC
C000F8     A2913+ZC#TTTN   DS     XL1 TCT RECORD NUMBER
C000F9     A2914+          DS     XL1 UNUSED
C000FA     A2915+          DS     H UNUSED
           A2916+*      MULTI-THREAD USES ZC#CDR & ZC#CES INSTEAD OF ZC#TTTN & ZC#TINT
C000F8     A2917+          ORG    ZC#TTTN
C000F8     A2918+ZC#CDR    DS     H TCT RECORD NUMBER
```

Figure 12-6. Single-Thread Terminal Control Table (Part 4 of 5)

```
 LOC.       LINE    SOURCE STATEMENT
0000FA     A2919+ZC#CES    DS     H SUCC ACT REL ADDR _ ROLLBACK
0000FC     A2920+ZC#SCFR   DS     XL4 COUNT FIELD FOR ROLLBACK
           A2921+*
000100     A2922+ZC#TTIR   DS     XL1 TERM IND FOR ACTION PROG USING ROLLBACK
000100     A2923+ZC#TIR    EQU    ZC#TTIR OS/4 TAG
000100     A2924+          ORG    ZC#TIR
000100     A2925+ZC#TRWA   DS     F TRACE WORK AREA
000104     A2926+ZC#FBPA   DS     H * FIRST BLOCK OF PARTITION
000106     A2927+ZC#CBPA   DS     H * CURRENTLY ACCESSED BLOCK
000108     A2928+ZC#LBPA   DS     H * LAST BLOCK OF PARTITION
00010A     A2929+ZC#NRBCB  DS     H *# OF REM.BYTES IN CURR. BLOCK
           A2930+*
00010C     A2931+ZC#TLNAM  DS     CL4 LINE NAME
000110     A2932+ZC#TCHAR  DS     CL4 TERMINAL CHARACTERISTICS
000110     A2933+ZC#TTSL   EQU    ZC#TCHAR SCREEN LENGTH
000111     A2934+ZC#TTSW   EQU    ZC#TTSL+1 SCREEN WIDTH
000112     A2935+ZC#TTTYP  EQU    ZC#TTSW+1 TERMINAL TYPE
           A2936+*
           A2937+*   EQUATES FOR ZC#TTTYP
           A2938+*
000000     A2939+ZC#TTNFC  EQU    X'00' U100/U200/UTS10/TTY
000080     A2940+ZC#TT4PR  EQU    X'80' UTS400 PR
000040     A2941+ZC#TT4U2  EQU    X'40' UTS400 CP (U2 MODE)
000020     A2942+ZC#TT4U4  EQU    X'20' UTS400 CP (U4 MODE) OR UTS400
000010     A2943+ZC#TT327  EQU    X'10' IBM 3271
000008     A2944+ZC#TTU40  EQU    X'08' UTS40
000004     A2945+ZC#TTU20  EQU    X'04' UTS20
000002     A2946+ZC#TT40T  EQU    X'02' UTS400 TEXT EDITOR
           A2947+*
000113     A2948+ZC#TTATT  EQU    ZC#TTTYP+1 TERMINAL ATTRIBUTES
           A2949+*
           A2950+*   EQUATES FOR ZC#TTATT
           A2951+*
000080     A2952+ZC#TTKAN  EQU    X'80' KATAKANA
000040     A2953+ZC#TTNVI  EQU    X'40' NON-VIDEO
000020     A2954+ZC#TTSBT  EQU    X'20' SCREEN BYPASS
000010     A2955+ZC#TTPKT  EQU    X'10' PACKET PDN TERMINAL
000008     A2956+ZC#TTCST  EQU    X'08' CIRCUIT SWITCH PDN TERMINAL
000004     A2957+ZC#TTCCT  EQU    X'04' TERMINAL ON CLUSTER CONTROLLER
           A2958+*
000114     A2959+ZC#TINER  DS     F SFS ERROR FIELD
000118     A2960+ZC#TRIDA  DS     A PTR TO TRIDT ENTRY FOR CURRENT TRANSACTION
00011C     A2961+ZC#ALTID  DS     F ALTERNATE TERM ID
000120     A2962+ZC#TFIN   DS     OF THIS MUST ALWAYS BE AT END
000120     A2963+ZC#TLEN   EQU    *-ZC#DTCT
000000     A2964+ZO#OUTMT  CSECT
```

Figure 12-6. Single-Thread Terminal Control Table (Part 5 of 5)

```
  LOC.      LINE    SOURCE STATEMENT

             377             ZM#DTCT
000000     A 378+ZC#DTCT   DSECT  .          **** TERMINAL CONTROL TABLE RECORD ****
           A 379+*
000000     A 380+ZC#LINK   DS     F .        ACT LINK TO NEXT TCT IN QUEUE
000004     A 381+ZC#TID    DS     XL4 .      TERMINAL ID
000008     A 382+ZC#TAL    DS     F .        REL ADDR SOURCE TCT  (OS/3)
00000C     A 383+ZC#TALT   DS     F .        REL ADDR ALTERNATE TCT (OS/3)
000010     A 384+ZC#TTTA   DS     F .        CORRESPONDING TTT ADDRESS
000014     A 385+ZC#TESR   DS     F .        SUCC ACTION CNTRL TBL (ACT) ADDR - ROLLBACK
000018     A 386+ZC#TCDL   DS     H .        CONTINUITY DATA LENGTH
00001A     A 387+ZC#TLN    DS     XL1 .      LINE NUMBER
00001B     A 388+ZC#TTST   DS     XL7 .      STATUS BYTES
00001B     A 389+          ORG    ZC#TTST .                                        R10
00001B     A 390+ZC#TST    DS     X .                                              R10
           A 391+*
           A 392+*                           EQUATES FOR ZC#TTST/ZC#TST
           A 393+*
000080     A 394+ZC#TTLST EQU     X'80' .      LAST TCT
000040     A 395+ZC#TTTMD EQU     X'40' .      TEST MODE
000020     A 396+ZC#TTUM   EQU    X'20' .      URGENT MESSAGE, ACTION
000010     A 397+ZC#TTDWN EQU     X'10' .      TERMINAL DOWN
000008     A 398+ZC#TTHLD EQU     X'08' .      HOLD TERMINAL
000004     A 399+ZC#TTUT   EQU    X'04' .      URGENT TERMINAL
000002     A 400+ZC#TMWR   EQU    X'02' .      MSG WAIT (FOR ZZTST) RECEIVED
000001     A 401+ZC#TMTC   EQU    X'01' .      (S.T.) MWRITE FOR ZZTST (SINLGE THREAD)
000001     A 402+ZC#TOMW   EQU    X'01' .      (M.T.) OUTSTANDING MWRITE (MULTI THREAD)
           A 403+*
00001C     A 404+ZC#TST1   DS     X .                                              R10
           A 405+*
           A 406+*                           EQUATES FOR ZC#TST1
           A 407+*
000080     A 408+ZC#TTIM   EQU    X'80' .      INTERACTIVE MODE
000040     A 409+ZC#TTMT   EQU    X'40' .      MASTER TERMINAL
000020     A 410+ZC#TALTS EQU     X'20' .      ALTERNATE TERM SPECIFIED
000010     A 411+ZC#TTRC   EQU    X'10' .      ROLLBACK COMPLETE
000008     A 412+ZC#TTMWS EQU     X'08' .      IMS SENT MSG WAIT
000004     A 413+ZC#TTBTH EQU     X'04' .      BATCH TERMINAL
000002     A 414+ZC#TTRP   EQU    X'02' .      ROLLBACK IN PROCESS
000001     A 415+ZC#TTMS   EQU    X'01' .      MSG TO ORIG TERM SENT
           A 416+*
00001D     A 417+ZC#TST2   DS     X .                                              R10
00001D     A 418+ZC#TPRSF EQU     ZC#TST2 .
           A 419+*                             N    >> NOTIFY ICAM GRP. (B. MCCANN) << R11
           A 420+*                              O   >> IF  ZC#TST2'S  DISPLACEMENT  << R11
           A 421+*                               T  >> AND/OR THE VALUE OF ZC#TPRMQ << R11
           A 422+*                                E >> CHANGES (JHV).......         << R11
           A 423+*
           A 424+*                           EQUATES FOR ZC#TST2
           A 425+*
000080     A 426+ZC#TTUNS EQU     X'80' .      MWRITE ISSUED FROM ZO#UNSMT MODULE
000040     A 427+ZC#TTREL EQU     X'40' .      RELEASE BUFFER AT MWRITE COMPL
```

Figure 12-7. Multithread Terminal Control Table (Part 1 of 7)

```
 LOC.      LINE    SOURCE  STATEMENT
000020   A 428+ZC#TPRMQ EQU    X'20' .      MSG IN QUEUE
000010   A 429+ZC#TPRMP EQU    X'10' .      MSG IN PROCESS
000008   A 430+ZC#TTSTA EQU    X'08' .      SEND AUTO STATUS MESSAGE
000004   A 431+ZC#TCONT EQU    X'04' .      CONTINUOUS OUTPUT REQUESTED
000002   A 432+ZC#TDELN EQU    X'02' .      DEL NOTICE - ACTION TO BE SCHED
000001   A 433+ZC#TOIQ  EQU    X'01' .      OUTPUT GENERATED FOR INPUT QUEUIN
         A 434+*
00001E   A 435+ZC#TST3  DS     X .
         A 436+*
         A 437+*                          EQUATES FOR ZC#TST3
         A 438+*
000080   A 439+ZC#TTDR  EQU    X'80' .      DISCONNECT REQUESTED (S/T)
000040   A 440+ZC#TTQNE EQU    X'40' .      TERMINAL'S LOW QUEUE NOT EMPTY
000020   A 441+ZC#THDRS EQU    X'20' .      OUTPUT HEADER SAVED
000010   A 442+ZC#TIDN  EQU    X'10' .      INTERNAL DELIVERY NOTICE
000008   A 443+ZC#TIGM  EQU    X'08' .      IMS GENERATED ERROR MSG
000004   A 444+ZC#COIP  EQU    X'04' .      CONTINUOUS OUTPUT IN PROCESS (M/T)
000002   A 445+ZC#TNRDY EQU    X'02' .      NO IMS READY MSG TO THIS TERMINAL
000001   A 446+ZC#TUNAC EQU    X'01' .      SEND UNSOLICITED OUTPUT INDICATOR
         A 447+*                               FOR SWITCHED MESSAGES AT ACTION END
         A 448+*
00001F   A 449+ZC#TST4  DS     X .
         A 450+*
         A 451+*                          EQUATES FOR ZC#TST4
         A 452+*
000080   A 453+ZC#ERMEX EQU    X'80' .      A/M GENERATED ERROR MSG
000040   A 454+ZC#SFSRB EQU    X'40' .      REBUILD ALLOWED BY A/P
000020   A 455+ZC#ABTDY EQU    X'20' .      ABORT DYNAMIC SESSION
000010   A 456+ZC#DYTWD EQU    X'10' .      ABORT TERM WINDOW
000008   A 457+ZC#SIGN  EQU    X'08' .      SIGN ON FOR DYNAMIC SESSION
000004   A 458+ZC#ATTRI EQU    X'04' .      TERM HAS CONFIG. ATTRIBUTES
000002   A 459+ZC#CONSL EQU    X'02' .      CONSOLE TERMINAL
000001   A 460+ZC#CNTRD EQU    X'01' .      OUTSTANDING TCS/DISKETTE READ FUNCTION
         A 461+*
000020   A 462+ZC#TST5  DS     X .                DMS FLAGS
         A 463+*
         A 464+*                          EQUATES FOR ZC#TST5
         A 465+*
000080   A 466+ZC#IMPRT EQU    X'80' .      ISSUED IMPACT FOR ACTION
000040   A 467+ZC#DEPND EQU    X'40' .      DEPART PENDING
000040   A 468+ZC#DEPRT EQU    X'40' .      ACTION ISSUED DEPART
000020   A 469+ZC#DMSUP EQU    X'20' .      ISSUED DSM OPEN FOR UPDATE
000020   A 470+ZC#BND   EQU    X'20' .      BOUND/UNBOUND STATE
000010   A 471+ZC#UBPND EQU    X'10' .      UNBIND PENDING
000008   A 472+ZC#DMSRO EQU    X'08' .      DMS FORCED DEPART WITH ROLLBACK
000004   A 473+ZC#DMSUB EQU    X'04' .      DMS RUN UNIT UNBOUND
000008   A 474+ZC#UPDRU EQU    X'08' .      OPENED FOR UPDATE IN THIS RUN-UNIT
000004   A 475+ZC#UPDTD EQU    X'04' .      UPDATING RUN-UNIT IN THIS SUCCESS UNIT
000002   A 476+ZC#TCALL EQU    X'02' .      FUNCTION CALL/TERMINATION CALL
000001   A 477+ZC#DMSDR EQU    X'01' .      DMS REQUEST VIA D.R.M.
         A 478+*
000021   A 479+ZC#TST6  DS     X .                DMS FLAGS EXTENSION
```

Figure 12-7. Multithread Terminal Control Table (Part 2 of 7)

```
 LOC.      LINE   SOURCE STATEMENT
          A 480+*
          A 481+*                        EQUATES FOR ZC#TST6
          A 482+*
000080    A 483+ZC#DMSER EQU    X'80' .     DMS ERROR IN RUN-UNIT
000040    A 484+ZC#WRK1  EQU    X'40' .     TEMPORARY FLAG #1
000020    A 485+ZC#WRK2  EQU    X'20' .     TEMPORARY FLAG #2
000010    A 486+ZC#TTMDF EQU    X'10' .     MDEFER ISSUED FOR THIS TERMINAL
000008    A 487+ZC#SECTC EQU    X'08' .     CHECK TRANS. CODE FOR SECURITY
          A 488+*                 THE FOLLOWING STATUS BYTE TAGS ARE NOT CLEARED
          A 489+*                 WHEN A GLOBAL NETWORK DYNAMIC TERMINAL DOES A $$SOFF
          A 490+*                         ZC#TTLST
          A 491+*                         ZC#TTUT
          A 492+*                         ZC#TTMT
          A 493+*                         ZC#TNRDY
          A 494+*                         ZC#TUNAC
          A 495+*                         ZC#ATTRI
          A 496+*                         ZC#TSMSG  SET/CLEARED AT $$SON DEPENDING
          A 497+*                                   ON ZB#SMSG (ZB#SIB), DYNAMIC
          A 498+*                                   TERMS ONLY..
          A 499+*                                   NOT SET/CLEARED ON CONFIG TERMS
          A 500+*                                   (ZC#ATTRI) AT $$SON..
          A 501+*                         ZC#UATTD
          A 502+*
          A 503+*
000022    A 504+ZC#DDPST DS     X .         DDP STATUS BYTE
          A 505+*
          A 506+*                        EQUATES FOR ZC#DDPST
          A 507+*
000080    A 508+ZC#REMTR EQU    X'80' .     REMOTE TRANS
000040    A 509+ZC#FSOUT EQU    X'40' .     FIND SESSION OUTSTANDING
000020    A 510+ZC#PSEDO EQU    X'20' .     PSEUDO TCT
000010    A 511+ZC#DDPOT EQU    X'10' .     MWRITE FOR DDP
          A 512+*
000023    A 513+ZC#DDPMD DS     X .         DDP MODE
          A 514+*
          A 515+*                        EQUATES FOR ZC#DDP MODE
          A 516+*
0000D9    A 517+ZC#DTR   EQU    C'R' .      DIRECTORY TRANS. ROUTING
0000C1    A 518+ZC#PTRA  EQU    C'A' .      PROGRAM   TRANS. ROUTING - ACTIVATE
0000C3    A 519+ZC#PTRC  EQU    C'C' .      PROGRAM   TRANS. ROUTING - ABORT/CANCEL
0000C5    A 520+ZC#PTRE  EQU    C'E' .      PROGRAM   TRANS. ROUTING - END
          A 521+*
000024    A 522+ZC#SFLAG DS     XL1 .       GENERAL SFS FLAG  BYTE
          A 523+*
          A 524+*                        EQUATES FOR ZC#SFLAG
          A 525+*
000080    A 526+ZC#INFMT EQU    X'80' .     INPUT FORMAT
000040    A 527+ZC#DYNM  EQU    X'40' .     DYNAMIC MEMORY
000020    A 528+ZC#SFBT1 EQU    X'20' .     SFS FLAG 1
000010    A 529+ZC#ITCF  EQU    X'10' .     INVALID XTION
000008    A 530+ZC#SFBT2 EQU    X'08' .     SFS FLAG 2
          A 531+*
```

Figure 12-7. Multithread Terminal Control Table (Part 3 of 7)

```
LOC.     LINE   SOURCE STATEMENT
000025   A 532+ZC#SFIRC DS    XL1 .     SFS INPUT RETRY COUNT
         A 533+*
000026   A 534+ZC#TST7  DS    X .               IMS TERMINAL FLAGS EXTENSION
         A 535+*
         A 536+*                        EQUATES FOR ZC#TST7
         A 537+*
002680   A 538+ZC#TSMSG EQU   (ZC#TST7-ZC#DTCT)*256+X'80' . YES IMC STATUS MSGS
002640   A 539+ZC#UATTD EQU   (ZC#TST7-ZC#DTCT)*256+X'40' . UNATTENDED TERMINAL
002620   A 540+ZC#LQMSG EQU   (ZC#TST7-ZC#DTCT)*256+X'20' . ZZDEQ ACTIVE LOW Q
         A 541+*
000027   A 542+ZC#TST8  DS    X .               IMS FLAGS EXTENSION ---UNUSED---
         A 543+*
         A 544+*                        EQUATES FOR ZC#TST8         ---UNUSED---
         A 545+*
000028   A 546+ZC#TRCTA DS    A .       TRCT ADDR
00002C   A 547+ZC#TQE   DS    F .       CANCEL LINK
000030   A 548+ZC#PRFT  DS    F .       DISPL TO PROCESS FILE TABLE
000034   A 549+ZC#PQCNT DS    H .       PROCESS QUEUE COUNT
000036   A 550+ZC#MQCNT DS    XL1 .     LAST ICAM SVC
000037   A 551+ZC#TDELS DS    XL1 .     DELIVERY NOTICE STATUS
000038   A 552+ZC#LQCNT DS    H .       LOW QUEUE COUNT
00003A   A 553+ZC#TIN   DS    H .       TOTAL INPUT COUNT
00003C   A 554+ZC#TINT  DS    H .       TRANS. INPUT COUNT
00003E   A 555+ZC#TTCM  DS    H .       TERM COMMAND COUNT
000040   A 556+ZC#TINCH DS    F .       TOTAL NO. INPUT  CHARS.
000044   A 557+ZC#TOTCH DS    F .       TOTAL NO. OUTPUT  CHARS.
000048   A 558+ZC#TOC   DS    H .       TOTAL OUTPUT COUNT
00004A   A 559+ZC#TOMSZ DS    H .       SOURCE TERM O/P MSG. SIZE
00004C   A 560+ZC#TON   DS    F .       TIMER LINK
000050   A 561+ZC#IML   DS    H .       INPUT MESSAGE LENGTH
000052   A 562+ZC#OML   DS    H .       OUTPUT MESSAGE LENGTH
000054   A 563+ZC#TML   DS    H .       TIMER MESSAGE LENGTH (OS/3 M.T.)
         A 564+*                        OS/3 S.T. USES ZC#COSEQ INSTEAD OF ZC#TML
000054   A 565+ZC#COSEQ EQU   ZC#TML .     C/O SEQ COUNT (OS/3 S.T. ONLY)
000056   A 566+ZC#DML   DS    H .       DDP MSG. LENGTH
000058   A 567+ZC#IBF   DS    A .       INPUT  BUFFER ADDR
00005C   A 568+ZC#OBF   DS    A .       OUTPUT BUFFER ADDR
000060   A 569+ZC#TBF   DS    A .       TIMER  BUFFER ADDR
000064   A 570+ZC#DBF   DS    A .       DDP    BUFFER ADDR
000068   A 571+ZC#DPREL DS    A .       DDP    BUFFER RELEASE ADDR
00006C   A 572+ZC#TDELC DS    XL4 .     USER CONTINUOUS OUTPUT CODE
000070   A 573+ZC#SFSTC DS    A .       SFS TERMINAL CLASS ENTRY ADDR
000074   A 574+ZC#SFSFN DS    CL8 .     SFS FORMAT NAME
00007C   A 575+ZC#SESAD DS    A .       SESSION STAT TABLE ADDR
000080   A 576+ZC#SESID DS    F .       SESSION ID
000084   A 577+ZC#TDMEM DS    F .       SFS DYNAMIC MEMORY ADDR
000088   A 578+ZC#TTRID DS    CL8 .     TRANS ID (INITIAL DATE/TIME)
000088   A 579+ZC#TRID  EQU   ZC#TTRID .    OS/4 TAG
000090   A 580+ZC#DLCNT DS    H .       IMC DEADLOCK DETECTION COUNT
000092   A 581+         DS    H .       -------------- UNUSED --------------
000094   A 582+ZC#TCB   DS    A .       THREAD CONTROL BLOCK ADDR
000098   A 583+ZC#TLI   DS    8F .      TRANS LOCK INDICATOR
```

Figure 12-7. Multithread Terminal Control Table (Part 4 of 7)

```
 LOC.     LINE   SOURCE STATEMENT
0000B8   A 584+ZC#TAUM  DS     8F .      AUDITED UPDATE MAP
         A 585+*                           ZC#TLI AND ZC#TAUM MUST AGREE WITH ZT#TNUMF
         A 586+*                              IN THE THCB
0000D8   A 587+ZC#TTEXT DS     CL8 .     TRANSLATED TERM CMD/TRANS CODE
0000D8   A 588+ZC#TCODE EQU    ZC#TTEXT .     OS/4 TAG
0000E0   A 589+ZC#TDDRC DS     CL1 .     DDR NAME ID CHAR (HIGH BYTE = X'FD')
         A 590+*                           THE ABOVE FIELD IS DEFINED IN OS/4 BUT NOT
         A 591+*                              TAGGED
0000E1   A 592+ZC#TDDRN DS     CL7 .     DATA DEF REC NAME
0000E8   A 593+ZC#TDFN  DS     CL7 .     DEFINED FILE NAME
0000EF   A 594+         DS     X .       --------------  UNUSED  --------------
0000F0   A 595+ZC#TES   DS     F .       SUCC ACT RECORD RELATIVE ADDR
         A 596+*                           M.T. SYSTEMS USE ZC#ES & ZC#CDC IN PLACE OF
         A 597+*                              ZC#RES
0000F0   A 598+         ORG    ZC#TES .
0000F0   A 599+ZC#ES    DS     F .       SUCC ACTION CNTRL TBL (ACT) ADDR
0000F4   A 600+ZC#CDL   DS     H .       CONTINUITY DATA LENGTH
         A 601+*
0000F6   A 602+ZC#WAI   DS     H .       WORK AREA INC
0000F8   A 603+ZC#CDI   DS     H .       CONTINUITY DATA AREA INC
0000FA   A 604+ZC#TTTN  DS     XL1 .     TCT RECORD NUMBER
0000FB   A 605+         DS     XL1 .     --------------  UNUSED  --------------
0000FA   A 606+         ORG    ZC#TTTN .
         A 607+*                           M.T. USES ZC#CDR & ZC#CES INSTEAD OF
         A 608+*                              ZC#TTTN AND ZC#TINT
0000FA   A 609+ZC#CDR   DS     H .       TCT RECORD NUMBER
0000FC   A 610+ZC#CES   DS     F .       SUCC ACTION CNTRL TBL (ACT) ADDR - ROLLBACK
000100   A 611+ZC#SCFR  DS     XL4 .     COUNT FIELD FOR ROLLBACK
         A 612+*
000104   A 613+ZC#TTIR  DS     XL1 .     TERM IND FOR ACTION PROG USING ROLLBACK
000104   A 614+ZC#TIR   EQU    ZC#TTIR .      OS/4 TAG
000104   A 615+         ORG    ZC#TTIR .
000104   A 616+ZC#TRWA  DS     F .       TRACE WORK AREA
000108   A 617+ZC#FBPA  DS     F .       FIRST BLOCK OF PARTITION
00010C   A 618+ZC#CBPA  DS     F .       CURRENTLY ACCESSED BLOCK
000110   A 619+ZC#LBPA  DS     F .       LAST BLOCK OF PARTITION
000114   A 620+ZC#NRBCB DS     H .       NUM OF REM. BYTES IN CURR. BLOCK
         A 621+*
000116   A 622+ZC#TLNAM DS     CL4 .     LINE NAME
00011A   A 623+ZC#TCHAR DS     CL4 .     TERMINAL CHARACTERISTICS
00011A   A 624+         ORG    ZC#TCHAR .
00011A   A 625+ZC#TTSL  DS     X .       SCREEN LENGTH
00011B   A 626+ZC#TTSW  DS     X .       SCREEN WIDTH
00011C   A 627+ZC#TTTYP DS     X .       TERMINAL TYPE
         A 628+*
         A 629+*                         EQUATES FOR ZC#TTTYP
         A 630+*
000000   A 631+ZC#TTNFC EQU    X'00' .     U100/U200/UTS10/TTY
000080   A 632+ZC#TT4PR EQU    X'80' .     UTS400 PR
000040   A 633+ZC#TT4U2 EQU    X'40' .     UTS400 CP (U2 MODE)
000020   A 634+ZC#TT4U4 EQU    X'20' .     UTS400 CP (U4 MODE) OR UTS400
000010   A 635+ZC#TT327 EQU    X'10' .     IBM 3271
```

Figure 12-7. Multithread Terminal Control Table (Part 5 of 7)

```
 LOC.      LINE    SOURCE  STATEMENT
000008   A 636+ZC#TTU40 EQU    X'08' .       UTS40
000004   A 637+ZC#TTU20 EQU    X'04' .       UTS20
000002   A 638+ZC#TT40T EQU    X'02' .       UTS400 TEXT EDITOR
         A 639+*
00011D   A 640+ZC#TTATT DS     X .         TERMINAL ATTRIBUTES
         A 641+*
         A 642+*                           EQUATES FOR ZC#TTATT
         A 643+*
000080   A 644+ZC#TTKAN EQU    X'80' .       KATAKANA
000040   A 645+ZC#TTNVI EQU    X'40' .       NON-VIDEO
000020   A 646+ZC#TTSBT EQU    X'20' .       SCREEN BYPASS
000010   A 647+ZC#TTPKT EQU    X'10' .       PACKET PDN TERMINAL
000008   A 648+ZC#TTCST EQU    X'08' .       CIRCUIT SWITCH PDN TERMINAL
000004   A 649+ZC#TTCCT EQU    X'04' .       TERMINAL ON CLUSTER CONTROLLER
         A 650+*
00011E   A 651+         DS     H .         --------------  UNUSED  --------------
000120   A 652+ZC#TINER DS     F .         SFS ERROR FIELD
000124   A 653+ZC#TRIDA DS     A .         PTR TO TRIDT ENTRY FOR CURRENT TRANSACTION
000128   A 654+ZC#ALTID DS     F .         ALTERNATE TERM ID
         A 655+*
00012C   A 656+ZC#TSECA DS     A .         ADDR SECURITY USERID/PASSWORD PARAM LIST
         A 657+*
000130   A 658+ZC#TSECL DS     5F .        SECURITY PARAMETER LIST
000130   A 659+         ORG    ZC#TSECL . RESET LOC COUNTER TO BEGIN PARAM LIST
000130   A 660+ZC#TUID  DS     CL6 .       SECURITY USERID
000136   A 661+ZC#TUPW  DS     CL8 .       SECURITY PASSWORD
00013E   A 662+         DS     H .         --FILLER--  SECURITY PARAM LIST
000140   A 663+ZC#TSECE DS     F .         SECURITY ERROR WORD  (1ST BYTE USED)
000140   A 664+         ORG    ZC#TSECE . RESET LOC COUNTER TO BEGIN ERROR WORD
000140   A 665+ZC#IDPWE DS     X .         SECURITY ERROR BYTE
         A 666+*
         A 667+*                           EQUATES FOR ZC#IDPWE
         A 668+*
000080   A 669+ZC#INVLD EQU    X'80' .       INVALID USERID AND/OR PASSWORD
         A 670+*
000141   A 671+         DS     XL3 .       UNUSED 3 BYTES OF SECURITY ERROR WORD
         A 672+*
000144   A 673+ZC#TOTID DS     CL4 .       ORIGINATING TERM NAME PRIMARY HOST (DDP)
000148   A 674+ZC#TNODE DS     CL4 .       NODE PRIMARY HOST (DDP)
00014C   A 675+ZC#TBALL DS     H .         NMBR 4K BLOCKS ASSIGNED TO TRANSACTION
00014E   A 676+ZC#TBFLG DS     X .         TRANS BUFF PROCESSING FLAG
         A 677+*
         A 678+*                           EQUATES FOR ZC#TBFLG
         A 679+*
014E80   A 680+ZC#TBASS EQU    (ZC#TBFLG-ZC#DTCT)*256+X'80' . TRANS BUFF ASSIGNED
014E40   A 681+ZC#TBEXH EQU    (ZC#TBFLG-ZC#DTCT)*256+X'40' . NO MORE TRANS BUFF
         A 682+*                                                TO BE ASSIGNED
         A 683+*
00014F   A 684+         DS     X .         --------------  UNUSED  --------------
000150   A 685+ZC#TBA1  DS     F .         ADDR 1ST TRANS BUFF
000154   A 686+ZC#TBA2  DS     F .         ADDR 2ND TRANS BUFF
000158   A 687+ZC#TBA3  DS     F .         ADDR 3RD TRANS BUFF
```

Figure 12-7. Multithread Terminal Control Table (Part 6 of 7)

```
 LOC.      LINE   SOURCE STATEMENT
000150   A 688+ZC#TB1L   EQU    ZC#TBA1,1 .    NMBR 4K BLOCKS IN 1ST TRANS BUFF
000154   A 689+ZC#TB2L   EQU    ZC#TBA2,1 .    NMBR 4K BLOCKS IN 2ND TRANS BUFF
)00158   A 690+ZC#TB3L   EQU    ZC#TBA3,1 .    NMBR 4K BLOCKS IN 3ND TRANS BUFF
         A 691+*
         A 692+*                              REGISTER SAVE AREA
         A 693+*
00015C   A 694+ZC#TRSAV  DS     18F .         18 WORD REG. SAVE AREA
00015C   A 695+          ORG    ZC#TRSAV .
00015C   A 696+ZC#TSWDO  DS     F .
000160   A 697+ZC#TSBCK  DS     F .           SAVE AREA BACKWARD LINK ADDR
000164   A 698+ZC#TSFOR  DS     F .           SAVE AREA FORWARD LINK ADDR
000168   A 699+ZC#TSRTN  DS     F .           RE$, CALLERS RETURN ADDR
00016C   A 700+ZC#TSETY  DS     F .           RF$, CALLED ENTERY ADDR
000170   A 701+ZC#TSR0   DS     F .           R0$
000174   A 702+ZC#TSR1   DS     F .           R1$
000178   A 703+ZC#TSR2   DS     F .           R2$
00017C   A 704+ZC#TSR3   DS     F .           R3$
000180   A 705+ZC#TSR4   DS     F .           R4$
000184   A 706+ZC#TSR5   DS     F .           R5$
000188   A 707+ZC#TSR6   DS     F .           R6$
00018C   A 708+ZC#TSR7   DS     F .           R7$
000190   A 709+ZC#TSR8   DS     F .           R8$
000194   A 710+ZC#TSR9   DS     F .           R9$
000198   A 711+ZC#TSR10  DS     F .           RA$
00019C   A 712+ZC#TSR11  DS     F .           RB$
0001A0   A 713+ZC#TSR12  DS     F .           RC$
         A 714+*
         A 715+*                              PARAMETER LIST
         A 716+*
0001A4   A 717+ZC#TPRM1  DS     F .           PARAM #1
0001A8   A 718+ZC#TPRM2  DS     F .           PARAM #2
0001AC   A 719+ZC#TPRM3  DS     F .           PARAM #3
0001B0   A 720+ZC#TPRM4  DS     F .           PARAM #4
0001B4   A 721+ZC#TPRM5  DS     F .           PARAM #5
0001B8   A 722+ZC#TFIN   DS     OF .          <<< <<<  THIS MUST ALWAYS BE AT END  >>> >>>
0001B8   A 723+ZC#TLEN   EQU    *-ZC#DTCT
000000   A 724+IMSDSECT  CSECT
000000     725 IMSDSECT  CSECT
           726           END
```

Figure 12-7. Multithread Terminal Control Table (Part 7 of 7)

12.5. Sample Dump Action Program (FIXSAM)

Figure 12-8 shows the sample COBOL action program FIXSAM. This program produces two types of snap dumps depending on values entered at the terminal.

When the operator enters transaction code F#03 followed by the value T (Figure 12-8, line 303), FIXSAM moves an S to the termination indicator to produce a termination snap. Figure 12-9 shows the S termination snap dump.

When the operator enters transaction code F#03 followed by the value Y (Figure 12-8, line 302), FIXSAM issues a CALL SNAP that dumps working storage, the program information block, input message area, output message area, work area, and continuity data area without terminating the program.

A third type of snap dump is produced if the program terminates abnormally. An abnormal termination snap caused by a program check is shown in Figure 12-11. This dump varies in only a few details from the S termination snap.

```
LINE NO.       SOURCE ENTRY

                IDENTIFICATION DIVISION.
                PROGRAM-ID. FIXSAM.
                ENVIRONMENT DIVISION.
                CONFIGURATION SECTION.
                SOURCE-COMPUTER. UNIVAC-OS3.
                OBJECT-COMPUTER. UNIVAC-OS3.
                DATA DIVISION.
                WORKING-STORAGE SECTION.
                01  DICE-CODES.
               *
               *    SET CURSOR-COORD TO HOME X'10030000'.
                    05  CURS-HME                PIC X(4)    VALUE '    '.
               *
               *    POSITION CURSOR TO A NEW LINE X'10040000'.
                    05  NXT-LNE                 PIC X(4)    VALUE '    '.
               *
               *    SKIP 3 LINES AND BEGINNING OF LINE X'10040300'.
                    05  SKP-3LN                 PIC X(4)    VALUE '    '.
               *
               *    SKIP 2 LINES AND BEGINNING OF LINE X'10040200'.
                    05  SKP-2LN                 PIC X(4)    VALUE '    '.
               *
               *    START OF ENTRY CHARACTER  X'1E'.
                    05  SOE-CHAR                PIC X(1)    VALUE ' '.
               *
                01  NON-NUME-MSG                PIC X(49)   VALUE
                        'NON-NUMERIC VALUE ENTERED FOR READS DESIRED FIELD'.
               *
                01  TRANS-CAN-MSG               PIC X(40)   VALUE
                        'TRANSACTION CANCELLED DUE TO ABOVE ERROR'.
               *
                01  EOF-MSG                     PIC X(40)   VALUE
                        'END OF FILE REACHED DURING READ NUMBER  '.
               *
                01  ERR-MSG                     PIC X(40)   VALUE
                        'ERROR FROM SAM-GET  DURING READ NUMBER  '.
               *
                01  STAT-HDRS                   PIC X(47)   VALUE
                        'STATUS-CODE                 DETAILED STATUS CODE  '.
               *
                01  FSAMTIN                     PIC X(7)    VALUE 'FSMTFIL'.
               *
                01  FSAMDIN                     PIC X(7)    VALUE 'FSMDFIL'.
               *
                01  SUCC-MSG                    PIC X(54)   VALUE
                        'ENTER NUMBER OF READS FOR SAM VAR LENGTH FILES AS F#NN'.
               *
                01  DISCONNECT-MSG              PIC X(25)   VALUE
                        'LINE DISCONNECT REQUESTED'.
                01  HDG-LNE.
```

Figure 12-8. Sample Action Program (FIXSAM) Generating Snap Dumps (Part 1 of 7)

```
LINE NO.        SOURCE ENTRY

                    05 HD1                          PIC X(8)     VALUE 'NO. READ'.
                    05 FILLER                       PIC X(4)     VALUE SPACES.
                    05 HD2                          PIC X(7)     VALUE 'CUST-ID'.
                    05 FILLER                       PIC X(8)     VALUE SPACES.
                    05 HD3                          PIC X(13)   VALUE 'CUSTOMER NAME'.
                    05 FILLER                       PIC X(9)     VALUE SPACES.
                    05 HD4                          PIC X(8)     VALUE 'AMT PAID'.
                    05 FILLER                       PIC X(6)     VALUE SPACES.
                    05 HD5                          PIC X(4)     VALUE 'DATE'.
                    05 FILLER                       PIC X(5) VALUE SPACES.
           *
            01   SNP-ERR-MSG                        PIC X(42)    VALUE
                     'ERROR ON SNAP NO. 1  2  3  4  5            '.
            01   END-WS                             PIC X   VALUE '*'.
            LINKAGE SECTION.
            01   PIB. COPY PIB74.
                 02   STATUS-CODE                     PIC 9(4) COMP-4.
                 02   DETAILED-STATUS-CODE            PIC 9(4) COMP-4.
                 02   RECORD-TYPE REDEFINES DETAILED-STATUS-CODE.
                      03 PREDICTED-RECORD-TYPE        PIC X.
                      03 DELIVERED-RECORD-TYPE        PIC X.
                 02   SUCCESSOR-ID                    PIC X(6).
                 02   TERMINATION-INDICATOR           PIC X.
                 02   LOCK-ROLLBACK-INDICATOR         PIC X.
                 02   TRANSACTION-ID.
                      03 YEAR                         PIC 9(4) COMP-4.
                      03 TODAY                        PIC 9(4) COMP-4.
                      03 HR-MIN-SEC                   PIC 9(9) COMP-4.
                 02   DATA-DEF-REC-NAME               PIC X(7).
                 02   DEFINED-FILE-NAME               PIC X(7).
                 02   STANDARD-MSG-LINE-LENGTH        PIC 9(4) COMP-4.
                 02   STANDARD-MSG-NUMBER-LINES       PIC 9(4) COMP-4.
                 02   WORK-AREA-LENGTH                PIC 9(4) COMP-4.
                 02   CONTINUITY-DATA-INPUT-LENGTH    PIC 9(4) COMP-4.
                 02   CONTINUITY-DATA-OUTPUT-LENGTH   PIC 9(4) COMP-4.
                 02   WORK-AREA-INC                   PIC 9(4) COMP-4.
                 02   CONTINUITY-DATA-AREA-INC        PIC 9(4) COMP-4.
                 02   SUCCESS-UNIT-ID.
                      03 TRANSACTION-DATE.
                         04 YEAR                      PIC 99.
                         04 MONTH                     PIC 99.
                         04 TODAY                     PIC 99.
                      03 TIME-OF-DAY.
                         04 HOUR                      PIC 99.
                         04 MINUTE                    PIC 99.
                         04 SECOND                    PIC 99.
                      03 FILLER                       PIC XXX.
                 02   SOURCE-TERMINAL-CHARS.
                      03 SOURCE-TERMINAL-TYPE      PIC X.
                      03 SOURCE-TERM-MSG-LINE-LENGTH     PIC 9(4) COMP-4.
                      03 SOURCE-TERM-MSG-NUMBER-LINES    PIC 9(4) COMP-4.
                      03 SOURCE-TERM-ATTRIBUTES PIC X.
```

Figure 12-8. Sample Action Program (FIXSAM) Generating Snap Dumps (Part 2 of 7)

```
LINE NO.        SOURCE ENTRY

                       02  DDP-MODE                         PIC X.
                   01  IMA. COPY IMA74.
                       02 SOURCE-TERMINAL-ID                    PIC X(4).
                       02 DATE-TIME-STAMP.
                          03 YEAR                               PIC 9(4) COMP-4.
                          03 TODAY                              PIC 9(4) COMP-4.
                          03 HR-MIN-SEC                         PIC 9(9) COMP-4.
                       02 TEXT-LENGTH                           PIC 9(4) COMP-4.
                       02 AUXILIAPY-DEV-ID.
                          03 FILLER                             PIC X.
                          03 AUX-DEV-NO                         PIC X.
                       02  TRANS                        PIC X(2).
                       02  RECTORD                      PIC X(2).
                       02  NORECS REDEFINES RECTORD         PIC 99.
                       02  FILLER                       PIC X.
                       02  DISCONNECT                   PIC X.
                       02  FILLER                       PIC X.
                       02  SNAP                         PIC X.
                       02  FILLER                       PIC X.
                       02  EXT-SUCC                     PIC X.
                       02  END-IMA                      PIC X.
                   01  CDA.
                       02  DISCONNECT-SAV               PIC X.
                       02  SNAP-SAV                     PIC X.
                       02  END-CDA                      PIC X.
                   01  OMA. COPY OMA74.
                       02 DESTINATION-TERMINAL-ID           PIC X(4).
                       02 SFS-OPTIONS.
                          03 SFS-TYPE                       PIC X.
                          03 SFS-LOCATION                   PIC X.
                       02 FILLER                            PIC X(2).
                       02 CONTINUOUS-OUTPUT-CODE            PIC X(4).
                       02 TEXT-LENGTH                       PIC 9(4)    COMP-4.
                       02 AUXILIARY-DEVICE-ID.
                          03 AUX-FUNCTION                   PIC X.
                          03 AUX-DEVICE-NO                  PIC X.
                       02 OUT-MSG.
                       03  DICE1                        PIC X(4).
                       03  LINE1.
                           05  FILLER                   PIC X(15).
                           05  FILERD                   PIC X(7).
                           05  FILLER                   PIC X(8).
                           05  TSNP.
                               10  FILLER               PIC X(19).
                               10  SNP1                 PIC X.
                               10  FILLER               PIC X(2).
                               10  SNP2                 PIC X.
                               10  FILLER               PIC X(2).
                               10  SNP3                 PIC X.
                               10  FILLER               PIC X(2).
                               10  SNP4                 PIC X.
                               10  FILLER               PIC X(2).
```

Figure 12-8. Sample Action Program (FIXSAM) Generating Snap Dumps (Part 3 of 7)

```
LINE NO.        SOURCE ENTRY

                         10  SNP5              PIC X.
                         10  FILLER            PIC X(10).
                   03  DICE2                   PIC X(4).
                   03  LINE2                   PIC X(72).
                   03  DICE3                   PIC X(4).
                   03  LINE3                   PIC X(72).
                   03  DICE7                   PIC X(4).
                   03  LINE7.
                       05  FILLER              PIC X(15).
                       05  FILREAD             PIC X(7).
                       05  FILLER              PIC X(50).
                   03  DICE8                   PIC X(4).
                   03  LINE8                   PIC X(72).
                   03  DICE9                   PIC X(4).
                   03  LINE9                   PIC X(72).
                   03  DICE11                  PIC X(4).
                   03  LINE11                  PIC X(72).
                   03  DICE12                  PIC X(4).
                   03  SOE-DICE                PIC X.
                   03  END-OMA                 PIC X.
               01  WORK-AREA.
                   03  REC-IO-AREA-F.
                       05  CUST-ID             PIC 9(5).
                       05  CUST-NAME           PIC X(20).
                       05  AMT-PAID            PIC 9(5)V99.
                       05  DATE-PD.
                           10  MTH             PIC 9(2).
                           10  SLSH-1          PIC X.
                           10  DAYC             PIC 9(2).
                           10  SLSH-2          PIC X.
                           10  YR              PIC 9(2).
                       05  FILLER              PIC X(9).
                   03  DETAIL-LNE.
                       05  FILLER              PIC X(3).
                       05  RECS-RD             PIC 9(2).
                       05  FILLER              PIC X(8).
                       05  CUST-ID             PIC 9(5).
                       05  FILLER              PIC X(6).
                       05  CUST-NAME           PIC X(20).
                       05  FILLER              PIC X(4).
                       05  AMT-PAID            PIC $(6).99.
                       05  FILLER              PIC X(4).
                       05  DATE-PD.
                           10  MTH             PIC 9(2).
                           10  SLSH-1          PIC X.
                           10  DAYC             PIC 9(2).
                           10  SLSH-2          PIC X.
                           10  YR              PIC 9(2).
                       05  FILLER              PIC X(3).
                   03  ERR-LNE REDEFINES DETAIL-LNE.
                       05  ERROR-BLD           PIC X(40).
                       05  RECRD-ERR           PIC Z9.
```

Figure 12-8. Sample Action Program (FIXSAM) Generating Snap Dumps (Part 4 of 7)

```
LINE NO.      SOURCE ENTRY

                      05  FILLER                PIC X(30).
                  03  STATUS-LNE.
                      05  FILLER                PIC X(13).
                      05  STAT-ERR              PIC 9(4).
                      05  FILLER                PIC X(30).
                      05  D-STAT-ERR            PIC 9(4).
                      05  FILLER                PIC X(21).
                  03  REC-CNT                   PIC 9(2).
                  03  ERR-IND                   PIC 9.
                  03  STAT1                     PIC 9(4).
                  03  DSTAT1                    PIC 9(4).
                  03  STAT2                     PIC 9(4).
                  03  DSTAT2                    PIC 9(4).
                  03  STAT3                     PIC 9(4).
                  03  DSTAT3                    PIC 9(4).
                  03  STAT4                     PIC 9(4).
                  03  DSTAT4                    PIC 9(4).
                  03  STAT5                     PIC 9(4).
                  03  DSTAT5                    PIC 9(4).
                  03  FILENAME                  PIC X(7).
                  03  END-WA                    PIC X.
       PROCEDURE DIVISION USING FIB IMA WORK-AREA OMA CDA.

       OPTIONS-SAVE.
           MOVE CURS-HME TO DICE1.
           MOVE NXT-LNE TO DICE2, DICE3.
           IF SNAP IS EQUAL TO 'Y' OR 'N' OR 'T' MOVE SNAP TO SNAP-SAV
               ELSE MOVE 'N' TO SNAP-SAV.
           IF RECTORD IS NOT NUMERIC, MOVE NON-NUMB-MSG TO LINE2,
               MOVE TRANS-CAN-MSG TO LINE3,
               MOVE 232 TO TEXT-LENGTH OF OMA,
               GO TO SNAP-TEST.
           IF DISCONNECT IS EQUAL TO 'Y' MOVE DISCONNECT TO
               DISCONNECT-SAV, ELSE MOVE 'N' TO DISCONNECT-SAV.
       TAPE-REC-GET.
           MOVE ZERO TO ERR-IND, REC-CNT.
           MOVE 'FILE NAME' TO LINE1, LINE7.
           MOVE FSAMTIN TO FILENAME, FILERD.
           IF NORECS IS EQUAL TO ZERO,
               MOVE HDG-LNE TO LINE2
               MOVE SPACES TO DETAIL-LNE,
           MOVE NORECS TO RECS-RD,
               MOVE DETAIL-LNE TO LINE3,
               GO TO DISC-REC-GET.
           MOVE SPACES TO DETAIL-LNE.
           PERFORM SAM-GET THRU SAM-GET-EXIT UNTIL REC-CNT IS EQUAL TO

               NORECS.
           IF ERR-IND IS EQUAL TO ZERO,
               MOVE CORRESPONDING REC-IO-AREA-F TO DETAIL-LNE,
```

Figure 12-8. Sample Action Program (FIXSAM) Generating Snap Dumps (Part 5 of 7)

```
SOURCE ENTRY

         MOVE NORECS TO RECS-RD,
             MOVE HDG-LNE TO LINE2,
             MOVE DETAIL-LNE TO LINE3,
             GO TO DISC-REC-GET.
         MOVE ERR-LNE TO LINE2.
         MOVE STATUS-LNE TO LINE3.
     DISC-REC-GET.
         MOVE ZERO TO ERR-IND, REC-CNT
         MOVE FSAMDIN TO FILENAME FILREAD.
         MOVE SKP-2LN TO DICE7.
         MOVE NXT-LNE TO DICE8, DICE9.
         IF NORECS IS EQUAL TO ZERO,
             MOVE HDG-LNE TO LINE8
         MOVE SPACES TO DETAIL-LNE,
             MOVE ZEROS TO RECS-RD,
             MOVE DETAIL-LNE TO LINE9,
             GO TO SUCC-TEST.
         MOVE SPACES TO DETAIL-LNE.
         PERFORM SAM-GET THRU SAM-GET-EXIT UNTIL REC-CNT IS EQUAL TO

             NORECS.
         IF ERR-IND IS EQUAL TO ZERO,
             MOVE CORRESPONDING REC-IO-AREA-F TO DETAIL-LNE,




             MOVE HDG-LNE TO LINE8,
             MOVE NORECS TO RECS-RD,
             MOVE DETAIL-LNE TO LINE9,
             GO TO SUCC-TEST.
         MOVE ERR-LNE TO LINE8.
         MOVE STATUS-LNE TO LINE9.
     SUCC-TEST.
         MOVE SKP-2LN TO DICE11.
         IF EXT-SUCC IS NOT EQUAL TO 'N', MOVE 'E' TO
             TERMINATION-INDICATOR,
             MOVE 'SAMVIN' TO SUCCESSOR-ID,
             MOVE SUCC-MSG TO LINE11,
             MOVE NXT-LNE TO DICE12,
             MOVE SOE-CHAR TO SOE-DICE,
         MOVE 541 TO TEXT-LENGTH OF OMA,
             GO TO SNAP-TEST.
         MOVE 460 TO TEXT-LENGTH OF OMA.
         IF DISCONNECT IS EQUAL TO 'Y', MOVE DISCONNECT-MSG TO LINE11,
             MOVE 'C' TO AUX-FUNCTION,
```

Figure 12-8. Sample Action Program (FIXSAM) Generating Snap Dumps (Part 6 of 7)

```
LINE NO.       SOURCE ENTRY

                    MOVE 'E' TO TERMINATION-INDICATOR,
                    MOVE 'HANGUP' TO SUCCESSOR-ID,
                    MOVE 536 TO TEXT-LENGTH OF OMA.
                SNAP-TEST.
                    IF SNAP-SAV IS EQUAL TO 'N', GO TO NORM-RETURN.
                    MOVE '*' TO END-IMA END-OMA END-WA END-CDA.

                    IF SNAP-SAV IS EQUAL TO 'Y', PERFORM SNAP-ROUTINE.
                    IF SNAP-SAV IS EQUAL TO 'T', MOVE 'S' TO
                        TERMINATION-INDICATOR.
                    MOVE SPACES TO END-OMA.
                NORM-RETURN.
                    CALL 'RETURN'.
                SNAP-ROUTINE.
               *
               *    SNAP ACTIVATION RECORD AND PROGRAM.
               *
                    CALL 'SNAP' USING DICE-CODES END-WS PIP OMA IMA END-IMA OMA E


               -     ND-OMA WORK-AREA END-WA CDA END-CDA.
                    IF STATUS-CODE IS NOT EQUAL TO ZERO MOVE STATUS-CODE
                        TO STAT1 MOVE DETAILED-STATUS-CODE TO DSTAT1.
                SAM-GET.
                    CALL 'GET' USING FILENAME REC-IO-AREA-F.
                    ADD 1 TO REC-CNT.
                    IF STATUS-CODE IS EQUAL TO ZERO, GO TO SAM-GET-EXIT.
                    MOVE SPACES TO ERR-LNE, STATUS-LNE.
                    IF STATUS-CODE IS EQUAL TO 2, MOVE EOF-MSG TO ERR-LNE
                        ELSE MOVE ERR-MSG TO ERR-LNE.
                    MOVE REC-CNT TO RECRD-ERR.
                    MOVE NORECS TO REC-CNT.
                    MOVE 1 TO ERR-IND.
                    MOVE STAT-HDRS TO STATUS-LNE.
                    MOVE STATUS-CODE TO STAT-ERR.
                    MOVE DETAILED-STATUS-CODE TO D-STAT-ERR.
                SAM-GET-EXIT.
                    EXIT.
```

Figure 12-8. Sample Action Program (FIXSAM) Generating Snap Dumps (Part 7 of 7)

12.6. Analyzing the Termination Snap Dump

The first area of the S termination dump to examine is the edited headers. These include the allocation map that contains the dump addresses of the main storage areas snapped.

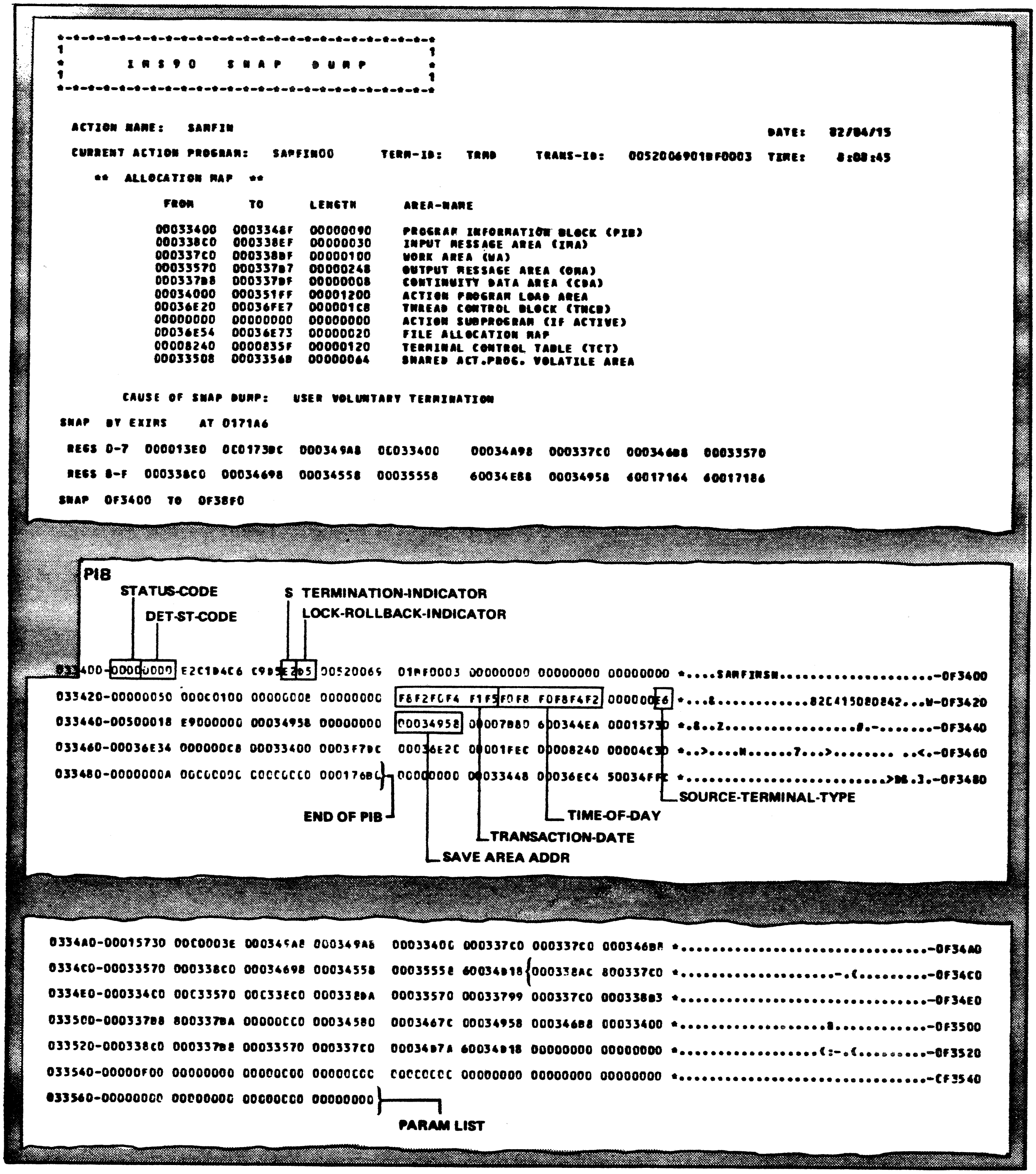
The action name is SAMFIN and the action program load module processing that action is also SAMFIN. The term-id (terminal identification) for this transaction is TRMD. This is the way the terminal that initiated the transaction was defined in the communications network definition. The allocation map that follows contains the beginning and end locations as well as the lengths of user interface areas, and other areas included in the snap dump. The locations refer to relative addresses. Relative addresses are printed on the far left side of the snap dump. All addresses are given in hexadecimal.

By examining the directory in Figure 12-9, notice that there are no addresses given for action subprogram area. The reason for this is that action program SAMFIN did not call a subprogram.

If you are not using an edited snap dump, that is, the snap contains no directory listing, it is still quite easy to locate all your action program's interface areas. Go directly to the thread control block. In this multithread example, it is at location 36E20 plus 15_{16} because the multithread layout begins at the 21st byte from the beginning thread control block address. (See Figure 12-9.) The first five full words (40 bytes) contain the relative addresses of the program information block, input message area, work area, output message area, and continuity data area, in that order.

Following the allocation map on Figure 12-9 is the reason for the snap dump: USER VOLUNTARY TERMINATION. Voluntary termination resulted when the action program moved S to the termination indicator.

In the sample snap dump (Figure 12-9), the register section contains only one set of registers because the action program terminated voluntarily. These are IMS registers. To find SAMFIN's registers, you must go to relative location PIB + 48_{16} (address 33448). Beginning at that location, count three full words. The third word contains the full word address of SAMFIN's save area (34958). The save area contains the action program registers.



```
*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*
1                                               1
*       I M S 9 0    S N A P    D U M P         *
1                                               1
*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*

  ACTION NAME:   SAMFIN                                                                         DATE:   82/04/15
  CURRENT ACTION PROGRAM:   SAMFIN00      TERM-ID:   TRMD      TRANS-ID:   0052006901BF0003  TIME:    8:08:45
     **  ALLOCATION MAP  **
              FROM        TO       LENGTH      AREA-NAME
            00033400  0003348F  00000090    PROGRAM INFORMATION BLOCK (PIB)
            000338C0  000338EF  00000030    INPUT MESSAGE AREA (IMA)
            000337C0  000338BF  00000100    WORK AREA (WA)
            00033570  000337B7  00000248    OUTPUT MESSAGE AREA (OMA)
            000337B8  000337BF  00000008    CONTINUITY DATA AREA (CDA)
            00034000  000351FF  00001200    ACTION PROGRAM LOAD AREA
            00036E20  00036FE7  000001C8    THREAD CONTROL BLOCK (TNCB)
            00000000  00000000  00000000    ACTION SUBPROGRAM (IF ACTIVE)
            00036E54  00036E73  00000020    FILE ALLOCATION MAP
            00008240  0000835F  00000120    TERMINAL CONTROL TABLE (TCT)
            00033508  0003356B  00000064    SHARED ACT.PROG. VOLATILE AREA

        CAUSE OF SNAP DUMP:   USER VOLUNTARY TERMINATION
 SNAP  BY EXIRS    AT 0171A6
  REGS 0-7  000013E0  0C0173BC  000349A8  0C033400   00034A98  000337C0  000346B8  00033570
  REGS 8-F  000338C0  00034698  00034558  00035558   60034E88  00034958  40017164  40017186
 SNAP  0F3400  TO  0F38F0

033400-00000000 E2C1D4C6 C9D5E2D5 00520069  01BF0003 00000000 00000000 00000000 *....SAMFINSN....................-0F3400
033420-00000050 000C0100 0000C00E 0000000C  F8F2F0F4 F1F5F0F8 F0F8F4F2 000000E6 *...&............82C415080842...W-0F3420
033440-00500018 E9000000 00034958 00000000  00034958 00007B80 60034 4EA 0001573D *.&..Z................#.-.......-0F3440
033460-00036E34 000000C8 00033400 0003F7DC  00036E2C 00001FEC 00008240 00004C3D *..>....H......7...>........ ..<.-0F3460
033480-0000000A 0000000C C000C0C0 000176BC  00000000 00033448 00036EC4 50034FFC *.........................>B.3.-0F3480

0334A0-00015730 00C0003E 000349A8 000349A6  0003340C 000337C0 000337C0 000346B8 *................................-0F34A0
0334C0-00033570 000338C0 00034698 00034558  0003555E 60034D18 000338AC 800337C0 *...................-.(.........-0F34C0
0334E0-000334C0 00C33570 00C338C0 000338DA  00033570 00033799 000337C0 000338B3 *................................-0F34E0
033500-000337B8 800337BA 00000CC0 00034580  0003467C 00034958 000346B8 00033400 *..................8.............-0F3500
033520-000338C0 000337B8 00033570 000337C0  00034B7A 60034D18 00000000 00000000 *.................(:-.(.........-0F3520
033540-00000F00 00000000 00000C00 00000CCC  C0CC0CCC 00000000 00000000 00000000 *................................-CF3540
033560-00000000 00000000 00000C00 00000000
```


Figure 12-9. Termination Snap Dump for SAMFIN Load Module (FIXSAM Action Program) (Part 1 of 3)

OMA

DICE CODE — START OMA — MESSAGE-LENGTH

```
                                             00000000 00000000 00000000 01CC0000 *................................-0F3540
033580-10030000 C6C9D3C5 40D5C1D4 C5404040  40404006 E2D4E5C6 C9D34040 40404040 *....FILE NAME       FSMTFIL     -0F3580
0335A0-40404040 40404040 40404C40 40404040  404C4C4C 40404040 40404040 40404040 *                                -0F35A0
0335C0-40404040 40404040 40404040 100400CC  C5D5C44C D6C640C6 C9D3C540 D9C5C1C3 *               ....END OF FILE REAC-0F35C0
0335E0-C8C5C440 C4E4D9C9 D5C74CD9 C5C1C440  D5E4D4C2 C5D94040 40F14040 40404040 *HED DURING READ NUMBER  1       -0F35E0
033600-40404040 40404040 40404C40 40404040  40404C4C 40404040 10040000 E2E3C1E3 *                            ....STAT-0F3600
033620-E4E260C3 D6C4C540 40F0F0F0 F2404040  40404040 40C4C5E3 C1C9D3C5 C440E2E3 *US-CODE  0002        DETAILED ST-0F3620
033640-C1E3E4E2 40C3D6C4 C5404CF0 F0F0FC40  404C4C4C 40404040 40404040 40404040 *ATUS CODE  0000                 -0F3640
033660-40404040 10040200 C6C9D3C5 40D5C1D4  C54C404C 404040C6 E2D4C4C6 C9D34040 *    ....FILE NAME      FSMDFIL  -0F3660
033680-40404040 404C4C4C 40404C40 40404040  40404040 40404040 40404040 40404040 *                                -0F3680
0336A0-40404040 40404040 40404C40 40404040  1004000C D5D64B40 D9C5C1C4 40404040 *                    ....NO. READ    -0F36A0
0336C0-C3E4E2E3 60C9C440 40404040 40404CC3  E4E2E3D6 D4C5D940 D5C1D4C5 40404040 *CUST-ID        CUSTOMER NAME    -0F36C0
0336E0-40404040 40C1D4E3 40D7C1C9 C4404040  404040C4 C1E3C540 40404040 10040000 *     AMT PAID       DATE      ....-0F36E0
033700-404040F0 F4404040 40404040 40F0F0F6  F2F04C4C 40404040 C6D6E4D5 C4D9E840 *   04        00620       FOUNDRY -0F3700
033720-D3D6C4C7 C5404040 40404040 40404040  5BF1F1F9 F0F04BF1 F1404040 40F0F861 *LODGE               $11900.11    08/-0F3720
033740-F1F561F7 F7404040 10040200 40404040  404C4C4C 40404040 40404040 40404040 *15/77   ....                    -0F3740
033760-40404040 4040404C 40404C40 40404040  4040404C 40404040 40404040 40404040 *                                -0F3760
****   0F3780   TO   0F37A0   SAME AS ABOVE
0337A0-40404040 40404040 40404C40 40404040  40404040 40404040 D5E35C0C 00000000 *                           NT*.....-0F37A0
```

END OF OMA

CDA

START OF WORK AREA — START CDA — END CDA

```
0337A0-40404040 40404040 40404C40 40404040  40404040 40404040 D5E35C0C 00000000 *                           NT*.....-0F37A0
                                                              N T
0337C0-F0F0F6F2 FCC6D6E4 D5C4D9E8 40D3D6C4  C7C5404C 40404040 40F1F1F9 F0F0F1F1 *00620FOUNDRY LODGE          1190011-0F37C0
0337E0-F0F861F1 F561F7F7 00000000 00000000  00404040 F0F44040 40404C40 4040F0F0 *08/15/77.........  04            00-0F37E0
033800-F6F2F040 40404040 40C6D6E4 D5C4D9E8  40D3D6C4 C7C54040 40404040 40404040 *620        FOUNDRY LODGE          -0F3800
033820-405BF1F1 F9F0F04B F1F14040 4040F0F8  61F1F561 F7F74040 40E2E3C1 E3E4E260 * $11900.11     08/15/77    STATUS--CF3820
033840-C3D6C4C5 4040F0F0 F0F24C40 40404C40  4040C4C5 E3C1C9D3 C5C440E2 E3C1E3E4 *CODE   0C02         DETAILED STATU-0F3840
033860-E240C3D6 C4C54040 F0F0FCF0 40404040  4040404C 40404040 40404040 40404040 *S CODE   0000                   -0F3860
033880-40F0F4F0 00000000 00000000 00000000  00000000 00000000 00000000 00000000 * 040............................-0F3880
0338A0-00000000 00000000 00000000 C6F2D4C4  C6C5D35C 00000000 00000000 0000000C *............FSMDFIL*............-0F38A0
```

END OF WORK AREA

IMA

START OF ACTION PROGRAM LOAD AREA — END OF IMA

```
                                            F # 0 4   N  T
0338C0-E3D9D4C4 00520069 01BF0C03 000F1C00  C67EF0F4 40D540E3 40D55C40 40404C40 *TPMD.............F#04 N T N*      -0F38C0
0338E0-40404040 40404040 40404C40 4040404C  00                                  *                .                -0F38E0
 SNAP   0F4000   TO   0F5200
034000-90ECD00C 18CF4700 0E005CE0 D05850E0  D0545C0C D05CD702 D05CD05C 88000008 *...........&...&...&..*P..*.*....-0F4000
034020-4200D05C 5010D050 4840D05E 89400001  4164C1EC D201D069 60004154 C2428840 *...*&..&. .;. ....A.K...-...B.. -CF4020
034040-00014160 D06C9108 50004780 C05EF363  600CDC55 DC056000 C1A24160 60069140 *...-.%..&....;3.-.....-.A..--.. -0F4040
034060-50014780 C0765810 D058487C 100245E0  C17C4160 60059258 D0684170 D06C1976 *&...............A@.--..$.....%..-0F4060
```

Figure 12-9. Termination Snap Dump for SAMFIN Load Module (FIXSAM Action Program)
(Part 2 of 3)

```
                              SAM FIN REGISTERS
034920-AAAAAAAA AAAAAAAA AAAAAAAA AAAAAAAA  AAAAAAAA AAAAAAAA 00000000 AAAAAAAA *................................-0F4920
034940-AAAAAAAA 001C0002 0E030000 01000201  00004020 21200700 00000000 00033448 *................ .............-0F4940
034960-000349A0 40034EF2 00015730 00000006  0000000C 000349A8 00033400 00034A98 *.... .+2.....................[.-0F4960
034980-000337C0 000346B8 00033570 000338C0  00034698 00034558 00035558 60034E88 *..........................-.+.-0F4980
0349A0-00034644 00000050 000338AC 800337C0  00033400 00033570 000338C0 000338DA *.......&........................-0F49A0
0349C0-00033570 00033799 000337C0 000338B3  000337B8 800337BA 00000000 00000000 *................................-0F49C0
0349E0-00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000 *................................-0F49E0
 ****  0F4A00  TO  0F4A80  SAME AS ABOVE
034A80-00000000 00000000 00000000 00000000  00000000 00000000 405BF1F1 F9F0F04B *...................... $11900.-0F4A80
034AA0-F1F10000 00000000 00000000 00000000  0000000C 00000000 00000000 00000000 *11..............................-0F4AA0
034AC0-00000000 00000000 00000000 00000000  58102018 58201000 5020A100 9200A100 *........................&.......-0F4AC0
034AE0-58201004 5020A104 9200A104 58201008  5020A110 9200A110 5820100C 5020A10C *....&...........&...........&...-0F4AE0
034B00-9200A10C 58201010 5020A108 9200A108  D70FA114 A11407FE D2037010 6000D203 *........&.......P.......K...-.K.-0F4BC0
034B20-705C6004 D20370A8 600495E8 801705C0  4780C014 95D58017 4780C014 95E38017 *.*-.K...-..Y.........N.......T..-0F4B20
```

```
     END ACTION PROGRAM LOAD AREA                            PIB ADDR
         OMA ADDR                                                  IMA ADDR
                CDA ADDR                                                  WA ADDR
035160-47F0F04C 47F0F048 47F0F044 47F0F040  47F0F03C 47F0F038 47F0F034 47F0F030 *.00<.00..00..00 .00..00..00..00.-0F5160
035180-47F0F02C 47F0F028 47F0F024 47F0F020  47F0F01C 47F0F018 47F0F014 47F0F010 *.00..00..00..00..00..00..00..00.-0F5180
0351A0-47F0F00C 47F0F008 47F0F004 05001B0F  89000008 88000008 9013D018 0510183D *.00..00..00.....................-0F51A0
0351C0-1B225833 00045923 00044770 10044900  1038477C 102E95E2 30004770 102E92FF *......................S.........-0F51C0
0351E0-D00C58DD 000498EC D00C07FE 58F30014  9813D01? 07FF0006 00000000 00000000 *.............3..................-0F51E0
035200-00                                                                     *                               -0F5200
THREAD CONTROL BLOCK START
 SNAP   0F6E20   TO   0F6FE8
036E20-FFFEBC50 00036E20 00000011 00036EF0  60016F32 00033400 000338C0 000337C0 *...&..>.......>0-.?............-0F6E20
                                                      BIT ALLOCATION MAP
036E40-00033570 000337B8 000338F0 00000000  0000C00C 00000802 00000000 00000000 *...........0......................-0F6E40
036E60-00000000 00000000 00000000 00000000  0000000C 0003DB48 0003F7DC 00000000 *.......................7.....-0F6E60
036E80-00008240 00000000 00000000 00520069  01BF0C03 280006E8 00000000 00000000 *... ...................Y........-0F6E80
036EA0-00000000 00C1B042 000334D8 0200003E  000C5F48 0001A8C8 00000000 00000000 *...........@......^....H........-0F6EA0
036EC0-00000000 00000000 00034958 0000C000  4001AB72 000046F6 00036EA4 00005ED8 *............... ......6..>...;@-0F6EC0
036EE0-0001A8C8 00036E20 000334C0 00005ED8  00000000 00036F38 00000000 60016F32 *...H..>.......;@......?.....-.?.-0F6EE0
036F00-000046F6 000173E4 000173B0 00000004  00036E20 00000001 00036E20 00000000 *...6...U..........>.......>.....-0F6F00
036F20-00008240 00008240 00007378 00008240  00033C04 000176B0 00000000 00000000 *... ... ...... ................-0F6F20
036F40-00000000 600021BE 00016F08 00000001  00000001 000018A0 00033400 00033400 *....-.....?.....................-0F6F40
036F60-00036E20 00000000 00000000 00000000  00000000 00000000 00000000 00000000 *..>.............................-0F6F60
036F80-00033448 50001DB0 000176B0 00008240  00033400 000018A0 00033400 00036E20 *....&.......... ..............>.-0F6F80
036FA0-00036E20 00000000 00000000 00033400  000338FC 00000000 00034000 00035200 *..>...............0...... .....-0F6FA0
036FC0-80000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000 *................................-0F6FC0
036FE0-00000000 00C04C30 FF  THREAD CONTROL BLOCK END                        *......<..                      -0F6FE0
```

Figure 12-9. Termination Snap Dump for SAMFIN Load Module (FIXSAM Action Program) (Part 3 of 3)

In Figure 12-9, the save address is 34958. Once you locate this address, which is in the action program load area, advance three full words (C_{16}). At location 34964 you will find your action program's registers 14, 15, and 0-12, in that order.

12.6.1. Finding Error Codes in the Program Information Block

Looking at Figure 12-9, SAMFIN's program information block begins at address 33400. The first word (4 bytes) contains the STATUS-CODE and DETAILED-STATUS-CODE fields. IMS returns values to these fields indicating the result of action program function calls. If the function call is successful, these fields contain zeros. Figure 12-9 shows that the function call made to IMS was successful because both STATUS-CODE and DETAILED-STATUS-CODE fields indicate a successful function call.

If, for example, IMS returned a status code of 03 and a detailed status code of 0B, it would mean that the action program made an invalid request and that the file requested was not assigned to this action at IMS configuration. Then, to find out exactly which file is involved, you must consult the parameter list address in the thread control block. (See Figures 12-4 and 12-5.)

For a complete listing of the values IMS returns in the STATUS-CODE and DETAILED-STATUS-CODE fields, see Appendix D.

12.6.2. Finding Other Data in the Program Information Block

Still in the program information block at relative location PIB + A_{16} is the TERMINATION-INDICATOR field. If your action program moves an S to this field, this location contains an E2 for voluntary termination snap. The value in this and any other program information block field varies depending on the action program and whether the program terminated voluntarily or involuntarily.

Relative location PIB + B_{16} is the LOCK-ROLLBACK- INDICATOR field. It contains D5 (character N), which is the default value. The value N establishes a new rollback point in the audit file (before-images of records to be updated) and releases all locks for this transaction.

By comparing the program information block fields listed in Figure 3-2 to the program information block area of the snap dump, you can see exactly what values all these fields contained when the dump occurred. For your convenience, we have noted a few of these fields in Figure 12-9: transaction-date (82/04/15), time-of-day (08/08/45), and source-terminal-type (hexadecimal E6 or character W) indicating a local workstation.

All 90-character positions of the program information block are displayed. Remember, however, that only the first 71 positions are accessible to your action program.

12.6.3. Finding Error Causes in the Output Message Area

Using the allocation map in Figure 12-9, we see that the output message area begins at address 33570. This area contains the 16-byte control header and the output message generated by the action program.

The first three words of SAMFIN's output message area (Figure 12-9) including the DESTINATION-TERMINAL-ID and DATE-TIME-STAMP fields contain zeros indicating that the destination terminal is the same as the source terminal.

Also, in the output message area at location 3357C or OMA + C_{16} is the 2-byte MESSAGE-LENGTH field. This field indicates the size of the output message to be generated (460 bytes).

Since SAMFIN does not use screen format services and is not a continuous output program, relative locations 3357E and 3357F, respectively, contain zeros.

Following the unused 2-byte AUXILIARY-DEVICE-ID field is the 4-byte DICE field containing the DICE sequence as the first four bytes of the output message text.

12.6.4. Finding Error Causes in the Input Message Area

The input message area begins at relative address 338C0. Its contents include the input message area control header (16 bytes) and the input data entered by the terminal operator. The terminal input starts at IMA + 10_{16} or 338D0. The terminal operator entered the transaction code, F#04. He didn't wish to test the disconnect feature in this run, so he entered an N. Since he was interested in terminating voluntarily with a snap dump, he entered T in the next position. We've noted these fields to assist you in finding them in the snap dump (Figure 12-9).

12.6.5. Finding Error Causes in the Continuity Data Area

By looking in the allocation map, we find that SAMFIN's continuity data area begins in location 337B8. Here, we see the character D5 or N. This indicates that the value of N was entered at the terminal to indicate that the disconnect feature was not being tested on this run. The next byte indicates an E3 or T meaning that the voluntary termination was used.

Finding these values tells us that our program executed the instruction which moved these values from the input area to the continuity data area. (See lines 232, 233, and 238-239 in FIXSAM's coding (Figure 12-8).)

12.6.6. Finding Error Causes in the Work Area

Similarly, the work area begins at location 337C0. To find customer identification, name, amount paid, and date paid values in this area of the dump indicates that SAMFIN executed instructions that placed these values there. See the GET function call (line 317, Figure 12-8), which actually moves these values from the disk or tape file to the work area.

If the program is compiled as reentrant, and work area size is not large enough, the compiler object code will overwrite customer information (such as customer identification, name, amount paid, and date paid), and the action program may abnormally terminate.

12.6.7. Finding Error Causes in the Action Program Load Area

Now, let's turn our attention to the action program load area. This is by far the lengthiest section of the snap dump. Data contained in the thread control block is equally essential to interpreting the program area, so these two areas will be discussed at the same time.

The thread control block is at location 36E20. As was previously mentioned, it contains the addresses of all the interface areas and the action program load area. This data is valuable only if you're using an unedited dump. However, the thread control block does contain other information very useful to the IMS programmer.

Using the multithread DSECT shown in Figure 12-5, find the ZT#TFAM allocation map tag and its location. Add this value to the thread control block address. In the example at location 36E54, there are four full words (single-thread) or eight full words (multithread) used for a file allocation bit map. To use this bit map, you must realize that four full words contain 128 bits and eight full words contain 256 bits. IMS uses these bits to indicate which specific files a user action program can access - one file per bit.

If bits are set to zero, the action program cannot access those files. Examining these locations can be very valuable in determining which files your action program was accessing during execution.

For example, if the high-order bit was on, the action program could access one file - the first file configured. If additional bits were on, additional files could be accessed. These bits are maintained in the same relative order as the actual files were configured.

Three labels from the multithread thread control block DSECT are sometimes helpful in debugging. Using the thread control block DSECT for multithread, Figure 12-5, find three labels:

- ZT#TRPLA
- ZT#TFC
- ZT#TUPDA

In single thread, the thread control block DSECT labels (Figure 12-4) are:

- ZT#HRPLA
- ZT#TFC
- ZT#TUPDA

To the left of the first label, ZT#TRPLA, find the address that is also the dump address of the parameter list that was passed for the function executed. In this case, the address of the parameter list was 334D8.

Next, find the ZT#TFC label representing an address in the dump. This address points to an area in the dump containing the number of parameters in the list and the hexadecimal code representing the last function call. You can go to this address and see the addresses of parameters that were passed. The last valid word in this list will contain a hexadecimal 80 in the first byte. Note that sometimes these function calls are issued by IMS and sometimes by your action program. For this reason, this data is not always useful in debugging.

You can determine the number of parameters passed on the last function call by counting the number of words containing valid addresses.

Table 12-1 lists all the IMS function calls and their corresponding hexadecimal values for use in debugging your action program.

Table 12-1. Hexadecimal Equivalents for Function Calls

Hexadecimal	Function Call	Hexadecimal	Function Call
06	RETURN	3A	GETUP
0A	SEND	3E	GET
0E	FIND	4A	SNAP
12	CLOSE	8E	SUBPROG
16	OPEN	92	SETLOAD
1A	UNLOCK	96	GETLOAD
1E	RELEASE	9A	DMS CALL
22	FREE	AA	SETK
26	ESETL	AE	ACTIVATE
2A	SETL	B2	RUN
2E	INSERT	BA	BRKPT
32	DELETE	BE	PRINT
36	PUT	C2	SCALL

Finally, find the label ZT#TUPDA in the DSECT and obtain its address in the same way. This address points to the area in the dump containing the last DTF or CDIB referenced by the last function call executed. This address is not within the range of the user snap dump and is useful only when a job dump is available.

12.7. Other Debugging Resources

If your action programs are in COBOL, in addition to their compile and link, a link map is useful. Figure 12-10 shows the link map for action program, FIXSAM.

The link map shows which COBOL object modules are included in the load module. The object module, FIXSAM, is included in the load module, SAMFIN, as well as the IMS interface module, ZF#LINK.

```
UNIVAC SYSTEM OS/3  LINKAGE EDITOR
DATE- 82/04/15 TIME- 07.51

CONTROL STREAM ENCOUNTERED AND PROCESSED AS FOLLOWS-

              // PARAM OUT=LOADLIB
              /$
                          LOADM SAMFIN
                          INCLUDE FIXSAM
                          INCLUDE ZF#LINK,$YSOBJ
                          ENTER FIXSAM
              /*
C@@MSI   *AUTO-INCLUDED*
C@@NUM   *AUTO-INCLUDED*
C@@SME   *AUTO-INCLUDED*


                                                  *DEFINITIONS DICTIONARY*

SYMBOL.    TYPE.  PHASE. ADDRESS.       SYMBOL.    TYPE.  PHASE. ADDRESS.       SYMBCL.    TYPE.  PHASE. ADDRESS.

ACTIVATE   ENTRY  ROOT   00001100       ADDKY      ENTRY  ROOT   00001124       ARETURN    ENTRY  ROOT   00001168
BUILD      ENTRY  ROOT   0000110C       C@@MSI     CSECT  ROOT   00000000       C@@NUM     CSECT  ROOT   000002A8
C@@SME     CSECT  ROOT   00C00468       CHTBL      ENTRY  ROOT   000010F8       CLOSE      ENTRY  ROOT   0000119C
CMDRB      ENTRY  ROOT   00C01160       DELETE     ENTRY  ROOT   0000117C       DELKY      ENTRY  ROOT   00001128
DLADR      ENTRY  ROOT   0000117C       DLKCP      ENTRY  ROOT   00001130       ENDCRL     ENTRY  ROOT   0000115C
ESETL      ENTRY  ROOT   CC001188       ESLMT      ENTRY  ROOT   00001188       FIND       ENTRY  ROOT   000011A0
FIXSAM     CSECT  ROOT   000004E8       FREE       ENTRY  ROOT   0000118C       GET        ENTRY  ROOT   00001170
GETLOAD    ENTRY  ROOT   00001118       GETUP      ENTRY  ROOT   00001174       GTADR      ENTRY  ROOT   00001180
INSERT     ENTRY  ROOT   00001180       KE$ALM     ENTRY  ROOT   00000000       KE$ALP     ENTRY  ABS    000011F8
KE$RES     ENTRY  ABS    000011F8       LNKCP      ENTRY  ROOT   0000112C       OPEN       ENTRY  ROOT   00001198
OPENF      ENTRY  ROOT   00001198       PUT        ENTRY  ROOT   00001178       RDID       ENTRY  ROOT   00001170
RDIDC      ENTRY  ROOT   000011A4       RDIDCL     ENTRY  ROOT   000011A0       RDIDL      ENTRY  ROOT   00001174
RDKEY      ENTRY  ROOT   CCCC1134       RDKEYC     ENTRY  ROOT   00001110       RDKEYCL    ENTRY  ROOT   0000110C
RDKEYL     ENTRY  ROOT   00001138       RDKYI      ENTRY  ROOT   0000113C       RDKYIC     ENTRY  ROOT   00001108
RDSQ       ENTRY  ROOT   00001148       RDSQC      ENTRY  ROOT   0000119C       RDSQCL     ENTRY  ROOT   00001194
RDSQI      ENTRY  ROOT   C000114C       RDSQIC     ENTRY  ROOT   00001164       RDSQL      ENTRY  ROOT   0000118C
RDSR       ENTRY  ROOT   C0001140       RDSRC      ENTRY  ROOT   00001190       RDSRCL     ENTRY  ROOT   00001168
RDSRL      ENTRY  ROOT   00001144       REBUILD    ENTRY  ROOT   00001110       RELREC     ENTRY  ROOT   00001190
RETURN     ENTRY  ROOT   0C0011A8       RUN        ENTRY  ROOT   000010FC       SEND       ENTRY  ROOT   000011A4
SETK       ENTRY  ROOT   00001104       SETL       ENTRY  ROOT   00001184       SETLOAD    ENTRY  ROOT   0000111C
SNAP       ENTRY  ROOT   00001164       SSLOCK     ENTRY  ROOT   00001150       SSUNLK     ENTRY  ROOT   00001154
STCRL      ENTRY  ROOT   00001158       STLMT      ENTRY  ROOT   00001184       SUB        ENTRY  ROOT   00001120
SUBPROG    ENTRY  ROOT   CC00112C       UNLOCK     ENTRY  ROOT   00001194       WRID       ENTRY  ROOT   00001178
XR3IMS     ENTRY  ROOT   00001114       ZF#LINK    CSECT  ROOT   000010F8


                                                    ** ALLOCATION MAP **

                          LOAD MODULE -   SAMFIN          SIZE -   000011F8

PHASE NAME  TRANS ADDR    FLAG      LABEL     TYPE      ESID       LNK ORG     HIADDR      LENGTH      OBJ ORG
SAMFIN00       NODE - ROOT                                         00000000    000011F7    000011F8
*** START OF AUTO-INCLUDED ELEMENTS -
```

Figure 12-10. Link Map for FIXSAM Action Program (Part 1 of 2)

```
PHASE NAME  TRANS ADDR    FLAG       LABEL      TYPE       ESID          LNK ORG      HIADDR      LENGTH      OBJ ORG
       - 11/10/81 00.00 -            C@@MSI      OBJ
                                     C@@MSI     CSECT       01          00000000     000002A7    000002A8    00000000
       - 10/30/81 00.00 -            C@@NUM      OBJ
                                     C@@NUM     CSECT       01          000002A8     00000465    000001BE    00000000
       - 10/30/81 00.00 -            C@@SME      OBJ
                                     C@@SME     CSECT       01          00000468     000004E1    0000007A    00000000
*** END OF AUTO-INCLUDED ELEMENTS -
       - 82/04/15 07.50 -            FIXSAM      OBJ
                                     FIXSAM     CSECT       01          000004E8     000010F7    00000C10    00000000
       - 81/12/22 06.58 -            ZF#LINK     OBJ
                                     ZF#LINK    CSECT       01          000010F8     000011F7    00000100    00000000
                                     ACTIVATE    ENTRY      01          00001100                             00000008
                                     SETK        ENTRY      01          00001104                             0000000C
                                     CHTBL       ENTRY      01          000010F8                             00000000
                                     RUN         ENTRY      01          000010FC                             00000004
                                     XR3IMS      ENTRY      01          00001114                             0000001C
                                     BUILD       ENTRY      01          0000110C                             00000014
                                     REBUILD     ENTRY      01          00001110                             00000018
                                     GET         ENTRY      01          00001170                             00000078
                                     GETUP       ENTRY      01          00001174                             0000007C
                                     PUT         ENTRY      01          00001178                             00000080
                                     DELETE      ENTRY      01          0000117C                             00000084
                                     INSERT      ENTRY      01          00001180                             00000088
                                     SETL        ENTRY      01          00001184                             0000008C
                                     FSETL       ENTRY      01          00001188                             00000090
                                     FREE        ENTRY      01          0000118C                             00000094
                                     RELREC      ENTRY      01          00001190                             00000098
                                     UNLOCK      ENTRY      01          00001194                             0000009C
                                     OPEN        ENTRY      01          00001198                             000000A0
                                     CLOSE       ENTRY      01          0000119C                             000000A4
                                     FIND        ENTRY      01          000011A0                             000000A8
                                     SEND        ENTRY      01          000011A4                             000000AC
                                     RETURN      ENTRY      01          000011A8                             000000B0
                                     ARETURN     ENTRY      01          00001168                             00000070
                                     SNAP        ENTRY      01          00001164                             0000006C
                                     SUB         ENTRY      01          00001120                             00000028
                                     RDSQL       ENTRY      01          0000118C                             00000094
                                     RDIDC       ENTRY      01          000011A4                             000000AC
                                     RDIDCL      ENTRY      01          000011A0                             000000A8
                                     RDSQC       ENTRY      01          0000119C                             000000A4
                                     RDSQCL      ENTRY      01          00001194                             0000009C
                                     RDSRC       ENTRY      01          00001190                             00000098
                                     RDSRCL      ENTRY      01          00001168                             00000070
                                     RDSQIC      ENTRY      01          00001164                             0000006C
                                     RDKEYC      ENTRY      01          00001110                             00000018
                                     RDKEYCL     ENTRY      01          0000110C                             00000014
                                     RDKYIC      ENTRY      01          00001108                             00000010
                                     GTADR       ENTRY      01          00001180                             00000088
                                     DLADR       ENTRY      01          0000117C                             00000084
                                     ADDKY       ENTRY      01          00001124                             0000002C
                                     DELKY       ENTRY      01          00001128                             00000030
                                     LNKCP       ENTRY      01          0000112C                             00000034
                                     DLKCP       ENTRY      01          00001130                             00000038
                                     WRID        ENTRY      01          00001178                             00000080
                                     RDID        ENTRY      01          00001170                             00000078

PHASE NAME  TRANS ADDR    FLAG       LABEL      TYPE       ESID          LNK ORG      HIADDR      LENGTH      OBJ ORG
                                     RDIDL       ENTRY      01          00001174                             0000007C
                                     RDKEY       ENTRY      01          00001134                             0000003C
                                     RDKEYL      ENTRY      01          00001138                             00000040
                                     RDKYI       ENTRY      01          0000113C                             00000044
                                     RDSR        ENTRY      01          00001140                             00000048
                                     RDSRL       ENTRY      01          00001144                             0000004C
                                     RDSQ        ENTRY      01          00001148                             00000050
                                     RDSQI       ENTRY      01          0000114C                             00000054
                                     STLMT       ENTRY      01          00001184                             0000008C
                                     ESLMT       ENTRY      01          00001188                             00000090
                                     SSLOCK      ENTRY      01          00001150                             00000058
                                     SSUNLK      ENTRY      01          00001154                             0000005C
                                     STCRL       ENTRY      01          00001158                             00000060
                                     ENDCRL      ENTRY      01          0000115C                             00000064
                                     CMDRB       ENTRY      01          00001160                             00000068
                                     OPENF       ENTRY      01          00001198                             000000A0
                                     SUBPROG     ENTRY      01          00001120                             00000028
                                     SETLOAD     ENTRY      01          0000111C                             00000024
                                     GETLOAD     ENTRY      01          00001118                             00000020
            000004E8

                                                       FLAG CODES -
B - BLK DATA CSECT     D - AUTO-DELETED        E - EXCLUSIVE 'A' REF    G - GENERATED EXTRN      I - INCLUSIVE 'V' REF
L - DEFERRED LENGTH    M - MULTIPLY DEFINED    N - NOT INCLUDED         P - PROMOTED COMMON      R - SHARED REC PRODUCED
S - SHARED ITEM        U - UNDEFINED REF       V - VCON ITEM
*ANY OTHER CODES REPRESENT PROCESS ERRORS*

LINK EDIT OF 'SAMFIN'   COMPLETED
DATE- 82/04/15 TIME- 07.53
ERRORS ENCOUNTERED- 0000  UPSI- X'00'
```

Figure 12-10. Link Map for FIXSAM Action Program (Part 2 of 2)

12.8. Analyzing an Abnormal Termination Snap Dump

Figure 12-11 shows the dump generated when action program SAMFIN terminates abnormally due to a program check error. This program check occurred because of an invalid instruction code.

All of the debugging techniques discussed for S termination snaps pertain to abnormal snap dumps except for information about the save area. In addition, the program status word plays an important part in determining the cause of an abnormal termination dump.

To find the address of the erroneous instruction, you must first go to the sixth, seventh, and eighth bytes of the program status word.

PSW

Bytes	1	2	3	4	5	6	7	8

In Figure 12-10, after the allocation map, the address in these bytes is 034C5C.

Bytes						03	4C	5C
	1	2	3	4	5	6	7	8

This is the address of the instruction immediately following the erroneous instruction. You go to address 034C5C and count back one instruction. The next question is: How long is the erroneous instruction? so you know how many bytes to count back from this address.

Once you locate the next sequential instruction after the erroneous one, look at the program status word in byte 5. The first 4 bits of this byte contain the instruction length code and condition code. You are interested in the two high-order (leftmost) bits of byte 5. Looking at the program status word (Figure 12-11), notice that byte 5 contains 40_{16}. In binary, this is:

LENGTH OF ERRONEOUS INSTRUCTION: 0100 0000

The two high-order bits can have one of the following binary configurations indicating a 2-, 4-, or 6-byte erroneous instruction.

Bit Configuration	Interpretation
01	2-byte instruction
10	4-byte instruction
11	6-byte instruction

SAMFIN's erroneous instruction has a bit configuration of 01, meaning it is a 2-byte instruction. Counting back from location 034C5C, two bytes show an instruction containing zeros.

Now you go to byte 4 of the program status word to obtain the interrupt code. The interrupt code is 01_{16}, an operation exception. This means that an illegal operation was attempted.

```
*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*
1                                               1
*       I M S 9 0    S N A P    D U M P         *
1                                               1
*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*

ACTION NAME:   SAMFIN                                                              DATE:   82/04/15

CURRENT ACTION PROGRAM:   SAPFIN00     TERM-ID:   TRMD     TRANS-ID:   0052006901C50006  TIME:    8:15:30

   **  ALLOCATION MAP  **

        FROM       TO        LENGTH      AREA-NAME

      00033400  0003348F  00000090    PROGRAM INFORMATION BLOCK (PIB)
      000338C0  000338EF  00000030    INPUT MESSAGE AREA (IMA)
      000337C0  000338BF  00000100    WORK AREA (WA)
      00033570  000337B7  00000248    OUTPUT MESSAGE AREA (OMA)
      000337B8  000337BF  00000008    CONTINUITY DATA AREA (CDA)
      00034000  000351FF  00001200    ACTION PROGRAM LOAD AREA
      00036E20  00036FE7  000001C8    THREAD CONTROL BLOCK (THCB)
      00000000  00000000  00000000    ACTION SUBPROGRAM (IF ACTIVE)
      00036E54  00036E73  00000020    FILE ALLOCATION MAP
      00008240  0000835F  00000120    TERMINAL CONTROL TABLE (TCT)
      00033508  0003356B  00000064    SHARED ACT.PROG. VOLATILE AREA

   CAUSE OF SNAP DUMP:   USER PROGRAM CHECK
```

Figure 12-11. Program Check Abnormal Termination Snap Dump for SAMFIN Load Module (FIXSAM Action Program) (Part 1 of 2)

INTERRUPT CODE

BITS 01100000

ADDRESS OF ERRONEOUS INSTRUCTION

```
PROGRAM STATUS WORD:    E0E6CE01    40034C5C
USER REGS 0-7   00000000  0003466C  00033400  00033400  000337C0  000337C0  000346B8  00033570
USER REGS 8-F   000338C0  00034698  00034558  00035558  60034BF4  00034958  900350EE  00034C56

 SNAP  BY EXIMS    AT 0171A6
  REGS 0-7  000013E0  000173BC  00033400  0C03340C   000337C0  000337C0  000346B8  00033570
  REGS 8-F  000338C0  00034698  00034558  00035558   60034BF4  00004AE8  60017164  60017186
 SNAP  0F3400  TO  0F38F0
033400-00000000 E2C1D4C6 C9D5D5D5 00520069  01C50006 00000000 00000000 00000000 *....SAMFINNN.....E..............-0F3400
033420-00000050 000C0100 00000008 00000000  F8F2FCF4 F1F5F0F8 F1F5F2F8 000000E6 *...&............82C41508152&...W-0F3420
033440-00500018 E9000000 E0E60E01 40034C5C  000C0C0C 0003466C 00033400 00033400 *.&..Z....W.. .<*.......%........-0F3440
033460-000337C0 000337C0 000346B8 00033570  000338CC 00034698 00034558 00035558 *...............................-0F3460
033480-60034BF4 00C34958 900350EE 00034C56  00000000 00033448 00036EC4 50034FFC *-..4......&...<...........>D&.].-0F3480
0334A0-00015730 00C0003E 000349A8 000349A8  0003340C 000337C0 000337C0 000346B8 *...............................-0F34A0
0334C0-00033570 000338C0 00034698 00C34558  00035558 60034BF4 000338AC 800337C0 *.................-..4........-0F34C0
0334E0-00033400 00C33570 C0C33EC0 000338DA  0003357C 00033799 000337C0 000338B3 *...............................-0F34E0
033500-000337B8 800337BA 000000C0 00034580  0003467C 00034958 000346B8 00033400 *..................a...........-0F3500

034BE0-D2067023 60F8F211 A0408012 F910A040  622705C0 4770C026 D2477060 61609240 *K...-82.. ..9.. ........K..-/-. -0F4BED
034C00-5031D246 50325031 D2015034 8012D247  70AC5031 58F09004 05EF9240 5031D246 *&.K.&.&.K.&...K...&..C..... &.K.-0F4C00
034C20-50325031 F211A050 50C194FC A051F211  A0608012 94FCA061 F911A050 A0604770 *&.&.2..&&A....2..-...../9..&.-..-0F4C20
034C40-C05247F0 C06641E0 C06218FC 90EFA114  58F09008 07FF47F0 C0300C00 A04C50C3 *...0............0.....0..... &C-0F4C40
034C60-F900A040 62274770 C0E2D204 503E5000  D2135049 5005D209 D1406232 F236A060 *9.. .....SK.&.&.K.&.&.K.J ..2..--0F4C60
```

BAD INSTRUCTION

Figure 12-11. Program Check Abnormal Termination Snap Dump for SAMFIN Load Module (FIXSAM Action Program) (Part 2 of 2)

12.9. Analyzing a CALL SNAP Dump

The CALL SNAP dump is useful in action program debugging because the program issuing the SNAP function call can continue processing. By specifying on the SNAP function call only those areas of your program that you want to examine, you obtain the data you want to check without terminating the program.

Figure 12-12 shows the dump generated by the SNAP function code issued from the SAMFIN action program (Figure 12-8, lines 312 and 313). Notice, each beginning and ending area requested is listed in the dump (Figure 12-12).

```
*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*
1                                               1
*       I M S 9 0    S N A P    D U M P         *
1                                               1
*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*

  ACTION NAME:   SAMFIN                                                                  DATE:   82/04/15

  CURRENT ACTION PROGRAM:   SAMFIN00      TERM-ID:   TRMD     TRANS-ID:   0052006901BD0001  TIME:    8:07:04

     **  ALLOCATION MAP  **

             FROM        TO        LENGTH       AREA-NAME

            00033400  0003348F  00000090    PROGRAM INFORMATION BLOCK (PIB)
            000338C0  000338EF  00000030    INPUT MESSAGE AREA (IMA)
            000337C0  000338BF  00000100    WORK AREA (WA)
            00033570  000337B7  00000248    OUTPUT MESSAGE AREA (OMA)
            000337B8  000337BF  00000008    CONTINUITY DATA AREA (CDA)
            00034000  000351FF  00001200    ACTION PROGRAM LOAD AREA
            00036E20  00036FE7  000001C8    THREAD CONTROL BLOCK (THCB)
            00000000  00000000  00000000    ACTION SUBPROGRAM (IF ACTIVE)
            00036E54  00036E73  00000020    FILE ALLOCATION MAP
            00008240  0000835F  00000120    TERMINAL CONTROL TABLE (TCT)
            00033508  0003356B  00000064    SHARED ACT.PROG. VOLATILE AREA

        CAUSE OF SNAP DUMP:   USER INLINE SNAP CALL

 SNAP  BY EXIMS    AT 0171A6

  REGS 0-7  000013E0  000334D8  000349A8  00033400    000337BA  000337C0  000346B8  00033570

  REGS 8-F  000338C0  00034698  00034558  00035558    60034E88  00033490  60017164  60017186

 SNAP  0F46B8  TO  0F4890

0346B8-10030000 10040000 10040300 10040200  1E000000 00000000 D5D6D560 D5E4D4C5 *.......................NON-NUME-0F46B8
0346D8-D9C9C340 E5C1D3E4 C540C5D5 E3C5D9C5  C440C6D6 D940D9C5 C1C4E240 C4C5E2C9 *RIC VALUE ENTERED FOR READS DESI-0F46D8
0346F8-D9C5C440 C6C9C5D3 C4000000 00000000  E3D9C1D5 E2C1C3E3 C9D6D540 C3C1D5C3 *RED FIELD.......TRANSACTION CANC-0F46F8
034718-C5D3D3C5 C440C4E4 C540E3D6 40C1C2D6  E5C540C5 D9D9D6D9 C5D5C440 D6C640C6 *ELLED DUE TO ABOVE ERROREND OF F-0F4718
034738-C9D3C540 D9C5C1C3 C8C5C440 C4E4D9C9  D5C740D9 C5C1C440 D5E4D4C2 C5D94040 *ILE REACHED DURING READ NUMBER  -0F4738
034758-C5D9D9D6 D940C6D9 D6D440E2 C1D460C7  C5E34040 C4E4D9C9 D5C740D9 C5C1C440 *ERROR FROM SAM-GET  DURING READ -0F4758
034778-D5E4D4C2 C5D94040 E2E3C1E3 E4E260C3  D6C4C540 40404040 40404040 40404040 *NUMBER  STATUS-CODE            -0F4778
034798-40C4C5E3 C1C9D3C5 C440E2E3 C1E3E4E2  40C3D6C4 C5404000 C6E2D4E3 C6C9D300 * DETAILED STATUS CODE  .FSMTFIL.-0F4798
0347B8-C6E2D4C4 C6C9D300 C5D5E3C5 D940D5E4  D4C2C5D9 40D6C640 D9C5C1C4 E240C6D6 *FSMDFIL.ENTER NUMBER OF READS FO-0F47B8
0347D8-D940E2C1 D440E5C1 D940D3C5 D5C7E3C8  40C6C9D3 C5E240C1 E240C67E D5D50000 *R SAM VAR LENGTH FILES AS F#NN..-0F47D8
0347F8-D3C9D5C5 40C4C9E2 C3D6D5D5 C5C3E340  D9C5D8E4 C5E2E3C5 C4000000 00000000 *LINE DISCONNECT REQUESTED.......-0F47F8
034818-D5D64B40 D9C5C1C4 40404040 C3E4E2E3  60C9C440 40404040 404040C3 E4E2E3D6 *NO. READ    CUST-ID        CUSTO-0F4818
```

Figure 12-12. CALL SNAP Dump for SAMFIN Load Module (FIXSAM Action Program)
(Part 1 of 2)

```
034838-D4C5D940 D5C1D4C5 4C4C4C40 40404C40  40C1D4E3 40D7C1C9 C4404040 404040C4 *MER NAME          AMT PAID      D-0F4838
034858-C1E3C540 40404040 C5D9D9D6 D940D6D5  40E2D5C1 D740D5D6 4B40F140 40F24040 *ATE     ERROR ON SNAP NO. 1  2  -0F4858
034878-F34040F4 4040F540 40404040 40404040  40400000 00000000 5C                *3  4  5           ......*         -0F4878
 SNAP  0F3400  TO  0F3570
033400-00000000 E2C1D4C6 C9D5D5D5 00520069  01BD0C01 00000000 00000000 00000000 *....SAMFINNN...................-0F3400
033420-00000050 00CCC100 00000CC8 0000CC00  F8F2F0F4 F1F5F0F8 F0F7F0F2 000000E6 *...&............82C415080702...W-0F3420
033440-00500018 E9C00000 00034958 00000000  00034958 00007B80 600344EA 00015730 *.&..Z................#.-.......-0F3440
033460-00036E34 000000C8 00033400 0003F7DC  00036E20 00001FEC 0000F240 00004C30 *..>....H......7...>........ ..<.-0F3460
033480-0000000C 00C0000C 00C00CC0 00000000  00000000 00033448 C0036EC4 40034F6E *........................>D .3>-0F3480
0334A0-00015730 00C0004A 000349A8 000349A8  0003340C C003376A 000337CC 000346B8 *.......[......................-0F34A0
0334C0-00033570 000336C0 00034698 00034558  0003555F 60034E88 000346B8 00034890 *.................-.+.........-0F34C0
0334E0-00033400 00C33570 000338C0 000338DA  00033570 00033799 000337C0 000338B3 *...............................-0F34E0
0335C0-000337E8 800337BA 0000CCCC 000345EC  0003467C 00034958 000346B8 00033400 *..................&...........-0F3500
033520-000338C0 000337B8 00033570 000337CC  00000C00 60034D18 00034EBE 60034E88 *..................-.(...+.-.+.-0F3520
033540-00000F00 00000000 00000C00 00000CCC  000CCC0C 00000000 00000000 00000000 *..............................-CF3540
033560-00000000 00000000 00000C00 00000000  00                                  *................             -0F3560
 SNAP  CF38C0  TO  0F38DA
0338C0-E3D9D4C4 00520069 01BD0001 000F0000  C67BF0F3 40D540E8 40D55C             *TRMD............F#03 N Y N*    -0F38C0
 SNAP  0F3570  TO  0F3799
033570-00000000 00000000 00000000 01CC0000  10030000 C6C9D3C5 40D5C1D4 C5404040 *...................FILE NAME   -0F3570
033590-404040C6 E2D4E3C6 C9D34C40 40404040  40404C4C 40404040 40404040 40404040 *   FSPTFIL                     -0F3590
0335B0-40404040 40404040 40404C40 40404040  40404C4C 40404040 40404040 10040000 *                          ....-0F35B0
0335D0-C5D5C440 D6C640C6 C9D3C540 D9C5C1C3  C8C5C44C C4E4D9C9 D5C740D9 C5C1C440 *END OF FILE REACHED DURING READ -0F35D0
0335F0-D5E4D4C2 C5D9404C 40F14C40 40404C4C  404C4C4C 40404C40 4040404C 40404040 *NUMBER   1                     -0F35F0
033610-40404040 40404040 10040000 E2E3C1E3  E4E260C3 D6C4C540 40F0F0FC F2404040 *        ....STATUS-CODE  0002  -0F3610
033630-40404040 40C4C5E3 C1C9D3C5 C440E2E3  C1E3E4E2 40C3D6C4 C54040F0 F0F0F040 *     DETAILED STATUS CODE  0000 -0F3630
033650-40404040 40404040 40404C40 40404C40  4040404C 10040200 C6C9D3C5 40D5C1D4 *                    ....FILE NAM-0F3650
033670-C5404040 404040C6 E2D4C4C6 C9D34040  4040404C 40404040 40404040 40404040 *E      FSPDFIL                  -0F3670
033690-40404040 40404040 40404C40 40404040  404C4C4C 40404040 4040404C 40404040 *                               -0F3690
0336B0-10040000 D5D64B40 D9C5C1C4 40404C4C  C3E4E2E3 60C9C440 40404040 404040C3 *....NO. READ    CUST-ID        C-0F36B0
0336D0-E4E2E3D6 D4C5D940 D5C1D4C5 40404C40  40404040 40C1D4E3 40D7C1C9 C4404040 *USTOMER NAME           AMT PAID  -0F36D0
0336F0-404040C4 C1E3C54C 40404040 10040000  404040FC F3404040 40404040 40F0F0F0 *   DATE     ....  C3          000-0F36F0
033710-F1F04040 4040404C C1D34050 40D2C1E8  7DE240E2 E3C5C1D2 40404040 40404040 *10      AL & KAY'S STEAK        -0F3710
033730-405BF2F1 F7F04BF0 F3404C40 40F1F161  F1F961F7 F6404040 10040200 40404040 * $2170.03    11/19/76   ....    -0F3730
033750-40404040 40404040 40404040 40404040  40404C4C 40404040 4040404C 40404040 *                               -0F3750
 ****  0F3770  TO  0F379C  SAME AS ABOVE
033790-40404040 40404040 405C                                                   *        *                      -0F3790
 SNAP  0F37C0  TO  0F38B3
0337C0-F0F0F0F1 FCC1D340 5040D2C1 E87DE24C  E2E3C5C1 D2404040 40F0F2F1 F7F0F0F3 *00010AL & KAY'S STEAK    0217003-0F37C0
0337E0-F1F161F1 F961F7F6 00000C00 00000000  0040404C F0F34040 40404040 4040F0F0 *11/19/76.........   03        00-0F37E0
033800-F0F1F040 40404040 40C1D340 5040D2C1  E87DE24C E2E3C5C1 D240404C 40404040 *010       AL & KAY'S STEAK      -0F3800
033820-40405BF2 F1F7F04B F0F34C40 4040F1F1  61F1F961 F7F64040 40E2E3C1 E3E4E260 *  $2170.03    11/19/76   STATUS--0F3820
033840-C3D6C4C5 4040F0F0 F0F24C40 40404040  404CC4C5 E3C1C9D3 C5C440E2 E3C1E3E4 *CODE  0002         DETAILED STATU-CF3840
033860-E240C3D6 C4C54040 F0F0F0F0 40404040  40404040 40404040 40404040 40404040 *S CODE  0000                    -0F3860
033880-40F0F3F0 0000C00C 00C0CCC0 00000C00  C00CCCCC 00000000 00000000 00000000 * 030...........................-CF3880
0338A0-00000000 00000000 00000000 C6E2D4C4  C6C5D35C                            *............FSMDFIL*          -0F38A0
 SNAP  0F37B8  TO  0F37BA
0337B8-D5E85C                                                                    *NY*                           -0F37B8
```

Figure 12-12. CALL SNAP Dump for SAMFIN Load Module (FIXSAM Action Program) (Part 2 of 2)

12.10. Online File Recovery

When a transaction terminates abnormally, or requests rollback before completion, IMS rolls back user data file modifications (updates, inserts, and deletions) that occurred in the transaction and issues messages to source terminal and system console. These messages are explained in the *System Messages Reference Manual,* UP-8076.

On rollback, IMS returns each MIRAM, ISAM, or DAM file, modified in the terminated transaction, to its logical state before the transaction was initiated or before the last rollback point was recorded on the audit file. When abnormal termination occurs, rollback occurs automatically.

You can request rollback upon normal termination of a transaction by moving special indicator values into the LOCK-ROLLBACK-INDICATOR field of the program information block. For more information on the use of this indicator, refer to 3.11.

Before update or deletion, IMS records in the audit file the current state of each record to be modified. In addition, before adding a new record to a file, IMS records in the audit file the keys or record numbers of records to be added. It also records data marking the initiation and termination of each transaction that modifies a file. If you specify a lock rollback indicator value to establish lock rollback points, IMS also records these rollback points in the audit file.

Table 12-2 lists the functions IMS performs to roll back file modifications.

Table 12-2. File Rollback

File Modification	Functions that Cause Modification	Functions Performed to Roll Back Modification
Update	GETUP, PUT	GETUP (current image) PUT (before-image)
Delete	GETUP, DELETE	INSERT (before-image)
Insert	INSERT	GETUP (current image), DELETE

12.10.1. Error Returns

When unrecoverable I/O errors occur in the audit file, IMS notifies the source terminal operator, sends an error message to the print file, and attempts rollback of all existing transactions logged in the audit file. If you didn't configure LOCK=UP in the configurator FILE section, IMS prohibits any additional update requests and returns a status code of 3 (invalid request) and one of the detailed status codes listed in Appendix D.

12.10.2. Prefix Area Format

If an I/O error occurs on a user data file during rollback of a file modification, IMS takes a snapshot dump of the prefix area of the record being rolled back. After the snapshot dump, IMS continues rolling back all modifications made to user data files for that transaction.

If an error occurs on the AUDCONF or AUDFILE during rollback of updates made by a transaction, IMS places the name, ZU#ROL, into the current action program name field of the prefix area.

Figure 12-13 shows the format of the prefix area, and Table 12-3 describes the content of each field.

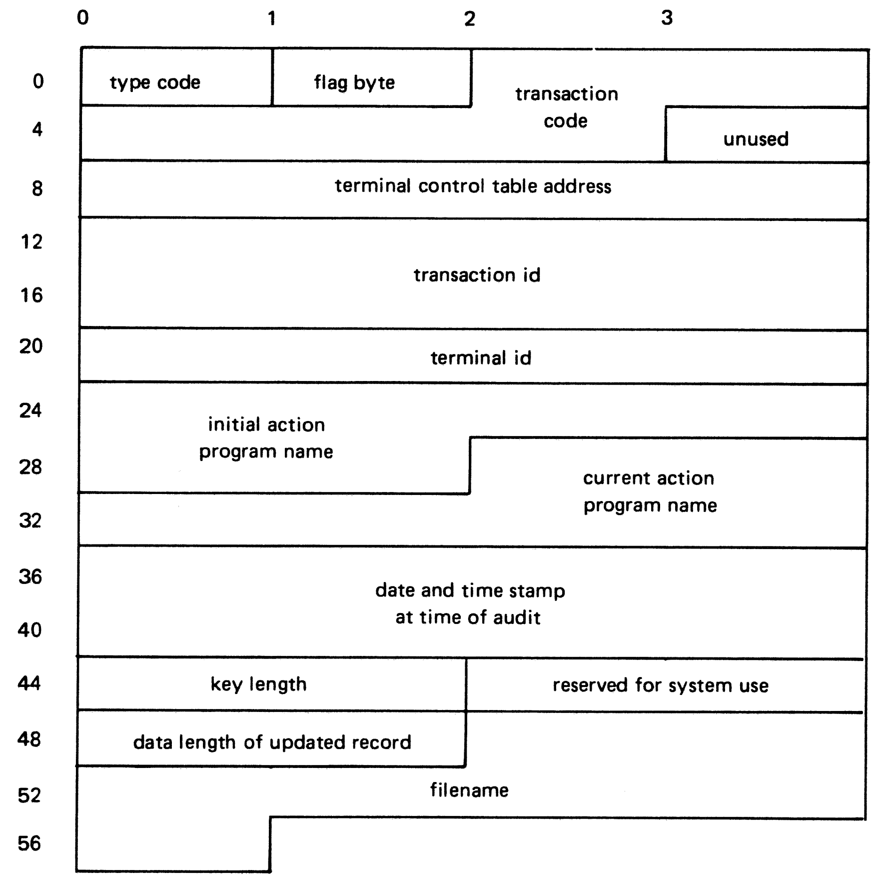


Figure 12-13. Format of Prefix Area of Records in the Audit File (Online Recovery)

Table 12-3. Contents of Prefix Area for Records in the Audit File (Online Recovery)

Label	Field Name	Bytes	Code	Description
ZF#RTC	Type code	0	Binary	Bits Set to 1 — Meaning 0 — Not used 1 — Not used 3 — Termination 4 — Not used 5 — Rollback point 6 — Before-image, MIRAM 6, 7 — Before-image, ISAM 7 — Before-image, DAM
ZF#AFB	Flag byte	1	Binary	Bits Set to 1 — Meaning 0 — First before-image for transaction 1 — Inserted record 2 — Abnormal termination 3 — Not used 4 — MIRAM, indexed 5-7 — Not used
ZF#ATC	Transaction code	2-6	EBCDIC	Configured code identifying the current transaction; one to five alphanumeric characters, left-justified in field
-	-	7	-	Unused
ZF#ACT	TCT address	8-11	Hexadecimal	Address of terminal control table (TCT) for terminal originating this transaction. Full-word aligned
ZF#ATRID	Transaction-id	12-19	Binary	Date-time of initiation of this transaction, in the form: yy-mm-dd-hh-mm-ss

continued

Table 12-3. Contents of Prefix Area for Records in the Audit File (Online Recovery) (cont.)

Label	Field Name	Bytes	Code	Description
ZF#ATMID	Terminal-id	20-23	Hexadecimal	Configured identification of network termination initiating this transaction
ZF#AIAP	Initial action program	24-29	EBCDIC	Program-name of first action program initiated for this transaction; one to six alphanumeric characters, left-justified
ZF#ACAP	Current action program	30-35	EBCDIC	Program-name of currently active action program
ZF#ADT	Date-time of audit	36-43	Binary	Date-time of writing this record to the audit file, in same form as transaction-id
ZF#KLIDA	Key length	44-45	Binary	Length of key in an indexed record; set to 0 for a DAM Record
ZF#CNKN	-	46-47	-	Reserved for system use
ZF#DLIDA or ZF#NAUT	Data length	48-49	Binary	Length of data portion of updated record, or number of active update transactions
ZF#FNM	File name	50-57	EBCDIC	Logical name of data file being accessed by current action program; one to seven alphanumeric characters, left-justified

Notes:

1. When records are written to the audit file for a UNIQUE action program, the transaction-code field contains OPEN, the initial-action-program field contains ZU#OPEN, and the current-action-program field contains the name of the UNIQUE module active at the time of audit.

2. When the current action program is accessing a defined file, a prefix is written for each logical record involved. In the prefix, the file-name field contains the LFD-name of a conventional user data file contributing a logical record (or part of one) to the defined record. It never contains the defined-file-name specified with the DFILE keyword.

12.11. COBOL Action Program Error Message Buffer

The COBOL error routines C@@MSI (1974 COBOL) and COBJERR (extended COBOL) record data in a 4-byte message buffer that corresponds to errors contained in the canned message file. To find the cause of error, locate this message buffer by checking for its address in general register 1 of the program dump listing. Table 12-4 shows the contents of the message buffer for 1974 COBOL and Table 12-5 describes the error messages.

Table 12-4. 1974 COBOL Message Buffer Contents

Byte	Hexadecimal Content	Description
0	C3	Canned message prefix
1	C5	Canned message prefix
2-3	nnnn	Hexadecimal message number

Note: *The hexadecimal message number in bytes 2 and 3 is one of the following and corresponds to the numbered COBOL message shown (nnnn). For the meaning of the message and suggested corrective action refer to the* System Messages Reference Manual, *UP-8076.*

Table 12-5. 1974 COBOL Error Messages for Action Programs

COBOL Message	Message Text
CE23	END OF PROCEDURE DIVISION EXECUTED
CE25	NEGATIVE VALUE EXPONENTIATED
CE29	FLOATING POINT ERROR

Table 12-6 shows the contents of the message buffer for extended COBOL. Table 12-7 describes the error messages.

Table 12-6. Extended COBOL Message Buffer Contents

Byte	Hexadecimal Content	Description
0	5B	Canned message indicator ($)
1-2	nnnn	Hexadecimal message number
3	40	End-of-table indicator (blank)

Note: *The hexadecimal message number in bytes 1 and 2 is one of the following and corresponds to the numbered COBOL message shown (nnnn). For the meaning of the message and suggested corrective action refer to the* System Messages Reference Manual, *UP-8076.*

Table 12-7. Extended COBOL Error Messages for Action Programs

Bytes 1-2 Contents	COBOL Message	Message Text
043A	CE03	END OF PROCEDURE DIVISION EXECUTED
043B	CE04	INVALID EXECUTION OF ENTRY POINT
043C	CE05	NEGATIVE VALUE EXPONENTIATED

If there is insufficient work area for 1974 COBOL reentrancy control variables, the action program may terminate with a program check, with the program status word dump address pointing to this message in the dump:

```
INSUFFICIENT WORKAREA FOR COBL74 REENTRANCY CONTROL
```

See Figure 12-14 for a sample program check snap dump.

For more information on COBOL reentrant action programming, see the *1974 American Standard COBOL Programming Reference Manual,* UP-8613.

```
*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*
1                                                 1
*        I M S 9 0    S N A P    D U M P          *
1                                                 1
*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*

  ACTION NAME:   DG758O                                                                  DATE:   85/09/13

  CURRENT ACTION PROGRAM:   DG758000     TERM-ID:   JVC2     TRANS-ID:   0055010000000001   TIME:   10:52:56

     **  ALLOCATION MAP  **

           FROM       TO        LENGTH       AREA-NAME

           00030800   0003088F  00000090     PROGRAM INFORMATION BLOCK (PIB)
           00031240   00031A37  000007F8     INPUT MESSAGE AREA (IMA)
           000311F0   0003123F  00000050     WORK AREA (WA)
           00030890   000310F7  000007F8     OUTPUT MESSAGE AREA (OMA)
           00031178   000311FF  00000078     CONTINUITY DATA AREA (CDA)
           000325B6   000337F7  00001200     ACTION PROGRAM LOAD AREA
           00034F30   00035143  00000214     THREAD CONTROL BLOCK (THCB)
           00000000   00000000  00000000     ACTION SUBPROGRAM (IF ACTIVE)
           00034F64   00034F83  00000020     FILE ALLOCATION MAP
           000059F0   00005B1B  0000012C     TERMINAL CONTROL TABLE (TCT)
           00000000   00000000  00000000     SHARED ACT.PROG. VOLATILE AREA

        CAUSE OF SNAP DUMP:   USER PROGRAM CHECK
PROGRAM STATUS WORD:   EDF60801    50032AB0
USER REGS 0-7   00000008   00030800   000311F0   00030800   00030FD8   00000000   00002FC0   000059F0
USER REGS 8-F   00004830   00031238   00000001   00000050   00030000   00030848   000059F0   60032972

 SNAP  BY R-JC777  AT 01219E
  REGS 0-7  00001800  0001238C  000311F0  00030900    00030FD8  00000000  00002EC0  000059F0
  REGS 8-F  00004830  00031238  00000001  00000050    00000000  000049BC  6001215C  6001217E
 SNAP  520000  TO  52F238
030800-00000000 C4C7F7F5 F8F0D5D5 00550100  00000001 00000000 00000000 00000000 *....DG758ONN....................-520000
030820-00000050 00180050 00500078 00000000  F8F5F0F9 F1F3F1F0 F5F2F5F2 000000F6 *...&...&.&......850913105252...-520020
030840-00500018 E9000000 EDE60801 50032AB0  00000008 00030800 000311F0 00030800 *.&..7....W..&.................0....-520040

~                                                                                                                  ~

032A58-45F0F172 182D18D4 50002008 50200004  411000C4 50100008 41A08008 41B08009 *..1....M&...&.......&...........-52F258
032A78-41B0BFFF 5090A03C 47000000 41100050  5010A038 5810F032 05E104A0 5850A080 *....&...........&&.....0......&..-52F278
032A98-58E0A07C 5670A074 5880A084 5890A040  58C0F02A 07FC0000 C9D5E2E4 C6C6C9C3 *.-.a.........  ..0.....INSUFFIC-52F298
032AB8-C9C5D5E3 40E6D6D9 D2C109C5 C1403C6D6  D940C3D6 C2D3F7F4 40D9C560 C5D5E3D9 *IENT WORKAREA FOR COBL74 RE-ENTR-52F2B8
032AD8-C1D5C3E8 40C3D6D5 E3D9D6D3 1255078E  413000FF 19534720 F1841835 06304430 *ANCY CONTROL.............1.......-52F2D8
032AF8-F1984123 20014143 40011B53 4650F17A  07FED200 40C02000 481CE000 1A1A98F0 *1....... ....&1:..K. ..........0-52F2F8
032B18-10C012FF 4780E002 18C01800 50001000  07FF0000 00000000 00000000 00000000 *...........&.....................-52F318
```

Figure 12-14. Snap Dump for User Program Check

12.12. Snap Dump Showing Allocated Transaction Buffers

Figure 12-15 shows the voluntary termination snap dump with three blocks of transaction buffers allocated.

The allocation map in Figure 12-15 shows the addresses of the blocks of transaction buffers and the length of each block of buffers (labels 1, 2, and 3).

The first block of transaction buffers is from 1B000 to 1EFFF. This block of buffers is 16K, or 4 contiguous transaction buffers.

The address of the second block of buffers is 1F000 to 20FFF. A length of 8K or 2 contiguous transaction buffers is allocated.

The third block is from 21000 to 21FFF, a length of 4K, or 1 transaction buffer.

On the listing of the snap dump, the labels 6, 7, and 8 point to the blocks of transaction buffers and their contents.

```
*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*
I                                                 I
*        I M S 9 0     S N A P     D U M P        *
I                                                 I
*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*

 ACTION NAME:    MEMREQ                                                                      DATE:    87/03/11

 CURRENT ACTION PROGRAM:    MEMREQ00       TERM-ID:    MOE2      TRANS-ID:    005700460000001  TIME:    17:49:34

    **  ALLOCATION MAP  **

          FROM        TO        LENGTH        AREA-NAME

        00045000   0004508F   00000090    PROGRAM INFORMATION BLOCK (PIB)
        000452F8   00045317   00000020    INPUT MESSAGE AREA (IMA)
        00045230   000452F7   000000C8    WORK AREA (WA)
        00045090   0004522F   000001A0    OUTPUT MESSAGE AREA (OMA)
        00000000   00000000   00000000    CONTINUITY DATA AREA (CDA)
        00046000   000465FF   00000700    ACTION PROGRAM LOAD AREA
        00048820   00048D4B   0000022C    THREAD CONTROL BLOCK (THCB)
        00000000   00000000   00000000    ACTION SUBPROGRAM (IF ACTIVE)
        00048354   00048B73   00000020    FILE ALLOCATION MAP
        00005AEC   00005CA3   000001B8    TERMINAL CONTROL TABLE (TCT)
        00000000   00000000   00000000    SHARED ACT.PROG. VOLATILE AREA
        00018000   0001EFFF   00004000    TRANSACTION BUFFERS
        0001F000   00020FFF   00002000
        00021000   00021FFF   00001000

      CAUSE OF SNAP DUMP:   USER VOLUNTARY TERMINATION

 SNAP  BY IMS150    AT 011EA2

  REGS 0-7  00001800  00011F80  00046000  00045000   0004FBC4  00048820  00000000  00045250

  REGS 8-F  00045000  000452F8  00045230  00045090   00000000  0004524C  60011E62  60011E82

018000-C2E4C6C6 C5D940F1 C2E4C6C6 C5D940F1  C2E4C6C6 C5D940F1 C2E4C6C6 C5D940F1 *BUFFER 1BUFFER 1BUFFER 1BUFFER 1-687800
 ****  687820  TO  687900  SAME AS ABOVE
018100-00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000 *................................-687900
 ****  687920  TO  688800  SAME AS ABOVE
01F000-C2                                                                       *B                              -688800
 SNAP  688800  TO  688800
01F000-C2E4C6C6 C5D940F2 C2E4C6C6 C5D940F2  C2E4C6C6 C5D940F2 C2E4C6C6 C5D940F2 *BUFFER 2BUFFER 2BUFFER 2BUFFER 2-688800
 ****  688820  TO  688900  SAME AS ABOVE
01F100-00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000 *................................-688900
 ****  688920  TO  690800  SAME AS ABOVE
021000-C2                                                                       *B                              -680800
 SNAP  680800  TO  68E800
021000-C2E4C6C6 C5D940F3 C2E4C6C6 C5D940F3  C2E4C6C6 C5D940F3 C2E4C6C6 C5D940F3 *BUFFER 3BUFFER 3BUFFER 3BUFFER 3-680800
 ****  680820  TO  680900  SAME AS ABOVE
021100-00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000 *................................-680900
 ****  680920  TO  68E800  SAME AS ABOVE
```

Figure 12-15. Snap Dump of MEMREQs with Three Blocks of Transaction Buffers Allocated

Appendix A
Statement Conventions

Throughout this document, certain conventions are observed in formats for statements and commands. General rules with examples pertaining to these conventions follow:

- Capital letters and punctuation marks (except braces, brackets, and ellipses) must be coded exactly as shown. For example:

  ```
  CALL 'GET' USING filename record-area record-number.
  ```

  is coded:

  ```
  CALL 'GET' USING CUSTFIL CUS-REC REC-KEY.
  ```

- Lowercase letters and words are generic terms representing information that you supply. Such terms may contain acronyms and hyphens for readability. For example:

  ```
  PROCEDURE DIVISION USING program-information-block
                           input-message-area
                           [work-area] [output-message-area]
                           [continuity-data-area].
  ```

  is coded:

  ```
  PROCEDURE DIVISION USING PIB IMA WA OMA CDA.
  ```

- Information within braces { } represents necessary entries, one of which must be chosen.

  For example:

  ```
  {CALL   } {GET  }  ,(filename,record-area,record-number)
  {ZG#CALL} {GETUP}
  ```

  is coded:

  ```
  1        10      16
  ----------------------------------------------
           ZG#CALL GET,(STATE,RECORD,SNKEY)
  ```

  or

  ```
           CALL   GETUP,(STATE,RECORD,SNKEY)
  ```

- Information within brackets [ ], including commas and semicolons, represents optional entries that you include or omit, depending on program requirements. Braces { } within brackets indicate that you must choose one of the entries if you include that operand. For example:

$$\left[\text{JUS=}\begin{Bmatrix}\text{L}\\\text{R}\end{Bmatrix}\right]$$

  is coded:

```
JUS=L
```

- Default parameter specifications are indicated by shading. For example, if no TYP parameter is specified as input to the edit table generator, the M is supplied, meaning alphanumeric type data is expected.

$$\left[\text{TYP=}\begin{Bmatrix}\text{A}\\\text{B}\\\text{M}\\\text{N}\\\text{P}\end{Bmatrix}\right]$$ (default value)

- A series of three periods vertically spaced (an ellipsis), occurring in a program example, indicates that other coding not directly relating to the example is omitted. For example:

```
PARA-1.
   CALL 'GET' USING STATE RECORD SNKEY.
   .
   .
   .
PARA-2.
```

Statement conventions and coding rules specific to individual functions are described where applicable throughout this document.

NOTES

NOTES

Appendix B
COBOL Action Programming Examples

B.1. Description

Appendix B contains compiler listings of sample COBOL action programs. Parts of coding from some of these programs appear out of context in different parts of the manual where specific subjects and how to handle the coding are described.

The COBOL action programs in this appendix illustrate the complete action program coding for simple and dialog transactions, external and immediate internal succession, use of screen format services, sending a message to another terminal, output-for-input queueing, continuous output, and assigning and controlling printer files.

The CSCAN action program series (Figures B-1 through B-17) consists of four action programs:

- DMSCAN
- DMDETL
- DMPYMT
- DMTOTL

These programs represent a series of simple transactions that:

- Page through a customer file (CSCAN transaction code)
- Display a customer's account status (CDETL transaction code)
- Apply payments to a customer's account (PAYMT transaction code)
- Request audit data about all payments applied to a customer's account (TOTAL transaction code)

Action programs ACT1 and ACT2 (Figures B-21 and B-22) illustrate a dialog transaction with ACT1 naming ACT2 as external successor.

JAMENU (Figure B-23) is one of a series of action programs that make up an entitlement accounting system. By validating a password entered from the terminal, JAMENU displays either a menu screen or an error screen.

In addition to using both external and immediate internal succession, JAMENU uses the BUILD function call to construct screen formatted messages for a valid or an invalid password.

The BEGIN1 action program (Figure B-24) illustrates use of the SEND function to initiate a transaction that performs continuous output at another terminal. It also shows the output-for-input queueing feature.

The PRINT action program (Figure B-25) creates continuous output, sends it to the source terminal, and uses delivery notice scheduling for control and recovery.

B.2. Sample COBOL Action Programs Performing Simple Transactions (CSCAN Series)

The four action programs DMSCAN, DMDETL, DMPYMT, and DMTOTL perform a series of simple transactions. The transaction code CSCAN starts the first transaction in the series.

These four action programs use three indexed files that have been defined to IMS in the FILE section of the configuration:

1. DMOALT — A customer file (alternate account file), sorted on zip code, customer last name, and customer account number sequence (See Figure B-14, lines 12 and 89-96.)

2. DMOMSTR — A customer master file, containing current financial data per customer and sorted in account number sequence. (See Figure B-15, lines 11 and 98-111, and Figure B-16, lines 11 and 94-99.)

3. DMOXACT — An audit file created or updated by the PAYMT transaction and accessed for display by the TOTAL transaction. (See Figure B-16, lines 12 and 100-115, and Figure B-17, lines 11 and 91-108.)

You begin the first transaction by keying in the transaction code, CSCAN on line 1 of the screen and pressing the TRANSMIT key.

```
CSCAN
```

Figure B-1. Initiating the CSCAN Transaction

The CSCAN transaction lists basic customer data by zip code, allowing you to scan the lists. The alternate account file, DMOALT, serves as an index to the customer master file, DMOMSTR. It is sequenced by zip code, customer last name, and customer account number. Figure B-2 shows the resulting output.

```
Line 1  CSCAN 07005 CHRISTIAN       023643
     2
     3  ▶CDETL  132106   HRDLICKA    RICHA  62     COLLINS   06003
     4  ▶CDETL  055760   MCMANUS     R      318    HOOVER    07003
     5  ▶CDETL  158607   MCQUADE     MICHA  153    FRANKL    07003
     6  ▶CDETL  060877   MEYER       R      P.O.   BOX       07003
     7  ▶CDETL  147306   RANDALL     WILLI  261    FRANKL    07003
     8  ▶CDETL  805260   ROHLFING    PAUL   1049   BROAD     07003
     9  ▶CDETL  805606   VANARMAN    JOHN   605 B  TROY      07003
    10  ▶CDETL  805612   VEATCH      STANL  39     OAKLAND   07003
    11  ▶CDETL  105451   WEST        RPBER  100    BELLEV    07003
    12  ▶CDETL  155798   WOOD        EMELL  28     WINDING   07003
```

Figure B-2. Output from CSCAN Transaction Code

The DMSCAN action program (Figure B-14, lines 111-128) displays the first ten records of the DMOALT file (Figure B-2, lines 3-12). The record displayed on line 1 of the screen is the next available record on the file.

By pressing the TRANSMIT key, you can display the next ten records on the file as shown in Figure B-3. (See the DMSCAN action program, Figure B-14, lines 135-141.) Notice that the CSCAN transaction code is displayed on line 1 of the screen, so that when you press TRANSMIT, a new transaction begins and DMSCAN is recheduled.

```
 CSCAN 07006 ROGERS

▶CDETL 023643    CHRISTIAN          GOEG     11 WOODCRE  07005
▶CDETL 023643    FITCH              E        BOX 25      07005
▶CDETL 105390    MORIARTY           T        272 ROCKAW  07005
▶CDETL 805592    TUCKER             CHARL    HILLCREST   07005
▶CDETL 181089    FISH               ROBER    17 CHERRY   07006
▶CDETL 091479    HAFLEIGH           WILLI    3 HIGHFIEL  07006
▶CDETL 139915    LAMBKA             IRWIN    DIRECTOR H  07006
▶CDETL 044246    LONGENECKER        R        20 RICHARD  07006
▶CDETL 179363    MAGEDMAN           DAVID    27 CEDARS   07006
▶CDETL 122399    MCLAUGHLIN         EDWAR    17 SPRUCE   07006
```

Figure B-3. Continuation of Output from CSCAN Transaction Code

You can continue displaying customer records until you reach the end of the file (Figure B-14, lines 151-156 and 175-194).

The CSCAN transaction allows you to scan in another way. Instead of displaying records at the beginning of a file and scanning until you find the customer zip code you want, you can display the first ten records with the desired zip code or higher. By entering the zip code you want after the CSCAN transaction code (see Figure B-4), the DMSCAN action program begins scanning the DMOALT file for the first record that contains that zip code (Figure B-14, lines 151-171 and 179-194).

```
CSCAN 07006█
```

Figure B-4. Initiating a Qualified CSCAN Transaction

Figure B-5 shows the results of this entry after you press the TRANSMIT key.

```
Line 1  CSCAN 07009 RILEY           805238
     2
     3 ▸CDETL 181089      FISH                ROBER    17 CHERRY    07006
     4 ▸CDETL 091479      HAFLEIGH            WILLI    3 HIGHFIEL   07006
     5 ▸CDETL 139915      LAMBKA              IRWIN    DIRECTOR H   07006
     6 ▸CDETL 044246      LONGENECKER         R        20 RICHARD   07006
     7 ▸CDETL 179363      MAGEDMAN            DAVID    27 CEDARS    07006
     8 ▸CDETL 122399      MCLAUGHLIN          EDWAR    17 SPRUCE    07006
     9 ▸CDETL 805257      ROGERS              CLESS    51 RAVINE    07006
    10 ▸CDETL 152069      WILLIAMS            GEORG    60 MCKINLE   07006
    11 ▸CDETL 181050      ROHRER              GARRY    219 CARTER   07008
    12 ▸CDETL 029997      BOONE               GEORG    64 BRUNSWI   07009
```

Figure B-5. Output from Qualified CSCAN Transaction Code

When you've found the customer account for which you want detailed information, you are ready to initiate the CDETL transaction. There are two ways to do this. Let's assume ROGERS is the customer for whom you want to display detailed account information.

1. You can enter the transaction code (CDETL) and ROGERS' account number (805257) on line 1 of the screen and press the TRANSMIT

2. You can forward tab the cursor to a position beyond the last name of the desired customer (ROGERS) as shown in Figure B-6 and press the TRANSMIT key. This method is more efficient because it reduces the number of keystrokes required and the possibility of erroneous data entry

```
Line 1   CSCAN 07009 RILEY           805238
     2
     3   ▸CDETL 181089      FISH                ROBER    17 CHERRY    07006
     4   ▸CDETL 091479      HAFLEIGH            WILLI    3 HIGHFIEL   07006
     5   ▸CDETL 139915      LAMBKA              IRWIN    DIRECTOR H   07006
     6   ▸CDETL 044246      LONGENECKER         R        20 RICHARD   07006
     7   ▸CDETL 179363      MAGEDMAN            DAVID    27 CEDARS    07006
     8   ▸CDETL 122399      MCLAUGHLIN          EDWAR    17 SPRUCE    07006
     9   ▸CDETL 805257      ROGERS              CLESS    51 RAVINE    07006
    10   ▸CDETL 152069      WILLIAMS            GEORG    60 MCKINLE   07006
    11   ▸CDETL 181050      ROHRER              GARRY    219 CARTER   07008
    12   ▸CDETL 029997      BOONE               GEORG    64 BRUNSWI   07009
```

Figure B-6. Initiating the CDETL Transaction

Figure B-7 shows the output screen resulting from using the cursor tabbing/TRANSMIT method of initiating the CDETL transaction. The customer information on the lower part of the screen is displayed by the DMDETL action program (Figure B-15, lines 127-167).

```
CSCAN 07009 RILEY            805238

▶CDETL 181089    FISH                 ROBER    17 CHERRY   07006
▶CDETL 091479    HAFLEIGH             WILLI    3 HIGHFIEL  07006
▶CDETL 139915    LAMBKA               IRWIN    DIRECTOR H  07006
▶CDETL 044246    LONGENECKER          R        20 RICHARD  07006
▶CDETL 179363    MAGEDMAN             DAVID    27 CEDARS   07006
▶CDETL 122399    MCLAUGHLIN           EDWAR    17 SPRUCE   07006
▶CDETL 805257    ROGERS               CLESS    51 RAVINE   07006
▶CDETL 152069    WILLIAMS             GEORG    60 MCKINLE  07006
▶CDETL 181050    ROHRER               GARRY    219 CARTER  07008
▶CDETL 029997    BOONE                GEORG    64 BRUNSWI  07009

CUSTOMER:  805257

CLESSEN    A ROGERS               PURCHASE PRICE:  $229.49
51 RAVINE AVENUE                        REVISION:       NO
CALDWELL         NJ 07006           PAYMENT PLAN         T
                                 CURRENT BALANCE:  $100.00
                                  PAYMENT AMOUNT:   $22.95

▶PAYMT 805257
```

Figure B-7. Output from CDETL Transaction

When the DMDETL program reads the master record successfully and it contains a Y in its last byte, the program moves the word 'YES' to the output field containing REVISION and you can make changes to the customer record you selected. (See Figure B-15, lines 199 and 200.) Otherwise, the DMDETL program moves the word 'NO' to the REVISION output field and you can display another customer's account information at the bottom of the screen.

Notice that the DMDETL program automatically succeeds to the PAYMT transaction when you update the customer whose detailed information you displayed. DMDETL accomplishes this by moving the transaction code, PAYMT, in the form of a constant from working storage to the output message area (Figure B-16, line 196). Then, when you move the cursor to a point beyond the PAYMT transaction code and account number, the PAYMT transaction begins.

There are two ways to initiate the PAYMT transaction:

1. Forward tab the cursor to a position beyond the account number following the PAYMT transaction code and press the TRANSMIT key. (See Figure B-8.)

2. Enter a payment amount different than the payment plan amount. You enter the amount next to the account number following the PAYMT transaction code and press the TRANSMIT key. (See Figure B-10.)

The first method instructs the DMPYMT action program to subtract the payment plan amount ($22.95 in Figure B-8) from this customer's current balance ($100.00 in Figure B-8). (See Figure B-16, line 157.)

```
 CSCAN 07009 RILEY           805238

▶CDETL 181089    FISH                 ROBER    17 CHERRY   07006
▶CDETL 091479    HAFLEIGH             WILLI    3 HIGHFIEL  07006
▶CDETL 139915    LAMBKA               IRWIN    DIRECTOR H  07006
▶CDETL 044246    LONGENECKER          R        20 RICHARD  07006
▶CDETL 179363    MAGEDMAN             DAVID    27 CEDARS   07006
▶CDETL 122399    MCLAUGHLIN           EDWAR    17 SPRUCE   07006
▶CDETL 805257    ROGERS               CLESS    51 RAVINE   07006
▶CDETL 152069    WILLIAMS             GEORG    60 MCKINLE  07006
▶CDETL 181050    ROHRER               GARRY    219 CARTER  07008
▶CDETL 029997    BOONE                GEORG    64 BRUNSWI  07009

 CUSTOMER:   805257

 CLESSEN     A  ROGERS            PURCHASE PRICE:   $229.49
 51 RAVINE AVENUE                       REVISION:        NO
 CALDWELL            NJ 07006       PAYMENT PLAN:         T
                                 CURRENT BALANCE:   $100.00
                                  PAYMENT AMOUNT:    $22.95
▶PAYMT 805257
```

Figure B-8. First Method for Initiating the PAYMT Transaction

Figure B-9 shows the results of this subtraction to obtain the customer's new balance.

```
 CSCAN 07009 RILEY          805238

▶CDETL 181089   FISH                 ROBER    17 CHERRY   07006
▶CDETL 091479   HAFLEIGH             WILLI    3 HIGHFIEL  07006
▶CDETL 139915   LAMBKA               IRWIN    DIRECTOR H  07006
▶CDETL 044246   LONGENECKER          R        20 RICHARD  07006
▶CDETL 179363   MAGEDMAN             DAVID    27 CEDARS   07006
▶CDETL 122399   MCLAUGHLIN           EDWAR    17 SPRUCE   07006
▶CDETL 805257   ROGERS               CLESS    51 RAVINE   07006
▶CDETL 152069   WILLIAMS             GEORG    60 MCKINLE  07006
▶CDETL 181050   ROHRER               GARRY    219 CARTER  07008
▶CDETL 029997   BOONE                GEORG    64 BRUNSWI  07009

 CUSTOMER:   805257

 CLESSEN     A  ROGERS           PURCHASE PRICE:   $229.49
 51 RAVINE AVENUE                      REVISION:        NO
 CALDWELL           NJ 07006       PAYMENT PLAN:         T
                                CURRENT BALANCE:   $100.00
                                 PAYMENT AMOUNT:    $22.95
▶PAYMT 805257

$22.95 PAYMENT ACCEPTED FOR CUST.  805257  NEW BALANCE:  $77.05
```

Figure B-9. Output from PAYMT Transaction Using Standard Payment Amount

Transmitting only the transaction code and customer account number confirms the amount applied to the customer's new balance. In addition, two processing operations occur:

1. The DMPYMT action program updates customer's current balance on the customer master file (DMOMSTR). (See Figure B-16, lines 158-159.)

2. The DMPYMT action program adds a payment transaction record to a daily terminal transaction file. (See Figure B-16, lines 169-200 especially lines 185-187.)

With the second method of initiating the PAYMT transaction, you enter a payment amount different than the payment plan amount next to the customer number that follows the PAYMT transaction code on the screen. Position your cursor next and depress the TRANSMIT key as shown in Figure B-10, line 21.

```
line 1   CSCAN 07009 RILEY          805238
     2
     3   ▶CDETL 181089    FISH                ROBER    17 CHERRY    07006
     4   ▶CDETL 091479    HAFLEIGH            WILLI    3 HIGHFIEL   07006
     5   ▶CDETL 139915    LAMBKA              IRWIN    DIRECTOR H   07006
     6   ▶CDETL 044246    LONGENECKER         R        20 RICHARD   07006
     7   ▶CDETL 179363    MAGEDMAN            DAVID    27 CEDARS    07006
     8   ▶CDETL 122399    MCLAUGHLIN          EDWAR    17 SPRUCE    07006
     9   ▶CDETL 805257    ROGERS              CLESS    51 RAVINE    07006
    10   ▶CDETL 152069    WILLIAMS            GEORG    60 MCKINLE   07006
    11   ▶CDETL 181050    ROHRER              GARRY    219 CARTER   07008
    12   ▶CDETL 029997    BOONE               GEORG    64 BRUNSWI   07009
    13
    14    CUSTOMER:   805257
    15
    16    CLESSEN     A  ROGERS           PURCHASE PRICE:   $229.49
    17    51 RAVINE AVENUE                      REVISION:        NO
    18    CALDWELL           NJ 07006       PAYMENT PLAN:         T
    19                                   CURRENT BALANCE:   $100.00
    20                                    PAYMENT AMOUNT:    $22.95
    21  ▶PAYMT 805257 575
```

Figure B-10. Second Method for Initiating PAYMT Transaction

Suppose you enter the value 575 ($5.75) next to the account number. When you press the TRANSMIT key, the result is as shown in Figure B-11.

```
Line 1   CSCAN 07009 RILEY          805238
     2
     3   ▶CDETL 181089    FISH                ROBER    17 CHERRY   07006
     4   ▶CDETL 091479    HAFLEIGH            WILLI    3 HIGHFIEL  07006
     5   ▶CDETL 139915    LAMBKA              IRWIN    DIRECTOR H  07006
     6   ▶CDETL 044246    LONGENECKER         R        20 RICHARD  07006
     7   ▶CDETL 179363    MAGEDMAN            DAVID    27 CEDARS   07006
     8   ▶CDETL 122399    MCLAUGHLIN          EDWAR    17 SPRUCE   07006
     9   ▶CDETL 805257    ROGERS              CLESS    51 RAVINE   07006
    10   ▶CDETL 152069    WILLIAMS            GEORG    60 MCKINLE  07006
    11   ▶CDETL 181050    ROHRER              GARRY    219 CARTER  07008
    12   ▶CDETL 029997    BOONE               GEORG    64 BRUNSWI  07009
    13
    14    CUSTOMER:   805257
    15
    16    CLESSEN     A  ROGERS            PURCHASE PRICE:    $229.49
    17    51 RAVINE AVENUE                      REVISION:         NO
    18    CALDWELL           NJ 07006        PAYMENT PLAN:          T
    19                                    CURRENT BALANCE:    $100.00
    20                                     PAYMENT AMOUNT:     $22.95
    21   PAYMT 805257
    22
    23  ▶$5.75  PAYMENT ACCEPTED FOR CUST.  805257  NEW BALANCE:   $94.25
```

Figure B-11. Result of Entering Different Payment Amount on PAYMT Transaction

DMPYMT confirms the receipt of payment by issuing a message (Figure B-16, lines 29-32 and 194-197) and applies the entered amount to the customer's new balance (Figure B-16, line 157).

The last action program, DMTOTL, totals all payment amounts entered for a particular customer. To initiate this audit trail program, you enter the TOTAL transaction code.

Let's assume that in addition to the payment plan amount of $22.95 for account number 805257, you've entered two payments for other customers, one for $5.75 and another for $3.00. You therefore entered three payments at terminal 1 totaling $31.70. By entering the TOTAL transaction code (Figure B-12, line 1), you can obtain an audit report display (Figure B-12, lines 3-6) showing the number of payments and total payment amount initiated from your terminal (TRM1).

```
TOTAL

TERMINAL         NUMBER OF          TOTAL
   ID           TRANSACTIONS       PAYMENTS

  TRM1               3              $31.70
```

Figure B-12. Result of Initiating the TOTAL Transaction

If you enter the option ALL following the transaction code, the DMTOTL action program also can accumulate totals for all transactions and all payments made at all terminals for an entire session.

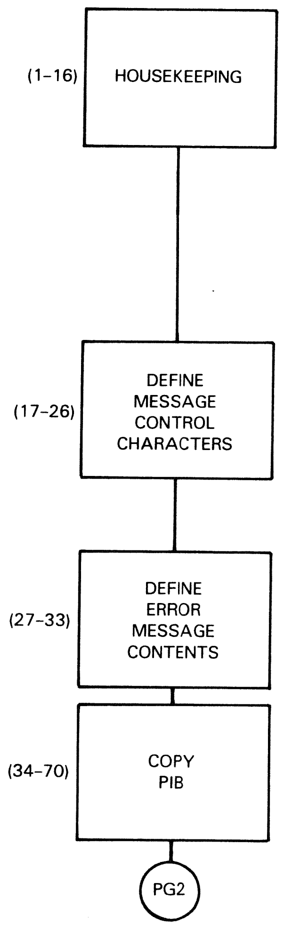
Suppose three transactions were entered from terminal 1 with total payments of $31.70. Then seven more transactions were entered at terminal 5 totaling $187.57. Finally, four more transactions were made at terminal 6 totaling $78.97 in payments.

When you enter TOTAL ALL at the terminal the DMTOTL action program not only accumulates the total transactions and payments for each terminal but also accumulates a grand total of transactions and payments made in this session. Figure B-13 illustrates the output message generated when you enter the transaction code TOTAL and the option ALL.

```
TOTAL ALL

TERMINAL            NUMBER OF           TOTAL
   ID              TRANSACTIONS        PAYMENTS

 TRM1                    3             $$31.70
 TRM5                    7             $187.57
 TRM6                                  $$78.97
 -----                 ----            --------
                                       $298.14
```

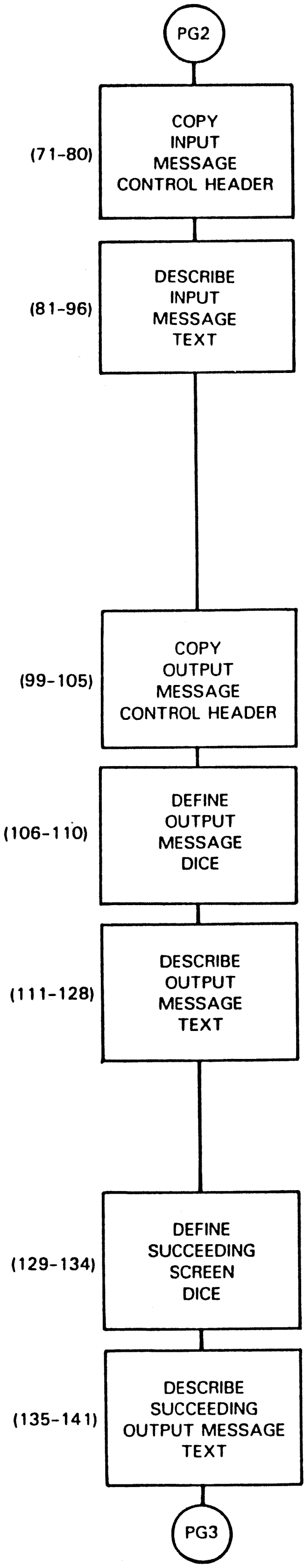
Figure B-13. Result of Initiating the TOTAL Transaction with ALL Option

General flowcharts for the coding in DMSCAN, DMDETL, DMPYMT, and DMTOTL action programs (Figures B-14 through B-17) adjoin each program. Program line numbers in parentheses near flowchart boxes represent the lines of coding that implement the process described.



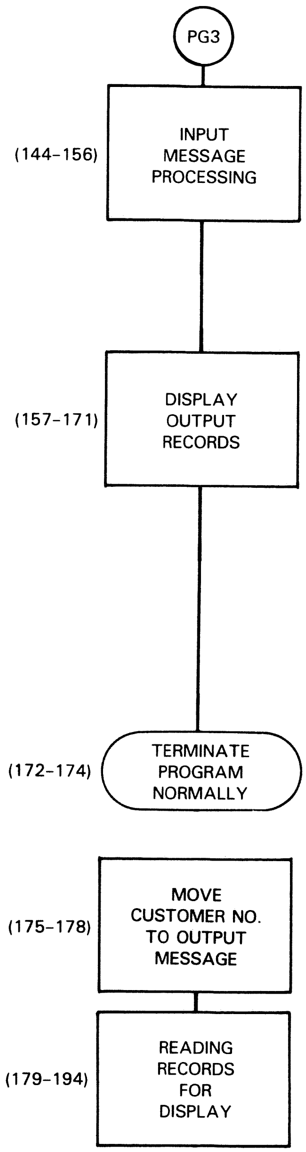

```
LINE NO. SOURCE ENTRY

00001   IDENTIFICATION DIVISION.
00002   PROGRAM-ID.  DMSCAN.
00003   AUTHOR.  E.O.F.S.F.  (NYNA 7/76)
00004   DATE-WRITTEN.  7/13/76.
00005   DATE-COMPILED. 82/05/03.
00006   ENVIRONMENT DIVISION.
00007   CONFIGURATION SECTION.
00008   SOURCE-COMPUTER.  UNIVAC-OS3.
00009   OBJECT-COMPUTER.  UNIVAC-OS3.
00010   DATA DIVISION.
00011   WORKING-STORAGE SECTION.
00012   77  DMOALT                  PIC X(7)    VALUE 'DMOALT'.
00013   77  OUT-MSG-LEN             PIC 9999    COMP-4      VALUE 768.
00014   77  GE                      PIC X       VALUE 'G'.
00015   77  CSCAN                   PIC X(5)    VALUE 'CSCAN'.
00016   77  CDETL                   PIC X(5)    VALUE 'CDETL'.
00017   01  SCOPE-CHAR.
00018       02 CR                   PIC X         VALUE ='0D'.
00019       02 DLE                  PIC X         VALUE ='10'.
00020       02 ESC                  PIC X         VALUE ='27'.
00021       02 HT                   PIC X         VALUE ='05'.
00022       02 STX                  PIC X         VALUE ='02'.
00023       02 EXT                  PIC X         VALUE ='03'.
00024       02 SOE                  PIC X         VALUE ='1E'.
00025       02 ONE                  PIC X         VALUE ='01'.
00026       02 THREE                PIC X         VALUE ='03'.
00027   01  ERR-MSG-LITS.
00028       02 FILLER               PIC X(19)   VALUE '**INVALID KEY**'.
00029       02 FILLER               PIC X(19)   VALUE '**END OF FILE**'.
00030       02 FILLER               PIC X(19)   VALUE '**INVALID REQUEST**'.
00031       02 FILLER               PIC X(19)   VALUE '**I/O ERROR**'.
00032   01  ERR-MSG-TAB             REDEFINES ERR-MSG-LITS.
00033       02 ERR                  PIC X(19)   OCCURS 4.
00034   LINKAGE SECTION.
00035   01  P-I-B.                  COPY PIB74.
00036       02  STATUS-CODE                     PIC 9(4) COMP-4.
00037       02  DETAILED-STATUS-CODE            PIC 9(4) COMP-4.
00038       02  RECORD-TYPE REDEFINES DETAILED-STATUS-CODE.
00039           03 PREDICTED-RECORD-TYPE        PIC X.
00040           03 DELIVERED-RECORD-TYPE        PIC X.
00041       02  SUCCESSOR-ID                    PIC X(6).
00042       02  TERMINATION-INDICATOR           PIC X.
00043       02  LOCK-ROLLBACK-INDICATOR         PIC X.
00044       02  TRANSACTION-ID.
00045           03 YEAR                         PIC 9(4) COMP-4.
00046           03 TODAY                        PIC 9(4) COMP-4.
00047           03 HR-MIN-SEC                   PIC 9(9) COMP-4.
00048       02  DATA-DEF-REC-NAME               PIC X(7).
00049       02  DEFINED-FILE-NAME               PIC X(7).
00050       02  STANDARD-MSG-LINE-LENGTH        PIC 9(4) COMP-4.
00051       02  STANDARD-MSG-NUMBER-LINES       PIC 9(4) COMP-4.
00052       02  WORK-AREA-LENGTH                PIC 9(4) COMP-4.
00053       02  CONTINUITY-DATA-INPUT-LENGTH    PIC 9(4) COMP-4.
00054       02  CONTINUITY-DATA-OUTPUT-LENGTH   PIC 9(4) COMP-4.
00055       02  WORK-AREA-INC                   PIC 9(4) COMP-4.
00056       02  CONTINUITY-DATA-AREA-INC        PIC 9(4) COMP-4.
00057       02  SUCCESS-UNIT-ID.
00058           03 TRANSACTION-DATE.
00059              04 YEAR                      PIC 99.
00060              04 MONTH                     PIC 99.
00061              04 TODAY                     PIC 99.
00062           03 TIME-OF-DAY.
00063              04 HOUR                      PIC 99.
00064              04 MINUTE                    PIC 99.
00065              04 SECOND                    PIC 99.
00066           03 FILLER                       PIC XXX.
00067       02  SOURCE-TERMINAL-CHARS.
00068           03 SOURCE-TERMINAL-TYPE       PIC X.
00069           03 SOURCE-TERM-MSG-LINE-LENGTH    PIC 9(4) COMP-4.
00070           03 SOURCE-TERM-MSG-NUMBER-LINES   PIC 9(4) COMP-4.
```

Figure B-14. Sample COBOL Action Program DMSCAN (Part 1 of 3)



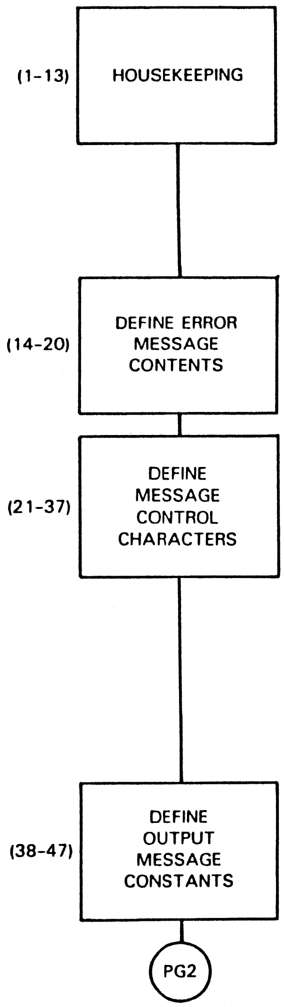

```
00071   01   I-M-A.                      COPY IMA74.
00072        02 SOURCE-TERMINAL-ID                        PIC X(4).
00073        02 DATE-TIME-STAMP.
00074           03 YEAR                                   PIC 9(4) COMP-4.
00075           03 TODAY                                  PIC 9(4) COMP-4.
00076           03 HR-MIN-SEC                             PIC 9(9) COMP-4.
00077        02 TEXT-LENGTH                               PIC 9(4) COMP-4.
00078        02 AUXILIARY-DEV-ID.
00079           03 FILLER                               PIC X.
00080           03 AUX-DEV-NO                           PIC X.
00081        02 FILLER               PIC X(6).
00082        02 ZIP-IN               PIC X(5).
00083        02 FILLER               PIC X.
00084        02 LN-CUSTID.
00085            03 LN-IN            PIC X(17).
00086            03 FILLER           PIC X(8).
00087        02 RED-LN-CUSTID        REDEFINES LN-CUSTID.
00088            03 CHAR             PIC X       OCCURS 25    INDEXED BY I.
00089   01   ALT-REC.
00090        02 ALT-KEY.
00091            03 ZIP              PIC X(5).
00092            03 LN               PIC X(17).
00093            03 CUSTOMER.
00094               04 KEY-CHAR      PIC X       OCCURS 6     INDEXED BY J.
00095        02 FN-5                 PIC X(5).
00096        02 ADDR-10              PIC X(10).
00097   01   O-M-A.                  COPY OMA74.
00098        02 DESTINATION-TERMINAL-ID          PIC X(4).
00099                 02 SFS-OPTIONS                        PIC X(2).
00100                 02 FILLER                             PIC X(2).
00101        02 CONTINUOUS-OUTPUT-CODE           PIC X(4).
00102        02 TEXT-LENGTH                   PIC 9(4)     COMP-4.
00103        02 AUXILIARY-DEVICE-ID.
00104           03 AUX-FUNCTION                  PIC X.
00105           03 AUX-DEVICE-NO                 PIC X.
00106        02 DICE-1.
00107            03 TEN-1            PIC X.
00108            03 FN-1             PIC X.
00109            03 Y-1              PIC X.
00110            03 X-1              PIC X.
00111        02 DISPLAY-TABLE.
00112            03 CUST-LINE                    OCCURS 10    INDEXED BY K.
00113               04 SOE-OUT       PIC X.
00114               04 TRAN-OUT      PIC X(5).
00115               04 FILLER        PIC X.
00116               04 CUST-OUT      PIC X(6).
00117               04 FILLER        PIC X(5).
00118               04 LN-OUT        PIC X(17).
00119               04 FILLER        PIC XX.
00120               04 ESC-OUT       PIC X.
00121               04 HT-OUT        PIC X.
00122               04 FILLER        PIC XX.
00123               04 FN-OUT        PIC X(5).
00124               04 FILLER        PIC X(5).
00125               04 ADDR-OUT      PIC X(10).
00126               04 FILLER        PIC X(5).
00127               04 ZIP-OUT       PIC X(5).
00128               04 CR-OUT        PIC X.
00129        02 TOP-OF-SCREEN.
00130            03 DICE-2.
00131               04 TEN-2         PIC X.
00132               04 FN-2          PIC X.
00133               04 Y-2           PIC X.
00134               04 X-2           PIC X.
00135            03 NEXT-TRAN        PIC X(5).
00136            03 FILLER           PIC X.
00137            03 NEXT-ZIP         PIC X(5).
00138            03 FILLER           PIC X.
00139            03 NEXT-LN          PIC X(17).
00140            03 FILLER           PIC X.
00141            03 NEXT-CUST        PIC X(6).
```

Figure B-14. Sample COBOL Action Program DMSCAN (Part 2 of 3)



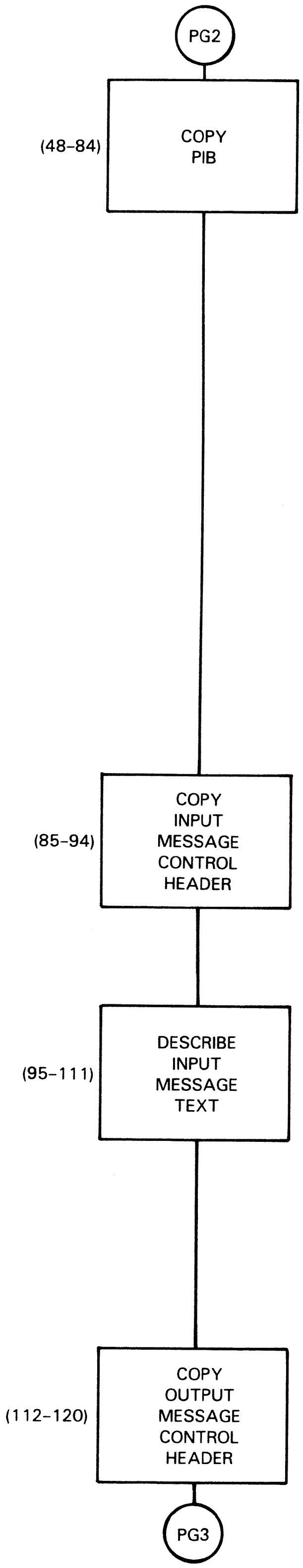

```
00142  PROCEDURE DIVISION
00143      USING P-I-B I-M-A ALT-REC O-M-A.
00144  BEGIN-PROC.
00145      MOVE SPACES TO DISPLAY-TABLE TOP-OF-SCREEN.
00146      MOVE DLE TO TEN-1 TEN-2.
00147      MOVE EXT TO FN-1.
00148      MOVE STX TO FN-2.
00149      MOVE THREE TO Y-1.
00150      MOVE ONE TO X-1 X-2 Y-2.
00151      IF TEXT-LENGTH IN I-M-A > 24
00152          THEN SET I TO TEXT-LENGTH IN I-M-A
00153               SET I DOWN BY 22
00154               IF CHAR (I) IS NUMERIC AND CHAR (I + 5) IS NUMERIC
00155                   THEN PERFORM MV-ID
00156                             VARYING J FROM 1 BY 1 UNTIL J > 6.
00157      MOVE LN-IN TO LN.
00158      MOVE ZIP-IN TO ZIP.
00159      CALL 'SETL'
00160          USING DMOALT GE ALT-KEY.
00161      IF STATUS-CODE > 0
00162          THEN MOVE ERR (STATUS-CODE) TO CUST-LINE (1)
00163               GO TO END-PROG.
00164      CALL 'GET'
00165          USING DMOALT ALT-REC.
00166      PERFORM READ-LOOP
00167          VARYING K FROM 1 BY 1 UNTIL K > 10.
00168      MOVE CSCAN TO NEXT-TRAN.
00169      MOVE ZIP TO NEXT-ZIP.
00170      MOVE LN TO NEXT-LN.
00171      MOVE CUSTOMER TO NEXT-CUST.
00172  END-PROG.
00173      MOVE OUT-MSG-LEN TO TEXT-LENGTH IN O-M-A.
00174      CALL 'RETURN'.
00175  MV-ID.
00176      MOVE CHAR (I) TO KEY-CHAR (J).

00177      MOVE SPACE TO CHAR (I).
00178      SET I UP BY 1.
00179  READ-LOOP.
00180      IF STATUS-CODE > 0
00181          THEN MOVE ERR (STATUS-CODE) TO CUST-LINE (K)

00182               GO TO END-PROG.
00183      MOVE SOE TO SOE-OUT (K).
00184      MOVE CDETL TO TRAN-OUT (K).
00185      MOVE CUSTOMER TO CUST-OUT (K).
00186      MOVE LN TO LN-OUT (K).
00187      MOVE ESC TO ESC-OUT (K).
00188      MOVE HT TO HT-OUT (K).
00189      MOVE FN-5 TO FN-OUT (K).
00190      MOVE ADDR-10 TO ADDR-OUT (K).
00191      MOVE ZIP TO ZIP-OUT (K).
00192      MOVE CR TO CR-OUT (K).
00193      CALL 'GET'
00194          USING DMOALT ALT-REC.
```

Figure B-14. Sample COBOL Action Program DMSCAN (Part 3 of 3)



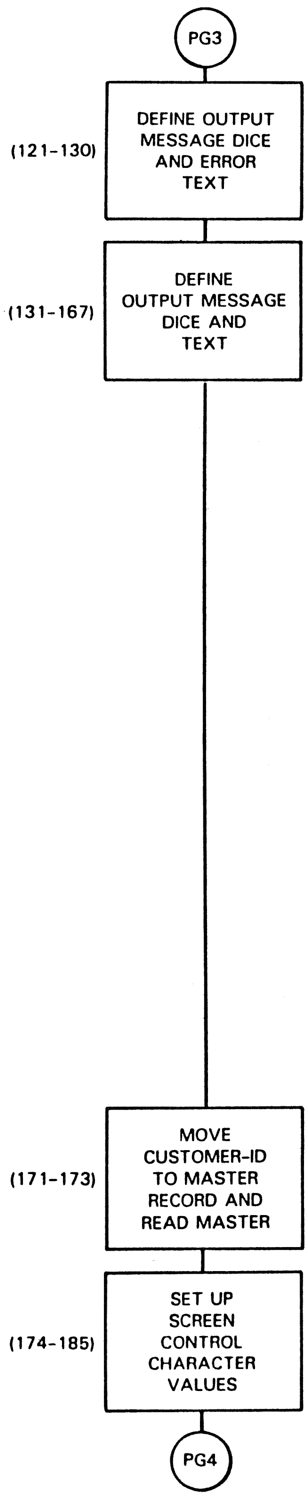

```
LINE NO. SOURCE ENTRY

00001  IDENTIFICATION DIVISION.
00002  PROGRAM-ID.  DMDETL.
00003  AUTHOR.  E.O.F.S.F.  (NYNA 7/76)
00004  DATE-WRITTEN.  7/16/76.
00005  ENVIRONMENT DIVISION.
00006  CONFIGURATION SECTION.
00007  SOURCE-COMPUTER.  UNIVAC-OS3.
00008  OBJECT-COMPUTER.  UNIVAC-OS3.
00009  DATA DIVISION.
00010  WORKING-STORAGE SECTION.
00011  77  DMOMSTR                PIC X(7)    VALUE 'DMOMSTR'.
00012  77  OUT-MSG-LEN            PIC 9999    COMP-4      VALUE 327.
00013  77  ERR-MSG-LEN            PIC 9999    COMP-4      VALUE  27.
00014  01  ERR-MSG-LITS.
00015      02 FILLER              PIC X(19)   VALUE '**INVALID KEY**'.
00016      02 FILLER              PIC X(19)   VALUE '**END OF FILE**'.
00017      02 FILLER              PIC X(19)   VALUE '**INVALID REQUEST**'.
00018      02 FILLER              PIC X(19)   VALUE '**I/O ERROR**'.
00019  01  ERR-MSG-TBL            REDEFINES ERR-MSG-LITS.
00020      02 ERR-MSG             PIC X(19)   OCCURS 4.
00021  01  SCOPE-CHAR.
00022      02 DLE                 PIC X         VALUE ='10'.
00023      02 STX                 PIC X         VALUE ='02'.
00024      02 EXT                 PIC X         VALUE ='C3'.
00025      02 SOE                 PIC X         VALUE ='1E'.
00026      02 CR                  PIC X         VALUE ='0D'.
00027      02 ONE                 PIC X         VALUE ='01'.
00028      02 THREE               PIC X         VALUE ='03'.
00029      02 FIVE                PIC X         VALUE ='05'.
00030      02 EIGHT               PIC X         VALUE ='08'.
00031      02 NINE                PIC X         VALUE ='09'.
00032      02 FIFTEEN             PIC X         VALUE ='0F'.
00033      02 SIXTEEN             PIC X         VALUE ='10'.
00034      02 EIGHTEEN            PIC X         VALUE ='12'.
00035      02 TWENTY-ONE          PIC X         VALUE ='15'.
00036      02 TWENTY-TWO          PIC X         VALUE ='16'.
00037      02 FORTY-ONE           PIC X         VALUE ='29'.
00038  01  MSG-LITS.
00039      02 CUSTOMER-LIT        PIC X(11)   VALUE 'CUSTOMER #:'.
00040      02 PURCH-PR            PIC X(15)   VALUE 'PURCHASE PRICE:'.
00041      02 PAYMT-PLAN          PIC X(13)   VALUE 'PAYMENT PLAN:'.
00042      02 PAYMT-AMT           PIC X(15)   VALUE 'PAYMENT AMOUNT:'.
00043      02 BAL                 PIC X(16)   VALUE 'CURRENT BALANCE:'.
00044      02 REVISION            PIC X(9)    VALUE 'REVISION:'.
00045      02 YES                 PIC XXX     VALUE 'YES'.
00046      02 KNO                 PIC XXX     VALUE ' NO'.
00047      02 PAYMT               PIC X(5)    VALUE 'PAYMT'.
```

Figure B-15. Sample COBOL Action Program DMDETL (Part 1 of 4)



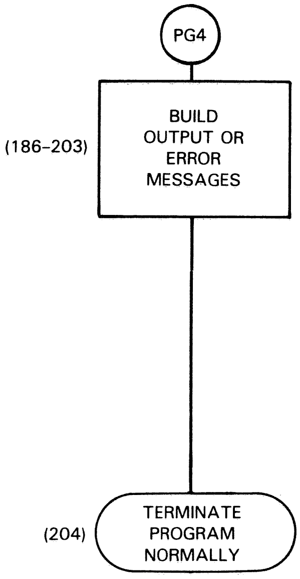

```
00048   LINKAGE SECTION.
00049   01   P-I-B.                  COPY PIB74.
00050        02   STATUS-CODE                    PIC 9(4) COMP-4.
00051        02   DETAILED-STATUS-CODE           PIC 9(4) COMP-4.
00052        02   RECORD-TYPE REDEFINES DETAILED-STATUS-CODE.
00053             03 PREDICTED-RECORD-TYPE       PIC X.
00054             03 DELIVERED-RECORD-TYPE       PIC X.
00055        02   SUCCESSOR-ID                   PIC X(6).
00056        02   TERMINATION-INDICATOR          PIC X.
00057        02   LOCK-ROLLBACK-INDICATOR        PIC X.
00058        02   TRANSACTION-ID.
00059             03 YEAR                        PIC 9(4) COMP-4.
00060             03 TODAY                       PIC 9(4) COMP-4.
00061             03 HR-MIN-SEC                  PIC 9(9) COMP-4.
00062        02   DATA-DEF-REC-NAME              PIC X(7).
00063        02   DEFINED-FILE-NAME              PIC X(7).
00064        02   STANDARD-MSG-LINE-LENGTH       PIC 9(4) COMP-4.
00065        02   STANDARD-MSG-NUMBER-LINES      PIC 9(4) COMP-4.
00066        02   WORK-AREA-LENGTH               PIC 9(4) COMP-4.
00067        02   CONTINUITY-DATA-INPUT-LENGTH   PIC 9(4) COMP-4.
00068        02   CONTINUITY-DATA-OUTPUT-LENGTH  PIC 9(4) COMP-4.
00069        02   WORK-AREA-INC                  PIC 9(4) COMP-4.
00070        02   CONTINUITY-DATA-AREA-INC       PIC 9(4) COMP-4.
00071        02   SUCCESS-UNIT-ID.
00072             03 TRANSACTION-DATE.
00073                04 YEAR                     PIC 99.
00074                04 MONTH                    PIC 99.
00075                04 TODAY                    PIC 99.
00076             03 TIME-OF-DAY.
00077                04 HOUR                     PIC 99.
00078                04 MINUTE                   PIC 99.
00079                04 SECOND                   PIC 99.
00080             03 FILLER                      PIC XXX.
00081        02   SOURCE-TERMINAL-CHARS.
00082             03 SOURCE-TERMINAL-TYPE     PIC X.
00083             03 SOURCE-TERM-MSG-LINE-LENGTH     PIC 9(4) COMP-4.
00084             03 SOURCE-TERM-MSG-NUMBER-LINES    PIC 9(4) COMP-4.
00085   01   I-M-A.                  COPY IMA74.
00086        02 SOURCE-TERMINAL-ID                   PIC X(4).
00087        02 DATE-TIME-STAMP.
00088           03 YEAR                              PIC 9(4) COMP-4.
00089           03 TODAY                             PIC 9(4) COMP-4.
00090           03 HR-MIN-SEC                        PIC 9(9) COMP-4.
00091        02 TEXT-LENGTH                          PIC 9(4) COMP-4.
00092        02 AUXILIARY-DEV-ID.
00093           03 FILLER                           PIC X.
00094           03 AUX-DEV-NO                       PIC X.
00095        02 FILLER               PIC X(6).
00096        02 CUSTID               PIC X(6).
00097        02 FILLER               PIC X(24).
00098   01   MSTR-REC.
00099        02 CUSTNO               PIC X(6).
00100        02 FN                   PIC X(10).
00101        02 MI                   PIC X.
00102        02 LN                   PIC X(17).
00103        02 ADDR                 PIC X(23).
00104        02 CITY                 PIC X(18).
00105        02 ST                   PIC XX.
00106        02 ZIP                  PIC X(5).
00107        02 PURCHASE-PRICE       PIC 999V99.
00108        02 PAY-PLAN             PIC X.
00109        02 PAY-AMT              PIC 999V99.
00110        02 BALANCE              PIC 999V99.
00111        02 UPDATE               PIC X.
00112   01   O-M-A.                  COPY OMA74.
00113        02 DESTINATION-TERMINAL-ID          PIC X(4).
00114                 02 SFS-OPTIONS                       PIC X(2).
00115                 02 FILLER                            PIC X(2).
00116        02 CONTINUOUS-OUTPUT-CODE           PIC X(4).
00117        02 TEXT-LENGTH                   PIC 9(4)    COMP-4.
00118        02 AUXILIARY-DEVICE-ID.
00119           03 AUX-FUNCTION                  PIC X.
00120           03 AUX-DEVICE-NO                 PIC X.
```

Figure B-15. Sample COBOL Action Program DMDETL (Part 2 of 4)



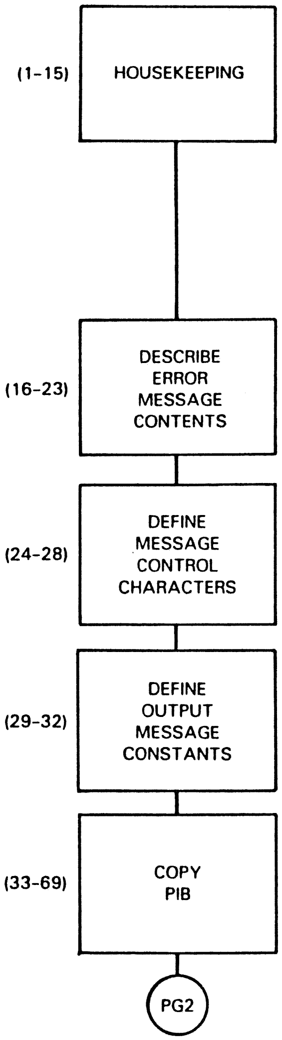

```
00121  02 DICE-1.
00122       03 DLE-1          PIC X.
00123       03 EXT-1          PIC X.
00124       03 Y-1            PIC X.
00125       03 X-1            PIC X.
00126  02 ERR-LINE            PIC X(19).
00127  02 CUST                REDEFINES ERR-LINE.
00128       03 CUSTOMER       PIC X(13).
00129       03 CUST-1         PIC X(6).
00130  02 DICE-2.
00131       03 DLE-2          PIC X.
00132       03 STX-2          PIC X.
00133       03 Y-2            PIC X.
00134       03 X-2            PIC X.
00135  02 FN                  PIC X(11).
00136  02 MI                  PIC XXX.
00137  02 LN                  PIC X(27).
00138  02 PURCH-PR            PIC X(17).
00139  02 PURCHASE-PRICE      PIC $$$9.99.
00140  02 CR-1                PIC X.
00141  02 ADDR                PIC X(47).
00142  02 REVISION            PIC X(15).
00143  02 UPD                 PIC XXX.
00144  02 CR-2                PIC X.
00145  02 CITY                PIC X(20).
00146  02 ST                  PIC XXXX.
00147  02 ZIP                 PIC X(19).
00148  02 PAYMT-PLAN          PIC X(21).
00149  02 PAY-PLAN            PIC X.
00150  02 DICE-3.
00151       03 DLE-3          PIC X.
00152       03 STX-3          PIC X.
00153       03 Y-3            PIC X.
00154       03 X-3            PIC X.
00155       02 BAL                PIC X(18).
00156       02 BALANCE            PIC $$$9.99.
00157       02 CR-3               PIC X.
00158       02 SOE-OUT            PIC X.
00159       02 PAYMT              PIC X(6).
00160       02 CUST-2             PIC X(34).
00161       02 PAYMT-AMT          PIC X(17).
00162       02 PAY-AMT            PIC $$$9.99.
00163       02 DICE-4.
00164            03 DLE-4         PIC X.
00165            03 STX-4         PIC X.
00166            03 Y-4           PIC X.
00167            03 X-4           PIC X.
00168  PROCEDURE DIVISION
00169       USING F-I-B I-M-A MSTR-REC O-M-A.

00170  BEGIN-PROC.
00171       MOVE CUSTID TO CUSTNO.
00172       CALL 'GET'
00173            USING DMOMSTR MSTR-REC CUSTNO.
00174       MOVE DLE TO DLE-1.
00175       MOVE EXT TO EXT-1.
00176       IF STANDARD-MSG-NUMBER-LINES NOT > 12
00177            THEN MOVE THREE TO Y-1
00178                 MOVE FIVE TO Y-2
00179                 MOVE EIGHT TO Y-3
00180                 MOVE NINE TO Y-4
00181            ELSE MOVE SIXTEEN TO Y-1
00182                 MOVE EIGHTEEN TO Y-2
00183                 MOVE TWENTY-ONE TO Y-3
00184                 MOVE TWENTY-TWO TO Y-4.
00185       MOVE ONE TO X-1.
```

Figure B-15. Sample COBOL Action Program DMDETL (Part 3 of 4)



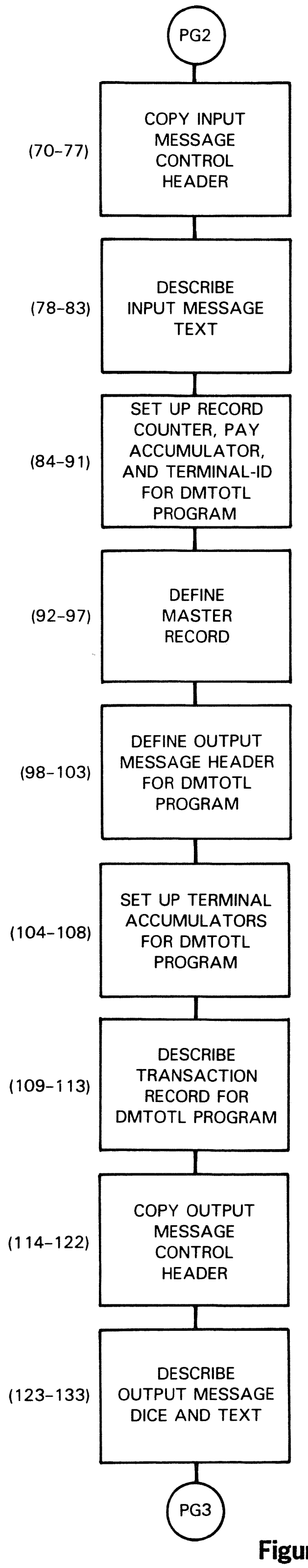

```
00186     IF STATUS-CODE = 0
00187         THEN MOVE CR TO CR-1 CR-2 CR-3
00188              MOVE DLE TO DLE-2 DLE-3 DLE-4
00189              MOVE STX TO STX-2 STX-3 STX-4
00190              MOVE ONE TO X-2
00191              MOVE FORTY-ONE TO X-3
00192              MOVE FIFTEEN TO X-4
00193              MOVE SOE TO SOE-OUT
00194              MOVE CUSTOMER-LIT TO CUSTOMER
00195              MOVE CUSTNO TO CUST-1 CUST-2
00196              MOVE CORR MSG-LITS TO O-M-A
00197              MOVE CORR MSTR-REC TO O-M-A
00198              MOVE OUT-MSG-LEN TO TEXT-LENGTH IN O-M-A
00199              IF UPDATE = 'Y'
00200                  THEN MOVE YES TO UPD
00201                  ELSE MOVE KNO TO UPD
00202         ELSE MOVE ERR-MSG (STATUS-CODE) TO ERR-LINE
00203              MOVE ERR-MSG-LEN TO TEXT-LENGTH IN O-M-A.
00204     CALL 'RETURN'.
```

Figure B-15. Sample COBOL Action Program DMDETL (Part 4 of 4)



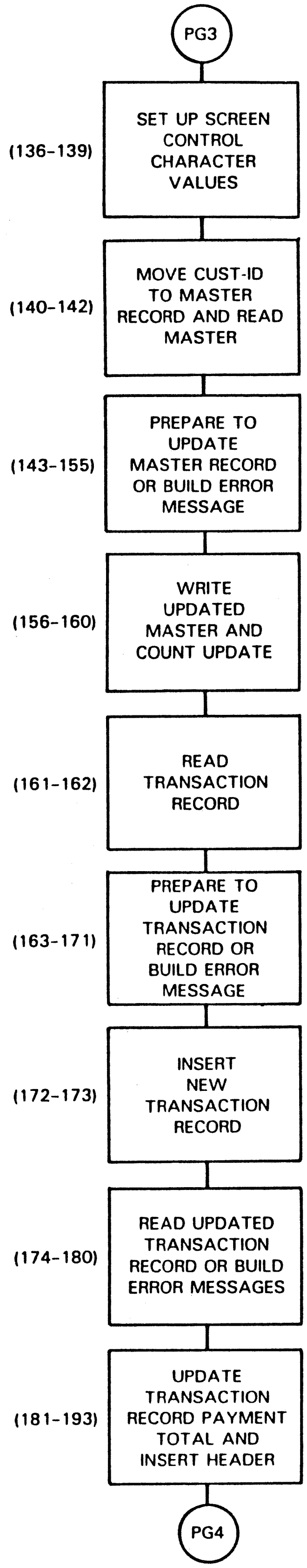

```
LINE NO. SOURCE ENTRY

00001  IDENTIFICATION DIVISION.
00002  PROGRAM-ID.  DMPYMT.
00003  AUTHOR.  E.O.F.S.F.  (NYNA 7/76)
00004  DATE-WRITTEN.  7/19/76.
00005  ENVIRONMENT DIVISION.
00006  CONFIGURATION SECTION.
00007  SOURCE-COMPUTER.  UNIVAC-OS3.
00008  OBJECT-COMPUTER.  UNIVAC-OS3.
00009  DATA DIVISION.
00010  WORKING-STORAGE SECTION.
00011  77   DMOMSTR                PIC X(7)     VALUE 'DMOMSTR '.
00012  77   DMOXAC                 PIC X(7)     VALUE 'DMOXACT '.
00013  77   TWELVE                 PIC X        VALUE ='12'.
00014  77   OUT-MSG-LEN            PIC 9999     COMP-4       VALUE 78.
00015  77   ERR-MSG-LEN            PIC 9999     COMP-4       VALUE 29.
00016  01   ERR-MSG-LITS.
00017       02 FILLER              PIC X(21)    VALUE '**INVALID KEY** '.
00018       02 FILLER              PIC X(21)    VALUE '**END OF FILE** '.
00019       02 FILLER              PIC X(21)    VALUE '**INVALID REQUEST** '.
00020       02 FILLER              PIC X(21)    VALUE '**I/O ERROR**'.
00021       02 FILLER              PIC X(21)   VALUE '**PAYMENT > BALANCE**'.
00022  01   ERR-MSG-TBL            REDEFINES ERR-MSG-LITS.
00023       02 ERR-MSG             PIC X(21)    OCCURS 5.
00024  01   DICE-CODE.
00025       02 DLE                 PIC X           VALUE ='10'.
00026       02 STX                 PIC X           VALUE ='02'.
00027       02 TWENTY-FOUR         PIC X           VALUE ='18'.
00028       02 ONE                 PIC X           VALUE ='01'.
00029  01   MSG-LIT.
00030       02 FILLER              PIC X(20)    VALUE ' PAYMENT ACCEPTED FO'.
00031       02 FILLER              PIC X(22)    VALUE 'R CUSTOMER #'.
00032       02 FILLER              PIC X(14)    VALUE 'NEW BALANCE:'.
00033  LINKAGE SECTION.
00034  01   P-I-B.                 COPY PIB74.
00035       02   STATUS-CODE                    PIC 9(4) COMP-4.
00036       02   DETAILED-STATUS-CODE           PIC 9(4) COMP-4.
00037       02   RECORD-TYPE REDEFINES DETAILED-STATUS-CODE.
00038            03 PREDICTED-RECORD-TYPE  PIC X.
00039            03 DELIVERED-RECORD-TYPE  PIC X.
00040       02   SUCCESSOR-ID                   PIC X(6).
00041       02   TERMINATION-INDICATOR          PIC X.
00042       02   LOCK-ROLLBACK-INDICATOR        PIC X.
00043       02   TRANSACTION-ID.
00044            03  YEAR                       PIC 9(4) COMP-4.
00045            03  TODAY                      PIC 9(4) COMP-4.
00046            03  HR-MIN-SEC                 PIC 9(9) COMP-4.
00047       02   DATA-DEF-REC-NAME              PIC X(7).
00048       02   DEFINED-FILE-NAME              PIC X(7).
00049       02   STANDARD-MSG-LINE-LENGTH       PIC 9(4) COMP-4.
00050       02   STANDARD-MSG-NUMBER-LINES PIC 9(4) COMP-4.
00051       02   WORK-AREA-LENGTH               PIC 9(4) COMP-4.
00052       02   CONTINUITY-DATA-INPUT-LENGTH   PIC 9(4) COMP-4.
00053       02   CONTINUITY-DATA-OUTPUT-LENGTH  PIC 9(4) COMP-4.
00054       02   WORK-AREA-INC                  PIC 9(4) COMP-4.
00055       02   CONTINUITY-DATA-AREA-INC       PIC 9(4) COMP-4.
00056       02   SUCCESS-UNIT-ID.
00057            03  TRANSACTION-DATE.
00058                04  YEAR                   PIC 99.
00059                04  MONTH                  PIC 99.
00060                04  TODAY                  PIC 99.
00061            03  TIME-OF-DAY.
00062                04  HOUR                   PIC 99.
00063                04  MINUTE                 PIC 99.
00064                04  SECOND                 PIC 99.
00065            03  FILLER                     PIC XXX.
00066       02   SOURCE-TERMINAL-CHARS.
00067            03  SOURCE-TERMINAL-TYPE  PIC X.
00068            03  SOURCE-TERM-MSG-LINE-LENGTH    PIC 9(4) COMP-4.
00069            03  SOURCE-TERM-MSG-NUMBER-LINES   PIC 9(4) COMP-4.
```

Figure B-16. Sample COBOL Action Program DMPYMT (Part 1 of 4)



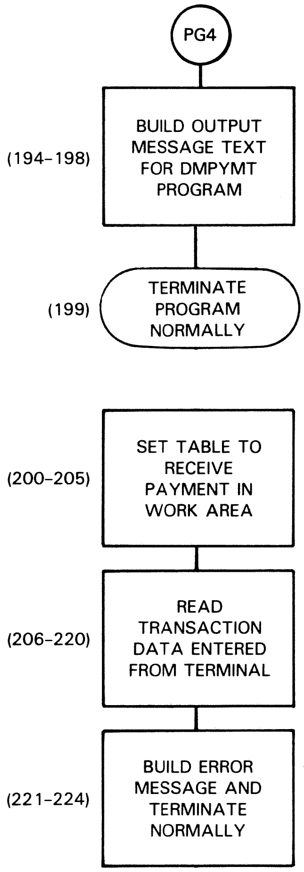

```
00070  01  I-M-A.                      COPY IMA74.
00071      02  SOURCE-TERMINAL-ID                   PIC X(4).
00072      02  DATE-TIME-STAMP.
00073          03  YEAR                             PIC 9(4)  COMP-4.
00074          03  TODAY                            PIC 9(4)  COMP-4.
00075          03  HR-MIN-SEC                       PIC 9(9)  COMP-4.
00076      02  TEXT-LENGTH                          PIC 9(4)  COMP-4.
00077      02  AUXILIARY-DEV-ID.
00078          03  FILLER                          PIC X.
00079          03  AUX-DEV-NO                      PIC X.
00080      02  FILLER              PIC X(6).
00081      02  CUSTID              PIC X(6).
00082      02  FILLER              PIC X.
00083      02  MSG-PAY.
00084          03  MSG-CHAR        PIC X      OCCURS 7    INDEXED BY I.
00085      02  FILLER              PIC X.
00086  01  W-A.
00087      02  REC-CTR             PIC 9(12)  COMP-4.
00088      02  PAY-AREA.
00089          03  PAY-CHAR        PIC X      OCCURS 5    INDEXED BY J.
00090      02  PAYMENT             REDEFINES PAY-AREA     PIC 999V99.
00091      02  TRM.
00092          03  FILLER          PIC XXX.
00093          03  TRM-NUM         PIC 9.
00094      02  MSTR-REC.
00095          03  CUSTNO          PIC X(6).
00096          03  FILLER          PIC X(82).
00097          03  PAY-AMT         PIC 999V99.
00098          03  BALANCE         PIC 999V99.
00099          03  FILLER          PIC X.
00100      02  XAC-HDR.
00101          03  YEAR            PIC 9999   COMP-4.
00102          03  TO-DAY          PIC 9999   COMP-4.
00103          03  PTR-FIRST       PIC 9999   COMP-4.
00104          03  PTR-NEXT        PIC 9999   COMP-4.
00105          03  FILLER          PIC X(8).
00106      02  XAC-TRM.
00107          03  TRM-ID          PIC 9.
00108          03  XAC-CTR         PIC 9999.
00109          03  TRM-TOTAL       PIC 9(5)V99.
00110          03  FILLER          PIC XXXX.
00111      02  XAC-REC             REDEFINES XAC-TRM.
00112          03  TRM-XAC         PIC 9.
00113          03  XAC-TIME        PIC 9(9)   COMP-4.
00114          03  CUSTOMER        PIC X(6).
00115          03  XAC-AMT         PIC 999V99.
00116  01  O-M-A.                  COPY OMA74.
00117      02  DESTINATION-TERMINAL-ID       PIC X(4).
00118                  02  SFS-OPTIONS                  PIC X(2).
00119                  02  FILLER                       PIC X(2).
00120      02  CONTINUOUS-OUTPUT-CODE        PIC X(4).
00121      02  TEXT-LENGTH                PIC 9(4)   COMP-4.
00122      02  AUXILIARY-DEVICE-ID.
00123          03  AUX-FUNCTION              PIC X.
00124          03  AUX-DEVICE-NO             PIC X.
00125      02  DICE-OUT.
00126          03  FILLER          PIC XX.
00127          03  DICE-Y          PIC X.
00128          03  FILLER          PIC X.
00129      02  OUT-MSG.
00130          03  PAY-OUT         PIC $$$9.99.
00131          03  LIT-OUT.
00132              04  FILLER      PIC X(32).
00133              04  CUST-OUT    PIC X(6).
00134              04  FILLER      PIC X(18).
00135          03  NEW-BAL         PIC $$$9.99.
```

Figure B-16. Sample COBOL Action Program DMPYMT (Part 2 of 4)



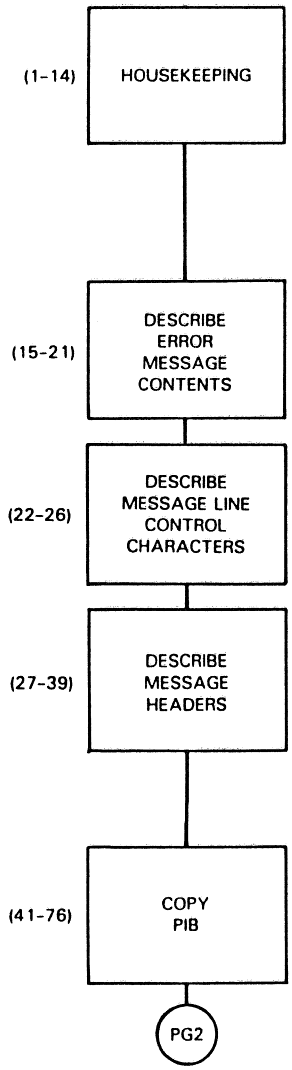

```
00136 PROCEDURE DIVISION
00137     USING P-I-B I-M-A W-A O-M-A.
00138 BEGIN-PROC.
00139     MOVE DICE-CODE TO DICE-OUT.
00140     IF STANDARD-MSG-NUMBER-LINES NOT > 12
00141         THEN MOVE TWELVE TO DICE-Y.
00142     MOVE CUSTID TO CUSTNO.
00143     CALL 'SETUP'
00144         USING DMOMSTR MSTR-REC CUSTNO.
00145     IF STATUS-CODE NOT = ZERO
00146         THEN GO TO ERR-OFF.
00147     MOVE ZERO TO PAYMENT.
00148     SET J TO 5.
00149     SUBTRACT 17 FROM TEXT-LENGTH IN I-M-A.
00150     PERFORM MV-NUM
00151         VARYING I FROM TEXT-LENGTH IN I-M-A BY -1 UNTIL I < 1.
00152     IF PAYMENT NOT > ZERO
00153         THEN MOVE PAY-AMT TO PAYMENT.
00154     IF PAYMENT > BALANCE
00155         THEN MOVE 5 TO STATUS-CODE
00156              GO TO ERR-OFF.
00157     SUBTRACT PAYMENT FROM BALANCE.
00158     CALL 'PUT'
00159         USING DMOMSTR MSTR-REC.
00160     IF STATUS-CODE NOT = ZERO
00161         THEN GO TO ERR-OFF.
00162     MOVE 1 TO REC-CTR.
00163     CALL 'GET'
00164         USING DMOXAC XAC-HDR REC-CTR.
00165     IF STATUS-CODE NOT = ZERO
00166         THEN GO TO ERR-OFF.
00167     IF TODAY IN DATE-TIME-STAMP NOT = TO-DAY IN XAC-HDR
00168         THEN PERFORM INIT-RTN.
00169     MOVE SOURCE-TERMINAL-ID TO TRM.
00170     MOVE TRM-NUM TO TRM-XAC.
00171     MOVE HR-MIN-SEC IN DATE-TIME-STAMP TO XAC-TIME.
00172     MOVE CUSTNO TO CUSTOMER.
00173     MOVE PAYMENT TO XAC-AMT.
00174     CALL 'INSERT'
00175         USING DMOXAC XAC-REC REC-CTR.
00176     IF STATUS-CODE NOT = ZERO
00177         THEN GO TO ERR-OFF.
00178     ADD 1 TRM-NUM GIVING REC-CTR.
00179     CALL 'GET'
00180         USING DMOXAC XAC-TRM REC-CTR.
00181     IF STATUS-CODE NOT = ZERO
00182         THEN GO TO ERR-OFF.
00183     MOVE TRM-NUM TO TRM-ID.
00184     ADD 1 TO XAC-CTR.
00185     ADD PAYMENT TO TRM-TOTAL.
00186     CALL 'INSERT'
00187         USING DMOXAC XAC-TRM REC-CTR.
00188     IF STATUS-CODE NOT = ZERO
00189         THEN GO TO ERR-OFF.
00190     ADD 1 TO PTR-NEXT.
00191     MOVE 1 TO REC-CTR.
00192     CALL 'INSERT'
00193         USING DMOXAC XAC-HDR REC-CTR.
```

Figure B-16. Sample COBOL Action Program DMPYMT (Part 3 of 4)



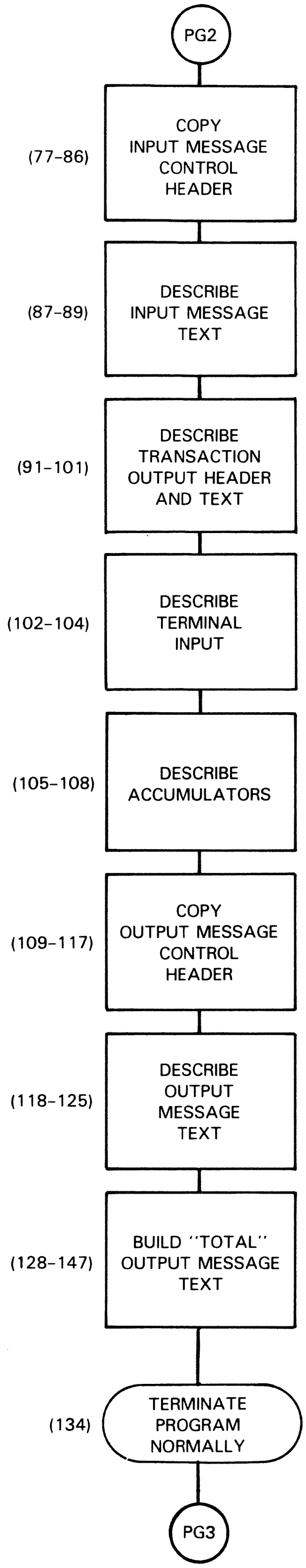

```
00194        IF STATUS-CODE NOT = ZERO
00195            THEN GO TO ERR-OFF.
00196        MOVE MSG-LIT TO LIT-OUT.
00197        MOVE PAYMENT TO PAY-OUT.
00198        MOVE CUSTNO TO CUST-OUT.
00199        MOVE BALANCE TO NEW-BAL.
00200        MOVE OUT-MSG-LEN TO TEXT-LENGTH IN O-M-A.
00201        CALL 'RETURN'.
00202    MV-NUM.
00203        IF MSG-CHAR (I) IS NUMERIC
00204            THEN MOVE MSG-CHAR (I) TO PAY-CHAR (J)
00205                 SET J DOWN BY 1
00206                 IF J < 1
00207                     THEN SET I TO 1.
00208    INIT-RTN.
00209        MOVE CORR DATE-TIME-STAMP TO XAC-HDR.
00210        MOVE PTR-FIRST TO PTR-NEXT.
00211        PERFORM TRM-INIT
00212            VARYING REC-CTR FROM 2 BY 1 UNTIL REC-CTR NOT < PTR-FIRST.
00213    TRM-INIT.
00214        CALL 'GET'
00215            USING DMOXAC XAC-TRM REC-CTR.
00216        IF STATUS-CODE NOT = ZERO
00217            THEN GO TO ERR-OFF.
00218        MOVE ZEROS TO XAC-CTR TRM-TOTAL.
00219        IF STATUS-CODE NOT = ZERO
00220            THEN GO TO ERR-OFF.
00221    ERR-OFF.
00222        MOVE ERR-MSG (STATUS-CODE) TO OUT-MSG.
00223        MOVE ERR-MSG-LEN TO TEXT-LENGTH IN O-M-A.
00224        CALL 'RETURN'.
```

Figure B-16. Sample COBOL Action Program DMPYMT (Part 4 of 4)



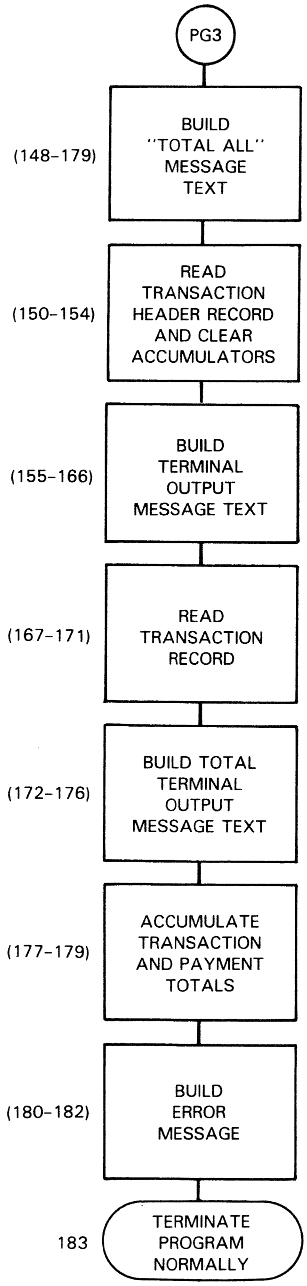

```
LINE NO. SOURCE ENTRY

00001 IDENTIFICATION DIVISION.
00002 PROGRAM-ID. DMTOTL.
00003 AUTHOR. E.O.F.S.F. (NYNA 7/76)
00004 DATE-WRITTEN. 9/13/76.
00005 ENVIRONMENT DIVISION.
00006 CONFIGURATION SECTION.
00007 SOURCE-COMPUTER. UNIVAC-OS3.
00008 OBJECT-COMPUTER. UNIVAC-OS3.
00009 DATA DIVISION.
00010 WORKING-STORAGE SECTION.
00011 77  DMOXAC                  PIC X(7)     VALUE 'DMOXACT'.
00012 77  MIN-MSG-LEN             PIC 9999     COMP-4  VALUE 126.
00013 77  ERR-MSG-LEN             PIC 9999     COMP-4  VALUE 29.
00014 77  MSG-LINE-LEN            PIC 9999     COMP-4  VALUE 40.
00015 01  ERR-MSG-LITS.
00016       02 FILLER             PIC X(21)    VALUE '••INVALID KEY•.'.
00017       02 FILLER             PIC X(21)    VALUE '••END OF FILE••'.
00018       02 FILLER             PIC X(21)    VALUE '••INVALID REQUEST••'.
00019       02 FILLER             PIC X(21)    VALUE '••I/O ERROR••'.
00020 01  ERR-MSG-TBL             REDEFINES ERR-MSG-LITS.
00021       02 ERR-MSG            PIC X(21)    OCCURS 4.
00022 01  DICE-CODE.
00023       02 DLE                PIC X          VALUE ='10'.
00024       02 ETX                PIC X          VALUE ='03'.
00025       02 THREE              PIC X          VALUE ='03'.
00026       02 ONE                PIC X          VALUE ='01'.
00027 01  MSG-HDR.
00028       02 FILLER             PIC X(14)    VALUE 'TERMINAL'.
00029       02 FILLER             PIC X(18)    VALUE 'NUMBER OF'.
00030       02 FILLER             PIC X(5)     VALUE 'TOTAL'.
00031       02 FILLER             PIC XXXX     VALUE ' '.
00032       02 FILLER             PIC X(10)    VALUE 'ID'.
00033       02 FILLER             PIC X(18)    VALUE 'TRANSACTIONS'.
00034       02 FILLER             PIC X(8)     VALUE 'PAYMENTS'.
00035       02 CR                 PIC X        VALUE ' '.
00036 01  DASH-LINE.
00037       02 FILLER             PIC X(18)    VALUE '    -----'.
00038       02 FILLER             PIC X(14)    VALUE '-----'.
00039       02 FILLER             PIC X(8)     VALUE '---------'.
00040 LINKAGE SECTION.
00041 01  P-I-B.                  COPY PIB74.
00042       02  STATUS-CODE                    PIC 9(4) COMP-4.
00043       02  DETAILED-STATUS-CODE           PIC 9(4) COMP-4.
00044       02  RECORD-TYPE REDEFINES DETAILED-STATUS-CODE.
00045           03 PREDICTED-RECORD-TYPE       PIC X.
00046           03 DELIVERED-RECORD-TYPE       PIC X.
00047       02  SUCCESSOR-ID                   PIC X(6).
00048       02  TERMINATION-INDICATOR          PIC X.
00049       02  LOCK-ROLLBACK-INDICATOR        PIC X.
00050       02  TRANSACTION-ID.
00051           03 YEAR                        PIC 9(4) COMP-4.
00052           03 TODAY                       PIC 9(4) COMP-4.
00053           03 HR-MIN-SEC                  PIC 9(9) COMP-4.
00054       02  DATA-DEF-REC-NAME              PIC X(7).
00055       02  DEFINED-FILE-NAME              PIC X(7).
00056       02  STANDARD-MSG-LINE-LENGTH       PIC 9(4) COMP-4.
00057       02  STANDARD-MSG-NUMBER-LINES      PIC 9(4) COMP-4.
00058       02  WORK-AREA-LENGTH               PIC 9(4) COMP-4.
00059       02  CONTINUITY-DATA-INPUT-LENGTH   PIC 9(4) COMP-4.
00060       02  CONTINUITY-DATA-OUTPUT-LENGTH  PIC 9(4) COMP-4.
00061       02  WORK-AREA-INC                  PIC 9(4) COMP-4.
00062       02  CONTINUITY-DATA-AREA-INC       PIC 9(4) COMP-4.
00063       02  SUCCESS-UNIT-ID.
00064           03 TRANSACTION-DATE.
00065               04 YEAR                    PIC 99.
00066               04 MONTH                   PIC 99.
00067               04 TODAY                   PIC 99.
00068           03 TIME-OF-DAY.
00069               04 HOUR                    PIC 99.
00070               04 MINUTE                  PIC 99.
00071               04 SECOND                  PIC 99.
00072           03 FILLER                      PIC XXX.
00073       02  SOURCE-TERMINAL-CHARS.
00074           03 SOURCE-TERMINAL-TYPE   PIC X.
00075           03 SOURCE-TERM-MSG-LINE-LENGTH      PIC 9(4) COMP-4.
00076           03 SOURCE-TERM-MSG-NUMBER-LINES     PIC 9(4) COMP-4.
```

Figure B-17. Sample COBOL Action Program DMTOTL (Part 1 of 3)




```
00077  01   I-M-A.                  COPY IMA74.
00078       02 SOURCE-TERMINAL-ID                   PIC X(4).
00079       02 DATE-TIME-STAMP.
00080          03 YEAR                              PIC 9(4) COMP-4.
00081          03 TODAY                             PIC 9(4) COMP-4.
00082          03 HR-MIN-SEC                        PIC 9(9) COMP-4.
00083       02 TEXT-LENGTH                          PIC 9(4) COMP-4.
00084       02 AUXILIARY-DEV-ID.
00085          03 FILLER                           PIC X.
00086          03 AUX-DEV-NO                       PIC X.
00087       02 FILLER               PIC X(6).
00088       02 OPT                  PIC XXX.
00089       02 FILLER               PIC XXX.
00090  01   W-A.
00091       02 XAC-HDR.
00092           03 FILLER           PIC XXXX.
00093           03 XAC-FIRST        PIC 9999     COMP-4.
00094           03 FILLER           PIC X(10).
00095       02 J-FILL-1             PIC X(256).
00096       02 XAC-TRM.
00097           03 TRM-ID           PIC 9.
00098           03 XAC-CTR          PIC 9999.
00099           03 TRM-TOTAL        PIC 9(5)V99.
00100           03 FILLER           PIC XXXX.
00101       02 J-FILL-2             PIC X(256).
00102       02 TRM.
00103           03 TRM-LIT          PIC XXX.
00104           03 TRM-NUM          PIC 9.
00105       02 PAY-TOT              PIC 9(5)V99.
00106       02 XAC-TOT              PIC 9999.
00107       02 REC-PTR              PIC 9(12)    COMP-4.
00108       02 FILLER               PIC X.
00109  01   O-M-A.                  COPY OMA74.
00110       02 DESTINATION-TERMINAL-ID       PIC X(4).
00111                02 SFS-OPTIONS                      PIC X(2).
00112                02 FILLER                           PIC X(2).
00113       02 CONTINUOUS-OUTPUT-CODE        PIC X(4).
00114       02 TEXT-LENGTH                PIC 9(4)    COMP-4.
00115       02 AUXILIARY-DEVICE-ID.
00116          03 AUX-FUNCTION                PIC X.
00117          03 AUX-DEVICE-NO               PIC X.
00118       02 DICE-OUT             PIC XXXX.
00119       02 HDR-OUT              PIC X(78).
00120       02 TOT-LINE             OCCURS 7     INDEXED BY I.
00121           03 CR-OUT           PIC XXX.
00122           03 TRM-OUT          PIC X(15).
00123           03 CTR-OUT          PIC ZZZ9.
00124           03 FILLER           PIC X(9).
00125           03 TOT-OUT          PIC $(5)9.99.
00126  PROCEDURE DIVISION
00127       USING P-I-B I-M-A W-A O-M-A.
00128  BEGIN-PROC.
00129       IF OPT = 'ALL'
00130           THEN PERFORM RTN-ALL
00131           ELSE PERFORM RTN-ONE.
00132       MOVE DICE-CODE TO DICE-OUT.
00133       MOVE MSG-HDR TO HDR-OUT.
00134       CALL 'RETURN'.
00135  RTN-ONE.
00136       MOVE SOURCE-TERMINAL-ID TO TRM.
00137       MOVE TRM-NUM TO REC-PTR.
00138       ADD 1 TO REC-PTR.
00139       CALL 'GET'
00140           USING DMOXAC XAC-TRM REC-PTR.
00141       IF STATUS-CODE NOT = ZERO
00142           THEN GO TO ERR-OFF.
00143       MOVE CR TO CR-OUT (I).
00144       MOVE TRM TO TRM-OUT (I).
00145       MOVE XAC-CTR TO CTR-OUT (I).
00146       MOVE TRM-TOTAL TO TOT-OUT (I).
00147       MOVE MIN-MSG-LEN TO TEXT-LENGTH IN O-M-A.
```

Figure B-17. Sample COBOL Action Program DMTOTL (Part 2 of 3)




```
00148  RTN-ALL.
00149      MOVE 1 TO REC-PTR.
00150      CALL 'GET'
00151          USING DMOXAC XAC-HDR REC-PTR.
00152      IF STATUS-CODE NOT = ZERO
00153          THEN GO TO ERR-OFF.
00154      MOVE ZEROS TO XAC-TOT PAY-TOT.
00155      MOVE 'TRM' TO TRM-LIT.
00156      ADD 1 TO REC-PTR.
00157      PERFORM SUM-TRM
00158          VARYING I FROM 1 BY 1 UNTIL REC-PTR NOT < XAC-FIRST.
00159      MOVE DASH-LINE TO TOT-LINE (I).
00160      SET I UP BY 1.
00161      MOVE CR TO CR-OUT (I).
00162      MOVE 'TOTAL' TO TRM-OUT (I).
00163      MOVE XAC-TOT TO CTR-OUT (I).
00164      MOVE PAY-TOT TO TOT-OUT (I).
00165      COMPUTE TEXT-LENGTH IN O-M-A = MIN-MSG-LEN +
00166                                     MSG-LINE-LEN * REC-PTR.
00167  SUM-TRM.
00168      CALL 'GET'
00169          USING DMOXAC XAC-TRM REC-PTR.
00170      IF STATUS-CODE NOT = ZERO
00171          THEN GO TO ERR-OFF.
00172      MOVE CR TO CR-OUT (I).
00173      MOVE TRM-ID TO TRM-NUM.
00174      MOVE TRM TO TRM-OUT (I).
00175      MOVE XAC-CTR TO CTR-OUT (I).
00176      MOVE TRM-TOTAL TO TOT-OUT (I).
00177      ADD XAC-CTR TO XAC-TOT.
00178      ADD TRM-TOTAL TO PAY-TOT.
00179      ADD 1 TO REC-PTR.
00180  ERR-OFF.
00181      MOVE ERR-MSG (STATUS-CODE) TO HDR-OUT.
00182      MOVE ERR-MSG-LEN TO TEXT-LENGTH IN O-M-A.
00183      CALL 'RETURN'.
```

Figure B-17. Sample COBOL Action Program DMTOTL (Part 3 of 3)

You may have noticed that in this series of action programs consisting of five separate transactions, each transaction contained only one action program. In other words, one action program received one input message and issued one output message for each transaction.

These action programs were chained together by placing the succeeding action program's transaction code itself into the output message issued by the current action program. In this way, control passed from one action program to another, establishing a sense of succession between the programs without actually moving values into the SUCCESSOR-ID and TERMINATION-INDICATOR fields of the PIB. This technique is effective for processing simple transactions in a series. However, there are situations that require more than one program to process a transaction. We call these *dialog* transactions.

B.3. Sample COBOL Action Programs Performing a Dialog Transaction with External Succession (ACT1 and ACT2)

The two action programs, ACT1 and ACT2, perform a dialog transaction. This transaction references two indexed files named STATE and CITY. The STATE file contains a record for each state. Each state record consists of a state name, state population, and capital city name. The CITY file contains a record for each city. In each city record is the city name, population, and state name. Assume for the purposes of this example that all city names in the CITY file are unique.

The purpose of this transaction is to provide information about a state. Each time you enter the transaction code S, IMS associates it with the action program ACT1. In addition to the transaction code, you include a state name (Figure B-18, line 0). ACT1 uses the state name you give to obtain a record from the STATE file.

```
0     S  ALASKA
1      STATE           STATE-POP        CAPITAL
2
3        ALASKA           226,000          JUNEAU
4
5      CAPITAL-POP?▶NO  YES
6
7            7,000■
```

Note:

The cursor (■) may appear at only one location on the screen at any one time. In this example, it also would have appeared after ALASKA when the operator entered the initial input message (line 0) and after NO upon transmission of the first output response built by ACT 1 (line 5). The start-of-entry character (▶) may appear at multiple locations.

Figure B-18. Sample Dialog Transaction with YES Option Taken

If the record exists, ACT1 responds by sending an output message to the terminal. The output message contains headers, the state name, population, and capital name plus a question asking if you want the capital's population (Figure B-18, lines 1-5). ACT1 moves output message headings (Figure B-21, lines 16 and 17) and control characters (lines 12-15) from the working-storage section to the output message area.

You can request capital city population or terminate the transaction. Start-of-entry (▶) and cursor (◪) characters are positioned in the output message area so that:

1. If you want to terminate the transaction without seeing capital population, press TRANSMIT.

2. If you want to see capital population, press TAB followed by TRANSMIT.

Before succeeding externally to ACT2, ACT1 saves the capital city name in the continuity data area (lines 108 and 109). When ACT1 succeeds to ACT2, IMS passes the contents of this area to ACT2 (lines 124 and 125). To succeed to ACT2, ACT1 moves a termination code of E for external succession to the TERMINATION-INDICATOR field (line 127). It also moves the name, ACT2, to the SUCCESSOR-ID field (line 128).

When you choose the YES option, ACT2 obtains the CITY record for capital city named in the continuity data area (Figure B-22, line 92), builds an output message containing the capital population (Figure B-18, line 7 and Figure B-22, lines 97-99), and terminates normally with the CALL RETURN function.

When you choose the NO option, ACT2 moves zero to the TEXT-LENGTH field in the output message area control header before terminating normally (Figure B-22, lines 93 and 94). Because ACT2 doesn't provide an output message, IMS returns the standard transaction termination message to the source terminal as shown in Figure B-19, line 6.

```
0      S  ALASKA
1      STATE                      STATE-POP          CAPITAL
2
3        ALASKA                      266,000           JUNEAU
4
5       CAPITAL-POP?▶NO    YES
6      TRANSACTION COMPLETE◪
```

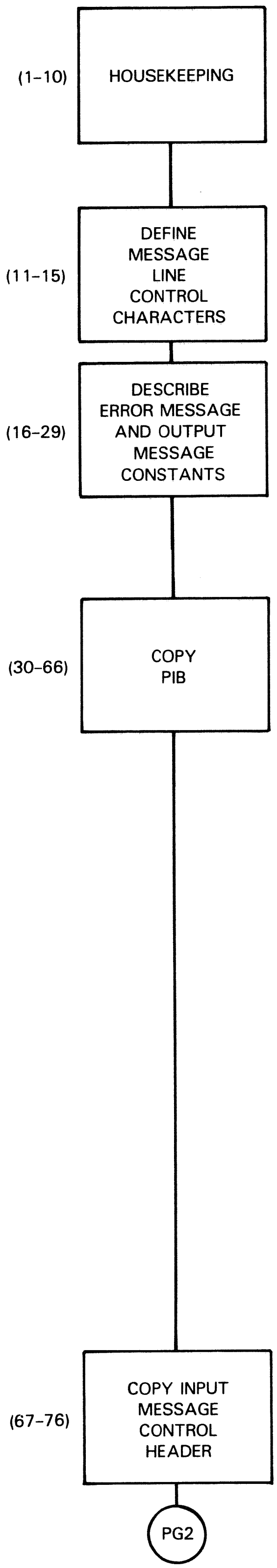
Figure B-19. Sample Dialog Transaction with NO Option Taken

Suppose you enter a state name that cannot be found in the STATE file. ACT1 builds an error message in the OMA (Figure B-21, lines 28 and 29) and moves the length of this error message to the TEXT-LENGTH field of the output message area control header to override the previous text length value (lines 115, 130-133). The transaction terminates normally with a CALL RETURN function and IMS sends the error output message to the terminal as shown in Figure B-20, line 1.

```
0      S  ALASKA
1      ERROR -STATE NAME INVALID
```

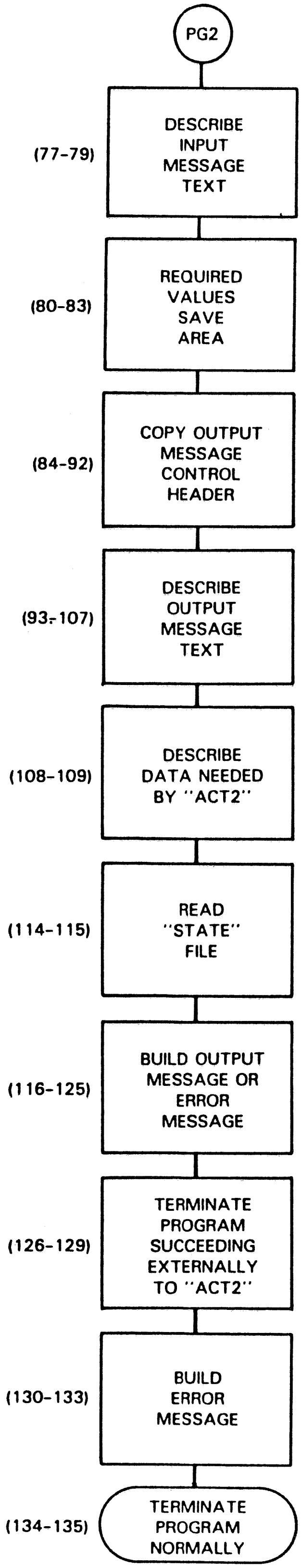
Figure B-20. Sample Transaction with Error Message

General flowcharts for the coding in ACT1 and ACT2 action programs (Figures B-21 and B-22) appear to the left of the program code in these figures. Program line numbers in parentheses to the side of the flowchart boxes represent the lines of coding that implement the process described.



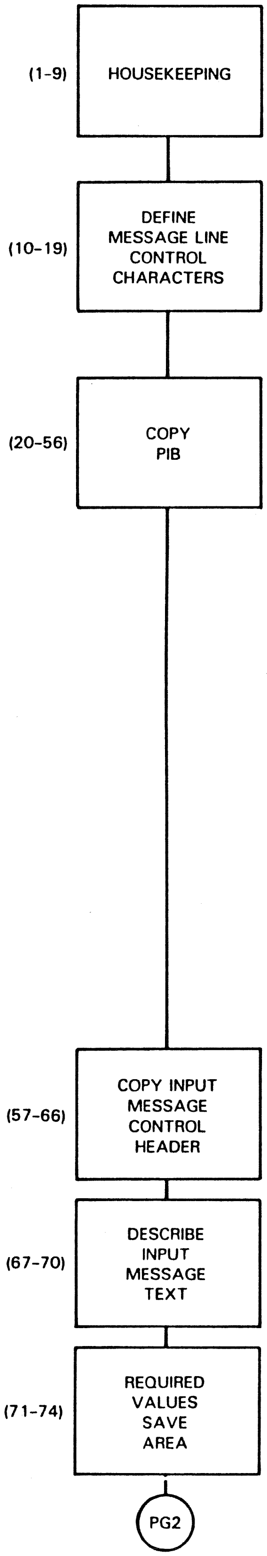

```
LINE NO.    SOURCE ENTRY

00001  IDENTIFICATION DIVISION.
00002  PROGRAM-ID. ACT1.
00003  ENVIRONMENT DIVISION.
00004  CONFIGURATION SECTION.
00005  SOURCE-COMPUTER. UNIVAC-OS3.
00006  OBJECT-COMPUTER. UNIVAC-OS3.
00007  DATA DIVISION.
00008  WORKING-STORAGE SECTION.
00009  77  STATE PIC A(7) VALUE 'STATE'.
00010  77  ERROR-TEXT-LENGTH PIC 9(4) COMP-4 VALUE 34.
00011  01  LINE-0.
00012      02  DLE              PIC X     VALUE ='10'.
00013      02  PCAC             PIC X     VALUE ='05'.
00014      02  ROW-0            PIC X     VALUE ='00'.
00015      02  COLUMN-0         PIC X     VALUE ='00'.
00016  01  LINE-1-MSG-1A       PIC X(39) VALUE 'STATE          STATE-POP
00017      '      CAPITAL'.
00018  01  LINE-5-MSG-1A.
00019      02  E-1              PIC X(13) VALUE 'CAPITAL-POP? '.
00020      02  SOE              PIC X     VALUE ='1E'.
00021      02  E-2              PIC X(7)  VALUE 'NO  YES'.
00022      02  ESC-1            PIC X     VALUE ='27'.
00023      02  HT               PIC X     VALUE ='05'.
00024      02  DLE              PIC X     VALUE ='10'.
00025      02  FC               PIC X     VALUE ='02'.
00026      02  ROW-5            PIC X     VALUE ='10'.
00027      02  COLUMN-16        PIC X     VALUE ='05'.
00028  01  LINE-1-MSG-1B.
00029      02 E-1 PIC X(26) VALUE 'ERROR - STATE NAME INVALID'.
00030  LINKAGE SECTION.
00031  01  PROGRAM-INFORMATION-BLOCK. COPY PIB74.
00032      02  STATUS-CODE                 PIC 9(4) COMP-4.
00033      02  DETAILED-STATUS-CODE        PIC 9(4) COMP-4.
00034      02  RECORD-TYPE REDEFINES DETAILED-STATUS-CODE.
00035          03 PREDICTED-RECORD-TYPE    PIC X.
00036          03 DELIVERED-RECORD-TYPE    PIC X.
00037      02  SUCCESSOR-ID                PIC X(6).
00038      02  TERMINATION-INDICATOR       PIC X.
00039      02  LOCK-ROLLBACK-INDICATOR     PIC X.
00040      02  TRANSACTION-ID.
00041          03 YEAR                     PIC 9(4) COMP-4.
00042          03 TODAY                    PIC 9(4) COMP-4.
00043          03 HR-MIN-SEC               PIC 9(9) COMP-4.
00044      02  DATA-DEF-REC-NAME           PIC X(7).
00045      02  DEFINED-FILE-NAME           PIC X(7).
00046      02  STANDARD-MSG-LINE-LENGTH    PIC 9(4) COMP-4.
00047      02  STANDARD-MSG-NUMBER-LINES   PIC 9(4) COMP-4.
00048      02  WORK-AREA-LENGTH            PIC 9(4) COMP-4.
00049      02  CONTINUITY-DATA-INPUT-LENGTH  PIC 9(4) COMP-4.
00050      02  CONTINUITY-DATA-OUTPUT-LENGTH  PIC 9(4) COMP-4.
00051      02  WORK-AREA-INC               PIC 9(4) COMP-4.
00052      02  CONTINUITY-DATA-AREA-INC    PIC 9(4) COMP-4.
00053          02  SUCCESS-UNIT-ID.
00054              03 TRANSACTION-DATE.
00055                 04 YEAR                    PIC 99.
00056                 04 MONTH                   PIC 99.
00057                 04 TODAY                   PIC 99.
00058              03 TIME-OF-DAY.
00059                 04 HOUR                    PIC 99.
00060                 04 MINUTE                  PIC 99.
00061                 04 SECOND                  PIC 99.
00062          03 UNIQUE-SUFFIX            PIC 999.
00063      02  SOURCE-TERMINAL-CHARS.
00064          03 SOURCE-TERMINAL-TYPE  PIC X.
00065          03 SOURCE-TERM-MSG-LINE-LENGTH   PIC 9(4) COMP-4.
00066          03 SOURCE-TERM-MSG-NUMBER-LINES  PIC 9(4) COMP-4.
00067  01  INPUT-MESSAGE-AREA. COPY IMA74.
00068      02 SOURCE-TERMINAL-ID               PIC X(4).
00069      02 DATE-TIME-STAMP.
00070         03 YEAR                          PIC 9(4) COMP-4.
00071         03 TODAY                         PIC 9(4) COMP-4.
00072         03 HR-MIN-SEC                    PIC 9(9) COMP-4.
00073      02 TEXT-LENGTH                      PIC 9(4) COMP-4.
00074      02 AUXILIARY-DEV-ID.
00075         03 FILLER                       PIC X.
00076         03 AUX-DEV-NO                   PIC X.
```

Figure B-21. Sample COBOL Action Program ACT1 (Part 1 of 2)



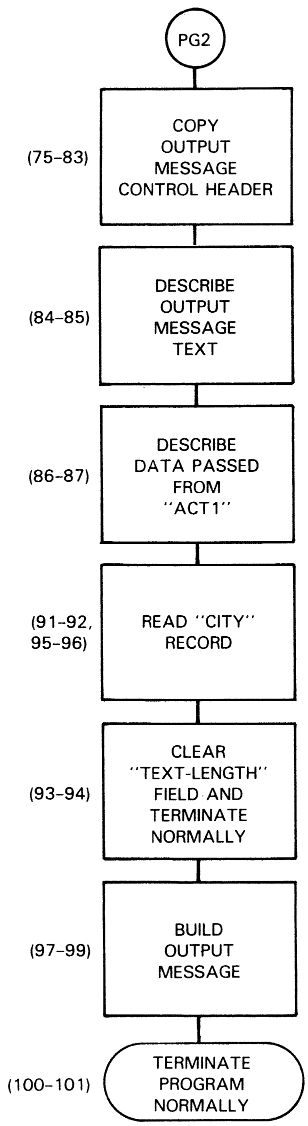

```
00077      02 TRANSACTION-CODE   PIC X.
00078      02 FILLER             PIC X.
00079      02 STATE-NAME-IN      PIC A(14).
00080  01  WORK-AREA.
00081      02 STATE-NAME PIC A(14).
00082      02 STATE-POP  PIC 9(8).
00083      02 CAPITAL    PIC A(25).
00084  01  OUTPUT-MESSAGE-AREA.       COPY OMA74.
00085      02 DESTINATION-TERMINAL-ID        PIC X(4).
00086               02 SFS-OPTIONS                      PIC X(2).
00087               02 FILLER                           PIC X(2).
00088      02 CONTINUOUS-OUTPUT-CODE         PIC X(4).
00089      02 TEXT-LENGTH                 PIC 9(4)    COMP-4.
00090      02 AUXILIARY-DEVICE-ID.
00091         03 AUX-FUNCTION                PIC X.
00092         03 AUX-DEVICE-NO               PIC X.
00093      02 LINE-0-OUT PIC X(4).
00094      02 LINE-1-OUT.
00095        03 E1-OUT           PIC X(39).
00096        03 CONTROL-1        PIC X(4).
00097        03 CONTROL-2        PIC X(4).
00098      02 LINE-3-OUT.
00099        03 FILLER           PIC XX.
00100        03 STATE-NAME       PIC A(14).
00101        03 FILLER           PIC X(4).
00102        03 STATE-POP        PIC 99,999,999.
00103        03 FILLER           PIC X(4).
00104        03 CAPITAL          PIC A(25).
00105        03 CONTROL-3        PIC X(4).
00106        03 CONTROL-4        PIC X(4).
00107      02 LINE-5-OUT PIC X(27).
00108  01  CONTINUITY-DATA-AREA.
00109      02 CAPITAL            PIC A(25).
00110  PROCEDURE DIVISION USING PROGRAM-INFORMATION-BLOCK
00111      INPUT-MESSAGE-AREA WORK-AREA OUTPUT-MESSAGE-AREA
00112      CONTINUITY-DATA-AREA.
00113  GET-STATE-RECORD.
00114      CALL 'GET' USING STATE WORK-AREA STATE-NAME-IN.
00115      IF STATUS-CODE EQUAL  1 GO TO PROCESS-ERROR.
00116  BUILD-OUTPUT-MESSAGE.
00117      MOVE LINE-0 TO LINE-0-OUT.
00118      MOVE LINE-1-MSG-1A TO E1-OUT.
00119      MOVE LINE-0 TO CONTROL-1 CONTROL-2.
00120      MOVE SPACES TO LINE-3-OUT.
00121      MOVE CORRESPONDING WORK-AREA TO LINE-3-OUT.
00122      MOVE LINE-0 TO CONTROL-3 CONTROL-4.
00123      MOVE LINE-5-MSG-1A TO LINE-5-OUT.
00124  SAVE-CONTINUITY-DATA.
00125      MOVE CAPITAL OF WORK-AREA TO CAPITAL OF CONTINUITY-DATA-AREA.
00126  TERM-WITH-EXTERNAL-SUCCESSOR.
00127      MOVE 'E' TO TERMINATION-INDICATOR.
00128      MOVE 'ACT200' TO SUCCESSOR-ID.
00129      CALL 'RETURN'.
00130  PROCESS-ERROR.
00131      MOVE LINE-0 TO LINE-0-OUT.
00132      MOVE LINE-1-MSG-1B TO LINE-1-OUT.
00133      MOVE ERROR-TEXT-LENGTH TO TEXT-LENGTH OF OUTPUT-MESSAGE-AREA.
00134  TERMINATE-NORMALLY.
00135      CALL 'RETURN'.
```

Figure B-21. Sample COBOL Action Program (Part 2 of 2)




```
LINE NO. SOURCE ENTRY

00001 IDENTIFICATION DIVISION.
00002 PROGRAM-ID. ACT2.
00003 ENVIRONMENT DIVISION.
00004 CONFIGURATION SECTION.
00005 SOURCE-COMPUTER. UNIVAC-OS3.
00006 OBJECT-COMPUTER. UNIVAC-OS3.
00007 DATA DIVISION.
00008 WORKING-STORAGE SECTION.
00009 77  CITY PIC A(7) VALUE 'CITY'.
00010 01  LINE-1.
00011       02  DLE-1              PIC X      VALUE ='10'.
00012       02  PCAC-1             PIC X      VALUE ='05'.
00013       02  ROW-O-1            PIC X      VALUE ='00'.
00014       02  COLUMN-O-1         PIC X      VALUE ='00'.
00015       02  DLE-2              PIC X      VALUE ='10'.
00016       02  PCAC-2             PIC X      VALUE ='05'.
00017       02  ROW-O-2            PIC X      VALUE ='00'.
00018       02  COLUMN-O-2         PIC X      VALUE ='00'.
00019       02  FILLER             PIC XX     VALUE SPACES.
00020 LINKAGE SECTION.
00021 01  PROGRAM-INFORMATION-BLOCK. COPY PIB74.
00022       02  STATUS-CODE                 PIC 9(4) COMP-4.
00023       02  DETAILED-STATUS-CODE        PIC 9(4) COMP-4.
00024       02  RECORD-TYPE REDEFINES DETAILED-STATUS-CODE.
00025           03 PREDICTED-RECORD-TYPE    PIC X.
00026           03 DELIVERED-RECORD-TYPE    PIC X.
00027       02  SUCCESSOR-ID                PIC X(6).
00028       02  TERMINATION-INDICATOR       PIC X.
00029       02  LOCK-ROLLBACK-INDICATOR     PIC X.
00030       02  TRANSACTION-ID.
00031           03 YEAR                     PIC 9(4) COMP-4.
00032           03 TODAY                    PIC 9(4) COMP-4.
00033           03 HR-MIN-SEC               PIC 9(9) COMP-4.
00034       02  DATA-DEF-REC-NAME           PIC X(7).
00035       02  DEFINED-FILE-NAME           PIC X(7).
00036       02  STANDARD-MSG-LINE-LENGTH    PIC 9(4) COMP-4.
00037       02  STANDARD-MSG-NUMBER-LINES   PIC 9(4) COMP-4.
00038       02  WORK-AREA-LENGTH            PIC 9(4) COMP-4.
00039       02  CONTINUITY-DATA-INPUT-LENGTH    PIC 9(4) COMP-4.
00040       02  CONTINUITY-DATA-OUTPUT-LENGTH    PIC 9(4) COMP-4.
00041       02  WORK-AREA-INC               PIC 9(4) COMP-4.
00042       02  CONTINUITY-DATA-AREA-INC    PIC 9(4) COMP-4.
00043           02  SUCCESS-UNIT-ID.
00044               03 TRANSACTION-DATE.
00045                  04 YEAR                   PIC 99.
00046                  04 MONTH                  PIC 99.
00047                  04 TODAY                  PIC 99.
00048               03 TIME-OF-DAY.
00049                  04 HOUR                   PIC 99.
00050                  04 MINUTE                 PIC 99.
00051                  04 SECOND                 PIC 99.
00052           03 UNIQUE-SUFFIX           PIC 999.
00053       02  SOURCE-TERMINAL-CHARS.
00054           03 SOURCE-TERMINAL-TYPE    PIC X.
00055           03 SOURCE-TERM-MSG-LINE-LENGTH    PIC 9(4) COMP-4.
00056           03 SOURCE-TERM-MSG-NUMBER-LINES   PIC 9(4) COMP-4.
00057 01  INPUT-MESSAGE-AREA. COPY IMA74.
00058       02 SOURCE-TERMINAL-ID                PIC X(4).
00059       02 DATE-TIME-STAMP.
00060          03 YEAR                           PIC 9(4) COMP-4.
00061          03 TODAY                          PIC 9(4) COMP-4.
00062          03 HR-MIN-SEC                     PIC 9(9) COMP-4.
00063       02 TEXT-LENGTH                       PIC 9(4) COMP-4.
00064       02 AUXILIARY-DEV-ID.
00065          03 FILLER                        PIC X.
00066          03 AUX-DEV-NO                    PIC X.
00067       02 FILLER               PIC X.
00068       02 NO-POP               PIC XX.
00069       02 FILLER               PIC XX.
00070       02 YES                  PIC XXX.
00071 01  WORK-AREA.
00072       02 CITIES               PIC A(25).
00073       02 CITY-POP             PIC 9(7).
00074       02 STATE                PIC A(14).
```

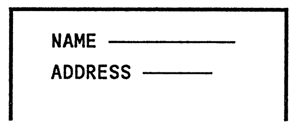
Figure B-22. Sample COBOL Action Program ACT2 (Part 1 of 2)




```
00075  01   OUTPUT-MESSAGE-AREA.       COPY OMA74.
00076       02 DESTINATION-TERMINAL-ID       PIC X(4).
00077                02 SFS-OPTIONS                       PIC X(2).
00078                02 FILLER                            PIC X(2).
00079       02 CONTINUOUS-OUTPUT-CODE        PIC X(4).
00080       02 TEXT-LENGTH                PIC 9(4)    COMP-4.
00081       02 AUXILIARY-DEVICE-ID.
00082          03 AUX-FUNCTION               PIC X.
00083          03 AUX-DEVICE-NO              PIC X.
00084       02 E-1                 PIC X(10).
00085       02 CAPITAL-POP         PIC 9,999,999.
00086  01   CONTINUITY-DATA-AREA.
00087       02 CAPITAL             PIC A(25).
00088  PROCEDURE DIVISION USING PROGRAM-INFORMATION-BLOCK
00089       INPUT-MESSAGE-AREA WORK-AREA OUTPUT-MESSAGE-AREA
00090       CONTINUITY-DATA-AREA.
00091  CHECK-RESPONSE.
00092       IF YES EQUAL  'YES' GO TO GET-CITY-RECORD.
00093       MOVE ZERO TO TEXT-LENGTH OF OUTPUT-MESSAGE-AREA.
00094       GO TO TERMINATE-NORMALLY.
00095  GET-CITY-RECORD.
00096       CALL 'GET' USING CITY WORK-AREA CAPITAL.
00097  BUILD-OUTPUT-MESSAGE.
00098       MOVE LINE-1 TO E-1.
00099       MOVE CITY-POP TO CAPITAL-POP.
00100  TERMINATE-NORMALLY.
00101       CALL 'RETURN'.
```

Figure B-22. Sample COBOL Action Program ACT2 (Part 2 of 2)

B.4. Sample COBOL Action Program Using Screen Format Services (JAMENU)



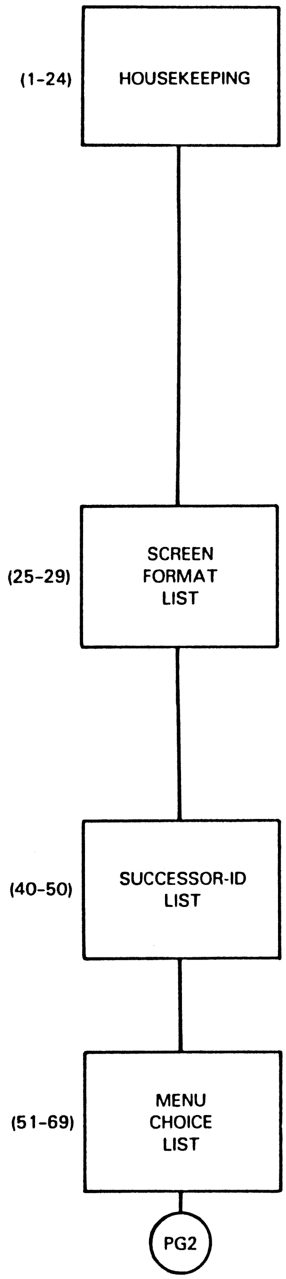
The JAMENU action program is the first of a series of programs that make up an entitlement accounting system. JAMENU processes a password entered as input from the terminal. If the password is valid, JAMENU displays a menu screen using screen format services.

The operator then chooses the menu number of the action program he needs to perform the next operation on his file. If the password he enters is invalid, JAMENU displays an error screen and terminates.

Figure B-23 is a compiler listing of the JAMENU action program. Because this program is one in a series of interrelated action programs, note that a special function call section (lines 269-363) includes many more calls than JAMENU uses. Including a repertoire of these calls in each action program makes them available for any logic used in each procedure division of programs in the series.

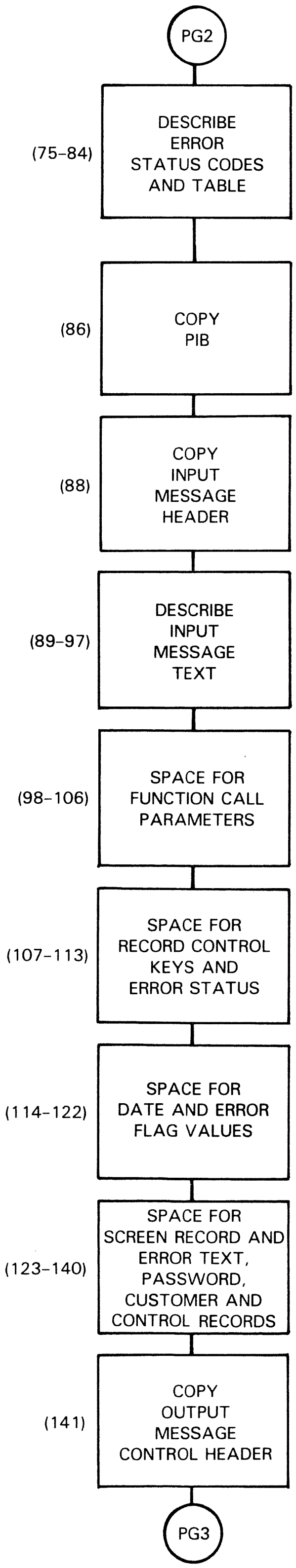
Also, in the working-storage section, all screen formats and successor-ids are identified enabling the program to reference any one of them, though it does not use all of them. This programming technique saves time particularly when a series of action programs can succeed differently to each other.

A flowchart corresponding to the JAMENU action program appears to the left of the coding in Figure B-23. Program line numbers in parentheses near the flowchart boxes represent the lines of coding that implement the process described.



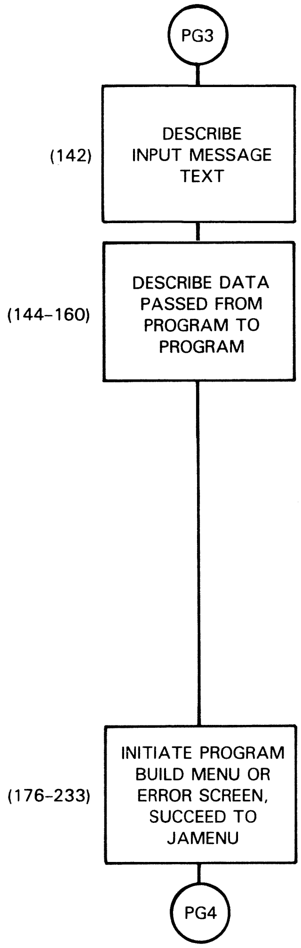

```
LINE NO. SOURCE ENTRY

000001 IDENTIFICATION DIVISION.
000002
000003 PROGRAM-ID.                            JAMENU.
000004*REMARKS.                               PROCESS SIGNON + MENU.
000005*-----------------------------------------------------------------*
000006*     THIS PROGRAM PROCESSES THE SIGNON AND SYSTEM/80 MENU        *
000007*     SCREEN FOR THE ENTITLEMENT ACCOUNTING SYSTEM.               *
000008*     IF THE SIGNON IS FOUND TO BE VALID, THE MENU WILL BE        *
000009*     DISPLAYED. OTHERWISE, THE ERROR OVERLAY SCREEN WILL BE      *
000010*     DISPLAYED AND THE TRANSACTION TERMINATED.                   *
000011*-----------------------------------------------------------------*
000012
000013 ENVIRONMENT DIVISION.
000014
000015 CONFIGURATION SECTION.
000016 SOURCE-COMPUTER.                       UNIVAC-OS3.
000017 OBJECT-COMPUTER.                       UNIVAC-OS3.
000018
000019 DATA DIVISION.
000020
000021 WORKING-STORAGE SECTION.
000022 77  CUST-FILENAME                      PIC X(7)       VALUE 'CUSTMST'.
000023 77  SCTL-FILENAME                      PIC X(7)       VALUE 'SYSCTL'.
000024
000025 01  SCREEN-FORMAT-IDS.
000026     05  SF-MENU                        PIC X(8)      VALUE 'JA$MENU '.
000027     05  SF-ADD1                        PIC X(8)      VALUE 'JA$ADD1 '.
000028     05  SF-ADD2                        PIC X(8)      VALUE 'JA$ADD2 '.
000029     05  SF-ADD3                        PIC X(8)      VALUE 'JA$ADD3 '.
000030     05  SF-CHG1                        PIC X(8)      VALUE 'JA$CHG1 '.
000031     05  SF-CHG2                        PIC X(8)      VALUE 'JA$CHG2 '.
000032     05  SF-CHG3                        PIC X(8)      VALUE 'JA$CHG3 '.
000033     05  SF-DEL1                        PIC X(8)      VALUE 'JA$DEL1 '.
000034     05  SF-DIS1                        PIC X(8)      VALUE 'JA$DIS1 '.
000035     05  SF-LST1                        PIC X(8)      VALUE 'JA$LST1 '.
000036     05  SF-WAR1                        PIC X(8)      VALUE 'JA$WAR1 '.
000037     05  SF-ERR1                        PIC X(8)      VALUE 'JA$ERR  '.
000038     05  SF-TERM                        PIC X(8)      VALUE 'JA$TERM '.
000039
000040 01  VALID-SUCCESSOR-IDS.
000041     05  MENU                           PIC X(6)       VALUE 'JAMENU'.
000042     05  CUST-ADD                       PIC X(6)       VALUE 'JAADD1'.
000043     05  CUST-CHG-1                     PIC X(6)       VALUE 'JACHG1'.
000044     05  CUST-CHG-2                     PIC X(6)       VALUE 'JACHG2'.
000045     05  CUST-CHG-3                     PIC X(6)       VALUE 'JACHG3'.
000046     05  CUST-DEL                       PIC X(6)       VALUE 'JADEL1'.
000047     05  CUST-DISPLAY                   PIC X(6)       VALUE 'JADIS1'.
000048     05  CUST-LIST                      PIC X(6)       VALUE 'JALST1'.
000049     05  WS-ACTIVITY                    PIC X(6)       VALUE 'JAWAR1'.
000050
000051 01  WS-TABLES.
000052     05  MENU-TABLE.
000053         10  FILLER         PIC X(9)  VALUE '01JAADD1I'.
000054         10  FILLER         PIC X(9)  VALUE '02JACHG1I'.
000055         10  FILLER         PIC X(9)  VALUE '03JACHG2I'.
000056         10  FILLER         PIC X(9)  VALUE '04JACHG3I'.
000057         10  FILLER         PIC X(9)  VALUE '05JADEL1I'.
000058         10  FILLER         PIC X(9)  VALUE '06JADIS1I'.
000059         10  FILLER         PIC X(9)  VALUE '07JALST1I'.
000060         10  FILLER         PIC X(9)  VALUE '08JAWAR1I'.
000061         10  FILLER         PIC X(9)  VALUE '09JAMENUN'.
000062         10  FILLER         PIC X(9)  VALUE '10JAMENUI'.
000063
000064     05  MENU-TBL REDEFINES MENU-TABLE OCCURS 10 TIMES
000065         INDEXED BY MENU-INDX.
000066         10  MENU-SEL                   PIC 9(2).
000067         10  MENU-NAME                  PIC X(6).
000068         10  MENU-IND                   PIC X.
000069
000070*************************************************************
000071*  THIS IS THE ERR PROCESSING TABLE FOR RETRIEVING ERR
000072*  MESSAGES FROM THE SYSTEM CONTROL FILE FOR DISPLAY
000073*  WITH THE OVERLAY.
000074*************************************************************
```

Figure B-23. Sample Action Program JAMENU Using Screen Formats (Part 1 of 6)



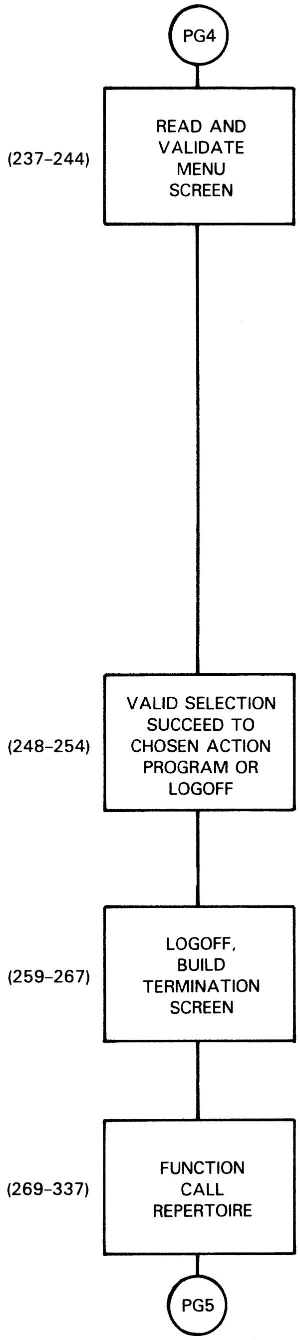

```
000075      05  ERR-STATUS-TABLE.
000076          10  FILLER                  PIC X(40)
000077              VALUE  '0104021203130414051506160717080109021020'.
000078
000079      05  ERR-TABLE REDEFINES ERR-STATUS-TABLE OCCURS 10 TIMES
000080                    INDEXED BY ERR-INDX.
000081          10  ERR-CODE                PIC 99.
000082          10  ERR-KEY                 PIC XX.
000083      05  NO-ERR                      PIC 99 VALUE 20.
000084/
000085 LINKAGE SECTION.
000086 01  PROGRAM-INFORMATION-BLOCK.  COPY PIB.
000087
000088 01  INPUT-MESSAGE-AREA.         COPY IMA.
000089      05  IMA-PASS-1.
000090          10  IMA-DICE               PIC X(4).
000091          10  IMA-SIGNON             PIC X(5).
000092          10  IMA-PASSWRD            PIC X(4).
000093      05  IMA-SCREEN-REC REDEFINES IMA-PASS-1.
000094          10  SR-CUST-NBR                        PIC 9(6).
000095          10  SR-MENU                            PIC 99.
000096          10  SR-TRSMIT                          PIC X.
000097          10  FILLER                             PIC X(4).
000098 01  WORK-AREA.
000099      05  IMS-PARAMETER-LIST.
000100          10  IMS-FILENAME            PIC X(7).
000101          10  IMS-RECORD-AREA         PIC X(256).
000102          10  IMS-KEY                 PIC X(14).
000103          10  IMS-FILE-POSITION       PIC X.
000104          10  IMS-ALGN                           COMP-4 SYNC.
000105          10  IMS-SCREEN-ID           PIC X(8).
000106          10  SCREEN-SIZE                  PIC 9(4) COMP SYNC.
000107      05  WA-CONTROL-KEY.
000108          10  CNTL1                   PIC X(2).
000109          10  CNTL2-3                 PIC X(4).
000110          10  CNTL23 REDEFINES CNTL2-3.
000111              15  CNTL2               PIC 9(2).
000112              15  CNTL3               PIC X(2).
000113      05  ERR-STATUS                  PIC 99.
000114      05  REFORMAT-DATE.
000115          10  P-MONTH                 PIC 99.
000116          10  P-DAY                   PIC 99.
000117          10  P-YEAR                  PIC 99.
000118      05  ERR-FLAG                          PIC X.
000119          88  ERR                             VALUE '1' '2' '3' '4'.
000120          88  SEL-ERR                           VALUE '2'.
000121          88  BLD-ERR                           VALUE '3'.
000122          88  PASSWRD-ERR                       VALUE '4'.
000123      05  SCREEN-RECORD.
000124          10  SR-DATE                           PIC 9(6).
000125          10  SR-TIME                           PIC 9(6).
000126      05  SR-ERR-TEXT                           PIC X(53).
000127      05   SG-STAT                              PIC X(5).
000128      05  PASSWRD-REC.
000129          10  FILLER                            PIC X(2).
000130          10  PASSWRD                           PIC X(4).
000131          10  PASSWRD-SEL                       PIC X(25).
000132          10  PASSWRD-MENU-SEL REDEFINES PASSWRD-SEL
000133                PIC X OCCURS 25 TIMES INDEXED BY PASSWRD-INDX.
000134          10  FILLER                            PIC X(33).
000135/
000136      05  CUST-RECORD.            COPY CUSTMST.
000137
000138      05  SCTL-RECORD.            COPY SYSCTL.
000139
000140
000141 01  OUTPUT-MESSAGE-AREA.        COPY OMA.
```

Figure B-23. Sample Action Program JAMENU Using Screen Formats (Part 2 of 6)



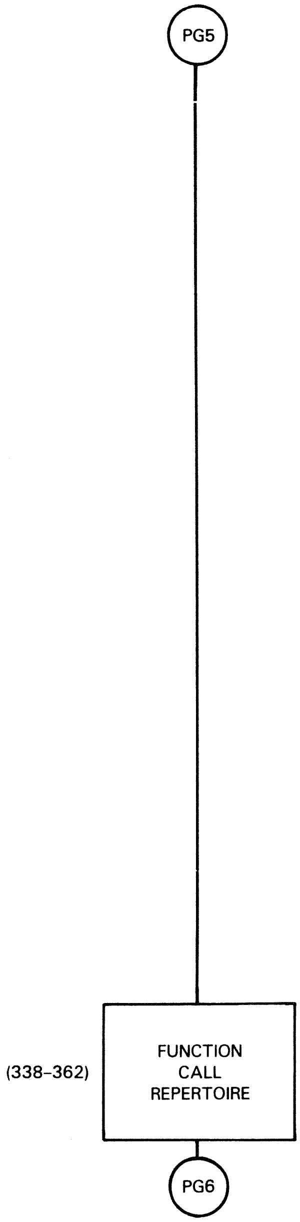

```
000142       05    OMA-TEXT                          PIC X(3000).
000143
000144 01    CONTINUITY-DATA-AREA.
000145       05   CDA-PASSWRD                        PIC X(4).
000146       05   CDA-MENU-SEL                       PIC X(25).
000147       05   CDA-PASSWRD-MENU-SEL   REDEFINES CDA-MENU-SEL
000148                PIC X OCCURS 25 TIMES.
000149       05   CDA-CUST-KEY.
000150            10   CDA-CUST-NBR              PIC 9(6).
000151       05   CDA-ACCT-CODE                  PIC X(4).
000152       05   PASS-FLAG                          PIC X.
000153            88   PASS-THRU                   VALUE '1''2''3''4''5'.
000154            88   PASS1                       VALUE '1'.
000155            88   PASS2                       VALUE '2'.
000156            88   PASS3                       VALUE '3'.
000157            88   PASS4                       VALUE '4'.
000158            88   PASS5                       VALUE '5'.
000159       05   CDA-STATUS-BYTE                    PIC X.
000160       05 CDA-PROGRAM-NAME                     PIC X(6).
000161/
000162 PROCEDURE DIVISION                  USING PROGRAM-INFORMATION-BLOCK
000163                                           INPUT-MESSAGE-AREA
000164                                           WORK-AREA
000165                                           OUTPUT-MESSAGE-AREA
000166                                           CONTINUITY-DATA-AREA.
000167 MAIN-LOOP SECTION.
000168*************************************************************
000169*   THE PASS FLAG IN THIS SECTION TELLS THE PROGRAM AT WHICH
000170*   POINT IMS HAS RETURNED CONTROL OF THE PROCESSING TO THE
000171*   PROGRAM A PASS 2 FLAG MEANS THE PROGRAM HAS ALREADY PUT
000172*   OUT THE SCREEN AND IS NOW READY TO ACCEPT THE DATA FROM
000173*   THAT SCREEN TO PROCESS. OTHERWISE THE PROGRAM WANTS TO
000174*   DO THE INITIAL PROCESSING TO PUT OUT A SCREEN.
000175*************************************************************
000176 000-BEGIN.
000177      IF   NOT PASS2
000178               PERFORM 100-INITIALIZE
000179               IF   NOT ERR
000180                        PERFORM 200-BUILD-SCREEN
000181               ELSE
000182                        PERFORM 900-ERR-MESSAGE
000183      ELSE
000184               PERFORM 250-READ-SCREEN.
000185      PERFORM 507-RETURN.
000186
000187*************************************************************
000188*   INITIALIZATION OF FIELDS AND FLAGS IS DONE HERE.
000189*   ALSO CHECKING IS DONE TO SEE IF THE PROGRAM ENTERED
000190* FROM A SIGN ON OR WAS CALLED FROM ANOTHER PROGRAM.
000191*   ONLY IF ENTER FROM A SIGN ON DOES THE PROGRAM RETRIEVE
000192* THE PASSWORD RECORD. OTHER WISE IT IS CARRIED TO CHECK
000193*   VALIDITY OF MENU SELECTION.
000194*************************************************************
000195 100-INITIALIZE.
000196      MOVE SPACE                              TO IMS-KEY
000197                                                 IMS-FILENAME
000198                                                 SP-ERR-TEXT.
000199      MOVE '2'                                TO PASS-FLAG.
000200      MOVE '0'                                TO ERR-FLAG.
000201      MOVE CORR P-TRANSACTION-DATE            TO REFORMAT-DATE.
000202      IF   CDA-PROGRAM-NAME   EQUAL LOW-VALUES
000203            MOVE IMA-PASSWRD                  TO CNTL2-3
000204            MOVE 'PW'                         TO CNTL1
000205            MOVE SPACE                        TO IMS-RECORD-AREA
000206            MOVE SCTL-FILENAME                TO IMS-FILENAME
000207            MOVE WA-CONTROL-KEY               TO IMS-KEY
000208            PERFORM 502-GET
000209            IF   ERR
000210                  MOVE '4'                    TO ERR-FLAG
000211            ELSE
000212                  MOVE IMS-RECORD-AREA        TO PASSWRD-REC
000213                  MOVE PASSWRD-SEL            TO CDA-MENU-SEL
000214                  MOVE PASSWRD                TO CDA-PASSWRD.
000215      MOVE MENU                               TO CDA-PROGRAM-NAME.
000216
```

Figure B-23. Sample Action Program JAMENU Using Screen Formats (Part 3 of 6)



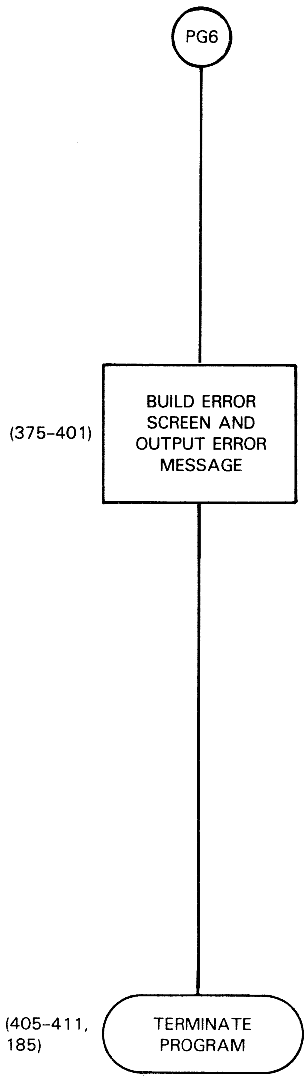

```
000217*****************************************************************
000218*  THE MAIN PROCESSING AND BUILDING OF THE SCREEN DATA IS DONE
000219* IN HERE.
000220*****************************************************************
000221 200-BUILD-SCREEN.
000222      MOVE IMA-SOURCE-TERMINAL-ID          TO OMA-DESTINATION-TERM-ID.
000223      MOVE SF-MENU                         TO IMS-SCREEN-ID.
000224      MOVE ALL '0'                         TO SCREEN-RECORD.
000225      MOVE REFORMAT-DATE                   TO SR-DATE.
000226      MOVE P-TIME-OF-DAY                   TO SR-TIME.
000227      MOVE 12                              TO SCREEN-SIZE.
000228      PERFORM 505-BUILD.
000229      IF ERR
000230         PERFORM 900-ERR-MESSAGE.
000231      MOVE MENU                            TO PIB-SUCCESSOR-ID.
000232      MOVE 'E'                             TO PIB-TERMINATION-IND.
000233
000234*****************************************************************
000235*  THE MENU SELECTION VALIDITY IS CHECKED HERE
000236*****************************************************************
000237 250-READ-SCREEN.
000238      IF CDA-PASSWRD-MENU-SEL (SR-MENU) NOT EQUAL TO '1'
000239              MOVE '2'                     TO ERR-FLAG.
000240      IF  ERR
000241              PERFORM 900-ERR-MESSAGE
000242      ELSE
000243              PERFORM 260-SET-MENU.
000244
000245*****************************************************************
000246* IF MENU SELECTION IS VALID CONTROL IS SET FOR NEXT STAGE.
000247*****************************************************************
000248 260-SET-MENU.
000249      MOVE MENU-NAME (SR-MENU)             TO PIB-SUCCESSOR-ID.
000250      MOVE MENU-IND (SR-MENU)              TO PIB-TERMINATION-IND.
000251      MOVE SR-CUST-NBR                     TO CDA-CUST-NBR.
000252      MOVE '0'                             TO PASS-FLAG.
000253      IF SR-MENU = 9
000254         PERFORM 270-LOGOFF.
000255*
000256*****************************************************************
000257*  BUILD TERMINATION SCREEN
000258*****************************************************************
000259 270-LOGOFF.
000260      MOVE IMA-SOURCE-TERMINAL-ID          TO OMA-DESTINATION-TERM-ID.
000261      MOVE SF-TERM                         TO IMS-SCREEN-ID.
000262      MOVE ALL '0'                         TO SCREEN-RECORD.
000263      MOVE CORR P-TRANSACTION-DATE         TO REFORMAT-DATE.
000264      MOVE REFORMAT-DATE                   TO SR-DATE.
000265      MOVE P-TIME-OF-DAY                   TO SR-TIME.
000266      MOVE 12                              TO SCREEN-SIZE.
000267      PERFORM 505-BUILD.
000268/
000269 IMS-CALLS SECTION.
000270
000271 500-SETL.
000272      CALL 'SETL'                   USING IMS-FILENAME
000273                                         IMS-FILE-POSITION.
000274 500-EXIT.
000275      EXIT.
000276
000277 501-ESETL.
000278      CALL 'ESETL'                  USING IMS-FILENAME.
000279      IF  PIB-STATUS-CODE IS GREATER THAN 0
000280              MOVE '1' TO ERR-FLAG.
000281 501-EXIT.
000282      EXIT.
000283
000284 502-GET.
000285      CALL 'GET'                    USING IMS-FILENAME
000286                                         IMS-RECORD-AREA
000287                                         IMS-KEY.
000288      IF  PIB-STATUS-CODE IS GREATER THAN 0
000289              MOVE '1' TO ERR-FLAG.
000290 502-EXIT.
```

Figure B-23. Sample Action Program JAMENU Using Screen Formats (Part 4 of 6)




```
000291      EXIT.
000292
000293 503-GETUP.
000294      CALL 'GETUP'                   USING IMS-FILENAME
000295                                           IMS-RECORD-AREA
000296                                           IMS-KEY.
000297      IF  PIB-STATUS-CODE IS GREATER THAN 0
000298             MOVE '1' TO ERR-FLAG.
000299 503-EXIT.
000300      EXIT.
000301
000302 504-PUT.
000303      CALL 'PUT'                     USING IMS-FILENAME
000304                                           IMS-RECORD-AREA.
000305      IF  PIB-STATUS-CODE IS GREATER THAN 0
000306             MOVE '1' TO ERR-FLAG.
000307 504-EXIT.
000308      EXIT.
000309
000310*+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
000311*  CALL FOR MAIN SCREEN FOR PROGRAM
000312*+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
000313 505-BUILD.
000314      CALL 'BUILD'                   USING OUTPUT-MESSAGE-AREA
000315                                           IMS-SCREEN-ID
000316                                           SCREEN-RECORD
000317                                           SCREEN-SIZE
000318                                           SG-STAT.
000319      IF PIB-STATUS-CODE IS GREATER THAN 0
000320         MOVE '3' TO ERR-FLAG.
000321 505-EXIT.
000322      EXIT.
000323
000324*+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
000325*  CALL FOR ERR OVERLAY SCREEN
000326*+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
000327 505-BUILD-ERR.
000328      CALL 'BUILD'                   USING OUTPUT-MESSAGE-AREA
000329                                           IMS-SCREEN-ID
000330                                           SR-ERR-TEXT
000331                                           SCREEN-SIZE
000332                                           SG-STAT.
000333      IF PIB-STATUS-CODE IS GREATER THAN 0
000334         MOVE '3' TO ERR-FLAG.
000335 505-BLD-ERR-EXIT.
000336      EXIT.
000337
000338 506-REBUILD.
000339      CALL 'REBUILD'                 USING IMS-SCREEN-ID
000340                                           IMS-RECORD-AREA.
000341 506-EXIT.
000342      EXIT.
000343
000344 507-RETURN.
000345      CALL 'RETURN'.
000346 507-EXIT.
000347      EXIT.
000348
000349 508-INSERT.
000350      CALL 'INSERT'                  USING IMS-FILENAME
000351                                           IMS-RECORD-AREA
000352                                           IMS-KEY.
000353      IF  PIB-STATUS-CODE IS GREATER THAN 0
000354             MOVE '1'                      TO ERR-FLAG.
000355 508-EXIT.
000356      EXIT.
000357
000358 599-SNAP.
```

Figure B-23. Sample Action Program JAMENU Using Screen Formats (Part 5 of 6)




```
000359         MOVE 'S' TO PIB-TERMINATION-IND.
000360         CALL 'SNAP' USING PROGRAM-INFORMATION-BLOCK CDA-STATUS-BYTE.
000361 599-EXIT.
000362         EXIT.
000363/
000364 ERROR-PROCESSING SECTION.
000365*
000366*****************************************************************
000367*   ERR PROCESSING IS DONE HERE.  THE TYPE OF ERR IS
000368*   DETERMINED AND A SEARCH OF THE ERR TABLE IS MADE
000369*   THE APPROPRIATE ERR MESSAGE IS RETRIEVED FROM THE
000370*   SYSTEM CONTROL FILE AND DISPLAY IT ON THE OVERLAY
000371*   ERR 8 IS ILLEGAL PASS WORD ERR 9 IS ILLEGAL MENU
000372*   SELECTION FOR PASSWORD  OTHER ERRS CONFORM TO IMS
000373*   STATUS ERRORS.
000374*****************************************************************
000375 900-ERR-MESSAGE.
000376         MOVE SPACE                              TO IMS-RECORD-AREA
000377                                                    IMS-FILENAME
000378                                                    IMS-KEY.
000379         MOVE SCTL-FILENAME                      TO IMS-FILENAME.
000380         IF PASSWRD-ERR
000381             MOVE '5'                            TO PASS-FLAG
000382             MOVE 8                              TO ERR-STATUS
000383         ELSE
000384         IF  SEL-ERR
000385                 MOVE 9                          TO ERR-STATUS
000386         ELSE
000387             MOVE PIB-STATUS-CODE                TO ERR-STATUS.
000388         MOVE 'EM'                               TO CNTL1.
000389         MOVE SPACE                              TO CNTL3.
000390         SET ERR-INDX                            TO 1.
000391         SEARCH ERR-TABLE
000392             AT END
000393                 MOVE NO-ERR                     TO CNTL2
000394             WHEN ERR-CODE (ERR-INDX) IS EQUAL TO ERR-STATUS
000395                 MOVE ERR-KEY (ERR-INDX)         TO CNTL2.
000396         MOVE WA-CONTROL-KEY                     TO IMS-KEY.
000397         PERFORM 502-GET.
000398         MOVE IMS-RECORD-AREA                    TO SCTL-RECORD.
000399         MOVE ALL '0' TO SR-ERR-TEXT.
000400         MOVE SCERR-TEXT                         TO SR-ERR-TEXT.
000401         MOVE SF-ERR1                            TO IMS-SCREEN-ID.
000402         MOVE 50              TO SCREEN-SIZE.
000403         MOVE IMA-SOURCE-TERMINAL-ID             TO OMA-DESTINATION-TERM-ID.
000404         PERFORM 505-BUILD-ERR.
000405         IF PASS5
000406             MOVE MENU                           TO PIB-SUCCESSOR-ID
000407             MOVE 'N'                            TO PIB-TERMINATION-IND
000408         ELSE
000409             MOVE MENU                           TO PIB-SUCCESSOR-ID
000410             MOVE 'F'                            TO PIB-TERMINATION-IND
000411             MOVE '0'                            TO PASS-FLAG.
```

Figure B-23. Sample Action Program JAMENU Using Screen Formats (Part 6 of 6)

The following discussion of the JAMENU action program assumes that you have already created a menu screen format called JA$MENU and filed it in the screen format file. Any line numbers referenced in this discussion refer to the code in the JAMENU action program, Figure B-23. Also, expansions of the program information block, input message area, and output message area cannot be seen in this listing; however, their fields may be referenced in the code (e.g., lines 406 and 407) and are available to JAMENU.

JAMENU uses two files (lines 22 and 23):

1. CUSTMST file

2. SYSCTL file

The CUSTMST file contains customer information. The SYSCTL file contains four types of records:

1. Account access records (AA)

2. Branch records (BR)

3. Error message text records (EM)

4. Password records (PW)

Each type record is identified by a 2-byte control key field. (See lines 108-112 and 129.) JAMENU accesses the SYSCTL file to validate passwords and retrieve error messages for display in the error message screen format.

JAMENU performs five types of routines. It:

1. Validates passwords

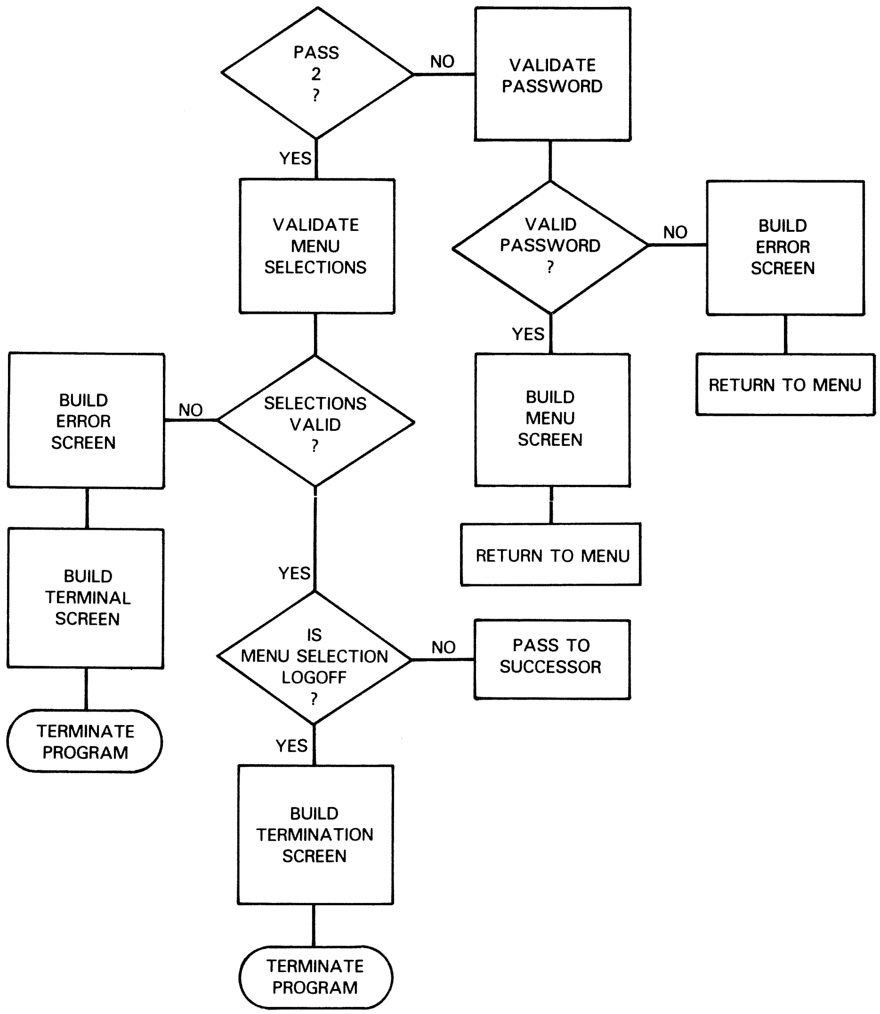
2. Builds menu screen

3. Validates menu selections

4. Builds error screen

5. Builds termination screen

The following general flowchart shows these main routines in the JAMENU program.



Begin executing the JAMENU program by entering the transaction code, MENU, followed by the password. This is considered the sign-on or first pass through JAMENU.

```
MENU CP50
```

On the first pass, JAMENU accesses the SYSCTL file to validate the password entered at the terminal. If the password is valid, JAMENU saves all data pertinent to that password in the continuity data area (lines 211-216), builds the menu screen (lines 221-232), and terminates in external succession to itself (JAMENU). Menu screen JA$MENU follows.

FIRST PASS

```
06/23/81        06:49:28              JAMENU                  02/09/81
                ENTITLEMENT ACCOUNTING SYSTEM
    SELECT ONE (1) OF THE FOLLOWING OPTIONS:
        1.  ADD A NEW CUSTOMER RECORD.
       *2.  UPDATE CUSTOMER NAME/ADDRESS INFORMATION.
       *3.  UPDATE BRANCH CUSTOMER INFORMATION.
       *4.  UPDATE CUSTOMER ENTITLEMENTS.
       *5.  DELETE A CUSTOMER RECORD.
       *6.  DISPLAY CUSTOMER INFORMATION.
        7.  LIST ALL ACCOUNTS (ON THE WORKSTATION).
        8.  ENTER WORKSTATION ACTIVITY RECORDS.
        9.  LOGOFF SYSTEM.
*ENTER CUSTOMER NUMBER _______
   MENU SELECTION: ___
   PLACE CURSOR HERE TO TRANSMIT [-]
```

In the menu screen build routine (lines 221-232), the BUILD function call that actually calls the menu screen identifies the buffer address where IMS receives the screen format as the output message area (line 314); the format name as IMS-SCREEN-ID (line 315, defined on line 105); the variable data as SCREEN-RECORD (line 316, defined on lines 123-125); the data size as SCREEN-SIZE (line 317, defined on line 106); and, the output status as SG-STAT (line 318, defined on line 127).

Notice, all the parameters you specify on the BUILD function must be defined in the work area.

If the BUILD function is unsuccessful (lines 319 and 320), JAMENU moves an error code of 3 to the ERR-FLAG (lines 118 and 121) indicating a build error.

If the password is invalid on the first pass, JAMENU accesses the YSCTL file via the EM record key for the error message record (lines 380-388), searches an error table to find the appropriate error message (lines 390-395), retrieves that error message (lines 396-398), builds the error message screen (lines 399-404), and terminates in external succession to itself (lines 408-411). The password error screen follows:

```
PASSWORD IS INVALID. ENTER AGAIN.
```

On the second pass through JAMENU, the program tests the menu selection made, to see if it is accessible to the password specified in the first pass. If the menu selection is valid for that password, JAMENU performs 260-SET-MENU (lines 248-255). This moves the correct program name to process the menu selection to the successor-id and an I to the termination indicator.

Notice here that the programmer has set up a menu table (lines 52-62) containing not only the menu selection numbers and their corresponding action programs but also the termination indicators used to end each action program. The menu is redefined with selection numbers (MENU-SEL) in the first 2 bytes of each table field, the action program names are in the next 6 bytes (MENU-NAME), and, finally, the termination indicators are in the last byte of each field (MENU-IND).

When the program moves the successor-id and termination indicator to the program information block (lines 248-250), it moves the menu name indexed by the menu number entered at the terminal. JAMENU picks up the correct program name for the successor-id by using this index value to reference the first 2 bytes of the menu table entry. Likewise, JAMENU moves the termination indicator value to the program information block by using the index value to reference the last byte of the menu table entry chosen.

Redefining the menu table (lines 52-68) saves coding by making three types of data accessible in one table: the menu selection numbers, action program names for successor-ids, and termination indicators.

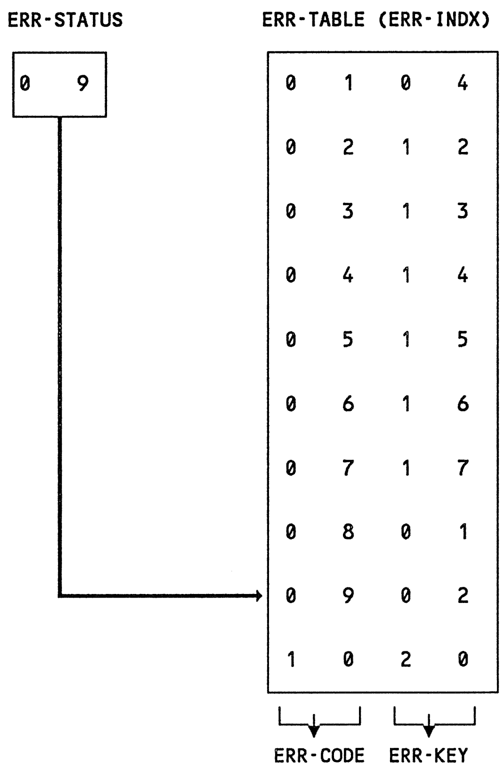
If the menu selection is invalid, JAMENU moves code 2 indicating selection error to ERR-FLAG (lines 237-241), builds the menu selection error message screen (lines 375-411), and succeeds externally to itself.

Several tests occur in the beginning error message building routine. The first separates password errors from menu selection errors and function call errors (lines 380-387).

For a password error, JAMENU places code 5 in the pass flag to force the normal termination of the transaction and moves 8 to the work area location, ERR-STATUS (lines 380-382).

For a menu selection error, JAMENU moves a 9 to ERR-STATUS in the work area (lines 113, 384, and 385). This code corresponds to one of the values 01 through 10 contained in the first 2 bytes of each table entry in the ERR-TABLE. These leading 2 bytes in each table entry also correspond to the index value being used to search ERR-TABLE (lines 75-83). Thus, when the value in ERR-STATUS equals the value in the first 2 bytes of an ERR-TABLE entry, JAMENU moves the contents of ERR-KEY (the last 2 bytes in the corresponding ERR-TABLE entry) to the record key area used to retrieve that error message record from the SYSCLT file (lines 394 and 395).

The following diagram illustrates the ERR-TABLE, its index (ERR-INDX), and the way JAMENU uses the value in ERR-STATUS to find the ERR-KEY value in the table by searching ERR-TABLE for the error code (ERR-CODE) that matches the value in ERR-STATUS.



JAMENU clears the work-area locations (lines 376-378). It moves the SYSCTL file name to the work area file name to prepare for retrieval of the SYSCTL record. This record contains the 'EM' prefix, the error message number to be sent to the screen, and the error message text (line 379).

To find the appropriate error message corresponding to the password error menu selection error, or other function call error, JAMENU searches the table, ERR-TABLE (lines 390-395). If it finds no corresponding error code, it moves a message number of 25 (line 83) to the key field (CNTL-2, line 395) used to call the corresponding record from the SYSCTL error message file (lines 396 and 397 and 284-289).

If, for example, JAMENU finds an 09 error code (lines 394 and 395), JAMENU uses error message number 02 from the ERR-TABLE (see ERR-TABLE diagram and coding line 77) as a key to locate the corresponding error message text in the SYSCTL file (lines 102, 107-112, and 396 and 397).

When JAMENU retrieves the SYSCTL error message (EM) record, it uses this message number to locate the error message text immediately following the 02 error number on the SYSCTL record. JAMENU then uses this message text in building the error message screen.

Notice in lines 398-404, including lines 327-334, that JAMENU clears the screen error text area to receive the error message text from the SYSCTL file; identifies the terminal to receive the error message; transmits the message; and terminates in external succession to itself. If a build error occurs, JAMENU sets the error flag to 3 and succeeds externally to itself.

If the menu selection including customer number is valid, JAMENU executes another short routine (260-SET-MENU, lines 248-254) that passes control to the appropriate action program to process the menu selection. This routine also checks for a logoff menu selection (9) that builds the termination screen similarly to the way JAMENU built the error message screen (lines 259-267). Successor programs selected from the menu perform file operations required. When processing is complete, control returns to the JAMENU program via immediate internal succession and the terminal operator again receives the menu screen to enter another selection.

B.5. Sample COBOL Action Program Performing Output-for-Input Queueing (BEGIN1)

The BEGIN1 action program (Figure B-24) initiates a continuous output print transaction at a terminal other than the source terminal. (See Figure B-25 for an action program performing continuous output.) To do this, BEGIN1 uses output-for-input queueing. By placing the output-for-input queueing function code into the AUX-FUNCTION field of the output message area header, BEGIN1 queues its output message as input to a different terminal.

The program also issues messages to the source terminal operator telling him whether the output message was successfully or unsuccessfully delivered to the destination terminal.

When activated at the source terminal, BEGIN1 expects an input message in the following format (lines 61-65):

```
BEGIN dest-terminal text
```

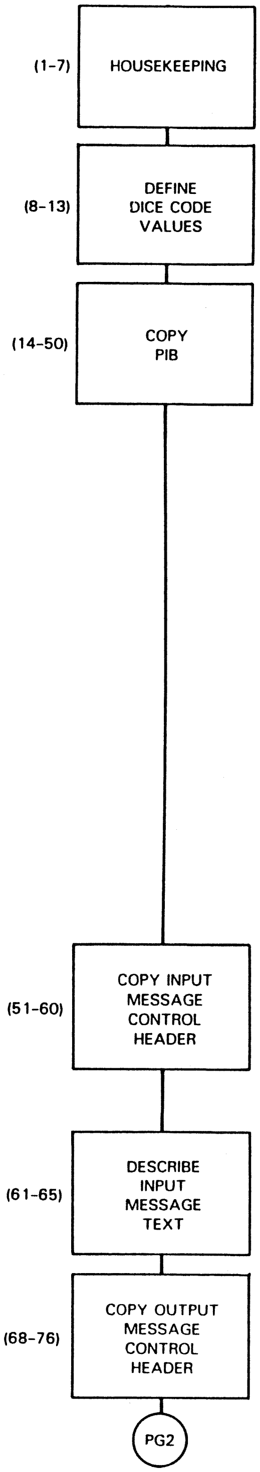
where:

`BEGIN`
: Is the 5-character transaction code the terminal operator enters to activate BEGIN1. (BEGIN should also appear in the configurator TRANSACT section.)

`dest-terminal`
: Is the 4-character *terminal-id* of the destination terminal where the continuous output print transaction is initiated. (Assign this same terminal-id in the ICAM network definition.)

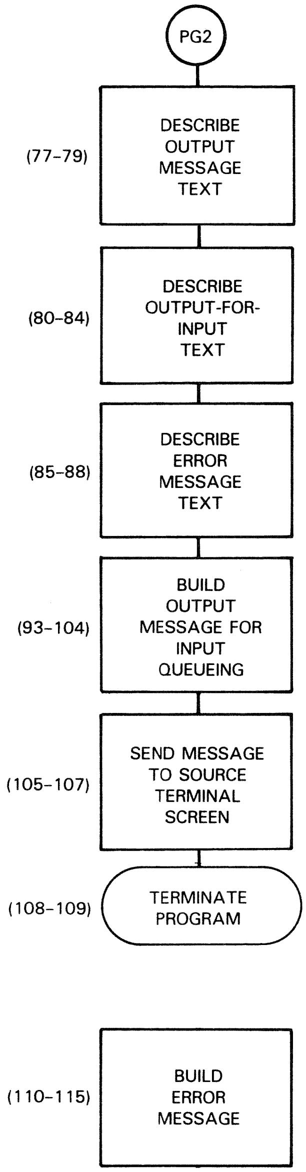
`text`
: Is the alphanumeric text entered by the source terminal operator. This text is the input message expected by the print transaction that performs continuous output at the destination terminal. It must begin with the transaction code that causes scheduling to initiate the transaction.

A flowchart describing the corresponding lines of BEGIN1 code is to the left of Figure B-24.




```
LINE NO. SOURCE ENTRY

00001  IDENTIFICATION DIVISION.
00002  PROGRAM-ID. BEGIN1.
00003  ENVIRONMENT DIVISION.
00004  CONFIGURATION SECTION.
00005  SOURCE-COMPUTER. UNIVAC-OS3.
00006  OBJECT-COMPUTER. UNIVAC-OS3.
00007  DATA DIVISION.
00008  WORKING-STORAGE SECTION.
00009  01  DICE-SEQ.
00010      02 DICE-CODE                PIC X      VALUE ='10'.
00011      02 FUNC-CODE                PIC X      VALUE ='01'.
00012      02 Y-COORD                  PIC X      VALUE ='0C'.
00013      02 X-COORD                  PIC X      VALUE ='00'.
00014  LINKAGE SECTION.
00015  01  PROGRAM-INFORMATION-BLOCK. COPY PIB74.
00016      02  STATUS-CODE                 PIC 9(4) COMP-4.
00017      02  DETAILED-STATUS-CODE        PIC 9(4) COMP-4.
00018      02  RECORD-TYPE REDEFINES DETAILED-STATUS-CODE.
00019          03 PREDICTED-RECORD-TYPE    PIC X.
00020          03 DELIVERED-RECORD-TYPE    PIC X.
00021      02  SUCCESSOR-ID                PIC X(6).
00022      02  TERMINATION-INDICATOR       PIC X.
00023      02  LOCK-ROLLBACK-INDICATOR     PIC X.
00024      02  TRANSACTION-ID.
00025          03 YEAR                     PIC 9(4) COMP-4.
00026          03 TODAY                    PIC 9(4) COMP-4.
00027          03 HR-MIN-SEC               PIC 9(9) COMP-4.
00028      02  DATA-DEF-REC-NAME           PIC X(7).
00029      02  DEFINED-FILE-NAME           PIC X(7).
00030      02  STANDARD-MSG-LINE-LENGTH    PIC 9(4) COMP-4.
00031      02  STANDARD-MSG-NUMBER-LINES   PIC 9(4) COMP-4.
00032      02  WORK-AREA-LENGTH            PIC 9(4) COMP-4.
00033      02  CONTINUITY-DATA-INPUT-LENGTH  PIC 9(4) COMP-4.
00034      02  CONTINUITY-DATA-OUTPUT-LENGTH  PIC 9(4) COMP-4.
00035      02  WORK-AREA-INC               PIC 9(4) COMP-4.
00036      02  CONTINUITY-DATA-AREA-INC    PIC 9(4) COMP-4.
00037          02  SUCCESS-UNIT-ID.
00038              03 TRANSACTION-DATE.
00039                 04 YEAR                    PIC 99.
00040                 04 MONTH                   PIC 99.
00041                 04 TODAY                   PIC 99.
00042              03 TIME-OF-DAY.
00043                 04 HOUR                    PIC 99.
00044                 04 MINUTE                  PIC 99.
00045                 04 SECOND                  PIC 99.
00046          03 UNIQUE-SUFFIX            PIC 999.
00047      02  SOURCE-TERMINAL-CHARS.
00048          03 SOURCE-TERMINAL-TYPE   PIC X.
00049          03 SOURCE-TERM-MSG-LINE-LENGTH    PIC 9(4) COMP-4.
00050          03 SOURCE-TERM-MSG-NUMBER-LINES   PIC 9(4) COMP-4.
00051  01  INPUT-MESSAGE-AREA. COPY IMA74.
00052      02 SOURCE-TERMINAL-ID             PIC X(4).
00053      02 DATE-TIME-STAMP.
00054         03 YEAR                        PIC 9(4) COMP-4.
00055         03 TODAY                       PIC 9(4) COMP-4.
00056         03 HR-MIN-SEC                  PIC 9(9) COMP-4.
00057      02 TEXT-LENGTH                    PIC 9(4) COMP-4.
00058      02 AUXILIARY-DEV-ID.
00059         03 FILLER                    PIC X.
00060         03 AUX-DEV-NO                PIC X.
00061      02 TRANS-CODE               PIC X(5).
00062      02 FILLER                   PIC X.
00063      02 DEST-TERM                PIC X(4).
00064      02 FILLER                   PIC X.
00065      02 TEXT-AREA                PIC X(29).
00066  01  WORK-AREA.
00067      02 DUMMY                    PIC X.
00068  01  OUTPUT-MESSAGE-AREA.      COPY OMA74.
00069      02 DESTINATION-TERMINAL-ID      PIC X(4).
00070             02 SFS-OPTIONS                 PIC X(2).
00071             02 FILLER                      PIC X(2).
00072      02 CONTINUOUS-OUTPUT-CODE       PIC X(4).
```

Figure B-24. Sample Action Program BEGIN1 Using Output-for-Input Queueing (Part 1 of 2)




```
00073      02 TEXT-LENGTH                    PIC 9(4)   COMP-4.
00074      02 AUXILIARY-DEVICE-ID.
00075         03 AUX-FUNCTION                   PIC X.
00076         03 AUX-DEVICE-NO                  PIC X.
00077      02 SEND-MSG.
00078         03 OUTPUT-TEXT                 PIC X(29).
00079         03 FILLER                      PIC X(14).
00080      02 BEGIN-MSG REDEFINES SEND-MSG.
00081         03 CURSOR-1                    PIC X(4).
00082         03 MSG-1                       PIC X(30).
00083         03 TERM-NAME                   PIC X(4).
00084         03 FILLER                      PIC X(5).
00085      02 ERROR-MSG REDEFINES SEND-MSG.
00086         03 CURSOR-2                    PIC X(4).
00087         03 MSG-2                       PIC X(35).
00088         03 ERROR-CODE                  PIC ZZZZ.
00089  PROCEDURE DIVISION USING PROGRAM-INFORMATION-BLOCK
00090                           INPUT-MESSAGE-AREA
00091                           WORK-AREA
00092                           OUTPUT-MESSAGE-AREA.
00093  MOVE-MESSAGE.
00094      MOVE DEST-TERM TO DESTINATION-TERMINAL-ID.
00095      SUBTRACT 11 FROM TEXT-LENGTH IN INPUT-MESSAGE-AREA
00096                GIVING TEXT-LENGTH IN OUTPUT-MESSAGE-AREA
00097      MOVE 'I' TO AUX-FUNCTION.
00098      MOVE TEXT-AREA TO OUTPUT-TEXT.
00099      CALL 'SEND' USING OUTPUT-MESSAGE-AREA.
00100      IF STATUS-CODE NOT EQUAL TO 0 GO TO ERROR-PROC.
00101      MOVE DICE-SEQ TO CURSOR-1.
00102      MOVE 'TRANSACTION BEGUN AT TERMINAL ' TO MSG-1
00103      MOVE DEST-TERM TO TERM-NAME.
00104      MOVE 42 TO TEXT-LENGTH IN OUTPUT-MESSAGE-AREA.
00105  TERMINATE-ROUTINE.
00106      MOVE LOW-VALUES TO DESTINATION-TERMINAL-ID.
00107      MOVE LOW-VALUE TO AUX-FUNCTION.
00108      MOVE 'N' TO TERMINATION-INDICATOR.
00109      CALL 'RETURN'.
00110  ERROR-PROC.
00111      MOVE DICE-SEQ TO CURSOR-2.
00112      MOVE 'TRANSACTION NOT BEGUN DUE TO ERROR ' TO MSG-2.
00113      MOVE DETAILED-STATUS-CODE TO ERROR-CODE.
00114      MOVE 47 TO TEXT-LENGTH IN OUTPUT-MESSAGE-AREA.
00115      GO TO TERMINATE-ROUTINE.
```

Figure B-24. Sample Action Program BEGIN1 Using Output-for-Input Queueing (Part 2 of 2)

When BEGIN1 is activated, the MOVE-MESSAGE routine forms an output message that is queued as input for the destination terminal. Line 94 places the destintation-terminal named in the input message into the output message header. Lines 95 and 96 specify the length of the output message, including four bytes for the TEXT-LENGTH field. Line 97 sets the AUXILIARY-FUNCTION field of the output message area header to the value (X'C9' or C'I') that directs IMS to queue the output message as input for the destination terminal. In line 99, the SEND function transmits the output message to the destination terminal.

If IMS encounters no errors in executing the SEND function, the operator of the originating terminal receives a message indicating that the print transaction was successfully queued at the destination terminal. Lines 101 and 102 provide the screen positioning and text of the message sent to the operator of the originating terminal. Line 106 sets the DESTINATION-TERMINAL-ID field of the output message area header to binary 0 and thus ensures that this message is sent to the source terminal. Line 107 ensures that this message is sent to the UNISCOPE screen instead of to the communications output printer (COP).

BEGIN1 terminates normally without succession (lines 108 and 109) and the source terminal is freed for other interactive use.

On the other hand, if IMS encounters an error in queueing the message output by BEGIN1 as input to the destination terminal, the ERROR-PROC routine (lines 100 and 110-115) formats an error message for output to the originating operator, and BEGIN1 terminates normally (lines 108 and 109). The output message is dequeued. The operator, depending on the nature of the error, may reenter the original input message.

Although the text of the message sent to the source terminal on successful return from the SEND function (line 102) states TRANSACTION BEGUN AT TERMINAL, this may not be true. All that actually occurred was that the output message was successfully queued as input from the destination terminal. If the transaction code it contains is invalid, however, or some other error intervenes, the print transaction does not begin. IMS does not report such occurrences to the originating action program, but to the destination terminal.

Remember, the purpose of BEGIN1 is to initiate a transaction at another terminal by sending a transaction code in the output message it queues as input to the destination terminal. Suppose the terminal operator enters this input:

```
BEGIN TRM5 PRINT ORDFILE 5732468 TRM1 COP
```

The MOVE statement on line 98 places this input into the output text area. The message entered by the terminal operator contains the transaction code needed to start the transaction at the destination terminal.

BEGIN1 redefines the output message text area to handle both a successful and an unsuccessful SEND operation.

If the SEND function is unsuccessful, BEGIN1 positions the cursor and moves the unsuccessful SEND message text to the output text. In this case, the source terminal operator receives the message,

```
TRANSACTION NOT BEGUN DUE TO  ERROR 0604
```

By examining the status and detailed status codes in Table D-4, you discover the reason for the error: the destination terminal or auxiliary device was invalid.

If the SEND function is successful, BEGIN1 positions the cursor and moves the successful SEND message text to the output text. The source terminal operator then receives the message,

```
TRANSACTION BEGUN AT TERMINAL TRM5
```

at his terminal (lines 101-104) and BEGIN1 terminates normally.

When the TRM1 operator receives the successful SEND message, the program PRINT begins processing the ORDFILE order number 5732468 at TRM5 and sends continuous output from the PRINT program to a communications output printer attached to TRM5.

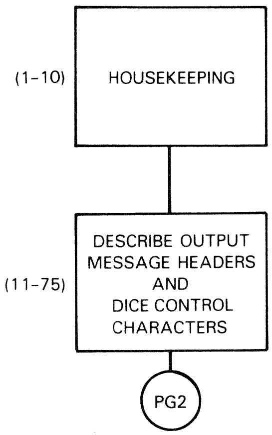
Most output-for-input queueing applications initiate a continuous output transaction at another terminal to free the source terminal for further interactive processing. The continuous output program initiated by the source terminal operator in the message entered on the BEGIN transaction was PRINT.

The PRINT action program showing how continuous output is handled follows in B.6.

B.6. Sample COBOL Action Program Performing Continuous Output with Delivery Notice Scheduling (PRINT)

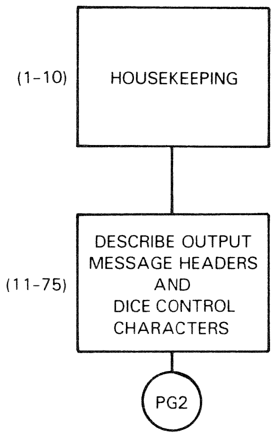
Figure B-25 illustrates a compiler listing of a sample COBOL action program, PRINT, with corresponding flowchart. The PRINT program:

- Prepares three types of output messages by processing customer order information entered at the terminal against an indexed file.
- Lists these messages as continuous output at the originating terminal. (If the parameter, COP, is included in the initial input message, the output from PRINT is sent to a communications output printer.)



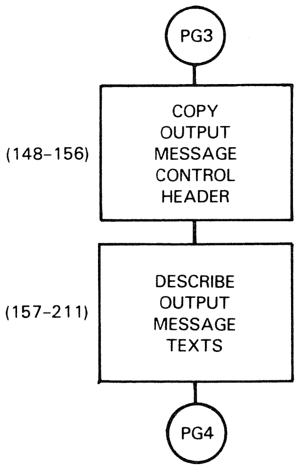

```
LINE NO.    SOURCE ENTRY

00001  IDENTIFICATION DIVISION.
00002  PROGRAM-ID. PRINT.
00003  ENVIRONMENT DIVISION.
00004  CONFIGURATION SECTION.
00005  SOURCE-COMPUTER. UNIVAC-OS3.
00006  OBJECT-COMPUTER. UNIVAC-OS3.
00007  DATA DIVISION.
00008  WORKING-STORAGE SECTION.
00009  77  POS-GE                          PIC X  VALUE 'G'.
00010  77  SUCCESSFUL-DEL-NOTICE           PIC X  VALUE ='C1'.
00011  01  TOTAL-POS.
00012      02 DICE-TP                      PIC X   VALUE ='10'.
00013      02 FUNC-TP                      PIC X    VALUE ='04'.
00014      02 Y-TP                         PIC X    VALUE ='00'.
00015      02 X-TP                         PIC X    VALUE ='33'.
00016  01  HEADER-LINES.
00017      02 ORDER-LINE.
00018         03 HOME-POS-CLEAR.
00019            05 DICE-HPC               PIC X      VALUE ='10'.
00020            05 FUNC-HPC               PIC X      VALUE ='03'.
00021            05 Y-HPC                  PIC X      VALUE ='00'.
00022            05 X-HPC                  PIC X      VALUE ='00'.
00023         03 MIDDLE-COL-POS.
00024            05 DICE-MCP               PIC X      VALUE ='10'.
00025            05 FUNC-MCP               PIC X      VALUE ='02'.
00026            05 Y-MCP                  PIC X      VALUE ='00'.
00027            05 X-MCP                  PIC X      VALUE ='37'.
00028         03 P-ORDER-HEAD              PIC X(10) VALUE 'ORDER #    '.
00029         03 P-ORDER-NO                PIC 9(7).
00030         03 NEWLINE-3.
00031            05 DICE-N3                PIC X      VALUE ='10'.
00032            05 FUNC-N3                PIC X      VALUE ='04'.
00033            05 Y-N3                   PIC X      VALUE ='02'.
00034            05 X-N3                   PIC X      VALUE ='00'.
00035      02 MAIL-LINES.
00036         03 P-NAME                    PIC X(20).
00037         03 NEWLINE-A.
00038            05 DICE-N1A               PIC X      VALUE ='10'.
00039            05 FUNC-N1A               PIC X      VALUE ='04'.
00040            05 Y-N1A                  PIC X      VALUE ='00'.
00041            05 X-N1A                  PIC X      VALUE ='00'.
00042         03 P-ADDR                    PIC X(15).
00043         03 NEWLINE-B.
00044            05 DICE-N1B               PIC X      VALUE ='10'.
00045            05 FUNC-N1B               PIC X      VALUE ='04'.
00046            05 Y-N1B                  PIC X      VALUE ='00'.
00047            05 X-N1B                  PIC X      VALUE ='00'.
00048         03 P-CITY                    PIC X(15).
00049         03 P-ZIP                     PIC X(5).
00050         03 NEWLINE-2.
00051            05 DICE-N2                PIC X      VALUE ='10'.
00052            05 FUNC-N2                PIC X      VALUE ='04'.
00053            05 Y-N2                   PIC X      VALUE ='01'.
00054            05 X-N2                   PIC X      VALUE ='00'.
00055      02 HEADING-LINE.
00056         03 PRODUCT-HEADING           PIC X(19)
00057                                      VALUE '        PRODUCT       '.
00058         03 UNIT-COST-HEADING         PIC X(11)
00059                                      VALUE 'UNIT-COST  '.
00060         03 AMOUNT-HEADING            PIC X(8)
00061                                      VALUE 'AMOUNT  '.
00062         03 SUBTOTAL-HEADING          PIC X(10)
00063                                      VALUE 'SUBTOTAL  '.
00064         03 SPACING                   PIC X(3)  VALUE '   '.
00065         03 TOTAL-HEADING             PIC X(8)   VALUE ' TOTAL   '.
00066         03 NEWLINE-C.
00067            05 DICE-N1C               PIC X       VALUE ='10'.
00068            05 FUNC-N1C               PIC X       VALUE ='04'.
00069            05 Y-N1C                  PIC X       VALUE ='00'.
00070            05 X-N1C                  PIC X       VALUE ='00'.
00071  01  ERROR-POSITION.
00072      03 DICE-EP                      PIC X       VALUE ='10'.
00073      03 FUNC-EP                      PIC X       VALUE ='01'.
00074      03 Y-EP                         PIC X       VALUE ='00'.
00075      03 X-EP                         PIC X       VALUE ='00'.
```

Figure B-25. Sample Action Program PRINT Performing Continuous Output (Part 1 of 6)



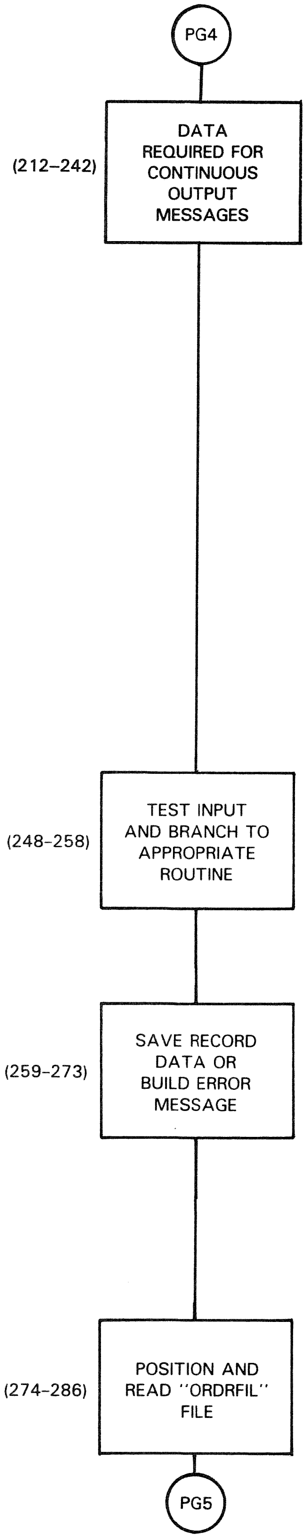

```
LINE NO.    SOURCE ENTRY

00001  IDENTIFICATION DIVISION.
00002  PROGRAM-ID. PRINT.
00003  ENVIRONMENT DIVISION.
00004  CONFIGURATION SECTION.
00005  SOURCE-COMPUTER. UNIVAC-OS3.
00006  OBJECT-COMPUTER. UNIVAC-OS3.
00007  DATA DIVISION.
00008  WORKING-STORAGE SECTION.
00009  77   POS-GE                            PIC X    VALUE 'G'.
00010  77   SUCCESSFUL-DEL-NOTICE             PIC X    VALUE ='C1'.
00011  01   TOTAL-POS.
00012       02 DICE-TP                        PIC X     VALUE ='10'.
00013       02 FUNC-TP                        PIC X      VALUE ='04'.
00014       02 Y-TP                           PIC X      VALUE ='00'.
00015       02 X-TP                           PIC X      VALUE ='33'.
00016  01   HEADER-LINES.
00017       02 ORDER-LINE.
00018          03 HOME-POS-CLEAR.
00019             05 DICE-HPC                 PIC X       VALUE ='10'.
00020             05 FUNC-HPC                 PIC X       VALUE ='03'.
00021             05 Y-HPC                    PIC X       VALUE ='00'.
00022             05 X-HPC                    PIC X       VALUE ='00'.
00023          03 MIDDLE-COL-POS.
00024             05 DICE-MCP                 PIC X       VALUE ='10'.
00025             05 FUNC-MCP                 PIC X       VALUE ='02'.
00026             05 Y-MCP                    PIC X       VALUE ='00'.
00027             05 X-MCP                    PIC X       VALUE ='37'.
00028          03 P-ORDER-HEAD                PIC X(10) VALUE 'ORDER #    '.
00029          03 P-ORDER-NO                  PIC 9(7).
00030          03 NEWLINE-3.
00031             05 DICE-N3                  PIC X       VALUE ='10'.
00032             05 FUNC-N3                  PIC X       VALUE ='04'.
00033             05 Y-N3                     PIC X       VALUE ='02'.
00034             05 X-N3                     PIC X       VALUE ='00'.
00035       02 MAIL-LINES.
00036          03 P-NAME                      PIC X(20).
00037          03 NEWLINE-A.
00038             05 DICE-N1A                 PIC X       VALUE ='10'.
00039             05 FUNC-N1A                 PIC X       VALUE ='04'.
00040             05 Y-N1A                    PIC X       VALUE ='00'.
00041             05 X-N1A                    PIC X       VALUE ='00'.
00042          03 P-ADDR                      PIC X(15).
00043          03 NEWLINE-B.
00044             05 DICE-N1B                 PIC X       VALUE ='10'.
00045             05 FUNC-N1B                 PIC X       VALUE ='04'.
00046             05 Y-N1B                    PIC X       VALUE ='00'.
00047             05 X-N1B                    PIC X       VALUE ='00'.
00048          03 P-CITY                      PIC X(15).
00049          03 P-ZIP                       PIC X(5).
00050          03 NEWLINE-2.
00051             05 DICE-N2                  PIC X       VALUE ='10'.
00052             05 FUNC-N2                  PIC X       VALUE ='04'.
00053             05 Y-N2                     PIC X       VALUE ='01'.
00054             05 X-N2                     PIC X       VALUE ='00'.
00055       02 HEADING-LINE.
00056          03 PRODUCT-HEADING             PIC X(19)
00057                                         VALUE '      PRODUCT      '.
00058          03 UNIT-COST-HEADING           PIC X(11)
00059                                         VALUE 'UNIT-COST  '.
00060          03 AMOUNT-HEADING              PIC X(8)
00061                                         VALUE 'AMOUNT  '.
00062          03 SUBTOTAL-HEADING            PIC X(10)
00063                                         VALUE 'SUBTOTAL  '.
00064          03 SPACING                     PIC X(3)  VALUE '   '.
00065          03 TOTAL-HEADING               PIC X(8)    VALUE ' TOTAL   '.
00066          03 NEWLINE-C.
00067             05 DICE-N1C                 PIC X        VALUE ='10'.
00068             05 FUNC-N1C                 PIC X        VALUE ='04'.
00069             05 Y-N1C                    PIC X        VALUE ='00'.
00070             05 X-N1C                    PIC X        VALUE ='00'.
00071  01   ERROR-POSITION.
00072       03 DICE-EP                        PIC X        VALUE ='10'.
00073       03 FUNC-EP                        PIC X        VALUE ='01'.
00074       03 Y-EP                           PIC X        VALUE ='00'.
00075       03 X-EP                           PIC X        VALUE ='00'.
```

Figure B-25. Sample Action Program PRINT Performing Continuous Output (Part 2 of 6)



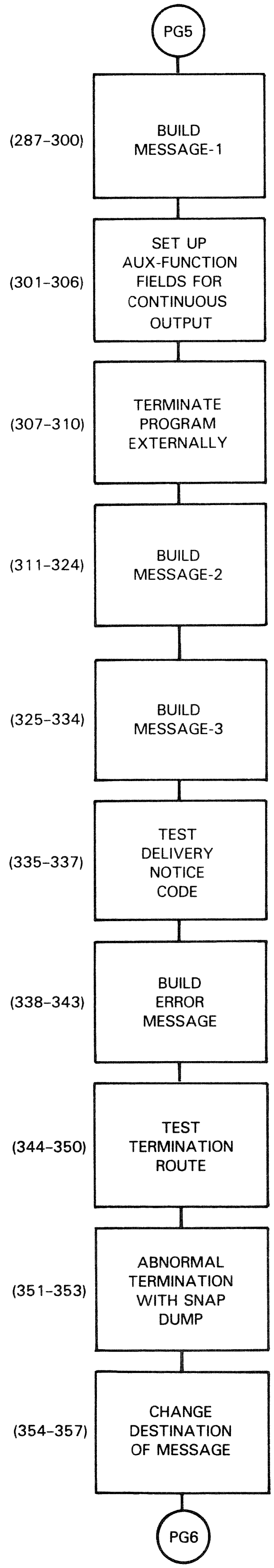

```
00148 01  OUTPUT-MESSAGE-AREA.        COPY OMA74.
00149     02 DESTINATION-TERMINAL-ID        PIC X(4).
00150              02 SFS-OPTIONS                    PIC X(2).
00151              02 FILLER                         PIC X(2).
00152     02 CONTINUOUS-OUTPUT-CODE         PIC X(4).
00153     02 TEXT-LENGTH                PIC 9(4)    COMP-4.
00154     02 AUXILIARY-DEVICE-ID.
00155        03 AUX-FUNCTION                PIC X.
00156        03 AUX-DEVICE-NO               PIC X.
00157     03 MESSAGE-1.
00158        05 FILLER                  PIC X(18).
00159        05 M-ORDER                 PIC 9(7).
00160        05 FILLER                  PIC X(4).
00161        05 M-NAME                  PIC X(20).
00162        05 FILLER                  PIC X(4).
00163        05 M-ADDR                  PIC X(15).
00164        05 FILLER                  PIC X(4).
00165        05 M-CITY                  PIC X(15).
00166        05 M-ZIP                   PIC X(5).
00167        05 FILLER                  PIC X(114).
00168     03 MESSAGE-2 REDEFINES MESSAGE-1.
00169        05 P-BRAND                 PIC X(17).
00170        05 COST                    PIC $$,$$$.99.
00171        05 FILLER                  PIC X(2).
00172        05 NUM                     PIC ZZZ.
00173        05 FILLER                  PIC X(2).
00174        05 P-SUBTOTAL              PIC $$,$$$,$$$.99.
00175        05 NEXTLINE-2              PIC X(4).
00176        05 FILLER                  PIC X(156).
00177     03 MESSAGE-3 REDEFINES MESSAGE-1.
00178        05 CURSOR-POS              PIC X(4).
00179        05 M-TOTAL                 PIC $$,$$$,$$$.99.
00180        05 VALIDITY-CHAR           PIC X.
00181        05 FILLER                  PIC X(188).
00182     03 MESSAGE-4 REDEFINES MESSAGE-1.
00183        05 POSITION-4              PIC X(4).
00184        05 HEADER-4                PIC X(42).
00185        05 ORDER-4                 PIC 9(7).
00186        05 FILLER                  PIC X(153).
00187     03 MESSAGE-5 REDEFINES MESSAGE-1.
00188        05 POSITION-5              PIC X(4).
00189        05 HEADER-5                PIC X(19).
00190        05 TERM-NAME               PIC X(4).
00191        05 FILLER                  PIC X(179).
00192     03 MESSAGE-6 REDEFINES MESSAGE-1.
00193        05 POSITION-6              PIC X(4).
00194        05 BREAK-OUTPUT            PIC X(53).
00195        05 FILLER                  PIC X(149).
00196     03 MESSAGE-7 REDEFINES MESSAGE-1.
00197        05 POSITION-7              PIC X(4).
00198        05 RESUME-ERROR-OUTPUT     PIC X(24).
00199        05 FILLER                    PIC X(178).
00200     03 MESSAGE-8 REDEFINES MESSAGE-1.
00201        05 POSITION-8              PIC X(4).
00202        05 END-OUTPUT              PIC X(23).
00203        05 FILLER                  PIC X(179).
00204     03 MESSAGE-9 REDEFINES MESSAGE-1.
00205        05 POSITION-9              PIC X(4).
00206        05 INPUT-ERROR-OUTPUT      PIC X(32).
00207        05 FILLER                  PIC X(170).
00208     03 MESSAGE-10 REDEFINES MESSAGE-1.
00209        05 POSITION-10             PIC X(4).
00210        05 FILE-ERROR-OUTPUT       PIC X(42).
00211        05 FILLER                  PIC X(160).
```

Figure B-25. Sample Action Program PRINT Performing Continuous Output (Part 3 of 6)



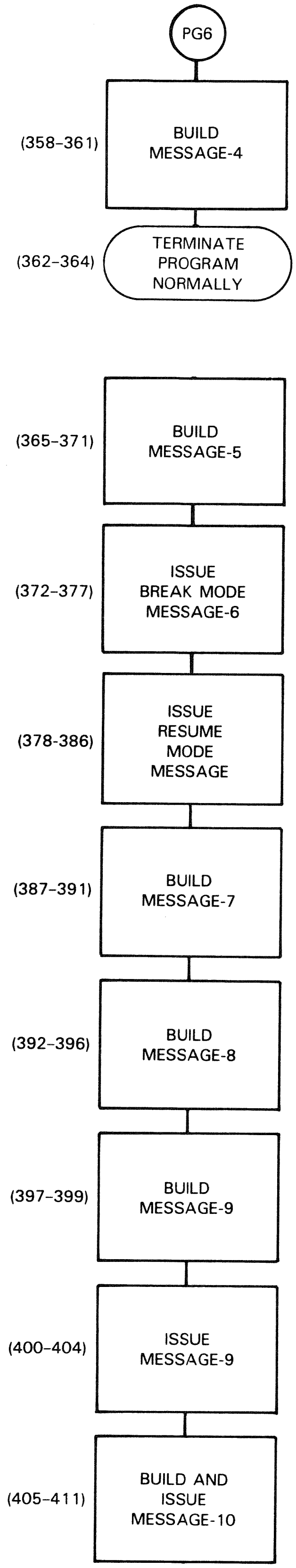

```
00212 01  CONTINUITY-DATA-AREA.
00213     03 CUSTOMER-RECORD.
00214        05 C-KEY                  PIC X(6).
00215        05 C-ID                   PIC X(5).
00216        05 C-NAME                 PIC X(20).
00217        05 C-ADDR                 PIC X(15).
00218        05 C-CITY                 PIC X(15).
00219        05 C-ZIP                  PIC X(5).
00220        05 C-TOTAL                PIC S9(7)V99   COMP-3.
00221        05 FILLER                  PIC X(14).
00222     03 PRODUCT-RECORD.
00223        05 P-KEY                  PIC X(6).
00224        05 PRODUCT                PIC X(17).
00225        05 UNIT-COST              PIC S9(3)V99   COMP-3.
00226        05 AMOUNT                 PIC S999       COMP-3.
00227        05 SUBTOTAL               PIC S9(7)V99   COMP-3.
00228        05 FILLER                  PIC X(47).
00229     03 CURRENT-ORDER-NO          PIC S9(7)  COMP-3.
00230     03 CURRENT-CONT-CODE REDEFINES CURRENT-ORDER-NO  PIC X(4).
00231     03 CURRENT-ENTRY-NO          PIC S999   COMP-3.
00232     03 CURRENT-TOTAL             PIC S9(7)V99  COMP-3.
00233     03 INIT-TERM                 PIC X(4).
00234     03 DEST-TERM                  PIC X(4).
00235     03 COP-OUTPUT                PIC X(3).
00236     03 FILE-KEY.
00237        05 FILE-KEY-1              PIC S9(7) COMP-3.
00238        05 FILE-KEY-2              PIC S9(3) COMP-3.
00239     03 FILE-NAME                  PIC X(7).
00240     03 INPUT-TOTAL               PIC S9(7)V99 COMP-3.
00241     03 BREAK-MODE                PIC X.
00242     03 PRINT-DEST                PIC X(4).
00243 PROCEDURE DIVISION USING PROGRAM-INFORMATION-BLOCK
00244                          INPUT-MESSAGE-AREA
00245                          WORK-AREA
00246                          OUTPUT-MESSAGE-AREA
00247                          CONTINUITY-DATA-AREA.
00248 EXAMINE-INPUT.
00249     IF TRANS-CODE EQUAL TO 'PRINT' GO TO BEGIN-TRANS.
00250     IF COMMAND-CODE EQUAL TO 'END '   GO TO END-TRANS.
00251     IF COMMAND-CODE EQUAL TO 'BREAK' GO TO BREAK-TRANS.
00252     IF COMMAND-CODE EQUAL TO 'RESUM' GO TO RESUME-TRANS.
00253     IF DEL-NOTICE-CODE EQUAL TO 'END '  GO TO END-OF-FILE.
00254     IF DEL-NOTICE-CODE EQUAL TO CURRENT-CONT-CODE
00255                                  GO TO DEL-NOTICE.
00256     MOVE 'INVALID DELIVERY NOTICE CODE     '
00257         TO INPUT-ERROR-OUTPUT.
00258     GO TO DEL-NOTICE-ERROR.
00259 BEGIN-TRANS.
00260     MOVE 0 TO CURRENT-ORDER-NO
00261     MOVE 0 TO CURRENT-ENTRY-NO
00262     MOVE 0 TO FILE-KEY-1  FILE-KEY-2.
00263     MOVE 0 TO CURRENT-TOTAL
00264     MOVE 0 TO BREAK-MODE
00265     MOVE SPACES TO INIT-TERM
00266     MOVE SPACES TO DEST-TERM
00267     MOVE AT-COP TO COP-OUTPUT.
00268     IF T-FILE-NAME NOT EQUAL TO 'ORDRFIL' GO TO INPUT-ERROR.
00269     MOVE INIT-TERMINAL TO INIT-TERM.
00270     MOVE SOURCE-TERMINAL-ID TO PRINT-DEST.
00271     IF T-ORDER-NO NOT EQUAL TO LOW-VALUES AND SPACES
00272         MOVE T-ORDER-NO TO FILE-KEY-1.
00273     MOVE T-FILE-NAME TO FILE-NAME.
00274 POSITION-FILE.
00275     CALL 'SETL' USING FILE-NAME POS-GE FILE-KEY.
00276     IF STATUS-CODE EQUAL TO 0 GO TO READ-RECORD.
00277     MOVE 'END ' TO CURRENT-CONT-CODE.
00278     GO TO TOTAL-PROC.
00279 READ-RECORD.
00280     CALL 'GET' USING FILE-NAME RECORD-AREA.
00281     IF STATUS-CODE EQUAL TO 1  GO TO FILE-ERROR.
00282     IF STATUS-CODE GREATER THAN 2 GO TO FILE-ERROR.
00283     IF STATUS-CODE EQUAL TO 2 GO TO END-OF-FILE.
00284     IF K-ORDER-ENTRY NOT EQUAL TO 0 GO TO PRODUCT-PROC.
00285     MOVE RECORD-AREA TO CUSTOMER-RECORD.
00286     IF CURRENT-TOTAL NOT EQUAL TO 0 GO TO TOTAL-PROC.
```

Figure B-25. Sample Action Program PRINT Performing Continuous Output (Part 4 of 6)




```
00287  CUSTOMER-PROC.
00288      MOVE C-TOTAL TO INPUT-TOTAL.
00289      MOVE K-ORDER-NO TO CURRENT-ORDER-NO.
00290      MOVE K-ORDER-NO TO FILE-KEY-1.
00291      MOVE K-ORDER-ENTRY TO CURRENT-ENTRY-NO.
00292      MOVE K-ORDER-ENTRY TO FILE-KEY-2.
00293      ADD 1 TO FILE-KEY-2.
00294      MOVE HEADER-LINES TO MESSAGE-1.
00295      MOVE CURRENT-ORDER-NO TO M-ORDER.
00296      MOVE C-NAME TO M-NAME.
00297      MOVE C-ADDR TO M-ADDR.
00298      MOVE C-CITY TO M-CITY.
00299      MOVE C-ZIP TO M-ZIP.
00300      MOVE 163 TO TEXT-LENGTH IN OUTPUT-MESSAGE-AREA.
00301  CREATE-CONTINUOUS-OUTPUT.
00302      IF COP-OUTPUT NOT EQUAL TO 'COP'
00303                                MOVE 'C' TO AUX-FUNCTION
00304                ELSE MOVE '7' TO AUX-FUNCTION
00305                     MOVE 1 TO AUX-DEVICE-NO.
00306      MOVE CURRENT-CONT-CODE TO CONTINUOUS-OUTPUT-CODE.
00307  EXTERNAL-TERMINATION.
00308      MOVE 'E' TO TERMINATION-INDICATOR.
00309      MOVE 'PRINTO' TO SUCCESSOR-ID.
00310      CALL 'RETURN'.
00311  PRODUCT-PROC.
00312      MOVE K-ORDER-ENTRY TO CURRENT-ENTRY-NO.
00313      MOVE K-ORDER-ENTRY TO FILE-KEY-2.
00314      ADD 1 TO FILE-KEY-2.
00315      MOVE RECORD-AREA TO PRODUCT-RECORD.
00316      ADD SUBTOTAL TO CURRENT-TOTAL.
00317      MOVE PRODUCT TO P-BRAND.
00318      MOVE UNIT-COST TO COST.
00319      MOVE AMOUNT TO NUM.
00320      MOVE SUBTOTAL TO P-SUBTOTAL.
00321      MOVE NEWLINE-A TO NEXTLINE-2.
00322      MOVE CURRENT-CONT-CODE TO CONTINUOUS-OUTPUT-CODE.
00323      MOVE 54 TO TEXT-LENGTH IN OUTPUT-MESSAGE-AREA.
00324      GO TO CREATE-CONTINUOUS-OUTPUT.
00325  TOTAL-PROC.
00326      IF INPUT-TOTAL EQUAL TO 0 MOVE CURRENT-TOTAL TO INPUT-TOTAL.
00327      MOVE SPACE TO VALIDITY-CHAR.
00328      MOVE INPUT-TOTAL TO M-TOTAL.
00329      IF INPUT-TOTAL NOT EQUAL TO CURRENT-TOTAL
00330                                MOVE '*' TO VALIDITY-CHAR.
00331      MOVE TOTAL-POS TO CURSOR-POS.
00332      MOVE 22 TO TEXT-LENGTH IN OUTPUT-MESSAGE-AREA.
00333      MOVE 0 TO CURRENT-TOTAL.
00334      GO TO CREATE-CONTINUOUS-OUTPUT.
00335  DEL-NOTICE.
00336      IF DEL-NOTICE-STATUS     EQUAL TO SUCCESSFUL-DEL-NOTICE
00337          GO TO POSITION-FILE.
00338  OUTPUT-ERROR.
00339      MOVE ERROR-POSITION TO POSITION-4.
00340      MOVE 'OUTPUT ERROR WHILE TRYING TO PRINT ORDER# ' TO
00341                                                 HEADER-4.
00342      MOVE CURRENT-ORDER-NO TO ORDER-4.
00343      MOVE 57 TO TEXT-LENGTH IN OUTPUT-MESSAGE-AREA.
00344  DESTINATION-DETERMINATION.
00345      IF INIT-TERM NOT EQUAL TO LOW-VALUES AND SPACES AND
00346          SOURCE-TERMINAL-ID
00347          GO TO SWITCH-ERROR-MSG.
00348      MOVE 1 TO BREAK-MODE.
00349      IF ERROR-IND EQUAL TO LOW-VALUE GO TO EXTERNAL-TERMINATION.
00350      IF ERROR-IND EQUAL TO 1 GO  TO NORMAL-TERMINATION.
00351  ABNORMAL-TERMINATION.
00352      MOVE 'S' TO TERMINATION-INDICATOR.
00353      CALL 'RETURN'.
00354  SWITCH-ERROR-MSG.
00355      MOVE INIT-TERM TO DESTINATION-TERMINAL-ID.
00356      CALL 'SEND' USING OUTPUT-MESSAGE-AREA.
00357      IF STATUS-CODE NOT EQUAL TO 0 GO TO ABNORMAL-TERMINATION.
```

Figure B-25. Sample Action Program PRINT Performing Continuous Output (Part 5 of 6)




```
00358  CREATE-NULL-MSG.
00359      MOVE LOW-VALUES TO DESTINATION-TERMINAL-ID.
00360      MOVE NEWLINE-A TO POSITION-4.
00361      MOVE 8 TO TEXT-LENGTH IN OUTPUT-MESSAGE-AREA.
00362  NORMAL-TERMINATION.
00363      MOVE 'N' TO TERMINATION-INDICATOR.
00364      CALL 'RETURN'.
00365  END-OF-FILE.
00366      MOVE 1 TO ERROR-IND.
00367      MOVE ERROR-POSITION TO POSITION-5.
00368      MOVE 'PRINT COMPLETED AT ' TO HEADER-5.
00369      MOVE PRINT-DEST TO TERM-NAME.
00370      MOVE 31 TO TEXT-LENGTH IN OUTPUT-MESSAGE-AREA.
00371      GO TO DESTINATION-DETERMINATION.
00372  BREAK-TRANS.
00373      MOVE 1 TO BREAK-MODE.
00374      MOVE 'BREAK ENFORCED - RESUME REQUIRED TO CONTINUE PRINTING'
00375           TO BREAK-OUTPUT.
00376      MOVE 61 TO TEXT-LENGTH IN OUTPUT-MESSAGE-AREA.
00377      GO TO EXTERNAL-TERMINATION.
00378  RESUME-TRANS.
00379      IF BREAK-MODE EQUAL TO 0 GO TO RESUME-ERROR.
00380      MOVE 0 TO BREAK-MODE.
00381      IF A-ORDER-NO EQUAL TO LOW-VALUES OR SPACES
00382          GO TO POSITION-FILE.
00383      MOVE A-ORDER-NO TO FILE-KEY-1.
00384      MOVE 0 TO FILE-KEY-2.
00385      MOVE 0 TO CURRENT-TOTAL.
00386      GO TO POSITION-FILE.
00387  RESUME-ERROR.
00388      MOVE ERROR-POSITION TO POSITION-7.
00389      MOVE 'RESUME INVALID - IGNORED' TO RESUME-ERROR-OUTPUT.
00390      MOVE 32 TO TEXT-LENGTH IN OUTPUT-MESSAGE-AREA.
00391      GO TO NORMAL-TERMINATION.
00392  END-TRANS.
00393      MOVE ERROR-POSITION TO POSITION-8.
00394      MOVE 'PRINT TRANSACTION ENDED' TO END-OUTPUT.
00395      MOVE 31 TO TEXT-LENGTH IN OUTPUT-MESSAGE-AREA.
00396      GO TO NORMAL-TERMINATION.
00397  INPUT-ERROR.
00398      MOVE 'INPUT IN ERROR - PRINT NOT BEGUN'
00399                                   TO INPUT-ERROR-OUTPUT.
00400  DEL-NOTICE-ERROR.
00401      MOVE 2 TO ERROR-IND.
00402      MOVE ERROR-POSITION TO POSITION-9.
00403      MOVE 40 TO TEXT-LENGTH IN OUTPUT-MESSAGE-AREA.
00404      GO TO DESTINATION-DETERMINATION.
00405  FILE-ERROR.
00406      MOVE 2 TO ERROR-IND.
00407      MOVE ERROR-POSITION TO POSITION-10.
00408      MOVE 'FILE ACCESS ERROR - TRANSACTION TERMINATED'
00409                                   TO FILE-ERROR-OUTPUT.
00410      MOVE 50 TO TEXT-LENGTH IN OUTPUT-MESSAGE-AREA.
00411      GO TO DESTINATION-DETERMINATION.
```

Figure B-25. Sample Action Program PRINT Performing Continuous Output (Part 6 of 6)

After delivery notice of each message is received from IMS, PRINT uses delivery notice scheduling to determine whether output should continue or error processing should occur. If output continues successfully, PRINT terminates in external succession, naming itself as successor to create the next output message to be printed. When end-of-file is reached, PRINT terminates normally, with an output message to the operator that printing is completed.

If the PRINT program receives an unsuccessful delivery notice, it does not terminate immediately but first reports an output error to the terminal operator and allows him to control further output, terminating in external succession to await his response. He may respond by breaking off, resuming, or terminating the transaction normally.

When it is first activated by action scheduling, PRINT expects to process an input message in the following form:

```
PRINT filename order-number init-terminal[COP]
```

where:

`PRINT`
: Is the transaction code that schedules the PRINT action program.

`filename`
: Is the name of the data file to be accessed. In this example, the file is an indexed file; PRINT expects to process a file named ORDRFIL and validates the filename keyed in (line 268, Figure B-25).

`order-number`
: Is an order number used as a key search argument in positioning the file for retrieval (lines 271 and 272).

`init-terminal`
: Is the terminal-id of the originating terminal, used in the switching of output error messages to the operator (line 355).

`COP`
: Is the 3-character code entered by the terminal operator to designate that output should be printed on the COP. Notice its use in line 302.

The input message received by the PRINT program in this example was sent from another terminal via the BEGIN1 action program as output-for-input queueing. The input message received by PRINT from TRM1 contains the transaction code that initiates the PRINT transaction at TRM5.

If the terminal operator at TRM1 entered the sample message shown in B.5, the message received by the PRINT action program is:

```
PRINT ORDFILE 5732468 TRM1 COP
```

On initial activation, PRINT passes control to the BEGIN-TRANS routine, which initializes certain fields of the continuity data area and work area and validates the name of the file to be processed (lines 259-268). BEGIN-TRANS positions the file for sequential processing and, retrieving a record (lines 269-275), processes it and the input message (lines 279-286). It forms a customer record (lines 287-300), a product record (lines 311-324), or a total record (lines 325-334) in the output message area; control then passes to the CREATE-CONTINUOUS-OUTPUT routine (lines 301-306).

Here, if the terminal operator did not key in COP to direct the output message to a communications output printer, the routine moves the hexadecimal value C3 to the AUX-FUNCTION byte of the AUXILIARY-DEVICE-ID field in the OMA header (line 303). This causes the output message to be written as continuous output on the screen of the originating terminal. Otherwise, line 304 moves the hexadecimal value F7 to this byte, to cause print-transparent continuous output on a communications output printer, and line 305 moves a 1 to the AUX-DEVICE-NO byte of the AUXILIARY-DEVICE-ID to specify the COP relative number as defined in the ICAM generation.

Line 306 moves into the CONTINUOUS-OUTPUT-CODE field of the OMA header a 4-character value (represented by the current order number). After an attempt is made to deliver the message as specified, this 4-character value identifies this output message when received in the 5-byte input message that IMS creates for the next activation of PRINT.

After specifying external succession (line 308) and moving its own program name into the SUCCESSOR-ID field of the program information block (line 309), PRINT terminates to await reactivation by action scheduling.

On receiving the 5-byte input message from IMS, the PRINT program is reactivated. PRINT examines the input message, DEL-NOTICE-CODE (first four bytes), to ensure that it is processing the expected input (line 348) and then proceeds to verify that the delivery attempt was successful. It does this at line 336 by comparing the fifth byte of the input message (DEL-NOTICE-STATUS) against the value 'A'. This value, which it has established for the constant SUCCESSFUL-DEL-NOTICE in a 77-level entry in the working-storage section (line 10), is the translated value for a successful delivery notice status (hexadecimal 81) reported to IMS by ICAM. On successful delivery, it resumes processing. If delivery was unsuccessful, PRINT does not attempt to determine the reason but sends an error message to the terminal operator. If an initiating terminal is specifed in the input message, PRINT sends error messages to that terminal.

PRINT terminates in external succession after it sends an output message to the operator informing him of unsuccessful delivery of the last continuous output message (line 349). It expects him to enter either the command RESUM (line 252) or the command END (line 250) and is prepared to process one of these as its next reactivation. If he enters the command END (line 396), the program terminates with normal termination. If he enters the command RESUM, the program allows him to continue printing from where he left off, or from an earlier order number specified as an optional parameter of the RESUM command (line 135).

PRINT voluntarily terminates abnormally, with a SNAP dump, when:

- It receives an unexpected input message on activation (line 258)
- The terminal operator attempts to access some file other than ORDRFIL (line 268)
- An unsuccessful return was made to the STATUS-CODE field of the program information block after issuing the GET function to ORDRFIL (lines 280-283)
- Any of its error or warning messages switched to the terminal operator were not successfully sent (line 357)

PRINT sends a message to the terminal operator before terminating when the operator enters the wrong file name (line 397) or there is an error on the GET function (line 405).

B.7. Sample COBOL Action Program Assigning Printer Files and Controlling Printer File Output (GRP1A)

The GRP1A action program:

- Reads a numeric field
- Builds a record in the output message area
- Prints output to print file JERRID by using PRINT and BRKPT function calls

You begin by keying in the transaction code GRP1A followed by a 3-digit number. (See Figure B-26.) The GRP1A program uses this number as a key to read a record from the data file (DATA2) into the work area. It transfers the input record contents from the work area to the output message area.

```
GRP1AΔΔΔ002
```

Figure B-26. Initiating the GRP1A Transaction

GRP1A uses the PRINT call function to assign the print file JERRID. The BRKPT call function then prints the contents to the spooled print file. (See Figure B-27.)

```
002JAMES SMITH

003MIKE BATES

004KAREN DAVIS
```

Figure B-27. Output from GRP1A Action Program

COBOL program GRP1A in Figure B-28 illustrates the use of PRINT and BRKPT function calls.

```
       IDENTIFICATION DIVISION.
       PROGRAM-ID. GRP1A.
       ENVIRONMENT DIVISION.
       CONFIGURATION SECTION.
       SOURCE-COMPUTER. UNIVAC-OS3.
       OBJECT-COMPUTER. UNIVAC-OS3.
       DATA DIVISION.
       WORKING-STORAGE SECTION.
       77  DATA2            PIC X(7) VALUE 'DATA2  '.
       77  POSITION-CODE    PIC X VALUE 'B'.
       77  PRTNAME  PIC X(7) VALUE 'JERRID '.
       01  PRINT-LEN PIC 99 COMP VALUE 23.
       LINKAGE SECTION.
       01  PIB. COPY PIB74.
C          02  STATUS-CODE              PIC 9(4) COMP-4.
C          02  DETAILED-STATUS-CODE     PIC 9(4) COMP-4.
C          02  RECORD-TYPE REDEFINES DETAILED-STATUS-CODE.
C              03 PREDICTED-RECORD-TYPE  PIC X.
C              03 DELIVERED-RECORD-TYPE  PIC X.
C          02  SUCCESSOR-ID             PIC X(6).
C          02  TERMINATION-INDICATOR    PIC X.
C          02  LOCK-ROLLBACK-INDICATOR  PIC X.
C          02  TRANSACTION-ID.
C              03  YEAR                 PIC 9(4) COMP-4.
C              03  TODAY                PIC 9(4) COMP-4.
C              03  HR-MIN-SEC           PIC 9(9) COMP-4.
C          02  DATA-DEF-REC-NAME        PIC X(7).
C          02  DEFINED-FILE-NAME        PIC X(7).
C          02  STANDARD-MSG-LINE-LENGTH  PIC 9(4) COMP-4.
C          02  STANDARD-MSG-NUMBER-LINES PIC 9(4) COMP-4.
C          02  WORK-AREA-LENGTH         PIC 9(4) COMP-4.
C          02  CONTINUITY-DATA-INPUT-LENGTH  PIC 9(4) COMP-4.
C          02  CONTINUITY-DATA-OUTPUT-LENGTH  PIC 9(4) COMP-4.
C          02  WORK-AREA-INC            PIC 9(4) COMP-4.
C          02  CONTINUITY-DATA-AREA-INC PIC 9(4) COMP-4.
C          02  SUCCESS-UNIT-ID.
C              03 TRANSACTION-DATE.
C                 04 YEAR               PIC 99.
C                 04 MONTH              PIC 99.
C                 04 TODAY              PIC 99.
C              03 TIME-OF-DAY.
C                 04 HOUR               PIC 99.
C                 04 MINUTE             PIC 99.
C                 04 SECOND             PIC 99.
```

Figure B-28. GRP1A Action Program (Part 1 of 3)

```
                 03 FILLER                 PIC XXX.
             02  SOURCE-TERMINAL-CHARS.
                 03 SOURCE-TERMINAL-TYPE  PIC X.
                 03 SOURCE-TERM-MSG-LINE-LENGTH   PIC 9(4) COMP-4.
                 03 SOURCE-TERM-MSG-NUMBER-LINES  PIC 9(4) COMP-4.
                 03 SOURCE-TERM-ATTRIBUTES PIC X.
             02  DDP-MODE                  PIC X.
         01  IMA. COPY IMA74.
             02  SOURCE-TERMINAL-ID        PIC X(4).
             02  DATE-TIME-STAMP.
                 03  YEAR                  PIC 9(4) COMP-4.
                 03  TODAY                 PIC 9(4) COMP-4.
                 03  HR-MIN-SEC            PIC 9(9) COMP-4.
             02  TEXT-LENGTH               PIC 9(4) COMP-4.
             02  AUXILIARY-DEV-ID.
                 03 FILLER                 PIC X.
                 03 AUX-DEV-NO             PIC X.
             02  FILLER   PIC X(11).
         01  WA.
             02  I-REC.
                 03   CODE-I   PIC 999.
                 03   NAME-I   PIC X(20).
                 03   ADDR-I   PIC X(20).
                 03   FILLER   PIC X(37).
         01  OMA.  COPY OMA74.
             02  DESTINATION-TERMINAL-ID   PIC X(4).
             02  SFS-OPTIONS.
                 03 SFS-TYPE               PIC X.
                 03 SFS-LOCATION           PIC X.
             02  FILLER                    PIC X(2).
             02  CONTINUOUS-OUTPUT-CODE    PIC X(4).
             02  TEXT-LENGTH               PIC 9(4)   COMP-4.
             02  AUXILIARY-DEVICE-ID.
                 03 AUX-FUNCTION           PIC X.
                 03 AUX-DEVICE-NO          PIC X.
             02  CODE-1   PIC 999.
             02  NAME-1   PIC X(20).
             02  CODE-2 PIC 999.
             02  NAME-2 PIC X(20).
             02  CODE-3 PIC 999.
             02  NAME-3 PIC X(20).
         PROCEDURE DIVISION USING PIB IMA WA OMA.

         S-BEGIN.
             MOVE 69 TO TEXT-LENGTH OF OMA.
             CALL 'SETL' USING DATA2 POSITION-CODE.
             CALL 'GET' USING DATA2 I-REC.
             MOVE CODE-I TO CODE-1.
             MOVE NAME-I TO NAME-1.
             CALL 'PRINT' USING PRTNAME CODE-1 PRINT-LEN.
             CALL 'GET' USING DATA2 I-REC.
```

Figure B-28. GRP1A Action Program (Part 2 of 3)

```
C               MOVE CODE-I TO CODE-2.
C               MOVE NAME-I TO NAME-2.
C               CALL 'PRINT' USING PRTNAME CODE-2 PRINT-LEN.
C               CALL 'GET' USING DATA2 I-REC.
C               MOVE CODE-I TO CODE-3.
C               MOVE NAME-I TO NAME-3.
C               CALL 'ESETL' USING DATA2.
C               CALL 'PRINT' USING PRTNAME CODE-3 PRINT-LEN.
C               CALL 'BRKPT' USING PRTNAME.
C               CALL 'RETURN'.
```

Figure B-28. GRP1A Action Program (Part 3 of 3)

B.8. Sample COBOL Program Setting Up Transaction Buffers

```
IDENTIFICATION DIVISION.


PROGRAM-ID.  TOBS.
AUTHOR.  B WHITE.
DATE-WRITTEN.  OCT 21, 1986.


ENVIRONMENT DIVISION.

CONFIGURATION SECTION.

SOURCE-COMPUTER.  UNIVAC-OS3.
OBJECT-COMPUTER.  UNIVAC-OS3.


DATA DIVISION.

WORKING-STORAGE SECTION.

LINKAGE SECTION.

01   PIB.
     COPY PIB74.

01   IMA.
     COPY IMA74.
     02   TRANS-CODE              PIC X(4).
     02   FILLER                  PIC X.
     02   ACCT-NO-IN              PIC 9(5).

01   WORK-AREA.

     02   SCREEN-NAME             PIC X(8).

     02   VARIABLE-DATA-1.
          04   ACCT-NO1           PIC 9(5).

     02   VARIABLE-DATA-2.
          04   ACCT-NO2           PIC 9(5).
          04   ERRMSG             PIC X(60).

     02   VARI-DATA-SIZE          PIC 9(4) COMP-4.

     02   VARI-DATA-STATUS.
          04   STATUS-BYTE-1      PIC 9.
          04   STATUS-BYTE-2      PIC 9.

     02   ACCT-NO-VERIFY          PIC 9(5).
          88   VALID-ACCT-NO      VALUES 10010 10020 10030 10040
                                         10050 10060 10070 10080
                                         10090 10100 10110 10120
                                         10130 10140 10150 10160
                                         10170 10180 10190 10200
                                         10210 10220 10230 10240
                                         10250.

     02   NUMB                    PIC 9(9) COMP-4 SYNC.

01   OMA.
     COPY OMA74.
     02   OMA-TEXT                PIC X(3020).

01   TRANS-BUFFER-AREA.
     02   ACCT-NO-BUFF            PIC 9(5).
```

NUMB defined as COMP–4 SYNC

01 record linkage user define your transaction buffer area

Figure B-29. Sample COBOL Programs Setting Up Transaction Buffers (Part 1 of 5)

```
       PROCEDURE DIVISION USING PIB IMA WORK-AREA OMA.


       MAIN-SECTION.
           MOVE 3020 TO TEXT-LENGTH OF OMA.
           PERFORM GET-TRANS-BUFFER.
           MOVE ACCT-NO-IN TO ACCT-NO-VERIFY ACCT-NO1 ACCT-NO2
               ACCT-NO-BUFF.
           IF NOT VALID-ACCT-NO
               PERFORM ERROR-ROUTINE.
           MOVE 5 TO VARI-DATA-SIZE.
           MOVE 'IMSSCRN1' TO SCREEN-NAME.
           CALL 'BUILD' USING OMA SCREEN-NAME VARIABLE-DATA-1
               VARI-DATA-SIZE VARI-DATA-STATUS.
           IF STATUS-CODE NOT = 0000
               MOVE 'S' TO TERMINATION-INDICATOR
               CALL 'RETURN'.
           MOVE 'TOBSUC' TO SUCCESSOR-ID
           MOVE 'E' TO TERMINATION-INDICATOR
           CALL 'RETURN'.

       GET-TRANS-BUFFER.
           MOVE 1 TO NUMB.
           CALL 'GETMEM' USING TRANS-BUFFER-AREA NUMB.
           IF STATUS-CODE NOT = 0000
               MOVE 'S' TO TERMINATION-INDICATOR
               CALL 'RETURN'.

       ERROR-ROUTINE.
           MOVE 'INVALID ACCT NO, PLEASE REPEAT TRANSACTION' TO ERRMSG.
           MOVE 'IMSSCRN2' TO SCREEN-NAME.
           MOVE 65 TO VARI-DATA-SIZE.
           MOVE 'N' TO TERMINATION-INDICATOR.
           CALL 'BUILD' USING OMA SCREEN-NAME VARIABLE-DATA-2
               VARI-DATA-SIZE VARI-DATA-STATUS.
           IF STATUS-CODE NOT = 0000
               MOVE 'S' TO TERMINATION-INDICATOR.
           CALL 'RETURN'.
```

move data to transaction buffer

externally succeed to TOBSU

want 1 4096-byte block

user-defined transaction buffer area

Figure B-29. Sample COBOL Programs Setting Up Transaction Buffers (Part 2 of 5)

```
IDENTIFICATION DIVISICN.

PROGRAM-ID.  TOBSU.
AUTHOR.  B WHITE.
DATE-WRITTEN.  CCT 21, 1986.


ENVIRONMENT DIVISION.

CONFIGURATION SECTICN.

SOURCE-COMPUTER.  UNIVAC-OS3.
OBJECT-COMPUTER.  UNIVAC-OS3.


DATA DIVISION.

WORKING-STORAGE SECTION.

77  FACCT-FILE                   PIC X(7)   VALUE 'FACCT'.

77  FTRAN-FILE                   PIC X(7)   VALUE 'FTRAN'.

LINKAGE SECTION.

01  PIB.
    COPY PIB74.

01  IMA.
    COPY IMA74.
    02  TYPE-IN                  PIC X.
    02  AMT-IN                   PIC 9(7)V99.

01  WORK-AREA.
    02  FACCT-RECORD.
        04  F-ACCTNO             PIC 9(5).
        04  F-BALANCE            PIC 9(7)V99.
        04  F-NAME               PIC X(20).
        04  F-ADDRESS            PIC X(40).
        04  FILLER               PIC X(6).

    02  FTRAN-RECORD.
        03  FTRAN-KEY.
            04  T-ACCT-NO        PIC 9(5).
            04  T-DATE           PIC 9(6).
            04  T-TIME           PIC 9(6).
        03  T-AMOUNT             PIC 9(7)V99.
        03  FILLER               PIC X(54).

    02  SCREEN-NAME              PIC X(8).

    02  VARIABLE-DATA1.
        04  ACCT-NO1             PIC 9(5).
        04  ERRMSG               PIC X(60).

    02  VARIABLE-DATA2.
        04  ACCT-NO2             PIC 9(5).
        04  PREV-BALANCE         PIC Z,ZZZ,ZZZ.99.
        04  TRANS-TYPE-OUT       PIC X(8).
        04  AMT-OUT              PIC Z,ZZZ,ZZZ.99.
        04  CURR-BALANCE         PIC Z,ZZZ,ZZZ.99.
```

Figure B-29. Sample COBOL Programs Setting Up Transaction Buffers (Part 3 of 5)

```
           02  VARI-DATA-SIZE          PIC 9(4)   COMP-4.

           02  VARI-DATA-STATUS.
               04   STATUS-BYTE-1      PIC 9.
               04   STATUS-BYTE-2      PIC 9.

           02  TYPE-VERIFY             PIC X.
               88  VALID-TYPE              VALUES 'D'
                                                  'W'.

           02  TRANS-BUFF-INTERROGATE.                       record in linkage
               04   WORD-1             PIC 9(9) COMP-4 SYNC.  section for
               04   WORD-2             PIC 9(9) COMP-4 SYNC.  interrogation
               04   WORD-3             PIC 9(9) COMP-4 SYNC.  be PIC 9(9) COMP-4 SYNC

           02  NUMB                    PIC 9(9) COMP-4 SYNC.


       01  OMA.
           COPY OMA74.

       01  TRANS-BUFFER-AREA.                                 01 record in linkage
           02  ACCT-NO-BUFF            PIC 9(5).              user-defined

       PROCEDURE DIVISION USING PIB IMA WORK-AREA OMA.

       MAIN-ROUTINE.
           MOVE 3020 TO TEXT-LENGTH OF OMA.
           PERFORM INTERROGATE-FOR-BUFFER.
           PERFORM GET-TRANS-BUFFER.
           MOVE ACCT-NO-BUFF TO ACCT-NO1 ACCT-NO2.            access buffer information
           MOVE TYPE-IN TO TYPE-VERIFY.
           IF NOT VALID-TYPE
               MOVE 'INVALID TYPE, PLEASE REPEAT TRANSACTION' TO ERRMSG
               PERFORM ERROR-ROUTINE.
           PERFORM READ-FACCT-RECORD.
           MOVE F-BALANCE TO PREV-BALANCE.
           MOVE AMT-IN TO AMT-OUT.
           IF TYPE-IN = 'D'
               PERFORM DEPOSIT-ROUTINE
           ELSE
               PERFORM WITHDRAW-ROUTINE.
           PERFORM WRITE-FACCT-RECORD.
           PERFORM WRITE-TRANSACTION-RECORD.
           PERFORM BUILD-OUTPUT-SCREEN.
           PERFORM RELEASE-TRANS-BUFFER.
           CALL 'RETURN'.

       INTERROGATE-FOR-BUFFER.
           MOVE 0 TO NUMB.                                    0 indicates interrogation
           CALL 'GETMEM' USING TRANS-BUFF-INTERROGATE NUMB.   02 record in linkage
           IF WORD-1 = 0000                                   word-1 should contain
               MOVE 'S' TO TERMINATION-INDICATOR              an address
               CALL 'RETURN'.

       GET-TRANS-BUFFER.
           MOVE 0 TO NUMB.                                    0 indicates acquire
           CALL 'GETMEM' USING TRANS-BUFFER-AREA NUMB.        01 record in linkage
           IF STATUS-CODE NOT = 0000
               MOVE 'S' TO TERMINATION-INDICATOR
               CALL 'RETURN'.
```

Figure B-29. Sample COBOL Programs Setting Up Transaction Buffers (Part 4 of 5)

```
       READ-FACCT-RECORD.
           CALL 'GETUP' USING FACCT-FILE FACCT-RECORD ACCT-NO-BUFF.
           IF STATUS-CODE NOT = 0000
               MOVE 'S' TO TERMINATION-INDICATOR
               CALL 'RETURN'.

       DEPOSIT-ROUTINE.
           ADD AMT-IN TO F-BALANCE.
           MOVE 'DEPOSIT ' TO TRANS-TYPE-OUT.

       WITHDRAW-ROUTINE.
           IF AMT-IN IS GREATER THAN F-BALANCE
               MOVE 'INSUFFICIENT FUNDS - TRANSACTION IS CANCELLED'
                   TO ERRMSG
               PERFORM ERROR-ROUTINE.
           SUBTRACT AMT-IN FROM F-BALANCE.
           MOVE 'WITHDRAW' TO TRANS-TYPE-OUT.

       WRITE-TRANSACTION-RECORD.
           MOVE ACCT-NO-BUFF TO T-ACCT-NO.
           MOVE TRANSACTION-DATE TO T-DATE.
           MOVE TIME-OF-DAY TO T-TIME.
           MOVE AMT-IN TO T-AMOUNT.
           CALL 'PUT' USING FTRAN-FILE FTRAN-RECORD.
           IF STATUS-CODE NOT = 0000
               MOVE 'S' TO TERMINATION-INDICATOR
               CALL 'RETURN'.

       BUILD-OUTPUT-SCREEN.
           MOVE F-BALANCE TO CURR-BALANCE.
           MOVE 'IMSSCRN3' TO SCREEN-NAME.
           MOVE 'N' TO TERMINATION-INDICATOR.
           MOVE 50 TO VARI-DATA-SIZE.
           CALL 'BUILD' USING OMA SCREEN-NAME VARIABLE-DATA2
               VARI-DATA-SIZE VARI-DATA-STATUS.
           IF STATUS-CODE NOT = 0000
               MOVE 'S' TO TERMINATION-INDICATOR.

       WRITE-FACCT-RECORD.
           CALL 'PUT' USING FACCT-FILE FACCT-RECORD.
           IF STATUS-CODE NOT = 0000
               MOVE 'S' TO TERMINATION-INDICATOR
               CALL 'RETURN'.

       ERROR-ROUTINE.
           MOVE 'IMSSCRN2' TO SCREEN-NAME.
           MOVE 65 TO VARI-DATA-SIZE.
           MOVE 'N' TO TERMINATION-INDICATOR.
           CALL 'BUILD' USING OMA SCREEN-NAME VARIABLE-DATA1
               VARI-DATA-SIZE VARI-DATA-STATUS.
           IF STATUS-CODE NOT = 0000
               MOVE 'S' TO TERMINATION-INDICATOR.
           CALL 'RETURN'.

       RELEASE-TRANS-BUFFER.
           CALL 'RELMEM' USING TRANS-BUFFER-AREA.
           IF STATUS-CODE NOT = 0000
               MOVE 'S' TO TERMINATION-INDICATOR
               CALL 'RETURN'.
```

release transaction buffer when finished

Figure B-29. Sample COBOL Programs Setting Up Transaction Buffers (Part 5 of 5)

Appendix C
Basic Assembly Language (BAL) Action Programming Examples

C.1. Description

Appendix C contains compiler listings of three action programs. These examples illustrate complete action program coding for simple and dialog transactions including the use of delayed internal succession. In addition, an IMS configuration supplies the parameters needed to run these action programs.

The ACT3 action program processes a simple inquiry transaction to retrieve the capital city name of the state entered at a terminal. The program terminates normally by default.

The SUPPLY action program, a more complex application, can terminate normally by default or abnormally by moving an 'S' to the TERMINATION-INDICATOR after determining that an S was entered as input. SUPPLY processes two successive simple transactions.

The APCHKS action program inserts or changes records entered at the terminal and uses delayed internal succession to call the APITMS action program. The APITMS action program uses delayed internal succession for error processing to return to the APCHKS action program for changes or corrections to records.

C.2. Sample BAL Action Program Performing a Simple Transaction (ACT3)

Action program, ACT3 (Figure C-2), processes a simple transaction. After receiving a transaction code of 'C' and the state name in its input message area (Figure C-1, line 1), ACT3 issues the ZG#CALL GET macroinstruction to retrieve the capital name from the STATE file (Figure C-2, line 31).

```
Line 1   C ALASKA

Line 2   CAPITAL:   JUNEAU
```

Figure C-1. Terminal Entry and Output Message for ACT3 Simple Inquiry Transaction

Here, ACT3 uses the state name entered at the terminal as a key to retrieve that state record from the STATE file.

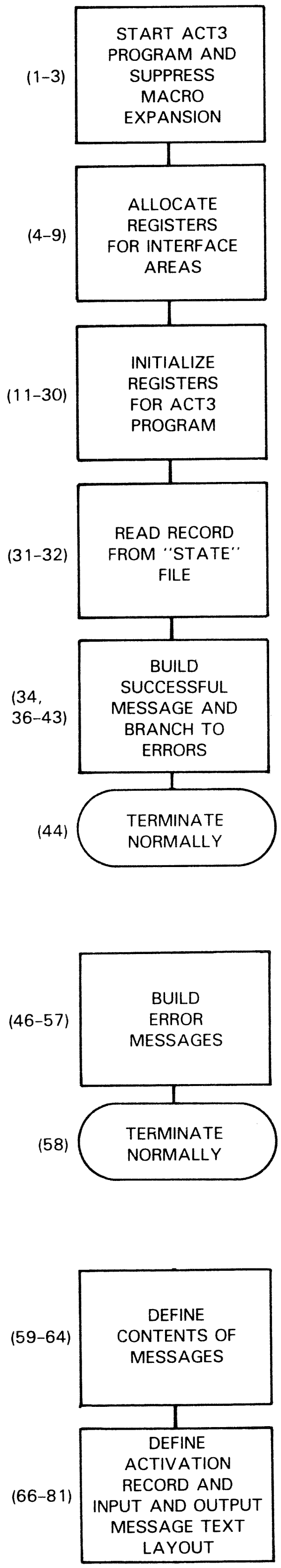
If IMS returns a successful status code of 0, ACT3 then builds the output message (Figure C-2, lines 32 and 36-44) by setting the 4-byte DICE sequence (line 36) and moving the MSGCON1 constant (line 40) and state capital name (line 76) into the output message area (line 43). Finally, after terminating normally by default (line 58), ACT3 sends the message to the terminal. See Figure C-1, line 2.

If there is an I/O error (a status code other than 0 or 1 in this action program) after ACT3 issues the ZG#CALL GET macroinstruction, ACT3 moves MSGCON3 to the output area (line 55), and sends the message 'I/O ERROR' to the terminal on normal termination (line 63).

If IMS returns a status code of 1 (line 50), ACT3 moves MSGCON2 to the output message area and terminates normally, sending the error message 'INVALID STATE NAME' to the terminal (line 52).

Notice that because N is the default value for the TERMINATION-INDICATOR field (ZA#PSIND) in the program information block, it is unnecessary to move the value 'N' to ZA#PSIND to terminate this transaction normally.

Because a specific value is not moved to the DESTINATION-TERMINAL-ID field (ZA#ODTID) of the output message area, the output message is sent to the source terminal. Also, because ACT3 doesn't move a specific length to the text-length field (ZA#OTL) in the output message area, the text length of the output message is taken from the value configured on the OUTSIZE parameter for this action.




```
LINE   SOURCE STATEMENT                                              OS/3 ASM

1              PRINT NOGEN
2    ACT3      START 0                        ACTION PROGRAM ENTRY POINT
3    * ALLOCATE REGISTERS TO COVER:
4              USING *,2                      THIS ACTION PROGRAM
5              USING ZA#DPIB,3                THE PROGRAM INFORMATION BLOCK
6              USING ZA#IMH,4                 THE INPUT MESSAGE AREA
7              USING WORK,5                   THE WORK AREA
8              USING ZA#OMH,6                 THE OUTPUT MESSAGE AREA
9    * INITIALIZE
10             STM    14,12,12(13)            SAVE ACTION SCHEDULING REGISTERS
11   *                                        RD5 CONTAINS SAVE AREA ADDRESS WHEN
12   *                                        CONTROL IS RECEIVED BY
13   *                                        ACTION PROGRAM.
14             LR     2,15                    ESTABLISH ADDRESSABILITY FOR ACTION
15   *                                        PROGRAM. RF5 CONTAINS ENTRY POINT
16   *                                        ADDRESS WHEN CONTROL IS RECEIVED
17   *                                        BY ACTION PROGRAM.
18             LM     3,6,0(1)                ESTABLISH ADDRESSABILITY FOR
19   *                                        ACTIVATION RECORD. R15 CONTAINS
20   *                                        PARAMETER LIST ADDRESS WHEN CONTROL
21   *                                        IS RECEIVED BY
22   *                                        ACTION PROGRAM.
23             LA     10,SAVEAREA                 GET ADDRESS OF ACT3 SAVE AREA
24             ST     10,8(,13)                   SET FORWARD POINTER FROM ACTION
25   *                                            SCHEDULING SAVE AREA
26             ST     13,4(,10)                   SET BACKWARD POINTER TO ACTION
27   *                                            SCHEDULING SAVE AREA
28             LR     13,10                         MAKE ACT3 SAVE AREA THE CURRENT
29   *                                              SAVE AREA
30   * GET STATE RECORD FROM FILE USING STATE NAME KEY IN INPUT MESSAGE
31             ZG#CALL GET,(STATE,RECORD,SNKEY)     ISSUE CALL TO IMS
32             CLI    ZA#PSC+1,0              TEST STATUS CODE RETURNED IN PROGRAM
33   *                                        INFORMATION BLOCK BY IMS
34             BNE    ERROR                   NON-ZERO MEANS ERROR
35   * BUILD OUTPUT MESSAGE
36             MVC    OUTTEXT(4),NEWLINE PUT DEVICE INDEPENDENT CONTROL
37   *                                        CHARACTERS INTO MESSAGE TO CLEAR
38   *                                        TO END OF LINE AND POSITION TO
39   *                                        BEGINNING OF NEXT LINE
40             MVC    OUTTEXT+4(L'MSGCON1),MSGCON1 PUT TEXT CONSTANT INTO
41   *                                              MESSAGE
42   *         PUT CAPITAL NAME INTO MESSAGE
43             MVC    OUTTEXT+4+L'MSGCON1(L'SCAPITAL),SCAPITAL
44             B      TERM
45   * PROCESS ERROR
46   ERROR     MVC    OUTTEXT(4),NEWLINE              CLEAR TO END OF LINE AND
47   *                                                POSITION TO BEGINNING
48   *                                                OF NEXT LINE
49             CLI    ZA#PSC+1,1                       TEST STATUS CODE
50             BNE    IOERROR
51   *                                        ONE MEANS INVALID KEY
52             MVC    OUTTEXT+4(L'MSGCON2),MSGCON2    PUT'INVALID STATE NAME'
53   *                                                INTO MESSAGE
54             B      TERM
55   IOERROR   MVC    OUTTEXT+4(L'MSGCON3),MSGCON3    PUT 'IO ERROR' INTO
56   *                                                MESSAGE
57   * TERMINATE EXECUTION OF ACTION PROGRAM BY RETURN CALL TO IMS.
58   TERM      ZG#CALL  RETURN
59   * CONSTANTS
60   STATE     DC     CL7'STATE'                 ISAM FILE NAME
61   MSGCON1   DC     C'CAPITAL'
62   MSGCON2   DC     C'INVALID STATE NAME'
63   MSGCON3   DC     C'I/O ERROR'
64   NEWLINE   ZO#POSC 0,0              ICAM PROCEDURE TO GENERATE DICE SEQUENCE
65   *                                  FOR NEW LINE CONTROL WITH CLEAR
66   * ACTIVATION RECORD DEFINITION
67             ZM#DPIB
68             ZM#DIMH
69   TCODE     DS     X               TRANSACTION CODE
70             DS     X               SPACE
71   SNKEY     DS     XL4            STATE NAME KEY
72   WORK      DSECT                 WORK AREA
73   RECORD    EQU    *
74   SNAME     DS     XL14           STATE NAME
75   SPOP      DS     XL8            STATE POPULATION
76   SCAPITAL  DS     XL25           STATE CAPITAL
77   SAVEAREA  DS     18A            REGISTER SAVE AREA
78   PLIST     DS     4A             PARAMETER LIST REFERENCE BY ZG#CALL MACRO
79             ZM#DOMH               OMA CONTROL HEADER
80   OUTTEXT   DS     XL42           OUTPUT MESSAGE TEXT AREA
81             END
```

Figure C-2. Sample BAL Action Program ACT3 Processing a Simple Transaction

C.3. Sample BAL Action Program Processing Successive Transactions (SUPPLY)

The SUPPLY action program (Figure C-7) processes successive simple transactions that display a screen format for the terminal operator to enter supply charges, verify the data entered, create or change a record, and display results.

When the terminal operator enters the transaction code SUPLY (Figure C-3), the SUPPLY action program returns the screen format (Figure C-4). The operator enters a TYPE code of I or G indicating the type of changes made, a branch number for the branch company being charged, and the amount (SUPPLIES) charged for supplies (Figure C-5).

```
SUPLY
```

Figure C-3. Initiating the SUPLY Transaction

```
 SUPLY     TYPE[  ]
 BRANCH       SUPPLIES          COPY PAPER
[   ]   [           ]      [          ] < >
```

Figure C-4. SUPPLY Action Program Screen Format Return

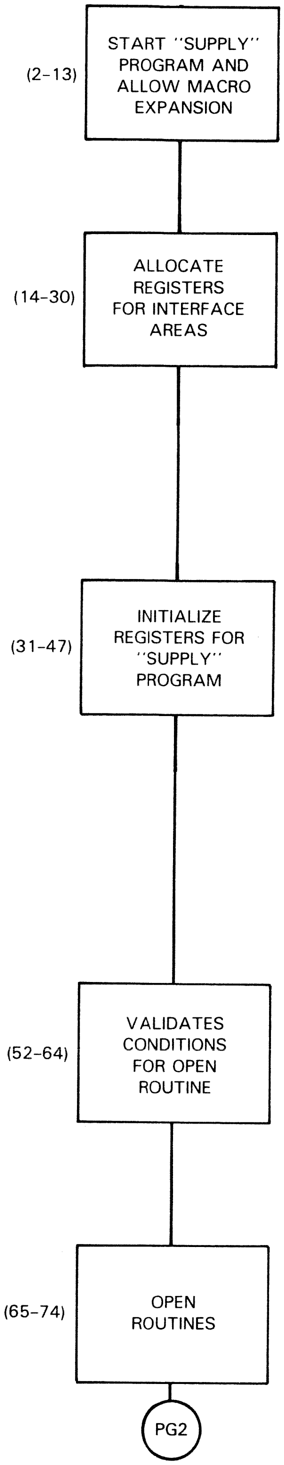
```
SUPLY    TYPE[I]
 BRANCH       SUPPLIES          COPY PAPER
[015]   [1250       ]      [          ] < >
```

Figure C-5. Reinitiating the SUPLY Transaction with Input Data

Next, he places the cursor and presses the transmit key. This reinitiates the SUPLY transaction, and the SUPPLY action program is scheduled again to verify the data and create the record. When the record is successfully changed or created, SUPPLY returns the name of the branch company and the type charges made to it (Figure C-6).

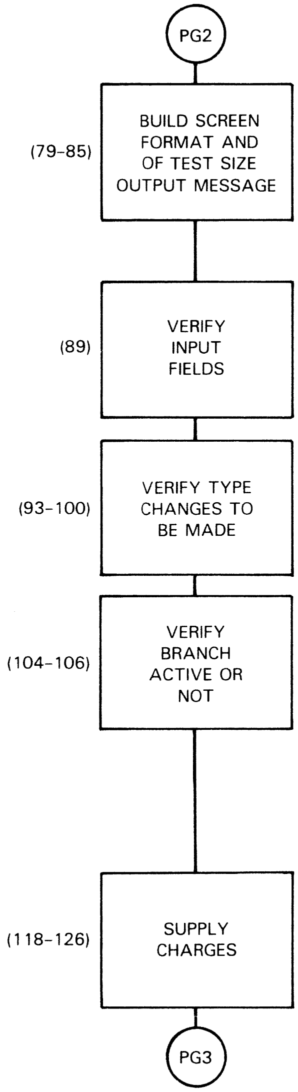
```
 SUPLY    TYPE[I]
 BRANCH      SUPPLIES         COPY PAPER
[   ]   [           ]     [          ] < >
ANNISTON
```

Figure C-6. Output from Second SUPLY Transaction



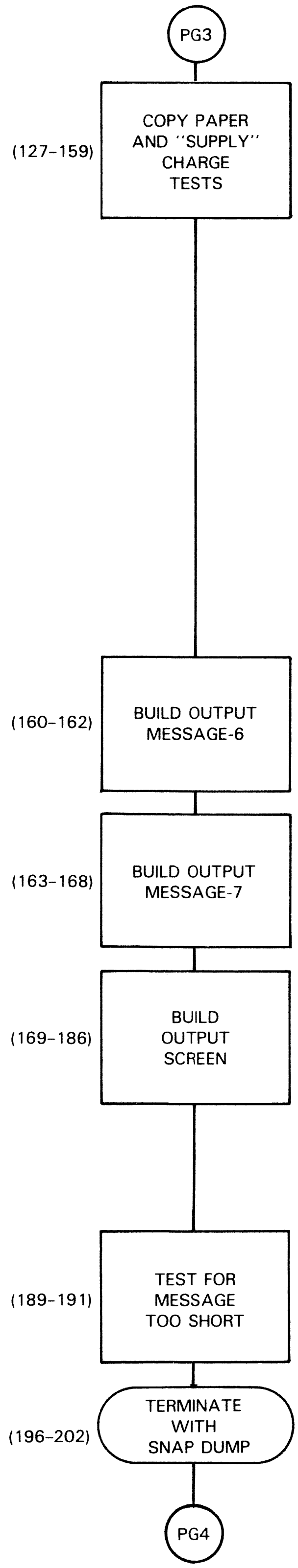

```
LINE    SOURCE STATEMENT                                                   OS/3 ASM

  2 SUPPLY   START 0
  3 ************************************************************************
  4 *                                                                      *
  5 *                 AUTHOR     : PAM DUIE                                *
  6 *                 DATE       : 05/05/78                                *
  7 *                 SITE       : GAY & TAYLOR, INC                       *
  8 *                 FUNCTION   : THIS PROGRAM WILL BE USED TO ENTER SUPPLY *
  9 *                              CHARGES AND VERIFY THE INFORMATION.     *
 10 *                 ***** C H A N G E   L O G *****                      *
 11 ************************************************************************
 13          PRINT GEN
 14 *                 ESTABLISH REGISTER EQUATES
 15 R0       EQU   0
 16 R1       EQU   1
 17 R2       EQU   2                    PROGRAM COVER #1
 18 R3       EQU   3                    PROGRAM COVER #2
 19 R4       EQU   4
 20 R5       EQU   5                    INTERNAL SUBROUTINE LINKAGE
 21 R6       EQU   6                    I/O NORMAL RETURN
 22 R7       EQU   7                    I/O ERROR RETURN
 23 R8       EQU   8                    CDA COVER (OPTIONAL)
 24 R9       EQU   9                    PIB COVER
 25 R10      EQU   10                   IMA COVER
 26 R11      EQU   11                   WORK COVER
 27 R12      EQU   12                   OMA COVER
 28 R13      EQU   13
 29 R14      EQU   14
 30 R15      EQU   15
 31 *              PROGRAM COVERING
 32          USING *,R2,R3              PROGRAM CODE
 33          USING ZA#DPIB,R9           PIB
 34          USING ZA#IMH,R10           IMA
 35          USING WORK,R11             WORK
 36          USING ZA#OMH,R12           OMA
 37 *              IMS INTERFACE
 38          STM   R14,R12,12(R13)      STORE REG IN CALLS' SAVE AREA
 39          LR    R2,R15               THIS PROGRAM ADDRESS
 40          LM    R9,R12,0(R1)          COVER IMS AREAS
 41          LR    R3,R2                PROGRAM SECOND COVER
 42          LA    R3,1(R3)
 43          LA    R3,4095(,R3)         ADD 4096
 44          LA    R7,SAVE              THIS PROGRAM SAVE AREA
 45          ST    R7,8(,R13)           PUT ADDR THIS SAVE IN CALLS' SAVE
 46          ST    R13,4(,R7)           PUT CALLS' SAVE ADDR IN THIS SAVE
 47          LR    R13,R7               SET REG 13 FOR THIS SAVE AREA
 49 ************************************************************************
 50 *              CHECK SECURITY FOR OPEN                                 *
 51 ************************************************************************
 52          MVC   TABKEY(8),BLANK
 53          MVC   TABKEY(3),=C'T80'
 54          MVC   TABKEY+3(2),=C'SC'
 55          LA    R7,OPN020
 56          BAL   R6,TABGET
 57          CLI   TABSTS,C' '
 58          BNE   OPN020
 59          MVI   WORK1,X'00'
 60          MVC   WORK1+1(7),WORK1
 61          MVC   WORK1+8(2),ZA#ISTID+2
 62          PACK  WORK1+6(2),WORK1+8(2)
 63          CVB   R6,WORK1             TERMINAL # TO BINARY
 64          LA    R7,TERMTAB-4         INIT TERMINAL FIELDS ADDRESS
 65 OPN010   LA    R7,4(0,R7)           NEXT TERMINAL FIELDS
 66          BCT   R6,OPN010            NOT  TERMINAL FIELD-GET NEXT
 67          CLC   0(3,R7),=C'   '
 68          BE    OPN020
 69          MVC   WHO(3),0(R7)         SAVE USER INITIALS
 70          CLC   3(1,R7),LIMIT        OVER LIMIT?
 71          BNH   START000
 72 OPN020   MVC   MSGOUT(LMSG2),MSG2 "APPLICATION NOT OPEN"
 73          MVC   ZA#OTL(2),=Y(0+LMSG2+4)
 74          B     TERM
```

Figure C-7. Sample BAL Action Program SUPPLY Processing Successive Transactions
(Part 1 of 9)



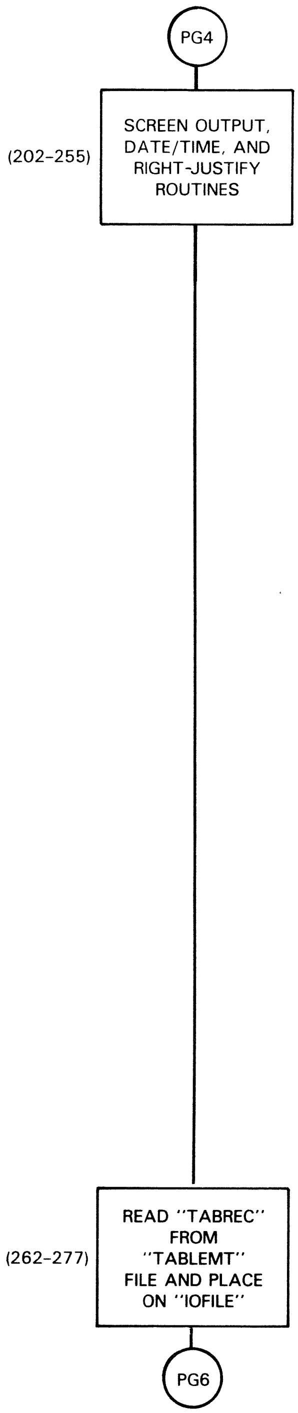

```
 76 ************************************************************************
 77 *                DETERMINE ACTION
 78 ************************************************************************
 79 STARTCOD EQU    *                       PROCESS MESSAGE
 80          BAL    R6,SCREENO              MOVE SCREEN FORMAT TO OMA
 81          CLC    ZA#ITL(2),=Y(TRANLEN-MSGIN+4+4)
 82          BNH    TERM
 83          CLC    ZA#ITL(2),=Y(TLEN-MSGIN+4+4)
 84          BNL    VERIFY00
 85          B      TOOSHORT
 86 *
 87 ************** VERIFY INPUT FIELDS
 88 *
 89 VERIFY00 EQU    *
 90 *
 91 ************** VERIFY TYPE
 92 *
 93          MVC    OTYPE,ITYPE
 94          CLI    ITYPE,C'G'
 95          BE     VERIFY05
 96          CLI    ITYPE,C'I'
 97          BE     VERIFY05
 98          MVI    LB011+2,X'1C'
 99          MVI    RB012+1,X'1D'
100          MVI    ERRST,C'Y'
101 *
102 ************** VERIFY BRANCH
103 *
104 VERIFY05 EQU    *
105          MVC    OBRC(3),IBRC
106          MVC    BRKEY(3),IBRC
107          LA     R7,NOGOT
108          BAL    R6,BRCGET
109          MVC    OBRNAME,BRNAME
110          CLI    BRCL,C' '               IS BRANCH ACTIVE?
111          BNE    NOGOT
112          B      VERIFY10
113 NOGOT    MVI    DICE041+2,X'1C'
114          MVI    DICE042+1,X'1D'
115          MVI    ERRST,C'Y'              SHOW ERROR
116 ************** ARE SUPPLY CHARGES NUMERIC?
117 *
118 VERIFY10 EQU    *
119          MVC    OSUPPLY,ISUPPLY
120          LA     R1,ISUPPLY
121          LH     R0,=H'10'
122          BAL    R5,RJ00
123          BZ     VERIFY25
124          MVI    DICE043+2,X'1C'
125          MVI    DICE044+1,X'1D'
126          B      TERM
```

Figure C-7. Sample BAL Action Program SUPPLY Processing Successive Transactions
(Part 2 of 9)



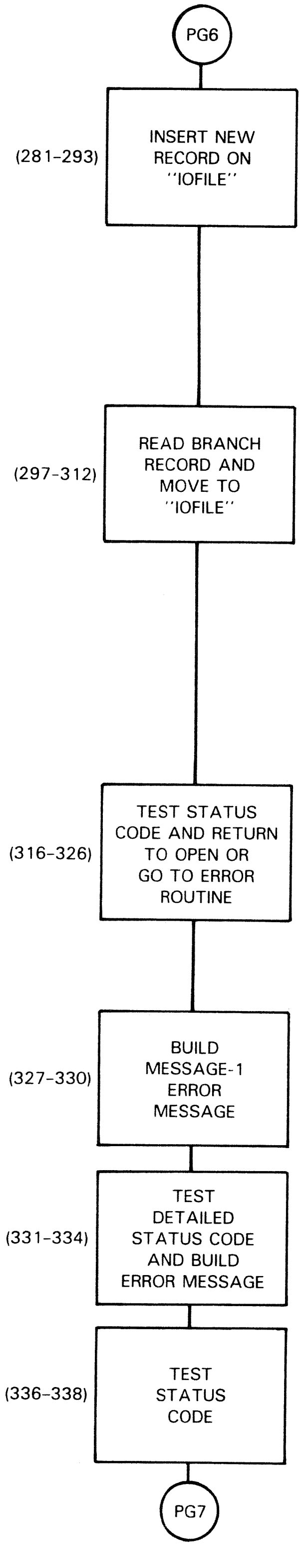

```
127 *
128 ************** IS FILM NUMERIC?
129 *
130 VERIFY25 EQU   *
131          MVC   OCP,ICP
132          LA    R1,ICP
133          LH    R0,=H'10'
134          BAL   R5,RJ00
135          BZ    VERIFY30
136          MVI   DICE045+2,X'1C'
137          MVI   DICE046+1,X'1D'
138          B     TERM
139 *
140 ************** ARE SUPPLY CHARGES ZERO?
141 *
142 VERIFY30 EQU   *
143          MVI   TEST,X'00'
144          CLC   ISUPPLY+1(9),=C'000000000'
145          BNE   VERIFY35
146          OI    TEST,X'80'                 SET BIT FOR SUPPLY=0
147 *
148 ************** IS COPY PAPER ZERO?
149 *
150 VERIFY35 EQU   *
151          CLC   ICP+1(9),=C'000000000'
152          BNE   ENDVER00
153          OI    TEST,X'40'
154 *
155 ************** TEST CONDITIONS FOR ERROR
156 *
157 ENDVER00 EQU   *
158          CLI   TEST,X'C0'                 ARE BOTH ZERO?
159          BNE   NEXTEST0                   NO-SEE IF NEITHER ARE ZERO
160          MVC   MSGOUT(LMSG6),MSG6         BOTH ZERO
161          MVC   ZA#OTL(2),=Y(0+LMSG6+4)
162          B     TERM
163 NEXTEST0 EQU   *
164          CLI   TEST,X'00'
165          BNE   INSERTSC
166          MVC   MSGOUT(LMSG7),MSG7
167          MVC   ZA#OTL(2),=Y(0+LMSG7+4)
168          B     TERM
169 INSERTSC EQU   *
170          CLI   ERRST,C'Y'
171          BE    TERM
172          MVC   WTYPE,ITYPE
173          MVI   WSTATUS,C' '
174          MVI   WRECID,C'B'
175          MVC   WBRC,IBRC
176          PACK  WSUPPLY(5),ISUPPLY+1(9)
177          PACK  WCP(5),ICP+1(9)
178          BAL   R6,DAYTIME
179          MVC   WTRTIME,HHMM
180          MVC   WTRDATE,YYMMDD
181          LA    R7,ABTERM
182          BAL   R6,DTFINSRT
183          MVC   OBRC(3),BLANK
184          MVC   OSUPPLY(10),BLANK
185          MVC   OCP(10),BLANK
186          B     TERM
187 **********************************
188 *              MESSAGE TOO SHORT
189 TOOSHORT MVC   MSGOUT(LMSG3),MSG3       CURSOR REPOSITIONED
190          MVC   ZA#OTL(2),=Y(0+LMSG3+4)
191          B     TERM
192 *
193 *
194 ************** TERMINATE PROGRAM
195 *
196 TERM     CLI   ISNAP,C'S'          ASK FOR SNAP?
197          BNE   GOBACK              NO
198 ABTERM   MVI   ZA#PSIND,C'S'       TERMINATE WITH SNAP
199 GOBACK   ZG#CALL RETURN
200+GOBACK   DS    0H
201+         L     15,=V(RETURN)
202+         BALR  14,15
```

Figure C-7. Sample BAL Action Program SUPPLY Processing Successive Transactions
(Part 3 of 9)



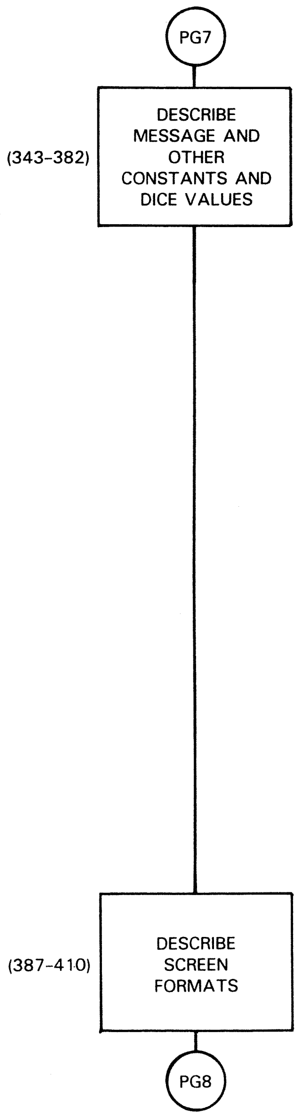

```
204 ******************************************************************************
205 *                                                                            *
206 *                  INTERNAL ROUTINES                                         *
207 *                                                                            *
208 ******************************************************************************
209 *
210 ************** MOVE SCREEN TO OMA
211 *
212 SCREENO  EQU   *
213          ST    R6,R6SAVE1
214          MVC   MSGOUT(LHEADER),SCREEN
215          MVC   OLINE1(LLINE1),LINE1
216          MVC   OLINE2(LLINE2),LINE2
217          MVC   OLINE3(LLINE3),LINE3
218          MVC   OLINE4(LLINE4),LINE4
219          MVC   OLINE5(LLINE5),LINE5
220          MVC   OLINE6(LLINE6),LINE6
221          MVC   ZA#OTL(4),=Y(ENDSCR-SCREEN+4)
222          L     R6,R6SAVE1
223          BR    R6                    RETURN
224 *
225 ************** DATE/TIME STAMP ****************************************
226 *
227 DAYTIME  EQU   *
228          ST    R6,R6SAVE2
229          GETIME S
230+         DS    0H
231+         SR    1,1
232+         SVC   7
233          ST    R0,WORK1              DATE-0YYMMDD+
234          UNPK  WORK1+4(7),WORK1(4)
235          MVC   YYMMDD(6),WORK1+5
236          OI    YYMMDD+5,X'F0'
237          ST    R1,WORK1              TIME-CHHMMSS+
238          UNPK  WORK1+4(7),WORK1(4)
239          MVC   HHMM(4),WORK1+5
240          OI    HHMM+3,X'F0'          FIX ZONE
241          L     R6,R6SAVE2
242          BR    R6
243 ************** RIGHT JUSTIFY ******************************************
244 *
245 *              REGISTER 0  = FIELD LENGTH ( LA R0,=H'XXXX' )
246 *              REGISTER 1  = ADDRESS OF FIELD
247 *              REGISTER 15 = RETURN STATUS CODE ( ZEROES IF NO ERROR )
248 RJ00     ORG   *
249          LA    R13,SAVE         LOAD ADDRESS OF PROGRAM SAVE AREA
250          DC    0Y(0)
251          EXTRN MODRJ1
252          L     R15,=A(MODRJ1)
253          BALR R14,R15           BRANCH TO RJ
254          LTR   R15,R15          SET CONDITION CODE FOR ERRORS
255          BR    R5
256 *
257 ************** FILE I/O ***********************************************
258 *
259 *
260 *              TABLE MASTER I/O
261 *
262 TABGET   MVC   IOKEY(8),TABKEY
263          MVI   IOKEY+8,C'G'
264          ZG#CALL GET,(TABLEMT,TABREC,TABKEY)
265+         DS    0H
266+         LA    15,TABLEMT
267+         ST    15,PLIST+4*(1-1)
268+         LA    15,TABREC
269+         ST    15,PLIST+4*(2-1)
270+         LA    15,TABKEY
271+         ST    15,PLIST+4*(3-1)
272+         OI    PLIST+4*(3-1),X'80'
273+         LA    1,PLIST
274+         L     15,=V(GET)
275+         BALR  14,15
276          MVC   IOFILE(7),TABLEMT
277          B     IOSTATUS
```

Figure C-7. Sample BAL Action Program SUPPLY Processing Successive Transactions
(Part 4 of 9)



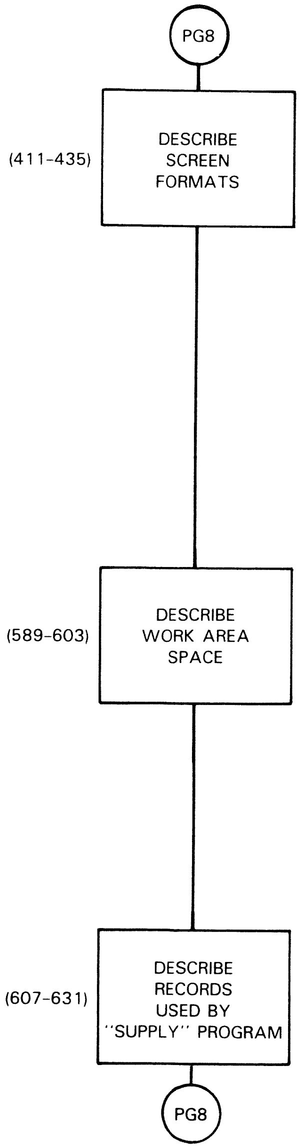

```
278 *
279 ************** DAILY TRANSACTION FILE
280 *
281 DTFINSRT MVI    IOKEY+15,C'I'
282          ZG#CALL INSERT,(TRANACT,DTFREC)
283+         DS     0H
284+         LA     15,TRANACT
285+         ST     15,PLIST+4*(1-1)
286+         LA     15,DTFREC
287+         ST     15,PLIST+4*(2-1)
288+         OI     PLIST+4*(2-1),X'80'
289+         LA     1,PLIST
290+         L      15,=V(INSERT)
291+         BALR   14,15
292          MVC    IOFILE(7),TRANACT
293          B      IOSTATUS
294 *
295 ************** BRANCH MASTER
296 *
297 BRCGET   MVC    IOKEY(3),BRKEY
298          MVI    IOKEY+3,C'G'
299 GETBRC   ZG#CALL GET,(BRANCHM,BRREC,BRKEY)
300+GETBRC   DS     0H
301+         LA     15,BRANCHM
302+         ST     15,PLIST+4*(1-1)
303+         LA     15,BRREC
304+         ST     15,PLIST+4*(2-1)
305+         LA     15,BRKEY
306+         ST     15,PLIST+4*(3-1)
307+         OI     PLIST+4*(3-1),X'80'
308+         LA     1,PLIST
309+         L      15,=V(GET)
310+         BALR   14,15
311          MVC    IOFILE(7),BRANCHM
312          B      IOSTATUS
313 *
314 ************** I/O STATUS
315 *
316 IOSTATUS EQU    *
317          CLI    ZA#PSC+1,0         SUCCESSFUL?
318          BER    R6                 YES
319          CLI    ZA#PSC+1,1         NO-INVALID KEY?
320          BER    R7                 YES
321          CLI    ZA#PDSC+1,5        FILE NOT DEFINED?
322          BNE    IO1                NO
323 IO0      CLI    IOERROR,C'R'       RETURN?
324          BNE    IOA                NO
325          SR     R10,R10            CLEAR RC
326          BR     R7
327 IOA      MVC    MSGOUT(LMSG1),MSG1
328          MVC    MSGOUT+DM1FILE(7),IOFILE
329          MVC    ZA#OTL(2),=Y(0+LMSG1+4)
330          B      TERM
331 IO1      CLI    ZA#PDSC+1,6        FILE CLOSED?
332          BNE    IO2
333          MVC    MSGOUT+DM1HOW(10),M1AVAL
334          B      IO0
335 STSTRN   DC     C'0123456789ABCDEFX'    STATUS CODE TRANSLATE TABLE
336 IO2      MVC    IOSTS(4),ZA#PSC
337          TR     IOSTS,STSTRN
338          B      ABTERM
340 ***************************************************************************
341 *                 PROGRAM CONSTANTS                                       *
342 ***************************************************************************
```

Figure C-7. Sample BAL Action Program SUPPLY Processing Successive Transactions (Part 5 of 9)




```
343 TABLEMT  DC     C'TABLEMT'
344 TRANACT  DC     C'TRANACT'
345 BRANCHM  DC     C'BRANCHM'
346 BLANK    DC     CL64' '
347 MSG1     DC     X'100218C11C40'
348 DM1FILE  EQU    *-MSG1
349          DC     CL7' '
350          DC     C'-FILE NOT '
351 DM1HOW   EQU    *-MSG1
352          DC     C'DEFINED    '
353          DC     C'TO IMS '
354          DC     X'1D'
355 LMSG1    EQU    *-MSG1
356 M1AVAL   DC     C'AVAILABLE '
357 MSG2     DC     X'100218C11C40'
358          DC     C'APPLICATION NOT OPEN'
359          DC     X'1D'
360 LMSG2    EQU    *-MSG2
361 MSG3     DC     X'100218C11C'
362          DC     C'CURSOR REPOSITIONED-RETRANSMIT'
363          DC     X'1D'
364 DM3DICE  EQU    *-MSG3
365          DC     X'1002042C'
366 LMSG3    EQU    *-MSG3
367 MSG4     DC     C'     MESSAGE FROM TERMINAL-'
368 M4TERM   DC     CL5' '
369          DC     CL28'*'
370 MSG5     DC     CL60' '
371 MSG6     DC     X'100218C11C'
372          DC     C'NO DATA ENTERED - REENTER
373          DC     X'1D'
374 DM6DICE  EQU    *-MSG6
375          DC     X'1002040D'
376 LMSG6    EQU    *-MSG6
377 MSG7     DC     X'100218C11C'
378          DC     C'ONLY SUPPLIES OR COPY PAPER VALID - REENTER'
379          DC     X'1D'
380 DM7DICE  EQU    *-MSG7
381          DC     X'1002040D'
382 LMSG7    EQU    *-MSG7
384 *
385 ************** SCREEN FORMAT ******************************************
386 *
387 SCREEN   EQU    *
388 DDICE0   DC     X'10020001'
389          DC     X'2704'
390          DC     XL18'00'
391 LHEADER  EQU    *-SCREEN
392 LINE1    ORG    * 1111111111111111111111111111111111111111111111111111
393          DC     C'SUPLY'              TRANSACTION CODE
394          DC     CL4' '
395          DC     X'0E'                 START PROTECT FIELD
396          DC     C'TYPE'
397 DLBU11   DC     X'27054ACF'           TAB-LB-END PROTECT
398 DOTYPE   DC     CL1' '
399 DRBU12   DC     X'0E4F'                ST PROTECT-RB
400 LLINE1   EQU    *-LINE1
401 LINE2    ORG    * 2222222222222222222222222222222222222222222222222222
402          DC     CL143' '
403 LLINE2   EQU    *-LINE2
404 LINE3    ORG    * 3333333333333333333333333333333333333333333333333333
405          DC     C' BRANCH'
406          DC     CL6' '
407          DC     C'SUPPLIES'
408          DC     CL9' '
409          DC     C'COPY PAPER'
410          DC     CL40' '
```

Figure C-7. Sample BAL Action Program SUPPLY Processing Successive Transactions
(Part 6 of 9)




```
411 LLINE3    EQU    *-LINE3
412 LINE4     ORG    * 4444444444444444444444444444444444444444444444444444444444444444
413 DDICE041  DC     X'27054A0F'                  TAB-LB-END-PROTECT
414 DOBRC     DC     CL3' '
415 DDICE042  DC     X'0E4F'                      RB-START PROTECT
416           DC     CL4' '
417 DDICE043  DC     X'27054A0F'
418 DOSUPPLY  DC     CL10' '
419 DDICE044  DC     X'0E4F'
420           DC     CL5' '
421 DDICE045  DC     X'27054A0F'
422 DOCP      DC     CL10' '
423 DDICE046  DC     X'0E4F'
424           DC     X'27054C0F4D6E'                < >
425           DC     X'10040000'
426 LLINE4    EQU    *-LINE4
427 LINE5     ORG    * 5555555555555555555555555555555555555555555555555555555555555555
428 DDICE51   DC     X'10040000'
429 LLINE5    EQU    *-LINE5
430 LINE6     ORG    * 6666666666666666666666666666666666666666666666666666666666666666
431           DC     CL1' '
432 DOBRNAME  DC     CL25' '                      BRANCH NAME
433 DICF241   DC     X'10020110'
434 LLINE6    EQU    *-LINE6
586 ***********************************************************************
587 *                WORK
588 ***********************************************************************
589 WORK      DSECT
590 WORK1     DS     2D
591 YYMMDD    DS     CL6                          YEAR,MONTH,DAY
592 HHMM      DS     CL4                          HOURS,MINUTES,
593 R6SAVE1   DS     F                            SCREENO
594 R6SAVE2   DS     F                            DAYTIME
595 PLIST     DS     4A                           PARAMETER LIST FOR "CALLS"
596 SAVE      DS     18F                          IMS SAVE AREA
597 IOFILE    DS     CL8                          I/O FILE
598 IOKEY     DS     CL15                         I/O KEY
599 IOSTS     DS     CL4                          I/O STATUS
600 IOERROR   DS     CL1                          I/O ERROR RETURN ON NOT DEFINED/AVAIL
601 WHO       DS     CL3                          USER INITIALS
602 TEST      DS     CL1
603 ERRST     DS     CL1
604 *
605 ************** TABLE REC
606 *
607 TABKEY    DS     CL8
608 TABREC    DS     CL80
609 TABSTS    EQU    TABREC+8,1
610 LIMIT     EQU    TABREC+15,1
611 TERMTAB   EQU    TABREC+16                    START OF TERMINAL FIELDS
612 *
613 ************** SUPPLY CHARGE RECORD
614 *
615 DTFKEY    DS     CL15
616 DTFREC    DS     CL165
617 WRECID    EQU    DTFREC,1                     RECORD ID
618 WBRC      EQU    DTFREC+1,3                   BRANCH
619 WTRDATE   EQU    DTFREC+4,6                   TRANSACTION DATE
620 WTRTIME   EQU    DTFREC+10,4                  TRANSACTION TIME
621 WTYPE     EQU    DTFREC+14,1                  TYPE
622 WSTATUS   EQU    DTFREC+15,1                  STATUS
623 WSUPPLY   EQU    DTFREC+16,5                  SUPPLY CHARGES-AMOUNT-PD
624 WCP       EQU    DTFREC+21,5                  COPY PAPER-PD2
625 *
626 ************** BRANCH RECORD
627 *
628 BRKEY     DS     CL3
629 BRREC     DS     CL250
630 BRNAME    EQU    BRREC+13,25                  BRANCH NAME
631 BRGL      EQU    BRREC+195,1                  GENERAL LEDGER STATUS
633 ***********************************************************************
634 *                OMA                                                  *
635 ***********************************************************************
636           ZM#DOMH
```

Figure C-7. Sample BAL Action Program SUPPLY Processing Successive Transactions
(Part 7 of 9)

PG8

(700–721) DESCRIBE RECORDS USED BY "SUPPLY" PROGRAM

```
700 MSGOUT    DS     CL2048
701 DICE0     EQU    MSGOUT+DDICE0-SCREEN,4
702 OLINE1    EQU    MSGOUT+LINE1-SCREEN 111111111111111111111111111111111111
703 LB011     EQU    OLINE1+DLB011-LINE1
704 OTYPE     EQU    OLINE1+DOTYPE-LINE1,1
705 RB012     EQU    OLINE1+DRB012-LINE1
706 OLINE2    EQU    MSGOUT+LINE2-SCREEN 222222222222222222222222222222222222
707 OLINE3    EQU    MSGOUT+LINE3-SCREEN 333333333333333333333333333333333333
708 OLINE4    EQU    MSGOUT+LINE4-SCREEN 444444444444444444444444444444444444
709 DICE041   EQU    OLINE4+DDICE041-LINE4
710 OBRC      EQU    OLINE4+DOBRC-LINE4,3
711 DICE042   EQU    OLINE4+DDICE042-LINE4
712 DICE043   EQU    OLINE4+DDICE043-LINE4
713 OSUPPLY   EQU    OLINE4+DOSUPPLY-LINE4,10
714 DICE044   EQU    OLINE4+DDICE044-LINE4
715 DICE045   EQU    OLINE4+DDICE045-LINE4
716 OCP       EQU    OLINE4+DOCP-LINE4,10
717 DICE046   EQU    OLINE4+DDICE046-LINE4
718 OLINE5    EQU    MSGOUT+LINE5-SCREEN 555555555555555555555555555555555555
719 OLINE6    EQU    MSGOUT+LINE6-SCREEN 666666666666666666666666666666666666
720 OBRNAME   EQU    OLINE6+DOBRNAME-LINE6,25
721                  END
```

```
UNIVAC SYSTEM OS/3  LINKAGE EDITOR                                                    VER000000
DATE- 81/04/16 TIME- 13.03

CONTROL STREAM ENCOUNTERED AND PROCESSED AS FOLLOWS-

          /$
                  LOADM SUPPLY
                  LINKOP ALIB=$Y$OBJ
                  LINKOP OUT=IMSLOD
                  LINKOP CMT='GAY.AND.TAYLOR'          DESCRIPTION
SUPPLY  *RUN LIBE MODULE*
GET     *AUTO-INCLUDED*
MODRJ1  *AUTO-INCLUDED*
```

DEFINITIONS DICTIONARY

SYMBOL.	TYPE.	PHASE.	ADDRESS.	SYMBOL.	TYPE.	PHASE.	ADDRESS.	SYMBOL.	TYPE.	PHASE.	ADDRESS.
ADDKY	ENTRY	ROOT	00000018	ARETURN	ENTRY	ROOT	0000005C	BUILD	ENTRY	ROOT	00000000
CLOSE	ENTRY	ROOT	00000090	CMDRB	ENTRY	ROOT	00000054	DELETE	ENTRY	ROOT	00000070
DELKY	ENTRY	ROOT	0000001C	DLADR	ENTRY	ROOT	00000070	DLKCP	ENTRY	ROOT	00000024
ENDCRL	ENTRY	ROOT	00000050	ESETL	ENTRY	ROOT	0000007C	ESLMT	ENTRY	ROOT	0000007C
FIND	ENTRY	ROOT	00000094	FREE	ENTRY	ROOT	00000080	GET	ENTRY	ROOT	00000064
GETLOAD	ENTRY	ROOT	0000000C	GETUP	ENTRY	ROOT	00000068	GTADR	ENTRY	ROOT	00000074
INSERT	ENTRY	ROOT	00000074	KE$ALP	ENTRY	ABS	000008B3	KE$RES	ENTRY	ABS	000008B3
LNKCP	ENTRY	ROOT	00000020	MODRJ1	CSECT	ROOT	000000F0	OPEN	ENTRY	ROOT	0000008C
OPENF	ENTRY	ROOT	0000008C	PUT	ENTRY	ROOT	0000006C	RDID	ENTRY	ROOT	00000064
RDIDL	ENTRY	ROOT	00000068	RDKEY	ENTRY	ROOT	00000028	RDKEYL	ENTRY	ROOT	0000002C
RDKYI	ENTRY	ROOT	00000030	RDSQ	ENTRY	ROOT	0000003C	RDSQI	ENTRY	ROOT	00000040
RDSQL	ENTRY	ROOT	00000080	RDSR	ENTRY	ROOT	00000034	RDSRL	ENTRY	ROOT	00000038
REBUILD	ENTRY	ROOT	00000004	RELREC	ENTRY	ROOT	00000084	RETURN	ENTRY	ROOT	0000009C
SEND	ENTRY	ROOT	00000098	SETL	ENTRY	ROOT	00000078	SETLOAD	ENTRY	ROOT	00000010
SNAP	ENTRY	ROOT	00000058	SSLOCK	ENTRY	ROOT	00000044	SSUNLK	ENTRY	ROOT	00000048
STCRL	ENTRY	ROOT	0000004C	STLMT	ENTRY	ROOT	00000078	SUB	ENTRY	ROOT	00000014
SUBPROG	ENTRY	ROOT	00000014	SUPPLY	CSECT	ROOT	000001DC	UNLOCK	ENTRY	ROOT	00000086
WRID	ENTRY	ROOT	0000006C	XR7DMS	ENTRY	ROOT	00000008	ZF#LINK	CSECT	ROOT	00000000

Figure C-7. Sample BAL Action Program SUPPLY Processing Successive Transactions
(Part 8 of 9)

```
                                                ** ALLOCATION MAP **

                         LOAD MODULE -    SUPPLY          SIZE -   000008B3

PHASE NAME  TRANS ADDR    FLAG       LABEL      TYPE       ESID         LNK ORG      HIADDR      LENGTH       OBJ ORG
SUPPLY00       NODE - ROOT                                             00000000     000008B2    000008B3
*** START OF AUTO-INCLUDED ELEMENTS -
       - 79/06/28 18.40 -            ZF#LINK     OBJ
                                     ZF#LINK    CSECT       01         00000000     000000EB    000000EC     00000000
                                     XR7DMS       ENTRY     01         00000008                              00000008
                                     BUILD        ENTRY     01         00000000                              00000000
                                     REBUILD      ENTRY     01         00000004                              00000004
                                     GET          ENTRY     01         00000064                              00000064
                                     GETUP        ENTRY     01         00000068                              00000068
                                     PUT          ENTRY     01         0000006C                              0000006C
                                     DELETE       ENTRY     01         00000070                              00000070
                                     INSERT       ENTRY     01         00000074                              00000074
                                     SETL         ENTRY     01         00000078                              00000078
                                     ESETL        ENTRY     01         0000007C                              0000007C
                                     FREE         ENTRY     01         00000080                              00000080
                                     RELREC       ENTRY     01         00000084                              00000084
                                     UNLOCK       ENTRY     01         00000088                              00000088
                                     OPEN         ENTRY     01         0000008C                              0000008C
                                     CLOSE        ENTRY     01         00000090                              00000090
                                     FIND         ENTRY     01         00000094                              00000094
                                     SEND         ENTRY     01         00000098                              00000098
                                     RETURN       ENTRY     01         0000009C                              0000009C
                                     ARETURN      ENTRY     01         0000005C                              0000005C
                                     SNAP         ENTRY     01         00000058                              00000058
                                     SUB          ENTRY     01         00000014                              00000014
                                     RDSQL        ENTRY     01         00000080                              00000080
                                     GTADP        ENTRY     01         00000074                              00000074
                                     DLADR        ENTRY     01         00000070                              00000070
                                     ADDKY        ENTRY     01         00000018                              00000018
                                     DELKY        ENTRY     01         0000001C                              0000001C
                                     LNKCP        ENTRY     01         00000020                              00000020
                                     DLKCP        ENTRY     01         00000024                              00000024
                                     WRID         ENTRY     01         0000006C                              0000006C
                                     RDID         ENTRY     01         00000064                              00000064
                                     RDIDL        ENTRY     01         00000068                              00000068
                                     RDKEY        ENTRY     01         00000028                              00000028
                                     RDKEYL       ENTRY     01         0000002C                              0000002C
                                     RDKYI        ENTRY     01         00000030                              00000030
                                     RDSR         ENTRY     01         00000034                              00000034
                                     RDSRL        ENTRY     01         00000038                              00000038
                                     RDSQ         ENTRY     01         0000003C                              0000003C
                                     RDSQI        ENTRY     01         00000040                              00000040
                                     STLMT        ENTRY     01         00000078                              00000078
                                     ESLMT        ENTRY     01         0000007C                              0000007C
                                     SSLOCK       ENTRY     01         00000044                              00000044
                                     SSUNLK       ENTRY     01         00000048                              00000048
                                     STCRL        ENTRY     01         0000004C                              0000004C
                                     ENDCRL       ENTRY     01         00000050                              00000050
                                     CMDRB        ENTRY     01         00000054                              00000054
                                     OPENF        ENTRY     01         0000008C                              0000008C
                                     SUBPROG      ENTRY     01         00000014                              00000014
                                     SETLOAD      ENTRY     01         00000010                              00000010
                                     GETLOAD      ENTRY     01         0000000C                              0000000C
       - 76/12/20 09.48 -            MODRJ1      OBJ
                                     MODRJ1     CSECT       01         000000F0     000001C9    000000DA     00000000
*** END OF AUTO-INCLUDED ELEMENTS -
       - 81/04/16 12.58 -            SUPPLY      OBJ
                                     SUPPLY     CSECT       01         00000100     000008B2    000006E3     00000000
          00000100


                                                      FLAG CODES -
B - BLK DATA CSECT    D - AUTO-DELETED       E - EXCLUSIVE 'A' REF   G - GENERATED EXTRN     I - INCLUSIVE 'V' REF
L - DEFERRED LENGTH   M - MULTIPLY DEFINED   N - NOT INCLUDED        P - PROMOTED COMMON     R - SHARED REC PRODUCED







S - SHARED ITEM       U - UNDEFINED REF      V - VCON ITEM
*ANY OTHER CODES REPRESENT PROCESS ERRORS*


LINK EDIT OF 'SUPPLY'   COMPLETED
DATE- 81/04/16 TIME- 13.05
ERRORS ENCOUNTERED- 0000  UPSI- X'00'
```

Figure C-7. Sample BAL Action Program SUPPLY Processing Successive Transactions
(Part 9 of 9)

C.4. Sample BAL Action Programs Performing Dialog Transactions (APCHKS Series)

The APCHKS action program uses delayed internal succession to call the APITMS action program (Figure C-11). The APITMS action program uses delayed internal succession for error processing to return to the APCHKS action program for changes or corrections to records.

C.4.1. The APCHKS Action Program

The APCHKS action program (Figure C-10) either adds new records to the master vendor file or updates and corrects records on that file. It also ends by accumulating a batch total of all checks paid.

When the terminal operator enters the transaction code, APCKS, the APCHKS action program builds a screen format as output, which is queued as input to the APITMS action program.

Here, APCHKS uses delayed internal succession (Figure C-10, lines 647-652) to call the APITMS action program (Figure C-11), which in turn sends out the screen format shown in Figure C-8.

```
APCKSADD:_CHG:_END:_      CHECKNUMBER:  _____ <>       VENDOR: ______    <>
............................  A   P    C H E C K S  ...........................
CHECKLEGEND:__________________________
                                                     NAME: ________________
                                           ADDRESS LINE-1: ________________
                                           ADDRESS LINE-2: ________________
                                             CITY & STATE: ________________
                                                 ZIP CODE: ________________
AMOUNT:___________    DATE:__/__/__    OVERRIDE CHECK #(SUPPRESS PRINT):_______
<>  <-TRANSMIT
```

Figure C-8. Screen Format 1 Generated by APITMS Action Program

The operator can add or change a record on the vendor master file, VENDORM, or end the work session and obtain a checks total. When adding or changing a record, he must supply a check number and vendor number followed by the name and address of the new vendor or vendor for update. In addition, he must supply the amount of the check for that vendor and the date, place the cursor, and transmit.

This transmit reschedules the APCHKS action program which in turn validates the new or updated vendor record data, adds it to or changes it in the vendor master file, and uses delayed internal succession to pass control to the APITMS action program.

C.4.2. The APITMS Action Program

This program (Figure C-11) receives control from the APCHKS action program and generates a screen (Figure C-9) for the operator to enter the item invoices designating account number, amount of check, description, and whether the check is for an employee or for an invoice.

```
APITS .................... A  P  I T E M  E N T R I E S .................
          ACCOUNT          AMOUNT               DESCRIPTION           E/I EMP  ''R''
000.                               ATTACHED INVOICES                      <  >
001.                                                                      <  >
002.                                                                      <  >
003.                                                                      <  >
004.                                                                      <  >
005.                                                                      <  >
006.                                                                      <  >
007.                                                                      <  >
008.                                                                      <  >
009.                                                                      <  >
010.                                                                      <  >
011.                                                                      <  >
012.                                                                      <  >
013.                                                                      <  >
014.                                                                      <  >
015.                                                                      <  >
016.                                                                      <  >
017.                                                                      <  >
018.                                                                      <  >
019.                                                                      <  >
        CHECK:63426     CHECK AMOUNT:     3,391.48    PAYEE:EQUIFAX SERVICES
```

Figure C-9. Screen Format 2 Generated by APITMS Action Program

After the terminal operator enters all item invoices, he can place the cursor in the TRANSMIT position and and press TRANSMIT, or enter an 'R' and press TRANSMIT.

If he transmits without entering an 'R', APITMS:

- Verifies all invoice entries by calling itself for each screen of 20 invoices until a blank line is reached
- Accumulates all amount fields for comparison with the check amount for that account
- Writes an APITMS record for each invoice line entered on the screen
- Creates a format on the screen with a prompting message to tell the operator how to print a check from the terminal. This format is not shown here.

If the check amount is not equal to the item invoice total, APITMS returns control to APCHKS and displays the erroneous record for the operator to make changes to the item or add new items. Again, it verifies the changes and when correct, either creates a format for checks to be printed or allows for an account review.

If the terminal operator enters 'R', APITMS passes control to APAUDT, which returns a screen containing invoice entries. APAUDT is not illustrated here.

At the end of a session, when the operator chooses the END option on the APITMS screen format 1 (Figure C-8), check totals have been accumulated in the AP header record of the APCHKS file. APCHKS then returns to the screen the batch total of all checks entered for that session.

LINE   SOURCE STATEMENT   OS/3 ASM

```
APCHKS    START 0
*******************************************************************************
*                   AUTHOR  : R L LEONARD
*                   DATE    : 12 MARCH 1980
*                   SITE    : GAY & TAYLOR INC, WINSTON-SALEM, NC, 27102
*                   PURPOSE: TO ADD AND CORRECT RECORDS FOR ACCOUNTS PAYABLE
*                            CHECKS
*                   CHANGE LOG
*******************************************************************************
          Y$$START                              .STARTING CONVENTIONS
Y$$B      EQU    * .START OF PROGRAM
*
************** REGISTER EQUATES
*
R0        EQU    0
R1        EQU    1
R2        EQU    2 .PIB COVER
R3        EQU    3 .IMA COVER
R4        EQU    4 .WORK COVER
R5        EQU    5 .OMA COVER
R6        EQU    6 .CDA COVER
R7        EQU    7 .INTERNAL ROUTINE LINKAGE
R8        EQU    8 .I/O - NORMAL RETURN ADDRESS
R9        EQU    9 .I/O - ERROR RETURN ADDRESS
R10       EQU    10 .PROGRAM COVER #3
R11       EQU    11 .PROGRAM COVER #2
R12       EQU    12 .PROGRAM COVER #1
R13       EQU    13
R14       EQU    14
R15       EQU    15
*
************** ESTABLISH PROGRAM COVERING
*
          USING *,R12,R11,R10 .PROGRAM CODE
          USING ZA#DPIB,R2 .PIB
          USING ZA#IMH,R3 .IMA
          USING WORK,R4 .WORK
          USING ZA#OMH,R5 .OMA
          USING CDA,R6 .CDA
*
************** ESTABLISH IMS INTERFACE
*
          STM    R14,R12,12(R13) .STORE REG IN CALLS' SAVE AREA
          LR     R12,R15 .ADDRESS OF THIS PROGRAM
          LM     R2,R6,0(R1) .ACTIVATION AREAS FROM PARAM
          LA     R11,SAVE .THIS PROGRAM SAVE AREA
          ST     R11,8(,R13) .PUT THIS SAVE INTO CALLS' SAVE
          ST     R13,4(,R11) .PUT CALLS' SAVE INTO THIS SAVE
          LR     R13,R11 .REG 13 = THIS SAVE AREA
          LR     R11,R12 .SECOND PROGRAM COVER
          LA     R11,1(R11)
          LA     R11,4095(R11)
          LR     R10,R11 .THIRD PROGRAM COVER
          LA     R10,1(R10)
          LA     R10,4095(R10)
          GETIME M
          DS     0H
          LA     1,1
          SVC    7
          ST     R1,STIM$ .STARTUP TIME
```

Figure C-10. APCHKS Action Program Processing a Dialog Transaction with Delayed Internal Succession (Part 1 of 22)

```
 64          DROP   R6                          .NO CDA
 65          PRINT   GEN
 66          BAL    R7,DAYTIME                  .GET DATE-TIME
 67 *
 68 ******** OPERATOR CANCEL
 69 *
 70          CLI    IMA+4,C'C'
 71          BE     EMSG8                       CANCEL
 72 ************************************************************************
 73 *                CHECK SECURITY
 74 ************************************************************************
 75          MVC    PASSKEY(5),=C'APCHK'
 76          Y$$SECUR                           .CHECK FOR OPEN-VALID
 77+*************************************************************************
 78+**               CHECK SECURITY FOR OPEN APPLICATION                    *
 79+**
 80+**                       ASSUMES KEY IN FIELD "PASSKEY"                 *
 81+*************************************************************************
 82+         MVC    KTABLEMT(3),=C'T60'
 83+         MVC    KTABLEMT+3(5),PASSKEY
 84+         LA     R9,Y$$0020 .NO FIND ADDRESS
 85+         BAL    R8,GTABLEMT .GET SECURITY RECORD
 86+         CLI    TABSTS,C' ' .RECORD ACTIVE?
 87+         BNE    Y$$0020 .NO
 88+         MVI    WORK1,X'00' .SETUP TO CVB
 89+         MVC    WORK1+1(7),WORK1
 90+         MVC    WORK1+8(2),ZA#ISTID+2 .TERMINAL ID
 91+         PACK   WORK1+6(2),WORK1+8(2)
 92+         CVB    R1,WORK1 .TERMINAL FIELD COUNTER
 93+         LA     R7,TERMTAB-4 .BEGINNING OF TERMINAL FIELDS
 94+Y$$0010  LA     R7,4(R7) .NEXT TERMINAL FIELDS
 95+         BCT    R1,Y$$0010 .COUNT DOWN TO THIS TERMINAL
 96+         CLC    0(3,R7),=C'   ' .OPEN?
 97+         BE     Y$$0020 .NO
 98+         MVC    WHO(3),0(R7) .SAVE USER INITIALS
 99+         CLC    3(1,R7),LIMIT .OPEN BUT OVER LIMIT (SET DOWN)
100+         BNH    Y$$0030 .NO
101+Y$$0020  MVC    OMA(LY$$M1),Y$$M1 .APPLICATION NOT OPEN
102+         MVC    ZA#OTL(2),=Y(0+LY$$M1+4) .MESSAGE LENGTH
103+         B      TERM
104+Y$$M1    DC     X'100A18011C'
105+         DC     C'APPLICATION NOT OPEN'
106+         DC     X'1010020000'
107+LY$$M1   EQU    *-Y$$M1
110                                                          Y$$TRAIL A
111+         PRINT OFF
121+         PRINT ON
122          CLC    IMA+11(3),=C'ADD'           TRANSMIT PROTECT?
123          BE     EMSG1                       YES
124 ************************************************************************
125 *               INITIALIZATIONS
126 ************************************************************************
127          Y$$IN 11                           EXTRACT SCREEN DATA
128+         LA     R0,11 .SCREEN NUMBER
129+         BAL    R8,MOVEIN .GO TO INPUT SCREEN ROUTINE
130          MVI    FILL,C'_'                   SETUP PROTECTED REPLACEMENT
131          MVI    PSTART,C':'
132          MVC    PSTART+1(LPDATA-1),PSTART
133          MVC    PMSG1(80),BLANKS
134          MVI    USTOP,X'FF'
135          MVI    PSTOP,X'FF'
```

Figure C-10. APCHKS Action Program Processing a Dialog Transaction with Delayed Internal Succession (Part 2 of 22)

```
*
************** GET AP HEADER
*
          MVC   KACCTPAY,BLANKS
          MVC   KACCTPAY(2),=C'AP'
          LA    R9,EMSG2                  "NOT FOUND"
          BAL   R8,GACCTPAY               GET HEADER
          MVC   HACCTPAY(165),RACCTPAY    SAVE RECORD
          CLI   UCHG,C' '                CHANGE?
          BE    L0034                    NO
*
*         ERRORS FROM ITEM ENTRIES?
*
          LA    R9,PMSG1                 ERROR MESSAGE
          TM    APHERR,X'01'            ITEMS=CHECK?
          BZ    L0030                    YES
          MVC   0(LMSG9,R9),MSG9         NOT=
          ED    DM9A(12,R9),APHITMT      ITEM TOTAL
          LA    R9,LMSG9(,R9)            NEXT POSITION
L0030     TM    APHERR,X'02'            CASH=0?
          BZ    L0032                    YES
          MVC   0(LMSG10,R9),MSG10       CASH NOT=0
          LA    R9,LMSG10(,R9)            NEXT POSITION
L0032     TM    APHERR,X'04'            ACCRUAL=0?
          BZ    L0034                    YES
          MVC   0(LMSG11,R9),MSG11       ACCRUAL NOT=0
          LA    R9,LMSG11(,R9)           NEXT POSITION
L0034     CLC   ZA#ITL(2),=Y(0+IMA1)     INITIAL SCREEN?
          BH    L0050                     NO
          CLC   APHCHKCT(5),BLANKS
          BE    FORMAT                    FORMAT SCREEN
          MVC   UCHECK(5),APHCHKCT
          B     FORMAT                    FORMAT SCREEN
L0050     EQU   *
          CLI   UEND,C' '                 END OF BATCH?
          BE    L0100                     NO
*
************** END OF BATCH ******************************************
*
                                                            Y$$TRAIL B
          PRINT OFF
          PRINT ON
          AP    APHREPT(5),APHBATCH(5)
          MVC   RACCTPAY(165),HACCTPAY
          MVC   RACCTPAY+2(6),=C'ZBATCH'
          MVC   RACCTPAY+8(3),APHBATHN
          MVC   RACCTPAY+41(2),YYMMDD
          MVC   RACCTPAY+37(4),YYMMDD
          CLI   UEND,C'N'                 NO OUTPUT RECORD?
          BE    L0060                     YES
          LA    R9,Y$$IOS30               ERROR
          BAL   R8,IACCTPAY               INSERT BATCH RECORD
L0060     MVC   OMA(LMSG3),MSG3           "TOTALS"
          MVC   OMA+DM3A(3),APHBATHN      BATCH #
          MVC   WORK1+4(2),YYMMDD
          MVC   WORK1(4),YYMMDD+2
          PACK  WORK1+6(4),WORK1(6)
          ED    OMA+DM3B(10),WORK1+6      DATE
          MVC   OMA+DM3C(3),APHCHKS       # OF CHECKS
          ED    OMA+DM3D(14),APHBATCH     AMOUNT
          PACK  WORK1(2),APHBATHN(3)      ADD 1 TO BATCH #
```

Figure C-10. APCHKS Action Program Processing a Dialog Transaction with Delayed Internal Succession (Part 3 of 22)

```
         AP     WORK1(2),=P'1'
         UNPK   APHBATHN(3),WORK1(2)
         OI     APHBATHN+2,X'F0'
         MVC    APHCHKCT(5),BLANKS          CLEAR COUNTERS
         SP     APHBATCH(5),APHBATCH(5)     BATCH TOTAL
         MVC    APHCHKS(3),=C'000'
         MVC    APHVODS(3),=C'000'
         MVC    APHITMS(3),=C'000'
         MVC    APHERRS(3),=C'000'
         MVC    APHITMC(3),=C'000'          ITEM COUNT
         MVC    ZA#OTL(2),=Y(D+LMSG3+4)
         MVC    KACCTPAY(15),BLANKS
         MVC    KACCTPAY(2),=C'AP'
         CLI    UEND,C'N'                   NO OUTPUT RECORD?
         BE     TERM                        YES
         LA     R9,Y$$IOS30
         BAL    R8,UACCTPAY
         MVC    RACCTPAY(165),HACCTPAY
         BAL    R8,PACCTPAY
         B      TERM
***********************************************************************
*                VALIDATE LINE 1
***********************************************************************
*
*************** CHECK FOR ADD/CHANGE
*
L0100    EQU    *                           CHECK ADD-CHG
                                                               Y$$TRAIL C
         PRINT  OFF
         PRINT  ON
         MVI    APHPRNT,C' '              CLEAR CHECK PRINT
         CLI    UADD,C' '
         BNE    L0140
         CLI    UCHG,C' '
         BNE    L0140
L0120    MVI    PADD,X'1C'
         MVI    PCHG,X'1C'
         MVI    ERR,C'Y'
         B      L0360
L0140    CLI    UADD,C' '
         BE     L0160
         CLI    UCHG,C' '
         BNE    L0120
L0160    EQU    *
         MVI    APHAOC,C'A'                 ADD
         CLI    UCHG,C' '
         BE     L0165
         MVI    APHAOC,C'C'                 CHANGE
*
*************** TRANSMIT POSITION 2
*
*
*************** TYPE
*
L0165    CLI    UTYPE,C' '                      TYPE ENTERED?
         BE     L0170
         MVC    APHTYPE(1),UTYPE
         B      L0175
L0170    MVI    APHTYPE,C'N'                NEW CHECK
*
*************** CHECK NUMBER
```

Figure C-10. APCHKS Action Program Processing a Dialog Transaction with Delayed Internal Succession (Part 4 of 22)

```
               AP     WORK1(2),=P'1'
               UNPK   APHBATHN(3),WORK1(2)
               OI     APHBATHN+2,X'F0'
               MVC    APHCHKCT(5),BLANKS        CLEAR COUNTERS
               SP     APHBATCH(5),APHBATCH(5)   BATCH TOTAL
               MVC    APHCHKS(3),=C'000'
               MVC    APHVODS(3),=C'000'
               MVC    APHITMS(3),=C'000'
               MVC    APHERRS(3),=C'000'
               MVC    APHITMC(3),=C'000'        ITEM COUNT
               MVC    ZA#OTL(2),=Y(0+LMSG3+4)
               MVC    KACCTPAY(15),BLANKS
               MVC    KACCTPAY(2),=C'AP'
               CLI    UEND,C'N'                 NO OUTPUT RECORD?
               BE     TERM                      YES
               LA     R9,Y$$IOS30
               BAL    R8,UACCTPAY
               MVC    RACCTPAY(165),HACCTPAY
               BAL    R8,PACCTPAY
               B      TERM
*****************************************************************************
*                     VALIDATE LINE 1
*****************************************************************************
*
************** CHECK FOR ADD/CHANGE
*
L0100          EQU    *                         CHECK ADD-CHG
                                                                Y$$TRAIL C
               PRINT  OFF
               PRINT  ON
               MVI    APHPRNT,C' '             CLEAR CHECK PRINT
               CLI    UADD,C' '
               BNE    L0140
               CLI    UCHG,C' '
               BNE    L0140
L0120          MVI    PADD,X'1C'
               MVI    PCHG,X'1C'
               MVI    ERR,C'Y'
               B      L0360
L0140          CLI    UADD,C' '
               BE     L0160
               CLI    UCHG,C' '
               BNE    L0120
L0160          EQU    *
               MVI    APHAOC,C'A'               ADD
               CLI    UCHG,C' '
               BE     L0165
               MVI    APHAOC,C'C'               CHANGE
*
************** TRANSMIT POSITION 2
*
*
************** TYPE
*
L0165          CLI    UTYPE,C' '                     TYPE ENTERED?
               BE     L0170
               MVC    APHTYPE(1),UTYPE
               B      L0175
L0170          MVI    APHTYPE,C'N'              NEW CHECK
*
************** CHECK NUMBER
```

Figure C-10. APCHKS Action Program Processing a Dialog Transaction with Delayed Internal Succession (Part 5 of 22)

```
                MVC    KPAYROLL(4),UVENDOR+1      GET EMPLOYEE
                MVI    KPAYROLL+4,C'0'
                LA     R9,L0320
                BAL    R8,GPAYROLL
                MVC    VMNAME(26),PMNAME
                MVC    VMADDR1(3),PMBRW           BRANCH OF WORK
                B      L0330
       L0300    MVC    KVENDORM(5),UVENDOR        GET VENDOR
                LA     R8,L0330
                BAL    R9,GVENDORM
       L0320    MVI    PVENDOR,X'1C'
                MVI    ERR,C'Y'
                B      L0360
       L0330    CLC    ZA#ITL(2),=Y(0+IMA3)      FULL SCREEN?
                BH     L0360
       *
       *        MOVE VENDOR TO SCREEN
       *
                CLI    UVENDOR,C'E'              EMPLOYEE
                BE     L0335
                MVC    UNAME(26),VMNAME          NAME
                MVC    UADDR1(25),VMADDR1        LINE 1
                MVC    UADDR2(25),VMADDR2        LINE 2
                MVC    UCITY(25),VMCITY          CITY AND STATE
                MVC    UZIP(5),VMZIP             ZIP CODE
                B      L0340
       L0335    MVC    UNAME(26),PMNAME          NAME
                MVC    UADDR1(3),PMBRW           BRANCH OF WORK
       *
       ************** SYSTEM DATE
       *
       L0340    MVC    UDATE(4),YYMMDD+2
                MVC    UDATE+4(2),YYMMDD
       *
       ************** ANY ERRORS ON LINE 1
       *
       L0360    CLI    ERR,C'Y'                   ERRORS?
                BE     FORMAT
                                                                 YSSTRAIL E
                PRINT  OFF
                PRINT  ON
                CLC    ZA#ITL(2),=Y(0+IMA3)       FULL SCREEN?
                BH     L0500                      VERIFY FIELDS
                MVI    UTRAN2,C'.'               FLAG TO EXPECT FULL SCREEN
                B      FORMAT
       ***********************************************************************
       *               VALIDATE SCREEN DATA
       ***********************************************************************
       L0500    EQU    *
                CLI    UTRAN2,C'.'               SHOULD BE FULL SCREEN?
                BNE    EMSG7                     NO
       *
       ************** CHECK NAME
       *
                CLC    UNAME(26),BLANKS
                BNE    L0504
                MVI    ERR,C'Y'
                MVI    PNAME,X'1C'
       *
       ************** CHECK CITY
       *
```

Figure C-10. APCHKS Action Program Processing a Dialog Transaction with Delayed Internal Succession (Part 6 of 22)

```
L0504      CLC    UADDR2(25),BLANKS
           BE     L0507
           CLC    UCITY+20(5),BLANKS       ROOM FOR ZIP?
           BE     L0507
           MVI    PCITY,X'1C'
           MVI    ERR,C'Y'
L0507      EQU    *
*
************** CHECK ZIP CODE
*
                                                                 Y$$TRAIL G
           PRINT  OFF
           PRINT  ON
           LA     R1,UZIP                   VALIDATE ZIP CODE
           BAL    R7,RJ5
           BZ     L0510
           MVI    PZIP,X'1C'
           MVI    ERR,C'Y'
*
************** CHECK AMOUNT
*
L0510      EQU    *
           MVC    PMSG1(10),UAMOUNT        SAVE INPUT
           LA     R1,UAMOUNT                VALIDATE AMOUNT
           BAL    R7,RJ10
           BZ     L0520
L0515      MVI    PAMOUNT,X'1C'
           MVI    ERR,C'Y'
           B      L0540
L0520      CLI    UAMOUNT,C'0'             AMOUNT TOO LARGE?
           BNE    L0515                    YES
*          IS THIS A VOID CHECK? (NEGATIVE AMOUNT)
           CLI    UTYPE,C' '               TYPE ENTERED?
           BNE    L0540                    YES-SKIP
           CLI    UCHG,C' '                CHANGE?
           BNE    L0540                    YES-SKIP
           PACK   WORK1+11(5),UAMOUNT+1(9)
           CP     WORK1+11(5),=P'0'        NEGATIVE?
           BNL    L0540                    NO
           MVI    APHTYPE,C'V'             VOID CHECK
*
************** CHECK DATE
*
L0540      MVC    WORK1(2),UDATE+4          VALIDATE DATE
           MVC    WORK1+2(4),UDATE
           BAL    R7,DATCHK
           BZ     L0560
           MVI    PDATE,X'1C'
           MVI    ERR,C'Y'
*
************** CHECK OVERRIDE CHECK NUMBER
L0560      EQU    *
           CLI    APHTYPE,C'V'             VOID CHECK?
           BNE    L0565
           CLC    UOVERIDE(5),BLANKS
           BNE    L0565                    OVERRIDE
           MVC    UAMOUNT(10),PMSG1        RESTORE INPUT AMOUNT FIELD
           MVC    PMSG1(LMSG12),MSG12
           B      L0575
L0565      CLC    UOVERIDE(5),BLANKS
           BE     L0600
```

Figure C-10. APCHKS Action Program Processing a Dialog Transaction with Delayed Internal Succession (Part 7 of 22)

```
486           LA     R1,UOVERIDE
487           BAL    R7,RJ5
488           BZ     L0580
489 LC575     MVI    POVERIDE,X'1C'
490           MVI    ERR,C'Y'
491           B      L0600
492 L0580     MVI    APHPRNT,C'N'                SUPPRESS PRINT FLAG
493           MVC    APHCHECK(5),UOVERIDE      OVERRIDE CHECK NUMBER
494 *
495 ***********************************************************************
496 *                ANY SCREEN DATA ERRORS
497 *
498 L0600     EQU    *
499                                                          YSSTRAIL H
500+          PRINT  OFF
510+          PRINT  ON
511           CLI    ERR,C'Y'                  ERRORS
512           BE     FORMAT                    YES
513 ***********************************************************************
514 *                ADD/UPDATE CHECK RECORD
515 ***********************************************************************
516                                                          YSSTRAIL L
517+          PRINT  OFF
527+          PRINT  ON
528           MVI    CACCTPAY,C' '
529           MVC    CACCTPAY+1(164),CACCTPAY MOVE DATA TO CHECK
530           MVC    APCRID(2),=C'AC'
531           MVC    APCTYPE(1),APHTYPE
532           MVC    APCCHECK(5),APHCHECK
533           PACK   APCTDATE(4),YYMMDD(6)
534           PACK   APCDATE(4),UDATE
535           MVC    APCVENDR(5),UVENDOR
536           PACK   APCAMT(5),UAMOUNT+1(9)
537           MVC    APCNAME(26),UNAME
538           MVC    APCADDR1(25),UADDR1
539           MVC    APCADDR2(25),UADDR2
540           MVC    APCCITY(25),UCITY
541           PACK   APCZIP(3),UZIP(5)
542           MVC    APCLEGND(25),ULEGEND
543           MVC    APCPRNT(1),APHPRNT
544           SP     APHOLD(5),APHOLD(5)
545           CLI    UCHG,C' '
546           BNE    L0700
547           MVC    RACCTPAY(165),CACCTPAY    ADD CHECK
548           LA     R9,EMSG6
549           BAL    R8,IACCTPAY
550           CLI    APCPRNT,C'N'              WAS CHECK TO PRINT?
551           BE     L0720                     NO
552           PACK   WORK1(3),APHCHKCT(5)      UPDATE NEXT CHECK NUMBER
553           AP     WORK1(3),=P'1'
554           UNPK   APHCHKCT(5),WORK1(3)
555           OI     APHCHKCT+4,X'F0'
556           B      L0720
557 L0700     MVC    KACCTPAY(15),CACCTPAY     UPDATE CHECK
558                                                          YSSTRAIL I
559+          PRINT  OFF
569+          PRINT  ON
570           LA     R9,EMSG4
571           BAL    R8,UACCTPAY
572                                                          YSSTRAIL M
573+          PRINT  OFF
```

Figure C-10. APCHKS Action Program Processing a Dialog Transaction with Delayed Internal Succession (Part 8 of 22)

```
583+           PRINT  ON
584            MVC    APHOLD(5),APAMT
585            MVC    RACCTPAY(165),CACCTPAY
586            BAL    R8,PACCTPAY
587 *          SETUP  HEADER WITH CHECK INFORMATION
588 LD720      MVC    APHITMC(3),=C'001'
589            MVC    APHDATE(6),UDATE
590            MVC    APHVENDR(5),UVENDOR
591            ZAP    APHAMT(5),APCAMT(5)
592            ZAP    APHITMT(5),=P'0'
593            MVC    APHNAME(26),UNAME
594            MVC    APHLEGND(25),ULEGEND
595            SP     APHACCR(5),APHACCR(5)
596            ZAP    APHCASH(5),=P'0'
597            SP     APHCASH(5),APHAMT(5)
598            MVI    APHERR,C' '
599            MVI    APHDONE,C' '
600            MVC    ZA#PSID(6),=C'APITMS'
601 ***********************************************************************
602 *                 UPDATE AP HEADER
603 ***********************************************************************
604 UPHEADER EQU      *
605                                                            Y$$TRAIL J
606+           PRINT OFF
616+           PRINT ON
617            MVC    KACCTPAY(15),BLANKS
618            MVC    KACCTPAY(2),=C'AP'
619            LA     R9,Y$$IOS30
620            BAL    R8,UACCTPAY
621            MVC    RACCTPAY(165),HACCTPAY
622            BAL    R8,PACCTPAY
623 ***********************************************************************
624 *                 FORMAT OMA
625 *
626 ***********************************************************************
627 FORMAT     EQU    *
628                                                            Y$$TRAIL K
629+           PRINT OFF
639+           PRINT ON
640            MVI    USNAP,C' '                CLEAR SNAP CODE
641            Y$$OUT 11
642+           LA     R0,11 .SCREEN NUMBER
643+           BAL    R8,MOVEOUT .SCREEN AND DATA
644 ***********************************************************************
645 *                 SETUP NEXT TRANSACTION
646 ***********************************************************************
647            CLC    ZA#PSID(6),=C'APITMS'
648            BNE    TERM
649            MVC    ZA#OTL(2),=H'14'
650            MVC    OMA+4(6),=C'APITS '
651            MVI    ZA#PSIND,C'0'       DELAYED INTERNAL SUCCESSION
652            B      TERM
653            Y$$IOSTS                      .INPUT/OUTPUT STATUS
655+************************************************************************
656+*                 INTERNAL ROUTINES                                    *
657+************************************************************************
658+*
659+*************** CHECK FILE I/O STATUS
660+*
```

Figure C-10. APCHKS Action Program Processing a Dialog Transaction with Delayed Internal Succession (Part 9 of 22)

```
+IOSTATUS ORG    *
+         CLI    ZA#PSC+1,0 .SUCCESSFUL?
+         BNE    Y$$IOS05 .NO
+         MVI    IOKEY,C' ' .CLEAR KEY
+         MVC    IOKEY+1(14),IOKEY
+         BR     R8
+Y$$IOS05 CLI    ZA#PSC+1,1 .INVALID KEY?
+         BER    R9
+         CLI    ZA#PDSC+1,5 .FILE NOT DEFINED?
+         BE     Y$$IOS10
+         CLI    ZA#PDSC+1,6 .FILE CLOSED?
+         BNE    Y$$IOS30
+Y$$IOS10 CLI    IORET,C'Y' .RETURN ON FILE NOT AVAILABLE?
+         BNE    Y$$IOS20
+         SR     R8,R8 .FLAG FOR FILE NOT AVAILABLE
+         BR     R9
+Y$$IOS20 MVC    OMA(LIOM2),IOM2 .FILE NOT AVAILABLE
+         MVC    ZA#OTL(2),=Y(0+LIOM2+4)
+         MVC    OMA+DIOM2-IOM2(20),IOFILE
+         B      TERM
+Y$$IOSTR DC     C'0123456789ABCDEFX'
+IOM1     DC     X'100A18011C'
+         DC     C'INVALID FILE I/O '
+DIOM1C   DC     CL5' ' .PIB STATUS
+DIOM1A   DC     CL21' ' .FILE NAME
+DIOM1B   DC     CL17' ' .FILE KEY
+         DC     C'CALL ISD'
+         DC     X'1010020000'
+LIOM1    EQU    *-IOM1
+IOM2     DC     X'100A18011C'
+DIOM2    DC     CL21' ' .FILE NAME
+         DC     C'FILE NOT AVAILABLE'
+         DC     X'1010020000'
+LIOM2    EQU    *-IOM2
+Y$$IOS30 MVC    IOSTS,ZA#PSC
+         TR     IOSTS,Y$$IOSTR .TRANSLATE TO PRINTABLE CHAR
+         MVC    OMA(LIOM1),IOM1 .FILE NOT AVAILABLE
+         MVC    OMA+DIOM1A-IOM1(21),IOFILE
+         MVC    OMA+DIOM1B-IOM1(16),IOKEY
+         MVC    OMA+DIOM1C-IOM1(4),IOSTS
+         MVC    ZA#OTL(2),=Y(0+LIOM1+4)
+         B      SNAP
 *
 ************** TABLE MASTER I/O
 *
 TABLEMT  Y$$GET 8
+*
+*               GET
+*
+GTABLEMT MVC    IOKEY(8),KTABLEMT .SAVE KEY
+         MVI    IOKEY+8,C'G' .TYPE OF I/O
+         ZG#CALL GET,(&FIL.,R&FIL.,K&FIL.)
+         DS     0H
+         LA     15,TABLEMT
+         ST     15,PLIST+4*(1-1)
+         LA     15,RTABLEMT
+         ST     15,PLIST+4*(2-1)
+         LA     15,KTABLEMT
+         ST     15,PLIST+4*(3-1)
+         OI     PLIST+4*(3-1),X'80'
```

Figure C-10. APCHKS Action Program Processing a Dialog Transaction with Delayed Internal Succession (Part 10 of 22)

```
+          LA     1,PLIST
+          L      15,=V(GET)
+          BALR   14,15
+          AI     #GET,1 .INCREMENT IO COUNT
+          MVC    IOFILE(20),TABLEMT+8 .SAVE FILE
+          B      IOSTATUS .CHECK I/O STATUS
 *
 ************** VENDOR MASTER I/O
 *
 VENDORM   YS$GET 5
+*
+*                GET
+*
+GVENDORM  MVC    IOKEY(5),KVENDORM .SAVE KEY
+          MVI    IOKEY+5,C'G' .TYPE OF I/O
+          ZG#CALL GET,(&FIL.,R&FIL.,K&FIL.)
+          DS     0H
+          LA     15,VENDORM
+          ST     15,PLIST+4*(1-1)
+          LA     15,RVENDORM
+          ST     15,PLIST+4*(2-1)
+          LA     15,KVENDORM
+          ST     15,PLIST+4*(3-1)
+          OI     PLIST+4*(3-1),X'80'
+          LA     1,PLIST
+          L      15,=V(GET)
+          BALR   14,15
+          AI     #GET,1 .INCREMENT IO COUNT
+          MVC    IOFILE(20),VENDORM+8 .SAVE FILE
+          B      IOSTATUS .CHECK I/O STATUS
 *
 ************** PERSONNEL MASTER I/O
 *
 PAYROLL   YS$GET 4
+*
+*                GET
+*
+GPAYROLL  MVC    IOKEY(4),KPAYROLL .SAVE KEY
+          MVI    IOKEY+4,C'G' .TYPE OF I/O
+          ZG#CALL GET,(&FIL.,R&FIL.,K&FIL.)
+          DS     0H
+          LA     15,PAYROLL
+          ST     15,PLIST+4*(1-1)
+          LA     15,RPAYROLL
+          ST     15,PLIST+4*(2-1)
+          LA     15,KPAYROLL
+          ST     15,PLIST+4*(3-1)
+          OI     PLIST+4*(3-1),X'80'
+          LA     1,PLIST
+          L      15,=V(GET)
+          BALR   14,15
+          AI     #GET,1 .INCREMENT IO COUNT
+          MVC    IOFILE(20),PAYROLL+8 .SAVE FILE
+          B      IOSTATUS .CHECK I/O STATUS
 *
 ************** ACCOUNTS PAYABLE MASTER I/O
 *
 ACCTPAY   YS$GET 15
+*
+*                GET
```

Figure C-10. APCHKS Action Program Processing a Dialog Transaction with Delayed Internal Succession (Part 11 of 22)

```
+*
+GACCTPAY MVC    IOKEY(15),KACCTPAY .SAVE KEY
+         MVI    IOKEY+15,C'G' .TYPE OF I/O
+         ZG#CALL GET,(&FIL.,R&FIL.,K&FIL.)
+         DS     0H
+         LA     15,ACCTPAY
+         ST     15,PLIST+4*(1-1)
+         LA     15,RACCTPAY
+         ST     15,PLIST+4*(2-1)
+         LA     15,KACCTPAY
+         ST     15,PLIST+4*(3-1)
+         OI     PLIST+4*(3-1),X'80'
+         LA     1,PLIST
+         L      15,=V(GET)
+         BALR   14,15
+         AI     #GET,1 .INCREMENT IO COUNT
+         MVC    IOFILE(20),ACCTPAY+8 .SAVE FILE
+         B      IOSTATUS .CHECK I/O STATUS
 ACCTPAY  Y$$GETUP 15
+*
+*               GETUP
+*
+UACCTPAY MVC    IOKEY(15),KACCTPAY .SAVE KEY
+         MVI    IOKEY+15,C'U' .TYPE OF I/O
+         ZG#CALL GETUP,(&FIL.,R&FIL.,K&FIL.)
+         DS     0H
+         LA     15,ACCTPAY
+         ST     15,PLIST+4*(1-1)
+         LA     15,RACCTPAY
+         ST     15,PLIST+4*(2-1)
+         LA     15,KACCTPAY
+         ST     15,PLIST+4*(3-1)
+         OI     PLIST+4*(3-1),X'80'
+         LA     1,PLIST
+         L      15,=V(GETUP)
+         BALR   14,15
+         AI     #GETUP,1 .INCREMENT IO COUNT
+         MVC    IOFILE(20),ACCTPAY+8 .SAVE FILE
+         B      IOSTATUS .CHECK I/O STATUS
 ACCTPAY  Y$$PUT 15
+*
+*               PUT
+*
+PACCTPAY MVC    IOKEY(15),KACCTPAY .SAVE KEY
+         MVI    IOKEY+15,C'P' .TYPE OF I/O
+         ZG#CALL PUT,(&FIL.,R&FIL.)
+         DS     0H
+         LA     15,ACCTPAY
+         ST     15,PLIST+4*(1-1)
+         LA     15,RACCTPAY
+         ST     15,PLIST+4*(2-1)
+         OI     PLIST+4*(2-1),X'80'
+         LA     1,PLIST
+         L      15,=V(PUT)
+         BALR   14,15
+         AI     #PUT,1 .INCREMENT IO COUNT
+         MVC    IOFILE(20),ACCTPAY+8 .SAVE FILE
+         B      IOSTATUS .CHECK I/O STATUS
 ACCTPAY  Y$$INSRT 15
+*
```

Figure C-10. APCHKS Action Program Processing a Dialog Transaction with Delayed Internal Succession (Part 12 of 22)

```
+*               INSERT
+*
+IACCTPAY MVC    IOKEY(15),KACCTPAY .SAVE KEY
+         MVI    IOKEY+15,C'I' .TYPE OF I/O
+         ZG#CALL INSERT,(EFIL.,REFIL.)
+         DS     0H
+         LA     15,ACCTPAY
+         ST     15,PLIST+4*(1-1)
+         LA     15,RACCTPAY
+         ST     15,PLIST+4*(2-1)
+         OI     PLIST+4*(2-1),X'80'
+         LA     1,PLIST
+         L      15,=V(INSERT)
+         BALR   14,15
+         AI     #INSERT,1 .INCREMENT IO COUNT
+         MVC    IOFILE(20),ACCTPAY+8 .SAVE FILE
+         B      IOSTATUS .CHECK I/O STATUS
          Y$$NOW                        DATE-TIME
+*
+************** DATE AND TIME STAMP ****************************************
+*
+DAYTIME  ORG    *
+         GETIME S
+         DS     0H
+         SR     1,1
+         SVC    7
+         ST     R0,WORK1 .DATE-0YYMMDD+
+         UNPK   WORK1+4(7),WORK1(4)
+         MVC    YYMMDD(6),WORK1+5
+         OI     YYMMDD+5,X'F0' .FIX SIGN
+         ST     R1,WORK1 .TIME-0HHMMSS+
+         UNPK   WORK1+4(7),WORK1(4)
+         MVC    HHMMSS(6),WORK1+5
+         OI     HHMMSS+5,X'F0' .FIX SIGN
+         BR     R7 .RETURN REGISTER
          Y$$RJ                        RIGHT JUSTIFY
+*
+************** RIGHT JUSTIFY *********************************************
+*
+*
+*               R0  = FIELD LENGTH
+*               R1  = FIELD ADDRESS
+*               R15 = RETURN STATUS
+*
+RJ1      LA     R0,1 .SET LENGTH
+         B      RJ
+RJ2      LA     R0,2 .SET LENGTH
+         B      RJ
+RJ3      LA     R0,3 .SET LENGTH
+         B      RJ
+RJ4      LA     R0,4 .SET LENGTH
+         B      RJ
+RJ5      LA     R0,5 .SET LENGTH
+         B      RJ
+RJ6      LA     R0,6 .SET LENGTH
+         B      RJ
+RJ7      LA     R0,7 .SET LENGTH
+         B      RJ
+RJ8      LA     R0,8 .SET LENGTH
+         B      RJ
```

Figure C-10. APCHKS Action Program Processing a Dialog Transaction with Delayed Internal Succession (Part 13 of 22)

```
+RJ9        LA    R0,9 .SET LENGTH
+           B     RJ
+RJ10       LA    R0,10 .SET LENGTH
+           B     RJ
+RJ11       LA    R0,11 .SET LENGTH
+           B     RJ
+RJ         ST    R7,RJSAVE .SAVE RETURN ADDRESS
+           LA    R13,SAVE .PROGRAM SAVE AREA
+           DC    OY(0)
+           EXTRN MODRJ1 .RIGHT JUSTIFY MODULE
+           L     R15,=A(MODRJ1)
+           BALR  R14,R15 .BRANCH TO RJ
+           L     R7,RJSAVE .RESTORE RETURN ADDRESS
+           LTR   R15,R15 .SET CONDITION CODE FOR ERRORS
+           BR    R7 .RETURN TO CALL
            YS$DATE                          DATE VALIDATION
+*
+************** DATE VALIDATION *****************************************
+*
+DATCHKYM   MVI   WORK1+4,C'0' .PLUG DAY = 1
+           MVI   WORK1+5,C'1'
+DATCHK     ST    R7,DVSAVE .SAVE RETURN ADDRESS
+           LA    R1,WORK1
+           BAL   R7,RJ6 .TEST FOR NUMERIC
+           BNZ   DVOUT
+           LTR   R7,R7 .SET CONDITION CODE
+           CLC   WORK1(2),=C'70' .UNDER LOW YEAR?
+           BL    DVOUT
+           CLC   WORK1(2),=C'99' .OVER HIGH YEAR?
+           BH    DVOUT
+           CLC   WORK1+2(2),=C'01' .UNDER LOW MONTH?
+           BL    DVOUT
+           CLC   WORK1+2(2),=C'12' .OVER HIGH MONTH
+           BH    DVOUT
+           CLC   WORK1+4(2),=C'01' .UNDER LOW DAY?
+           BL    DVOUT
+           CLC   WORK1+4(2),=C'31' .OVER HIGH DAY?
+           BH    DVOUT
+           SR    R7,R7 .DATE OK
+DVOUT      LTR   R7,R7 .SET CONDITION CODE
+           L     R7,DVSAVE .RESTORE RETURN ADDRESS
+           BR    R7
            YS$MVIN                            INPUT SCREEN FORMATING
+*
+************** MOVE IMA DATA TO SCREEN WORK AREA
+*
+MOVEIN     ST    R0,SCREEN# .SCREEN NUMBER
+           MVC   IOKEY(4),SCREEN# .SCREEN NUMBER
+           MVI   IOKEY+4,C'G' .GET
+           MVI   IOFILE,C' '
+           MVC   IOFILE+1(19),IOFILE .CLEAR TO SPACES
+           MVC   IOFILE(13),=C'SCREEN FORMAT' .FILE NAME
+           ZG#CALL MSGIN,(SCRNUM,IN$MSG)
+           DS    0H
+           LA    15,SCRNUM
+           ST    15,PLIST+4*(1-1)
+           LA    15,IN$MSG
+           ST    15,PLIST+4*(2-1)
+           OI    PLIST+4*(2-1),X'80'
+           LA    1,PLIST
```

Figure C-10. APCHKS Action Program Processing a Dialog Transaction with Delayed Internal Succession (Part 14 of 22)

```
+           L      15,=V(MSGIN)
+           BALR   14,15
+           LA     R9,ABTERM .I/O ERROR ADDRESS
+           B      IOSTATUS .CHECK I/O STATUS
            YS$MVOUT                          OUTPUT SCREEN FORMAT
+*
+*************** MOVE DATA FROM SCREEN WORK AREA TO OMA
+*
+MOVEOUT    ST     R0,SCREEN# .SCREEN NUMBER
+           MVC    IOKEY(4),SCREEN# .SCREEN NUMBER
+           MVI    IOKEY+4,C'P' .PUT
+           MVI    IOFILE,C' '
+           MVC    IOFILE+1(19),IOFILE .CLEAR TO SPACES
+           MVC    IOFILE(13),=C'SCREEN FORMAT' .FILE NAME
+           ZG#CALL MSGOUT,(SCRNUM,OUT$MSG,PDATA) .SCREEN AND DATA
+           DS     0H
+           LA     15,SCRNUM
+           ST     15,PLIST+4*(1-1)
+           LA     15,OUT$MSG
+           ST     15,PLIST+4*(2-1)
+           LA     15,PDATA
+           ST     15,PLIST+4*(3-1)
+           OI     PLIST+4*(3-1),X'80'
+           LA     1,PLIST
+           L      15,=V(MSGOUT)
+           BALR   14,15
+           B      YS$M0010
+MOVEOUTS   ST     R0,SCREEN#
+           MVC    IOKEY(4),SCREEN# .SCREEN NUMBER
+           MVI    IOKEY+4,C'P' .PUT
+           MVI    IOFILE,C' '
+           MVC    IOFILE+1(19),IOFILE .CLEAR TO SPACES
+           MVC    IOFILE(13),=C'SCREEN FORMAT' .FILE NAME
+           ZG#CALL MSGOUT,(SCRNUM)        .SCREEN ONLY (NO DATA)
+           DS     0H
+           LA     15,SCRNUM
+           ST     15,PLIST+4*(1-1)
+           OI     PLIST+4*(1-1),X'80'
+           LA     1,PLIST
+           L      15,=V(MSGOUT)
+           BALR   14,15
+YS$M0010   LA     R9,ABTERM .I/O ERROR ADDRESS
+           B      IOSTATUS .CHECK I/O STATUS
 APCHKS     YS$SNAP                           SNAP DUMP
+*
+*************** SNAP DUMP OF ACTION PROGRAM ****************************
+*
+SNAPIT     ORG    *
+      ZG#CALL SNAP,(ZA#DPIB,EP,ZA#IMH,EI,WORK,EW,ZA#OMH,EO,ENAM.,YS$E)
+           DS     0H
+           LA     15,ZA#DPIB
+           ST     15,PLIST+4*(1-1)
+           LA     15,EP
+           ST     15,PLIST+4*(2-1)
+           LA     15,ZA#IMH
+           ST     15,PLIST+4*(3-1)
+           LA     15,EI
+           ST     15,PLIST+4*(4-1)
+           LA     15,WORK
+           ST     15,PLIST+4*(5-1)
```

Figure C-10. APCHKS Action Program Processing a Dialog Transaction with Delayed Internal Succession (Part 15 of 22)

```
            LA     15,EW
            ST     15,PLIST+4*(6-1)
            LA     15,ZA#OMH
            ST     15,PLIST+4*(7-1)
            LA     15,EO
            ST     15,PLIST+4*(8-1)
            LA     15,APCHKS
            ST     15,PLIST+4*(9-1)
            LA     15,YSSE
            ST     15,PLIST+4*(10-1)
            OI     PLIST+4*(10-1),X'80'
            LA     1,PLIST
            L      15,=V(SNAP)
            BALR   14,15
            BR     R7 .RETURN REGISTER
*****************************************************************************
*                  TERMINATION
*****************************************************************************
            YSSTERM
*****************************************************************************
**                 PROGRAM TERMINATION                                      *
*****************************************************************************
TERM        CLI    ISNAP,C'N' .REQUEST NORMAL TERMINATION WITH SNAP?
            BE     SNAP .YES
            CLI    ISNAP,C'S' .REQUEST ABNORMAL TERMINATION WITH SNAP?
            BNE    FINISH .NO-NORMAL TERMINATION
ABTERM      MVI    ZA#PSIND,C'S' .TERMINATE WITH SNAP DUMP
            B      FINISH
SNAP        GETIME M
SNAP        DS     0H
            LA     1,1
            SVC    7
            ST     R1,ETIMS
           ZG#CALL SNAP,(ZA#DPIB,EP,ZA#IMH,EI,WORK,EW,ZA#OMH,EO,YSSB,YSSE)
            DS     0H
            LA     15,ZA#DPIB
            ST     15,PLIST+4*(1-1)
            LA     15,EP
            ST     15,PLIST+4*(2-1)
            LA     15,ZA#IMH
            ST     15,PLIST+4*(3-1)
            LA     15,EI
            ST     15,PLIST+4*(4-1)
            LA     15,WORK
            ST     15,PLIST+4*(5-1)
            LA     15,EW
            ST     15,PLIST+4*(6-1)
            LA     15,ZA#OMH
            ST     15,PLIST+4*(7-1)
            LA     15,EO
            ST     15,PLIST+4*(8-1)
            LA     15,YSSB
            ST     15,PLIST+4*(9-1)
            LA     15,YSSE
            ST     15,PLIST+4*(10-1)
            OI     PLIST+4*(10-1),X'80'
            LA     1,PLIST
            L      15,=V(SNAP)
            BALR   14,15
FINISH      GETIME M
```

Figure C-10. APCHKS Action Program Processing a Dialog Transaction with Delayed Internal Succession (Part 16 of 22)

```
1081+FINISH    DS     0H
1082+          LA     1,1
1083+          SVC    7
1084+          ST     R1,ETIMS  .ENDING TIME
1085+          ZG#CALL RETURN        .RETURN CONTROL TO IMS
1086+          DS     0H
1087+          L      15,=V(RETURN)
1088+          BALR   14,15
1090           YS$MSG 1
1091+EMSG1     MVC    OMA(LMSG1),MSG1
1092+          MVC    ZA#OTL(2),=Y(0+LMSG1+4)
1093+          B      TERM
1094           YS$MSG 2
1095+EMSG2     MVC    OMA(LMSG2),MSG2
1096+          MVC    ZA#OTL(2),=Y(0+LMSG2+4)
1097+          B      TERM
1098           YS$MSG 3
1099+EMSG3     MVC    OMA(LMSG3),MSG3
1100+          MVC    ZA#OTL(2),=Y(0+LMSG3+4)
1101+          B      TERM
1102           YS$MSG 4,N
1103+EMSG4     MVC    OMA(LMSG4),MSG4
1104+          MVC    ZA#OTL(2),=Y(0+LMSG4+4)
1105           MVC     OMA+M4A-MSG4(15),KACCTPAY
1106           B       TERM
1107           YS$MSG 5
1108+EMSG5     MVC    OMA(LMSG5),MSG5
1109+          MVC    ZA#OTL(2),=Y(0+LMSG5+4)
1110+          B      TERM
1111           YS$MSG 6
1112+EMSG6     MVC    OMA(LMSG6),MSG6
1113+          MVC    ZA#OTL(2),=Y(0+LMSG6+4)
1114+          B      TERM
1115           YS$MSG 7
1116+EMSG7     MVC    OMA(LMSG7),MSG7
1117+          MVC    ZA#OTL(2),=Y(0+LMSG7+4)
1118+          B      TERM
1119           YS$MSG 8
1120+EMSG8     MVC    OMA(LMSG8),MSG8
1121+          MVC    ZA#OTL(2),=Y(0+LMSG8+4)
1122+          B      TERM
1123 ***************************************************************************
1124 *                CONSTANTS
1125 ***************************************************************************
1126 ACCTPAY   DC     C'ACCTPAY ACCOUNTS PAYABLE      '
1127 TABLEMT   DC     C'TABLEMT SECURITY/CODES        '
1128 VENDORM   DC     C'VENDORM VENDOR MASTER         '
1129 PAYROLL   DC     C'PAYROLL PAYROLL MASTER        '
1130 BLANKS    DC     CL80' '
1131 *
1132 ************** MESSAGES
1133 *
1134 MSG1      DC     X'100A18011C'
1135           DC     C'PLEASE USE "TRANSMIT UNPROT DISPL" KEY TO RETRANSMIT'
1136           DC     X'1D10C02C000'
1137 LMSG1     EQU    *-MSG1
1138 MSG2      DC     X'100A18011C'
1139           DC     C'THE ACCOUNTS PAYABLE CONTROL RECORD CANNOT BE FOUND. '
1140           DC     C'PLEASE CONTACT ISD'
```

Figure C-10. APCHKS Action Program Processing a Dialog Transaction with Delayed Internal Succession (Part 17 of 22)

```
              DC     X'1D10020000'
     LMSG2    EQU    *-MSG2
     MSG3     DC     X'100A0000'
              DC     C'A/P BATCH # '
     M3A      DC     CL4' '                          BATCH #
     M3B      DC     X'40212020612020612020'   DATE
              DC     CL5' '
     M3C      DC     CL3' '                          # OF CHECKS
              DC     C' CHECKS TOTALING $'
     M3D      DC     X'40206B2020206B20212048202060'
              DC     X'10020000'
     LMSG3    EQU    *-MSG3
     DM3A     EQU    M3A-MSG3
     DM3B     EQU    M3B-MSG3
     DM3C     EQU    M3C-MSG3
     DM3D     EQU    M3D-MSG3
     MSG4     DC     X'100A18011C'
     M4A      DC     CL15' '
              DC     C'=THIS CHECK CANNOT BE FOUND. PLEASE CORRECT AND RETRY'
              DC     X'1D10020000'
     LMSG4    EQU    *-MSG4
     MSG5     DC     X'100A18011C'
              DC     C'ACTIVITY FOR THE PREVIOUS CHECK IS NOT COMPLETE'
              DC     X'1D10020000'
     LMSG5    EQU    *-MSG5
     MSG6     DC     X'100A18011C'
              DC     C'THIS CHECK IS ALREADY IN OUR FILE. '
              DC     C'PLEASE CORRECT AND RETRY'
              DC     X'1D10020000'
     LMSG6    EQU    *-MSG6
     MSG7     DC     X'100A18011C'
              DC     C'THE CURSOR WAS NOT IN THE EXPECTED POSITION. '
              DC     C'PLEASE CORRECT AND RETRY'
              DC     X'1D10020000'
     LMSG7    EQU    *-MSG7
     MSG8     DC     X'100A00001C'
              DC     C'THIS ACTION HAS BEEN TERMINATED BY OPERATOR REQUEST'
              DC     X'1D10020000'
     LMSG8    EQU    *-MSG8
     MSG9     DC     X'1C'
              DC     C'ITEMS TOTAL ='
     M9A      DC     X'40202020202020212048202060'
              DC     X'1D'
     LMSG9    EQU    *-MSG9
     DM9A     EQU    M9A-MSG9
     MSG10    DC     X'1C'
              DC     C'CASH NOT = 0'
              DC     X'1D'
     LMSG10   EQU    *-MSG10
     MSG11    DC     X'1C'
              DC     C'ACCRUAL NOT = 0'
              DC     X'1D'
     LMSG11   EQU    *-MSG11
     MSG12    DC     X'1C'
              DC     C'VOID CHECK REQUIRES OVERRIDE CHECK NUMBER'
              DC     X'1D'
     LMSG12   EQU    *-MSG12
              PRINT  GEN
              Y$$PIB                           .PROGRAM INFORMAION BLOCK
```

Figure C-10. APCHKS Action Program Processing a Dialog Transaction with Delayed Internal Succession (Part 18 of 22)

```
1200+*********************************************************************************
1201+*                  LITERAL POOL                                                 *
1202+*********************************************************************************
1203+          LTORG
1204+                   =V(GET)
1205+                   =V(GETUP)
1206+                   =V(PUT)
1207+                   =V(INSERT)
1208+                   =A(MODRJ1)
1209+                   =V(MSGIN)
1210+                   =V(MSGOUT)
1211+                   =V(SNAP)
1212+                   =V(RETURN)
1213+                   =Y(0+LYS$M1+4)
1214+                   =C'AP'
1215+                   =Y(0+IMA1)
1216+                   =C'ZBATCH'
1217+                   =Y(0+LMSG3+4)
1218+                   =Y(0+IMA3)
1219+                   =C'AC'
1220+                   =C'APITMS'
1221+                   =H'14'
1222+                   =C'APITS  '
1223+                   =Y(0+LIOM2+4)
1224+                   =Y(0+LIOM1+4)
1225+                   =C'70'
1226+                   =C'99'
1227+                   =C'01'
1228+                   =C'12'
1229+                   =C'31'
1230+                   =Y(0+LMSG1+4)
1231+                   =Y(0+LMSG2+4)
1232+                   =Y(0+LMSG4+4)
1233+                   =Y(0+LMSG5+4)
1234+                   =Y(0+LMSG6+4)
1235+                   =Y(0+LMSG7+4)
1236+                   =Y(0+LMSG8+4)
1237+                   =C'APCHK'
1238+                   =C'T80'
1239+                   =C'    '
1240+                   =C'ADD'
1241+                   =P'1'
1242+                   =C'000'
1243+                   =C'00000'
1244+                   =P'0'
1245+                   =C'001'
1246+                   =C'SCREEN FORMAT'
1247+YSSE      EQU    * .END OF PROGRAM
1369 WORK      YS$WORK                              .WORK AREA
1370+*********************************************************************************
1371+*                  WORK AREA                                                    *
1372+*********************************************************************************
1373+WORK      DSECT
1374+STIMS     DS     A .START TIME (MILLISECONDS)
1375+ETIMS     DS     A .END TIME (MILLISECONDS)
1376+#GET      DS     H .NUMBER OF GET
1377+#GETUP    DS     H .          GETUP
1378+#PUT      DS     H .          PUT
1379+#INSERT   DS     H .          INSERT
1380+SAVE      DS     18F .PROGRAM SAVE AREA
```

Figure C-10. APCHKS Action Program Processing a Dialog Transaction with Delayed Internal Succession (Part 19 of 22)

```
+PLIST     DS     4A .PARAMETER LIST FOR "CALLS"
+WHO       DS     CL3 .USER INITIALS
+WORK1     DS     2D .WORK FIELD
+PASSKEY   EQU    WORK1,5 .SECURITY RECORD FILE KEY
+IOFILE    DS     CL20 .LAST FILE I/O
+IOKEY     DS     CL20 .LAST FILE I/O KEY
+IOSTS     DS     CL4 .LAST FILE I/O STATUS
+IORET     DS     CL1 .FILE NOT AVAILABLE-RETURN
+ERR       DS     CL1 .ERROR FLAG
+YYMMDD    DS     CL6 .DATE
+HHMMSS    DS     CL6 .TIME
 RJSAVE    DS     A
 DVSAVE    DS     A
 TRAILS    DS     CL26
 TRAILS1   DS     A
 TRAILS2   DS     A
           Y$SSWORK                        .SDMPS WORK AREA
+*
+************** SDMPS WORK AREA **************************************
+*
+SCRNUM    DS     D .SCREEN NUMBER
+SCREEN#   EQU    SCRNUM+4,4
+SCREENW   DS     CL180 .SCREEN WORK AREA
+MAXITL    EQU    SCREENW,2 .MAXIMUM INPUT TEXT LENGTH
+*
+************** SDMPS I/O AREAS
+*
+UDATA     EQU    *
+OUT$MSG   EQU    * .OUTPUT MESSAGE DATA
+FILL      DS     CL1 .OUTPUT FILL CHARACTER
+IN$MSG    EQU    * .INPUT MESSAGE DATA
 *
 ************** UNPROTECTED DATA
 *
 USTART    EQU    *
 UTRAN     DS     CL5                       TRANSACTION CODE
 USNAP     DS     CL1                       SNAP CODE
 IMA1      EQU    *-USTART
 UADD      DS     CL1                       ADD
 UCHG      DS     CL1                       CHANGE
 UEND      DS     CL1                       END
 UTYPE     DS     CL1                       CHECK TYPE
 UCHECK    DS     CL5                       CHECK NUMBER
 UTRAN1    DS     CL1
 IMA2      EQU    *-USTART
 UVENDOR   DS     CL5                       VENDOR CODE
 UTRAN2    DS     CL1
 IMA3      EQU    *-USTART
 ULEGEND   DS     CL25                      CHECK LEGEND
 UNAME     DS     CL26                      PAYEE NAME
 UADDR1    DS     CL25                      PAYEE ADDRESS LINE 1
 UADDR2    DS     CL25                      PAYEE ADDRESS LINE 2
 UCITY     DS     CL25                      PAYEE CITY AND STATE
 UZIP      DS     CL5                       PAYEE ZIP CODE
 UAMOUNT   DS     CL10                      CHECK AMOUNT
 UDATE     DS     CL6                       CHECK DATE (MMDDYY)
 UOVERIDE  DS     CL5                       OVERRIDE CHECK NUMBER
 UTRAN3    DS     CL1
 LUDATA    EQU    *-UDATA-1
 USTOP     DS     CL1
```

Figure C-10. APCHKS Action Program Processing a Dialog Transaction with Delayed Internal Succession (Part 20 of 22)

```
*
************** PROTECTED REPLACEMENT DATA
*
PDATA     EQU   *
PSTART    EQU   *
PADD      DS    CL1
PCHG      DS    CL1
PEND      DS    CL1
PCHECK    DS    CL1
PVENDOR   DS    CL1
PLEGEND   DS    CL1
PNAME     DS    CL1
PADDR1    DS    CL1
PADDR2    DS    CL1
PCITY     DS    CL1
PZIP      DS    CL1
PAMOUNT   DS    CL1
PDATE     DS    CL1
POVERIDE  DS    CL1
PMSG1     DS    CL80
LPDATA    EQU   *-PSTART
PSTOP     DS    CL1
*************************************************************************************
*                     RECORD AREAS
*************************************************************************************
                YS$SY104                                  .SECURITY RECORD
+*
+************** TABLE MASTER RECORD
+*
+KTABLEMT DS    CL6
+RTABLEMT DS    CL80
+TABSTS   EQU   RTABLEMT+06,1 STATUS
+LIMIT    EQU   RTABLEMT+15,1 PASSWORD LIMIT
+TERMTAB  EQU   RTABLEMT+16 TERMINAL FIELDS
*
******** AP002 VENDOR MASTER
*
KVENDORM DS     CL5
RVENDORM DS     CL199
VMNAME    EQU   RVENDORM+5,26            NAME
VMADDR1   EQU   RVENDORM+31,25           ADDRESS 1
VMADDR2   EQU   RVENDORM+57,25           ADDRESS 2
VMCITY    EQU   RVENDORM+83,25           CITY
VMZIP     EQU   RVENDORM+109,5           ZIP CODE
*
******** PE010 PERSONNEL MASTER
*
KPAYROLL  DS    CL5
RPAYROLL  DS    CL421
PMNAME    EQU   RPAYROLL+12,26           NAME
PMADDR1   EQU   RPAYROLL+41,25           ADDRESS
PMCITY    EQU   RPAYROLL+70,25           CITY
PMZIP     EQU   RPAYROLL+99,5            ZIP CODE
PMBRW     EQU   RPAYROLL+200,3           BRANCH OF WORK
*
************** ACCOUNTS PAYABLE
*
KACCTPAY  DS    CL15
RACCTPAY  DS    CL165
```

Figure C-10. APCHKS Action Program Processing a Dialog Transaction with Delayed Internal Succession (Part 21 of 22)

```
*
*        AP100  HEADER
*
APAMT    EQU    RACCTPAY+29,5
HACCTPAY DS     CL165
APHRID   EQU    HACCTPAY,2
APHREPT  EQU    HACCTPAY+16,5          PD2   REPORT TOTAL
APHBATCH EQU    HACCTPAY+21,5          PD2   BATCH TOTAL
APHCHKCT EQU    HACCTPAY+26,5                CHECK COUNTER
APHTYPE  EQU    HACCTPAY+31,1                CHECK TYPE
APHCHECK EQU    HACCTPAY+32,5                CHECK NUMBER
APHDATE  EQU    HACCTPAY+37,6                CHECK DATE
APHVENDR EQU    HACCTPAY+43,5                CHECK VENDOR
APHITMT  EQU    HACCTPAY+53,5          PD2   ITEM TOTAL
APHITMC  EQU    HACCTPAY+58,3                ITEM COUNT
APHAMT   EQU    HACCTPAY+48,5          PD2   CHECK AMT
APHNAME  EQU    HACCTPAY+61,26               NAME
APHLEGND EQU    HACCTPAY+87,26               LEGEND
APHPRNT  EQU    HACCTPAY+113,1               PRINT
APHBATHN EQU    HACCTPAY+114,3               BATCH NUMBER
APHCHKS  EQU    HACCTPAY+117,3               NUMBER OF CHECKS
APHVODS  EQU    HACCTPAY+120,3               NUMBER OF VOIDS
APHERRS  EQU    HACCTPAY+123,3               NUMBER OF ERROR PASSES
APHITMS  EQU    HACCTPAY+126,4               NUMBER OF ITEMS
APHOLD   EQU    HACCTPAY+130,5         PD2   OLD CHECK AMOUNT
APHCASH  EQU    HACCTPAY+135,5               CASH TOTAL
APHACCR  EQU    HACCTPAY+140,5               ACCRUAL TOTAL
APHERR   EQU    HACCTPAY+145,1               ERROR CODE
APHAOC   EQU    HACCTPAY+146,1               ADD OR CHANGE
APHDONE  EQU    HACCTPAY+147,1               COMPLETION
*
******** AP103  CHECK
*
CACCTPAY DS     CL165
APCRID   EQU    CACCTPAY,2                   "AC"
APCTYPE  EQU    CACCTPAY+2,1                 TYPE
APCCHECK EQU    CACCTPAY+3,5                 CHECK NUMBER
APCTDATE EQU    CACCTPAY+16,4          PD0   TRANSACTION DATE
APCDATE  EQU    CACCTPAY+20,4          PD0   DATE
APCVENDR EQU    CACCTPAY+24,5                VENDOR
APCAMT   EQU    CACCTPAY+29,5          PD2   AMOUNT
APCNAME  EQU    CACCTPAY+34,26               NAME
APCADDR1 EQU    CACCTPAY+60,25               ADDRESS 1
APCADDR2 EQU    CACCTPAY+85,25               ADDRESS 2
APCCITY  EQU    CACCTPAY+110,26              CITY
APCZIP   EQU    CACCTPAY+136,3         PD0   ZIP CODE
APCLEGND EQU    CACCTPAY+139,25              LEGEND
APCPRNT  EQU    CACCTPAY+164,1               PRINT
OMA      Y$$OMA 2568                        .OUTPUT MESSGE AREA
+EW      EQU    * .END OF WORK AREA
CDA      Y$$CDA                             .CONTINUITY DATA AREA
+***********************************************************************
+*              CONTINUITY DATA AREA                                    *
+***********************************************************************
+CDA     DSECT
+        DS     0H
         END
```

Figure C-10. APCHKS Action Program Processing a Dialog Transaction with Delayed Internal Succession (Part 22 of 22)

```
LINE    SOURCE STATEMENT                                                OS/3 ASM

APITMS   START 0
**************************************************************************
*                  AUTHOR  : R L LEONARD
*                  DATE    : 28 MARCH 1980
*                  SITE    : GAY & TAYLOR INC.,WINSTON-SALEM,NC,27102
*                  PURPOSE: TO ENTER AND VERIFY ITEM CHARGES FROM AP CHECKS
*                  CHANGE LOG:
**************************************************************************
         Y$$START                             .STARTING CONVENTIONS
Y$$B     EQU   * .START OF PROGRAM
*
*************** REGISTER EQUATES
*
R0       EQU   0
R1       EQU   1
R2       EQU   2 .PIB COVER
R3       EQU   3 .IMA COVER
R4       EQU   4 .WORK COVER
R5       EQU   5 .OMA COVER
R6       EQU   6 .CDA COVER
R7       EQU   7 .INTERNAL ROUTINE LINKAGE
R8       EQU   8 .I/O - NORMAL RETURN ADDRESS
R9       EQU   9 .I/O - ERROR RETURN ADDRESS
R10      EQU   10 .PROGRAM COVER #3
R11      EQU   11 .PROGRAM COVER #2
R12      EQU   12 .PROGRAM COVER #1
R13      EQU   13
R14      EQU   14
R15      EQU   15
*
*************** ESTABLISH PROGRAM COVERING
*
         USING *,R12,R11,R10 .PROGRAM CODE
         USING ZA#DPIB,R2 .PIB
         USING ZA#IMH,R3 .IMA
         USING WORK,R4 .WORK
         USING ZA#OMH,R5 .OMA
         USING CDA,R6 .CDA
*
*************** ESTABLISH IMS INTERFACE
*
         STM   R14,R12,12(R13) .STORE REG IN CALLS' SAVE AREA
         LR    R12,R15 .ADDRESS OF THIS PROGRAM
         LM    R2,R6,0(R1) .ACTIVATION AREAS FROM PARAM
         LA    R11,SAVE .THIS PROGRAM SAVE AREA
         ST    R11,8(,R13) .PUT THIS SAVE INTO CALLS' SAVE
         ST    R13,4(,R11) .PUT CALLS' SAVE INTO THIS SAVE
         LR    R13,R11 .REG 13 = THIS SAVE AREA
         LR    R11,R12 .SECOND PROGRAM COVER
         LA    R11,1(R11)
         LA    R11,4095(R11)
         LR    R10,R11 .THIRD PROGRAM COVER
         LA    R10,1(R10)
         LA    R10,4095(R10)
         GETIME M
         DS    0H
         LA    1,1
         SVC   7
```

Figure C-11. APITMS Action Program Processing a Dialog (Part 1 of 29)

```
  61+           ST     R1,STIMS .STARTUP TIME
  63            DROP   R6                            .NO CDA
  64            PRINT  GEN
  65            BAL    R7,DAYTIME                    .GET DATE-TIME
  66                                                          YS$TRAIL A
  67+           PRINT  OFF
  77+           PRINT  ON
  78            MVC    PASSKEY(5),=C'APCHK'
  79            YS$SECUR                             .PASSWORD SECURITY
  80+***********************************************************************
  81+*                 CHECK SECURITY FOR OPEN APPLICATION                  *
  82+*
  83+*                        ASSUMES KEY IN FIELD "PASSKEY"                *
  84+***********************************************************************
  85+           MVC    KTABLEMT(3),=C'T80'
  86+           MVC    KTABLEMT+3(5),PASSKEY
  87+           LA     R9,YS$0020 .NO FIND ADDRESS
  88+           BAL    R8,GTABLEMT .GET SECURITY RECORD
  89+           CLI    TABSTS,C' ' .RECORD ACTIVE?
  90+           BNE    YS$0020 .NO
  91+           MVI    WORK1,X'00' .SETUP TO CVB
  92+           MVC    WORK1+1(7),WORK1
  93+           MVC    WORK1+8(2),ZA#ISTID+2 .TERMINAL ID
  94+           PACK   WORK1+6(2),WORK1+8(2)
  95+           CVB    R1,WORK1 .TERMINAL FIELD COUNTER
  96+           LA     R7,TERMTAB-4 .BEGINNING OF TERMINAL FIELDS
  97+YS$0010    LA     R7,4(R7) .NEXT TERMINAL FIELDS
  98+           BCT    R1,YS$0010 .COUNT DOWN TO THIS TERMINAL
  99+           CLC    0(3,R7),=C'   ' .OPEN?
 100+           BE     YS$0020 .NO
 101+           MVC    WHO(3),0(R7) .SAVE USER INITIALS
 102+           CLC    3(1,R7),LIMIT .OPEN BUT OVER LIMIT (SET DOWN)
 103+           BNH    YS$0030 .NO
 104+YS$0020    MVC    OMA(LYS$M1),YS$M1 .APPLICATION NOT OPEN
 105+           MVC    ZA#OTL(2),=Y(0+LYS$M1+4) .MESSAGE LENGTH
 106+           B      TERM
 107+YS$M1      DC     X'100A18011C'
 108+           DC     C'APPLICATION NOT OPEN'
 109+           DC     X'1D10020000'
 110+LYS$M1     EQU    *-YS$M1
 111+YS$0030    ORG    *
 113            MVC    KACCTPAY(15),BLANKS
 114            CLC    ZA#ITL(2),=Y(IMA1-USTART)
 115            BNH    L0020
 116            CLC    IPROT(5),=C'A   P'
 117            BE     EMSG1                  USE UNPROT
 118 L0020      EQU    *
 119            CLC    ZA#ITL(2),=Y(UACCT1-USTART+1) DATA ENTERED?
 120            BNH    L0030                  NO
 121            YS$IN  12                     .GET INPUT DATA
 122+           LA     R0,12 .SCREEN NUMBER
 123+           BAL    R8,MOVEIN .GO TO INPUT SCREEN ROUTINE
 124 L0030      MVI    FILL,C' '              UNPROTECTED FILL CHARACTER
 125            MVI    PSTART,C' '
 126            MVC    PSTART+1(PSTOP-PSTART-1),PSTART  CLEAR PROT REPLACE
 127            MVI    USTOP,X'FF'
 128            MVI    PSTOP,X'FF'
 129            CLC    IMA+4(5),=C'APRNT'     .PRINT?
 130            BNE    L0040                  .YES PRINT CHECK
```

Figure C-11. APITMS Action Program Processing a Dialog (Part 2 of 29)

```
131 *****                                                    Y$$TRAIL B
132            MVC    KACCTPAY(2),=C'AC'
133            MVI    KACCTPAY+2,C'N'
134            MVC    KACCTPAY+3(5),IMA+10      CHECK NUMBER
135            CLI    IMA+15,C'V'               VOID CHECK?
136            BNE    L0035                     NO
137            MVI    KACCTPAY+2,C'V'
138 L0035      B      L0610
139 L0040      MVC    KACCTPAY(2),=C'AP'        GET HEADER
140            LA     R9,EMSG2
141            BAL    R8,GACCTPAY
142            MVC    ACCTPAYH(165),RACCTPAY    STORE HEADER
143 *************************************************************************
144 *                 BUILD BASE SCREEN
145 *************************************************************************
146 *
147 *          CHECK DATA
148 *
149            CLI    HTYPE,C'N'               NEW CHECK?
150            BE     L0050                    YES
151            MVC    PTYPE(1),HTYPE
152 L0050      MVC    PCHECK(5),HCHECK
153            MVC    PCAMT(14),=X'40206B2020206B2021204B202060'
154            ED     PCAMT(14),HAMOUNT
155            MVC    PCNAME(25),HNAME
156 *
157 *          LINE NUMBERS
158 *
159            LA     R10,PLIN#1               FIRST LINE # POSITION
160            LA     R6,20                  COUNTER
161            PACK   WORK1(2),HITMCNT(3)
162 L0060      UNPK   0(3,R10),WORK1(2)        MOVE INTO LINE # POSITION
163            OI     2(R10),X'F0'              FIX SIGN
164            AP     WORK1(2),=P'1'            NEXT ITEM
165            LA     R10,PLLINE(,R10)         NEXT LINE
166            BCT    R6,L0060
167            CLC    ZA#ITL(2),=Y(UACCT1-USTART+1) VERIFY DATA?
168            BNL    L0120                     YES
169            CLI    HACTION,C'C'              CHANGE?
170            BE     L0080                     YES
171 *
172 ******** ADD SCREEN
173 *
174 *****                                                    Y$$TRAIL D
175            MVC    UDESPT1(26),HLEGEND
176            B      L9000                     SCREEN OUT
177 *
178 ******** CHANGE SCREEN (GET ITEMS FOR DISPLAY)
179 *
180 L0080      LA     R6,20                    LINE COUNTER
181            LA     R10,UACCT1                FIRST LINE
182                                                          Y$$TRAIL E
183+           PRINT  OFF
193+           PRINT  ON
194            MVC    KACCTPAY(15),BLANKS
195            MVC    KACCTPAY(2),=C'AI'
196            MVC    KACCTPAY+2(6),HTYPE
197            MVC    KACCTPAY+8(3),HITMCNT
198            MVI    POSITION,C'G'
199            LA     R9,EMSG3
```

Figure C-11. APITMS Action Program Processing a Dialog (Part 3 of 29)

```
                BAL    R8,SACCTPAY                  SET START OF FILE
      L0090     LA     R9,EMSG4
                BAL    R8,NACCTPAY                 READ NEXT AP ITEM
                MVC    ACCTPAYI(165),RACCTPAY     MOVE TO ITEM AREA
                CLC    RACCTPAY+2(6),HTYPE         SAME CHECK?
                BNE    L9000                       FORMAT SCREEN AND OUT
                MVC    D(8,R10),AIACCT
                UNPK   DAMT(10,R10),AIAMT(5)
                CP     AIAMT(5),=P'0'
                BNL    L0100
                MVI    DAMT(R10),C'-'
                OI     DAMT+9(R10),X'F0'
      L0100     MVC    DDESPT(30,R10),AIDESCPT
                MVC    DEMP(4,R10),AIEMP
                LA     R10,ULLINE(,R10)
                BCT    R6,L0090
                B      L9000                       FORMAT SCREEN AND OUT
      ****************************************************************************
      *                VERIFY LINE ITEMS
      ****************************************************************************
      L0120     LA     R6,20                      LINE COUNTER
                LA     R10,PLIN#1
                                                                YSSTRAIL F
                PRINT  OFF
                PRINT  ON
                ST     R10,PROLINE                 PROTECTED POINTER
                LA     R10,UACCT1                  UNPROTECTED POINTER
                MVC    BRCH(4),UACCT1
                MVC    DESCPTH(30),UDESPT1
      L0130     CLC    0(ULLINE,R10),BLANKS        THIS LINE BLANK?
                BE     L0320                       YES-CHECK FOR ERRORS
                                                                YSSTRAIL G
                PRINT  OFF
                PRINT  ON
                MVC    LAST(1),DXMIT(R10)          SAVE LAST ITEM FLAG
                CLI    DXMIT(R10),C'R'            REVIEW?
                BNE    L0132                      NO
                MVC    REVIEW(1),DXMIT(R10)       SAVE REVIEW REQUEST
      L0132     EQU    *
                CLC    0(4,R10),BLANKS             NO BRANCH?
                BNE    L0140
                MVC    0(4,R10),BRCH               MOVE HOLD BRANCH
      L0140     EQU    *
      *
      *                CHECK ACCOUNT NUMBER
      *
                                                                YSSTRAIL H
                PRINT  OFF
                PRINT  ON
                MVC    KACCTMST(8),0(R10)          HIT ACCOUNT MASTER
      *         ACCOUNT MASTER FILE
                MVC    KACCOUNT(8),0(R10)
                LA     R8,L0150
                BAL    R9,GACCTMST
                MVI    ERR,C'Y'
                L      R9,PROLINE
                OI     DCACCT(R9),X'C1'            ACCT MST ERROR CODE
                MVI    DBACCT(R9),X'1C'
                B      L0200                       CHECK AMOUNT
      *         BRANCH MASTER FILE
```

Figure C-11. APITMS Action Program Processing a Dialog (Part 4 of 29)

```
LO150    CLI   0(R10),C'0'                 BRANCH ACCOUNT?
         BNE   LO180                       NO, GENERAL LEDGER ACCOUNT
         MVC   KBRANCHM(3),1(R10)
         MVC   BRCH(4),0(R10)              SAVE ACCOUNT CODE
         LA    R8,LO160                    GET BRANCH
         BAL   R9,GBRANCHM
         MVI   ERR,C'Y'
         L     R9,PROLINE
         OI    DCACCT(R9),X'C2'            BRANCH ERROR CODE
         MVI   DBACCT(R9),X'1C'
*        CHART OF ACCOUNTS FILE
LO160    MVC   KACCOUNT(4),=C'0000'         BRANCH ACCOUNT
LO180    EQU   *
         LA    R8,LO190
         BAL   R9,GACCOUNT                 GET CHART OF ACCOUNTS
         MVI   ERR,C'Y'
         L     R9,PROLINE
         OI    DCACCT(R9),X'C4'            ACCOUNT ERROR CODE
         MVI   DBACCT(R9),X'1C'
         B     LO200                       CHECK AMOUNT
LO190    MVC   INCOME(1),CAINC
         MVC   EXPENS(1),CAEXP
         L     R9,PROLINE
         MVC   DPCOA(1,R9),CACOA           CASH/ACCRUAL CODE
*
*        AMOUNT
*
LO200    MVC   WORK1+5(10),DAMT(R10)       SAVE FIELD
         LA    R1,WORK1+5
                                                         YSSTRAIL I
+        PRINT OFF
+        PRINT ON
         BAL   R7,RJ10
         BZ    LO220
         MVI   ERR,C'Y'
         L     R9,PROLINE
         MVI   DBAMT(R9),X'1C'
LO220    PACK  WORK1(5),WORK1+6(9)
         CLI   CACOA,C'C'                  CASH ACCOUNT
         BE    LO240
         AP    HACCR(5),WORK1(5)
         B     LO260
LO240    AP    HCASH(5),WORK1(5)
LO260    EQU   *
*
*        DESCRIPTION
*
                                                         YSSTRAIL J
+        PRINT OFF
+        PRINT ON
         CLC   DDESPT(30,R10),BLANKS
         BNE   LO265
         MVC   DDESPT(30,R10),DESCPTH      DUP LAST DESCRIPTION
LO265    MVC   DESCPTH(30),DDESPT(R10)     SAVE LAST DESCRIPTION
*
*        EXPENSE/INCOME EMPLOYEE NUMBER
*
LO270    L     R9,PROLINE
         CLI   INCOME,C' '                INCOME ACCOUNT?
         BE    LO280                       NO
         CLC   DEMP(4,R10),BLANKS          ANY EMPLOYEE #?
```

Figure C-11. APITMS Action Program Processing a Dialog (Part 5 of 29)

```
               BNE    L0290                      YES
               OI     DCEMP(R9),X'D4'            INCOME AND NO EMP #
               B      L0298                      FLAG ERROR
      L0280    EQU    *
               CLC    DEMP(4,R10),BLANKS
               BE     L0315                      NO EMP #
      L0290    EQU    *
               MVC    KPAYROLL(4),DEMP(R10)
               MVI    KPAYROLL+4,C'0'
               LA     R8,L0300
               BAL    R9,GPAYROLL                GT EMPLOYEE
      L0292    L      R9,PROLINE
               OI     DCEMP(R9),X'D1'            EMP NOT FOUND
               B      L0298                      FLAG ERROR
      L0298    MVI    ERR,C'Y'
               L      R9,PROLINE
               MVI    DBEMP(R9),X'1C'
               B      L0315
      L0300    CLI    INCOME,C' '                INCOME ACCOUNT?
               BNE    L0315                      YES-DO NOT NEED EXPENSE CAL
               MVC    KTABLEMT(8),BLANKS
               MVC    KTABLEMT(3),=C'T10'
               MVC    KTABLEMT+3(3),PMCAL
               LA     R8,L0310
               BAL    R9,GTABLEMT                GET CLASSIFICATION
               L      R9,PROLINE
               OI     DCEMP(R9),X'D2'            CLAS NOT FOUND
               B      L0298
      L0310    CLI    IMEXP,C' '                 EPENSE CLASS?
               BNE    L0315                      YES-OK
               L      R9,PROLINE
               OI     DCEMP(R9),X'D4'            NOT EXP EMP
               B      L0298                      FLAG ERROR
      L0315    EQU    *
    *
    *          SETUP FOR NEXT LINE
    *
                                                                 YS$TRAIL K
               PRINT  OFF
               PRINT  ON
               LA     R10,ULLINE(,R10)           NEXT UNPROTECT LINE
               L      R9,PROLINE
               LA     R9,PLLINE(,R9)             NEXT PROTECT LINE
               ST     R9,PROLINE
               CLI    LAST,C'Y'                  LAST ITEM?
               BE     L0320                      YES
               BCT    R6,L0130                   NEXT LINE
    *******************************************************************************
    *          ADD/UPDATE LINE ITEMS
    *******************************************************************************
      L0320    EQU    *
                                                                 YS$TRAIL L
               PRINT  OFF
               PRINT  ON
               LA     R6,20
               LA     R10,PLIN#1                 PROT DATA
               ST     R10,PROLINE                SAVE ADDRESS
               LA     R10,UACC11
      L0325    CLI    ERR,C'Y'                    ANY ERRORS?
               BE     L9000                       FORMAT AND OUT
               MVC    LAST(1),DXMIT(R10)
    *
```

Figure C-11. APITMS Action Program Processing a Dialog (Part 6 of 29)

```
*************** BUILD RECORD
*
               MVC   KACCTPAY(2),=C'AI'
               MVC   KACCTPAY+2(6),HTYPE
               MVC   KACCTPAY+8(3),HITMCNT
               CLC   0(ULLINE,R10),BLANKS       ITEM?
               BNE   L0328                     NO
               MVI   LAST,C'Y'                SET LAST ITEM
               B     L0400
L0328          MVI   ACCTPAYI,C' '
               MVC   ACCTPAYI+1(164),ACCTPAYI
               MVC   AIRID(2),=C'AI'
               MVC   AITYPE(6),HTYPE
               MVC   AICNT(3),HITMCNT
               MVC   AIVENDOR(5),HVENDOR
               MVC   AIACCT(8),0(R10)
               MVC   WORK1(10),DAMT(R10)
               LA    R1,WORK1
               BAL   R7,RJ10
               BZ    L0330
               MVI   ERR,C'Y'
               L     R9,PROLINE
               OI    DBAMT(R9),X'10'
               B     L0331
L0330          PACK  AIAMT(5),WORK1(10)
L0331          MVC   AIEMP(4),DEMP(R10)
               MVC   AIDESCPT(30),DDESPT(R10)
               L     R9,PROLINE
               MVC   AICOA(1),DPCOA(R9)         CASH/ACCRUAL CODE
               CLI   HACTION,C'C'               CHANGE?
               BE    L0340                      YES
*
*************** ADD RECORD
*
L0335          MVC   AIBATCH(3),HBATCH          BATCH #
               MVC   RACCTPAY(165),ACCTPAYI
               LA    R8,L0390
               BAL   R9,IACCTPAY
               MVI   ZA#PLRI,C'0'               ROLLBACK UPDATES
               MVI   ERR,C'Y'
               L     R9,PROLINE
               MVI   2(R9),X'1C'
               B     L0390
*
*************** UPDATE RECORD
*
L0340          MVC   AIERR(3),HBATCH            CORRECTION BATCH #
               LA    R8,L0380
               BAL   R9,UACCTPAY
                                                           YSSTRAIL M
               PRINT OFF
               PRINT ON
               B     L0335                      ADDING ITEM ON CHANGE
L0360          MVI   ZA#PLRI,C'0'               ROLLBACK UPDATES
               L     R9,PROLINE
               MVI   2(R9),X'1C'
               MVI   ERR,C'Y'
               B     L0390
```

Figure C-11. APITMS Action Program Processing a Dialog (Part 7 of 29)

```
513 L0380      MVC     RACCTPAY(165),ACCTPAYI
514                                                                  Y$STRAIL  N
515+           PRINT   OFF
525+           PRINT   ON
526            LA      R9,L0360
527            BAL     R8,PACCTPAY
528 *
529 *          UPDATE  HEADER DATA
530 *
531 L0390      PACK    WORK1(2),HITMCNT(3)
532            AP      WORK1(2),=P'1'
533            UNPK    HITMCNT(3),WORK1(2)
534            OI      HITMCNT+2,X'F0'            FIX  SIGN
535            AP      HITMTOT(5),AIAMT(5)
536            PACK    WORK1(3),HITEMS(4)
537            AP      WORK1(3),=P'1'
538            UNPK    HITEMS(4),WORK1(3)         NUMBER  OF  ITEMS
539            OI      HITEMS+3,X'F0'             FIX  SIGN
540            LA      R10,ULLINE(,R10)
541            L       R9,PROLINE
542            LA      R9,PLLINE(,R9)
543            ST      R9,PROLINE
544            CLI     LAST,C'Y'                  LAST  ITEM
545            BE      L0400
546            BCT     R6,L0325
547 ************************************************************************
548 *          SETUP NEXT ACTION
549 ************************************************************************
550 L0400      CLI     ERR,C'Y'
551            BE      L9000                       FORMAT  AND  OUT
552                                                                  Y$STRAIL  O
553+           PRINT   OFF
563+           PRINT   ON
564            MVI     HERRCDE,C' '
565            CP      HITMTOT(5),HAMOUNT(5)
566            BE      L0420
567            OI      HERRCDE,X'F1'              ITEM  TOTAL  NOT  =  CHECK
568 L0420      CP      HCASH(5),=P'0'
569            BE      L0440
570            OI      HERRCDE,X'F2'              CSH  NOT  =  0
571 L0440      CP      HACCR(5),=P'0'
572            BE      L0460
573            OI      HERRCDE,X'F4'              ACCRUAL  NOT  =  0
574 *
575 ********   DETERMINE SUCCESSOR
576 *
577 L0460      CLI     LAST,C'Y'              LAST  ITEM?
578            BE      L0480                  YES
579            MVI     ZA#PSIND,C'0'            EXPECT  MORE  ITEM  NEXT  SCREEN
580            MVC     ZA#PSID(6),=C'APITMS'
581            MVC     OMA+4(6),=C'APITS '    TRANSACTION  CODE
582            MVC     ZA#OTL(2),=H'14'       LENGTH
583            B       L0520
584 L0480      CLI     HERRCDE,C' '
585            BE      L0500
586            MVI     ZA#PSIND,C'0'            BALANCE  ERRORS-CORRECT  CHECK
587            MVC     ZA#PSID(6),=C'APCHKS'
588            MVC     ZA#OTL(2),=Y(0+LMSG11+8)    LENGTH
589            MVC     OMA+4(LMSG11),MSG11      APCKS  TRANSACTION
590            MVC     OMA+4+DM11A(1),HTYPE
```

Figure C-11. APITMS Action Program Processing a Dialog (Part 8 of 29)

```
         MVC   OMA+4+DM11B(5),HCHECK
         MVC   HITMCNT(3),=C'001'
         MVI   HACTION,C'C'              CHANGE
         MVI   HCOMPL,C' '
         B     L0520
*
*
*
L0500    EQU   *
         AP    HBATOT(5),HAMOUNT(5)    ADD CHECK TO BATCH TOTAL
         CLI   HACTION,C'C'              CHANGE?
         BNE   L0505                     NO
         SP    HBATOT(5),HOLD(5)         CORRECT FOR PREVIOUS AMOUNT
L0505    CLI   REVIEW,C'R'               REVIEW ITEMS?
         BNE   L0510                      NO
         MVI   ZA#PSIND,C'D'            DELAYED INTERNAL SUCCESSION
         MVC   ZA#PSID(6),=C'APAUDT'
         MVC   OMA+4(LMSG12),MSG12        MESSAGE FOR APAUD
         MVC   OMA+4+DM12A(1),HTYPE       CHECK TYPE
         MVC   OMA+4+DM12B(5),HCHECK      CHECK #
         MVC   ZA#OTL(2),=Y(0+LMSG12+8) LENGTH
         B     L0515
L0510    CLI   HPRINT,C'N'
         BNE   L0515
L0512    MVI   ZA#PSIND,C'D'
         MVC   ZA#PSID(6),=C'APCHKS'
         MVC   OMA+4(6),=C'APCKS '    TRANSACTION CODE
         MVC   ZA#OTL(2),=H'14'       LENGTH
L0515    CLI   HACTION,C'A'             ADD/
         BNE   L0518
         PACK  WORK1(2),HCHKS(3)        ADD 1 TO # OF CHECKS
         AP    WORK1(2),=P'1'
         UNPK  HCHKS(3),WORK1(2)
         OI    HCHKS+2,X'F0'
L0518    MVI   HCOMPL,C'C'              COMPLETE
L0520    MVC   KACCTPAY(15),BLANKS
         MVC   KACCTPAY(2),=C'AP'
         LA    R9,EMSG2
         BAL   R8,UACCTPAY
         MVC   RACCTPAY(165),ACCTPAYH
         LA    R9,EMSG2
         BAL   R8,PACCTPAY
L0540    CLI   ZA#PSIND,C'N'             SUCCESSOR?
         BNE   TERM                      YES-TERM
*
*************** CHECK AMOUNT TRANSLATION
*
*
L0600    MVC   KACCTPAY(15),BLANKS       SETUP CHECK PRINT
         MVC   KACCTPAY(2),=C'AC'
         MVC   KACCTPAY+2(6),HTYPE
L0610    LA    R9,EMSG5                  NOT FOUND
         BAL   R8,GACCTPAY               GET CHECK
         MVC   ACCTPAYC(165),RACCTPAY    MOVE TO CHECK AREA
                                                    YS$TRAIL P
         PRINT OFF
         PRINT ON
         CLI   CPRINT,C'N'               NO PRINT?
         BE    L0510
         CP    CAMOUNT(5),=P'0'          NEGATIVE OR ZERO CHECK?
```

Figure C-11. APITMS Action Program Processing a Dialog (Part 9 of 29)

```
                BNH    L0510
                B      L0620
                DC     0Y(0)
                EXTRN  CKGD50
                ENTRY  NMERA
                ENTRY  ALP1
                ENTRY  ALP2
                ENTRY  IDN
NMERA           DC     PL8'0'                    AMOUNT
ALP1            DC     CL50' '                   LINE 1
ALP2            DC     CL50' '                   LINE 2
IDN             DC     C'2'
                DS     0F
L0620           EQU    *
                ZAP    NMERA(8),CAMOUNT(5)
                L      R15,=A(CKGD50)
                BALR   R14,R15
                LTR    R15,R15
                BNZ    EMSG7                     ERRORS
                MVC    PAY10(50),ALP1
                MVC    PAY20(50),ALP2
                MVC    LEGENDO(25),CLEGEND
                MVC    VENDORO(5),CVENDOR
                MVC    CHECKO(5),KACCTPAY+3
                MVC    NAMEO(26),CNAME
                MVC    ADDR10(25),CADDR1
                UNPK   WORK1(7),CDATE(4)
                MVC    DATEO(6),WORK1+1
                MVC    WORK1(14),=X'5C206B2020206B2021204B202060'
                ED     WORK1(14),CAMOUNT
                MVC    AMOUNTO(13),WORK1+1
                CLI    AMOUNTO+12,C'*'          * FROM EDIT
                BNE    L0630                    NO-LEAVE IT
                MVI    AMOUNTO+12,C' '          BLANK IT
L0630           CLC    CADDR2(25),BLANKS        ADDRESS 2?
                BE     L0640                    NO
                MVC    ADDR20(25),CADDR2
                MVC    CITYO(25),CCITY
                MVI    CITYO+18,C' '
                B      L0660
L0640           MVC    ADDR20(25),CCITY
                MVC    CITYO(25),BLANKS
L0660           CP     CZIP(3),=P'0'            ZIP CODE?
                BE     L0680
                UNPK   CITYO+19(5),CZIP(3)
L0680           EQU    *
                MVI    CITYO+25,X'0C'           FORM FEED(TOP OF PAGE)
                MVI    CITYO+26,X'FF'
                MVC    UTRAN(6),=C'APCKS '      TRANSACTION CODE
                MVC    UTRAN+6(4),BLANKS
                MVI    UTRAN+10,X'FF'
                MVI    PSTART,C':'
                MVC    PSTART+1(4),PSTART
                MVI    FILL,C' '
                YSSOUT 13
                LA     R0,13 .SCREEN NUMBER
                BAL    R8,MOVEOUT .SCREEN AND DATA
                B      TERM
*****************************************************************
*                OUTPUT SCREEN
*****************************************************************
```

Figure C-11. APITMS Action Program Processing a Dialog (Part 10 of 29)

```
721 L9000       EQU   *
722                                                                   YS$TRAIL Q
723+            PRINT OFF
733+            PRINT ON
734             YS$OUT 12
735+            LA     R0,12 .SCREEN NUMBER
736+            BAL    R8,MOVEOUT .SCREEN AND DATA
737                                                                   YS$TRAIL R
738+            PRINT OFF
748+            PRINT ON
749             B      TERM
750             YS$IOSTS                           .I/O STATUS
752+*********************************************************************
753+**                  INTERNAL ROUTINES                                *
754+*********************************************************************
755+**
756+*************** CHECK FILE I/O STATUS
757+**
758+IOSTATUS ORG   *
759+            CLI    ZA#PSC+1,0 .SUCCESSFUL?
760+            BNE    YS$IOS05 .NO
761+            MVI    IOKEY,C' ' .CLEAR KEY
762+            MVC    IOKEY+1(14),IOKEY
763+            BR     R8
764+YS$IOS05 CLI      ZA#PSC+1,1 .INVALID KEY?
765+            BER    R9
766+            CLI    ZA#PDSC+1,5 .FILE NOT DEFINED?
767+            BE     YS$IOS10
768+            CLI    ZA#PDSC+1,6 .FILE CLOSED?
769+            BNE    YS$IOS30
770+YS$IOS10 CLI      IORET,C'Y' .RETURN ON FILE NOT AVAILABLE?
771+            BNE    YS$IOS20
772+            SR     R8,R8 .FLAG FOR FILE NOT AVAILABLE
773+            BR     R9
774+YS$IOS20 MVC      OMA(LIOM2),IOM2 .FILE NOT AVAILABLE
775+            MVC    ZA#OTL(2),=Y(0+LIOM2+4)
776+            MVC    OMA+DIOM2-IOM2(20),IOFILE
777+            B      TERM
778+YS$IOSTR DC       C'0123456789ABCDEFX'
779+IOM1     DC       X'100A18011C'
780+         DC       C'INVALID FILE I/O '
781+DIOM1C   DC       CL5' ' .PIB STATUS
782+DIOM1A   DC       CL21' ' .FILE NAME
783+DIOM1B   DC       CL17' ' .FILE KEY
784+         DC       C'CALL ISD'
785+         DC       X'1D10020000'
786+LIOM1    EQU      *-IOM1
787+IOM2     DC       X'100A18011C'
788+DIOM2    DC       CL21' ' .FILE NAME
789+         DC       C'FILE NOT AVAILABLE'
790+         DC       X'1D10020000'
791+LIOM2    EQU      *-IOM2
792+YS$IOS30 MVC      IOSTS,ZA#PSC
793+         TR       IOSTS,YS$IOSTR .TRANSLATE TO PRINTABLE CHAR
794+         MVC      OMA(LIOM1),IOM1 .FILE NOT AVAILABLE
795+         MVC      OMA+DIOM1A-IOM1(21),IOFILE
796+         MVC      OMA+DIOM1B-IOM1(16),IOKEY
797+         MVC      OMA+DIOM1C-IOM1(4),IOSTS
798+         MVC      ZA#OTL(2),=Y(0+LIOM1+4)
799+         B        SNAP
```

Figure C-11. APITMS Action Program Processing a Dialog (Part 11 of 29)

```
                YS$MVIN                          .GET IMA DATA
+*
+************** MOVE IMA DATA TO SCREEN WORK AREA
+*
+MOVEIN    ST     R0,SCREEN# .SCREEN NUMBER
+          MVC    IOKEY(4),SCREEN# .SCREEN NUMBER
+          MVI    IOKEY+4,C'G' .GET
+          MVI    IOFILE,C' '
+          MVC    IOFILE+1(19),IOFILE .CLEAR TO SPACES
+          MVC    IOFILE(13),=C'SCREEN FORMAT' .FILE NAME
+          ZG#CALL MSGIN,(SCRNUM,IN$MSG)
+          DS     0H
+          LA     15,SCRNUM
+          ST     15,PLIST+4*(1-1)
+          LA     15,IN$MSG
+          ST     15,PLIST+4*(2-1)
+          OI     PLIST+4*(2-1),X'80'
+          LA     1,PLIST
+          L      15,=V(MSGIN)
+          BALR   14,15
+          LA     R9,ABTERM .I/O ERROR ADDRESS
+          B      IOSTATUS .CHECK I/O STATUS
           YS$MVOUT                              .PUT OMA DATA
+*
+************** MOVE DATA FROM SCREEN WORK AREA TO OMA
+*
+MOVEOUT   ST     R0,SCREEN# .SCREEN NUMBER
+          MVC    IOKEY(4),SCREEN# .SCREEN NUMBER
+          MVI    IOKEY+4,C'P' .PUT
+          MVI    IOFILE,C' '
+          MVC    IOFILE+1(19),IOFILE .CLEAR TO SPACES
+          MVC    IOFILE(13),=C'SCREEN FORMAT' .FILE NAME
+          ZG#CALL MSGOUT,(SCRNUM,OUT$MSG,PDATA) .SCREEN AND DATA
+          DS     0H
+          LA     15,SCRNUM
+          ST     15,PLIST+4*(1-1)
+          LA     15,OUT$MSG
+          ST     15,PLIST+4*(2-1)
+          LA     15,PDATA
+          ST     15,PLIST+4*(3-1)
+          OI     PLIST+4*(3-1),X'80'
+          LA     1,PLIST
+          L      15,=V(MSGOUT)
+          BALR   14,15
+          B      YS$MO010
+MOVEOUTS  ST     R0,SCREEN#
+          MVC    IOKEY(4),SCREEN# .SCREEN NUMBER
+          MVI    IOKEY+4,C'P' .PUT
+          MVI    IOFILE,C' '
+          MVC    IOFILE+1(19),IOFILE .CLEAR TO SPACES
+          MVC    IOFILE(13),=C'SCREEN FORMAT' .FILE NAME
+          ZG#CALL MSGOUT,(SCRNUM)          .SCREEN ONLY (NO DATA)
+          DS     0H
+          LA     15,SCRNUM
+          ST     15,PLIST+4*(1-1)
+          OI     PLIST+4*(1-1),X'80'
+          LA     1,PLIST
+          L      15,=V(MSGOUT)
+          BALR   14,15
+YS$MO010  LA     R9,ABTERM .I/O ERROR ADDRESS
```

Figure C-11. APITMS Action Program Processing a Dialog (Part 12 of 29)

```
         B      IOSTATUS .CHECK I/O STATUS
 ACCTPAY YS$GET 15
*
*               GET
*
GACCTPAY MVC    IOKEY(15),KACCTPAY .SAVE KEY
         MVI    IOKEY+15,C'G' .TYPE OF I/O
         ZG#CALL GET,(&FIL.,R&FIL.,K&FIL.)
         DS     0H
         LA     15,ACCTPAY
         ST     15,PLIST+4*(1-1)
         LA     15,RACCTPAY
         ST     15,PLIST+4*(2-1)
         LA     15,KACCTPAY
         ST     15,PLIST+4*(3-1)
         OI     PLIST+4*(3-1),X'80'
         LA     1,PLIST
         L      15,=V(GET)
         BALR   14,15
         AI     #GET,1 .INCREMENT IO COUNT
         MVC    IOFILE(20),ACCTPAY+8 .SAVE FILE
         B      IOSTATUS .CHECK I/O STATUS
 ACCTPAY YS$READ 15
*
*               READ (SEQUENTIAL GET)
*
NACCTPAY MVC    IOKEY(15),KACCTPAY .SAVE KEY
         MVI    IOKEY+15,C'N' .TYPE OF I/O
         ZG#CALL GET,(&FIL.,R&FIL.)
         DS     0H
         LA     15,ACCTPAY
         ST     15,PLIST+4*(1-1)
         LA     15,RACCTPAY
         ST     15,PLIST+4*(2-1)
         OI     PLIST+4*(2-1),X'80'
         LA     1,PLIST
         L      15,=V(GET)
         BALR   14,15
         AI     #GET,1 .INCREMENT IO COUNT
         MVC    IOFILE(20),ACCTPAY+8 .SAVE FILE
         B      IOSTATUS .CHECK I/O STATUS
 ACCTPAY YS$GETUP 15
*
*               GETUP
*
UACCTPAY MVC    IOKEY(15),KACCTPAY .SAVE KEY
         MVI    IOKEY+15,C'U' .TYPE OF I/O
         ZG#CALL GETUP,(&FIL.,R&FIL.,K&FIL.)
         DS     0H
         LA     15,ACCTPAY
         ST     15,PLIST+4*(1-1)
         LA     15,RACCTPAY
         ST     15,PLIST+4*(2-1)
         LA     15,KACCTPAY
         ST     15,PLIST+4*(3-1)
         OI     PLIST+4*(3-1),X'80'
         LA     1,PLIST
         L      15,=V(GETUP)
         BALR   14,15
         AI     #GETUP,1 .INCREMENT IO COUNT
```

Figure C-11. APITMS Action Program Processing a Dialog (Part 13 of 29)

```
                MVC    IOFILE(20),ACCTPAY+8 .SAVE FILE
                B      IOSTATUS .CHECK I/O STATUS
      ACCTPAY   Y$$PUT 15
*
*                      PUT
*
      PACCTPAY  MVC    IOKEY(15),KACCTPAY .SAVE KEY
                MVI    IOKEY+15,C'P' .TYPE OF I/O
                ZG#CALL PUT,(&FIL.,R&FIL.)
                DS     0H
                LA     15,ACCTPAY
                ST     15,PLIST+4*(1-1)
                LA     15,RACCTPAY
                ST     15,PLIST+4*(2-1)
                OI     PLIST+4*(2-1),X'80'
                LA     1,PLIST
                L      15,=V(PUT)
                BALR   14,15
                AI     #PUT,1 .INCREMENT IO COUNT
                MVC    IOFILE(20),ACCTPAY+8 .SAVE FILE
                B      IOSTATUS .CHECK I/O STATUS
      ACCTPAY   Y$$INSRT 15
*
*                      INSERT
*
      IACCTPAY  MVC    IOKEY(15),KACCTPAY .SAVE KEY
                MVI    IOKEY+15,C'I' .TYPE OF I/O
                ZG#CALL INSERT,(&FIL.,R&FIL.)
                DS     0H
                LA     15,ACCTPAY
                ST     15,PLIST+4*(1-1)
                LA     15,RACCTPAY
                ST     15,PLIST+4*(2-1)
                OI     PLIST+4*(2-1),X'80'
                LA     1,PLIST
                L      15,=V(INSERT)
                BALR   14,15
                AI     #INSERT,1 .INCREMENT IO COUNT
                MVC    IOFILE(20),ACCTPAY+8 .SAVE FILE
                B      IOSTATUS .CHECK I/O STATUS
      ACCTPAY   Y$$SETLK 15
*
*                      SET SEQUENTIAL MODE BY SPECIFIED KEY
*
      SACCTPAY  MVC    IOKEY(15),KACCTPAY .SAVE KEY
                MVI    IOKEY+15,C'S' .TYPE OF I/O
                ZG#CALL SETL,(&FIL.,POSITION,K&FIL.)
                DS     0H
                LA     15,ACCTPAY
                ST     15,PLIST+4*(1-1)
                LA     15,POSITION
                ST     15,PLIST+4*(2-1)
                LA     15,KACCTPAY
                ST     15,PLIST+4*(3-1)
                OI     PLIST+4*(3-1),X'80'
                LA     1,PLIST
                L      15,=V(SETL)
                BALR   14,15
                MVC    IOFILE(20),ACCTPAY+8 .SAVE FILE
                B      IOSTATUS .CHECK I/O STATUS
```

Figure C-11. APITMS Action Program Processing a Dialog (Part 14 of 29)

```
 ACCTPAY  Y$$ESETL 15
+*
+*                SET RANDOM MODE
+*
+EACCTPAY MVC     IOKEY(15),KACCTPAY .SAVE KEY
+         MVI     IOKEY+15,C'E' .TYPE OF I/O
+         ZG#CALL ESETL,(&FIL.)
+         DS      0H
+         LA      15,ACCTPAY
+         ST      15,PLIST+4*(1-1)
+         OI      PLIST+4*(1-1),X'80'
+         LA      1,PLIST
+         L       15,=V(ESETL)
+         BALR    14,15
+         MVC     IOFILE(20),ACCTPAY+8 .SAVE FILE
+         B       IOSTATUS .CHECK I/O STATUS
 ACCOUNT  Y$$GET 8
+*
+*                GET
+*
+GACCOUNT MVC     IOKEY(8),KACCOUNT .SAVE KEY
+         MVI     IOKEY+8,C'G' .TYPE OF I/O
+         ZG#CALL GET,(&FIL.,R&FIL.,K&FIL.)
+         DS      0H
+         LA      15,ACCOUNT
+         ST      15,PLIST+4*(1-1)
+         LA      15,RACCOUNT
+         ST      15,PLIST+4*(2-1)
+         LA      15,KACCOUNT
+         ST      15,PLIST+4*(3-1)
+         OI      PLIST+4*(3-1),X'80'
+         LA      1,PLIST
+         L       15,=V(GET)
+         BALR    14,15
+         AI      #GET,1 .INCREMENT IO COUNT
+         MVC     IOFILE(20),ACCOUNT+8 .SAVE FILE
+         B       IOSTATUS .CHECK I/O STATUS
 BRANCHM  Y$$GET 3
+*
+*                GET
+*
+GBRANCHM MVC     IOKEY(3),KBRANCHM .SAVE KEY
+         MVI     IOKEY+3,C'G' .TYPE OF I/O
+         ZG#CALL GET,(&FIL.,R&FIL.,K&FIL.)
+         DS      0H
+         LA      15,BRANCHM
+         ST      15,PLIST+4*(1-1)
+         LA      15,RBRANCHM
+         ST      15,PLIST+4*(2-1)
+         LA      15,KBRANCHM
+         ST      15,PLIST+4*(3-1)
+         OI      PLIST+4*(3-1),X'80'
+         LA      1,PLIST
+         L       15,=V(GET)
+         BALR    14,15
+         AI      #GET,1 .INCREMENT IO COUNT
+         MVC     IOFILE(20),BRANCHM+8 .SAVE FILE
+         B       IOSTATUS .CHECK I/O STATUS
 ACCTMST  Y$$GET 8
+*
+*                GET
```

Figure C-11. APITMS Action Program Processing a Dialog (Part 15 of 29)

```
+*
+GACCTMST MVC   IOKEY(8),KACCTMST .SAVE KEY
+         MVI   IOKEY+8,C'G' .TYPE OF I/O
+         ZG#CALL GET,(&FIL.,R&FIL.,K&FIL.)
+         DS    0H
+         LA    15,ACCTMST
+         ST    15,PLIST+4*(1-1)
+         LA    15,RACCTMST
+         ST    15,PLIST+4*(2-1)
+         LA    15,KACCTMST
+         ST    15,PLIST+4*(3-1)
+         OI    PLIST+4*(3-1),X'80'
+         LA    1,PLIST
+         L     15,=V(GET)
+         BALR  14,15
+         AI    #GET,1 .INCREMENT IO COUNT
+         MVC   IOFILE(20),ACCTMST+8 .SAVE FILE
+         B     IOSTATUS .CHECK I/O STATUS
 PAYROLL  Y$$GET 4
+*
+*              GET
+*
+GPAYROLL MVC   IOKEY(4),KPAYROLL .SAVE KEY
+         MVI   IOKEY+4,C'G' .TYPE OF I/O
+         ZG#CALL GET,(&FIL.,R&FIL.,K&FIL.)
+         DS    0H
+         LA    15,PAYROLL
+         ST    15,PLIST+4*(1-1)
+         LA    15,RPAYROLL
+         ST    15,PLIST+4*(2-1)
+         LA    15,KPAYROLL
+         ST    15,PLIST+4*(3-1)
+         OI    PLIST+4*(3-1),X'80'
+         LA    1,PLIST
+         L     15,=V(GET)
+         BALR  14,15
+         AI    #GET,1 .INCREMENT IO COUNT
+         MVC   IOFILE(20),PAYROLL+8 .SAVE FILE
+         B     IOSTATUS .CHECK I/O STATUS
 TABLEMT  Y$$GET 8
+*
+*              GET
+*
+GTABLEMT MVC   IOKEY(8),KTABLEMT .SAVE KEY
+         MVI   IOKEY+8,C'G' .TYPE OF I/O
+         ZG#CALL GET,(&FIL.,R&FIL.,K&FIL.)
+         DS    0H
+         LA    15,TABLEMT
+         ST    15,PLIST+4*(1-1)
+         LA    15,RTABLEMT
+         ST    15,PLIST+4*(2-1)
+         LA    15,KTABLEMT
+         ST    15,PLIST+4*(3-1)
+         OI    PLIST+4*(3-1),X'80'
+         LA    1,PLIST
+         L     15,=V(GET)
+         BALR  14,15
+         AI    #GET,1 .INCREMENT IO COUNT
+         MVC   IOFILE(20),TABLEMT+8 .SAVE FILE
+         B     IOSTATUS .CHECK I/O STATUS
```

Figure C-11. APITMS Action Program Processing a Dialog (Part 16 of 29)

```
                YSSNOW                                  .DATE/TIME
+*
+**************  DATE AND TIME STAMP  ***********************************
+*
+DAYTIME        ORG    *
+               GETIME S
+               DS     0H
+               SR     1,1
+               SVC    7
+               ST     R0,WORK1 .DATE-0YYMMDD+
+               UNPK   WORK1+4(7),WORK1(4)
+               MVC    YYMMDD(6),WORK1+5
+               OI     YYMMDD+5,X'F0' .FIX SIGN
+               ST     R1,WORK1 .TIME-0HHMMSS+
+               UNPK   WORK1+4(7),WORK1(4)
+               MVC    HHMMSS(6),WORK1+5
+               OI     HHMMSS+5,X'F0' .FIX SIGN
+               BR     R7 .RETURN REGISTER
                YSSRJ                                   .RIGHT JUSTIFY
+*
+**************  RIGHT JUSTIFY  *****************************************
+*
+*
+*                      R0  = FIELD LENGTH
+*                      R1  = FIELD ADDRESS
+*                      R15 = RETURN STATUS
+*
+RJ1            LA     R0,1 .SET LENGTH
+               B      RJ
+RJ2            LA     R0,2 .SET LENGTH
+               B      RJ
+RJ3            LA     R0,3 .SET LENGTH
+               B      RJ
+RJ4            LA     R0,4 .SET LENGTH
+               B      RJ
+RJ5            LA     R0,5 .SET LENGTH
+               B      RJ
+RJ6            LA     R0,6 .SET LENGTH
+               B      RJ
+RJ7            LA     R0,7 .SET LENGTH
+               B      RJ
+RJ8            LA     R0,8 .SET LENGTH
+               B      RJ
+RJ9            LA     R0,9 .SET LENGTH
+               B      RJ
+RJ10           LA     R0,10 .SET LENGTH
+               B      RJ
+RJ11           LA     R0,11 .SET LENGTH
+               B      RJ
+RJ             ST     R7,RJSAVE .SAVE RETURN ADDRESS
+               LA     R13,SAVE .PROGRAM SAVE AREA
+               DC     0Y(0)
+               EXTRN  MODRJ1 .RIGHT JUSTIFY MODULE
+               L      R15,=A(MODRJ1)
+               BALR   R14,R15 .BRANCH TO RJ
+               L      R7,RJSAVE .RESTORE RETURN ADDRESS
+               LTR    R15,R15 .SET CONDITION CODE FOR ERRORS
+               BR     R7 .RETURN TO CALL
 APITMS         YSSSNAP                                 .SNAP DUMP
```

Figure C-11. APITMS Action Program Processing a Dialog (Part 17 of 29)

```
+*
+*************** SNAP DUMP OF ACTION PROGRAM ***************************
+*
+SNAPIT   ORG    *
+     ZG#CALL SNAP,(ZA#DPIB,EP,ZA#IMH,EI,WORK,EW,ZA#OMH,EO,ENAM.,YSSE)
+         DS     OH
+         LA     15,ZA#DPIB
+         ST     15,PLIST+4*(1-1)
+         LA     15,EP
+         ST     15,PLIST+4*(2-1)
+         LA     15,ZA#IMH
+         ST     15,PLIST+4*(3-1)
+         LA     15,EI
+         ST     15,PLIST+4*(4-1)
+         LA     15,WORK
+         ST     15,PLIST+4*(5-1)
+         LA     15,EW
+         ST     15,PLIST+4*(6-1)
+         LA     15,ZA#OMH
+         ST     15,PLIST+4*(7-1)
+         LA     15,EO
+         ST     15,PLIST+4*(8-1)
+         LA     15,APITMS
+         ST     15,PLIST+4*(9-1)
+         LA     15,YSSE
+         ST     15,PLIST+4*(10-1)
+         OI     PLIST+4*(10-1),X'80'
+         LA     1,PLIST
+         L      15,=V(SNAP)
+         BALR   14,15
+         BR     R7 .RETURN REGISTER
          YSSTERM                       .PROGRAM TERMINATION
+*************************************************************************
+*                    PROGRAM TERMINATION                                *
+*************************************************************************
+TERM     CLI    ISNAP,C'N' .REQUEST NORMAL TERMINATION WITH SNAP?
+         BE     SNAP .YES
+         CLI    ISNAP,C'S' .REQUEST ABNORMAL TERMINATION WITH SNAP?
+         BNE    FINISH .NO-NORMAL TERMINATION
+ABTERM   MVI    ZA#PSIND,C'S' .TERMINATE WITH SNAP DUMP
+         B      FINISH
+SNAP     GETIME M
+SNAP     DS     OH
+         LA     1,1
+         SVC    7
+         ST     R1,ETIMS
+        ZG#CALL SNAP,(ZA#DPIB,EP,ZA#IMH,EI,WORK,EW,ZA#OMH,EO,YSSB,YSSE)
+         DS     OH
+         LA     15,ZA#DPIB
+         ST     15,PLIST+4*(1-1)
+         LA     15,EP
+         ST     15,PLIST+4*(2-1)
+         LA     15,ZA#IMH
+         ST     15,PLIST+4*(3-1)
+         LA     15,EI
+         ST     15,PLIST+4*(4-1)
+         LA     15,WORK
+         ST     15,PLIST+4*(5-1)
+         LA     15,EW
```

Figure C-11. APITMS Action Program Processing a Dialog (Part 18 of 29)

```
+          ST     15,PLIST+4*(6-1)
+          LA     15,ZA#OMH
+          ST     15,PLIST+4*(7-1)
+          LA     15,EO
+          ST     15,PLIST+4*(8-1)
+          LA     15,Y$$B
+          ST     15,PLIST+4*(9-1)
+          LA     15,Y$$E
+          ST     15,PLIST+4*(10-1)
+          OI     PLIST+4*(10-1),X'80'
+          LA     1,PLIST
+          L      15,=V(SNAP)
+          BALR   14,15
+FINISH    GETIME M
+FINISH    DS     0H
+          LA     1,1
+          SVC    7
+          ST     R1,ETIM$  .ENDING TIME
+          ZG#CALL RETURN       .RETURN CONTROL TO IMS
+          DS     0H
+          L      15,=V(RETURN)
+          BALR   14,15
           Y$$MSG 1
+EMSG1     MVC    OMA(LMSG1),MSG1
+          MVC    ZA#OTL(2),=Y(0+LMSG1+4)
+          B      TERM
           Y$$MSG 2
+EMSG2     MVC    OMA(LMSG2),MSG2
+          MVC    ZA#OTL(2),=Y(0+LMSG2+4)
+          B      TERM
           Y$$MSG 3
+EMSG3     MVC    OMA(LMSG3),MSG3
+          MVC    ZA#OTL(2),=Y(0+LMSG3+4)
+          B      TERM
           Y$$MSG 4
+EMSG4     MVC    OMA(LMSG4),MSG4
+          MVC    ZA#OTL(2),=Y(0+LMSG4+4)
+          B      TERM
           Y$$MSG 5
+EMSG5     MVC    OMA(LMSG5),MSG5
+          MVC    ZA#OTL(2),=Y(0+LMSG5+4)
+          B      TERM
           Y$$MSG 7
+EMSG7     MVC    OMA(LMSG7),MSG7
+          MVC    ZA#OTL(2),=Y(0+LMSG7+4)
+          B      TERM
           Y$$MSG 10
+EMSG10    MVC    OMA(LMSG10),MSG10
+          MVC    ZA#OTL(2),=Y(0+LMSG10+4)
+          B      TERM
 ***********************************************************************
 *                    CONSTANTS
 ***********************************************************************
 ACCTPAY   DC     C'ACCTPAY ACCOUNTS PAYABLE       '
 ACCOUNT   DC     C'ACCOUNT CHART OF ACCOUNTS      '
 BRANCHM   DC     C'BRANCHM BRANCH MASTER          '
 ACCTMST   DC     C'ACCTMST ACCOUNT SUMMARY MST    '
 PAYROLL   DC     C'PAYROLL PAYROLL MASTER         '
 TABLEMT   DC     C'TABLEMT SECURITY AND CODE      '
 BLANKS    DC     CL80' '
```

Figure C-11. APITMS Action Program Processing a Dialog (Part 19 of 29)

```
MSG1     DC    X'100A18011C'
         DC    C'USE "TRAN UNPROT DISPL"'
         DC    X'1D1002000J'
LMSG1    EQU   *-MSG1
*
MSG2     DC    X'100A18011C'
         DC    C'AP HEADER NOT FOUND. CONTACT ISD'
         DC    X'1D10020000J'
LMSG2    EQU   *-MSG2
*
MSG3     DC    X'100A18011C'
         DC    C'AP SETLL ERROR'
         DC    X'1D10020000'
LMSG3    EQU   *-MSG3
*
MSG4     DC    X'100A18011C'
         DC    C'ITEM NOT FOUND'
         DC    X'1D10020000'
LMSG4    EQU   *-MSG4
*
MSG5     DC    X'100A18011C'
         DC    C'CHECK NOT FOUND'
         DC    X'1D10020000'
LMSG5    EQU   *-MSG5
*
MSG7     DC    X'100A18011C'
         DC    C'CHECK AMOUNT CANNOT BE TRANSLATED'
         DC    X'1D10020000'
LMSG7    EQU   *-MSG7
*
MSG10    DC    X'100A18011C'
         DC    C'AP ITEMS'
         DC    X'1D10020000'
LMSG10   EQU   *-MSG10
*
MSG11    DC    C'APCKS '
         DC    X'3F3F'
         DC    C'X'                          CHANGE
         DC    X'3F3F'
M11A     DC    X'05'
         DC    X'3F'
M11B     DC    CL5' '
         DC    X'3FC5'
LMSG11   EQU   *-MSG11
DM11A    EQU   M11A-MSG11
DM11B    EQU   M11B-MSG11
*
MSG12    DC    C'APAUD '
         DC    CL3' '
         DC    X'3F'
M12A     DC    CL4' '                        CHECK TYPE
         DC    X'3F'
M12B     DC    CL5' '                        CHECK #
         DC    X'3F'
         DC    CL2' '
LMSG12   EQU   *-MSG12
DM12A    EQU   M12A-MSG12
DM12B    EQU   M12B-MSG12
*
         PRINT GEN
```

Figure C-11. APITMS Action Program Processing a Dialog (Part 20 of 29)

```
1340          YSSPIB                                        .PROGRAM INFORMATION BLOCK
1341+***************************************************************************************
1342+*                 LITERAL POOL                                                        *
1343+***************************************************************************************
1344+         LTORG
1345+                  =C'0000'
1346+                  =A(CKGD50)
1347+                  =V(MSGIN)
1348+                  =V(MSGOUT)
1349+                  =V(GET)
1350+                  =V(GETUP)
1351+                  =V(PUT)
1352+                  =V(INSERT)
1353+                  =V(SETL)
1354+                  =V(ESETL)
1355+                  =A(MODRJ1)
1356+                  =V(SNAP)
1357+                  =V(RETURN)
1358+                  =Y(0+LYSSM1+4)
1359+                  =Y(IMA1-USTART)
1360+                  =Y(UACCT1-USTART+1)
1361+                  =C'AC'
1362+                  =C'AP'
1363+                  =X'40206B202020206B2021204B202C60'
1364+                  =C'AI'
1365+                  =C'APITMS'
1366+                  =C'APITS '
1367+                  =H'14'
1368+                  =C'APCHKS'
1369+                  =Y(0+LMSG11+8)
1370+                  =C'APAUDI'
1371+                  =Y(0+LMSG12+8)
1372+                  =C'APCKS '
1373+                  =X'5C206B202020206B2021204B202060'
1374+                  =Y(0+LIOM2+4)
1375+                  =Y(0+LIOM1+4)
1376+                  =Y(0+LMSG1+4)
1377+                  =Y(0+LMSG2+4)
1378+                  =Y(0+LMSG3+4)
1379+                  =Y(0+LMSG4+4)
1380+                  =Y(0+LMSG5+4)
1381+                  =Y(0+LMSG7+4)
1382+                  =Y(0+LMSG10+4)
1383+                  =C'APCHK'
1384+                  =C'T80'
1385+                  =C'    '
1386+                  =C'A    P'
1387+                  =C'APRNT'
1388+                  =P'1'
1389+                  =P'0'
1390+                  =C'T10'
1391+                  =C'CC1'
1392+                  =C'SCREEN FORMAT'
1393+YSSE     EQU     * .END OF PROGRAM
1516 WORK     YSSWORK                                        .WORK AREA
1517+***************************************************************************************
1518+*                 WORK AREA                                                           *
1519+***************************************************************************************
```

Figure C-11. APITMS Action Program Processing a Dialog (Part 21 of 29)

```
+WORK      DSECT
+STIM$     DS      A .START TIME (MILLISECONDS)
+ETIM$     DS      A .END TIME (MILLISECONDS)
+#GET      DS      H .NUMBER OF GET
+#GETUP    DS      H .          GETUP
+#PUT      DS      H .          PUT
+#INSERT   DS      H .          INSERT
+SAVE      DS      18F .PROGRAM SAVE AREA
+PLIST     DS      4A .PARAMETER LIST FOR "CALLS"
+WHO       DS      CL3 .USER INITIALS
+WORK1     DS      2D .WORK FIELD
+PASSKEY   EQU     WORK1,5 .SECURITY RECORD FILE KEY
+IOFILE    DS      CL20 .LAST FILE I/O
+IOKEY     DS      CL20 .LAST FILE I/O KEY
+IOSTS     DS      CL4 .LAST FILE I/O STATUS
+IORET     DS      CL1 .FILE NOT AVAILABLE-RETURN
+ERR       DS      CL1 .ERROR FLAG
+YYMMDD    DS      CL6 .DATE
+HHMMSS    DS      CL6 .TIME
 RJSAVE    DS      A
 EXPENS    DS      CL1
 INCOME    DS      CL1
 PROLINE   DS      A
 POSITION  DS      CL1
 LAST      DS      CL1
 BRCH      DS      CL4
 DESCPTH   DS      CL30
 REVIEW    DS      CL1
 TRAILS    DS      CL250
 TRAILS1   DS      A
 TRAILS2   DS      A
           Y$$SWORK                           .SDMPS WORK SPACE
+*
+************** SDMPS WORK AREA **************************************
+*
+SCRNUM    DS      D .SCREEN NUMBER
+SCREEN#   EQU     SCRNUM+4,4
+SCREENW   DS      CL180 .SCREEN WORK AREA
+MAXITL    EQU     SCREENW,2 .MAXIMUM INPUT TEXT LENGTH
+*
+************** SDMPS I/O AREAS
+*
+UDATA     EQU     *
+OUT$MSG   EQU     * .OUTPUT MESSAGE DATA
+FILL      DS      CL1 .OUTPUT FILL CHARACTER
+IN$MSG    EQU     * .INPUT MESSAGE DATA
 *
 ************* UNPROTECTED DATA
 *
 USTART    EQU     *
 UTRAN     DS      CL5                        .TRANSACTION CODE
 USNAP     DS      CL1                        .SNAP CODE
 USLINE    EQU     *                          .START OF LINE ITEM UNPROT
 IMA1      EQU     *
 UACCT1    DS      CL8                        .ACCOUNT NUMBER
 UAMT1     DS      CL10                       .AMOUNT
 UDESPT1   DS      CL30                       .DESCRIPTION
 UEMP1     DS      CL4                        .EMPLOYEE NUMBER
 UXMIT1    DS      CL2                        .TRANSMIT POSITION
 ULLINE    EQU     *-UACCT1                   .END OF LINE ITEM UNPROT
```

Figure C-11. APITMS Action Program Processing a Dialog (Part 22 of 29)

```
UACCT2    DS    CL8                         .ACCOUNT NUMBER
UAMT2     DS    CL10                        .AMOUNT
UDESPT2   DS    CL30                        .DESCRIPTION
UEMP2     DS    CL4                         .EMPLOYEE NUMBER
UXMIT2    DS    CL2                         .TRANSMIT POSITION
UACCT3    DS    CL8                         .ACCOUNT NUMBER
UAMT3     DS    CL10                        .AMOUNT
UDESPT3   DS    CL30                        .DESCRIPTION
UEMP3     DS    CL4                         .EMPLOYEE NUMBER
UXMIT3    DS    CL2                         .TRANSMIT POSITION
UACCT4    DS    CL8                         .ACCOUNT NUMBER
UAMT4     DS    CL10                        .AMOUNT
UDESPT4   DS    CL30                        .DESCRIPTION
UEMP4     DS    CL4                         .EMPLOYEE NUMBER
UXMIT4    DS    CL2                         .TRANSMIT POSITION
UACCT5    DS    CL8                         .ACCOUNT NUMBER
UAMT5     DS    CL10                        .AMOUNT
UDESPT5   DS    CL30                        .DESCRIPTION
UEMP5     DS    CL4                         .EMPLOYEE NUMBER
UXMIT5    DS    CL2                         .TRANSMIT POSITION
UACCT6    DS    CL8                         .ACCOUNT NUMBER
UAMT6     DS    CL10                        .AMOUNT
UDESPT6   DS    CL30                        .DESCRIPTION
UEMP6     DS    CL4                         .EMPLOYEE NUMBER
UXMIT6    DS    CL2                         .TRANSMIT POSITION
UACCT7    DS    CL8                         .ACCOUNT NUMBER
UAMT7     DS    CL10                        .AMOUNT
UDESPT7   DS    CL30                        .DESCRIPTION
UEMP7     DS    CL4                         .EMPLOYEE NUMBER
UXMIT7    DS    CL2                         .TRANSMIT POSITION
UACCT8    DS    CL8                         .ACCOUNT NUMBER
UAMT8     DS    CL10                        .AMOUNT
UDESPT8   DS    CL30                        .DESCRIPTION
UEMP8     DS    CL4                         .EMPLOYEE NUMBER
UXMIT8    DS    CL2                         .TRANSMIT POSITION
UACCT9    DS    CL8                         .ACCOUNT NUMBER
UAMT9     DS    CL10                        .AMOUNT
UDESPT9   DS    CL30                        .DESCRIPTION
UEMP9     DS    CL4                         .EMPLOYEE NUMBER
UXMIT9    DS    CL2                         .TRANSMIT POSITION
UACCT10   DS    CL8                         .ACCOUNT NUMBER
UAMT10    DS    CL10                        .AMOUNT
UDESPT10  DS    CL30                        .DESCRIPTION
UEMP10    DS    CL4                         .EMPLOYEE NUMBER
UXMIT10   DS    CL2                         .TRANSMIT POSITION
UACCT11   DS    CL8                         .ACCOUNT NUMBER
UAMT11    DS    CL10                        .AMOUNT
UDESPT11  DS    CL30                        .DESCRIPTION
UEMP11    DS    CL4                         .EMPLOYEE NUMBER
UXMIT11   DS    CL2                         .TRANSMIT POSITION
UACCT12   DS    CL8                         .ACCOUNT NUMBER
UAMT12    DS    CL10                        .AMOUNT
UDESPT12  DS    CL30                        .DESCRIPTION
UEMP12    DS    CL4                         .EMPLOYEE NUMBER
UXMIT12   DS    CL2                         .TRANSMIT POSITION
UACCT13   DS    CL8                         .ACCOUNT NUMBER
UAMT13    DS    CL10                        .AMOUNT
UDESPT13  DS    CL30                        .DESCRIPTION
UEMP13    DS    CL4                         .EMPLOYEE NUMBER
UXMIT13   DS    CL2                         .TRANSMIT POSITION
```

Figure C-11. APITMS Action Program Processing a Dialog (Part 23 of 29)

```
UACCT14   DS    CL8                        .ACCOUNT NUMBER
UAMT14    DS    CL10                       .AMOUNT
UDESPT14  DS    CL30                       .DESCRIPTION
UEMP14    DS    CL4                        .EMPLOYEE NUMBER
UXMIT14   DS    CL2                        .TRANSMIT POSITION
UACCT15   DS    CL8                        .ACCOUNT NUMBER
UAMT15    DS    CL10                       .AMOUNT
UDESPT15  DS    CL30                       .DESCRIPTION
UEMP15    DS    CL4                        .EMPLOYEE NUMBER
UXMIT15   DS    CL2                        .TRANSMIT POSITION
UACCT16   DS    CL8                        .ACCOUNT NUMBER
UAMT16    DS    CL10                       .AMOUNT
UDESPT16  DS    CL30                       .DESCRIPTION
UEMP16    DS    CL4                        .EMPLOYEE NUMBER
UXMIT16   DS    CL2                        .TRANSMIT POSITION
UACCT17   DS    CL8                        .ACCOUNT NUMBER
UAMT17    DS    CL10                       .AMOUNT
UDESPT17  DS    CL30                       .DESCRIPTION
UEMP17    DS    CL4                        .EMPLOYEE NUMBER
UXMIT17   DS    CL2                        .TRANSMIT POSITION
UACCT18   DS    CL8                        .ACCOUNT NUMBER
UAMT18    DS    CL10                       .AMOUNT
UDESPT18  DS    CL30                       .DESCRIPTION
UEMP18    DS    CL4                        .EMPLOYEE NUMBER
UXMIT18   DS    CL2                        .TRANSMIT POSITION
UACCT19   DS    CL8                        .ACCOUNT NUMBER
UAMT19    DS    CL10                       .AMOUNT
UDESPT19  DS    CL30                       .DESCRIPTION
UEMP19    DS    CL4                        .EMPLOYEE NUMBER
UXMIT19   DS    CL2                        .TRANSMIT POSITION
UACCT20   DS    CL8                        .ACCOUNT NUMBER
UAMT20    DS    CL10                       .AMOUNT
UDESPT20  DS    CL30                       .DESCRIPTION
UEMP20    DS    CL4                        .EMPLOYEE NUMBER
UXMIT20   DS    CL2                        .TRANSMIT POSITION
DAMT      EQU   UAMT1-USLINE               .DISPLACEMENT OF AMOUNT
DDESPT    EQU   UDESPT1-USLINE             .DISPLACEMENT OF DESCRIPTION
DEMP      EQU   UEMP1-USLINE               .DISPLACEMENT OF EMPLOYEE #
DXMIT     EQU   UXMIT1-USLINE              .DISPLACEMENT OF TRANSMIT
USTOP     DS    CL1
*
*************** PROTECTED REPLACEMENT
*
PDATA     EQU   *
PSTART    EQU   *
PSLINE    EQU   *                          .START OF LINE ITEM
PLIN#1    DS    CL3                        .LINE NUMBER
PCACCT1   DS    CL1                        .ACCOUNT ERROR CODE
PBACCT1   DS    CL1                        .ACCOUNT BLINKER
PCOA1     DS    CL1                        .CASH/ACCRUAL
PBAMT1    DS    CL1                        .AMOUNT BLINKER
PBDESP1   DS    CL1                        .DESCRIPTION BLINKER
PCEMP1    DS    CL1                        .EMPLOYEE ERROR CODE
PBEMP1    DS    CL1                        .EMPLOYEE BLINKER
PELINE    EQU   *                          .END OF LINE ITEM
PLLINE    EQU   PELINE-PSLINE
PLIN#2    DS    CL3                        .LINE NUMBER
PCACCT2   DS    CL1                        .ACCOUNT ERROR CODE
PBACCT2   DS    CL1                        .ACCOUNT BLINKER
PCOA2     DS    CL1                        .CASH/ACCRUAL
```

Figure C-11. APITMS Action Program Processing a Dialog (Part 24 of 29)

```
PBAMT2   DS    CL1                          .AMOUNT BLINKER
PBDESP2  DS    CL1                          .DESCRIPTION BLINKER
PCEMP2   DS    CL1                          .EMPLOYEE ERROR CODE
PBEMP2   DS    CL1                          .EMPLOYEE BLINKER
PLIN#3   DS    CL3                          .LINE NUMBER
PCACCT3  DS    CL1                          .ACCOUNT ERROR CODE
PBACCT3  DS    CL1                          .ACCOUNT BLINKER
PCOA3    DS    CL1                          .CASH/ACCRUAL
PBAMT3   DS    CL1                          .AMOUNT BLINKER
PBDESP3  DS    CL1                          .DESCRIPTION BLINKER
PCEMP3   DS    CL1                          .EMPLOYEE ERROR CODE
PBEMP3   DS    CL1                          .EMPLOYEE BLINKER
PLIN#4   DS    CL3                          .LINE NUMBER
PCACCT4  DS    CL1                          .ACCOUNT ERROR CODE
PBACCT4  DS    CL1                          .ACCOUNT BLINKER
PCOA4    DS    CL1                          .CASH/ACCRUAL
PBAMT4   DS    CL1                          .AMOUNT BLINKER
PBDESP4  DS    CL1                          .DESCRIPTION BLINKER
PCEMP4   DS    CL1                          .EMPLOYEE ERROR CODE
PBEMP4   DS    CL1                          .EMPLOYEE BLINKER
PLIN#5   DS    CL3                          .LINE NUMBER
PCACCT5  DS    CL1                          .ACCOUNT ERROR CODE
PBACCT5  DS    CL1                          .ACCOUNT BLINKER
PCOA5    DS    CL1                          .CASH/ACCRUAL
PBAMT5   DS    CL1                          .AMOUNT BLINKER
PBDESP5  DS    CL1                          .DESCRIPTION BLINKER
PCEMP5   DS    CL1                          .EMPLOYEE ERROR CODE
PBEMP5   DS    CL1                          .EMPLOYEE BLINKER
PLIN#6   DS    CL3                          .LINE NUMBER
PCACCT6  DS    CL1                          .ACCOUNT ERROR CODE
PBACCT6  DS    CL1                          .ACCOUNT BLINKER
PCOA6    DS    CL1                          .CASH/ACCRUAL
PBAMT6   DS    CL1                          .AMOUNT BLINKER
PBDESP6  DS    CL1                          .DESCRIPTION BLINKER
PCEMP6   DS    CL1                          .EMPLOYEE ERROR CODE
PBEMP6   DS    CL1                          .EMPLOYEE BLINKER
PLIN#7   DS    CL3                          .LINE NUMBER
PCACCT7  DS    CL1                          .ACCOUNT ERROR CODE
PBACCT7  DS    CL1                          .ACCOUNT BLINKER
PCOA7    DS    CL1                          .CASH/ACCRUAL
PBAMT7   DS    CL1                          .AMOUNT BLINKER
PBDESP7  DS    CL1                          .DESCRIPTION BLINKER
PCEMP7   DS    CL1                          .EMPLOYEE ERROR CODE
PBEMP7   DS    CL1                          .EMPLOYEE BLINKER
PLIN#8   DS    CL3                          .LINE NUMBER
PCACCT8  DS    CL1                          .ACCOUNT ERROR CODE
PBACCT8  DS    CL1                          .ACCOUNT BLINKER
PCOA8    DS    CL1                          .CASH/ACCRUAL
PBAMT8   DS    CL1                          .AMOUNT BLINKER
PBDESP8  DS    CL1                          .DESCRIPTION BLINKER
PCEMP8   DS    CL1                          .EMPLOYEE ERROR CODE
PBEMP8   DS    CL1                          .EMPLOYEE BLINKER
PLIN#9   DS    CL3                          .LINE NUMBER
PCACCT9  DS    CL1                          .ACCOUNT ERROR CODE
PBACCT9  DS    CL1                          .ACCOUNT BLINKER
PCOA9    DS    CL1                          .CASH/ACCRUAL
PBAMT9   DS    CL1                          .AMOUNT BLINKER
PBDESP9  DS    CL1                          .DESCRIPTION BLINKER
PCEMP9   DS    CL1                          .EMPLOYEE ERROR CODE
PBEMP9   DS    CL1                          .EMPLOYEE BLINKER
```

Figure C-11. APITMS Action Program Processing a Dialog (Part 25 of 29)

```
PLIN#10   DS    CL3       .LINE NUMBER
PCACCT10  DS    CL1       .ACCOUNT ERROR CODE
PBACCT10  DS    CL1       .ACCOUNT BLINKER
PCOA10    DS    CL1       .CASH/ACCRUAL
PBAMT10   DS    CL1       .AMOUNT BLINKER
PBDESP10  DS    CL1       .DESCRIPTION BLINKER
PCEMP10   DS    CL1       .EMPLOYEE ERROR CODE
PBEMP10   DS    CL1       .EMPLOYEE BLINKER
PLIN#11   DS    CL3       .LINE NUMBER
PCACCT11  DS    CL1       .ACCOUNT ERROR CODE
PBACCT11  DS    CL1       .ACCOUNT BLINKER
PCOA11    DS    CL1       .CASH/ACCRUAL
PBAMT11   DS    CL1       .AMOUNT BLINKER
PBDESP11  DS    CL1       .DESCRIPTION BLINKER
PCEMP11   DS    CL1       .EMPLOYEE ERROR CODE
PBEMP11   DS    CL1       .EMPLOYEE BLINKER
PLIN#12   DS    CL3       .LINE NUMBER
PCACCT12  DS    CL1       .ACCOUNT ERROR CODE
PBACCT12  DS    CL1       .ACCOUNT BLINKER
PCOA12    DS    CL1       .CASH/ACCRUAL
PBAMT12   DS    CL1       .AMOUNT BLINKER
PBDESP12  DS    CL1       .DESCRIPTION BLINKER
PCEMP12   DS    CL1       .EMPLOYEE ERROR CODE
PBEMP12   DS    CL1       .EMPLOYEE BLINKER
PLIN#13   DS    CL3       .LINE NUMBER
PCACCT13  DS    CL1       .ACCOUNT ERROR CODE
PBACCT13  DS    CL1       .ACCOUNT BLINKER
PCOA13    DS    CL1       .CASH/ACCRUAL
PBAMT13   DS    CL1       .AMOUNT BLINKER
PBDESP13  DS    CL1       .DESCRIPTION BLINKER
PCEMP13   DS    CL1       .EMPLOYEE ERROR CODE
PBEMP13   DS    CL1       .EMPLOYEE BLINKER
PLIN#14   DS    CL3       .LINE NUMBER
PCACCT14  DS    CL1       .ACCOUNT ERROR CODE
PBACCT14  DS    CL1       .ACCOUNT BLINKER
PCOA14    DS    CL1       .CASH/ACCRUAL
PBAMT14   DS    CL1       .AMOUNT BLINKER
PBDESP14  DS    CL1       .DESCRIPTION BLINKER
PCEMP14   DS    CL1       .EMPLOYEE ERROR CODE
PBEMP14   DS    CL1       .EMPLOYEE BLINKER
PLIN#15   DS    CL3       .LINE NUMBER
PCACCT15  DS    CL1       .ACCOUNT ERROR CODE
PBACCT15  DS    CL1       .ACCOUNT BLINKER
PCOA15    DS    CL1       .CASH/ACCRUAL
PBAMT15   DS    CL1       .AMOUNT BLINKER
PBDESP15  DS    CL1       .DESCRIPTION BLINKER
PCEMP15   DS    CL1       .EMPLOYEE ERROR CODE
PBEMP15   DS    CL1       .EMPLOYEE BLINKER
PLIN#16   DS    CL3       .LINE NUMBER
PCACCT16  DS    CL1       .ACCOUNT ERROR CODE
PBACCT16  DS    CL1       .ACCOUNT BLINKER
PCOA16    DS    CL1       .CASH/ACCRUAL
PBAMT16   DS    CL1       .AMOUNT BLINKER
PBDESP16  DS    CL1       .DESCRIPTION BLINKER
PCEMP16   DS    CL1       .EMPLOYEE ERROR CODE
PBEMP16   DS    CL1       .EMPLOYEE BLINKER
PLIN#17   DS    CL3       .LINE NUMBER
PCACCT17  DS    CL1       .ACCOUNT ERROR CODE
PBACCT17  DS    CL1       .ACCOUNT BLINKER
PCOA17    DS    CL1       .CASH/ACCRUAL
```

Figure C-11. APITMS Action Program Processing a Dialog (Part 26 of 29)

```
PBAMT17  DS     CL1                                   .AMOUNT BLINKER
PBDESP17 DS     CL1                                   .DESCRIPTION BLINKER
PCEMP17  DS     CL1                                   .EMPLOYEE ERROR CODE
PBEMP17  DS     CL1                                   .EMPLOYEE BLINKER
PLIN#18  DS     CL3                                   .LINE NUMBER
PCACCT18 DS     CL1                                   .ACCOUNT ERROR CODE
PBACCT18 DS     CL1                                   .ACCOUNT BLINKER
PCOA18   DS     CL1                                   .CASH/ACCRUAL
PBAMT18  DS     CL1                                   .AMOUNT BLINKER
PBDESP18 DS     CL1                                   .DESCRIPTION BLINKER
PCEMP18  DS     CL1                                   .EMPLOYEE ERROR CODE
PBEMP18  DS     CL1                                   .EMPLOYEE BLINKER
PLIN#19  DS     CL3                                   .LINE NUMBER
PCACCT19 DS     CL1                                   .ACCOUNT ERROR CODE
PBACCT19 DS     CL1                                   .ACCOUNT BLINKER
PCOA19   DS     CL1                                   .CASH/ACCRUAL
PBAMT19  DS     CL1                                   .AMOUNT BLINKER
PBDESP19 DS     CL1                                   .DESCRIPTION BLINKER
PCEMP19  DS     CL1                                   .EMPLOYEE ERROR CODE
PBEMP19  DS     CL1                                   .EMPLOYEE BLINKER
PLIN#20  DS     CL3                                   .LINE NUMBER
PCACCT20 DS     CL1                                   .ACCOUNT ERROR CODE
PBACCT20 DS     CL1                                   .ACCOUNT BLINKER
PCOA20   DS     CL1                                   .CASH/ACCRUAL
PBAMT20  DS     CL1                                   .AMOUNT BLINKER
PBDESP20 DS     CL1                                   .DESCRIPTION BLINKER
PCEMP20  DS     CL1                                   .EMPLOYEE ERROR CODE
PBEMP20  DS     CL1                                   .EMPLOYEE BLINKER
DCACCT   EQU    PCACCT1-PLIN#1                        .DISPLACEMENT OF ACCT ERR CODE
DBACCT   EQU    PBACCT1-PLIN#1                        .DISPLACEMENT OF ACCT BLINKER
DPCOA    EQU    PCOA1-PLIN#1                          .DISPLACEMENT OF CASH/ACCRUAL
DBAMT    EQU    PBAMT1-PLIN#1                         .DISPLACEMENT OF AMOUNT BLINKER
DBDESPT  EQU    PBDESP1-PLIN#1                        .DISPLACEMENT OF DESCPT BLINKER
DCEMP    EQU    PCEMP1-PLIN#1                         .DISPLACEMENT OF EMP ERR CODE
DBEMP    EQU    PBEMP1-PLIN#1                         .DISPLACEMENT OF EMP BLINKER
PTYPE    DS     CL1                                   .CHECK TYPE
PCHECK   DS     CL5                                   .CHECK NUMBER
PCAMT    DS     CL14                                  .CHECK AMOUNT
PCNAME   DS     CL25                                  .CHECK PAYEE
PSTOP    DS     CL1
*
*               CHECK PRINT FORMAT
*
PAY10    EQU    PSTART+5,50
PAY20    EQU    PAY10+50,50
LEGENDO  EQU    PAY20+50,25
VENDORO  EQU    LEGENDO+25,5
CHECKO   EQU    VENDORO+5,5
NAMEO    EQU    CHECKO+5,26
ADDR10   EQU    NAMEO+26,25
DATEO    EQU    ADDR10+25,6
AMOUNTO  EQU    DATEO+6,13
ADDR20   EQU    AMOUNTO+13,25
CITYO    EQU    ADDR20+25,25
****************************************************************************
*               RECORD AREAS
****************************************************************************
```

Figure C-11. APITMS Action Program Processing a Dialog (Part 27 of 29)

```
                YSSSY104                         .SECURITY RECORD
+*
+*************** TABLE MASTER RECORD
+*
+KTABLEMT DS    CL8
+RTABLEMT DS    CL80
+TABSTS   EQU   RTABLEMT+08,1 STATUS
+LIMIT    EQU   RTABLEMT+15,1 PASSWORD LIMIT
+TERMTAB  EQU   RTABLEMT+16 TERMINAL FIELDS
 *
 ************** ACCOUNTS PAYABLE
 *
 KACCTPAY DS    CL15                             .KEY
 RACCTPAY DS    CL165                            .RECORD
 *
 *        AP100 HEADER
 *
 ACCTPAYH DS    CL165
 HBATOT   EQU   ACCTPAYH+21,5                     BATCH TOTAL
 HCHKCNT  EQU   ACCTPAYH+26,5                     NEXT CHECK COUNTER
 HTYPE    EQU   ACCTPAYH+31,1                     CHECK TYPE
 HCHECK   EQU   ACCTPAYH+32,5                     CHECK NUMBER
 HDATE    EQU   ACCTPAYH+37,6                     CHECK DATE
 HVENDOR  EQU   ACCTPAYH+43,5                     CHECK VENDOR
 HAMOUNT  EQU   ACCTPAYH+48,5   PD2               CHECK AMOUNT
 HITMTOT  EQU   ACCTPAYH+53,5   PD2               CHECK ITEM TOTAL
 HITMCNT  EQU   ACCTPAYH+58,3                     CHECK ITEM COUNT
 HNAME    EQU   ACCTPAYH+61,26                    PAYEE
 HLEGEND  EQU   ACCTPAYH+87,26                    LEGEND
 HPRINT   EQU   ACCTPAYH+113,1                    CHECK PRINT
 HBATCH   EQU   ACCTPAYH+114,3                    BATCH NUMBER
 HCHKS    EQU   ACCTPAYH+117,3                    NUMBER OF CHECKS
 HITEMS   EQU   ACCTPAYH+126,4                    ITEM COUNT
 HOLD     EQU   ACCTPAYH+130,5 PD2                OLD CHECK AMOUNT
 HCASH    EQU   ACCTPAYH+135,6 PD2                CHECK CASH TOTAL
 HACCR    EQU   ACCTPAYH+140,6 PD2                CHECK ACCRUAL TOTAL
 HERRCDE  EQU   ACCTPAYH+145,1                    CHECK ERROR CODE
 HACTION  EQU   ACCTPAYH+146,1                    CHECK ACTION CODE
 HCOMPL   EQU   ACCTPAYH+147,1                    CHECK COMPLETION CODE
 *
 *        AP103 CHECK
 *
 ACCTPAYC DS    CL165
 CAMOUNT  EQU   ACCTPAYC+29,5   PD2               CHECK AMOUNT
 CDATE    EQU   ACCTPAYC+20,4
 CVENDOR  EQU   ACCTPAYC+24,5
 CNAME    EQU   ACCTPAYC+34,26
 CADDR1   EQU   ACCTPAYC+60,25
 CADDR2   EQU   ACCTPAYC+85,25
 CCITY    EQU   ACCTPAYC+110,26
 CZIP     EQU   ACCTPAYC+136,3   PDC
 CLEGEND  EQU   ACCTPAYC+139,25
 CPRINT   EQU   ACCTPAYC+164,1
 *
 *        AP104 ITEM
 *
```

Figure C-11. APITMS Action Program Processing a Dialog (Part 28 of 29)

```
ACCTPAYI DS     CL165
AIRID    EQU    ACCTPAYI+00,2                    .RECORD ID
AITYPE   EQU    ACCTPAYI+02,1                    .CHECK TYPE
AICHECK  EQU    ACCTPAYI+03,5                    .CHECK NUMBER
AICNT    EQU    ACCTPAYI+08,3                    .ITEM COUNT
AIVENDOR EQU    ACCTPAYI+19,5                    .VENDOR
AIACCT   EQU    ACCTPAYI+24,8                    .ACCOUNT NUMBER
AIAMT    EQU    ACCTPAYI+32,5                    .AMOUNT
AIEMP    EQU    ACCTPAYI+53,4                    .EMPLOYEE
AIDESCPT EQU    ACCTPAYI+57,30                   .DESCRIPTION
AIBATCH  EQU    ACCTPAYI+87,3                    .BATCH #
AIERR    EQU    ACCTPAYI+90,3                    .ERROR BATCH #
AICOA    EQU    ACCTPAYI+93,1                    .CASH OR ACCRUAL
*
*        GL001  ACCOUNT MASTER
*
KACCTMST DS     CL8
RACCTMST DS     CL80
AMSTS    EQU    RACCTMST+8,1                      STATUS
*
*        SY000  BRANCH MASTER
*
KBRANCHM DS     CL3
RBRANCHM DS     CL250
BMSTS    EQU    RBRANCHM,1                        STATUS
*
*        GL003  CHART OF ACCOUNTS
*
KACCOUNT DS     CL8
RACCOUNT EQU    RBRANCHM+50,80
CASTS    EQU    RACCOUNT+8,1                      STATUS
CACOA    EQU    RACCOUNT+38,1                     CASH OR ACCRUAL
CAEXP    EQU    RACCOUNT+46,1                     EXPENSE ACCOUNT
CAINC    EQU    RACCOUNT+49,1                     INCOME ACCOUNT
*
*        PE010  PERSONNEL MASTER
*
KPAYROLL DS     CL5
RPAYROLL DS     CL421
PMSTS    EQU    RPAYROLL,1                       STATUS
PMCAL    EQU    RPAYROLL+172,1                    CLASSIFICATION
*
*        SY002  PERSONNEL CLASSIFICATION
*
TMSTS    EQU    RTABLEMT+8,1
TMEXP    EQU    RTABLEMT+32,1
OMA      Y$$OMA 2568
+EW      EQU    * .END OF WORK AREA
CDA      Y$$CDA
+*************************************************************************
+*               CONTINUITY DATA AREA                                     *
+*************************************************************************
+CDA     DSECT
+        DS     0H
         END
```

Figure C-11. APITMS Action Program Processing a Dialog (Part 29 of 29)

C.5. Sample IMS Configuration

Figure C-12 is a sample IMS configuration of the SUPPLY, APCHKS, APITMS, and APAUDT action programs. Notice these programs are prepared to receive DICE sequences and therefore the EDIT=NONE parameter is specified in the ACTION sections of this configuration.

```
NETWORK BATCH=NO CONFID=C02 NAME=GTN1 PASSWORD=GTN1 TERMS=14
GENERAL AUDITNUM=50 CHRS/LIN=80 LNS/MSG=24 MAXCONT=3880
OPTIONS            CONTOUT=NO DLLOAD=NO FUPDATE=YES
         OPCOM=YES
         RECOVERY=NO RESEND=NO
         SNAPED=NO
         SUBPROG=YES TOMFILE=NO  TOMTRCL=NO
         UNIQUE=TRAN
         UNSOL=NO
TIMEOUTS ACTION=60
         STATUS=30
FILE     BRANCHM FILETYPE=ISAM BLKSIZE=0512 LOCK=TR
                 TYPEFLE=RANSEQ UPDATE=YES RECFORM=FIXBLK PCYLOFL=20
                 RECSIZE=250 KEYLOC=10 KEYLEN=3
                 IOAREA1=BRANCHM KEYARG=BRANCHM WORK1=BRANCHM
                 IOROUT=ADDRTR IOREG=8 WORKS=YES
                 INDAREA=BRANCHM INDSIZE=256
FILE     TABLEMT FILETYPE=ISAM BLKSIZE=0512 LOCK=TR
                 TYPEFLE=RANSEQ UPDATE=YES RECFORM=FIXBLK PCYLOFL=30
                 RECSIZE=080 KEYLOC=0 KEYLEN=8
                 IOAREA1=TABLEMT KEYARG=TABLEMT WORK1=TABLEMT
FILE     SCRFIL  FILETYPE=DAMR BLKSIZE=2560 IOAREA1=SCRFIL READID=YES
                 RELATIVE=R SEEKADR=SCRFIL WRITEID=YES LOCK=UP
FILE     PAYROLL FILETYPE=ISAM BLKSIZE=1280 LOCK=TR
                 TYPEFLE=RANSEQ UPDATE=YES RECFORM=FIXBLK PCYLOFL=30
                 RECSIZE=421 KEYLOC=6 KEYLEN=5
                 IOAREA1=PAYROLL KEYARG=PAYROLL WORK1=PAYROLL
                 IOROUT=ADDRTR IOREG=8 WORKS=YES
FILE     ACCOUNT FILETYPE=ISAM BLKSIZE=0512 LOCK=TR
                 TYPEFLE=RANSEQ UPDATE=YES RECFORM=FIXBLK PCYLOFL=10
                 RECSIZE=080 KEYLOC=0 KEYLEN=8
                 IOAREA1=ACCOUNT KEYARG=ACCOUNT WORK1=ACCOUNT
                 IOROUT=ADDRTR IOREG=8 WORKS=YES
FILE     ACCTMST FILETYPE=ISAM BLKSIZE=0512 LOCK=TR
                 TYPEFLE=RANSEQ UPDATE=YES RECFORM=FIXBLK PCYLOFL=20
                 RECSIZE=080 KEYLOC=0 KEYLEN=8
                 IOAREA1=ACCTMST KEYARG=ACCTMST WORK1=ACCTMST
                 IOROUT=ADDRTR IOREG=8 WORKS=YES
FILE     ACCTPAY FILETYPE=ISAM BLKSIZE=1022 LOCK=TR
                 TYPEFLE=RANSEQ UPDATE=YES RECFORM=FIXBLK PCYLOFL=40
                 RECSIZE=165 KEYLOC=0 KEYLEN=15
                 IOAREA1=ACCTPAY KEYARG=ACCTPAY WORK1=ACCTPAY
                 IOROUT=ADDRTR IOREG=8 WORKS=YES
```

Figure C-12. Sample IMS Configuration (Part 1 of 2)

```
FILE      VENDORM  FILETYPE=ISAM BLKSIZE=1022 LOCK=TR
                   TYPEFLE=RANSEQ UPDATE=YES RECFORM=FIXBLK PCYLOFL=10
                   RECSIZE=199 KEYLOC=0 KEYLEN=5
                   IOAREA1=VENDORM KEYARG=VENDORM WORK1=VENDORM
                   IOROUT=ADDRTR IOREG=8 WORKS=YES
FILE      TRANACT  FILETYPE=ISAM BLKSIZE=1022 LOCK=TR
                   TYPEFLE=RANSEQ UPDATE=YES RECFORM=FIXBLK PCYLOFL=30
                   RECSIZE=165 KEYLOC=0 KEYLEN=15
                   IOAREA1=TRANACT KEYARG=TRANACT WORK1=TRANACT
                   IOROUT=ADDRTR IOREG=8 WORKS=YES
TERMINAL  TM08    IMSREADY=NO
TERMINAL  TM07    IMSREADY=NO
TERMINAL  TM06    IMSREADY=NO
TERMINAL  TM09    IMSREADY=NO
TERMINAL  TM04
TERMINAL  TM10    IMSREADY=NO
TERMINAL  TM05    IMSREADY=NO
TERMINAL  TM11
TERMINAL  TM03
TERMINAL  TM12     MASTER=YES
TERMINAL  TM01
TRANSACT  APCKS   ACTION=APCHKS
TRANSACT  APITS   ACTION=APITMS
TRANSACT  APAUD   ACTION=APAUDT
TRANSACT  SUPLY   ACTION=SUPPLY
ACTION    APITMS   EDIT=NONE
                   FILES=ACCOUNT,ACCTMST,ACCTPAY,BRANCHM,PAYROLL
                   FILES=SCRFIL,TABLEMT,VENDORM
                   INSIZE=STAN MAXSIZE=9472 OUTSIZE=2568 WORKSIZE=3584
                   ALLRNT=NO  BYPASS=2 MAXUSERS=1
ACTION    APAUDT   EDIT=NONE
                   FILES=ACCOUNT,ACCTPAY,BRANCHM,SCRFIL,PAYROLL
                   FILES=TABLEMT,VENDORM
                   INSIZE=STAN MAXSIZE=8960 OUTSIZE=2568 WORKSIZE=3072
                   ALLRNT=NO  BYPASS=2 MAXUSERS=1
ACTION    APCHKS   EDIT=NONE
                   FILES=ACCTPAY,PAYROLL,SCRFIL,TABLEMT,VENDORM
                   INSIZE=STAN MAXSIZE=7936 OUTSIZE=2568 WORKSIZE=2048
                   ALLRNT=NO  BYPASS=2 MAXUSERS=1
ACTION    SUPPLY   EDIT=NONE
                   FILES=BRANCHM,TABLEMT,TRANACT
                   INSIZE=STAN MAXSIZE=2304 OUTSIZE=STAN WORKSIZE=1024
                   ALLRNT=NO  BYPASS=5 MAXUSERS=1
PROGRAM   APITMS  ERET=YES TYPE=SER
PROGRAM   APCHKS  ERET=YES TYPE=RNT
PROGRAM   APAUDT  ERET=YES TYPE=RNT
PROGRAM   SUPPLY  ERET=YES TYPE=SER
```

Figure C-12. Sample IMS Configuration (Part 2 of 2)

Appendix D
Status Codes and Detailed Status Codes

IMS returns a status code and sometimes both status and detailed status codes after each function call issued by your action program. IMS places these codes in the STATUS-CODE and DETAILED-STATUS-CODE fields of the program information block. Your action program then tests the contents of these program information block fields and performs routines to handle the conditions indicated by them.

A successful execution of a function call issues a status code 0, and usually a detailed status code of 0. For status code 0, defined records and transaction buffers use the detailed status codes to return advisory information. (See Section 5.12 and 10.8.)

Table D-1 shows the status codes and their meaning for sequential and random I/O functions issued to sequential, relative, indexed, and defined files.

Table D-2 lists the status code values returned to the program information block.

Table D-3. shows the advisory information detailed status codes for the status code 0.

Table D-4 shows detailed status codes IMS returns with invalid key status code 1.

Table D-5 lists the detailed status codes for status code 2.

Table D-6 describes detailed status codes IMS returns with status code 3 for invalid request errors.

Table D-7 lists the detailed status codes IMS returns with status code 4 for I/O errors.

Table D-8 lists the detailed status codes IMS returns with status code 5 for violation of data definition.

Table D-9 lists detailed status codes returned by IMS with status code 6 for internal message control errors.

Table D-10 explains detailed status codes returned with status code 7 for screen formatting errors.

Table D-1. Status Codes for I/O Function Calls

Status Codes	Sequential Functions												Random Functions															Printer File Functions			Status Code Meaning
	Seq. Files		Relative Files			Indexed File				Defined Files			Relative Files					Indexed Files					Defined Files					Sequential Output Files			
	GET	PUT	SETL	GET	ESETL	SETL	SETK	GET	ESETL	SETL	GET	ESETL	GET	GETUP	PUT	INSERT	DELETE	GET	GETUP	PUT	INSERT	DELETE	GET	GETUP	PUT	INSERT	DELETE	PRINT	UNLOCK	BRKPT	
0	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Successful
0											X																				Detail cycle
1			X										X	X	X	X	X														Invalid record number
1						X												X	X				X	X		X					Invalid key
1				X							X																				Invalid record type
1																												X			Forms overflow
2	X			X				X																							End of file (DAM files only)*
2	X	X		X				X					X	X	X	X	X	X	X	X	X	X						X			Unallocated optional file
2											X																				Total cycle
3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Invalid request
4	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			I/O error
5																							X	X	X	X	X				Violation of data definition

* When using an indexed file via a SETL function and then consecutive GET functions

Table D-2. Values Returned in PIB Status Code after Function Calls

Status Code (Decimal)	Status Code (Hexadecimal)	Description
0	00	Successful Defined record (see Section 5.12) Transaction buffers (see Table D-3)
1	01	Invalid key or record number Defined files - predicted record type not correct Printer files - forms overflow
2	02	End of data, empty set
3	03	Invalid request
4	04	I/O error
5	05	Violation of data definition
6	06	Internal message control error
7	07	Screen format error

Table D-3. Detailed Status Codes for Status Code 0

Detailed Status Code (Decimal)	Detailed Status Code (Hexadecimal) All Functions	Description
0	00	Successful call
	Transaction buffers	
0	00	No buffers allocated to the transaction prior to this successful call
1	01	1 block of buffers allocated to the transaction prior to this successful call
2	02	2 blocks of buffers allocated to the transaction prior to this successful call
	Defined files See Table D-1 and Sections 3.7 and 5.12	

Table D-4. Detailed Status Codes for Invalid Key Errors - Status Code 1

Detailed Status Code (Decimal)	Detailed Status Code (Hexadecimal)	Description	Meaning
01	01	Invalid duplicate key count	Internal error Named format cannot be found Duplicate key count value on random GET function is zero or exceeds number of duplicate keys
225	E1	No identifier supplied	Insert an IDENTIFIER statement in the data definition
226	E2	Identifier too long	Identifier must be 1 to 30 alphanumeric characters
228	E4	Identifier out of range	Value entered at terminal is not in range of VALUE clause specified in data definition

Table D-5. Detailed Status Codes for Status Code 2

Detailed Status Code	Description
0	End of data/end of load module
# (record type)	Defined records: First byte = Predicted record type Second byte = Delivered record type

Table D-6. Detailed Status Codes for Invalid Requests - Status Code 3

Code (Decimal)	Code (Hexadecimal)	Description	Meaning
1	01	Incorrect number of parameters	The number of parameter addresses contained in a request parameter list is inconsistent with the function requested. This error can result from the failure of BAL action programs to set the sign bit in the final address word in a request parameter list as required by standard linkage conventions.
2	02	Function code out of legal range	This error may occur when an action program inadvertently writes into the IMS link module that is linked to a serially reusable or sharable action program, or control passes improperly from an action program to IMS.
3	03	Incorrect parameter value	The parameter list address passed to IMS on a request is 0, or an address contained in the parameter list is 0, or the actual value of a parameter is incorrect. This error can also occur when an I/O area for a DAM file was not half-word aligned.
4	04	Shared record not in use by this transaction	This code does not apply to user action program requests.
5	05	File not defined Transaction buffer not allocated	A logical or defined file named in a request to IMS is not configured or defined via the data definition processor. One of the addresses submitted in the list of transaction buffers to be released is not pointing to a buffer assigned to the transaction.

continued

Table D-6. Detailed Status Codes for Invalid Requests - Status Code 3 (cont.)

Code (Decimal)	Code (Hexadecimal)	Description	Meaning
6	06	File not open	The ZZCLS master terminal command closed a logical file named in a request to IMS or data management closed a logical file as the result of an unrecoverable error.
7	07	Function invalid for type of file	The function specified in a request to IMS is not valid for the type of file named. For example, the action program issued a SETL function call for a nonindexed file.
8	08	Record(s) not locked	The action program issued an UNLOCK function when no locks existed.
9	09	PUT or DELETE request not preceded by a GETUP request	The function sequence for an update operation is not valid.
10	0A	Illegal function requested	The requested function is not consistent with the DTF or RIB parameters in the configuration.
11	0B	File not assigned to this action	The action program requested a logical file that was not named in the configured definition of the action making the request, or the preceding action did not name a defined file.

continued

Table D-6. Detailed Status Codes for Invalid Requests - Status Code 3 (cont.)

Code (Decimal)	Code (Hexadecimal)	Description	Meaning
12	0C	Required module not included in configuration	The action program requested a feature not included in the IMS load module at configuration time. Required module not in configuration. The activation of RESMEM was not specified in the IMS configuration. Screen format services not configured. No continuous output configured.
13	0D	Capacity exceeded on INSERT request	An action program requested insertion of a record into a MIRAM of ISAM file, but insufficient space exists to contain the new record.
14	0E	Insufficient space in main	User must allocate more main storage. The transaction buffer pool is exhausted. Returned if a contiguous block of space is not available. This error is also returned, if RESMEM parameters were overridden with 0.
15	0F	Update not permitted in configuration	An action program requested an update function; but update was disallowed at configuration time.
16	10	Update suppressed for files	The requested update is not permitted because of an I/O error in the audit file.
17	11	Trace file down	File recovery is not operational; only file displays are allowed.

continued

Table D-6. Detailed Status Codes for Invalid Requests - Status Code 3 (cont.)

Code (Decimal)	Code (Hexadecimal)	Description	Meaning
18	12	Record was locked by another transaction (single-thread only)	Under single-thread, an action program issued either a GETUP or INSERT request on a record; but this record was already locked by some other transaction.
20	14	Work-area address invalid or SETLOAD was not issued before GETLOAD	Check the order in which you issued SETLOAD and GETLOAD calls; make sure that work area is word aligned. Invalid request; save-area address invalid or SETLOAD was not issued before GETLOAD.
21	15	Data buffer too small (less than 10 bytes)	Make sure the value specified on the size parameter of the GETLOAD call is greater than 10. Invalid request; data buffer too small (less than 10 bytes).
22	16	Another SETLOAD call was issued between the initial SETLOAD and the GETLOAD call	Check that an additional SETLOAD call was not issued before the GETLOAD call.
24	18	Busy status, PRINT function issued when printer file assigned to another terminal.	Issue PRINT function when printer not busy.
25	19	Invalid USER-ID password	

Table D-7. Detailed Status Codes for I/O Errors - Status Code 4

File Type	Error Code	Description
MIRAM	DMnn	nn is the hexadecimal value of data management area error code contained in the first byte of the detailed status code. The second byte of detailed status code is error subcode interpretation. (See 3.6 and the System Messages Reference Manual, UP-8076
DAM	filename-C+2	Is the value in the detailed status code. For interpretation, refer to Data Management User Guide, UP-8068.
	XX	I/O error. XX is the error code (in binary) returned by the OS/3 loader, if DOWLINE LOAD is used. Note that these error codes are explained in the System Messages Reference Manual, UP-8076.

Table D-8. Detailed Status Codes for Violation of Data Definition - Status Code 5

Detailed Status Code (Decimal)	Detailed Status Code (Hexadecimal)	Description
*	*	Incorrect VALUE statement Inconsistent PIC clause Change not permitted Value missing for a MUST ADD item

* No detailed status code returned, but status code 5 can signify one of the above in the description list.

Table D-9. Detailed Status Codes for Internal Message Control Errors - Status Code 6

Detailed Status Code (Decimal)	Detailed Status Code (Hexadecimal)	Description	Meaning
2	05	Destination terminal busy, on hold, or down	Output-for-input queueing was: 1. Destination terminal is in interactive mode. 2. Destination tereminal has an input message on queue. 3. ZZHLD or ZZDWN command was entered for destination terminal. 4. Destination terminal is marked physically down to ICAM. 5. IMS cannot allocate main storage buffer (multithread) only. INBUFSIZ specification inadequate.
3	03	Destination terminal physically or logically down, message queued	SEND function was issued for message switching. Message is queued at destination terminal and is retransmitted when terminal becomes operational.
4	04	Invalid specification in output message header Invalid terminal name or type	Invalid destination terminal-id or auxiliary-device-id; or AUX-FUNCTION field contains X'C3', X'F3', or X'F7' (not valid with SEND function).
5	05	No ICAM network buffer	Insufficient buffer space allocated in ICAM network definition.
6	06	Disk error	Output error occurred on attempt to write message to disk; error passed to IMS by ICAM.

continued

Table D-9. Detailed Status Codes for Internal Message Control Errors - Status Code 6 (cont.)

Detailed Status Code (Decimal)	Detailed Status Code (Hexadecimal)	Description	Meaning
7	07	Invalid length specification	In delayed internal succession or output-for-input queueing, output message length was larger than the input buffer pool.
8	08	Insufficient resource error	In switched message, cannot retrieve file from process file table after five attempts. Must generate new files. In delayed internal succession, insufficient main storage allocation. Must increase main storage allocation. Must increase main storage on job card.
9	09	Output message error	An action scheduled for program routing has terminated with E succession at the secondary node.

Table D-10. Detailed Status Codes for Screen Formatting Errors - Status Code 7

Detailed Status Code (Decimal)	Detailed Status Code (Hexadecimal)	Description	Meaning
0	00	Validation error; all error fields in variable data area replaced by hexadecimal Fs and affected field-error statuses set in the output-status area	Check validation error codes returned in status byte for invalid field.
1	01	Buffer address indicates a format area not large enough to receive the screen format	Check the length field in output message header portion of format area to find actual length required for the format described.
2	02	Variable data area not large enough	Check data-size parameter on the CALL BUILD function and increase the length or size of the data-size parameter. Make it at least as large as the screen size.
3	03	Insufficient number of terminals configured for SFS	Check SFS parameter in the OPTIONS section of configurator.
4	04	Variable data specified when no variable data area exists	Variable data parameter specified in BUILD function, but no output fields or option indicators described for the screen format.
5	05	Format dimensions are greater than screen dimensions	Check screen format generation for length of screen format.
6	06	Fatal error; I/O error reading format file	Get DM error message from console; refer to the System Messages Reference Manual, UP-8076.
7	07	REBUILD not allowed	User issued output-only screen and can issue a REBUILD only with input fields.
8	08	Invalid field in variable data area	On REBUILD, data description in action program doesn't match screen format generation.

continued

Table D-10. Detailed Status Codes for Screen Formatting Errors - Status Code 7 (cont.)

Detailed Status Code (Decimal)	Detailed Status Code (Hexadecimal)	Description	Meaning
9	09	Variable-data parameter specified but no error field detected	Screen coordinator checked all data in variable-data area and no fields of hexadecimal Fs found.
10	0A	Screen format incorrectly generated	On BUILD, data description in action program doesn't match screen format generation.
11	0B	SFS failed	System error. Take dump and contact your Unisys representative.
16	10	SFS failed during input conversion	Inadequate main storage in system; or format contains protected fields and terminal does not have protect feature or is not in protect mode.
17	11	Screen format services error	Take IMS job dump and contact your Unisys representative.
18	12	Screen format can't be transmitted because this is a program-initiated DDP transaction.	Action program processing DDP transaction attempted to send screen format to initiating action program.

Appendix E
Generating Edit Tables

E.1. Purpose

The edit table generator offers a convenient means for converting unformatted input received from terminal operators into fixed formats required by action programs and checking this input for types of data, value ranges, and presence of required fields.

The output of the edit table generator is written to the named record file (NAMEREC). From there it is loaded at the appropriate time by IMS. Each edit table is associated with a particular action at configuration time via the EDIT parameter in an ACTION section. The edit table utility can be run either before or after configuration, but the NAMEREC file must be previously initialized.

E.2. Generator Input Coding Rules for Edit Table

Input to the edit table generator is in the form of keyword parameters that define the edit table, the fields you want edited, and the edit criteria for each field. Note that the statement conventions in Appendix A also apply.

To code input to the edit table generator, apply the following rules:

1. Input entries must contain sequence numbers in columns 77 through 80, in ascending order. The lowest permissible sequence number is 0001.

2. Parameters can be coded in any column between 1 and 76. Blanks are ignored and are permitted anywhere in the edit table definition.

Example

```
1                                                         77   80
-----------------------------------------------------------------
SEP=;ETAB=ETABTST;KEY=1;POS=0;MAN=Y;LEN=5;                0 1 0 0
KEY=2;FIL= ;JUS=L;LEN=15;MAN=Y;TYP=A;POS=5;               0 2 0 0
KEY=3;FIL= ;JUS=L;LEN=20;POS=20;TYP=M;;                   0 3 0 0
```

3. Specifications for an edit table and for each field can span more than one line. However, a keyword and its value must be contained on one line.

Example

```
INCORRECT                                 |             CORRECT
-------------------------------------------------------------------------------------
SEP=;ETAB=ETABTST;KEY=1;POS=      0100    | SEP=;ETAB=ETABTST;KEY=1;POS=0;     0100
0;MAN=Y;LEN=5;MAN=Y;LEN=5;;       0200    |
                                          |
     KEYWORD AND VALUE                    |
     NOT ON SAME LINE                     |
```

4. A new edit table specification must start on a new line. Each field need not begin on a new line.

Example

```
     INCORRECT                               |            CORRECT
---------------------------------------------------------------------------------------------
     SEP=;ETAB=ETABTST;KEY=1;POS=0;   0100   |  SEP=;ETAB=ETABTST;KEY=1 POS=0;         0100
     MAN=Y;LEN=5;                     0200   |  MAN=Y;LEN=5;KEY=2;FIL= ;JUS=L;         0200
     KEY=2;FIL= ;JUS=L;LEN=15;MAN=Y;  0300   |  LEN=15;MAN=Y;TYP=A;POS=5;;             0300
     TYP=A;POS=5;;SEP=;ETAB=TABL1,    0400   |  SEP=,ETAB=TABL1,KEY=1,LEN=20,          0400
     KEY=1,LEN=20,POS=20,,            0500   |  POS=20,,                               0500
                                             |
      NEW EDIT TABLE NOT                     |     NEW FIELD NEED
      SPECIFIED ON NEW LINE                  |     NOT START
                                             |     ON NEW LINE
```

5. The field separator character specified by the SEP keyword parameter must be used as the field separator throughout the edit table specification, as well as in the input message to be edited. Double separator characters indicate the end of the edit definition. A new edit table can establish a different separator character.

Example

INCORRECT

```
SEP=;ETAB=ETABTST,KEY=1,POS=0;   0100
MAN=Y;LEN=5;                     0200
```

END OF EDIT DEFINITION NEEDS DOUBLE SEPARATOR

SAME FIELD SEPARATOR NOT USED THROUGHOUT EDIT TABLE DEFINITION

CORRECT

```
SEP=;ETAB=ETABTST;KEY=1;POS=0;      0100
MAN=Y;LEN=5;;                       0200
SEP=.ETAB=TABL4.KEY=1.POS=0.        0300
MAN=Y.LEN=5..                       0400
```

ESTABLISHES A NEW SEPARATOR CHARACTER

6. The SEP, ETAB, and KEY parameters must be coded in the prescribed order; the remaining keyword parameters can be specified in any order. SEP and ETAB are coded once for each edit table. The remaining parameters are repeated for each field in the input message to be edited.

Example

INCORRECT

```
SEP=;POS=;LEN=5;KEY=1;      0100
ETAB=ETABTST;;              0200
```

ETAB AND KEY PARAMETERS DON'T IMMEDIATELY FOLLOW SEP

CORRECT

```
SEP=;ETAB=ETABTST;KEY=1;POS=0;      0100
MAN=Y;LEN=5;;                       0200
```

7. Numeric values are positive unless preceded by a minus sign (-). The plus sign (+) is not permitted in numeric values. The number of numeric characters used to specify a numeric value may not exceed the length specified by the LEN parameter.

Example

INCORRECT		CORRECT	
SEP=;ETAB=TABL1;KEY=1;LEN=5;	0100	SEP=;ETAB=TABL1;KEY=1;LEN=5;	0100
POS=0;MAX=+200000;MIN=-1;;	0200	POS=0;MAX=20000;MIN=-1;;	0200

PLUS SIGN NOT ALLOWED

NUMBER OF CHARACTERS EXCEEDS LENGTH GIVEN IN LEN PARAMETER

E.3. Edit Table Generator Parameters

The input parameters you give to the edit table generator must follow this format:

```
SEP=separator-character

ETAB=tablename

KEY= {keyword }
     {position}

LEN=field-length

POS=starting-position

[FIL=fill-character]

[JUS= {L} ]
[     {R} ]

[MAN= {N} ]
[     {Y} ]

[MAX=maximum-value]
[MIN=minimum-value]

[    {A} ]
[    {B} ]
[TYP={M} ]
[    {N} ]
[    {P} ]
```

The separator parameter specifies the field separator character for both the edit table definition and the input message to be edited. It cannot be a blank, equal sign, or minus sign. This parameter is required, must be the first entry on the first line of the edit table definition, and can be specified only once per edit table.

The edit table name parameter names the edit table and must immediately follow the SEP parameter. This specification associates the edit table with an action at configuration, via the EDIT=tablename option in the ACTION section.

The key field parameter identifies the input message field for which edit criteria are specified in subsequent parameters and must be the first parameter specified for each field. The edit table generator associates all subsequent specifications with this field until it encounters another KEY parameter. Input fields can be positional or keyword. Positional fields precede keyword fields.

KEY=*position* specifies the relative position of the field as it appears in the input message. Positional fields must be defined in numeric order, starting with 1.

KEY=*keyword* specifies a 1- to 3-character alphanumeric identification. The first character must be alphabetic for a keyword field in the input message. The terminal operator enters keyword fields in the form *keyword=data*. For example, when you specify KEY=OLD, the terminal operator might enter OLD=57500 for this field. Once a keyword field is identified in the edit table definition, all subsequent fields must be defined as keyword fields.

Figure E-1 shows the correct coding for positional and keyword parameters to the edit table generator.

```
                 POSITIONAL--------┐
                                   ▼
                 SEP=;ETAB=TABL1;KEY=1;POS=0;MAN=Y;LEN=5;         0100
POSITIONAL-----> KEY=2;FIL= ;JUS=L;LEN=15;MAN=Y;TYP=A;POS=5;      0200
KEYWORD -------->{KEY=NEW;FIL= ;JUS=L;LEN=10;POS=20;TYP=M;        0300
                 {KEY=OLD;FIL= ;JUS=L;LEN=10;POS=30;TYP=M;;       0400
```

Figure E-1. Edit Table Parameter Description with Positional and Keyword Parameters

The length parameter specifies the length of the edited field and is a required parameter. You may specify a maximum of 255 characters for alphanumeric fields and four characters for binary fields. Ten characters is the maximum length for numeric fields unless you specify both MIN and MAX parameters for this field. If you identify a numeric field in the action program as packed decimal, you can specify up to 16 characters in the LEN parameter.

Notes:

1. *If the field-length is larger than the width of the screen on which data is to be entered, IMS removes the DICE code at the end of each line of terminal input and replaces it with a blank character. You must provide for these additional blank characters in the action program and include them in the field-length specified by the LEN parameter.*

2. *The length specified for binary (TYP=B) and packed (TYP=P) fields is the maximum length for the field in the input message, not the length of the field in your program. For example, if a field is defined as packed with a LEN=3, the largest number the terminal operator can key in is 999, even though 1000 may be represented in a packed field in 3 bytes.*

3. *If the transaction code (the first field in the input message) is less than five characters, the terminal operator must key in a space before entering the separator character for the next field. You must include the space in the field-length specified by the LEN parameter.*

TRANSACTION CODE IS PAY

SO

OPERATOR ENTERS

AND LEN=4;

The length of the first field can be greater than five characters, but only the first five characters are used in the transaction code. The LEN parameter should specify the actual length of the field.

The starting position parameter specifies the starting position of this field as it appears in the edited message and is a required parameter. The first field starts at 0.

The fill character parameter optionally specifies the fill character inserted in the edited field when the field the terminal operator enters as input is shorter than the field-length specified by the LEN parameter. The default fill character is 0. If you want to fill with spaces (X'40'), code either "FIL=" or "FIL=△"; i.e., you can include or omit a space before the separator character for the next field. Binary fields are always filled with binary zeros; therefore, this parameter is ignored if specified for a binary field.

JUS=L left-justifies this field in the edited message. Binary and packed fields are always right-justified; therefore, this parameter is ignored if specified for binary or packed fields.

JUS=R right-justifies this field in the edited message and is the default assumed.

MAN=N indicates that this field is not mandatory in the edited message for input to be acceptable.

MAN=Y indicates that this field is mandatory in the edited message.

The maximum value parameter specifies the maximum value allowed for the field in the input message. This parameter applies only to numeric fields. The highest value allowed is 2 to the thirty-first power minus 1: 2^{31}-1. The number of characters in this value must not exceed the length specified by the LEN parameter.

The minimum value parameter specifies the minimum value allowed for the field in the input message. This parameter applies only to numeric fields. The lowest value allowed is minus 2 to the thirty-first power minus 1: -(2^{31}-1). The number of characters in this value must not exceed the length specified by the LEN parameter.

The type parameter describes the type of data to be contained in the edited field.

TYP=A specifies alphabetic data. A field defined to the editor as alphabetic is treated as an alphanumeric field.

TYP=B specifies binary data.

TYP=M specifies alphanumeric data and is the default value.

TYP=N specifies numeric data.

TYP=P specifies packed decimal data.

E.4. Executing the Edit Table Generator

Once you code input parameters describing the edit table format and the NAMEREC file is initialized, you can execute the ZH#EDT edit table generator using the control stream illustrated in Figure E-2.

```
// JOB ADDEDT,,A000
// DVC 20 // LFD PRNTR
// OPTION DUMP
// DVC 50 // VOL DS9999 // LBL NAMEREC,DS9999 // LFD NAMEREC
// EXEC ZH#EDT
/$
     input parameters
       .      .
       .      .
       .      .
     input parameters
/*
/&
// FIN
```

Figure E-2. Sample Execution of Edit Table Generator

If the input definition is acceptable, the generated edit table is written to the NAMEREC file and the following message is issued:

```
tablename ADDED
```

If the edit table has the same name as a table already existing in the NAMEREC file, the new edit table replaces the existing table, and the following message is issued:

```
TABLE ADDED, DUPLICATE DELETED
```

If errors cause rejection of the edit table, the following message is issued:

```
tablename REJECTED
```

Another way to determine edit table errors is to look at the UPSI byte. The following UPSI byte values pertain to the edit table error status:

UPSI Byte Contents	Meaning
00	No errors
40	Warning. ZH#EDT continues processing edit table input parameters; but no edit table is built.
80	Fatal error. Edit table processing terminates.

E.5. Error Processing

When the edit table generator encounters a file I/O error or certain types of input errors, it terminates and prints a message in the output listing. The resulting value in the UPSI byte is 80. Most types of input errors do not cause termination. Processing and validation continues, but an error message is printed and the edit table is rejected. Input specifications for the edit table generator are not printed in the output listing. This type of error results in an UPSI byte value of 40.

If an I/O error occurs while reading input to the edit table generator, the following message is issued, and the program terminates with an UPSI byte value of 80:

```
INPUT READ ERROR, SCAN TERMINATED
```

If an error occurs while opening, reading, or closing the named record file, the following error message is issued and the program terminates with an UPSI byte value of 80:

```
FILE ERROR, SCAN TERMINATED
```

Errors in the input statements are reported in the following format:

```
nnnn cc error-message-text
```

where:

nnnn
: Is the sequence number in columns 77 through 80 of the card containing the error.

cc
: Is the column number of the beginning of the input text that is in error. This column number is suppressed if the error is detected during final validation of all parameters for a given field.

error-message-text
: Is the description of the error as listed in Table E-1.

An example of an input statement error and the resultant error message follows:

Input

```
SEP=,ETAB=EDIT1,KEY=1,LEN=5,POS=0,JUS=X,MAN=Y,      0002
```

Error Message

```
0002 39 JUSTIFICATION ILLEGAL
```

Table E-1 lists alphabetically the message texts inserted into the input statement error message. In each case, processing continues, unless otherwise indicated in the explanation column.

Table E-1. Edit Table Diagnostic Messages

Error Message Text	Explanation
B TYPE LENGTH GR THAN 4	Four characters (one full word) is maximum.
CARDS NOT IN SEQUENCE	Scan terminated, run aborted.*
DOUBLE SEPARATOR MISSING	Warning only; end-of-file encountered while searching for separator.
DUPLICATE NAME	Duplicate name for nonpositional field
FIELD NOT ACCEPTED, KEYS STARTED	Positional parameters not allowed after nonpositionals started.
FIELD NOT IN SEQUENCE	Positional parameters must be in sequence.
FILLER MUST BE SINGLE CHARACTER	Self-explanatory
ILLEGAL FIELD TYPE	Only A, B, M, N, or P accepted
INVALID MAN SPECIFICATION	Only Y or N accepted
INVALID NAME	Name too long or contains invalid characters.
INVALID SEPARATOR	Scan terminated, run aborted; = and - are not allowed as separators.*
JUSTIFICATION ILLEGAL	Only R or L accepted
KEYWORD ETAB MISSING	Self-explanatory
KEYWORD INVALID	Self-explanatory

* These errors set the UPSI byte to 80; all other errors in this table result in an UPSI byte value of 40.

continued

Table E-1. Edit Table Diagnostic Messages (cont.)

Error Message Text	**Explanation**
KEYWORD KEY= MISSING	Self-explanatory
KEYWORD SEP= MISSING	Scan terminated, run aborted.*
LEN OR POS EXCEEDS MAX	Maximum length is 255; maximum position is 32,767.
LEN OR POS MISSING	Required parameters
LEN ZERO	Length must be at least 1.
MAX OR MIN ABSOLUTE VALUE TOO LARGE	2^{31}-1 is largest absolute value allowed.
N TYPE LENGTH GR THAN 10	Ten characters is maximum unless MAX and MIN both specified.
NO DEFAULT FOR THIS FIELD	Parameter value must be specified.
NO FIELDS DEFINED	Empty table not allowed.
P TYPE LENGTH GR THAN 16	Sixteen characters maximum for packed-decimal field.
REPEATED FIELD	Parameter already specified.
SEPARATOR CHARACTER MISSING	Self-explanatory
SEQUENCE NUMBER NOT NUMERIC	Scan terminated, run aborted.*
= SIGN MUST FOLLOW KEYWORD	Self-explanatory
TOO MANY FIELDS	Scan terminated, run aborted; output buffer overflow.*
xxx OVERLAPS yyy	Warning only; overlapping fields permitted.

* These errors set the UPSI byte to 80; all other errors in this table result in an UPSI byte value of 40.

E.6. Entering Input Messages from a Terminal

When the terminal operator enters an input message for which you've generated an edit table, an IMS component called the expanded input editor processes it. The following considerations apply when entering input messages from the terminal:

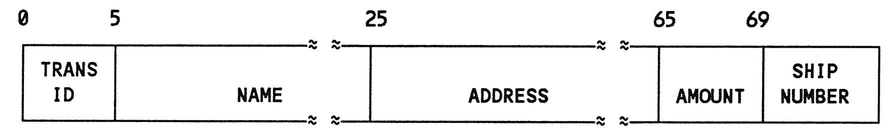
- When an input message contains a transaction code, the transaction code must always be the first field. If the transaction code is less than five characters, enter a space before keying in the separator character.
- Positional fields begin with the first nonblank character and extend to the next separator. Positional fields must appear in the same order as specified in the edit table definition. If you omit a positional field, enter an additional separator character in its position. A positional field entered as input may not contain an equal sign.
- Keywords must be followed by an equal sign with no intervening blanks. Data starts immediately after the equal sign and extends to the next field separator.
- Numeric values are positive unless preceded by a minus sign. The plus sign (+) is an invalid character.
- Error messages are displayed on the first line of the display terminal; therefore, it is recommended that you start input messages on the second line so that the input is not erased by an error message.
- If you continue fields from one line to another, IMS removes the DICE code at the end of each line and replaces it with a blank character which it sends to the action program as part of the data. Always enter on one line fields that do not exceed the width of the screen. If a field exceeds the screen width and must be continued from one line to another, avoid splitting a word between lines.
- If the terminal input ends with a positional parameter (no keyword parameters are specified), enter a separator character at the end of the input message; otherwise, the input message could be partially deleted. A correct terminal entry is:

```
INFOR,BIOLOGY,CLASS2,MARY J. BLISS,
```

When terminal input ends with a keyword parameter, this is not necessary.

E.7. Sample Edit Table Application Using Positional and Keyword Parameters

Figure E-3 and Table E-2 describe sample input to the edit table generator for an accounts receivable application and the format in which the edited input is delivered to the action program.




```
1                                                                77 80
SEP=,ETAB=EDIT1,KEY=1,LEN=5, POS=0, MAN=Y,                       0001
KEY=2,LEN=20, POS=5, FIL=,JUS=L,MAN=Y,                           0002
KEY=3,LEN=40,POS=25,FIL= ,JUS=L,                                 0003
KEY=AMT,LEN=4, POS=65, MIN=1000, TYP=B,MAN=Y,FIL=0,JUS=R,        0004
KEY=SN, LEN=6,POS=69,FIL=,JUS=R,,                                0005
```

Figure E-3. Sample Input to Edit Table Generator and Format of Input Delivered to Action Program

Table E-2. Description of Sample Input to Edit Table Generator

Line	Parameter	Explanation
1	SEP=,	The field separator is a comma for both the edit specification and input from the terminal.
	ETAB=EDIT1	The edit table name is EDIT1.
	KEY=1	The first field described is positional. It must be the first field in the input message.

continued

Table E-2. Description of Sample Input to Edit Table Generator (cont.)

Line	Parameter	Explanation
	LEN=5	The edited field is five characters long.
	POS=0	In the edited message the field begins in position 0.
	MAN=Y	The field must be present for the message to be acceptable.
2	KEY=2	The field is positional. It must be the second field in the input message.
	LEN=20	The edited field is 20 characters long.
	POS=5	In the edited message the field begins in position 5.
	FIL=	The field is to be blank filled in the edited message.
	JUS=L	The field is to be left-justified in the edited message.
	MAN=Y	The field must be present for the message to be acceptable.
3	KEY=3	The field is positional. It must be the third field in the input message.
	LEN=40	The edited field is 40 characters long.
	POS=25	In the edited message, the field begins in position 25.
	FIL=	The field is to be blank filled in the edited message.
	JUS=L	The field is to be left-justified in the edited message.
4	KEY=AMT	The field is a keyword field. AMT=n must be specified in the input message.
	LEN=4	The edited field is four characters long.
	POS=65	In the edited message, the field begins in position 65.
	MIN=1000	The minimum level allowed for the message to be acceptable is $10.00 (entered as 1000).
	TYP=B	In the edited message, the field is to be converted to binary.
	MAN=Y	The field must be present for the message to be acceptable.
	FIL=0	The field is to be zero-filled in the edit message. (This parameter could have been omitted.)

continued

Table E-2. Description of Sample Input to Edit Table Generator (cont.)

Line	Parameter	Explanation
	JUS=R	The field is to be right-justified in the edited message. (This parameter could have been omitted.)
5	KEY=SN	The field is a keyword field.
	LEN=6	The edited field is six characters long.
	POS=69	In the edited message, the field begins in position 69.
	FIL=	The field is to be blank filled in the edited message.
	JUS=R	The field is to be right-justified in the edited message. (This parameter could have been omitted.)
	–	End of edit definition.

The following examples show freeform input from the terminal and the resulting messages sent to the action program in accordance with the edit table specifications or, in case of error, the output message displayed at the terminal. Note that in the edited messages, the 4-character binary field specified for the AMT entry is represented by an underlined, 4-hexadecimal-digit field. Spaces between each delimiter and the first character of the next field are ignored.

Terminal input:

```
PAYMT, JOHN D. SMITH,1112 BREEZE DR. PHILA.PA. 19160,
AMT=2500,SN=123456
```

Edited message received by action program:

```
PAYMTJOHNΔD.ΔSMITHΔΔΔΔΔΔΔ1112ΔBREEZEΔDR.ΔPHILA.ΔPA.Δ19160
ΔΔΔΔΔΔΔΔ09C4123456
```

Terminal input:

```
PAYMT,JOHN D. SMITH,,SN=123456,AMT=2500
```

Edited message received by action program:

```
PAYMTJOHNΔD.ΔSMITHΔΔΔΔΔΔΔΔΔΔΔΔΔΔΔΔΔΔΔΔΔΔΔΔΔΔΔΔΔΔΔΔΔΔΔΔΔΔΔ
ΔΔΔΔΔΔΔΔΔΔΔΔΔΔ09C4123456
```

The address field was not specified as mandatory in the edit table input and is omitted here; an additional comma is coded in its position. The AMT and SN fields are keyword fields and need not be entered in the order defined in the edit table input.

Terminal input:

```
PAYMT ,JOHN D. SMITH,1112 BREEZE DR. PHILA. PA. 19160,
AMT=2500,SN=123456
```

Output message:

```
ILLEGAL INPUT
```

The transaction code field is longer than the LEN specification.

Terminal input:

```
PAYMT,JOHN D. SMITH,1112 BREEZE DR. PHILA. PA.19160,
AMT=700,SN=123456
```

Output message:

```
AMT IS BELOW MIN
```

Edit table specifies AMT must be at least 1000.

Terminal input:

```
PAYMT, JOHN D. SMITH,1112 BREEZE DR. PHILA. PA. 19160,SN=123456
```

Output message:

```
AMT MISSING
```

AMT was specified as mandatory.

E.8. Sample Edit Table Application Including Action Program

This sample application describes an edit table for a customer purchase/payment application and includes the action program that uses edit table input.

E.8.1. Edit Table for the Purchase/Payment Application

Figure E-4 describes the input to the edit table generator.

```
SEP=;ETAB=ETABTST;KEY=1;POS=0;MAN=Y;LEN=5;                              0100
KEY=2;FIL= ;JUS=L;LEN=15;MAN=Y;TYP=A;POS=5;                             0200
KEY=3;FIL= ;JUS=L;LEN=20;POS=20;TYP=M;                                  0300
KEY=4;MIN=0001;MAX=9999;TYP=B;LEN=4;POS=40;MAN=Y;                       0400
KEY=5;MIN=-99999999;MAX=99999999;TYP=P;POS=44;LEN=8;MAN=Y;              0500
KEY=6;FIL=0;MIN=-20000;MAX=999999999;TYP=N;POS=52;LEN=10;MAN=Y;;        0600
```

Figure E-4. Sample Input to Edit Table Generator

Line 100 designates a semicolon as the field separator for both the edit specification and the input from the terminal. The edit table is named ETABTST. The first input field is positional and is the transaction code. The field begins in position 0, is mandatory, and is 5 characters long.

Line 200 describes the second input field as positional with blank-fill where the input entry is shorter than 15 characters. This second field is left-justified, 15 characters long, mandatory, alphanumeric, and begins in position 5.

Line 300 describes the third input field as positional with blank-fill, left-justified, 20 characters long and alphanumeric. The TYP=M parameter is not required because it is the default.

Line 400 describes the fourth input field as positional and allows a value of not less than 1 and not more than 9999 with a length of 4 characters. In the edited message, the field is converted to binary and begins in position 40. The field is mandatory.

Line 500 describes the fifth input field as positional with a minimum value of -99999999 and a maximum value of 99999999 in packed decimal format. The field begins in position 44, is 8 characters long, and is mandatory.

Line 600 describes the sixth input field as positional with a zero fill character, minimum value of -20000 and maximum value of 999999999 in numeric format beginning in position 52 for a length of 10 characters. The field is mandatory.

E.8.2. Action Program (EDITST) for Purchase/Payment Application

Figure E-5 provides the EDITST action program coding that processes the input message received from the edit table and issues an output message to the terminal.

```
       IDENTIFICATION DIVISION.
       PROGRAM-ID. EDITST.
       INSTALLATION. SPERRY-UNIVAC,BLUE BELL,PA.
       DATE-WRITTEN. FEBRUARY 1978.
       ENVIRONMENT DIVISION.
       CONFIGURATION SECTION.
       SOURCE-COMPUTER. UNIVAC-OS3.
       OBJECT-COMPUTER. UNIVAC-OS3.
       DATA DIVISION.
       WORKING-STORAGE SECTION.
       01  CRT                      PIC X(4) VALUE IS '    '.
       01  NXT-LNE                  PIC X(4) VALUE IS '    '.
       01  DEPOSIT                  PIC X(8)  VALUE IS 'PURCHASE'.
       01  WITHDRW                  PIC X(7)  VALUE IS 'PAYMENT'.
       01  LINE3-HEAD.
           05  NAME                 PIC X(4)  VALUE 'NAME'.
           05  FILLER               PIC X(26) VALUE SPACE.
           05  ADDRESS              PIC X(7)  VALUE 'ADDRESS'.
           05  FILLER               PIC X(23) VALUE SPACE.
           05  ACCOUNT              PIC X(7)  VALUE 'ACCOUNT'.
           05  FILLER               PIC X(13) VALUE SPACE.
       01  LINE6-HEAD.
           05  TRANSACT             PIC X(8)  VALUE 'TRANSACT'.
           05  FILLER               PIC X(12) VALUE SPACE.
           05  AMOUNT               PIC X(6)  VALUE 'AMOUNT'.
           05  FILLER               PIC X(14) VALUE SPACE.
           05  BALANCEO             PIC X(12) VALUE 'BALANCE(OLD)'.
           05  FILLER               PIC X(8)  VALUE SPACE.
           05  BALANCEN             PIC X(12) VALUE 'BALANCE(NEW)'.
           05  FILLER               PIC X(8)  VALUE SPACE.
       LINKAGE SECTION.
       01  PIB.      COPY      PIB74.
           02  STATUS-CODE                     PIC 9(4) COMP-4.
           02  DETAILED-STATUS-CODE            PIC 9(4) COMP-4.
           02  RECORD-TYPE REDEFINES DETAILED-STATUS-CODE.
               03 PREDICTED-RECORD-TYPE        PIC X.
               03 DELIVERED-RECORD-TYPE        PIC X.
           02  SUCCESSOR-ID                    PIC X(6).
           02  TERMINATION-INDICATOR           PIC X.
           02  LOCK-ROLLBACK-INDICATOR         PIC X.
           02  TRANSACTION-ID.
               03 YEAR                         PIC 9(4) COMP-4.
               03 TODAY                        PIC 9(4) COMP-4.
               03 HR-MIN-SEC                   PIC 9(9) COMP-4.
           02  DATA-DEF-REC-NAME               PIC X(7).
           02  DEFINED-FILE-NAME               PIC X(7).
           02  STANDARD-MSG-LINE-LENGTH        PIC 9(4) COMP-4.
           02  STANDARD-MSG-NUMBER-LINES       PIC 9(4) COMP-4.
           02  WORK-AREA-LENGTH                PIC 9(4) COMP-4.
           02  CONTINUITY-DATA-INPUT-LENGTH    PIC 9(4) COMP-4.
```

Figure E-5. Sample Action Program (EDITST) Using Edit Table Generator Input
(Part 1 of 3)

```
                02  CONTINUITY-DATA-OUTPUT-LENGTH   PIC 9(4) COMP-4.
                02  WORK-AREA-INC                   PIC 9(4) COMP-4.
                02  CONTINUITY-DATA-AREA-INC        PIC 9(4) COMP-4.
                02  SUCCESS-UNIT-ID.
                    03 TRANSACTION-DATE.
                       04  YEAR                     PIC 99.
                       04  MONTH                    PIC 99.
                       04  TODAY                    PIC 99.
                    03 TIME-OF-DAY.
                       04  HOUR                     PIC 99.
                       04  MINUTE                   PIC 99.
                       04  SECOND                   PIC 99.
                    03 FILLER                       PIC XXX.
                02  SOURCE-TERMINAL-CHARS.
                    03 SOURCE-TERMINAL-TYPE   PIC X.
                    03 SOURCE-TERM-MSG-LINE-LENGTH    PIC 9(4) COMP-4.
                    03 SOURCE-TERM-MSG-NUMBER-LINES   PIC 9(4) COMP-4.
                02  DDP-MODE                        PIC X.
            01  IMA.     COPY    IMA74.
                02 SOURCE-TERMINAL-ID                     PIC X(4).
                02 DATE-TIME-STAMP.
                   03 YEAR                                PIC 9(4) COMP-4.
                   03 TODAY                               PIC 9(4) COMP-4.
                   03 HR-MIN-SEC                          PIC 9(9) COMP-4.
                02 TEXT-LENGTH                            PIC 9(4) COMP-4.
                02 AUXILIARY-DEV-ID.
                   03 FILLER                              PIC X.
                   03 AUX-DEV-NO                          PIC X.
                02  LINE-1-IN.
                 07 TRANSACT          PIC X(5).
                 07 IN-NAME           PIC A(15).
                 07 IN-ADDR           PIC X(20).
                 07 IN-ACC-NO         PIC 9(8)   COMP.
                 07 IN-AMOUNT         PIC S9(13)V99 COMP-3.
                 07 IN-BALANCE        PIC S9(8)V99.
            01  OMA.     COPY    OMA74.
                02 DESTINATION-TERMINAL-ID            PIC X(4).
                02 SFS-OPTIONS                        PIC X(2).
                02 FILLER                             PIC X(2).
                02 CONTINUOUS-OUTPUT-CODE             PIC X(4).
                02 TEXT-LENGTH                        PIC 9(4)    COMP-4.
                02 AUXILIARY-DEVICE-ID.
                   03 AUX-FUNCTION                    PIC X.
                   03 AUX-DEVICE-NO                   PIC X.
                02  OUTPUT-MSG-TEXT.
                03   LINE1-DICE       PIC X(4).
                03   LINE1-OUT        PIC X(80).
                03   LINE2-DICE       PIC X(4).
                03   LINE3-DICE       PIC X(4).
                03   LINE3-HEADER     PIC X(80).
                03   LINE4-DICE       PIC X(4).
                03   LINE4-OUT.
                 05 NAMEALP           PIC A(15).
                 05 FILLER            PIC X(15).
                 05 ADDR-ALPNUM       PIC X(20).
                 05 FILLER            PIC X(10).
                 05 ACC-NO-BIN        PIC 9(8).
                 05 FILLER            PIC X(12).
                03   LINE5-DICE       PIC X(4).
                03   LINE6-DICE       PIC X(4).
```

Figure E-5. Sample Action Program (EDITST) Using Edit Table Generator Input
(Part 2 of 3)

```
           03  LINE6-HEADER       PIC X(80).
           03  LINE7-DICE         PIC X(4).
           03  LINE7-OUT.
            05 TYPE-TRANS         PIC X(8).
            05 FILLER             PIC X(12).
            05 AMOUNT-PAC         PIC 9(14).99CR.
            05 FILLER             PIC X(2).
            05 BAL-OLD-NUM        PIC 9(8).99CR.
            05 FILLER             PIC X(8).
            05 BAL-NEW-NUM        PIC 9(8).99CR.
           03  LINE8-DICE         PIC X(4).
       01  WORK.
           05  UNPAC-AMT          PIC 9(14)V99.
       PROCEDURE DIVISION USING PIB IMA WORK OMA.

       HOUSEKEEPING.
           MOVE CR1 TO LINE1-DICE.
           MOVE NXT-LNE TO LINE2-DICE, LINE3-DICE, LINE4-DICE,


               LINE5-DICE, LINE6-DICE, LINE7-DICE, LINE8-DICE.
           MOVE TRANSACT OF LINE-1-IN TO LINE1-OUT.
           MOVE LINE3-HEAD TO LINE3-HEADER.
           MOVE LINE6-HEAD TO LINE6-HEADER.
       INPUT-CHECK.
           MOVE IN-NAME TO NAMEALP.
           MOVE IN-ADDR TO ADDR-ALPNUM.
           MOVE IN-ACC-NO TO ACC-NO-BIN.
           IF IN-AMOUNT IS LESS THAN 0 THEN MOVE WITHDRAW TO TYPE-TRANS
               ELSE MOVE DEPOSIT TO TYPE-TRANS.
           MOVE IN-AMOUNT TO AMOUNT-PAC.
           MOVE IN-BALANCE TO BAL-OLD-NUM.
           ADD IN-AMOUNT , IN-BALANCE
                   GIVING BAL-NEW-NUM.
           MOVE 430 TO TEXT-LENGTH OF OMA.
       EXIT-PROG.
           CALL 'RETURN'.
```

Figure E-5. Sample Action Program (EDITST) Using Edit Table Generator Input
(Part 3 of 3)

E.8.3. Processing the Purchase/Payment Application

When the terminal operator enters the unformatted input -- transaction code, name, address, account number, amount, and balance as follows:

```
WIDEP;JAN HALS;1422 AMBER LN PHILA;472;11000;35000
```

the edit table generator formats the input according to your edit table input parameters (Figure E-4), and the action program EDITST (Figure E-5) receives this edited input in its input message area as follows:

```
WIDEP;JANΔHALSΔΔΔΔΔΔΔ;1422ΔAMBERΔLNΔPHILAΔ01D8;
00011000;0000035000
```

Note that for easier identification in this example, the binary account field expected as input to the action program is shown here as a hexadecimal value and underlined.

The EDITST action program receives this input message giving the old balance and payment amount, computes a new balance, and generates a 5-line output message as follows:

```
Line 1 | WIDEP
     2 |
     3 | NAME                            ADDRESS                          ACCOUNT
     4 | ANDREW S. WYETH                 1422 AMBER LN PHILA.             00000472
     5 |
     6 | TRANSACT          AMOUNT                  BALANCE(OLD)       BALANCE(NEW)
     7 | PURCHASE          0000000000110.00        00000350.00        00000460.00
```

In the Procedure Division, EDITST moves the transaction code into the first line of the output message, double spaces, moves the NAME-ADDRESS-ACCOUNT header to line 3, double spaces, moves the TRANSACT-AMOUNT-BALANCES header to line 6, and begins computations based on your terminal input.

EDITST places the name, address, and account number entered at the terminal in line 4 of the output message. Note that the account number entered at the terminal is decimal; however, the edit table generator converts this number to binary and EDITST receives it as a binary field.

Note that in your action program, any fields describing decimal values keyed in at the terminal must be defined large enough to accommodate the field as received from the edit table generator. For example, an 8-digit decimal number entered as an amount from the terminal and defined by LEN=8 and TYP=P in the edit table parameters (Figure E-4, line 500) is defined in the program's input and output message texts as a 16-byte packed field (Figure E-5, line 84 and 116). This field sizing also applies to binary values.

Next, EDITST tests the amount field (IN-AMOUNT) entered as input to see if it is less than zero. If the amount entered was negative, it was for payment; otherwise, it was for purchase. EDITST moves these respective constants to the output message area.

After this, the program moves the input amount and old balance to the output message area and adds either the negative payment amount or the positive purchase amount to the old balance giving the new balance.

Finally, the total output message text length is moved to the output message area TEXT-LENGTH field before the RETURN function ends the transaction. When the RETURN function executes, EDITST sends the type transaction, amount of payment or purchase, old balance, and new balance to line 7 of the output message and, the entire output message text to the designated lines.

Appendix F
Using Device-Independent Expressions and Field Control Characters

F.1. General Information

You use device independent control expressions (DICE sequences) to format input and output messages handled by action programs. These codes are needed to control various operations, such as cursor positioning and carriage return, on a terminal screen.

This appendix supplies all DICE sequences and their interpretations, describes how to use them in formatting messages in your action programs, and discusses the DICE macroinstructions used in BAL action programs to create the DICE sequences. In addition, it presents limited information concerning the use of field control characters.

F.2. Formatting Messages

F.2.1. Output Messages

There are numerous methods for formatting output messages. The action program can use:

1. Screen format services. For a complete discussion of how to use screen format services, see Section 7.

2. Device-independent control expressions

3. Format control expressions with UNISCOPE 100 and 200 display terminals

4. Field control characters (FCCs) with workstations and UTS terminals

This appendix supplies information on DICE sequences and how to use them. Also included is information concerning field control characters.

When a program uses format control expressions, it must include a different formatting routine for each type of terminal receiving the output. Figure F-1 illustrates this.

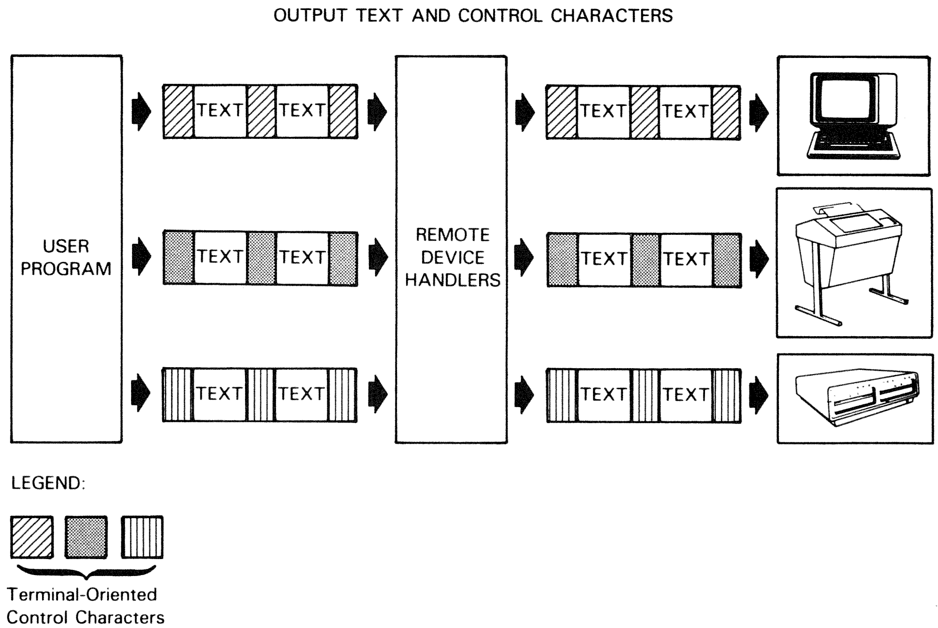


Figure F-1. Using Terminal-Oriented Control Characters to Format Messages

Using DICE sequences to format messages eliminates this problem. The remote device handler converts DICE sequences to control characters for each destination terminal, regardless of type. Some of the control character functions are:

- Line feed - cursor movement to the first space of a new line
- Form feed - cursor to the home position of a new page
- Carriage return - cursor to the beginning of the same line
- Cursor movement to a specific row and column on a display

You can place DICE sequences anywhere in a message. As you can see in Figure F-2, DICE sequences simplify message formatting.

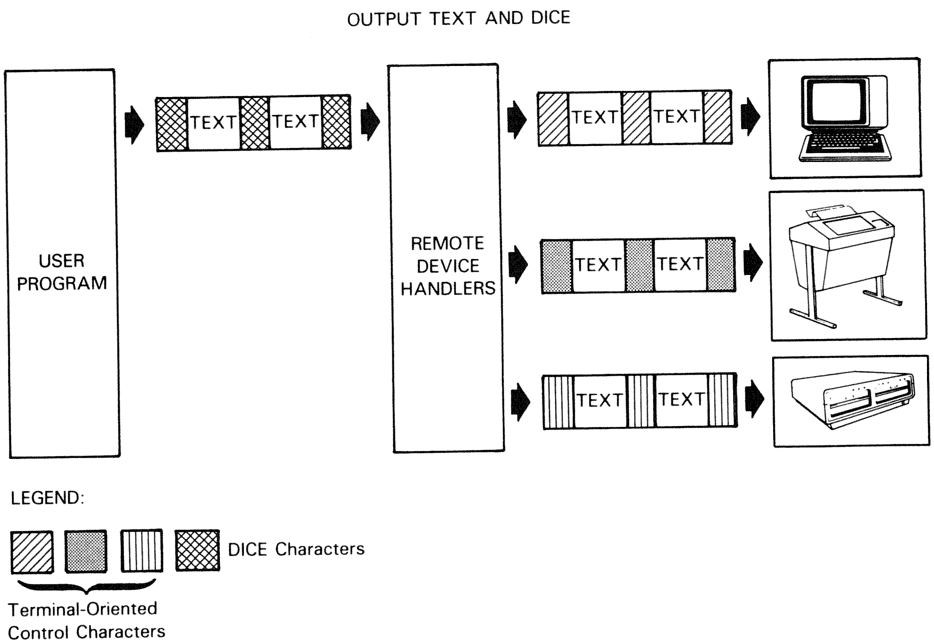


Figure F-2. Using Dice Sequences to Format Messages

F.2.2. Input Messages

For input, the remote device handler converts control characters received in a message into DICE sequences. For certain terminals, your program can analyze these sequences to determine cursor position. In addition, input DICE is handy for message switch applications because control characters in each input message are converted to DICE sequences. The remote device handler converts these sequences into the appropriate control characters for the destination terminal.

When you specify EDIT=c or EDIT=tablename in the ACTION section of the IMS configuration, input DICE is stripped from your input message. You should specify EDIT=c or EDIT=tablename in your IMS configuration. (Specify EDIT=tablename only when you generate an edit table for the action. See Appendix E.)

F.3. DICE and ICAM

You can turn DICE on or off when you define your communications network with the DICE operand of the TERM macroinstruction.

```
DICE= ({ON })
      ({OFF})
```

where:

DICE=ON
Remote device handler creates input DICE according to your input terminal cursor movements.

DICE=OFF
Remote device handler does not create input DICE.

The default is DICE=(ON). It is recommended that you specify DICE=(ON) or omit this operand because many IMS features require the use of input DICE. Certain terminal commands and IMS transaction codes are not available when you specify DICE=(OFF).

See *Integrated Communications Access Method (ICAM) Technical Overviews*, UP-9744, for a detailed explanation of input DICE creation, and the *IMS System Support Functions Programming Guide,* UP-11907, for specific IMS considerations.

F.4. DICE Sequence Format

select character	function code	m field	n field

where:

`select character`
: Hexadecimal character (10) designates the start of a DICE sequence.

`function code`
: Defines the device control sequence that is recognized by the remote device handlers on input. On output, this code is a 1-character field defining the operation to be performed on the text message. DICE function codes are listed in Table F-1.

`m field` and `n field`
: These fields are treated as parameters to the DICE function code. Their actual definition varies and is determined by the individual DICE macroinstruction. Generally, m relates to vertical positioning and n refers to horizontal positioning.

These fields may be expressed in absolute values (m_a and n_a) or relative displacement values (m_r and n_r). The absolute values align the text message to the actual location (row and column) on a page or screen. The relative displacement values give a relative location from the present position of the cursor, that is, move cursor two rows down and one column to the right. All values are expressed in hexadecimal notation. If you choose to use DICE macroinstructions, these parameters must be specified.

F.5. Using DICE Macroinstructions in BAL Programs

DICE macroinstructions let you create DICE sequences (DICE constants) in the same way you would create constants in your program; when the assembler expands a DICE macroinstruction, your program creates a constant at that location.

On output, when your program is ready to send a message, it moves the DICE constants created from the DICE macroinstructions into the appropriate places in your message before it issues the output request. The remote device handler converts the DICE constants into the corresponding control characters to produce the necessary positioning.

On input, DICE sequences are automatically created by the remote device handlers unless you specify the DICE=(OFF) parameter in your network definition. Table F-1 lists the DICE macroinstructions, function code generated, and m and n coordinates as they apply to particular devices on input and output.

You must specify m and n coordinates in your program according to the absolute and relative values expressed in Table F-1. m_a and n_a are absolute values of m and n; m_r and n_r are relative displacements of m and n. For CRT terminals, the home position is $(m_a, n_a)=(1,1)$. For character- or page-oriented devices that allow position to top of form, the top-of-form position is $(m_a,n_a)(1,1)$.

- Absolute positions

  Absolute positions of m_a and n_a may range as follows:

  m_a ranges 1 to r

  where:

  r = maximum number of rows (CRT), or maximum number of lines per page.

  n_a ranges 1 to c

  where:

  c = maximum number of columns (CRT), or maximum number of character positions per line.

- Relative positions

  Relative displacements of m_r and n_r may begin at zero and range to the bottom and right margin of the screen or page.

  If a value of m or n falls outside of the legal range, that value of m or n will cause the following action:

  m_a or n_a = 0 is interpreted as m_a or n_a = 1

Specifying an absolute or relative value for m or n that is greater than the screen or page size causes unpredictable results.

F.6. Generating DICE Codes

Macroinstructions are issued to generate the DICE codes.

LABEL	ΔOPERATIONΔ	OPERAND
[symbol]	dice-macroinstruction	m,n

where:

`[symbol]`
: An optional alphanumeric character string, from one to eight characters long, that identifies the specific instruction line.

`dice-macroinstruction`
: You specify the appropriate name from the macroinstruction column of Table F-1 for the desired DICE sequence.

`m`
: A decimal number (0 to 255) indicating the number of lines or rows the terminal should advance before starting output of the message (Table F-1).

`n`
: A decimal number (0 to 255) indicating the number of spaces or columns to the right the terminal should space before starting output of the message (Table F-1).

```
     1           10      16
    ---------------------------
1.  NEWLINE     ZO#POS 0,0
2.  COORDI      ZO#COORD 5,10
```

1. This DICE sequence causes movement to a new line.

2. New text starts at line 5, column 10.

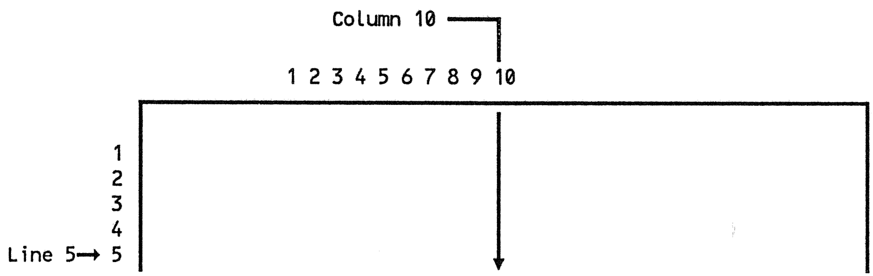


Table F-1. Dice Input/Output Commands, Codes, and Device Interpretation

DICE Macro-instruction	Function	Function Code Value	I/O	m	n	Character-oriented Devices①	CRT Devices	Page Printing Devices (n is Not Interpreted)	Communications Output Printer (COP) or Terminal Printer (TP)
ZO#COORD	Set coordinates	01_{16}	INPUT	m	n	Not used	m and n represent the start-of-entry (SOE) cursor coordinates.	Not used	Not used
			OUTPUT	m_a	n_a	Action is optional.②	Move cursor to row m and column n.	Action is optional.②	Action is optional.②
ZO#FORM	Forms control	02_{16}	INPUT	01	01	Form feed	Form feed	Not used	Not used
			OUTPUT	m_a	n_a	Form feed, carriage return, and advance to line m and column n (m-1 line feeds and n—1 spaces to the right)	Move cursor to row m and column n.	Top of form and advance to line m (m-1 line feeds)	Form feed, line feed, and advance to line m and column n (m—1 line feeds and n—1 spaces to the right)
ZO#FORMC	Forms control with clear unprotected data	03_{16}	INPUT	—	—	Not used	Not used	Not used	Not used
			OUTPUT	m_a	n_a	Action is optional.②	Move cursor to row m and column n, and clear unprotected data to end of screen.	Action is optional②	Action is optional.②
ZO#POS	New line control	04_{16}	INPUT	00	00	Carriage return, line feed	Cursor return	Not used	Not used
			OUTPUT	m_r	n_r	Carriage return, line feed, followed by m line feeds and n spaces to the right.	Move cursor to beginning of next line. Then move cursor m lines down and n columns to the right	Advance (m+1) lines.	Line feed, followed by m line feeds and n spaces to the right.
ZO#POSC	New line control with clear	05_{16}	INPUT	—	—	Not used	Not used	Not used	Not used
			OUTPUT	m_r	n_r	Carriage return, line feed, followed by m line feeds and n spaces to the right	Same as 04_{16} except area between start and end positions is cleared.	Advance (m+1) lines.	Line feed, followed by m line feeds and n spaces to the right

continued

Table F-1. Dice Input/Output Commands, Codes, and Device Interpretation (cont.)

DICE Macro-instruction	Function	Function Code Value	I/O	m	n	Character-oriented Devices①	CRT Devices	Page Printing Devices (n is Not Interpreted)	Communications Output Printer (COP) or Terminal Printer (TP)
ZO#CUR	Current position control	06_{16}	INPUT	01	00	Line feed	Line feed	End of input card	Not used
			OUTPUT	m_r	n_r	m line feeds and n spaces to the right	Move cursor m lines down and n columns to the right.	Advance m lines.	Insert n spaces if nonsignificant space suppression is allowed. If not, insert n DC3 characters; m is not interpreted.③
ZO#CURC	Current position control with clear	07_{16}	INPUT	—	—	Not used	Not used	Not used	Not used
			OUTPUT	m_r	n_r	m line feeds and n spaces to the right	Insert n spaces if nonsignificant space suppression is allowed. If not, insert n DC3 characters; m is not interpreted.③	Advance m lines.	Insert n spaces if nonsignificant space suppression is allowed. If not, insert n DC3 characters; m is not interpreted.③
ZO#BEG	Beginning of current line control	08_{16}	INPUT	00	00	Carriage return	Not used	Not used	Not used
			OUTPUT	m_r	n_r	Carriage return followed by m line feeds and n spaces to the right	Move cursor to beginning of current line. Then move cursor m lines down and n columns to the right.	Advance m lines.	m line feeds and n spaces to the right.
ZO#TABS	Set tab stop at an absolute position④	09_{16}	INPUT	—	—	Not used	Not used	Not used	Not used
			OUTPUT	m_a	n_a	No line feed, space to right.	Set tab stop at row m and column n.	Advance m lines.	Not used
ZO#FORMA	Forms control with clear; protected/unprotected data	$0A_{16}$	INPUT	—	—	Not used	Not used	Not used	Not used
			OUTPUT	m_a	n_a	Action is optional.②	Move cursor to row m and column n and clear protected/unprotected data to end of screen.	Action is optional.②	Action is optional.②

continued

Table F-1. Dice Input/Output Commands, Codes, and Device Interpretation (cont.)

DICE Macro-instruction	Function	Function Code Value	I/O	m	n	Character-oriented Devices①	CRT Devices	Pages Printing Devices (n is Not Interpreted)	Communications Output Printer (COP) or Terminal Printer (TP)①
ZO#ERSLN	Erase to end of line	$0B_{16}$	INPUT	—	—	Not used	Not used	Not used	Not used
			OUTPUT	m_a	n_a	No action	Cursor does not move. Unprotected data to the end of a line or to the end of the first unprotected field is cleared, whichever comes first.	Advance 0 lines.	Not used

Notes:

1 Most character-oriented terminals can be strapped to handle the carriage return (CR) character and the line feed (LF) character as follows:

- CR

  1. print mechanism moves to beginning of the same line

  or

  2. print mechanism moves to the beginning of the same line followed by a line feed

- LF

  1. line feed (no column change)

  or

  2. line feed followed by return of the print mechanism to the beginning of the new line

To achieve device independence between terminal types, the character-oriented terminals must use the first option for CR and the first option for LF if the device macroinstruction is ZO#CUR or ZO#BEG.

Use the first option when the character-oriented terminals are a part of a message switch environment.

Certain terminals do not have a form-feed capability (that is, some teletypewriters). For these terminals, the DICE expressions that specify form feed will line feed.

continued

Table F-1. DICE Input/Output Commands, Codes, and Device Interpretation (cont.)

2 The set coordinates macroinstruction (ZO#COORD) or the forms control with clear macroinstruction (ZO#FORMC), when acted upon by character-oriented or page-printing terminals, will vary in its action, depending on the usage of the DICE keyword parameter of the TERM macroinstruction at network definition time:

```
TERM  ...,DICE= ({FORMS  }) ,...
                ({NEWLINE})
```

When FORMS is specified, the set coordinates macroinstruction is interpreted as the forms control macroinstruction.

When NEWLINE is specified, the set coordinates macroinstruction and the forms control with clear macroinstruction will result in a carriage return, line feed for character-oriented terminals, or advance one line for page-oriented terminals; m and n are not interpreted.

When the DICE parameter is not specified, the default option is NEWLINE.

3 The UNISCOPE display terminal suppresses nonsignificant spaces on each line (except for the line containing the cursor) when text is transmitted to the processor or printed locally on the COP or TP.

Your program may send data to the UNISCOPE screen containing significant blank segments that include the last column of the screen. If this data is transmitted from the terminal to the processor or is printed locally on the COP or TP, the blank segments must consist of nonspace characters that are nondisplayable. The DC3 character meets these qualifications. The ICAM interface provides your program with the capability to prevent nonsignificant space suppression on the UNISCOPE display terminal. The "current position control with clear" is the only DICE macroinstruction that can perform a clear function if your program is preventing nonsignificant space suppression.

Note:

The ASCII-to-EBCDIC translation table is modified so that the DC3 character is translated to space 40_{16} for input from the UNISCOPE display terminal.

4 When using DICE function code 09_{16} for setting a tab stop, m=0 and n=0 results in a tab stop being placed at the current cursor location (no cursor positioning is performed). This applies to UNISCOPE and UTS 400 devices only. For teletypewriters and DCT 500 terminals, a space character is inserted.

When m or n is greater than the maximum allowable m or n, action varies depending on the remote terminal:

- UNISCOPE display terminals - wraparound occurs on the screen.
- Character-oriented terminals - gives different results depending on device characteristics.

F.7. Interpreting DICE Sequences

When using DICE, your program does not need to be aware of the terminal type. A particular DICE denotes the same positioning on any terminal. There are some exceptions that result from terminal limitations.

The interpretation of a DICE by the remote device handler is controlled by:

1. DICE function code
2. DICE m and n fields
3. The terminal involved
4. The particular device on the terminal being used

The remote device handlers currently provide device-independent support for three classes of remote terminal devices:

1. Hard-copy character-oriented devices, such as the Unisys Data Communications Terminal 475 (DCT 475), Data Communications Terminal 500 (DCT 500), Data Communications Terminal 524 (DCT 524), and Data Communications Terminal 1000 (DCT 1000), and Teletype teletypewriter models 28, 32, 33, 35, and 37.
2. Hard-copy page printer device, such as the Unisys 1004 Card Processor System, Data Communications Terminal 2000 (DCT 2000), and the IBM 2780.
3. CRT-type terminals, such as the UNISCOPE 100 and 200 and the UTS 400 display terminals.

Table F-2 defines the primary output device and the primary input device for each terminal type.

Table F-2. DICE Primary Devices

Terminal Type	Primary Output Device	Primary Input Device
Character-oriented terminals	Printer	Keyboard
Page printing terminals	Printer	Card reader
CRT terminals	Screen	Keyboard

In addition to the specified primary devices, each terminal has the ability to support one or more auxiliary devices. The auxiliary devices suggested by each terminal are listed in Table F-3.

Table F-3. DICE Usage for Auxiliary Devices

Remote Terminals	Auxiliary Device	DICE Usage
UNISCOPE	Tape cassette (TCS) Communications output printer (COP) 800 terminal printer (TP)	DICE is applied to the COP. 1
DCT 1000	Card reader/card punch Paper tape reader/punch	DICE is applied as if the output/input is to/from the primary device, even though it is for the auxiliary device. 2
DCT 500/TTY	Paper tape reader/punch	
DCT 524	Tape cassette (TCS) in paper tape read and write only	
Batch terminals	Punch	DICE is used for end of network buffer sentinel. No forms control action is taken.

Continued

Table F-3. DICE Usage for Auxiliary Devices (cont.)

Notes:

1 When the print transparent option is not used, DICE is applied to the UNISCOPE screen even though the output is sent to an auxiliary device of the UNISCOPE terminal. In this case, the format of the data printed on the COP or TP is identical to the screen format. Nonsignificant space suppression by the UNISCOPE terminal may have to be prevented to keep the formats identical.

The full capability of DICE cannot be applied to the COP because of hardware characteristics. All data to a UNISCOPE auxiliary device passes through the UNISCOPE terminal. When DICE is applied to the COP, the use of print transparent mode means that no carriage returns are transferred to the COP. Line feeds and form feeds take a storage position in the UNISCOPE storage and are nondisplayable. These characters are passed to the COP where:

- An LF causes a line feed followed by return of the print mechanism to the beginning of the new line
- An FF causes a page eject and positioning of the print mechanism at the beginning of the first line of the form

The COP has no tabbing capability.

These characteristics are reflected in the interpretation of DICE output function codes for the COP as shown in Table F-2.

For messages sent to a UNISCOPE auxiliary device with transparent transfer, the cursor to home (ESC e) sequence is inserted at the beginning of the text by the RDH.

2 The control characters that are generated from the DICE macroinstructions are always created for the primary device of a character-oriented device, even though your program is sending to an auxiliary device. The message and these control characters (carriage returns, line feeds, form feeds, and spaces) will be punched/written by the output auxiliary device that was specified by your program or was switch-selected by the terminal operator. If the punched/written data is later read by the terminal's input auxiliary device, the carriage returns, line feeds, and form feeds are converted to input DICE as specified in Table F-1.

F.8. Using DICE Sequences in a COBOL Action Program

Though COBOL action programs do not issue DICE macroinstructions, they do use the function code values in PICTURE clauses to position messages and control the cursor. Table F-1 lists and explains the possible DICE I/O commands. The following example of output message coding (Figure F-3) illustrates a COBOL action program's use of DICE sequences to issue the terminal message shown following the code (Figure F-4).

```
01 O-M-A             COPY OMA.
   02  DESTINATION-TERMINAL-ID         PIC X(4).
   02  SFS-OPTIONS.
       03  SFS-TYPE                    PIC X(2).
       03  SFS-LOCATION                PIC X(2).
   02  FILLER                          PIC X(2).
   02  CONTINUOUS-OUTPUT-CODE          PIC X(4).
   02  TEXT-LENGTH                     PIC 9(4)    COMP-4.
   02  AUXILIARY-DEVICE-ID.
       03  AUX-FUNCTION                PIC X.
       03  AUX-DEVICE-NO               PIC X.
   02  OUTPUT-TEXT.
       03  DICE-SEQ-1                  PIC X(4)   VALUE ='100A0A1E'.
       03  LINE-1                      PIC X(22)  VALUE 'YOU USE DICE SEQUENCES'.
       03  DICE-SEQ-2                  PIC X(4)   VALUE ='10010C20'.
       03  LINE-2                      PIC X(18)  VALUE 'ON THE OUTPUT FORM'.
       03  DICE-SEQ-3                  PIC X(4)   VALUE ='10040E22'.
       03  LINE-3                      PIC X(14)  VALUE 'TO FORMAT YOUR'.
       03  DICE-SEQ-4                  PIC X(4)   VALUE ='10081026'.
       03  LINE-4                      PIC X(7)   VALUE 'MESSAGE'.
```

Figure F-3. COBOL Action Program Using DICE Sequences to Format Output Message

```
COLUMN              30  32  34     38
                     |   |   |      |
ROW                  v   v   v      v
 10 ---------------> YOU USE DICE SEQUENCES
 12 -------------------> ON THE OUTPUT FORM
 14 -----------------------> TO FORM YOUR
 16 ------------------------------> MESSAGE
```

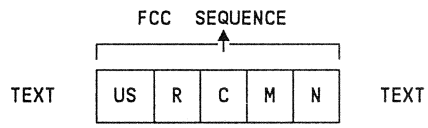
Figure F-4. A DICE Formatted Output Message on the Terminal Screen

Here is a brief description of the DICE sequences used in Figure F-3.

DICE Sequence	Description
100A0A1E	The select character 10 signals the start of the DICE sequence. The function code (0A) clears all protected and unprotected data from the terminal screen. The m field (0A) and the n field (1E) position the cursor to row 10, column 30.
10010C20	The select character 10 is always the same and signals the start of the DICE sequence. The function code (01) sets coordinates as directed by the m and n fields of the DICE sequence. The m field (0C) and the n field (20) position the cursor at row 12, column 32.
10040E22	The select character is the same as before. The function code (04) moves the cursor to the beginning of the text line and then sets the coordinates as directed by the m and n fields. The m field (0E) and the n field (22) position the cursor two rows below where it presently is and in column 34.
10081026	The select character is again the same. The function code (08) returns the cursor to the beginning of the current line. The m field (10) and the n field (26) position the cursor two rows below the current line and in column 38.

F.9. Using Field Control Characters

Each field control character (FCC) sequence contains a preface control character, a screen row number, screen column number, and two character places that define the screen operations being performed by the sequence. The field control character sequence format is:



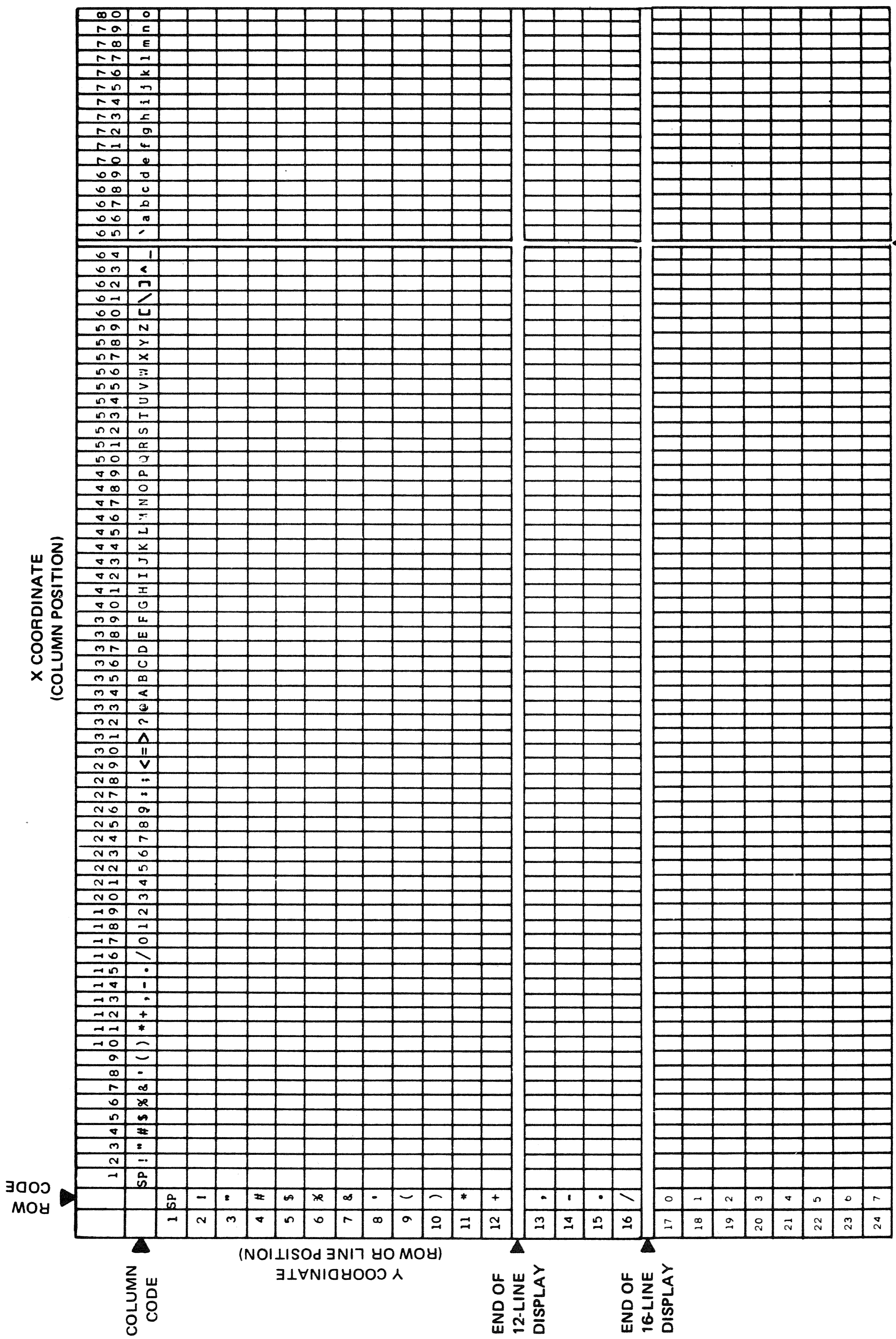
US is the control character that signals the start of a field control character sequence. It corresponds to a hexadecimal 1F.

R is the number of the row in which the field control character is placed. This is the hexadecimal value equivalent to the row code for the screen row indicated in Figure F-5.

C is the number of the column in which the field control character is placed. This is the hexadecimal value equivalent to the column code for the screen column indicated in Figure F-5.

M is a hexadecimal value placed in the sequence to define bits 4, 5, 6, and 7 of the field control character operation. Table F-4 lists the hexadecimal codes you can use.

N is a hexadecimal value placed in the sequence to define bits 0, 1, 2, and 3 of the field control character operation. Table F-5 lists the hexadecimal codes you can use.



NOTE:

The addressing sequence will always be:
Y position (lines 1 through 12, 16, or 24);
then X position (columns 1 through 64 or 80).

Figure F–5. Row and Column Coordinate Values Used in Field Control Sequences

Table F-4. Hexadecimal Codes Used as M in the FCC Sequence

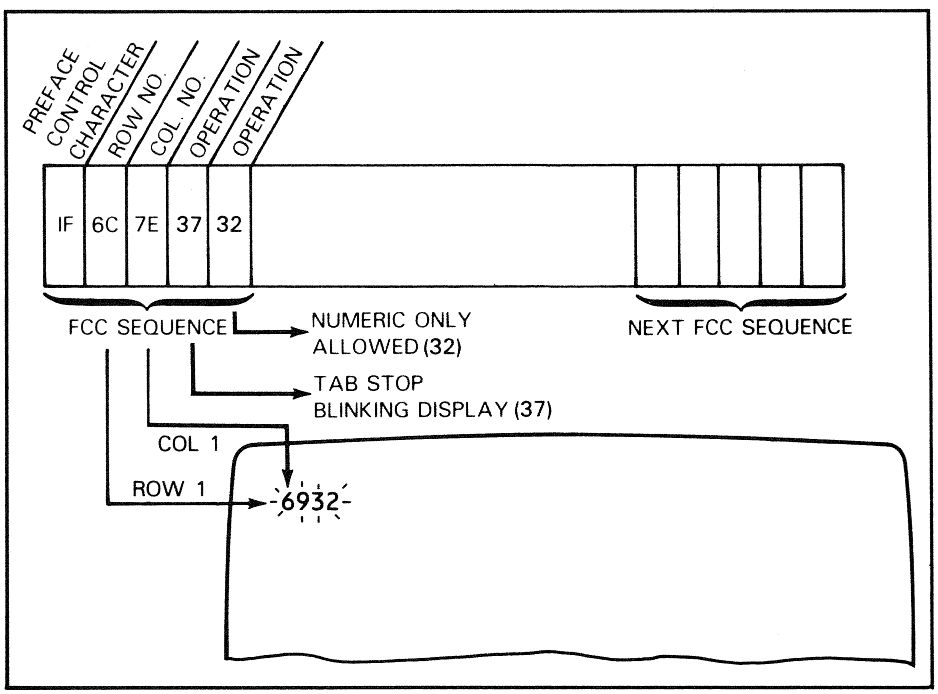
ASCII Character	Hexadecimal Code	Field Characteristics
0	30	Tab stop, normal intensity, changed field*
1	31	Tab stop, display off (no intensity), changed field*
2	32	Tab stop, low intensity, changed field*
3	33	Tab stop, blinking display, changed field*
4	34	Tab stop, normal intensity
5	35	Tab stop, display off (no intensity)
6	36	Tab stop, low intensity
7	37	Tab stop, blinking display
8	38	Not tab stop, normal intensity, changed field*
9	39	Not tab stop, display off (no intensity), changed field*
:	3A	Not tab stop, low intensity, changed field*
;	3B	Not tab stop, blinking display, changed field*
<	3C	Not tab stop, normal intensity
=	3D	Not tab stop, display off (no intensity)
>	3E	Not tab stop, low intensity
?	3F	Not tab stop, blinking display

* Normally, when an FCC is generated by the host processor, the changed-field designator is cleared. However, the host processor can generate individual FCCs with the changed-field designator set; this capability may be used for selective transfer or transmission of fields which were not in fact changed by the terminal operator. By sending an ESC u code to the terminal in a text message, the host processor can clear the changed-field designators in all FCCs without regenerating each FCC and without altering the data within the fields.

Table F-5. Hexadecimal Codes Used as N in the FCC Sequence

ASCII Character	Hexadecimal Code	Field Characteristics
0	30	Any input allowed
1	31	Alpha only allowed
2	32	Numeric only allowed
3	33	Protected (no entries and no changes allowed)
4	34	Any input allowed, right-justified
5	35	Alpha only allowed, right-justified
6	36	Numeric only allowed, right-justified

The following diagram illustrates a field control character sequence and the resulting output display of a numeric field to which this sequence is applied. Notice the 1F preface control character is followed by a row and column positioning of the field at 6 rows down ($6C_{16}$) and 30 columns across ($7E_{16}$) the screen. At this screen location, the next character, the operation value, (37_{16}, Table F-4) specifies a tab stop with blinking display. The last character (32_{16}, Table F-5) specifies numeric fields only allowed.



Appendix G
Difference between Extended COBOL and 1974 American Standard COBOL

G.1. Differences

If you use the extended COBOL compiler, there are a number of differences in coding, compiling, and linking your action programs. Table G-1 explains.

Table G-1. Differences for Extended COBOL and 1974 COBOL Action Programs

Extended COBOL	1974 COBOL
No reentrant code parameter supported	Reentrant code parameter format is: `// PARAM IMSCOD=REN`
Shared code parameter format is: `// PARAM OUT=(M)`	Shared code parameter format is: `// PARAM IMSCOD=YES`
Linkage editor INCLUDE statement: `INCLUDE prog-id00`	Linkage editor INCLUDE statement: `INCLUDE prog-id`

I/O function code format is:
 	
`ENTER LINKAGE.`
`CALL statement.`
`ENTER COBOL.`
	I/O function code format is:
	
	`CALL statement.`

DICE code sequences expressed as DICE value multipunch equivalent. (See Figure G-3.)	DICE code sequences expressed as DICE value hexadecimal equivalent.
Restricted reserved words different from 1974 COBOL (See 2.3.)	Restricted reserved words different from extended COBOL (See G.6.)

G.2. Shared Code Parameter

Using the shared code parameter allows the extended or 1974 COBOL compilers to check the program for conformance to IMS syntax and to issue appropriate compilation diagnostics. If you use this option along with the configurator parameters, TYPE and SHRDSIZE, programs are allowed to run as shared under multithread IMS.

For shared code parameter formats for extended and 1974 COBOL, see Table G-1. Section 11 provides more details about compiling sharable and nonsharable action COBOL programs.

G.3. Reentrant Code Parameter

Reentrant action programs are only supported under 1974 COBOL. Specify the TYPE=RNT parameter in your IMS configuration, and compile the program with the IMSCOD=REN parameter to run reentrant COBOL action programs. Increase the work area size designation in your IMS configuration to include the compiler's object program reentrancy control area size. The 1974 COBOL compiler checks the program for conformance to IMS syntax and generates a reentrant object module.

G.4. Object Module Name in Linkage Editor Control Stream

When the extended COBOL compiler compiles your action program, it appends the first six characters of your program-id with zeros. Thus, when naming the object modules on your linkage editor INCLUDE statement, you must append the two zeros.

The 1974 COBOL object module name is composed of the first six characters of the program-id. Thus, the object name on the INCLUDE statement should be the same.

G.5. ENTER Statements

When you use the extended COBOL compiler, each I/O function call you issue from your action program must be preceded by an ENTER LINKAGE statement and followed by an ENTER COBOL statement. For example, if you issued a CALL 'GET' function, you must use the following coding format:

```
ENTER LINKAGE.
CALL 'GET' USING filename  record-area  key.
ENTER COBOL.
```

For compiling action programs with the 1974 COBOL compiler, only the I/O function call is needed. The ENTER statements are accepted by the compiler but cause warning diagnostics.

Figure G-2 illustrates the extended COBOL coding required for the DISP action program. In addition, Figure G-3 illustrates the multipunch DICE code equivalents that DISP copies from the IMS COPY library (Figure G-2, line 12).

You initiate the DISP action program by entering the transaction code, DISP (in this case the same name as the program), and the 5-digit numeric key of the record desired. Figure G-1 shows the input message and corresponding output display.

```
INPUT    DISP 01234
OUTPUT   CODE    CUSTOMER NAME          ADDRESS          CITY-STATE   ZIP
         01234    JOHN DOE               1212 JACKSON     PHILA.,PA    19101
            BALANCE-DUE   PAYMENT-DUE        YR-TO-DATE  VOL
                 358.22         50.00               1,065.38
```

Figure G-1. Sample Transaction Displaying Customer Record

DISP retrieves a record from the customer file (CUSTFIL) and displays it at the terminal (Figure G-2, line 75). In case of an invalid record key in the input message, or any error condition detected by IMS, the program moves an error message to the output message area and terminates the transaction (lines 77 and 86-95).

Note that DISP uses DICE, previously coded and filed in a copy library (Figure G-3) for homing the cursor, clearing the screen, and repositioning the cursor to a new line (lines 70-72).

```
IDENTIFICATION DIVISION.
PROGRAM-ID.  DISP.
ENVIRONMENT DIVISION.
CONFIGURATION SECTION.
SOURCE-COMPUTER. UNISYS-9030.
OBJECT-COMPUTER. UNISYS-9030.
DATA DIVISION.
WORKING-STORAGE SECTION.
77  CUSTFIL  PIC X(7) VALUE 'CUSTFIL'.
77  TEXT-1   PIC X(32) VALUE 'PROCESSING ERROR.STATUS CODE ='.
77  TEXT-2   PIC X(23) VALUE 'DETAILED STATUS CODE = '.
01  DICE COPY DICE.
01  CUSHDR1.
    02  CUSHD1   PIC A(6)  VALUE ' CODE '.
    02  CUSHD2   PIC A(20) VALUE 'CUSTOMER NAME      '.
    02  CUSHD3   PIC A(15) VALUE 'ADDRESS       '.
    02  CUSHD4   PIC A(15) VALUE 'CITY-STATE    '.
    02  CUSHD5   PIC A(5)  VALUE 'ZIP  '.
01  CUSHDR2.
    02  CUSHD6   PIC A(15) VALUE '   BALANCE-DUE '.
    02  CUSHD7   PIC A(15) VALUE '  PAYMENT-DUE  '.
    02  CUSHD8   PIC A(15) VALUE ' YR-TO-DATE VOL'.
LINKAGE SECTION.
01  PROGRAM-INFORMATION-BLOCK. COPY PIB.
01  INPUT-MESSAGE-AREA. COPY IMA.
    02  TRANSAC-CDE  PIC X(4).
    02  FILLER       PIC X.
    02  REC-KEY      PIC X(5).
    02  REC-NO REDEFINES REC-KEY  PIC 9(5).
01  WORK-AREA.
    02  CUS-REC.
        03  CDE           PIC X(5).
        03  NAME          PIC X(20).
        03  ADDR          PIC X(15).
        03  CTY-STE       PIC X(15).
        03  ZIP           PIC 9(5).
        03  BLNCE-DUE     PIC S9(9)V99   COMP-3.
        03  DUE-IN        PIC S9(9)V99   COMP-3.
        03  YTD-VOL       PIC 9(6)V99.
    02  ERROR-MSGE.
        03  TXT-1         PIC X(32).
```

Figure G-2. Sample Extended COBOL Action Program DISP (Part 1 of 2)

```
                03  STAT          PIC 9(4).
                03  TXT-2         PIC X(23).
                03  DSTAT         PIC 9(4).
        01  OUTPUT-MESSAGE-AREA COPY OMA.
            02  LINE-0        PIC X(4).
            02  LINE-1        PIC X(64).
            02  CR-1          PIC X(4).
            02  LINE-2.
                03  CDE       PIC X(5).
                03  FILLER    PIC X.
                03  NAME      PIC X(20).
                03  ADDR      PIC X(15).
                03  CTY-STE   PIC X(15).
                03  ZIP       PIC X(5).
            02  CR-2              PIC X(4).
            02  LINE-3            PIC X(45).
            02  CR-3              PIC X(4).
            02  LINE-4.
                03  FILLER        PIC X.
                03  OUT-BAL       PIC ZZZ,ZZZ,ZZ9.99
                03  FILLER        PIC X(5).
                03  OUT-DUE       PIC ZZZ,ZZZ,ZZZ.99.
                03  FILLER        PIC X(5).
                03  OUT-VOL       PIC ZZZ,ZZZ.99.
            02  CR-4              PIC X(4).
            02  LINE-13           PIC X(4).
        PROCEDURE DIVISION USING PROGRAM-INFORMATION-BLOCK
             INPUT-MESSAGE-AREA WORK-AREA OUTPUT-MESSAGE-AREA.
        STRT-CDE-SECT.
            MOVE CURS-COORD TO LINE-0.
            MOVE CURS-HME TO LINE-13.
            MOVE CR TO CR-1, CR-2, CR-3, CR-4.
        CUSTOMER-FILE-SECT.
            ENTER LINKAGE.
            CALL 'GET' USING CUSTFIL CUS-REC REC-KEY.
            ENTER COBOL.
            IF STATUS-CODE IS NOT = 0 GO TO PROCESS-ERROR.
            MOVE CUSHDR1 TO LINE-1.
            MOVE CORR CUS-REC TO LINE-2.
            MOVE CUSHDR2 TO LINE-3.
            MOVE BLNCE-DUE TO OUT-BAL.
            MOVE DUE-IN TO OUT-DUE.
            MOVE YTD-VOL TO OUT-VOL.
            GO TO NORMAL-TERM.
        PROCESS-ERROR.
            MOVE TEXT-1 TO TXT-1.
            MOVE STATUS-CODE TO STAT.
            MOVE TEXT-2 TO TXT-2.
            MOVE DETAILED-STATUS-CODE TO DSTAT.
            MOVE ERROR-MSGE TO LINE-1.
            MOVE REC-KEY TO ADDR OF LINE-2.
        NORMAL-TERM.
            ENTER LINKAGE.
            CALL 'RETURN'.
            ENTER COBOL.
```

Figure G-2. Sample Extended COBOL Action Program DISP (Part 2 of 2)

```
       01  DICE COPY DICE.
      *    DICE SPECIAL CHARACTERS FOR PROGRAM DISP.
      *
      *    FORMS CONTROL & CLEAR. CURSOR TO ROW Y. COLUMN X. AND CLEAR
      *    SCREEN. X'100030201'
      *    MULTIPUNCHES 12-11-9-8-1. 12-9-3.  12-9-2. 12-9-1.
      *
           02 CURS-COORD.
              03  DICE-1     PIC X(2) VALUE '  '.
              03  ROW-Y1     PIC X(1) VALUE '  '.
              03  COL-X1     PIC X(1) VALUE '  '.
      *
           POSITION CONTROL NEW LINE.X'10040000'.
      *    MULTIPUNCHES 12-11-9-8-1. 12-9-4.  12-0-9-8-1.  12-0-9-8-1.
      *
       77  CR                PIC X(4) VALUE '    '.
      *
      *    SET COORD-CURSOR TO HOME. X'10010000'.
      *    MULTIPUNCHES 12-11-9-8-1. 12-9-8-1. 12-0-9-8-1. 12-0-9-8-1.
      *
       77  CURS-HME          PIC X(4) VALUE '     '.
      *
      *    POSITION CONTROL & CLEAR. CLEAR TO END OF LINE & NEW LINE.
      *    X '10050000'.
      *    MULTIPUNCHES 12-11-9-8-1. 12-9-5. 12-0-9-8-1. 12-0-9-8-1.
      *
       77  CLR-LINE          PIC X(4) VALUE '     '.
      *
      *    APPENDING CODE FOR UNISCOPE-100 COP. X'12'.
      *    MULTIPUNCH 11-9-2.
      *
       77  DC                PIC X(1) VALUE ' '.
      *
      *    START OF ENTRY CHARACTER SOE. X'1E'.
      *    MULTIPUNCH 11-9-8-6.
      *
       77  SOE               PIC X(1) VALUE ' '.
```

Figure G-3. Example of DICE Sequences Filed in a COPY Library

G.6. DICE Codes

When you compile an action program with the extended COBOL compiler, you must express DICE sequences using the multipunch equivalents of the DICE values. Figure G-3 shows an example of the statement describing multipunch DICE values used in the DISP action program (Figure G-2, line 12). The comments in this copy library module explain the hexadecimal values equivalent to the blank multipunch values.

The 1974 COBOL compiler permits you to use the hexadecimal DICE values directly in the action program. The following examples illustrate three possible applications of hexadecimal DICE values that conform to 1974 standards.

```
01 DICE
   03 FIELD-1 PIC X.
   03 FIELD-2 PIC X.
   03 FIELD-3 PIC X.
   03 FIELD-4 PIC X.
MOVE ='10' TO FIELD-1.
MOVE ='03' TO FIELD-2.
MOVE ='01' TO FIELD-3.
MOVE ='01' TO FIELD-4.
```

```
03 DICE PIC X(4).
MOVE ='10030101' TO DICE.
```

```
77 DICE PIC X(4) VALUE ='10030101'.
```

For more detail about DICE code sequences, their interpretation, and use, see Appendix F.

G.7. Extended COBOL Language Restrictions

Some COBOL verbs, clauses, and sections are illegal in extended COBOL action programs. If you compile them with the shared code parameter, PARAM OUT=(M), the compiler locates and deletes them from your program. (See Section 11.)

The following reserved words are illegal in extended COBOL action programs:

ALTER
CLOSE
DECLARATIVE SECTION
ENTRY
EXHIBIT
EXIT-PROGRAM
FILE SECTION
INPUT-OUTPUT SECTION
INSERT
OPEN
READ
READY TRACE
RELEASE
RESET TRACE
RETURN
REWRITE
SEEK
SEGMENT-LIMIT
SORT
STOP
SYSCHAN-t
SYSCONSOLE
SYSERR[-m]
SYSIN
SYSIN-96
SYSIN-128
SYSLOG
SYSLST
WRITE

Other COBOL verbs must not have working-storage items as receiving operands. These verbs are:

ADD
COMPUTE
DIVIDE
EXAMINE (replacing option)
MOVE
MULTIPLY
PERFORM (varying option)
SEARCH (varying option)
SET
SUBTRACT
TRANSFORM

If you compile your action program with the shared code parameter, the compiler flags the erroneous statement and issues a precautionary diagnostic.

Appendix H
Listing IMS DSECTs

To assemble and produce a listing of the DSECTs for your current system, you use the job control statements and the data stream in Figure H-1.

```
// JOB IMSDSECT,,,,,,(P,E)
// OGBL NUMLST=1
// DVC 20   // SPL ,2X32,&NUMLST,,262144,,,,32000   // LFD  PRNTR
// DVC RES // LBL $Y$MAC // LFD *PROC
// WORK1
// WORK2
// EXEC ASM
// PARAM OUT=(N)
// PARAM LIN=PROC
/$
*         @COL73:80 ON 11:42 SEQ 'IMS00100' BY 100
*         @COL73:80 CH ALL TO ''
         TITLE 'OS/3  -  IMS DSECTS / EQUATES
*
IMSDSECT START 0
*
         PRINT ON,GEN,DATA
         USING  *,15
                    EJECT
         ZM#DACT
                    EJECT
         ZM#DFCTI
                    EJECT
         ZM#DFCT
                    EJECT
         ZM#DIMH
                    EJECT
         ZM#DOMH
                    EJECT
         ZM#DPCT
                    EJECT
         ZM#DPIB
                    EJECT
         ZM#DSIB
                    EJECT
         ZM#DTCT
                    EJECT
         ZM#DTHCB
                    EJECT
         ZM#DTIDT
                    EJECT
         END
/*
/&
```

Figure H-1. JCL and Data Stream to List IMS DSECTs

Index

A

B

C

D

E

F

G

H

I

J

K

L

M

N

O

P

R

S

T