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OS

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IBM System/360 Operating System:

Programmer's Guide to Debugging

This publication describes the major debugging facilities provided with the System/360 Operating System for the assembler language programmer:

- Abnormal termination and shapshot dumps.
- Indicative dumps.
- Core image dumps.
- Stand-alone hexadecimal dumps.

The text explains those aspects of system control pertinent to debugging facility offers, and outlines procedures for invoking and interpreting dumps issued at the three operating system levels: PCP, MFT, and MVT.

Debugging facilities inherent in higher languages and additional aids open to the assembler language programmer are discussed in other SRL publications.

Fourth Edition (June, 1970)

This is a major revision of, and obsoletes C28-6670-2. The new subtasking option of the MFT control program is described, and those control differences that must be understood to debug a program run on a subtasking system are explained. All changes to the text, and small changes to illustrations, are indicated by a vertical line to the left of the change. New figures have been added. Changed and added illustrations are denoted by the symbol • to the left of the caption.

This edition applies to release 19 of IBM System/360 Operating System and to all subsequent releases until otherwise indicated in new editions or Technical Newsletters. Changes are continually made to the information herein; before using this publication in connection with the operation of IBM systems, consult the latest IBM System/360 Newsletter, Order No. GN20-0360, for the editions that are applicable and current.

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Preface

This publication is intended to help you use the debugging facilities provided with the IBM System/360 Operating System. To fulfill this purpose, the publication is divided into two sections: "Section 1: Operating System Concepts," and "Section 2: Interpreting Dumps." You should read the introduction to familiarize yourself with the debugging facilities before proceeding to Section 1.

Section 1 deals with internal aspects of the operating system that you should know to use the debugging facilities efficiently. A working knowledge of this information will provide you with the means of determining the status of the system at the time of the failure, and the course of events which led up to that failure. It includes information from other System Reference Library publications, Program Logic Manuals, and Installation Guides. You should be familiar with the information covered in Section 1 before attempting to use Section 2.

Section 2 includes instructions for invoking, reading, and interpreting dumps issued by systems with PCP, MFT, and MVT. It presents an after-the-fact look at a dump. You've put in a run, it failed, and you now have a dump before you. Where do you start; what do you look at; what does it all mean? The section begins with a general debugging procedure, followed by topics dealing with each type of dump. Each topic tells how to invoke a particular dump, what information the dump contains, and how to use this information in following the debugging procedure. The material in Section 2 is intended to aid you in interpreting dumps and isolating errors.

Before reading this publication, you should have a general knowledge of operating system features and concepts as presented in the prerequisite publications. Occasionally, the text refers you to other publications for detailed discussions beyond the scope of this book.

For information on debugging facilities provided within higher languages, consult the programmers' guides associated with the respective languages. Other System/360 Operating System publications, such as TESTRAN and Messages and Codes, describe additional debugging aids provided for the assembler language programmer.

Prerequisite Publications

IBM System/360: Principles of Operation, GA22-6821

IBM System/360 Operating System:

Introduction, GC28-6534

Concepts and Facilities, GC28-6535

Supervisor and Data Management Services, GC28-6646

Reference Publications

IBM System/360 Operating System:

System Control Blocks, GC28-6628

Messages and Codes, GC28-6631

Supervisor and Data Management Macro Instructions, GC28-6647

System Programmer's Guide, GC28-6550

Service Aids, GC28-6719

Contents

SUMMARY OF MAJOR CHANGES - RELEASE 19 . 7

INTRODUCTION 9

SECTION 1: OPERATING SYSTEM CONCEPTS . 10
Task Management 10
Task Control Block 10
Request Blocks 10
Active RB Queue 13
Load List 13
Job Pack Area Queue (MFT with Subtasking only) 14
Effects of LINK, ATTACH, XCTL, and LOAD 15
System Task Control Differences . . 16
Main Storage Supervision 19
Storage Control in Systems With PCP 19
Storage Control in Systems with MFT (Without Subtasking) 20
Storage Control in Systems with MFT (With Subtasking) 20
Storage Control for a Region in Systems with MVT 21
Storage Control for a Subpool in Systems with MVT 22
Storage Control for a Load Module in Systems with MVT 23
System Control Blocks and Tables 25
Communications Vector Table (CVT) . 25
Task Input/Output Table (TIOT) . . . 25
Unit Control Block (UCB) 25
Event Control Block (ECB) 25
Input/Output Block (IOB) 25
Data Control Block (DCB) 25
Data Extent Block (DEB) 25
Summary of Control Block Relationships 25
Traces 27
Save Area Chain 27
Trace Table 28

SECTION 2: INTERPRETING DUMPS 30
General Debugging Procedure 30
Debugging Procedure Summary 32
ABEND/SNAP Dump (Systems with PCP and MFT) 33
Invoking an ABEND/SNAP Dump (PCP,MFT) 33
Contents of an ABEND/SNAP Dump (PCP,MFT) 36
Guide to Using an ABEND/SNAP Dump (PCP, MFT) 47
ABEND/SNAP Dump (Systems with MVT) . . . 49
Invoking an ABEND/SNAP Dump (MVT) . 49
Contents of an ABEND/SNAP Dump (MVT) 49
Guide to Using an ABEND/SNAP Dump (MVT) 66
Indicative Dump 68
Contents of an Indicative Dump . . . 68
Guide to Using an Indicative Dump . 70
Core Image Dump 71
Damage Assessment Routine (DAR) . . . 71
System Failure 71
The SYS1.DUMP Data Set 71
Tape 71
Direct Access 71
The Print Dump Program (IEAPRINT) . . 72
Input to the Print Dump Program . . 73
Output From the Print Dump Program . 73
Contents of a Core Image Dump 73
Low Storage and Registers 73
Main Storage 73
Stand-Alone Dump 75
Invoking a Stand-Alone Dump 75
Contents of a Stand-Alone Dump . . . 75
Guide to Using a Core Image or a Stand-Alone Dump 78
Guide to Using a PCP Dump 79
Guide to Using an MFT Dump 80
Finding the Partiiton TCBS 81
Guide to Using an MVT Dump 84

APPENDIX A: SVCs 87

APPENDIX B: COMPLETION CODES 91

APPENDIX C: SYSTEM MODULE NAME PREFIXES 95

APPENDIX D: LIST OF ABBREVIATIONS . . . 96

APPENDIX E: ECB COMPLETION CODES . . . 97

APPENDIX F: UCB SENSE BYTES 98

APPENDIX G: SERVICE AIDS 99

APPENDIX H: CONTROL BLOCK POINTERS . .100

INDEX 107

Illustrations

Figure 1. Control Information Available Through the TCB 10
Figure 2. RB Formats 12
Figure 3. Active RB Queue 13
Figure 4. Load List (PCP, MFT) . . . 13
Figure 5. Job Pack Area queue 15
Figure 6. Main Storage Snapshot (PCP) 16
Figure 7. Main Storage Snapshot (MFT Without Subtasking) 17
Figure 8. Main Storage Snapshot (MFT With Subtasking) 18
Figure 9. Main Storage Snapshot (MVT) 18
Figure 10. Storage Control (PCP) . . . 19
Figure 11. Storage Control for a Partition (MFT Without Subtasking) . . 20
Figure 12. Storage Control for Subtask Storage (MFT with Subtasking) 20
Figure 13. Storage Control for a Region (MVT) 22
Figure 14. Storage Control for a Subpool (MVT) 23
Figure 15. Storage Control for a Load Module (MVT) 24
Figure 16. Control Block Relationships 26
Figure 17. Save Area Trace 27
Figure 18. Trace Table Entries (PCP) . 28
Figure 19. Trace Table Entries (MFT) . 28
Figure 20. Trace Table Entries (MVT) . 28
Figure 21. Trace Table Entries (MVT with Model 65 multiprocessing) 29
Figure 22A. Sample of an ABEND Dump (PCP, MFT) 34
Figure 22B. Sample of an ABEND Dump (PCP, MFT) 35
Figure 23. SYSABEND DD Statements . . 36
Figure 24A. Sample of Complete ABEND Dump (MVT) 50
Figure 24B. Sample of Complete ABEND Dump (MVT) 51
Figure 25. Contents of an Indicative Dump 68
Figure 26. Sample JCL Statements Required for IEAPRINT 72
Figure 27. Sample of a Core Image Dump 74
Figure 28. Sample of a Stand-Alone Dump 77
Figure 29. Sample Trace Table Entries (PCP) 80
Figure 30. Re-Creating the Task Structure 81
Figure 31. Sample Trace Table Entries (MFT) 82
Figure 32. Sample Trace Table Entries (MVT) 84
Figure 33. Recreating the Task Structure 85
Figure 34. Control Block Flow 103
Figure 35. MVT Storage Control Flow .105

Summary of Major Changes--Release 19

Item	Description	Areas Affected
Input/Output Recovery Management Support (I/O RMS)	SVC 85 has been added to APPENDIX A.	90
7094 Emulator the Model 85	SVC numbers 88 and 89 have been added to APPENDIX A.	90
	The system module name prefix IIN has been added to APPENDIX C.	95
2495 Tape Cartridge Reader	A description of the UCB sense bytes for this unit has been added to APPENDIX F.	98
Optical Readers 1285/87/88	A description of the UCB sense bytes for these units has been added to APPENDIX F.	98
1419 Magnetic Character Reader and 1275 Optical Reader	A description of the UCB sense bytes for these units has been added to APPENDIX F.	98
OS Volume Statistics	SVC number 91 has been added to APPENDIX A.	90
Service Aids	A new APPENDIX, APPENDIX G, has been added to briefly describe the debugging facilities provided by the new service aids.	99
IEHATLAS	SVC number 86 has been added to APPENDIX A.	90

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Item	Description	Areas Affected
Attach in MFT	Various sections have been added to explain the MFT with subtasking system, the debugging of modules run on that system, and the ABEND/SNAP dumps produced by it.	11-21,33-35,39-43 47,81-82,84,100
Write to Programmer	SVC 90 has been added to APPENDIX A.	90
	A pointer to the Job Step Control Block (JSCB) has been included in APPENDIX H.	100-101
Resolution of the transient area contention problem	The transient area loading task has been included in discussions and artwork concerning the MFT TCB queue.	17-18
Main Storage Hierarchy support MVT extension	A secondary link pack area may be present in an MVT system with main storage hierarchy support.	18
The sections on core image dumps and stand-alone dumps have been combined	The debugging procedures used for these dumps are the same and are now presented under the one chapter headed: Guide to Using a Core Image or a Stand-Alone Dump.	78-86
Expanded Index	The index has been expanded and more cross referencing entries have been provided.	107-112
Various small changes	Various small improvements have been made throughout the manual.	

Introduction

Debugging is possibly the most important aspect of programming. Few programmers, especially those involved in control program modification, ever produce a perfect solution in one run; abnormal termination is inevitable and must be prepared for.

Program debugging in an operating system environment is made more difficult by the large volume of control information, the presence of control program routines, and the changing contents of main storage. Frequently, a large part of debugging lies in determining what state the system was in when the error occurred and which essential information was obscured.

To debug problem programs efficiently, you should be familiar with the system control information reflected in dumps. This control information, in the form of control blocks and traces, tells you what has happened up to the point of error and where key information related to the program is located.

This book is therefore designed to:

- Help you prepare proper dump data set definitions.
- Provide an insight into the IBM System/360 Operating System and its complex aspects of task management, storage supervisor, control blocks, and debugging aids.
- Give you a starting point, an approach, and a method of debugging.

The IBM System/360 Operating System provides extensive degugging facilities to aid you in locating errors and determining the system state quickly. Some debugging aids, such as console messages, provide limited information that may not always help you identify the error. This manual discusses those debugging facilities that provide you with the most extensive information:

a. Abnormal termination (ABEND) and snapshot (SNAP) dumps.
b. Indicative dumps.
c. Core image dumps.
d. Stand-alone hexadecimal dumps.

ABEND and SNAP Dumps are invoked by ABEND and SNAP macro instructions, respectively. They are grouped in a single category because they provide identical information. In addition to a hexadecimal dump of main storage, they can contain conveniently edited control information and displays of the operating system nucleus and trace table.

Indicative dumps contain control information useful in isolating the instruction that caused an abnormal end of task situation. The information is similar to that given in an ABEND/SNAP dump, but does not include a dump or main storage.

Core image dumps are taken by the damage assessment routine (DAR) at the time of a system failure. The dump is written to a SYS1.DUMP data set which you may print by means of the IEAPRINT print dump program. The dump consists of a first page, containing edited control information, followed by a dump of the printable contents of main-storage, beginning at location 00. Each line contains the hexadecimal address of the first byte in the line, eight main-storage words in hexadecimal, and the same eight words in EBCDIC.

Stand-alone dumps, invoked by the dump program you have produced from the IMDSADMP macro instruction (see Appendix G) or by a System/360 Operating System card program number UT-056, offer a complete picture of main storage at a given time. They are, for the most part, unedited. Each line contains the hexadecimal address of the first byte in the line, eight main-storage words in hexadecimal, and the same eight words in EBCDIC.

General Notes:

- Displacements and addresses shown in the text and illustrations of this publication are given in decimal numbers, followed by the corresponding hexadecimal number in parentheses, e.g., TCB+14(E); location 28(1C); SVC 42(2A). All other numbers in the text are decimal, e.g., the seventeenth word of the TCB; a 4-word control block; 15 job steps.
- Control block field names referred to are those used in the IBM System/360 Operating System: System Control Blocks manual, GC28-6628.
- Wherever possible, diagrams, and reproductions of dumps have been included to aid you during the debugging process.

Section 1: Operating System Concepts

To effectively use the debugging aids provided by the IBM System/360 Operating System, you should be familiar with those control blocks, traces, and other control information that can lead you quickly to the source of error. This section of the manual introduces you to the control information that you must know to interpret dumps. It is divided into four topics:

- TASK MANAGEMENT
- MAIN STORAGE SUPERVISION
- SYSTEM CONTROL BLOCKS AND TABLES
- TRACES

The first two topics deal with those aspects of task management and main storage management, respectively, that are represented in dumps. The third topic describes the remaining system control blocks and tables helpful in pinpointing errors. The last topic covers tracing features that are useful in re-creating the events that led to an error condition.

Note: The descriptions of system control blocks and tables in this section emphasize function rather than byte-by-byte contents. Appendix H summarizes the contents of those control blocks most useful in debugging.

For a more detailed description of system control blocks and tables, please see the System Control Blocks publication, GC28-6628.

Task Management

The task management control information most useful in debugging with a dump includes the task control block and its associated request blocks and elements. These items have the same basic functions at each of the three control program levels. Their functions, interactions, and relationships to other system features are discussed in this topic. A summary of how task supervision differs at each system level concludes the topic.

Task Control Block

The operating system keeps pointers to all information related to a task in a task control block (TCB). For the most part, the TCB contains pointers to other system control blocks. By using these pointers, you can learn such facts as what I/O devices were allocated to the task, which data sets were open, and which load modules were requested.

Figure 1 shows some of the control information that can be located by using the pointers in the TCB. Later, in the discussion of system control blocks and tables, Figure 1 is expanded to show the actual block names and pointer addresses.

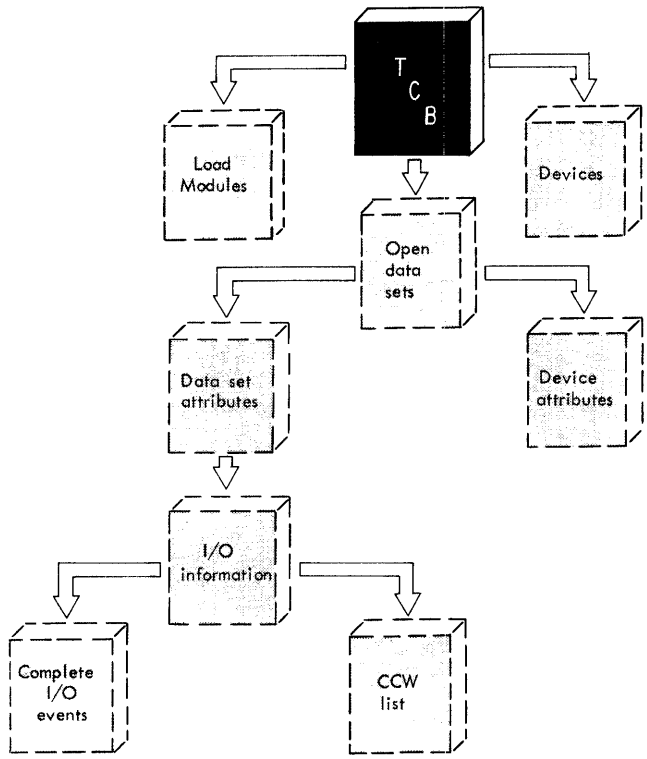


Figure 1. Control Information Available Through the TCB

Request Blocks

Frequently, the routines that comprise a task are not all brought into main storage with the first load module. Instead, they are requested by the task as it requires them. This dynamic loading capability necessitates another type of control block to describe each load module associated with a task -- a request block (RB). An RB is created by the control program when it receives a request from the system or from a problem program to fetch a load module for execution, and at other times, such as when a type II supervisor call (SVC) is issued. By looking at RBs, you can

determine which load modules have been executed, why each lost control, and, in most cases, which one was the source of an error condition.

There are seven types of RBs created by the control program:

- Program request block (PRB)
- Supervisor request block (SVRB)
- Interrupt request block (IRB)
- Supervisor interrupt request block (SIRB)
- Loaded program request block (LPRB)
- Loaded request block (LRB)
- Finch request block (FRB)

Of these, you will most often encounter the PRB and SVRB in dumps. The type of RB created depends on the routine or load module with which it is associated.

PRB (Systems with PCP and MFT): A PRB is created whenever an XCTL, LINK, or ATTACH macro instruction is issued. It is located immediately before the load module with which it is associated.

PRB (Systems with MVT): A PRB is created whenever an XCTL or LINK macro instruction is issued. It is located in a fixed area of the operating system.

SVRB: An SVRB is created each time a type II, III, or IV supervisor call is issued. (Type I SVC routines are resident, but run disabled; they do not require a request block.) This block is used to store information if an interruption occurs during execution of these SVC routines. A list of SVCs, including their numbers and types, appears in Appendix A.

IRB: An IRB is created each time an asynchronous exit routine is executed. It is associated with an event that can occur at an unpredictable time during program execution, such as a timing routine initiated by an STIMER macro instruction. The IRB is filled at the time the event occurs, just before control is given to the exit routine.

SIRB: An SIRB is similar to an IRB, except that it is associated only with IBM-supplied input/output error routines. Its associated error routine is fetched from the SYS1.SVCLIB data set.

LPRB: (PCP and MFT only): An LPRB is created when a LOAD macro instruction is issued unless the LOAD macro instruction specifies:

- A routine that has already been loaded.
- A routine that is being loaded in response to a LOAD macro instruction previously issued by a task in the partition (MFT with subtasking).
- A routine that is "only loadable" (see LRB).

An LPRB is located immediately before the load module with which it is associated. Routines for which an LPRB is created can also be invoked by XCTL, LINK, and ATTACH macro instructions.

LRB: (PCP and MFT only): The LRB is a shortened form of an LPRB. Routines associated with LRBs can be invoked only by a LOAD macro instruction. This attribute is assigned to a routine through the OL (only loadable) subparameter in the PARM parameter of the EXEC statement that executes the linkage editor. The most common reason for assigning this attribute is that linkage conventions for XCTL, LINK, and ATTACH are not followed. This request block is located immediately before the load module with which it is associated.

FRB (MFT with subtasking only): An FRB is created and attached to the job pack area queue, during LOAD macro instruction processing, if the requested module is not already in the job pack area. The FRB describes a module being loaded in response to a LOAD macro instruction. Any subsequent requests for the same module, received while it is still being loaded, are deferred by means of wait list elements (WLEs) queued to the FRB. When the module is fully loaded, an LRB or an LPRB is created, the FRB is removed from the job pack area queue, and any requests, represented by wait list elements, are reinitiated.

Figure 2 shows the relative size of the seven types of RBs and the significant fields in each.

In Figure 2, the "size" field tells the number of doublewords in both the RB and its associated load module. The PSW contained in the "resume PSW" field reflects the reason that the associated load module lost control. Other fields are discussed in succeeding topics.

LPRB

-12	Major RB address (MFT with subtasking)	
-8	Load list pointers (PCP, MFT)	
-4	Absent (MVT)	
0	Module name (PCP, MFT) Last half of user's PSW (MVT)	
8	Size	Flags
12(C) Use Ct	Entry point (PCP, MFT); CDE (MVT)	
16 (10)	Resume PSW	
28 (1C) Wait Ct	Next RB	

LRB

-8	Load list pointers (PCP, MFT)	
-4	Absent (MVT)	
0	Module name (PCP, MFT) Last half of user's PSW (MVT)	
8	Size	Flags
12 (C) Use Ct	Entry point (PCP, MFT); CDE (MVT)	

PRB

0	Module name (PCP, MFT) Last half of user's PSW (MVT)	
8	Size	Flags
12 (C) Use Ct	Entry point (PCP, MFT); CDE (MVT)	
16 (10)	Resume PSW	
28 (1C) Wait Ct	Next RB	

FRB

-8 -4	Load list pointers	
0	Module name	
8	Size	Flags
12 (C)	Address of WLE	
16 (10)	Address of TCB	
20 (14)	Address of LPRB	

Program Extent List

+ 0	Length of extent in hiearchy 0
+ 4	Length of extent in hiearchy 1
+ 8	Address of extent in hiearchy 0
+ 12(C)	Address of extent in hiearchy 1

Note: Program extent list is added to LPRB, LRB, or PRB if the program described was hiearchy block loaded.

SVRB

0	Module name (PCP, MFT) Last half of user's PSW (MVT)	
8	Size	Flags
12 (C) Use Ct	Entry point (PCP, MFT); CDE (MVT)	
16 (10)	Resume PSW	
28 (1C) Wait Ct	Next RB	
32 (20)	Register Save Area	
96 (60)	Extended Save Area	

IRB

0	Module name (PCP, MFT) Last half of user's PSW (MVT)	
8	Size	Flags
12 (C) Use Ct	Entry point (PCP, MFT); CDE (MVT)	
16 (10)	Resume PSW	
28 (1C) Wait Ct	Next RB	
32 (20)	Register Save Area	

SIRB

0	Module name (PCP, MFT) Last half of user's PSW (MVT)	
8	Size	Flags
12 (C) Use Ct	Entry point (PCP MFT); CDE (MVT)	
16 (10)	Resume PSW	
28 (1C) Wait Ct	Next RB	
32 (20)	Register Save Area	

• Figure 2. RB Formats

Thus far, the characteristics of the TCB and its associated RBs have been discussed. With the possibility of many RBs subordinate to one task, it is necessary that queues of RBs be maintained. In systems with PCP and MFT without subtasking, two queues are maintained by the system -- the active RB queue and the load list. In MFT systems with subtasking, a job pack area queue, containing FRBs, and LRBs and LPRBs that represent reenterable modules is also maintained. MVT systems maintain an active RB queue and a contents directory. The contents directory is made up of three separate queues: the link pack area control queue (LPAQ); the job pack area control queue (JPAQ); and the load list.

Active RB Queue

The active RB queue is a chain of request blocks associated with active load modules and SVC routines. This queue can contain PRBs, SVRBs, IRBs, SIRBs, and under certain circumstances, LPRBs. Figure 3 illustrates how the active RB queue links together the TCB and its associated RBs.

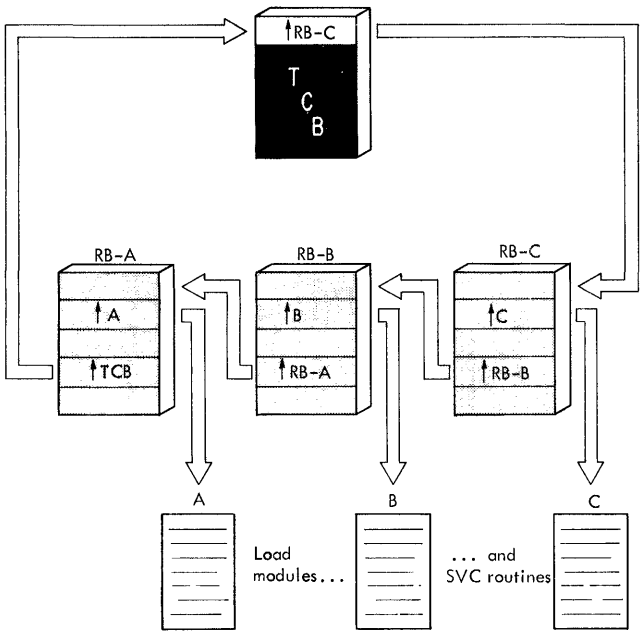


Figure 3. Active RB Queue

The request blocks in the active RB queue in Figure 3 represent three load modules. Load module A invokes load module B, and B, in turn, invokes C. When execution of A began, only one RB existed. When the first invoking request was encountered, a second RB was created, the TCB field that points to the most recent RB was changed, and A's status information was stored in RB-A. A similar set of actions occurred when the second invoking request was encountered. As each load module is executed and control is returned to the next higher level load module, its RB is removed from the chain and pointers are updated accordingly.

Load List

The load list is a chain of request blocks or elements associated with load modules invoked by a LOAD macro instruction. The load list differs from the active RB queue in that RBs and associated load modules are not deleted automatically. They remain intact until they are deleted with a DELETE macro instruction or job step termination occurs. By looking at the load list, you can determine which system and problem program routines were loaded before the dump was taken. The format of the load list differs with control program levels.

Systems with PCP and MFT (without subtasking): At these control program levels, the load list associated with a TCB contains LRBs and LPRBs. RBs on the load list are linked together somewhat differently from those on the active RB queue because of the characteristics of the LOAD macro instruction. Because RBs may be deleted from a load list in a different order than they were created (depending on the order of DELETE macro instructions), they must have both forward and backward pointers. Figure 4 illustrates how a load list links together a TCB and three RBs.

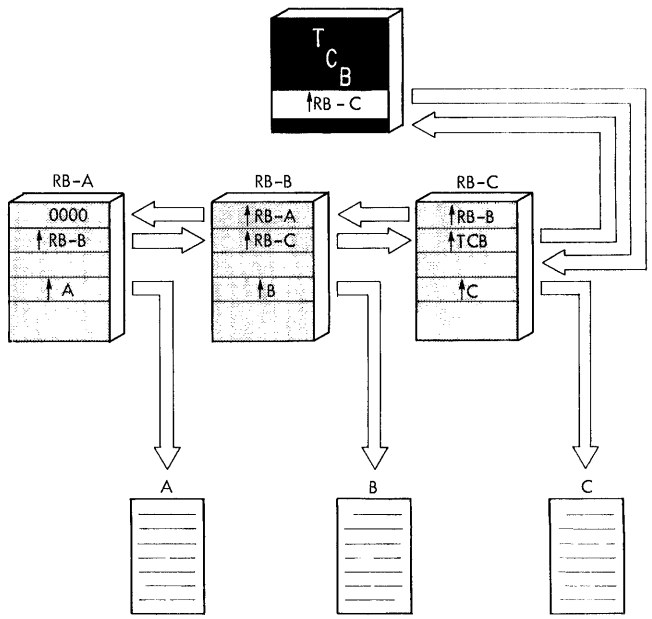


Figure 4. Load List (PCP, MFT)

Here, each RB contains a pointer both to the previous RB and the next most recent RB in the list. If there is no previous or more recent RB, these fields contain zeros and a pointer to the TCB, respectively.

Another field of a load list RB that merits consideration is the use count. Whenever a LOAD macro instruction is issued, the load list is searched to see if the routine is already loaded. If it is loaded, the system increments the use count by one and passes the entry point address to the requesting routine.

Each time a DELETE macro instruction is issued for the routine, the use count is decremented by one. When it reaches zero, the RB is removed from the load list and storage occupied by the associated routine is freed.

Systems with MFT (with subtasking): At this control program level, the load list is used as described for PCP and MFT without subtasking, with the following exceptions:

1. The LRBs and LPRBs queued on the load list represent modules that are not reenterable. LRBs and LPRBs representing reenterable modules are queued on the job pack area queue.
2. When a LOAD macro instruction is issued, the system searches the job pack area queue before searching the load list.

Systems with MVT: Instead of LRBs and LPRBs created as a result of LOAD macro instructions, the load list maintained by a system with MVT contains elements representing load modules. Load list elements (LLEs) are associated with load modules through another control medium called the contents directory.

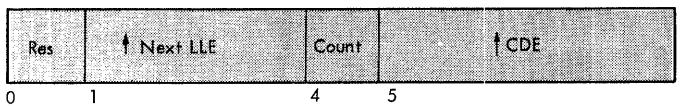
The contents directory is made up of three separate queues: the link pack area control queue (LPAQ), the job pack area control queue (JPAQ), and the load list.

The LPAQ is a record of every program in the system link pack area. This area contains reenterable routines specified by the control program or by the user. The routines in the system link pack area can be used repeatedly to perform any task of any job step in the system. The entries in the LPAQ are contents directory entries (CDEs).

There is a JPAQ for each job step in the system that uses a program not in the link pack area. The JPAQ, like the LPAQ, is made up of CDEs. It describes routines in a job step region. The routines in the job pack area can be either reenterable or not reenterable. These routines however, cannot be used to perform a task that is not part of the job step.

The load list represents routines that are brought into a job pack area or found in the link pack area by the routines that perform the Load function. The entries in the load list are load list elements, not CDEs. Each load list element is associated with a CDE in the JPAQ or the LPAQ; the programs represented in the load list are thus also represented in one of the other contents directory queues.

Load list elements also contain a count field that corresponds to the use count in a LPRB or LRB. Each time a LOAD macro instruction is issued for a load module already represented on the load list, the count is incremented by one. As corresponding DELETE macro instructions are issued, the count is decremented until it reaches zero. An LLE has the following format:



Byte 0: Reserved (RES).

Bytes 1-3: Pointer to the next more recent LLE on the load list.

Byte 4: Count.

Bytes 5-7: Pointer to the corresponding CDE.

More will be said about CDEs in the next topic of Section 1, titled "Main Storage Supervision."

Job Pack Area Queue (MFT with Subtasking only)

In an MFT system with subtasking, the job pack area queue is a chain of request blocks associated with load modules invoked by a LOAD macro instruction. The queue contains FRBs, and those LRBs and LPRBs that represent reenterable modules. FRBs are queued on the job pack area queue until the requested module is completely loaded. When the module is completely loaded into main storage, the FRB is removed from the Job Pack Area Queue and replaced with an LRB or an LPRB queued on the Job Pack Area Queue if the loaded module is reenterable, and on the load list if it is not.

In the MFT with subtasking configuration, the load list represents non-reenterable modules, while the job pack

area queue represents only reenterable modules within the partition. These RBs on the job pack area queue are not deleted automatically, but remain intact until they are deleted by a DELETE macro instruction, or until job step termination occurs. Reenterable load modules are therefore retained in the partition for use by the job step task or any subtasks which may be created.

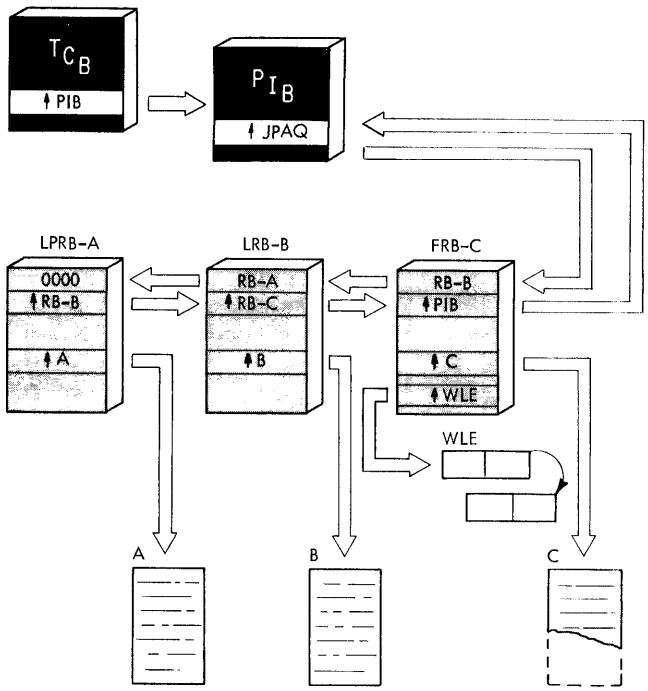
Whenever a LOAD macro instruction is issued, the job pack area queue is searched. If the routine is already fully loaded and represented by an LRB or an LPRB on the JPAQ (the routine is reenterable), the system increments the use count by one and passes the module entry point address to the requesting routine. If an FRB for the requested module is found, a wait list element (WLE) representing the deferred request is queued to the FRB, and the request is placed in a wait. When the requested routine is fully loaded, the system releases the request from the wait condition, and the request is re-initiated. If no RB for the requested routine is found, an FRB is created and queued on the JPAQ. The system then searches the load list of the requesting task for an RB for the requested routine. If an RB for that routine is found on the load list (the routine is not reenterable), the use count is incremented by one, the entry point address of the module is passed to the requesting routine, and the FRB is dequeued from the JPAQ. If no RB is found on the load list, the FRB remains on the JPAQ and the system begins loading the requested module.

Each time a DELETE macro instruction is issued for the routine, the use count is decremented by one (the DELETE routine ignores FRBs). When the use count reaches zero, the RB is removed from the queue.

Figure 5 illustrates how the job pack area queue is chained to a TCB.

In Figure 5, each RB contains a pointer to the previous RB and a pointer to the next RB on the queue. If there is no previous RB on the queue, that pointer will contain zero; if there is no next RB on the queue (this RB is the most recent on the JPAQ), the next RB pointer will point back to the job pack area queue pointer in the PIB.

Two wait list elements (WLEs) are queued to FRB-C representing deferred requests waiting until the initial loading of the module is completed. The last WLE contains zero in its forward pointer, indicating that it is the last element on the WLE queue.



•Figure 5. Job Pack Area queue

Effects of LINK, ATTACH, XCTL, and LOAD

In the previous paragraphs we have mentioned the LINK, ATTACH, XCTL, and LOAD macro instructions. A brief description of each will be helpful at this point. LINK, ATTACH, XCTL, and LOAD, though similar, have some distinguishing characteristics and system dependencies worth mentioning. By knowing what happens when these macro instructions are issued, you can make more effective use of the active RB queue and the load list.

LINK: A LINK results in the creation of a PRB chained to the active RB queue. Upon completion of the invoked routine, control is returned to the invoking routine. In systems with PCP and MFT, the RB is removed from the queue. The storage occupied by the invoked routine is freed unless the routine is also represented on the load list, or on the job pack area queue in MFT systems with subtasking. In systems with MVT, the use count in the RB is decremented by one; if it is then zero, the RB and the storage occupied by the routine are marked for deletion. A LINK macro instruction generates an SVC 6.

ATTACH: An ATTACH is similar to the other three macro instructions in systems with PCP or with MFT without subtasking. In systems with MFT (with subtasking) or MVT,

ATTACH is the means for dynamically creating a separate but related task -- a subtask. At the PCP and MFT (without subtasking) levels, tasks cannot create subtasks. ATTACH effectively performs the same functions as LINK at these control program levels, with two notable additions:

1. You can request an exit routine to be given control upon normal completion of the attached routine.

2. You can request the posting of an event control block upon the routine's completion.

Exit routines are represented by additional RBs on the active RB queue. The ATTACH macro instruction generates an SVC 42(2A).

XCTL: An XCTL also results in the creation of a PRB and immediate transfer of control to the invoked routine. However, XCTL differs from the other macro instructions in that, upon completion of the invoked routine, control is passed to a routine other than the invoking routine. In fact, an XCTL does not result in the creation of a lower level RB. Instead, the invoking routine and its associated RBs are deleted when the XCTL is issued. In effect, the RB for the invoked routine replaces the invoking routine's RB. The XCTL macro instruction generates an SVC 7.

LOAD: The LOAD macro instruction was treated previously in the discussion of the load list. To summarize: the system responds to a LOAD by fetching the routine into main storage and passing the entry point address to the requesting routine in register 0. Because the system does not have an indication of when the routine is no longer needed, a LOAD must be accompanied by a corresponding DELETE macro instruction. If not, the routine and its RB remain intact until the job step is terminated. The LOAD macro instruction generates an SVC 8.

System Task Control Differences

Thus far, this topic has dealt with the aspects of task supervision that are similar at the three control program levels. There are, however, some major areas of difference, namely:

1. The number of tasks that can be known to the system concurrently.

2. The layout of main storage.

3. The additional main storage control information in systems with MVT.

The first two subjects are discussed here, by system. The third subject, because of its volume, is discussed in the next topic of Section 1.

Systems with PCP: The distinguishing characteristic of an operating system with the primary control program is that it handles a single task. It has one TCB at any given time, which resides in the system nucleus. Jobs are processed sequentially, one step at a time. ATTACH macro instructions are treated similarly to LINKs; that is, they do not create subtasks.

Figure 6 is a snapshot of main storage in a system with PCP. The fixed area contains those routines, control blocks, and tables that are brought into main storage at IPL, and never overlaid. It also may contain optional access method and SVC routines which are normally nonresident, and an optional list of absolute addresses for routines which reside on direct access devices. These options can be selected during system generation.

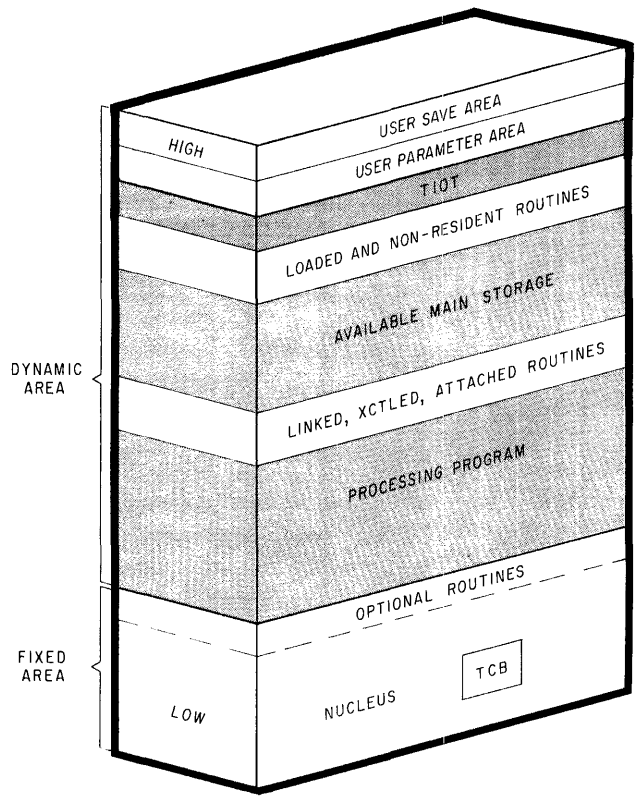


Figure 6. Main Storage Snapshot (PCP)

The dynamic area contains, in lower main storage adjacent to the fixed area, the processing program and routines invoked by

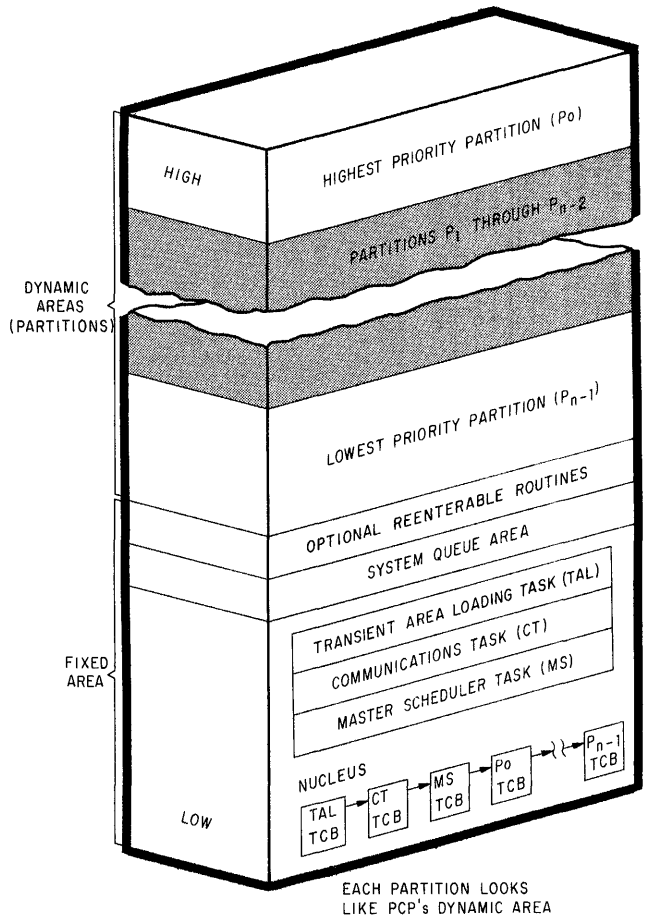
LINK, XCTL, and ATTACH macro instructions. At some points in the job processing flow, the processing program may be a job management routine. Upper main storage contains the user save area, user parameter area, task input/output table, routines requested by LOAD macro instructions, and non-resident routines, such as access method routines.

Systems with MFT (Without Subtasking): Operating Systems that provide multiprogramming with a fixed number of tasks without the subtasking option (MFT without subtasking), resemble systems with PCP except that the dynamic area may be divided into as many as 52 partitions. Partitions sizes and attributes are defined during system generation. These sizes and attributes remain fixed unless redefined by the operator during or after system initialization. Each partition contains one task. Three additional tasks, the transient area loading task, the communication task, and the master scheduler task, reside in the fixed area. One TCB exists for each task. All TCBs are linked by dispatching priority in a TCB queue, beginning with the TCBs for the three resident tasks.

The dynamic area may contain as many as 3 reading tasks, as many as 36 writing tasks, and as many as 15 job step tasks, so long as the total number of tasks does not exceed 52. Jobs are processed sequentially in a partition, one job step at a time. An ATTACH macro instruction, as in systems with PCP, is treated similarly to a LINK.

Because more than one task exists at any given time, systems with MFT introduce the concept of task switching. The relative dispatching priority of tasks is determined by the TCB queue. Control of the CPU must often be relinquished by one task and given to another of higher priority. MFT dumps contain task switching information often important in reconstructing the environment at the time of task failure.

Figure 7 is a snapshot of main storage in a system with MFT (without subtasking), having n partitions. The fixed area contains the nucleus (including the TCB queue, transient area loading task, communications task, and master scheduler task), and the system queue area. The fixed area may also contain the same system generation options discussed under the heading "Systems with PCP," and a reenterable load module area, which is optional in MFT. Each partition in the dynamic area is similar to the entire dynamic area of PCP.



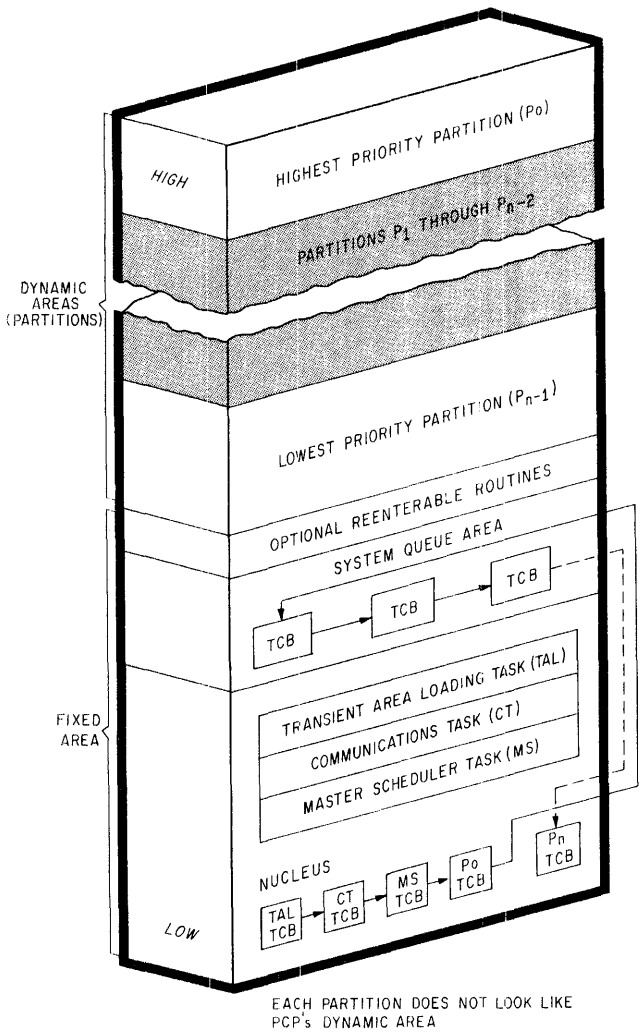
• Figure 7. Main Storage Snapshot (MFT Without Subtasking)

Systems with MFT (With Subtasking): Operating Systems that provide multiprogramming with a fixed number of tasks with the subtasking option (MFT with subtasking) more closely resemble systems with MVT, and differ from MFT systems without subtasking in the following major areas:

1. MFT with subtasking has an ATTACH facility similar to the ATTACH facility in MVT. While the number of job step TCBs still may not exceed 15, the number of tasks in any partition, and therefore the total number of tasks in the system, is now variable. Job step task TCBs reside in the nucleus. They are queued, following the system task TCBs, in the same manner as in MFT without subtasking. When subtasks are created, however, the subtask TCBs are placed in the system queue area and queued to the job step TCBs according to dispatching priority (TCBTCB field), and according to subtask relationships (TCBNTC, TCBOTC, TCBLTC fields).

2. MFT with subtasking provides the ability to change the dispatching priority of any task within a partition through the use of the CHAP macro instruction. For information regarding the use of the CHAP macro instruction, refer to the publication IBM System/360 Operating System: Supervisor and Data Management Services, GC28-6646.

Figure 8 is a snapshot of main storage in an MFT system with subtasking having n partitions. Note here that the TCBs in the nucleus are all job step TCBs, while those residing in the sytem queue area are the subtask TCBs.



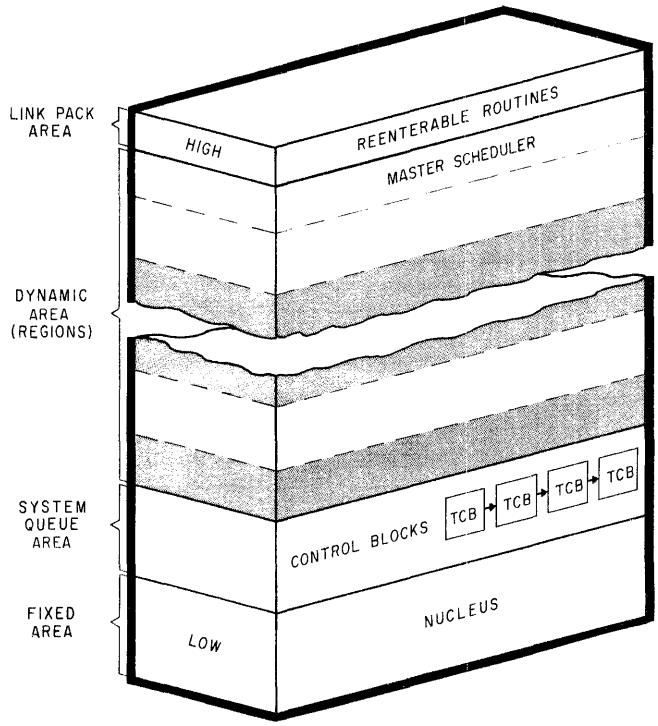
• Figure 8. Main Storage Snapshot (MFT With Subtasking)

Systems with MVT: In Operating Systems that provide multiprogramming with a variable number of tasks (MVT), as many as 15 job steps can be executed concurrently. Each job step requests an area of main storage called a region and is executed as a job step task. In addition, system tasks request regions and can be executed concurrently with job step tasks.

Regions are assigned automatically from the dynamic area when tasks are initiated. Regions are constantly redefined according to the main storage requirements of each new task.

With the facility of attaching subtasks available to each task through the ATTACH macro instruction, the number of TCBs in the system is variable. Tasks gain control of the CPU by priority. To keep track of the priority and status of each task in the system, TCBs are linked together in a TCB queue.

Figure 9 is a snapshot of main storage in a system with MVT. The fixed area is occupied by the resident portion of the control program loaded at IPL. The system queue space is reserved for control blocks and tables built by the control program. The dynamic area is divided into variable-sized regions, each of which is allocated to a job step task or a system task. Finally, the link pack area contains selected reenterable routines, loaded at IPL. If an IBM 2361 Core Storage device and Main Storage Hierarchy Support are included in the system, a secondary link pack area may be created in Hierarchy 1 to contain other reenterable routines.



• Figure 9. Main Storage Snapshot (MVT)

Main Storage Supervision

Because main storage is allocated dynamically in an operating system, current storage control information must be kept. Such information is contained in a series of control blocks called queue elements. In systems with PCP and MFT without subtasking, queue elements reflect areas of main storage that are unassigned. In MFT systems with subtasking, a gotten subtask area queue element (GQE) is introduced to record storage obtained for a subtask by a supervisor issued GETMAIN macro instruction. In systems with MVT, more elaborate storage control is maintained; at any given time, queue elements reflect the distribution of main storage in regions, subpools, and load modules. A familiarity with storage control information is necessary to understand the main storage picture provided in dumps.

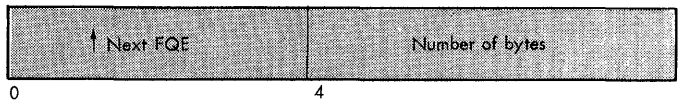
The dynamic area may be significantly expanded by including IBM 2361 Core Storage in the system. Main Storage Hierarchy Support for IBM 2361 Models 1 and 2 permits selective access to either processor storage (hierarchy 0) or 2361 Core Storage (hierarchy 1). If IBM 2361 Core Storage is not included, requests for storage from hierarchy 1 are obtained from hierarchy 0. If 2361 Core Storage is not present in an MVT system and a region is defined to exist in two hierarchies, a two-part region is established within processor storage. The two parts are not necessarily contiguous.

Storage Control in Systems With PCP

The chain of storage control information in a system with PCP begins at a table called the main storage supervisor (MSS) boundary box, located in the system nucleus. This table, pointed to by the TCBMSS field of the TCB, contains three words. The first word points to a free queue element (FQE) associated with the highest free area in processor storage. The second word points to the first doubleword outside the nucleus. The third word contains the highest address in processor storage plus one.

If Main Storage Hierarchy Support for IBM 2361 Models 1 and 2 is included in the system, the boundary box is expanded to six words. The first byte of the expanded boundary box contains a "1" in bit 7 to indicate that hierarchy support is included. The second set of three words describes storage in hierarchy 1. The first word of this second set points to an FQE associated with the highest free area in hierarchy 1. The second word points to the first doubleword in hierarchy 1. The third word points to the highest position in hierarchy 1 plus one. If 2361 Core Storage is not included in the system, the hierarchy 1 pointers are set to zero.

FQE: Each free area in main storage is described by an FQE. FQEs are chained, beginning with the FQE associated with the free area having the highest address. If Main Storage Hierarchy Support is present, one FQE chain exists for each hierarchy specified. Each FQE occupies the first 8 bytes of the area it describes. It has the following format:



Bytes 0-3: Pointer to FQE associated with next lower free area or, if this is the last FQE, zeros.

Bytes 4-7: Number of bytes in the free area.

Storage control in systems with PCP is summarized in Figure 10.

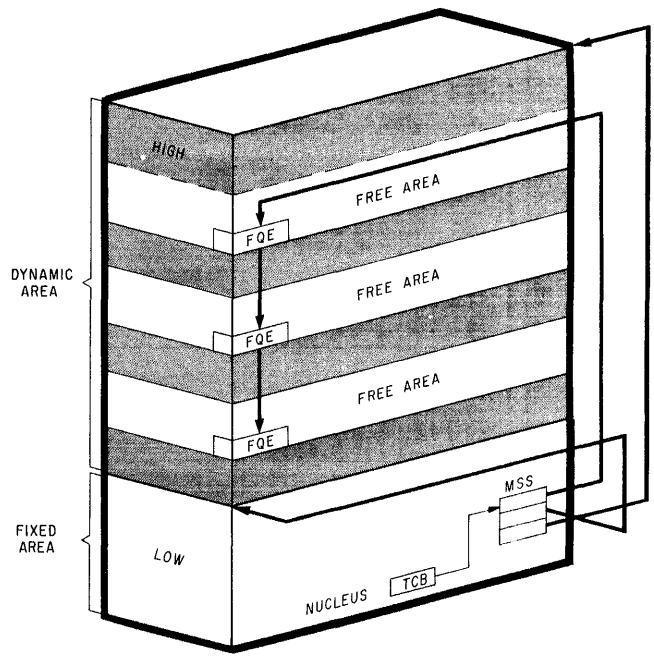


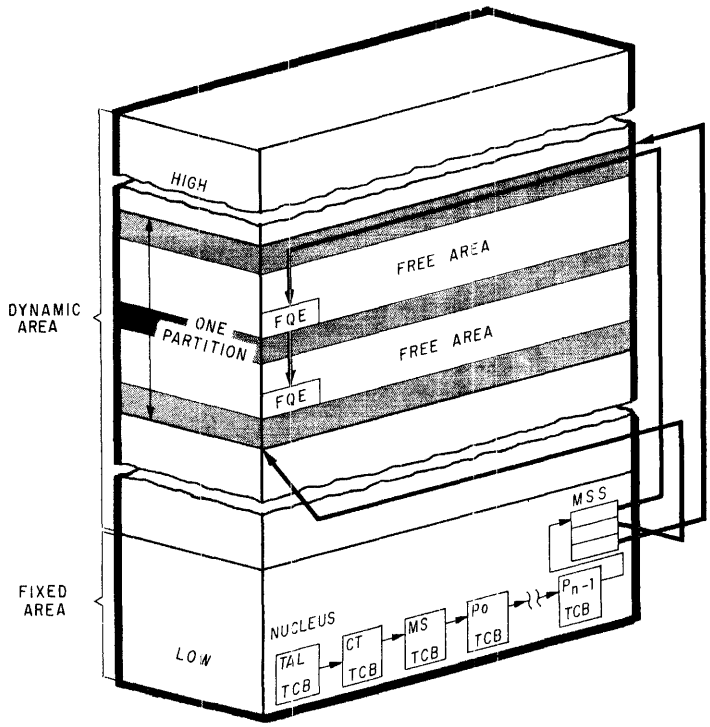
Figure 10. Storage Control (PCP)

Storage Control in Systems with MFT (Without Subtasking)

Storage control information in systems with MFT without subtasking is similar to that in systems with PCP, except that one MSS boundary box is maintained for each partition. The TCB associated with the partition contains a pointer (TCBMSS) to the boundary box.

If Main Storage Hierarchy Support is included, the first half of each expanded boundary box describes the processor storage (hierarchy 0) partition segment, and the second half describes the 2361 Core Storage (hierarchy 1) partition segment. Any partition segment not currently assigned storage in the system has the applicable boundary box pointers set to zero. If the partition is established entirely within hierarchy 0, or if 2361 Core Storage is not included in the system, the hierarchy 1 pointers in the second half of the expanded boundary box are set to zero. If a partition is established entirely within hierarchy 1, the hierarchy 0 pointers in the first half of the expanded boundary box are set to zero.

The boundary box format for MFT is identical to the format for PCP. The pointers, however, point to the boundaries of the partition and to the partition FQEs rather than to the boundaries of storage. Figure 11 summarizes storage control in systems with MFT.

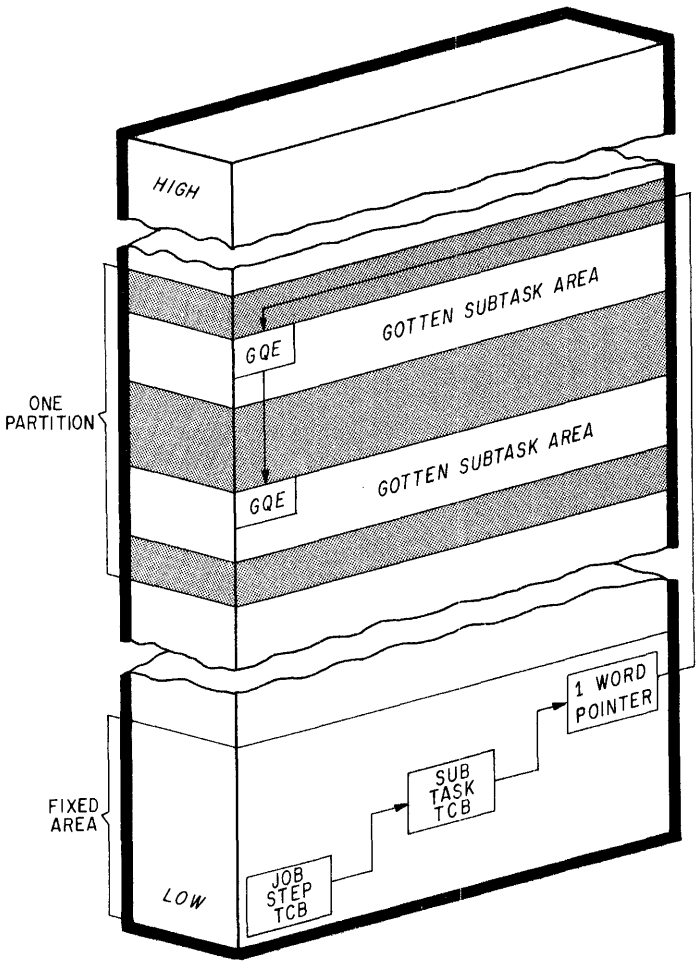


•Figure 11. Storage Control for a Partition (MFT Without Subtasking)

Storage Control in Systems with MFT (With Subtasking)

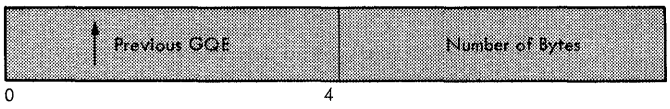
Storage control information for the job step or partition TCB in MFT systems with subtasking is handled in the same way as in MFT systems without subtasking. However, when subtasks are created, the supervisor builds another control block, the Gotten subtask area Queue Element (GQE). The GQEs associated with each subtask originate from a one word pointer addressed by the TCBMSS field of the subtask TCB.

GQE: Each area in main storage belonging to a subtask, and obtained by a supervisor issued GETMAIN macro instruction, is described by a gotten subtask area queue element (GQE). GQEs are chained in the order they are created. The TCBMSS field of the subtask TCB contains the address of a word which points to the most recently created GQE.



•Figure 12. Storage Control for Subtask Storage (MFT with Subtasking)

If Main Storage Hierarchy Support is present in the system, the GQE chain can span from hierarchy 0 to hierarchy 1 and back in any order. Each GQE occupies the first eight bytes of the area it describes, and has the following format:



Bytes 0-3: Pointer to the Previous GQE or, if zero, this is the last GQE on the chain.

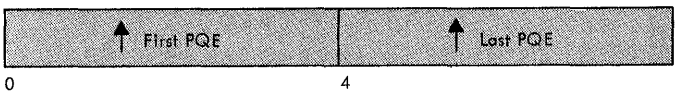
Bytes 4-7: Number of bytes in the gotten subtask area.

Figure 12 summarizes the chaining of GQEs to a subtask TCB.

Storage Control for a Region in Systems with MVT

Unassigned areas of main storage within each region of a system with MVT are reflected in a queue of partition queue elements (PQEs) and a series of free block queue elements (FBQEs).

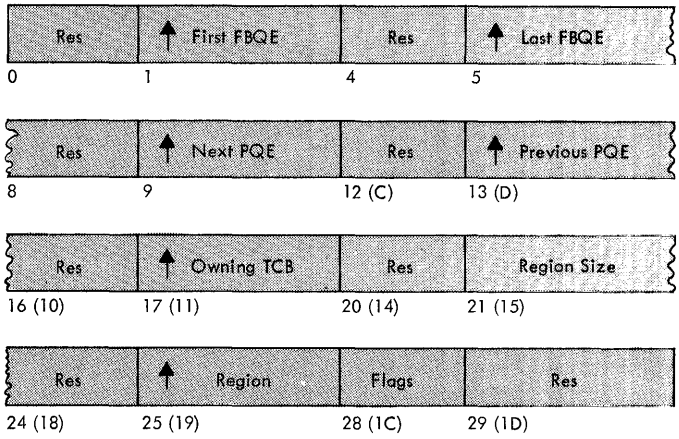
PQE: The partition queue associated with a region resides in the system queue space. It is connected to the TCBs for all tasks in the job step through a dummy PQE located in the system queue space. A dummy PQE has the following format:



Bytes 0-3: Pointer to the first PQE in the partition queue.

Bytes 4-7: Pointer to the last PQE in the partition queue.

In systems that do not include the rollout/rollin feature or Main Storage Hierarchy Support for IBM 2361 Models 1 and 2, there is one PQE for each job step. If the rollout feature is used, additional PQEs are added each time a job step borrows storage space from existing steps or acquires unassigned free space to satisfy an unconditional GETMAIN request. These additional PQEs are removed from the queue as the rollin feature is used. If Main Storage Hierarchy Support is present, one PQE exists for each hierarchy used by the job step. A PQE has the following format:



Bytes 1-3: Pointer to the first FBQE or, if there are no FBQEs, a pointer to the PQE itself.

Bytes 5-7: Pointer to the last FBQE or, if there are no FBQEs, a pointer to the PQE itself.

Bytes 9-11(B): Pointer to the next PQE or, if this is the last PQE, zeros.

Bytes 13-15(D-F): Pointer to the previous PQE or, if this is the first PQE, zeros.

Bytes 17-19(11-13): Pointer to the TCB of the owning job step.

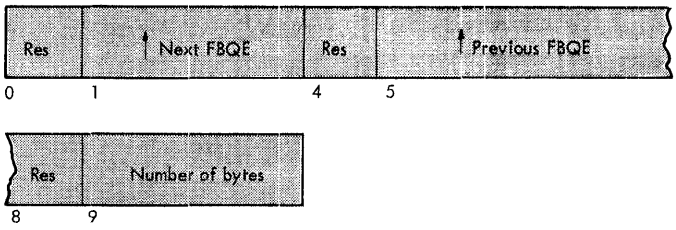
Bytes 21-23(15-17): Size of the region, in 2K (2048) bytes.

Bytes 25-27(19-1B): Pointer to the first byte of the region.

Byte 28(1C): Rollout flags.

FBQE: The FBQEs chained to a PQE reflect the total amount of free space in a region. Each FBQE is associated with one or more contiguous 2K blocks of free storage area. FBQEs reside in the lowest part of their associated area. As area distribution within the region changes, FBQEs are added to and deleted from the free block queue.

An FBQE has the following format:



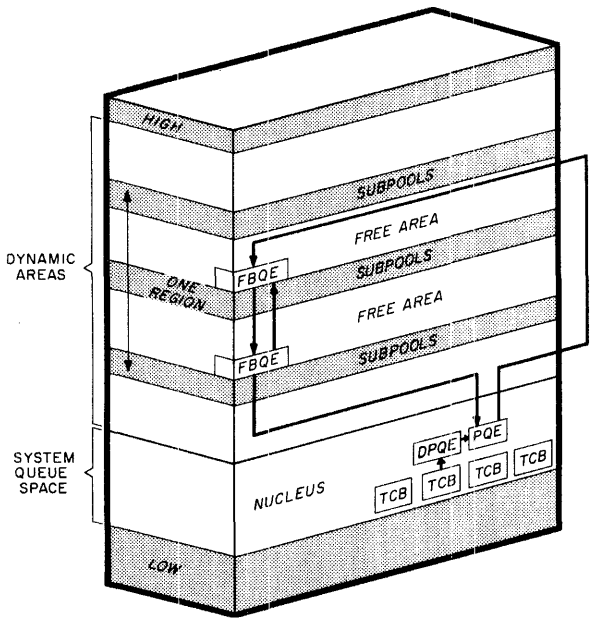
Bytes 1-3: Pointer to the next lower FBQE or, if this is the last FBQE, a pointer to the PQE.

Bytes 5-7: Pointer to the preceding FBQE, or, if this is the first FBQE, a pointer to the PQE.

Bytes 9-12(C): Number of bytes in the free block.

The remaining main storage in a region is used by problem programs and system programs. For convenience in referring to storage areas, the total amount of space assigned to a task represents one or more numbered subpools. (Subpools can also be shared by tasks.) Subpools are designated by a number assigned to the area through a GETMAIN macro instruction. Subpool numbers available for problem program use range from 0 through 127. Subpool numbers 128 through 255 are either unavailable or used by system programs.

Storage control elements and queues for a region are summarized in Figure 13.

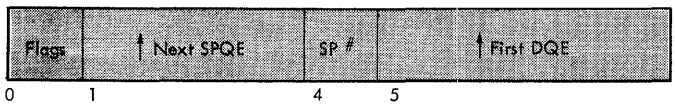


• Figure 13. Storage Control for a Region (MVT)

Storage Control for a Subpool in Systems with MVT

Main storage distribution within each subpool is reflected in a subpool queue element (SPQE) and queues of descriptor queue elements (DQEs) and free queue elements (FQEs).

SPQE: SPQEs are associated with the subpools created for a task. SPQEs reside in the system queue space and are chained to the TCB(s) that use the subpool. They serve as a link between the TCB and the descriptor queue, and may be part of a subpool queue if the task uses more than one subpool. If a subpool is used by more than one task, only one SPQE is created. An SPQE has the following format:



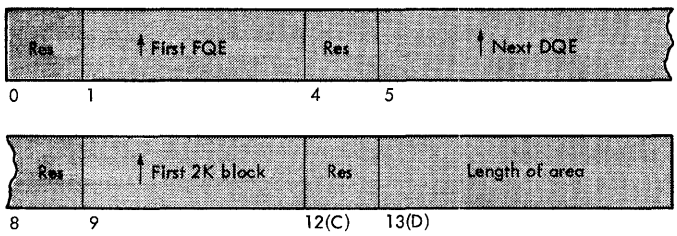
Byte 0:
- Bit 0 - Subpool is owned by this task if zero; shared, and owned by another task, if one.
- Bit 1 - This SPQE is the last on the queue, if one.
- Bit 2 - Subpool is shared and owned by this task, if one.
- Bits 3-7 - Reserved.

Bytes 1-3: Pointer to next SPQE or, in last SPQE, zero.

Byte 4: Subpool number.

Bytes 5-7: Pointer to first DQE or, if the subpool is shared, a pointer to the "owning" SPQE.

DQE: DQEs associated with each SPQE reflect the total amount of space assigned to a subpool. Each DQE is associated with one or more 2K blocks of main storage set aside as a result of a GETMAIN macro instruction. Each DQE is also the starting point for the free queue. A DQE has the following format:

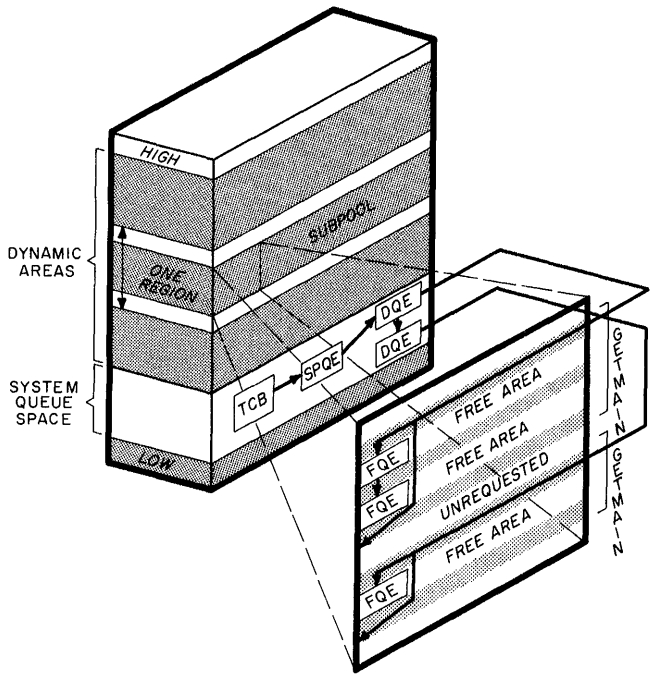


Bytes 1-3: Pointer to the FQE associated with the first free area.

Bytes 5-7: Pointer to the next DQE or, if this is the last DQE, zeros.

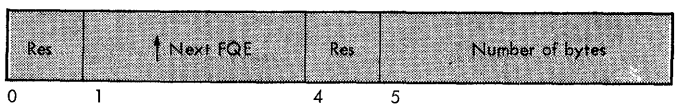
Bytes 9-11(B): Pointer to first 2K block described by this DQE.

Bytes 13-15(D-F): Length in bytes of area described by this DQE.



•Figure 14. Storage Control for a Subpool (MVT)

FQE: The FQE describes a free area within a set of 2K blocks described by a DQE. It occupies the first eight bytes of that free area. Since the FQE is within the subpool, it has the same protect key as the task active within that subpool. Extreme care should be exercised to see that FQEs are not destroyed by the problem program. If an FQE is destroyed, the free space that it describes is lost to the system and cannot be assigned through a GETMAIN. As area distribution within the set of blocks changes, FQEs are added to and deleted from the free queue. An FQE has the following format:



Bytes 1-3: Pointer to the next lower FQE or, if this is the last FQE, zeros.

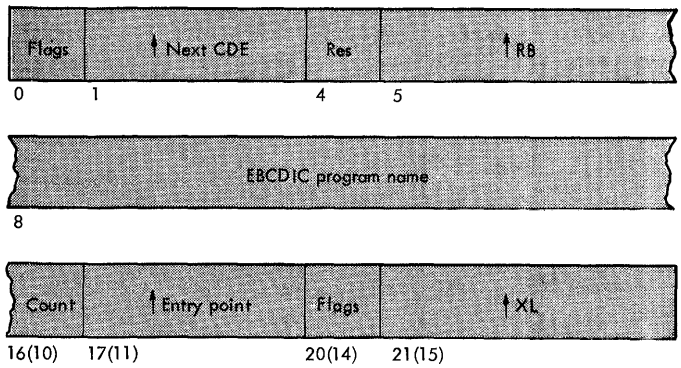
Bytes 5-7: Number of bytes in the free area.

A subpool is summarized in Figure 14.

Storage Control for a Load Module in Systems with MVT

Each load module in main storage is described by a contents directory entry (CDE) and an extent list (XL) that tells how much space it occupies.

CDE: The contents directory is a group of queues, each of which is associated with an area of main storage. The CDEs in each queue represent the load modules residing in the associated area. There is a CDE queue for the link pack area and one for each region, or job pack area. The TCB for the job step task that requested the region points to the first CDE for that region. Contents directory queues reside in the system queue space. A CDE has the following format:



Byte 0: Flag bits, when set to one, indicate:
- Bit 0 - Module was loaded by NIP.
- Bit 1 - Module is in process of being loaded.
- Bit 2 - Module is reenterable.
- Bit 3 - Module is serially reusable.
- Bit 4 - Module may not be reused.
- Bit 5 - This CDE reflects an alias name (a minor CDE).
- Bit 6 - Module is in job pack area.
- Bit 7 - Module is not only-loadable.

Bytes 1-3: Pointer to next CDE.

Bytes 5-7: Pointer to the RB.

Bytes 8-15(F): EBCDIC name of load module.

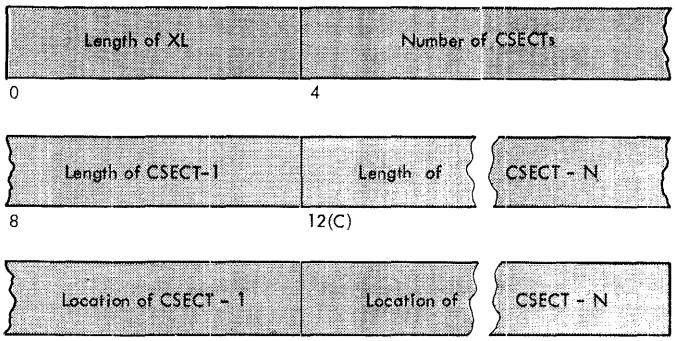
Byte 16(10): Use count.

Bytes 17-19(11-13): Entry point address of load module.

Byte 20: Flag bits, when set to one, indicate:
- Bit 0 - Reserved.
- Bit 1 - Module is inactive.
- Bit 2 - An extent list has been built for the module.
- Bit 3 - This CDE contains a relocated alias entry point address.
- Bit 4 - The module is refreshable.
- Bits 5, 6, 7 - Reserved.

Bytes 21-23(15-17): Pointer to the XL for this module or, if this is a minor CDE, pointer to the major CDE.

XL: The total amount of main storage occupied by a load module is reflected in an extent list (XL). XLs are located in the system queue space. An XL has the following format:



Bytes 0-3: Length of XL in bytes.

Bytes 4-7: Number of scattered control sections. If the control sections are block-loaded, 1.

Remaining Bytes: Length in bytes of each control section in the module (4 bytes for each control section) and starting location of each control section (4 bytes for each control section).

Storage control elements and queues for load modules are summarized in Figure 15.

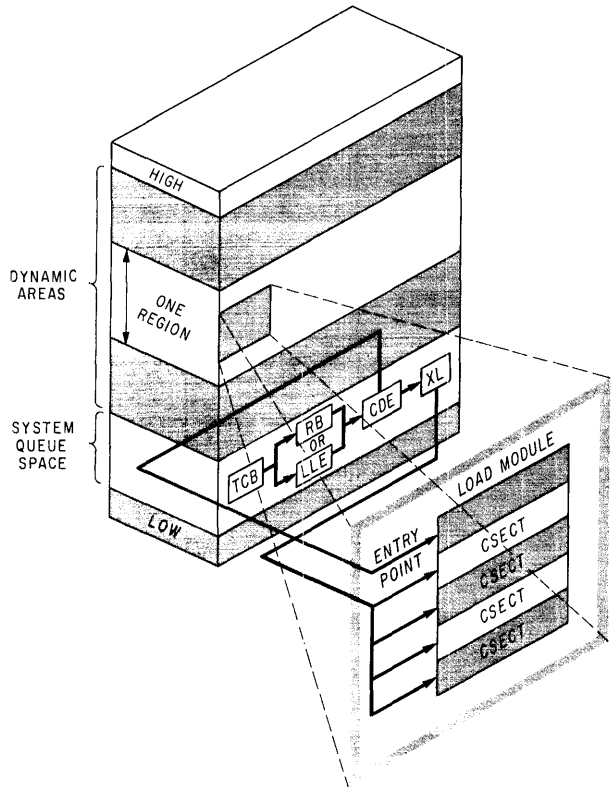


Figure 15. Storage Control for a Load Module (MVT)

System Control Blocks and Tables

In addition to the key task management control blocks (TCB and RB), several other control blocks containing essential debugging information are built and maintained by data management and job management routines. Although some of these blocks are not readily identifiable on a storage dump, they can be located by following chains of pointers that begin at the TCB.

The control blocks discussed here have the same basic functions at each control program level. The precise byte-by-byte contents of the blocks can be found in the publication System Control Blocks. Block contents useful in debugging are listed in Appendix H.

Communications Vector Table (CVT)

The CVT provides a means of communication between nonresident routines and the control program nucleus. Its most important role in debugging is its pointer to two words of TCB addresses. These words enable you to locate the TCB of the active task, and from there to find other essential control information. Storage location 16(10) contains a pointer to the CVT.

Task Input/Output Table (TIOT)

A TIOT is constructed by job management for each task in the system. It contains primarily pointers to control blocks used by I/O support routines. It is usually located in the highest part of the main storage area occupied by the associated task (in systems with MVT, TIOTs are in the system queue space.) Through the TIOT, you can obtain addresses of unit control blocks allocated to the task, the job and step name, the ddnames associated with the step, and the status of each device and volume used by the data sets.

Unit Control Block (UCB)

The UCB describes the characteristics of an I/O device. One UCB is associated with each I/O device configured into a system. The UCB's most useful debugging aid is the sense information returned by the last sense command issued to the associated device.

Event Control Block (ECB)

The ECB is a 1-word control block created when a READ or WRITE macro instruction is issued, initiating an asynchronous I/O operation. At the completion of the I/O operation, the access method routine posts the ECB. By checking this ECB, the completion status of an I/O operation can be determined. In all access methods but QTAM, the ECB is the first word of a larger block, the data event control block.

Input/Output Block (IOB)

The IOB is the source of information required by the I/O supervisor. It is filled in with information taken from an I/O operation request. In debugging, it is useful as a source of pointers to the DCB associated with the I/O operation and the channel commands associated with a particular device.

Data Control Block (DCB)

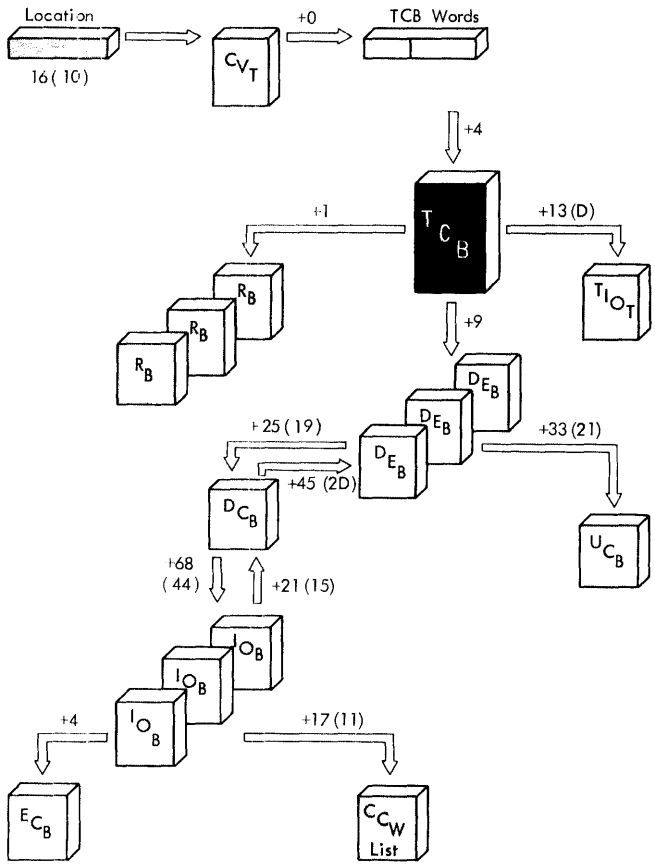
The DCB is the place where the operating system and the problem program store all pertinent information about a data set. It may be completely filled by operands in the DCB macro instruction, or partially filled in and completed when the data set is opened, with subparameters in a DD statement and/or information from the data set label. The format of DCBs differs slightly for each of the various access methods and device types. The DCB's primary debugging aids are its pointers to the DEB and current IOB associated with its data set, and the offset value of the ddname in the TIOT.

Data Extent Block (DEB)

A DEB describes a data set's auxiliary storage assignments and contains pointers to some other control blocks. The DEB is created and queued to the TCB at the time a data set is opened. Each TCB contains a pointer to the first DEB on its chain. Through this pointer you can find out which data sets are opened for the task at a given time, what extents are occupied by open data sets, and where the DCB and UCB are located.

Summary of Control Block Relationships

Figure 16, an expansion of Figure 1, shows the relationships among the principal control blocks and tables in the System/360 Operating System.



•Figure 16. Control Block Relationships

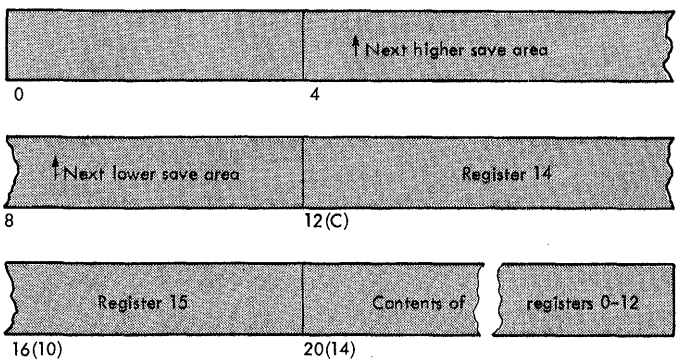
Traces

Two features that assist you in tracing the flow of your program are the save area chain and the trace table (the trace table is optional at system generation.) Both these features are edited and clearly identified on ABEND/SNAP dumps, and can be located easily on core image and stand-alone dumps.

Save Area Chain

When control is passed from one load module to another, the requested module is responsible for storing the contents of general registers. This necessitates the use of separate save areas for each level of load module in a task. With the different types of linkages that can occur, save areas must be chained so that each one points to both its predecessor and successor.

A save area is a block of 72 bytes containing chain pointers and register contents. It has the following format:



Bytes 4-7: Pointer to the next higher level save area or, if this is the highest level save area, zeros.

Bytes 8-11(B): Pointer to the next lower level save area or, if this is the lowest level save area, unused.

Bytes 12-15(C-F): Contents of register 14 (optional)

Bytes 16-19(10-13): Contents of register 15 (optional)

Bytes 20-71(14-3F): Contents of registers 0 to 12

The save area for the first or highest level load module in a task (save area 1) is provided by the control program. The address of this area is contained in register 13 when the load module is first entered. It is the responsibility of the highest level module to:

1. Save registers 0-12 in bytes 20-71(14-3F) of save area 1 when it is entered.
2. Establish a new save area (save area 2).
3. Place the contents of register 13 into bytes 4-7 of save area 2.
4. Place the address of save area 2 into register 13.
5. Place the address of save area 2 into bytes 8-11(B) of save area 1.

At this point, the save areas appear as shown in Figure 17.

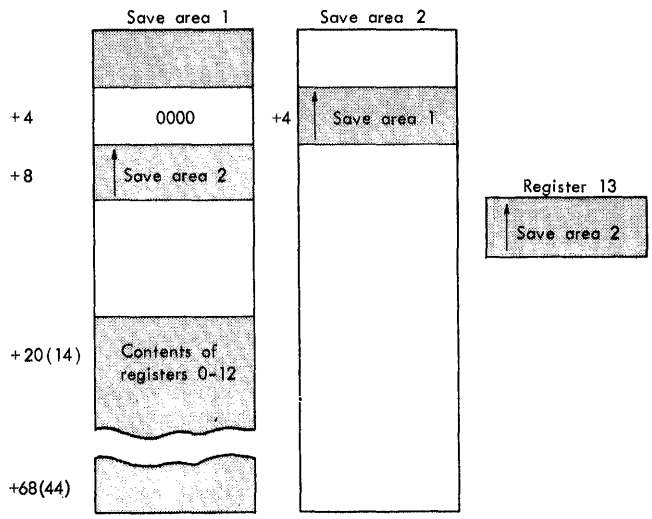


Figure 17. Save Area Trace

If a module requests a lower level module, it must perform actions 1 through 4 to ensure proper restoration of registers when it regains control. (Action 5 is not required, but must be performed if the dump printout of the field is desired.) A module that does not request a lower level module need only perform the first action.

ABEND and SNAP dumps include edited information from all save areas associated with the dumped task under the heading "SAVE AREA TRACE". In a stand-alone dump, the highest level save area can be located through a field of the TCB. Subsequent save areas can be located through the save area chain.

Trace Table

The tracing routine is an optional feature specified during system generation. This routine places entries, each of which is associated with a certain type of event, into a trace table. The size of the table is also a system generation option; when the table is filled, the routine overlays old entries with new entries, beginning at the top of the table (the entry having the lowest storage address). The contents and size of a trace table are highly system-dependent.

Systems with PCP: Trace table entries for systems with PCP are 4 words long and represent occurrences of SIO, I/O, and SVC interruptions. Figure 18 shows the word contents of each type of entry.

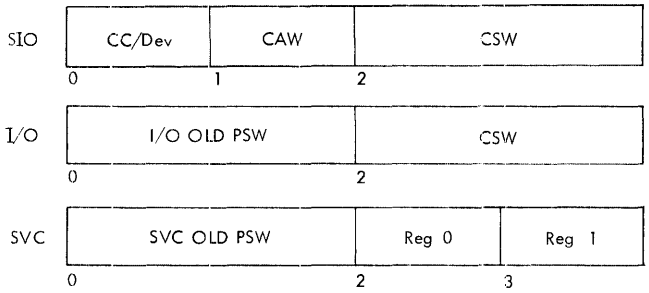


Figure 18. Trace Table Entries (PCP)

Systems with MFT: Systems with MFT have the same type of trace table entries as PCP, plus an additional type representing task switches, as shown in Figure 19.

Systems with MVT: The trace table in a system with MVT is expanded to include more entries and more information in each entry. Trace table printouts occur only on SNAP dumps and stand-alone dumps. Entries are eight words long and represent occurences of SIO, external, SVC, program, and I/O interruptions, and dispatcher loaded PSWs.

Figure 20 shows the word contents of trace table entries for SNAP dumps and stand-alone dumps. Figure 21 shows the contents of trace table entries as filled by MVT with Model 65 multiprocessing. (SSM -- set system mask -- entries are optional.)

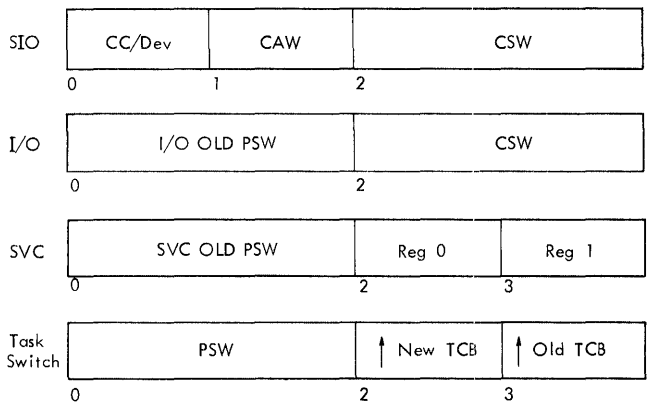
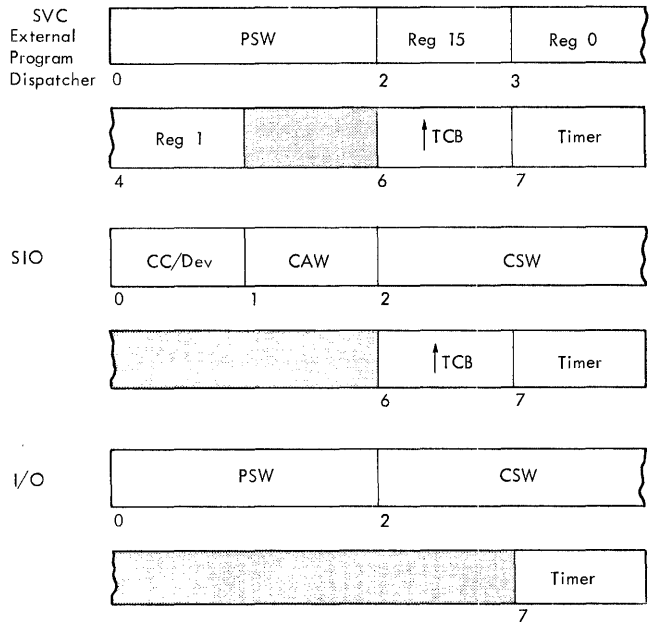


Figure 19. Trace Table Entries (MFT)



•Figure 20. Trace Table Entries (MVT)

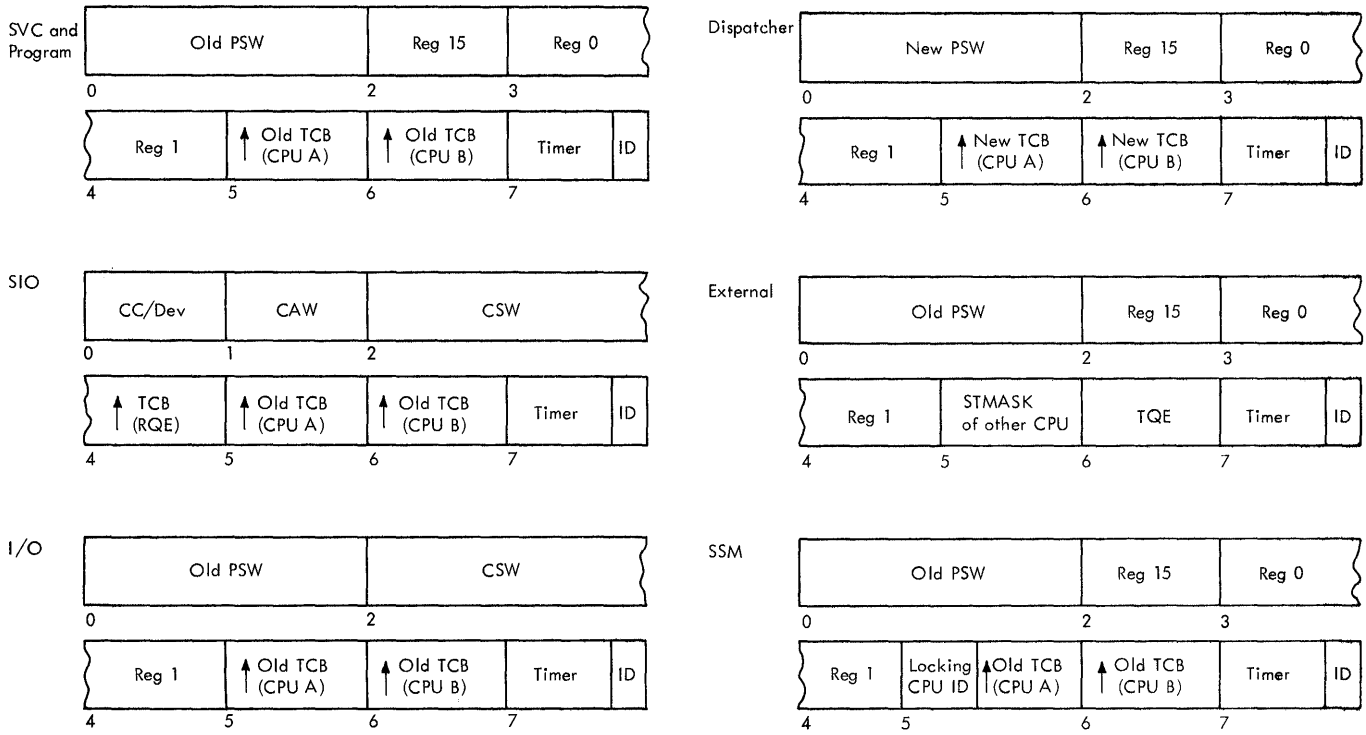


Figure 21. Trace Table Entries (MVT with Model 65 multiprocessing)

Section 2: Interpreting Dumps

How are ABEND dumps invoked? What does information in a SNAP dump mean? What useful facts can be gleaned from an indicative dump? Where are key tables and control blocks in a stand-alone dump?

These and similar debugging questions are answered in this section of the manual. Topics comprising Section 2 describe each of the debugging facilities introduced earlier -- what information they provide, where to find this information , and how to apply it.

The introduction to this section describes a general procedure for debugging with a dump. Subsequent topics deal with

- ABEND/SNAP dumps issued by systems with PCP and MFT.
- ABEND/SNAP dumps issued by systems with MVT.
- Indicative dumps.
- Core Image dumps.
- Stand-alone dumps.

Each topic includes instructions for invoking the dump, a detailed description of the dump's contents, and a guide to using the dump, with specific instructions for following the general debugging procedure.

General Debugging Procedure

The first facts you must determine in debugging with an operating system dump are the cause of the abnormal termination and whether it occurred in a system routine or a problem program. To aid you in making these determinations, ABEND, SNAP, and indicative dumps provide two vital pieces of information -- the completion code and the active RB queue. Similar information can be obtained from a core image dump or a stand-alone dump by analyzing PSWs and re-creating an active RB queue.

A Completion code is printed at the top of ABEND, SNAP, and indicative dumps. It consists of a system code and a user code. The system code is supplied by the control program and is printed as a 3-digit hexadecimal number. The user code is the code you supplied when you issued your own ABEND macro instruction; it is printed as a 4-digit decimal number. If the dump shows a user code, the error is in your program, and the completion code should lead you directly to the source of error. Normally, however, a system code will be listed; this indicates that the operating system issued the ABEND. Often the system completion code gives enough information for you to determine the cause of the error. The explanations of system completion codes, along with a short explanation of the action to be taken by the programmer to correct the error, are contained in the publication IBM System/360 Operating System: Messages and Codes, GC28-6631.

To locate the load module that had control at the time the dump was issued, find the RB associated with the module. If the dump resulted from an ABEND or SNAP macro instruction, the third most recent RB on the queue represents the load module that had control. The most recent and second most recent RBs represent the ABDUMP and ABEND routines, respectively. Core image dumps and stand-alone dumps contain PSW information that can be used to identify the load module in control.

Once you have located the RB or load module, look at its name. If it does not have a name, it is probably an SVRB for an SVC routine, such as one resulting from a LINK, ATTACH, XCTL or LOAD macro instruction. To find the SVC number, look at the last three digits of the resume PSW in the previous RB on the queue. If a previous RB does not exist, the RB in question is an SVRB for a routine invoked by an XCTL macro instruction. Register 15 in the extended save area of the RB gives a pointer to a parameter list containing the name of the routine that issued the XCTL.

If the RB does not bear the name of one of your load modules, either an RB was overlaid or termination occurred during execution of a system routine. The first three characters of the name identify the system component; Appendix C contains a list of component names to aid you in determining which load module was being executed.

If the RB bears the name of one of your load modules, you can be reasonably certain that the source of the abnormal termination lies in your object code. However, an access method routine may be at fault. This possibility arises because your program branches to access method routines

through a supervisor-assisted linkage, instead of invoking them. Thus, an access method routine is not represented on the active RB queue. To ascertain whether an access method routine was the source of the abnormal termination, you must examine the resume PSW field in the RB. If the last 3 bytes in this field point to a main storage address outside your program, check the load list to see if an access method routine is loaded at that address. If it is, you can assume that it, and not your program, was the source of abnormal termination.

Abnormal Termination in System Routines: By analyzing the RB's name field or the SVC number in the previous RB, you can determine which system load module requested the termination. If the RB has a system module name, the first three characters tell you the name of the system component. The remaining characters in the name identify the load module in error.

Remember, although a system routine had control when the dump was taken, a problem program error may indirectly have been at fault. Such a situation might result from an incorrectly specified macro instruction,an FQE modified inadvertently, a request for too much storage space, a branch to an invalid storage address, etc. To determine the function of the load module that had control, consult Appendix C. With its function in mind, the completion code together with an examination of the trace table may help you to uncover which instruction in the problem program incorrectly requested a system function.

Program Check Interruptions in Problem Programs: If you have determined from the completion code or PSWs and evaluation of the RB queue that the dump resulted from a program check in your problem program, examine the status of your program in main storage. (If you have received only an indicative dump, you must obtain either an ABEND/SNAP dump or a stand-alone dump at this point.) Locate your program using pointers in the RB. If its entry point does not coincide with the lower boundary of the program, you can find the lower boundary by adding 32(20) to the address of the RB (systems with PCP and MFT). The RB's size field gives the number of doublewords occupied by the RB, the program, and associated supervisor work areas. ABEND/SNAP dumps with PCP and MFT have the storage boundaries of the problem program calculated and printed.

Next, locate the area within your program that was executed immediately prior to the dump. To do this, you must examine the program check old PSW. Pertinent information in this PSW includes:

Bits 12-15: AMWP bits

Bits 32,33: Instruction length in halfwords.

Bits 40-63: Instruction address

A useful item of information in the PSW is the P bit of the AMWP bits (bits 12-15). If the P bit is on, the PSW was stored while the CPU was operating in the problem program state. If it is off, the CPU was operating in the supervisor state.

Find the last instruction executed before the dump was taken by subtracting the instruction length from the instruction address. This gives you the address of the instruction that caused the termination. If the source program was written in a higher level language, you must evaluate the instructions that precede and follow the instruction at fault to determine their function. You can then relate the function to a statement in the source program.

Other Interruptions in Problem Programs: If the completion code or PSWs and the active RB queue indicate a machine check interruption, a hardware error has occurred. Call your IBM Field Engineering representative and show him the dump.

If an external interruption is indicated, with no other type of interruption, the dump probably was taken by the operator. Check with him to find out why the dump was taken at this point. The most likely reasons are an unexpected wait or a program loop. If a trace table exists, examine it for the events preceding the trouble or, if the trace table was made ineffectual by a program loop, resubmit the job and take a dump at an earlier point in the program. You may want to consider using the TESTRAN facility to find where the program loop occurred.

The remaining causes of a dump are an error during either execution of an SVC or an I/O interruption. In either case, examine the trace table. Entries in the table tell you what events occurred leading up to termination. From the sequence of events, you should be able to determine what caused a dump to be taken. From here, you can turn to system control blocks and save areas to get specific information. For example, you can find the sense information issued as a result of a unit check in the UCB, a list of the open data sets from the DEB chain, the CCW list from the IOB, the reason for an I/O interrupt in the status portion of the CSW, etc.

Debugging Procedure Summary

1. Look at the completion code or PSW printouts to find out what type of error occurred. Common completion codes and causes are explained in Appendix B.

2. Check the name of the load module that had control at the time the dump was taken by looking at the active RB's.

3. If the name identifies a system routine, proceed to step 4. If the name identifies a problem program and the completion code or PSW indicates a program check, proceed to step 6. If the name identifies a problem program, and the completion code or PSW indicates other than a program check, proceed to step 10.

---

4. Find the function of the system routine using Appendix C.

5. If the dump contains a trace table, begin at the most recent entry and proceed backward to locate the most recent SVC entry indicating the problem state. From this entry, proceed forward in the table, examining each entry for an error that could have caused the system routine to be terminated.

---

6. If the name identifies one of your load modules, check the instruction address and the load list to see if an access method routine last had control. If so, return to step 4.

7. Locate your program in the dump.

8. Locate the last instruction executed before the dump.

9. Examine the instruction and, if the program was written in a high-level language, the instructions around it for a possible error in object code.

---

10. If a machine check interruption is indicated, call your IBM Field Engineering representative.

11. If only an external interruption is indicated, ask the operator why he took the dump. Resubmit the job and take a dump at the point where trouble first occurred.

12. Examine the trace table, if one is present, for events leading up to the termination. Use trace table entries and/or information in system control blocks and save areas to isolate the cause of the error.

ABEND/SNAP Dump (Systems With PCP and MFT)

ABEND/SNAP dumps for systems with PCP and MFT are discussed together because they are nearly identical in format. System differences in the contents of the dumps are shaded for easy recognition. Debugging instructions for the dumps are discussed later, in the guide to using the dump.

ABEND/SNAP storage dumps are issued whenever the control program or problem program issues an ABEND or SNAP macro instruction, or the operator issues a CANCEL command requesting a dump, and proper dump data sets have been defined. However, in the event of a system failure, if a SYS1.DUMP data set has been defined and is available, a full core image dump will be provided, as explained in the section headed "Core Image Dump."

Since, in an MFT with subtasking system, subtasks may be created, you may receive one or more partial dumps in addition to the complete dump of the task that caused the abnormal termination. A complete dump includes a printout of all control information related to the terminating task, and the nucleus and all allocated storage within the partition in which the abending task resided. A partial dump of a task related to the terminating task includes only control information. The partial dump is identified by either ID=001 or ID=002 printed in the first line of the dump. Figure 22 is a copy of the first few pages of a complete ABEND dump of an MFT system with subtasking. It illustrates some of the key areas on an ABEND dump, as issued by systems with PCP and MFT. Those portions of the dump that would only appear on a dump of a subtasking system are noted in the later discussions as appearing only in a dump of an MFT with subtasking system.

Invoking an ABEND/SNAP Dump (PCP,MFT)

ABEND dumps are produced as a result of an ABEND macro instruction, issued either by a processing program or an operating system routine. The macro instruction requires a DD statement in the input stream for each job step that is subject to abnormal termination. This DD statement must be identified by one of the special ddnames SYSABEND or SYSUDUMP. SYSABEND results in edited control information, the system nucleus, the trace table, and a dump of main storage; SYSUDUMP excludes the nucleus and the trace table. In the event of a system failure, the Damage Assessment routine (DAR) attempts to write a core image dump to the SYS1.DUMP data set. A full explanation of core image dumps may be found in the section headed "Core Image Dump."

SNAP Dumps result from a problem program issuing a SNAP macro instruction. The contents of a SNAP dump vary according to the operands specified in the SNAP macro instruction. SNAP dumps also require a DD statement in the input stream. This DD statement has no special characteristics except that its ddname must not be SYSABEND or SYSUDUMP. The processing program must define a DCB for the snapshot data set. The DCB macro instruction must contain, in addition to the usual DCB requirements, the operands DSORG=PS, RECFM=VBA, MACRF=(W), BLKSIZE=882 or 1632, and LRECL=125. In addition, the DCB must be opened before the first SNAP macro instruction is issued.

Reference: The SNAP and DCB macro instructions are discussed in the publication Supervisor and Data Management Macro Instructions.

Device and Space Considerations: DD statements for ABEND/SNAP dumps, must contain parameters appropriate for a basic sequential (BSAM) data set. Data sets can be allocated to any device supported by the basic sequential access method. There are several ways to code these DD statements depending on what type of device you choose and when you want the dump printed.

If you wish to have the dump printed immediately, code a DD statement defining a printer data set.

```
//SYSABEND DD UNIT=1443,DCB=(...
```

If your installation operates under a system with PCP or MFT, and a printer is associated with the SYSOUT class, you can also obtain immediate printing by routing the data set through the output stream.

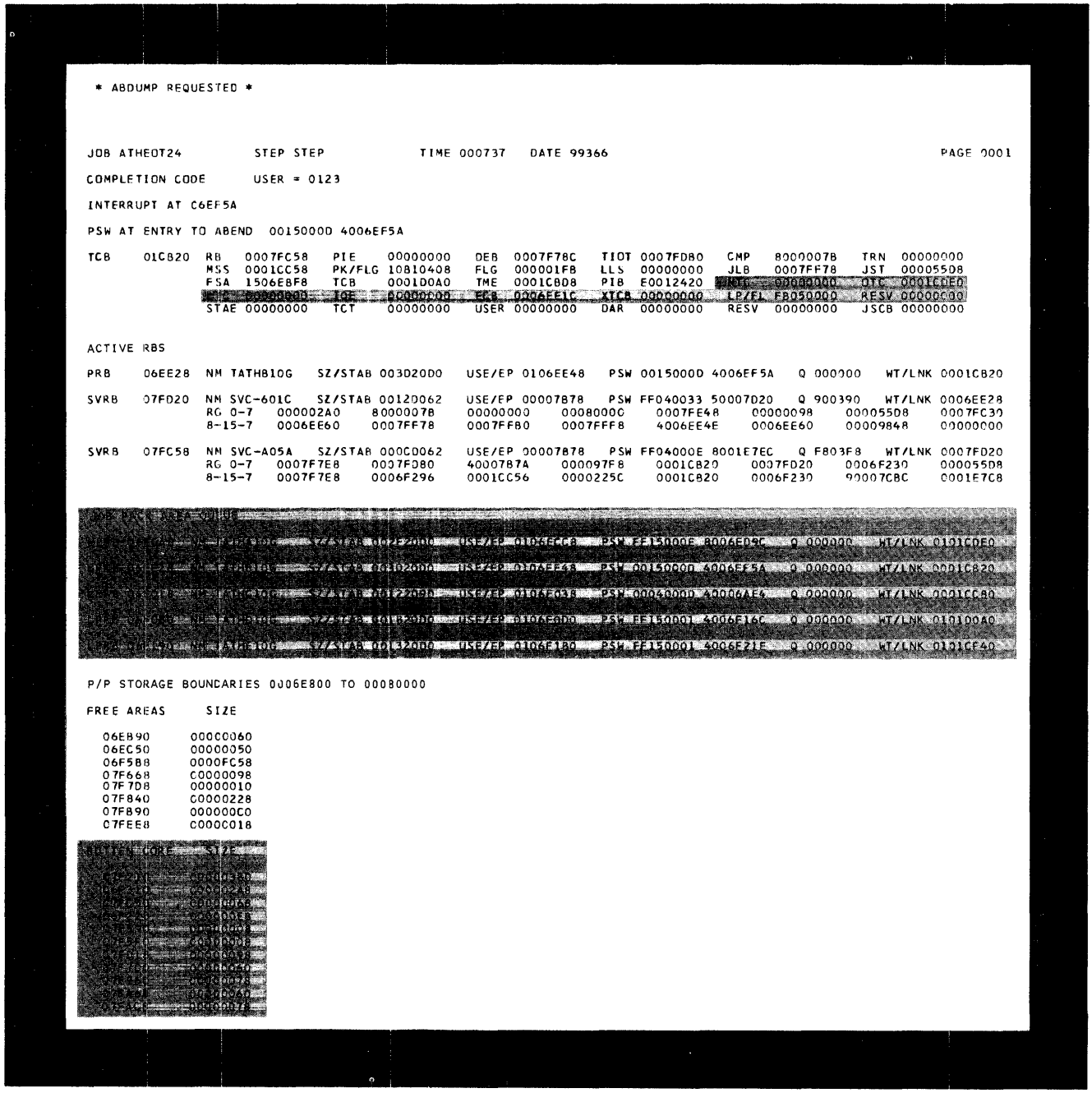
```
//SNAPDUMP DD SYSOUT=A,DCB=(...
```

This type of request is the easiest, most economical way to provide for a dump. All other DD statements result in the tying up of an output unit or delayed printing of the dump.

If you wish to retain the dump, you can keep or catalog it on a direct access or tape unit. The last step in the pertinent job can serve several functions: to print out key data sets in steps that have been

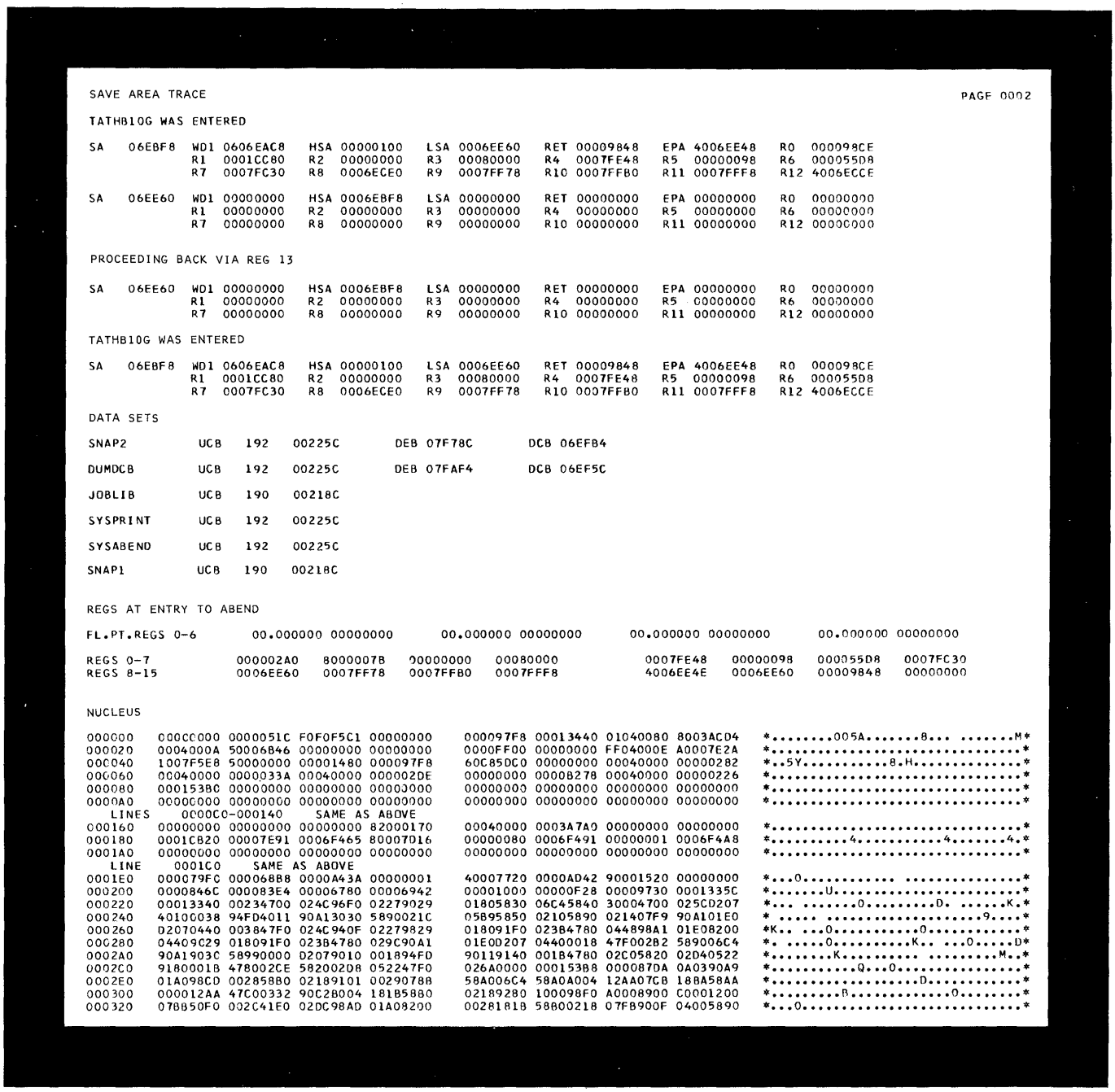
abnormally terminated, to print an ABEND or SNAP dump stored in an earlier step, or to release a tape volume or direct access space acquired for dump data sets. Conditional execution of the last step can be established through proper use of the COND parameter and its subparameters, EVEN and ONLY, on the EXEC statement.

Direct access space should be requested in units of average block size rather than in cylinders (CYL) or tracks (TRK). If abnormal termination occurs and the data set is retained, the tape volume or direct access space should be released (DELETE in the DISP parameter) at the time the data set is printed.



```
 * ABDUMP REQUESTED *


JOB ATHEOT24          STEP STEP            TIME 000737   DATE 99366                                    PAGE 0001

COMPLETION CODE       USER = 0123

INTERRUPT AT C6EF5A

PSW AT ENTRY TO ABEND  00150000 4006EF5A

TCB     01C820  RB   0007FC58   PIE    00000000   DEB  0007F78C   TIOT 0007FD80   CMP   8000007B   TRN  00000000
                MSS  0001CC58   PK/FLG 10810408   FLG  000001FB   LLS  00000000   JLB   0007FF78   JST  000055D8
                FSA  1506E8F8   TCB    0001D0A0   TME  0001CBD8   PIB  E0012420   PKEY  00000000   OTC  0001CDE0
                WMP  00000003   IOE    00000000   EC8  0006EE1C   XTCB 00000000   LP/FL FB050000   RESV 00000000
                STAE 00000000   TCT    00000000   USER 00000000   DAR  00000000   RESV  00000000   JSCB 00000000


ACTIVE RBS

PRB     06EE28  NM TATHB10G    SZ/STAB 003D20D0    USE/EP 0106EE48   PSW 00150000 4006EF5A   Q 000000   WT/LNK 0001CB20

SVRB    07FD20  NM SVC-601C    SZ/STAB 00120062    USE/EP 00007878   PSW FF040033 50007D20   Q 900390   WT/LNK 0006EE28
                RG 0-7   000002A0    8000007B    00000000    00080000    0007FE48    00000098    000055D8    0007FC30
                8-15-7   0006EE60    0007FF78    0007FFB0    0007FFF8    4006EE4E    0006EE60    00009848    00000000

SVRB    07FC58  NM SVC-A05A    SZ/STAB 000CD062    USE/EP 00007878   PSW FF04000E 8001E7EC   Q F803F8   WT/LNK 0007FD20
                RG 0-7   0007F7E8    0007FD80    40007B7A    000097F8    0001CB20    0007FD20    0006F230    000055D8
                8-15-7   0007F7E8    0006F296    0001CC56    0000225C    0001CB20    0006F230    00007CBC    0001E7C8

P/P STORAGE BOUNDARIES 0006E800 TO 00080000

FREE AREAS      SIZE

  06EB90      00000060
  06EC50      00000050
  06F5B8      0000FC58
  07F668      00000098
  07F7D8      00000010
  07F840      00000228
  07FB90      000000C0
  07FEE8      00000018
```

•Figure 22A. Sample of an ABEND Dump (PCP, MFT)



```
SAVE AREA TRACE                                                                                                    PAGE 0002

TATHB10G WAS ENTERED

SA    06EBF8  WD1 0606EAC8   HSA 00000100   LSA 0006EE60   RET 00009848   EPA 4006EE48   R0  000098CE
              R1  0001CC80   R2  00000000   R3  00080000   R4  0007FE48   R5  00000098   R6  000055D8
              R7  0007FC30   R8  0006ECE0   R9  0007FF78   R10 0007FFB0   R11 0007FFF8   R12 4006ECCE

SA    06EE60  WD1 00000000   HSA 0006EBF8   LSA 00000000   RET 00000000   EPA 00000000   R0  00000000
              R1  00000000   R2  00000000   R3  00000000   R4  00000000   R5  00000000   R6  00000000
              R7  00000000   R8  00000000   R9  00000000   R10 00000000   R11 00000000   R12 00000000

PROCEEDING BACK VIA REG 13

SA    06EE60  WD1 00000000   HSA 0006EBF8   LSA 00000000   RET 00000000   EPA 00000000   R0  00000000
              R1  00000000   R2  00000000   R3  00000000   R4  00000000   R5  00000000   R6  00000000
              R7  00000000   R8  00000000   R9  00000000   R10 00000000   R11 00000000   R12 00000000

TATHB10G WAS ENTERED

SA    06EBF8  WD1 0606EAC8   HSA 00000100   LSA 0006EE60   RET 00009848   EPA 4006EE48   R0  000098CE
              R1  0001CC80   R2  00000000   R3  00080000   R4  0007FE48   R5  00000098   R6  000055D8
              R7  0007FC30   R8  0006ECE0   R9  0007FF78   R10 0007FFB0   R11 0007FFF8   R12 4006ECCE

DATA SETS

SNAP2          UCB   192   00225C        DEB 07F78C        DCB 06EFB4

DUMDCB         UCB   192   00225C        DEB 07FAF4        DCB 06EF5C

JOBLIB         UCB   190   00218C

SYSPRINT       UCB   192   00225C

SYSABEND       UCB   192   00225C

SNAP1          UCB   190   00218C

REGS AT ENTRY TO ABEND

FL.PT.REGS 0-6       00.000000 00000000       00.000000 00000000       00.000000 00000000       00.000000 00000000

REGS 0-7           000002A0   8000007B   00000000   00080000           0007FE48   00000098   000055D8   0007FC30
REGS 8-15          0006EE60   0007FF78   0007FFB0   0007FFF8           4006EE4E   0006EE60   00009848   00000000

NUCLEUS

000000   000CC000 0000051C F0F0F5C1 00000000    000097F8 00013440 01040080 8003ACD4   *........005A.......8... .......M*
000020   0004000A 50006B46 00000000 00000000    0000FF00 00000000 FF04000E A0007E2A   *.....................................*
000040   1007F5E8 50000000 00001480 000097F8    60C85DC0 00000000 00040000 00000282   *..5Y.....8.H.....................*
000060   00040000 0000033A 00040000 000002DE    00000000 0000B278 00040000 00000226   *.....................................*
000080   000153B0 00000000 00000000 00003000    00000000 00000000 00000000 00000000   *.....................................*
0000A0   00000000 00000000 00000000 00000000    00000000 00000000 00000000 00000000   *.....................................*
   LINES    0000C0-000140     SAME AS ABOVE
000160   00000000 00000000 00000000 82000170    00040000 0003A7A0 00000000 00000000   *.....................................*
000180   0001CB20 00007E91 0006F465 80007D16    00000080 0006F491 00000001 0006F4A8   *.........4.........4.......4.*
0001A0   00000000 00000000 00000000 00000000    00000000 00000000 00000000 00000000   *.....................................*
   LINE     0001C0     SAME AS ABOVE
0001E0   000079FC 000068B8 0000A43A 00000001    40007720 0000AD42 90001520 00000000   *...0.....  ..... .............*
000200   0000846C 000083E4 00006780 00006942    00001000 00000F28 00009730 0001335C   *.......U.....................*
000220   00013340 00234700 024C96F0 02279029    01805830 06C45840 30004700 025CD207   *... .......0.........D. ......K.*
000240   40100038 94FD4011 90A13030 5890021C    05B95850 02105890 021407F9 90A101E0   * ..... .....................9....*
000260   D2070440 003847F0 024C940F 02279829    018091F0 023B4780 044898A1 01E08200   *K.. ...0.........0.............*
000280   04409C29 018091F0 023B4780 029C90A1    01E0D207 04400018 47F002B2 589006C4   *. .....0.........K.. ...0.....D*
0002A0   90A1903C 58990000 D2079010 001894FD    90119140 001B4780 02C05820 02D40522   *........K.......... .........M..*
0002C0   91800018 478002CE 582002D8 052247F0    026A0000 000153B8 000087DA 0A0390A9   *.....Q...0.....0.................*
0002E0   01A098CD 002858B0 02189101 0029078B    58A006C4 58A0A004 12AA07CB 18BA58AA   *.....................D.....*
000300   000012AA 47C00332 90C2B004 181B5880    02189280 100098F0 A0008900 C0001200   *.........B.............0.....*
000320   078B50F0 002C41E0 02DC98AD 01A08200    00281818 58800218 07FB900F 04005890   *...0.....................*
```

• Figure 22B. Sample of an ABEND Dump (PCP, MFT)

Sample DD Statements: Figure 23 shows a set of job steps that include DD statements for ABEND dump data sets.

The SYSABEND DD statement in STEP2 takes advantage of the direct access space acquired in STEP1 by indicating MOD in the DISP parameter. Note that the space request in STEP1 is large so that the dumping operation is not inhibited due to insufficient space. The final SYSABEND DD statement in the job should indicate a disposition of DELETE to free the space acquired for dumping.

Contents of an ABEND/SNAP Dump (PCP, MFT)

This explanation of the contents of ABEND/SNAP dumps for systems with PCP and MFT is interspersed with sample sections taken from an ABEND dump. Capital letters represent the headings found in all dumps, and lowercase letters, information that varies with each dump. The lowercase letter used indicates the mode of the information, and the number of letters indicates its length:

- h represents 1/2 byte of hexadecimal information
- d represents 1 byte of decimal information
- c represents a 1-byte character

You may prefer to follow the explanation on your own ABEND or SNAP dump.

```
//STEP1   EXEC  PGM=PROGRAM1
//SYSABEND DD   DSNAME=DUMP,UNIT=2311,DISP=(,KEEP,KEEP),                X
//              VOLUME=SER=1234,SPACE=(TRK,(110,10))

      other DD statements

//STEP2   EXEC  PGM=PROGRAM2
//SYSABEND DD   DSNAME=*.STEP1.SYSABEND,DISP=(MOD,DELETE,KEEP),         X
//              VOL=REF=*.STEP1.SYSABEND
```

Figure 23. SYSABEND DD Statements

```
  * * * A B D U M P   R E Q U E S T E D * * *
 *ccccccc...
JOB cccccccc          STEP cccccccc        TIME dddddd   DATE ddddd                    PAGE dddd
COMPLETION CODE       SYSTEM = hhh (or USER = dddd)
cccccc...
INTERRUPT AT hhhhhh
PSW AT ENTRY TO ABEND (SNAP) hhhhhhhh hhhhhhhh
```

* * * A B D U M P R E Q U E S T E D * * *
identifies the dump as an ABEND or SNAP dump.

*ccccccc.....
is omitted or is one or more of the following:

*CORE NOT AVAILABLE, LOC. hhhhhhhhhhhh TAKEN...
indicates that the ABDUMP routine confiscated storage locations hhhhhh through hhhhhh because not enough storage was available. This area is printed under P/P STORAGE, but can be ignored because the problem program originally in it was overlaid during the dumping process.

*MODIFIED, /SIRB/DEB/LLS/ARE/MSS...
indicates that the one or more queues listed were destroyed or their elements dequeued during abnormal termination:

- SIRB -- system interruption request block queue. One or more SIRB elements were found in the active RB queue: these elements are always dequeued during dumping.
- DEB -- DEB queue. If the first message also appeared, either a DEB or an associated DCB was overlaid.
- LLS -- load list. If the first message also appeared, one or more loaded RBs were overlaid.
- ARB -- active RB queue. If the first message also appeared, one or more RBs were overlaid.
- MSS -- boundary box queue. One or more MSS elements were dequeued, but an otherwise valid control block was found in the free area specified by an MSS element.

*FOUND ERROR IN /DEB/LLS/ARB/MSS...
indicates that one or more of the following contained an error:

- DEB: data extent block
- LLS: load list
- ARB: active RB
- MSS: boundary box

This message appears with either the first or second message above. The error could be: improper boundary alignment, control block not within storage assigned to the program being dumped, or an infinite loop (300 times is the maximum for this test). For an MSS block, 4 other errors could also be found: incorrect descending sequence (omitting loop count), overlapping free areas, free area not entirely within the storage assigned to the program being dumped, or count in count field not a multiple of 8.

JOB cccccccc
is the job name specified in the JOB statement.

STEP cccccccc
is the step name specified in the EXEC statement for the problem program being dumped.

TIME dddddd
is the hour (first 2 digits), minute (second 2 digits), and second (last 2 digits) when the ABDUMP routine began processing.

DATE ddddd
is the year (first 2 digits) and day of the year (last 3 digits). For example, 67352 would be December 18, 1967.

PAGE dddd
is the page number. Appears at the top of each page.

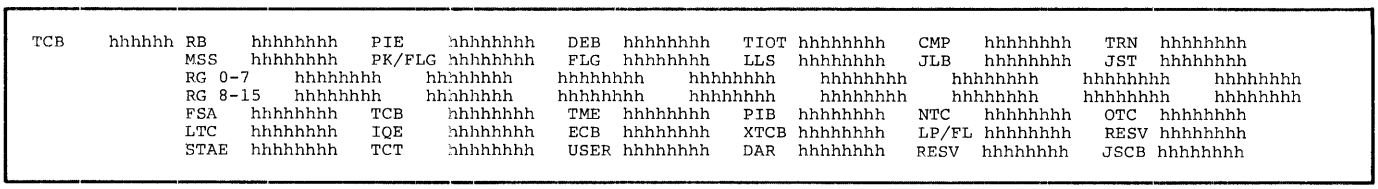
COMPLETION CODE SYSTEM=hhh or COMPLETION CODE USER=dddd
is the completion code supplied by the control program (SYSTEM=hhh) or the problem program (USER=dddd). Either SYSTEM=hhh or USER=dddd is printed, but not both. Common completion codes are explained in Appendix B.

ccccccc...
explains the completion code or, if a program interruption occurred: PROGRAM INTERRUPTION ccccc... AT LOCATION hhhhhh,

where ccccc is the program interruption cause -- OPERATION, PRIVILEGED OPERATION, EXECUTE, PROTECTION, ADDRESSING, SPECIFICATION, DATE, FIXED-POINT OVERFLOW, FIXED-POINT DIVIDE, DECIMAL OVERFLOW, DECIMAL DIVIDE, EXPONENT OVERFLOW,EXPONENT UNDERFLOW, SIGNIFICANCE, or FLOATING-POINT DIVIDE; and hhhhhh is the starting address of the instruction being executed when the interruption occurred.

INTERRUPT AT hhhhhh
is the address of next instruction to be executed in the problem program. It is obtained from the resume PSW of the PRB or LPRB in the active RB queue at the time abnormal termination was requested.

PSW AT ENTRY TO ABEND hhhhhhhh hhhhhhhh or
PSW AT ENTRY TO SNAP hhhhhhhh hhhhhhhh
is the PSW for the problem or control program that had control when abnormal termination was requested or when the SNAP macro instruction was executed.



TCB hhhhhh
is the starting address of the TCB.

RB hhhhhhhh
is the TCBRBP field (bytes 0 through 3): starting address of the active RB queue and, consequently, the most recent RB on the queue (usually ABEND's RB).

PIE hhhhhhhh
is the TCBPIE field (bytes 4 through 7): starting address of the program interruption element (PIE) for the task.

DEB hhhhhhhh
is the TCBDEB field (bytes 8 through 11): starting address of the DEB queue.

TIOT hhhhhhhh
is the TCBTIO field (bytes 12 through 15): starting address of the TIOT.

CMP hhhhhhhh
is the TCBCMP field (bytes 16 through 19): task completion code in hexadecimal. System codes are shown in the third through fifth digits and user codes in the sixth through eighth.

TRN hhhhhhhh
is the TCBTRN field (bytes 20 through 23): starting address of control core (table) for controlling testing of the task by TESTRAN.

MSS hhhhhhhh
is the TCBMSS field (bytes 24 through 27): starting address of the main storage supervisor's boundary box.

PK/FLG hhhhhhhh
contains, in the first 2 digits, the TCBPKF field (byte 28): protection key.

FLG hhhhhhhh
contains, in the first 4 digits, the last 2 bytes of the TCBFLGS field (bytes 32 and 33): last 2 flag bytes.

contains, in the next 2 digits, the TCBIMP field (byte 34): in systems

with PCP, both digits are zeros; in systems with MFT, number of resources on which the task is queued.

contains, in the last 2 digits, the TCBDSP field (byte 35):

- Reserved in PCP and MFT without subtasking; both digits are zero.
- In MFT with subtasking, this field contains the dispatching priority of the TCB.

LLS hhhhhhhh
is the TCBLLS field (bytes 36 through 39): starting address of the RB most recently added to the load list.

JLB hhhhhhhh
is the TCBJLB field (bytes 40 through 43): starting address of the DCB for the JOBLIB data set.

JST hhhhhhh
is the TCBJST field (bytes 44 through 47). Not currently used in PCP or MFT without subtasking. In MFT with subtasking - the starting address of the TCB for the job step task.

RG 0-7 and RG 8-15
is the TCBGRS field (bytes 48 through 111): contents of general registers 0 through 7 and 8 through 15, as stored in the save area of the TCB when a task switch occurred. These 2 lines appear only in TCBs of tasks other than the task in control when the dump was requested.

FSA hhhhhhhh
contains, in the first 2 digits, the TCBIDF field (byte 112): TCB identifier field.

contains, in the last 6 digits, the TCBFSA field (bytes 113 through 115): starting address of the first problem program save area. This save area was set up by the control program when the job step was initiated.

TCB hhhhhhhh
is the TCBTCB field (bytes 116 through 119): in systems with PCP, all digits are zeros; in systems with MFT, starting address of the next TCB of lower priority or, if this is the last TCB, zeros.

TME hhhhhhhh
is the TCBTME field (bytes 120 through 123): starting address of the timer element created when an STIMER macro instruction is issued by the task. This field is not printed if the computer does not contain the timer option.

PIE hhhhhhhh
is the TCBPIB field (bytes 124 through 127): starting address of the program information block (MFT) or zeros (PCP).

NTC hhhhhhhh (printed only in MFT)
is the TCBNTC field (bytes 128 through 131):

MFT without subtasking: zeros.

MFT with subtasking: the starting address of the TCB for the previous subtask on this subtask TCB queue. This field is zero both in the job step task, and in the TCB for the first subtask created by a parent task.

OTC hhhhhhhh (printed only in MFT)
is the TCBOTC field (bytes 132 through 135): starting address of the TCB for the parent task. Both in the TCB for the job step task, and in MFT systems without subtasking this field is zero.

LTC hhhhhhhh (printed only in MFT)
is the TCBLTC field (bytes 136 through 139): starting address of the TCB for the most recent subtask created by this task. This field is zero in the TCB for the last subtask of a job step, or in the TCB for a task that does not create subtasks. This field is always zero in an MFT system without subtasking.

IQE hhhhhhhh (printed only in MFT)
is the TCBIQE field (bytes 140 through 143).

MFT without subtasking: zero.

MFT with subtasking: starting address of the interruption queue element (IQE) for the ETXR exit routine. This routine is specified by the ETXR operand of the ATTACH macro instruction that created the TCB being dumped. The routine is to be entered when the task terminates.

ECB hhhhhhhh (printed only in MFT)
is the TCBECB field (bytes 144 through 147).

MFT without subtasking: zero.

MFT with subtasking: starting address of the ECB field to be posted by the control program at task termination. This field is zero if the task was attached without an ECB operand.

XTCB hhhhhhhh (printed only in MFT)
reserved for future use.

LP/FL hhhhhhhh (printed only in MFT)
MFT without subtasking: reserved.

MFT with subtasking: contains in the first byte, the limit priority of the task (byte 152). contains, in the last three bytes the field TCBFTFLG (bytes 153 through 155) - flag bytes.

RESV hhhhhhhh (printed only in MFT)
reserved for future use.

STAE hhhhhhhh
contains, in the first 2 digits, STAE flags (byte 160).

contains, in the last 6 digits, the TCBNSTAE field (bytes 161 through 163): starting address of the current STAE control block for the task. This field is zero if STAE has not been issued.

TCT hhhhhhhh
is the TCBTCT field (bytes 164 through 167):

PCP: Zeros.

MFT: Address of the Timing Control Table (TCT) Zeros of the System Management Facilities option is not present in the system.

USER hhhhhhhh
is the TCBUSER field (bytes 168 through 171): to be used as the user chooses.

DAR hhhhhhhh
contains, in the first 2 digits, Damage Assessment Routine (DAR) flags (byte 172);

MFT only, contains, in the last 6 digits, the secondary non-dispatchability bits (bytes 173 through 175).

RESV hhhhhhhh
reserved for future use.

JSCB hhhhhhhh
is the TCBJSCB field (bytes 180 through 183): the last three bytes contain the address of the Job Step Control Block.

```
ACTIVE RBS

cccc hhhhhh  NM cccccccc    SZ/STAB hhhhhhhh   USE/EP hhhhhhhh   PSW hhhhhhhh hhhhhhhh   Q hhhhhh   WT/LNK hhhhhhhh
             RG 0-7   hhhhhhhh    hhhhhhhh    hhhhhhhh    hhhhhhhh    hhhhhhhh    hhhhhhhh    hhhhhhhh    hhhhhhhh
             RG 8-15  hhhhhhhh    hhhhhhhh    hhhhhhhh    hhhhhhhh    hhhhhhhh    hhhhhhhh    hhhhhhhh    hhhhhhhh
```

ACTIVE RBS
identifies the next lines as the contents of the active RBs queued to the TCB.

cccc hhhhhh
indicates the RB type and its starting address.

The RB types are:

PRB Program request block

SIRB Supervisor interrupt request block

LPRB Loaded program request block

IRB Interruption request block

SVRB Supervisor request block

NM xxxxxxxx
is the XRBNM field (bytes 0 through 7): in PRB, LRB, and LPRB, the program name; in IRB, the first byte contains flags for the timer or, if

the timer is not being used, contains no meaningful information; in SVRB for a type 2 SVC routine, the first 4 bytes contain the TTR of the load module in the SVC library, and the last 4 bytes contain the SVC number in signed, unpacked decimal.

SZ/STAB hhhhhhhh
contains in the first 4 digits, the XRBSZ field (bytes 8 and 9): number of contiguous doublewords in the RB, the program (if applicable), and associated supervisor work areas.

contains in the last 4 digits, the XSTAB field (bytes 10 and 11): flag bytes.

USE/EP hhhhhhhh
contains, in the first 2 digits, the XRBUSE field (byte 12): use count.

contains, in the last 6 digits, the XRBEP field (bytes 13 through 15): address of entry point in the associated program.

PSW hhhhhhhh hhhhhhhh
is the XRBPSW field (bytes 16 through 23): resume PSW.

Q hhhhhh
is the last 3 bytes of the XRBQ field (bytes 25 through 27): in PRB and LPRB, starting address of an LPRB for an entry identified by an IDENTIFY macro instruction; in IRB, starting address of a request element; in SVRB for a type 3 or 4 SVC, size of the program in bytes.

WT/LNK hhhhhhhh
contains, in the first 2 digits, the XRBWT field (byte 28): wait count.

contains, in the last 6 digits, the XRBLNK field (bytes 29 through 31): primary queuing field. It is the starting address of the previous RB for the task or, in the first RB to be placed on the queue, the starting address of the TCB.

RG 0-7 and RG 8-15
is the XRBREB field (bytes 32 through 95 in IRBs and SVRBs): contents of general registers 0 through 15 stored in the RB. These 2 lines do not appear for PRBs, LPRBs, and LRBs.

```
LOAD LIST
cccc hhhhhh  NM cccccccc   SZ/STAB hhhhhhhh  USE/EP hhhhhhhh  PSW hhhhhhhh hhhhhhhh   Q hhhhhh   WT/LNK hhhhhhhh
```

LOAD LIST
identifies the next lines as the contents of the load list queued to the TCB.

cccc hhhhhh
indicates the RB type and its starting address.

The RB types are:

LRB	Loaded request block
LPRB	Loaded program request block
D-LPRB	Dummy loaded program request block. (Present if the resident reenterable load module option was selected in MFT).

NM cccccccc
is the XRBNM field (bytes 0 through 7): program name.

SZ/STAB hhhhhhhh
contains, in the first 4 digits, the XRBSZ field (bytes 8 and 9): number of contiguous doublewords for the RB, the program (if applicable), and associated supervisor work areas.

contains, in the last 4 digits, the XSTAB field (bytes 10 and 11): flag bytes.

USE/EP hhhhhhhh
contains, in the first 2 digits, the XRBUSE field (byte 12): use count.

contains, in the last 6 digits, the XRBEP field (bytes 12 through 15): address of entry point in the program.

PSW hhhhhhhh hhhhhhhh
is the XRBPSW field (bytes 16 through 23): resume PSW.

Q hhhhhh
is the last 3 bytes of the XRBQ field (bytes 25 through 27): in LPRB, starting address of an LPRB for an entry identified by an IDENTIFY macro instruction; in LRB, unused.

WT/LNK hhhhhhhh
contains, in the first 2 digits, the XRBWT field (byte 28): wait count.

contains, in the last 6 digits, the XRBLNK field (bytes 29 through 31): primary queuing field for LRBs and LPRBs also on the active RB queue. It points to the previous RB for the task or, in the oldest RB in the queue, back to the TCB.

```
JOB PACK AREA QUEUE

cccc hhhhhh  NM cccccccc   SZ/STAB hhhhhhhh  USE/EP hhhhhhhh  PSW hhhhhhhh hhhhhhhh  Q hhhhhh  WT/LNK hhhhhhhh
cccc hhhhhh  NM cccccccc   SZ/STAB hhhhhhhh  WTL    hhhhhhhh  REQ hhhhhhhh  TLPRB hhhhhhhh
cccc hhhhhh  NM cccccccc   SZ/STAB hhhhhhhh  USE/EP hhhhhhhh  PSW hhhhhhhh hhhhhhhh  Q hhhhhh  WT/LNK hhhhhhhh
```

JOB PACK AREA QUEUE (MFT with subtasking only)
identifies the next lines as the contents of the job pack area queue originating in the partition information block (PIB).

cccc hhhhhh
indicates the RB type and its starting address.

The RB types are:

FRB	Finch request block
LRB	Loaded request block
LPRB	Loaded program request block

NM cccccccc
is the XRBNM field (bytes 0 through 7): Program name.

SZ/STAB hhhhhhhh
contains, in the first 4 digits, the XRBSZ field (bytes 8 and 9): number of contiguous doublewords for the RB, the program (if applicable), and associated supervisor work areas.

contains, in the last 4 digits, the XSTAB field (bytes 10 and 11): flag bytes.

USE/EP hhhhhhhh (LPRB, LRB Only)
contains, in the first 2 digits, the XRBUSE field (byte 12): use count.

contains, in the last 6 digits, the XRBEP field (bytes 13 through 15): address of entry point in the program.

WTL hhhhhhhh (FRB Only)
is the XRWTL field of the FRB (bytes 12 through 15): address of the most recent wait list element (WLE) on the WLL queue.

PSW hhhhhhhh hhhhhhhh (LPRB, LRB Only)
is the XRBPSW field (bytes 16 through 23): resume PSW.

REQ hhhhhhhh (FRB Only)
is the XRREQ field of the FRB (bytes 16 through 19): address of the TCB of the requesting task.

TLPRB hhhhhhhh (FRB Only)
is the XRTLPRB field of the FRB (bytes 20 through 23): address of the LPRB built by the Finch routine for the requested program.

Q hhhhhh (LRB, LPRB Only)
is the last 3 bytes of the XRBQ field (bytes 25 through 27):

- in an LPRB, the starting address of an LPRB for an entry identified by an IDENTIFY macro instruction.
- in an LRB, unused.

WT/LNK hhhhhhhh (LRB, LPRB Only)
contains, in the first 2 digits, the XRBWT field (byte 28): wait count.

contains, in the last 6 digits (bytes 29 through 31): primary queuing field for RBs. These RBs may be queued either on the job pack area queue or on the active RB queue. It points to the previous RB for the task or, in the oldest RB on the queue, back to the TCB.

```
P/P STORAGE BOUNDARIES hhhhhhhh TO hhhhhhhh

FREE AREAS      SIZE

  hhhhhh      hhhhhhhh

GOTTEN CORE     SIZE

  hhhhhh      hhhhhhhh

SAVE AREA TRACE

cccccccc WAS ENTERED VIA LINK (CALL) ddddd AT EP ccccc...

SA    hhhhhh  WD1 hhhhhhhh   HSA hhhhhhhh   LSA hhhhhhhh   RET hhhhhhhh   EPA hhhhhhhh   R0  hhhhhhhh
              R1  hhhhhhhh   R2  hhhhhhhh   R3  hhhhhhhh   R4  hhhhhhhh   R5  hhhhhhhh   R6  hhhhhhhh
              R7  hhhhhhhh   R8  hhhhhhhh   R9  hhhhhhhh   R10 hhhhhhhh   R11 hhhhhhhh   R12 hhhhhhhh

INCORRECT BACK CHAIN

PROCEEDING BACK VIA REG 13
```

P/P STORAGE BOUNDARIES hhhhhhhh TO hhhhhhhh
: gives the addresses of the lower and upper boundaries of a main storage area assigned to the task. This heading is repeated for every noncontiguous block of storage owned by the task.

FREE AREAS SIZE

hhhhhh hhhhhh
. .
. .
. .
hhhhhh hhhhhh
: are the starting addresses of free areas and the size, in bytes, of each area contained within the P/P STORAGE BOUNDARIES field listed above.

GOTTEN CORE SIZE

hhhhhh hhhhhhhh
. .
. .
. .
hhhhhh hhhhhhhh
: (Printed only in a dump of a system with the MFT with subtasking option). These figures represent the starting addresses of the gotten areas (those areas obtained for a subtask through a supervisor issued GETMAIN macro instruction), and the size, in bytes, of each area contained within the P/P STORAGE BOUNDARIES field listed above. If main storage hierarchy support is included in the system, the values in this field can address storage in either hierarchy 0 or hierarchy 1, or both.

SAVE AREA TRACE
: identifies the next lines as a trace of the save areas for the program.

cccccccc WAS ENTERED
: is the name of the program that stored register contents in the save area. This name is obtained from the RB.

VIA LINK (CALL) ddddd
: indicates the macro instruction (LINK or CALL) used to give control to the next lower level module, and is the ID operand, if it was specified, of the LINK or CALL macro instruction.

AT EP ccccc...
: is the entry point identified, which appears only if it was specified in the SAVE macro instruction that filled the save area.

SA hhhhhh
: is the starting address of the save area.

WD1 hhhhhhhh
: is the first word of the save area: use of this word is optional.

HSA hhhhhhhh
: is the second word of the save area: starting address of the save area in the next higher level module. In the first save area in a job step, this word contains zeros. In all other save areas, this word must be filled.

LSA hhhhhhhh
: is the third word of the save area (register 13): starting address of the save area in the next lower level module.

RET hhhhhhhh
: is the fourth word of the save area (register 14): return address. Optional.

EPA hhhhhhhh
is the fifth word of the save area (register 15): entry point to the invoked module. Optional.

R0 hhhhhhhh R1 hhhhhhhh ... R12 hhhhhhhh
are words 6 through 18 of the save area (registers 0 through 12): contents of registers 0 through 12 immediately after the linkage for the module containing the save area.

INCORRECT BACK CHAIN
indicates that the following lines may not be a save area because the second word in this area does not point back to the previous save area in the chain.

PROCEEDING BACK VIA REG 13
indicates that the next 2 save areas are (1) the save area in the lowest level module, followed by (2) the save area in the next higher level module. The lowest save area is assumed to be the save area pointed to by register 13. These 2 save areas appear only if register 13 points to a full word boundary and does not contain zeros.

```
DATA SETS
***** N O T  F O R M A T T E D *****
cccccccc      UCB   ddd   hhhhhh      DEB hhhhhh       DCB hhhhhh
**D/S FORMATTING TERMINATED**
```

DATA SETS
indicates that the next lines present information about the data sets for the task. For unopened data sets, only the ddname and UCB information are printed.

N O T F O R M A T T E D
indicates that the abnormal termination dump routine confiscated storage (indicated by *CORE NOT AVAILABLE, LOC. hhhhhh-hhhhhh TAKEN); because DCBs may have been overlaid, data set information is not presented.

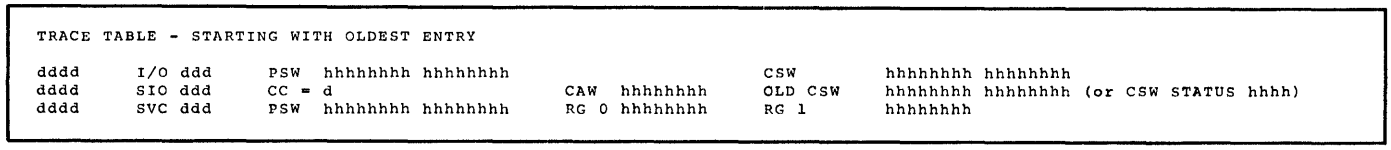
cccccccc
is the name field (ddname) of the DD statement.

UCB ddd hhhhhh
is the unit to which the data set was assigned, and the starting address of the UCB for that unit. If the data set was assigned to several units, the additional units are identified on following lines.

DEB hhhhhh
is the starting address of the DEB for the data set. Appears only for open data sets.

DCB hhhhhh
is the starting address of the DCB for the data set. Appears only for open data sets.

D/S FORMATTING TERMINATED
indicates that no more data set information is presented because a DCB is incorrect, possibly because a program incorrectly modified it.



TRACE TABLE -- STARTING WITH OLDEST ENTRY
identifies the next lines as the contents of the trace table. Each entry is presented on one line. The types of entries are:

I/O Input/output interruption entry

SIO Start input/output (SIO) entry

SVC Supervisor call (SVC) interruption entry

dddd
is the number assigned to each entry. The oldest entry receives the number 0001.

I/O ddd
is the channel and unit that caused the input/output interruption.

PSW hhhhhhhh hhhhhhhh
is the program status word that was stored when the input/output interruption occurred.

CSW hhhhhhhh hhhhhhhh
is the channel status word that was stored when the input/output interruption occurred.

SIO ddd
is the device specified in the SIO instruction.

CC=d
is the condition code resulting from execution of the SIO instruction. Zero indicates a successful start.

CAW hhhhhhhh
is the channel address word used by the SIO instruction.

OLD CSW hhhhhhhh hhhhhhhh
is the channel status word stored during execution of an SIO operation. It appears when CC is not equal to 1.

CSW STATUS hhhh
is the status portion of the channel status word stored during execution of an SIO instruction. Appears when CC is equal to 1.

SVC ddd
is the SVC instruction's operand.

PSW hhhhhhhh hhhhhhhh
is the PSW stored during the SVC interruption. (After release 11, an F in the fifth digit of the first word identifies the entry as representing a task switch.)

RG 0 hhhhhhhh
is the contents of register 0 as passed to the SVC routine.

RG 1 hhhhhhhh
is the contents of register 1 as passed to the SVC routine.

```
REGS AT ENTRY TO ABEND (SNAP)

FLTR 0-6          hhhhhhhhhhhhhhhh      hhhhhhhhhhhhhhhh            hhhhhhhhhhhhhhhh      hhhhhhhhhhhhhhhh

REGS 0-7          hhhhhhhh  hhhhhhhh  hhhhhhhh  hhhhhhhh          hhhhhhhh  hhhhhhhh  hhhhhhhh  hhhhhhhh
REGS 8-15         hhhhhhhh  hhhhhhhh  hhhhhhhh  hhhhhhhh          hhhhhhhh  hhhhhhhh  hhhhhhhh  hhhhhhhh
```

REGS AT ENTRY TO ABEND or REGS AT ENTRY TO SNAP
: identifies the next 3 lines as the contents of the floating point and general registers when the abnormal termination routine received control in response to an ABEND macro instruction or when the SNAP routine received control in response to a SNAP macro instruction.

FLTR 0-6
: is the contents of floating point registers 0, 2, 4, and 6.

REGS 0-7
: is the contents of general registers 0 through 7.

REGS 8-15
: is the contents of general registers 8 through 15.

```
NUCLEUS

hhhhhh   hhhhhhhh hhhhhhhh hhhhhhhh hhhhhhhh    hhhhhhhh hhhhhhhh hhhhhhhh hhhhhhhh   *ccccccccccccccccccccccccccccccc*
hhhhhh   hhhhhhhh hhhhhhhh hhhhhhhh hhhhhhhh    hhhhhhhh hhhhhhhh hhhhhhhh hhhhhhhh   *ccccccccccccccccccccccccccccccc*
   LINE    hhhhhh    SAME AS ABOVE
hhhhhh   hhhhhhhh hhhhhhhh hhhhhhhh hhhhhhhh    hhhhhhhh hhhhhhhh hhhhhhhh hhhhhhhh   *ccccccccccccccccccccccccccccccc*
   LINES    hhhhhh-hhhhhh    SAME AS ABOVE
hhhhhh   hhhhhhhh hhhhhhhh hhhhhhhh hhhhhhhh    hhhhhhhh hhhhhhhh hhhhhhhh hhhhhhhh   *ccccccccccccccccccccccccccccccc*
P/P STORAGE

hhhhhh   hhhhhhhh hhhhhhhh hhhhhhhh hhhhhhhh    hhhhhhhh hhhhhhhh hhhhhhhh hhhhhhhh   *ccccccccccccccccccccccccccccccc*
hhhhhh   hhhhhhhh hhhhhhhh hhhhhhhh hhhhhhhh    hhhhhhhh hhhhhhhh hhhhhhhh hhhhhhhh   *ccccccccccccccccccccccccccccccc*
hhhhhh   hhhhhhhh hhhhhhhh hhhhhhhh hhhhhhhh    hhhhhhhh hhhhhhhh hhhhhhhh hhhhhhhh   *ccccccccccccccccccccccccccccccc*
   LINES    hhhhhh-hhhhhh    SAME AS ABOVE
hhhhhh   hhhhhhhh hhhhhhhh hhhhhhhh hhhhhhhh    hhhhhhhh hhhhhhhh hhhhhhhh hhhhhhhh   *ccccccccccccccccccccccccccccccc*
          END OF DUMP
```

The content of main storage is given under 2 headings: NUCLEUS and P/P STORAGE. Under these headings, the lines have the following format:

- First entry: the address of the initial byte of main storage contents presented on the line.
- Next 8 entries: 8 full words (32 bytes) of main storage in hexadecimal.
- Last entry (surrounded by asterisks): the same 8 full words of main storage in EBCDIC. Only A through Z, 0 through 9, and blanks are printed; a period is printed for anything else. An exception occurs in the printed lines representing the ABDUMP work area. The contents of the ABDUMP work area during the printing of EBCDIC characters differs from the contents during printing of the hexadecimal characters because a portion of the work area is used to write lines to the printer. This exception should not create any problems since the contents of the ABDUMP work area is of little use in debugging.

The following lines may also appear:

LINES hhhhhhhh-hhhhhhhh SAME AS ABOVE
: are the starting addresses of the first and last line of a group of lines that are identical to the line immediately preceding.

LINE hhhhhh SAME AS ABOVE
: is the starting address of a line that is identical to the line immediately preceding.

NUCLEUS
identifies the next lines as the contents of the control program nucleus.

P/P STORAGE
identifies the next lines as the contents of the main storage area assigned to the task (problem program).

END OF DUMP
indicates that the dump or snapshot is completed.

Guide to Using an ABEND/SNAP Dump (PCP, MFT)

Cause of Abnormal Termination: Evaluate the user (USER Decimal code) or system (SYSTEM=hex code) completion code using Appendix B or the publication Messages and Codes.

Active RB Queue: The first RB shown on the dump represents the oldest RB on the queue. The RB representing the load module that had control when the dump was taken is third from the bottom. The last RB represents the ABDUMP routine, and the second from last, the ABEND routine. The names of load modules represented in the active RB queue are given in the RB field labeled NM in the dump. Names of load modules in SVC routines are presented in the format:

```
NM    SVC-mnnn
```

where m is the load module number (minus 1) in the routine and nnn is the signed decimal SVC number. The last two RBs on an ABEND/SNAP dump will always be SVRBs with edited names SVC-105A (ABDUMP--SVC 51) and SVC-401C (ABEND--SVC 13).

Resume PSW: The resume PSW field is the fourth entry in the first line of each RB printout. It is identified by the subheading PSW. For debugging purposes, the resume PSW of the third RB from the bottom, on the dump, is most useful. The last three characters of the first word give the SVC number or the I/O device address, depending on which type of interruption caused the associated routine to lose control. It also provides the CPU state at the time of the interruption (bit 15), the length of the last instruction executed in the program (bits 32,33), and the address of the next instruction to be executed (bytes 5-8).

Load List and Job Pack Area Queue: The load module that had control at the time of abnormal termination may not contain the instruction address pointed to by the resume PSW. In that case, look at the RBs on the load list and on the job pack area queue (MFT with subtasking). Compare the instruction address with the entry points of each load module (shown in the last 3 bytes of the field labeled USE/EP). The module which contains the instruction pointed to by the resume PSW is the one in which abnormal termination occurred. The name of the load module is indicated in the field labeled NM.

Trace Table: Entries in the trace table reflect SIO, I/O, and SVC interruptions. SIO entries can be used to locate the CCW (through the CAW), which reflects the operation initiated by an SIO instruction. If the SIO operation was not successful, the CSW STATUS portion of the entry will show you why it failed.

I/O entries reflect the I/O old PSW and the CSW that was stored when the interruption occurred. From the PSW, you can learn the address of the device on which the interruption occurred (bytes 2 and 3), the CPU state at the time of interruption (bit 15), and the instruction address where the interruption occurred (bytes 5-8). The CSW provides you with the unit status (byte 4), the channel status (byte 5), and the address of the previous CCW plus 8 (bytes 0-3).

SVC entries provide the SVC old PSW and the contents of registers 0 and 1. The PSW offers you the hexadecimal SVC number (bits 20-31), the CPU mode (bit 15), and the address of the SVC instruction (bytes 5-8). The contents of registers 0 and 1 are useful in that many system macro instructions use these registers for parameter information. Contents of registers 0 and 1 for each SVC interruption are given in Appendix A.

Note: If an ABEND macro instruction is issued by the system when a program check interruption causes abnormal termination, an SVC entry does not appear in the trace table, but is reflected in the PSW at entry to ABEND.

Free Areas: ABEND/SNAP dumps do not print out areas of main storage that are available for allocation. Since the ABEND routine uses some available main storage, the only way you can determine the amount of free storage available when abnormal termination occurred is to re-create the situation and take a stand-alone dump.

MFT Considerations: Dumps issued by systems with MFT include an additional trace table entry for task switches. This entry looks similar to an SVC entry, except that words 3 and 4 of the entry contain the address of the TCBs for the "new" and "old" tasks being performed, respectively. The trace table entries for one particular task are contained between sets of two task switch entries. Word 3 of the beginning task switch entry and word 4 of the ending task switch entry point to the TCB for that task. With release 11 and following releases, task switch entries are identified by a fifth digit of 'F'.

Note: To find all the entries for the terminated task, on a dump issued prior to release 11, obtain the TCB addresses under the TCB heading of the dump and scan the trace table under words 3 and 4 for these addresses. Then enclose the areas that begin with an entry having the TCB address in word 3, and end with an entry having the same TCB address in word 4. If words 3 and 4 contain the same address, disregard the task switch entry.

ABEND/SNAP Dump (Systems With MVT)

MVT dumps differ from PCP and MFT dumps in the addition of detailed main storage control information, the omission of a complete main storage dump, and the omission of a trace table in ABEND dumps. MVT dumps occur immediately after an abnormal termination, provided an ABEND or SNAP macro instruction was issued and proper dump data sets were defined. However, if a system failure has occurred and a SYS1.DUMP data set has been defined and is available, a full core image dump is provided, as explained in the section headed "Core Image Dump."

With MVT's subtask creating capability, you may receive one or more partial dumps in addition to a complete dump of the task that caused abnormal termination. A complete dump includes all control information associated with the terminating task and a printout of the load modules and subpools used by the task. A partial dump of a task related to the terminating task includes only control information. A partial dump is identified by either ID=001 or ID=002 printed in the first line of the dump. Figure 24 shows the key areas of a complete dump.

In systems with MVT, you can effect termination of a job step task upon abnormal termination of a lower level task. To do this, you must either terminate each task upon finding an abnormal termination completion code issued by its subtask or pass the completion code on to the next higher level task.

Invoking an ABEND/SNAP Dump (MVT)

ABEND/SNAP dumps issued by systems with MVT are invoked in the same manner as those under systems with PCP and MFT. They result from an ABEND or SNAP macro instruction in a system or user program, accompanied by a properly defined data set. In the case of a system failure, the Damage Assessment routine (DAR) attempts to write a core image dump to the SYS1.DUMP data set. A full explanation of core image dumps may be found in the section headed "Core Image Dump." The instructions that invoke an ABEND/SNAP dump in MVT environment are the same as those given in the preceding topic for systems with PCP and MFT. However, some additional considerations must be made in requesting main storage and direct access space.

MVT Considerations: In specifying a region size for a job step subject to abnormal termination, you must consider the space requirements for opening a SYSABEND or SYSUDUMP data set (if there is one), and loading the ABDUMP routine and required data management routines. This space requirement can run as high as 6000 bytes.

Direct access devices are used frequently for intermediate storage of dump data sets in systems with MVT. To use direct access space efficiently, the space for the dump data set should be varied, depending on whether or not abnormal termination is likely. A small quantity should be requested if normal termination is expected. To prevent termination of the dump due to a lack of direct access space, always specify an incremental (secondary) quantity when coding a SPACE parameter for a dump data set. You can obtain a reasonable estimate of the direct access space required for an ABEND/SNAP dump by adding, (1) the number of bytes in the nucleus, (2) the part of the system queue space required by the task (9150 bytes is a sufficient estimate), and (3) the amount of region space occupied by the task. Multiply the sum by 4, and request this amount of space in 1024-byte blocks.

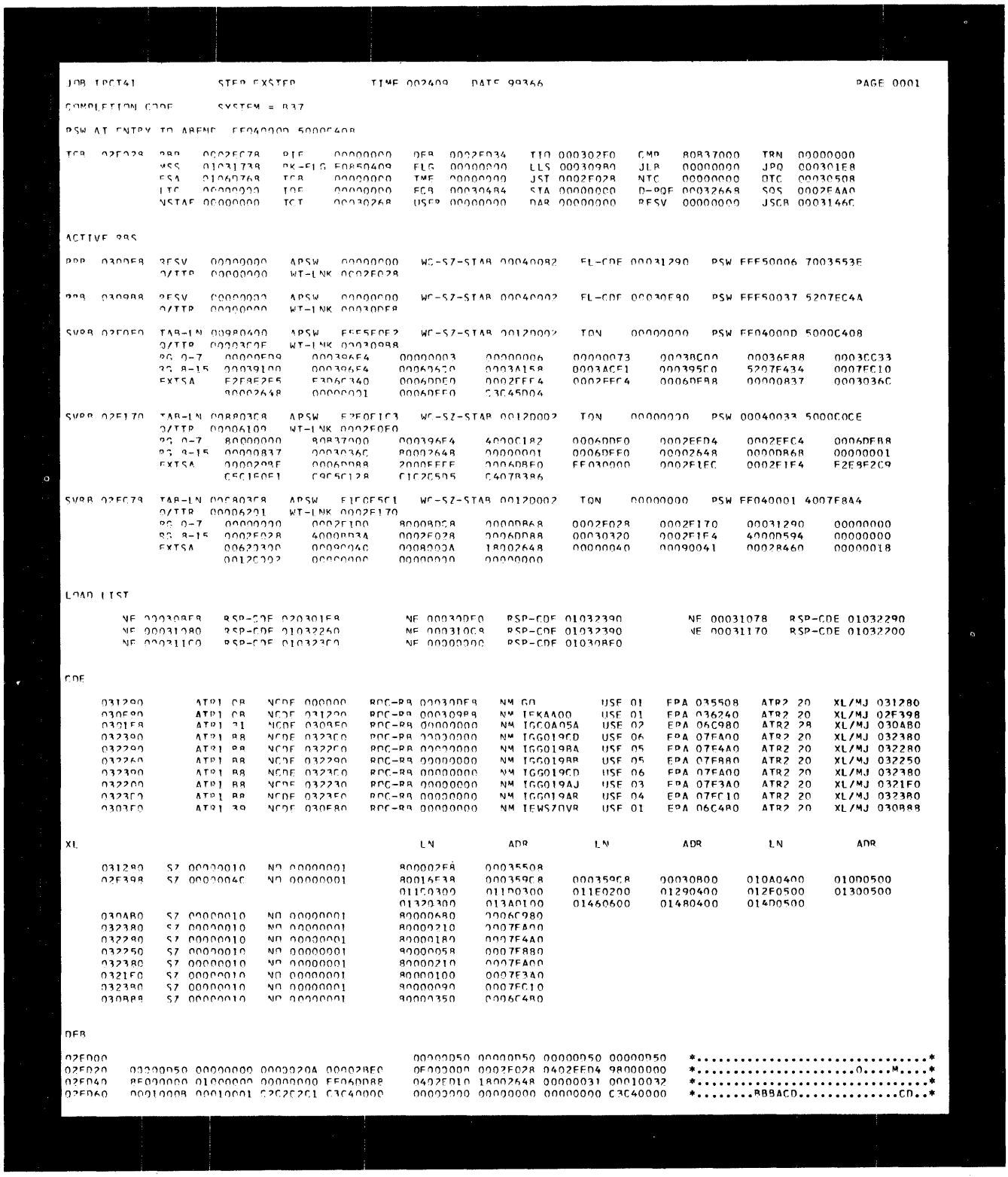
This formula gives the space requirements for one task. Request additional space if partial dumps of subtasks and invoking tasks will be included.

Contents of an ABEND/SNAP Dump (MVT)

This explanation of the contents of ABEND/SNAP dumps issued by systems with MVT is interspersed with sample sections from an ABEND dump. Capital letters represent the headings found in all dumps, and lowercase letters, information that varies with each dump. The lowercase letter used indicates the mode of the information and the number of letters indicates its length:

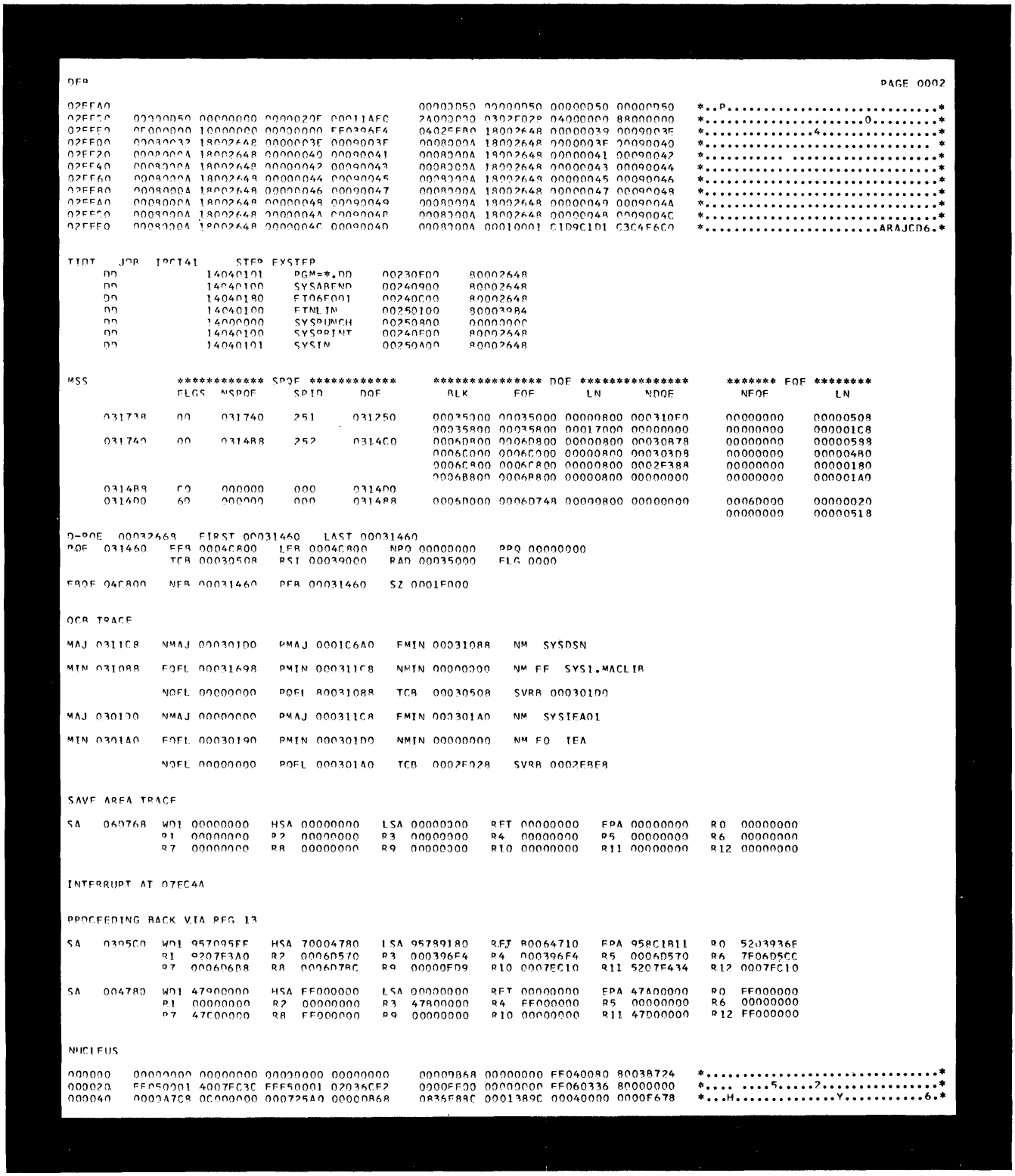
- h represents 1/2 byte of hexadecimal information
- d represents 1 byte of decimal information
- c represents a 1-byte character

You may prefer to follow the explanation on your own ABEND or SNAP dump.



```
JOB IPCT41          STEP EXSTEP          TIME 002409   DATE 99366                                    PAGE 0001

COMPLETION CODE     SYSTEM = 837

PSW AT ENTRY TO ABEND  FF040000 5000C408

TCB  002E028  PIE    00000000   DEB  002E034   TIO 000302F0   CMP   80837000   TRN  00000000
              PSS    01031738   PK-FLG F0850409  FLG  00000000   LLS 0003098C   JLB  00000000   JPQ  000301E8
              ESA    01060768   TCB  00000000   TME  00000000   JST 002E028   NTC  00000000   DTC  00030508
              LTC    00000000   IQE  00000000   ECB  000304B4   STA 00000000   D-PQE 00032668   SQS  0002EAA0
              NSTAE 00000000   TCT  00030268   USER 00000000   DAR 00000000   RESV 00000000   JSCB 0003146C


ACTIVE SRS

PRB  030DE8  RESV   00000000   APSW   00000000   WC-SZ-STAB 00040082   FL-CDE 00031290   PSW FFF50006 7003553E
             Q/TTR  00000000   WT-LNK 002E028

PRB  030988  RESV   00000000   APSW   00000000   WC-SZ-STAB 00040002   FL-CDE 00030E90   PSW FFF50037 5207EC4A
             Q/TTR  00000000   WT-LNK 00030DE8

SVRB 02E0E0  TAB-LN 00980400   APSW   FFF5E0E2   WC-SZ-STAB 00120002   TQN    00000000   PSW FF040000 5000C408
             Q/TTR  00003C0E   WT-LNK 00030988
             RG 0-7   00000E09    000396E4   00000003   00000006   00000073   00038C00   00036E88   0003CC33
             RG 8-15  00039100    000396E4   00069620   0003A158   0003ACE1   000395C0   5207E434   0007EC10
             EXTSA    E2E8E2E5    E306C340   0006DDE0   0002FEC4   0006DE88   00000837   0003036C
                      00002648    00000001   0006DEE0   C3C45D04

SVRB 02E170  TAB-LN 00880308   APSW   E2E0E1C3   WC-SZ-STAB 00120002   TQN    00000030   PSW 00040033 5000C0CE
             Q/TTR  00006109   WT-LNK 0002E0E0
             RG 0-7   80000000    80837000   000396E4   4000C182   0006DDE0   0002EED4   0002EEC4   0006DE88
             RG 8-15  00000837    0003036C   80002648   00000001   0006DEE0   00002648   00000868   00000001
             EXTSA    00002098    0006D088   2000EEEE   0006DBE0   FF030000   0002E1EC   0002E1E4   E2E8E2C9
                      C5C1E0E1    C9C5C138   C1C2C5D5   C407B386

SVRB 02EC78  TAB-LN 00C803C8   APSW   E1E0E5C1   WC-SZ-STAB 00120002   TQN    00000000   PSW FF040001 4007E844
             Q/TTR  00006201   WT-LNK 0002E170
             RG 0-7   00000000    0002E100   80008D68   00000868   0002E028   0002E170   00031290   00000000
             RG 8-15  0002E028    4000B03A   0002E028   0006DD88   00030320   0002E1E4   40000594   00000000
             EXTSA    00620330    00090040   0008003A   18002648   00000040   00090041   00028460   00000018
                      00120002    00000000   00000030   00000000

LOAD LIST

        NE 030308E8   RSP-CDE 020301E8        NE 00030DE0   RSP-CDE 01032390        NE 00031078   RSP-CDE 01032290
        NE 00031080   RSP-CDE 01032260        NE 000310C8   RSP-CDE 01032390        NE 00031170   RSP-CDE 01032200
        NE 000311C0   RSP-CDE 010323C0        NE 00000000   RSP-CDE 01030BE0


CDE

     031290       ATR1 C8   NCDE 000000   RDC-RB 00030DE8   NM GO          USE 01   EPA 035508   ATR2 20   XL/MJ 031280
     030E90       ATR1 C8   NCDE 031200   RDC-RB 000309B8   NM IEKAA00     USE 01   EPA 036240   ATR2 20   XL/MJ 02E398
     0301E8       ATR1 31   NCDE 0308E0   RDC-RB 00000000   NM IGC0A05A    USE 02   EPA 06C980   ATR2 28   XL/MJ 030AB0
     032390       ATR1 88   NCDE 0323C0   RDC-RB 00030000   NM IGG019CD    USE 06   EPA 07EA00   ATR2 20   XL/MJ 032380
     032290       ATR1 88   NCDE 0322C0   RDC-RB 00000000   NM IGG019BA    USE 05   EPA 07E4A0   ATR2 20   XL/MJ 032280
     032260       ATR1 88   NCDE 032290   RDC-RB 00000000   NM IGG019BR    USE 05   EPA 07E880   ATR2 20   XL/MJ 032250
     032300       ATR1 88   NCDE 0323E0   RDC-RB 00000000   NM IGG019CD    USE 06   EPA 07EA00   ATR2 20   XL/MJ 032380
     032200       ATR1 88   NCDE 032230   RDC-RB 00000000   NM IGG019AJ    USE 03   EPA 07E3A0   ATR2 20   XL/MJ 0321E0
     0323C0       ATR1 88   NCDE 0323E0   RDC-RB 00000000   NM IGG019AR    USE 04   EPA 07EC10   ATR2 20   XL/MJ 032380
     0303E0       ATR1 38   NCDE 030E80   RDC-RB 00000000   NM IEWS70VR    USE 01   EPA 06C4B0   ATR2 20   XL/MJ 030B88


XL                                                LN          ADR          LN          ADR          LN          ADR

     031280   SZ 00000010   NO 00000001        80000EF8   00035508
     02E398   SZ 00030040   NO 00000001        80016E38   000359C8   000359C8   00030800   010A0400   01000500
                                               011C0300   011D0300   011E0200   01290400   012E0500   01300500
                                               01320300   013A0100   01460600   01480400   01400500
     030AB0   SZ 00000010   NO 00000001        80000680   0006C980
     032380   SZ 00000010   NO 00000001        80000210   0007EA00
     032290   SZ 00000010   NO 00000001        80000180   0007E4A0
     032250   SZ 00000010   NO 00000001        80000058   0007E880
     032380   SZ 00000010   NO 00000001        80000210   0007EA00
     0321E0   SZ 00000010   NO 00000001        80000100   0007E3A0
     032380   SZ 00000010   NO 00000001        80000090   0007EC10
     030B88   SZ 00000010   NO 00000001        80000350   0006C4B0


DEB

02E000                                                  00000D50 00000D50 00000D50 00000D50   *................................*
02E020   00000D50 00000000 00000204 00002BE0            0E000000 0002E028 0402EED4 98000000   *.....................0....M....*
02E040   BE000000 01000000 00000000 FF060D88            0402ED10 18002648 00000031 00010032   *................................*
02E060   00010008 00010001 C2C2C2C1 C3C40000            00002000 00000000 00000000 C3C40000   *........BBBACD..............CD..*
```

• Figure 24A. Sample of Complete ABEND Dump (MVT)



```
DFR                                                                                                    PAGE 0002

02FEA0                                                  00003D50 00000D50 00000D50 00000D50   *..P.....................*
02FEB0   00000D50 00000000 0000020F 00011AE0            2A003000 0302E028 04000000 88000000   *.....................0.....*
02FEC0   0E000000 10000000 00030000 FE0396E4            0402FEB0 18002648 00000039 0009003E   *..................4.....>*
02FED0   00030032 18002648 0000003E 0009003F            00080004 18002648 0000003E 00090040   *.....2....&....>.....?...@*
02FEE0   00080004 18002648 00000040 00090041            00080004 18002648 00000041 00090042   *.....4....&....@.....A...B*
02FEF0   00080004 18002648 00000042 00090043            00080004 18002648 00000043 00090044   *.....4....&....B.....C...D*
02FF00   00080004 18002648 00000044 00090045            00080004 18002648 00000045 00090046   *.....4....&....D.....E...F*
02FF10   00080004 18002648 00000046 00090047            00080004 18002648 00000047 00090048   *.....4....&....F.....G...H*
02FF20   00080004 18002648 00000048 00090049            00080004 18002648 00000049 0009004A   *.....4....&....H.....I...J*
02FF30   00080004 18002648 0000004A 0009004B            00080004 18002648 0000004B 0009004C   *.....4....&....J.....K...L*
02FF40   00080004 18002648 0000004C 0009004D            00080004 00010001 C1D9C1D1 C3C4E6C9   *.....4....&....L.....%..ARAJCD6I*

TIOT   JOB  IPCT41     STEP EXSTEP
     DD              14040101     PGM=*.DD     00230E00     80002648
     DD              14040100     SYSABEND     00240900     80002648
     DD              14040180     ET06E001     00240C00     80002648
     DD              14040100     ETNLIN       00250100     80003984
     DD              14000000     SYSPUNCH     00250800     00000000
     DD              14040100     SYSPRINT     00240E00     80002648
     DD              14040101     SYSIN        00250A00     80002648

MSS              ************ SRQE ************      *************** DQE ***************      ******* EQE ********
                 FLGS  NSRQE     SRID     DQE          BLK       EQE       LN       NDQE        NEQE       LN

     031738      00    031740    251      031250       00035000 00035000 00000800 000310E0       00000000   00000508
                                                       00035800 00035800 00017000 00000000       00000000   000001C8
     031740      00    031488    252      0314C0       0006D800 0006D800 00000800 00030A78       00000000   00000588
                                                       0006C000 0006C000 00000800 000303D8       00000000   00000480
                                                       0006C800 0006C800 00000800 0002E388       00000000   00000180
                                                       0006B800 0006B800 00000800 00000000       00000000   000001A0
     031488      F0    000000    000      031400
     031400      60    000000    000      031488       0006D000 0006D748 00000800 00000000       0006D000   00000020
                                                                                                 00000000   00000518

D-RQE  00032669   FIRST 00031460   LAST 00031460
RQE  031460    FRR 0004C800   LER 0004C800   NRQ 00000000   PRQ 00000000
               TCB 00030508   RST 00039000   RAD 00035000   FLG 0000

ERQE 04C800    NER 00031460   PER 00031460   SZ 0001E000

QCB TRACE

MAJ 0311C8   NMAJ 00030100   PMAJ 0001C6A0   FMIN 00031088   NM  SYSDSN

MIN 031088   FQEL 00031698   PMIN 000311C8   NMIN 00000000   NM FF  SYS1.MACLIB

             NQEL 00000000   PQEL 80031088   TCB  00030508   SVRB 00030100

MAJ 030100   NMAJ 00000000   PMAJ 000311C8   FMIN 000301A0   NM  SYSIEA01

MIN 0301A0   FQEL 00030190   PMIN 00030100   NMIN 00000000   NM F0  IEA

             NQEL 00000000   PQEL 000301A0   TCB  0002F028   SVRB 0002EBE8

SAVE AREA TRACE

SA   060768  WD1 00000000   HSA 00000000   LSA 00000300   RET 00000000   EPA 00000000   R0  00000000
             R1  00000000   R2  00000000   R3  00000000   R4  00000000   R5  00000000   R6  00000000
             R7  00000000   R8  00000000   R9  00000300   R10 00000000   R11 00000000   R12 00000000

INTERRUPT AT 07EC4A

PROCEEDING BACK VIA REG 13

SA   0305C0  WD1 957095FF   HSA 70004780   LSA 95789180   RET 80064710   EPA 958C1811   R0  5203936E
             R1  9207E3A0   R2  0006D570   R3  000396E4   R4  000396E4   R5  0006D570   R6  7E06D5CC
             R7  00060688   R8  0006D78C   R9  00000ED9   R10 0007EC10   R11 5207E434   R12 0007EC10

SA   004780  WD1 47900000   HSA FF000000   LSA 00000000   RET 00000000   EPA 47A00000   R0  FF000000
             R1  00000000   R2  00000000   R3  47800000   R4  FF000000   R5  00000000   R6  00000000
             R7  47C00000   R8  FF000000   R9  00000000   R10 00000000   R11 47D00000   R12 FF000000

NUCLEUS

000000   00000000 00000000 00000000 00000000    00000868 00000000 FF040080 80038724   *.....................h.....*
000020   FF050001 4007EC3C FFF50001 02036CE2    0000FF00 00000000 FF060336 80000000   *.... ....5....2.....h.....*
000040   0003A7C8 0C000000 00072580 00000868    0836F88C 00013890 00040000 0000F678   *...H.....Y.....h.....6.*
```

• Figure 24B. Sample of Complete ABEND Dump (MVT)

```
JOB cccccccc          STEP cccccccc        TIME dddddd   DATE ddddd    ID = ddd                              PAGE dddd
COMPLETION CODE       SYSTEM = hhh (or USER = dddd)
PSW AT ENTRY TO ABEND (SNAP)  hhhhhhhh hhhhhhhh
```

JOB cccccccc
: is the job name specified in the JOB statement.

STEP cccccccc
: is the step name specified in the EXEC statement for the problem program associated with the task being dumped.

TIME dddddd
: is the hour (first 2 digits), minute (next 2 digits), and second (last 2 digits) when the abnormal termination dump routine began processing.

DATE ddddd
: is the year (first 2 digits) and day of the year (last 3 digits). For example, 67352 would be December 18, 1967.

ID=ddd
: is an identification of the dump. For dumps requested by an ABEND macro instruction, this identification is:

  - Absent if the dump is of the task being abnormally terminated.
  - 001 if the dump is of a subtask of the task being abnormally terminated. (Note that, when a task is abnormally terminated, its subtasks are also abnormally terminated.)
  - 002 if the dump is of a task that directly or indirectly created the task being abnormally terminated, up to and including the job step task.

PAGE dddd
: is the page number. Appears at the top of each page. Page numbers begin at 0001 for each task or subtask dumped.

COMPLETION CODE SYSTEM=hhh or COMPLETION CODE USER=dddd
: is the completion code supplied by the control program (SYSTEM=hhh) or the problem program (USER=dddd).

PSW AT ENTRY TO ABEND hhhhhhhh hhhhhhhh or PSW AT ENTRY TO SNAP hhhhhhhh hhhhhhhh
: is the PSW for the problem program or control program routine that had control when abnormal termination was requested, or when the SNAP macro instruction was executed. It is not necessarily the PSW at the time the error condition occurred.

```
TCB  hhhhhh  RBP   hhhhhhhh   PIE   hhhhhhhh   DEB  hhhhhhhh   TIO hhhhhhhh   CMP   hhhhhhhh   TRN  hhhhhhhh
             MSS   hhhhhhhh   PK-FLG hhhhhhhh   FLG  hhhhhhhh   LLS hhhhhhhh   JLB   hhhhhhhh   JPQ  hhhhhhhh
             RG 0-7     hhhhhhhh    hhhhhhhh    hhhhhhhh    hhhhhhhh    hhhhhhhh    hhhhhhhh    hhhhhhhh     hhhhhhhh
             RG 8-15    hhhhhhhh    hhhhhhhh    hhhhhhhh    hhhhhhhh    hhhhhhhh    hhhhhhhh    hhhhhhhh     hhhhhhhh
             FSA   hhhhhhhh   TCB    hhhhhhhh   TME  hhhhhhhh   JST hhhhhhhh   NTC   hhhhhhhh   OTC  hhhhhhhh
             LTC   hhhhhhhh   IQE    hhhhhhhh   ECB  hhhhhhhh   STA hhhhhhhh   D-PQE hhhhhhhh   SQS  hhhhhhhh
             NSTAE hhhhhhhh   TCT    hhhhhhhh   USER hhhhhhhh   DAR hhhhhhhh   RESV  hhhhhhhh   JSCB hhhhhhhh
```

TCB hhhhhh
: is the starting address of the TCB.

RBP hhhhhhhh
: is the TCBRBP field (bytes 0 through 3): starting address of the active RB queue and, consequently, the most recent RB on the queue.

PIE hhhhhhhh
: is the TCBPIE field (bytes 4 through 7): starting address of the program interruption element (PIE) for the task; however, in an abnormal termination dump for the task causing the abnormal termination, zeros. The field is zeroed by the ABEND routine to prevent interruptions during dumping.

DEB hhhhhhhh
is the TCBDEB field (bytes 8 through 11): starting address of the DEB queue. Under the heading DEB in the dump, the prefix section for the first DEB in the queue is presented in the first 8-digit entry on the first line. The 6-digit entry at the left of each line under DEB is the address of the second column on the line, whether or not the column is filled.

TIO hhhhhhhh
is the TCBTIO field (bytes 12 through 15): starting address of the TIOT.

CMP hhhhhhhh
is the TCBCMP field (bytes 16 through 19): task completion code or contents of register 1 when the dump was requested. System codes are given in the third through fifth digits and user codes in the sixth through eight digits.

TRN hhhhhhhh
is the TCBTRN field (bytes 20 through 23): starting address of the control core (table) for controlling testing of the task by TESTRAN.

MSS hhhhhhhh
is the TCBMSS field (bytes 24 through 27): starting address of SPQE most recently added to the SPQE queue.

PK-FLG hhhhhhhh
contains, in the first 2 digits, the TCBPKF field (byte 28): protection key.

contains, in the last 6 digits, the first 3 bytes of the TCBFLGS field (bytes 29 through 31): first 3 flag bytes.

FLG hhhhhhhh
contains, in the first 4 digits, the last 2 bytes of the TCBFLGS (bytes 32 and 33): last 2 flag bytes.

contains, in the next 2 digits, the

TCBLMP field (byte 34): limit priority (converted to an internal priority, 0 to 255).

contains, in the last 2 digits, the TCBDSP field (byte 35): dispatching priority (converted to an internal priority, 0 to 255).

LLS hhhhhhhh
is the TCBLLS field (bytes 36 through 39): starting address of the load list element most recently added to the load list.

JLB hhhhhhhh
is the TCBJLB field (bytes 40 through 43): starting address of the DCB for the JOBLIB data set.

JPQ hhhhhhhh
is the TCBJPQ field (bytes 41 through 47): when translated into binary bits:

- Bit 0 is the purge flag.
- Bits 1 through 7 are reserved for future use and are zeros.
- Bits 8 through 31 are the starting address of the queue of CDEs for the job pack area control queue, which is for programs acquired by the job step.

The TCBJPQ field is used only in the first TCB in the job step; it is zeros for all other TCBs.

RG 0-7 and RG 8-15
is the TCBGRS field (bytes 48 through 111): contents of general registers 0 through 7 and 8 through 15, as stored in the save area of the TCB when a task switch occurred. These 2 lines appear only in dumps of tasks other than the task in control when the dump was requested.

FSA hhhhhhhh
contains, in the first 2 digits, the TCBQEL field (byte 112): count of enqueue elements.

contains, in the last 6 digits, the TCBFSA field (bytes 113 through 115): starting address of the first problem program save area. This save area was set up by the control program when the job step was initiated.

TCB hhhhhhhh
is the TCBTCB field (bytes 116 through 119): starting address of the next lower priority TCB on the TCB queue or, if this is the lowest priority TCB, zeros.

TME hhhhhhhh
is the TCBTME field (bytes 120 through 123): starting address of the timer element created when an STIMER macro instruction is issued by the task.

JST hhhhhhhh
is the TCBJSTCB field (bytes 124 through 127): starting address of the TCB for the job step task. For tasks with a protection key of zero, this field contains the starting address of the TCB.

NTC hhhhhhhh
is the TCBNTC field (bytes 128 through 131): the starting address of the TCB for the previous subtask on this subtask queue. This field is zero in the job step task, and in the TCB for the first subtask created by a parent task.

OTC hhhhhhhh
is the TCBOTC field (bytes 132 through 135): starting address of TCB for the parent task. In the TCB for the job step task, this field contains the address of the initiator.

LTC hhhhhhhh
is the TCBLTC field (bytes 136 through 139): starting address of the TCB for the most recent subtask created by this task. This field is zero in the TCB for the last subtask of a job step, or in a TCB for a task that does not create subtasks.

IQE hhhhhhhh
is the TCBIQE field (bytes 140 through 143): starting address of the interruption queue element (IQE) for the ETXR exit routine. This routine is specified by the ETXR operand of the ATTACH macro instruction that created the TCB being dumped. The routine is to be entered when the task terminates.

ECB hhhhhhhh
is the TCBECB field (bytes 144 through 147): starting address of the ECB to be posted by the control program at task termination. This field is zero if the task was attached without an ECB operand.

STA hhhhhhhh
contains zeros, reserved for future use.

D-PQE hhhhhhhh
is the TCBPQE field (bytes 152 through 155): starting address minus 8 bytes of the dummy PQE. This field is passed by the ATTACH macro instruction to each TCB in a job step.

SQS hhhhhhhh
is the TCBAQE field (bytes 156 through 159): starting address of the allocation queue element (AQE).

NSTAE hhhhhhhh
contains, in the first 2 digits, STAE flags (byte 160).

contains, in the last 6 digits, the TCBNSTAE field (bytes 161 through 163): starting address of the current STAE control block for the task. This field is zero if STAE has not been issued.

TCT hhhhhhhh
is the TCBTCT field (bytes 164 through 167): address of the Timing Control Table (TCT).

USER hhhhhhhh
is the TCBUSER field (bytes 168 through 171): to be used as the user chooses.

DAR hhhhhhhh
contains, in the first two digits, Damage Assessment Routine (DAR) flags (byte 172);

MFT only, contains, in the last 6 digits, the secondary non-dispatchability bits (bytes 173 through 175).

RESV hhhhhhhh
reserved for future use.

JSCB hhhhhhhh
is the TCBJSCB field (bytes 180 through 183): the last three bytes contain the address of the Job Step Control Block.

```
ACTIVE RBS

cccc hhhhhh  cccccc hhhhhhhh   APSW   hhhhhhhh   WC-SZ-STAB hhhhhhhh   cccccc hhhhhhhh   PSW hhhhhhhh hhhhhhhh
             Q/TTR  hhhhhhhh   WT-LNK hhhhhhhh
             RG 0-7   hhhhhhhh    hhhhhhhh    hhhhhhhh    hhhhhhhh    hhhhhhhh    hhhhhhhh    hhhhhhhh    hhhhhhhh
             RG 8-15  hhhhhhhh    hhhhhhhh    hhhhhhhh    hhhhhhhh    hhhhhhhh    hhhhhhhh    hhhhhhhh    hhhhhhhh
             EXTSA    hhhhhhhh    hhhhhhhh    hhhhhhhh    hhhhhhhh    hhhhhhhh    hhhhhhhh    hhhhhhhh    hhhhhhhh
                      hhhhhhhh    hhhhhhhh    hhhhhhhh    hhhhhhhh
```

ACTIVE RBS
identifies the next lines as the contents of the active RBs queued to the TCB, beginning with the oldest RB first.

cccc hhhhhh
indicates the RB type (cccc) and starting address (hhhhhh).

The RB types are:

PRB program request block
IRB interruption request block
SVRB supervisor request block

cccccc hhhhhhhh
indicates the RB's function (cccccc) and bytes 0 through 3 of the RB (hhhhhhhh):

- RESV hhhhhhhh indicates PRB or SVRB for resident routines. Bytes 0 through 3 are reserved for later use and contain zeros.
- TAB-LN hhhhhhhh indicates SVRB for transient routines. The first 4 digits contain the RBTABNO field (bytes 0 and 1): displacement from the beginning of the transient area control table (TACT) to the entry for the module represented by the RB. The last 4 digits contain the RBRTLNTH field (bytes 2 and 3): length of the SVC routine.
- FL-PSA hhhhhhhh indicates IRB. The first 2 digits contain the RBTMFLD field (byte 0): indicators for the timer routines. This byte contains zeros when the IRB does not represent a timer routine. The last 6 digits contain the RBPSAV field (bytes 1 through 3): starting address of the problem program register save area (PSA).

APSW hhhhhhhh
is the RBABOPSW field (bytes 4 through 7):

- In PRB, right half of the problem program's PSW when the interruption occurred.
- In IRB or SVRB for type II SVC routines, right half of routine's PSW during execution of ABEND or ABTERM, or zeros.
- In SVRB for type III or IV SVC routines, right half of routine's PSW during execution of ABEND or ABTERM, or the last four characters of the name of the requested routine. (The last two characters give the SVC number.)

WC-SZ-STAB hhhhhhhh
contains, in the first 2 digits, the RBWCSA field (byte 8): wait count in effect at time of abnormal termination of the program.

contains, in the second 2 digits, the RBSIZE field (byte 9): size of the RB in doublewords.

contains, in the last 4 digits, the RBSTAB field (bytes 10 and 11): status and attribute bits.

cccccc hhhhhhhh
indicates the RB's function (cccccc) and bytes 12 through 15 of the RB (hhhhhhhh):

- FL-CDE hhhhhhhh indicates SVRB for resident routines, or PRB. The first 2 digits contain the RBCDFLGS field (byte 12): control flags.

The last 6 digits contain the RBCDE field (bytes 13 through 15): starting address of the CDE for the module associated with this RB.

- EPA hhhhhhhh is the RBEP field of an IRB (bytes 12 through 15): entry-point address of asynchronously executed routine.

- TQN hhhhhhhh indicates SVRB for transient routines. Is the RBSVTQN field (bytes 12 through 15): address of the next RB in the transient control queue.

PSW hhhhhhhh hhhhhhhh
is the RBOPSW field (bytes 16 through 23): resume PSW.

Q/TTR hhhhhhhh
- In PRBs and SVRBs for resident routines, contains zeros in the first 2 digits. The last 6 digits contain the RBPGMQ field (bytes 25 through 27): queue field for serially reusable programs (also called the secondary queue).

- In IRBs, contains the RBUSE field in the first 2 digits (byte 24): count of requests for the same exit (ETXR). The RBIQE field in last 6 digits (bytes 25 through 27): starting address of the queue of interruption queue elements (IQE), or zeros in the first 4 digits and the RBIQE field in the last 4 digits (bytes 26 and 27): starting address of the request queue elements.

- In SVRBs for transient routines the first 2 digits contain the RBTAWCSA field (byte 24): number of requests (used if transient routine is overlaid) and the last 6 digits, the RBSVTTR field (bytes 25 through 27): relative track address for the SVC routine.

WT-LNK hhhhhhhh
contains, in the first 2 digits, the RBWCF field (byte 28): wait count.

contains, in the last 6 digits, the RBLINK field (bytes 29 through 31): starting address of the previous RB on the active RB queue (primary queuing field) or, if this is the first or only RB, the starting address of the TCB.

RG 0-7 and RG 8-15
is the RBGRSAVE field (bytes 32 through 95): in SVRBs and IRBs, contents of registers 0 through 15.

EXTSA
- In IRBs, contains the RBNEXAV field in the first 8 digits (bytes 96 through 99): address of next available interruption queue element (IQE), and in the remaining digits, the interruption queue element work space (up to 1948 bytes).

- In SVRBs, contains the RBEXSAVE field (bytes 96 through 143): extended save area for SVC routine.

```
LOAD LIST
        NE hhhhhhhh   RSP-CDE hhhhhhhh        NE hhhhhhhh   RSP-CDE hhhhhhhh        NE hhhhhhhh   RSP-CDE hhhhhhhh
```

LOAD LIST
identifies the next lines as the contents of the load list elements (LLEs) queued to the TCB by its TCBLLS field. The contents of 3 load list elements are presented per line until all elements in the queue are shown.

NE hhhhhhhh
contains, in the first 2 digits, LLE byte 0: zeros.

contains, in the last 6 digits, LLE bytes 1 through 3: starting address of the next element in the load list.

RSP-CDE hhhhhhhh
contains, in the first 2 digits, LLE byte 4: the count of the number of requests made by LOAD macro instructions for the indicated load module. This count is decremented by DELETE macro instructions.

contains, in the last 6 digits, LLE bytes 5 through 7: starting address of the CDE for the load module.

```
CDE
     hhhhhhhh    ATR1 hh   NCDE hhhhhh   ROC-RB hhhhhhhh   NM cccccccc   USE hh   EPA hhhhhh   ATR2 hh   XL/MJ hhhhhh
```

CDE
: identifies the next lines as the contents directory. One entry is presented per line.

hhhhhhhh
: is the starting address of the entry given on the line.

ATR1 hh
: is the attribute flags.

NCDE hhhhhh
: is the starting address of the next entry in the contents directory.

ROC-RB hhhhhhhh
: contains, in the first 2 digits, zeros.

  contains, in the last 6 digits, the starting address of the RB for the load module represented by this entry.

NM cccccccc
: is the name of the entry point to the load module represented by this entry.

USE hh
: is the count of the uses (through ATTACH, LINK, and XCTL macro instructions) of the load module, and of the number of LOAD macro instructions executed for the module.

EPA hhhhhh
: is the entry point address associated with the name in the NM field.

ATR2 hh
: is the attribute flags.

XL/MJ hhhhhh
: is the starting address of the extent list (XL) for a major CDE, or the starting address of the major CDE for a minor CDE. (Minor CDEs are for aliases.)

```
XL                                                  LN        ADR       LN        ADR       LN        ADR
     hhhhhh   SZ hhhhhhhh   NO hhhhhhhh        hhhhhhhh  hhhhhhhh  hhhhhhhh  hhhhhhhh
```

XL
: indicates the next lines are entries in the extent list, which is queued to the major contents directory entry. Each extent list entry is given in one or more lines. Only the first line for an entry contains the left 3 columns; additional lines for an entry contain information only in the right 6 columns.

hhhhhh
: is the starting address of the entry.

SZ hhhhhhhh
: is the total length, in bytes, of the entry.

NO hhhhhhhh
: is the number of scattered control sections in the load module described by this entry. If this number is 1, the load module was loaded as one block.

LN hhhhhhhh
: gives the length, in bytes, of the control sections in the load module described by this entry. Bit 0 is set to 1 in the last, or only, LN field to signal the end of the list of lengths.

ADR hhhhhhhh
: gives the starting addresses of the control sections. Each ADR field is paired with the LN field to its left.

```
DEB

     hhhhhh                              hhhhhhhh   hhhhhhhh          hhhhhhhh   hhhhhhhh   hhhhhhhh   hhhhhhnh
     hhhhhh         hhhhhhhh   hhhhhhhh  hhhhhhhh   hhhhhhhh          hhhhhhhh   hhhhhhhh   hhhhhhhh   hhhhhhhh
     hhhhhh         hhhhhhhh   hhhhhhhh  hhhhhhhh   hhhhhhhh          hhhhhhhh   hhhhhhhh   hhhhhhhh   hhhhhhhh
     hhhhhh         hhhhhhhh   hhhhhhhh

TIOT   JOB  cccccccc   STEP  cccccccc   PROC  cccccccc
     DD             hhhhhhhh    cccccccc    hhhhhhhh    hhhhhhhh
```

DEB
identifies the next lines as the contents of the DEBs and their prefix sections. The first 6 digits in each line give the address of the DEB contents shown on the line, beginning with the second column. The first six digits of the first line contains the prefix section for the first DEB on the queue.

TIOT
identifies the next lines as the contents of the TIOT.

JOB cccccccc
is the name of the job whose task is being dumped.

STEP cccccccc
is the name of the step whose task is being dumped.

PROC cccccccc
is the name for the job step that called the cataloged procedure. This field appears if the job step whose task is being dumped was part of a cataloged procedure.

DD
identifies the line as the contents of the DD entry in the TIOT.

```
MSS              ************ SPQE ************      *************** DQE ***************      ******* FQE ********
                 FLGS  NSPQE     SPID     DQE          BLK      FQE       LN      NDQE          NFQE         LN

      hhhhhh     hh    hhhhhh    ddd      hhhhhh       hhhhhh hhhhhh     hhhhhh  hhhhhh      hhhhhhhh     hhhhhhhh

D-PQE hhhhhh  FIRST  hhhhhhhh  LAST  hhhhhhhh

PQE   hhhhhh    FFB  hhhhhhhh  LFB   hhhhhhhh  NPQ  hhhhhhhh  PPQ  hhhhhhhh
                TCB  hhhhhhhh  RSI   hhhhhhhh  RAD  hhhhhhhh  FLG  hhhhhhhh

FBQE  hhhhhh    NFB  hhhhhhhh  PFB   hhhhhhhh  SZ   hhhhhhhh
 .              .              .              .
 .              .              .              .
 .              .              .              .
PQE   hhhhhh    FFB  hhhhhhhh  LFB   hhhhhhhh  NPQ  hhhhhhhh  PPQ  hhhhhhhh
                TCB  hhhhhhhh  RSI   hhhhhhhh  RAD  hhhhhhhh  FLG  hhhhhhhh

FBQE  hhhhhh    NFB  hhhhhhhh  PFB   hhhhhhhh  SZ   hhhhhhhh
```

MSS
identifies the next lines as the contents of the main storage supervisor queue. This queue includes subpool queue elements (SPQE), descriptor queue elements (DQE), and free queue elements (FQE).

hhhhhh
is the starting address of the first element shown on the line.

SPQE
identifies the 4 columns beneath it as the contents of SPQEs.

FLGS hh
is the SPQE flag byte.

NSPQE hhhhhh
is the starting address of the next SPQE in the queue.

SPID ddd
is the subpool number.

DQE hhhhhh
for a subpool owned by the task being dumped: the starting address of the first DQE for the subpool.

for a subpool that is shared: the starting address of the SPQE for the task that owns the subpool.

DQE
identifies the 4 columns beneath it as the contents of DQEs.

BLK hhhhhh
is the starting address of the allocated 2K block of main storage or set of 2K blocks.

FQE hhhhhh
is the starting address of the first FQE within the allocated blocks.

LN hhhhhh
is the length, in bytes, of the allocated blocks.

NDQE hhhhhh
is the starting address of the next DQE.

FQE
identifies the 2 columns beneath it as the contents of FQEs.

NFQE hhhhhhhh
is the starting address of the next FQE.

LN hhhhhhhh
indicates the number of bytes in the free area.

D-PQE hhhhhh
is the TCBPQE field (bytes 152 through 155): starting address minus 8 bytes of the dummy PQE shown on the line.

FIRST hhhhhhhh
is the starting address of the first PQE.

LAST hhhhhhhh
is the starting address of the last PQE.

PQE hhhhhh
is the starting address of the PQE shown on the line.

FFB hhhhhhhh
is bytes 0 through 3 of the PQE: starting address of the first FBQE. If no FBQEs exist, this field is the starting address of this PQE

LFB hhhhhhhh
is bytes 4 through 7 of the PQE: starting address of the last FBQE. If no FBQEs exist, this field is the starting address of this PQE.

NPQ hhhhhhhh
is bytes 8 through 11 of the element: starting address of the next PQE or, if this is the last PQE, zeros.

PPQ hhhhhhhh
is bytes 12 through 15 of the element: starting address of the preceding PQE or, if this is the first PQE, zeros.

TCB hhhhhhhh
is bytes 16 through 19 of the element: starting address of the TCB for the job step to which the space belongs or, if the space was obtained from unassigned free space, zeros.

RSI hhhhhhhh
is bytes 20 through 23 of the element: size of the region described by this PQE (a multiple of 2048).

RAD hhhhhhhh
is bytes 24 through 27 of the element: starting address of the region described by this PQE.

FLG hhhhhhhh
is byte 28 of the element:

bit 0 when 0, indicates space described by this PQE is owned;

when 1, indicates space is borrowed.

bit 1 when 1, indicates region has been rolled out (meaningful only when bit 0 is 0).
bit 2 when 1, indicates region has been borrowed.
bit 3-7, reserved for future use.

Note: PQE information is contained in two lines on the dump. When the rollout/rollin feature or Main Storage Hierarchy Support is included in the system, PQE information (with associated FBQEs) appears once in the dump for each region segment of the job step. (Each PQE on the partition queue defines a region segment. A job step's region contains more than one segment only when the step has rolled out another step or steps, or Main Storage Hierarchy Support is present.)

FBQE hhhhhh
is the starting address of the FBQE shown on the line.

NFB hhhhhhhh
is bytes 0 through 3 of the element: starting address of the next FBQE. In the highest or only FBQE, this field contains the address of the PQE.

PFB hhhhhhhh
is bytes 4 through 7 of the element: starting address of the previous FBQE. In the lowest or only FBQE, the field contains the address of the PQE.

SZ hhhhhhhh
is bytes 8 through 11 of the element: size, in bytes, of the free area.

```
QCB TRACE
MAJ hhhhhh   NMAJ hhhhhhhh   PMAJ hhhhhhhh   FMIN hhhhhhhh   NM  cccccccc
MIN hhhhhh   FQEL hhhhhhhh   PMIN hhhhhhhh   NMIN hhhhhhhh   NM xx  xxxxxxxx
             NQEL hhhhhhhh   PQEL hhhhhhhh   TCB  hhhhhhhh   SVRB hhhhhhhh
```

QCB TRACE
identifies the next lines as a trace of the queue control blocks (QCB) associated with the job step. Lines beginning with MAJ show major QCBs, lines beginning with MIN show minor QCBs, and lines beginning with NQEL show queue elements (QEL).

MAJ hhhhhh
is the starting address of the major QCB whose contents are given on the line.

NMAJ hhhhhhhh
is the starting address of the next major QCB for the job step.

PMAJ hhhhhhhh
is the starting address of the previous major QCB for the job step.

FMIN hhhhhhhh
is the starting address of the first minor QCB associated with the major QCB given on the line.

NM cccccccc
is the name of the serially reusable resource represented by the major QCB.

MIN hhhhhh
is the starting address of the minor QCB whose contents are given on the line.

FQEL hhhhhhhh
is the starting address of the first queue element (QEL), which represents a request to gain access to a serially reusable resource or set of resources.

PMIN hhhhhhhh
is the starting address of the previous minor QCB.

NMIN hhhhhhhh
is the starting address of the next minor QCB.

NM xx xxxxxxxx
indicates, in the first 2 digits, the scope of the name or address of the minor QCB being dumped. If the scope is hexadecimal FF, the name is known to the entire operating system. If the scope is hexadecimal 00 or 10 through F0, the name is known only to the job step; in this case, the scope is the protection key of the TCB enqueuing the minor QCB.

Also contains, in the last 8 digits, the name or the starting address of the minor QCB.

NQEL hhhhhhhh
indicates, by hexadecimal 10 in the first 2 digits, that the queue element on the line represents a request for step-must-complete; by 00, ordinary request; and by 20, a set-must-complete request.

Also contains, in the last 6 digits, the starting address of the next queue element in the queue, or for the last queue element in the queue, zeros.

PQEL hhhhhhhh
indicates, by hexadecimal 80 in the first 2 digits, that the queue element represents a shared request or, by hexadecimal 00, that the element represents an exclusive request. (If

the shared DASD option was selected, hexadecimal 40 in the first 2 digits indicates an exclusive RESERVE request and 00 indicates a shared RESERVE request.)

TCB hhhhhhhh
is the starting address of the TCB under which the ENQ macro instruction was issued.

SVRB hhhhhhhh
is the starting address of the SVRB under which the routine for the ENQ macro instruction is executed, or, after the requesting task receives control of the resource, the UCB address of a device being reserved through a RESERVE macro instruction (the latter value occurs only when the shared DASD option was selected).

```
SAVE AREA TRACE

cccccccc WAS ENTERED VIA LINK (CALL) ddddd AT EP ccccc...

SA    hhhhhh  WD1 hhhhhhhh   HSA hhhhhhhh   LSA hhhhhhhh  RET hhhhhhhh  EPA hhhhhhhh  R0  hhhhhhhh
              R1  hhhhhhhh   R2  hhhhhhhh   R3  hhhhhhhh  R4  hhhhhhhh  R5  hhhhhhhh  R6  hhhhhhhh
              R7  hhhhhhhh   R8  hhhhhhhh   R9  hhhhhhhh  R10 hhhhhhhh  R11 hhhhhhhh  R12 hhhhhhhh

INCORRECT BACK CHAIN

INTERRUPT AT hhhhhh

PROCEEDING BACK VIA REG 13
```

SAVE AREA TRACE
identifies the next lines as a trace of the save areas for the program. Each save area is presented in 3 or 4 lines. The first line gives information about the linkage that last used the save area. This line will not appear when the RB for the linkage cannot be found. The second line gives the contents of words 0 through 5 of the save area. The third and fourth lines give the contents of words 6 through 18 of the save area; these words are the contents of registers 0 through 12. Save areas are presented in the following order:

1. The save area pointed to in the TCBFSA field of the TCB. This save area is the first one for the problem program; it was set up by the control program when the job step was initiated.

2. If the third word of the first save area was filled by the problem program, then the second save area shown is that of the next lower level module of the task. However, if the third word of the first area points to a location whose second word does not point back to the first area, the message INCORRECT BACK CHAIN appears, followed by possible contents of the second save area.

3. The third, fourth, etc. save areas are then shown, provided the third word in each higher save area was filled and the second word of each lower save area points back to the next higher save area. This process is continued until the end of the chain is reached (the third word in a save area contains zeros) or INCORRECT BACK CHAIN appears.

Following the forward trace, the message INTERRUPT AT hhhhhh appears, followed by the message PROCEEDING BACK VIA REG 13. Then, the save area in the lowest level module is presented, followed by the save area in the next higher level. The lowest save area is assumed to be the 76 bytes beginning with the byte addressed by register 13. These two save areas appear only if register 13 points to a full word boundary and does not contain zeros.

cccccccc WAS ENTERED
is the name of the module that stored register contents in the save area. This name is obtained from the RB.

VIA LINK ddddd or VIA CALL ddddd
indicates the macro instruction (LINK or CALL) used to give control to the next lower level module, and is the ID

operand, if it was specified, of the LINK or CALL macro instruction.

AT EP ccccc...
is the entry point identifier, which appears only if it was specified in the SAVE macro instruction that filled the save area.

SA hhhhhh
is the starting address of the save area.

WD1 hhhhhhhh
is the first word of the save area (optional).

HSA hhhhhhhh
is the second word of the save area: starting address of the save area in the next higher level module. In the first save area in a job step, this word contains zeros. In all other save areas, this word must be filled.

LSA hhhhhhhh
is the third word of the save area (register 13): starting address of the save area in the next lower level (called) module. If the module containing this save area did not fill the word, it contains zeros.

RET hhhhhhhh
is the fourth word of the save area (register 14): return address (optional); if the called module did not fill the word, it contains zeros.

EPA hhhhhhhh
is the fifth word of the save area (register 15): entry point to the called module. Use of this word is optional; if the called module did not fill the word, it contains zeros.

R0 hhhhhhhh R1 hhhhhhhh ... R12 hhhhhhhh
are words 6 through 18 of the save area (registers 0 through 12): contents of registers 0 through 12 for the module containing the save area immediately after the linkage. Use of these words is optional; if the called module did not fill these words, they contain zeros.

INCORRECT BACK CHAIN
indicates that the following lines may not be a save area because the second word in this area does not point back to the previous save area in the trace.

INTERRUPT AT hhhhhh
is the address of the next instruction to be executed in the problem program. It is obtained from the resume PSW word of the last PRB or LPRB in the active RB queue.

PROCEEDING BACK VIA REG 13
indicates that the next 2 save areas are (1) the save area in the lowest level module, followed by (2) the save area in the next higher level module. The lowest save area is the save area pointed to by register 13. These 2 save areas appear only if register 13 points to a fullword boundary and does not contain zero.

```
CPUx PSA

hhhhhh   hhhhhhhh hhhhhhhh hhhhhhhh hhhhhhhh    hhhhhhhh hhhhhhhh hhhhhhhh hhhhhhhh   *ccccccccccccccccccccccccccccccc*
hhhhhh   hhhhhhhh hhhhhhhh hhhhhhhh hhhhhhhh    hhhhhhhh hhhhhhhh hhhhhhhh hhhhhhhh   *ccccccccccccccccccccccccccccccc*


NUCLEUS

hhhhhh   hhhhhhhh hhhhhhhh hhhhhhhh hhhhhhhh    hhhhhhhh hhhhhhhh hhhhhhhh hhhhhhhh   *ccccccccccccccccccccccccccccccc*
hhhhhh   hhhhhhhh hhhhhhhh hhhhhhhh hhhhhhhh    hhhhhhhh hhhhhhhhhhhhhhhhh hhhhhhhh   *ccccccccccccccccccccccccccccccc*


NUCLEUS CONT.

hhhhhh   hhhhhhhh hhhhhhhh hhhhhhhh hhhhhhhh    hhhhhhhh hhhhhhhh hhhhhhhh hhhhhhhh   *ccccccccccccccccccccccccccccccc*
hhhhhh   hhhhhhhh hhhhhhhh hhhhhhhh hhhhhhhh    hhhhhhhh hhhhhhhh hhhhhhhh hhhhhhhh   *ccccccccccccccccccccccccccccccc*


REGS AT ENTRY TO ABEND (SNAP)

     FLTR 0-6      hhhhhhhhhhhhhhhh      hhhhhhhhhhhhhhhh              hhhhhhhhhhhhhhhh      hhhhhhhhhhhhhhhh

     REGS 0-7      hhhhhhhh   hhhhhhhh   hhhhhhhh   hhhhhhhh          hhhhhhhh   hhhhhhhh   hhhhhhhh   hhhhhhhh
     REGS 8-15     hhhhhhhh   hhhhhhhh   hhhhhhhh   hhhhhhhh          hhhhhhhh   hhhhhhhh   hhhhhhhh   hhhhhhhh

LOAD MODULE cccccccc

hhhhhh   hhhhhhhh hhhhhhhh hhhhhhhh hhhhhhhh    hhhhhhhh hhhhhhhh hhhhhhhh hhhhhhhh   *ccccccccccccccccccccccccccccccc*
hhhhhh   hhhhhhhh hhhhhhhh hhhhhhhh hhhhhhhh    hhhhhhhh hhhhhhhh hhhhhhhh hhhhhhhh   *ccccccccccccccccccccccccccccccc*
   LINES    hhhhhh-hhhhhh    SAME AS ABOVE
hhhhhh   hhhhhhhh hhhhhhhh hhhhhhhh hhhhhhhh    hhhhhhhh hhhhhhhh hhhhhhhh hhhhhhhh   *ccccccccccccccccccccccccccccccc*
hhhhhh   hhhhhhhh hhhhhhhh hhhhhhhh hhhhhhhh    hhhhhhhh hhhhhhhh hhhhhhhh hhhhhhhh   *ccccccccccccccccccccccccccccccc*
   LINE     hhhhhh     SAME AS ABOVE

CSECT dd OF cccccccc

hhhhhh   hhhhhhhh hhhhhhhh hhhhhhhh hhhhhhhh    hhhhhhhh hhhhhhhh hhhhhhhh hhhhhhhh   *ccccccccccccccccccccccccccccccc*
hhhhhh   hhhhhhhh hhhhhhhh hhhhhhhh hhhhhhhh    hhhhhhhh hhhhhhhh hhhhhhhh hhhhhhhh   *ccccccccccccccccccccccccccccccc*
```

The contents of main storage are given under 6 headings: CPUx PSA, NUCLEUS, NUCLEUS CONT., LOAD MODULE cccccccc, CSECT dd OF cccccccc, and in the trace table, SP ddd BLK hh. Under these headings, the lines have the following format:

- First entry: the address of the initial bytes of the main storage presented on the line.
- Next 8 entries: 8 full words (32 bytes) of main storage in hexadecimal.
- Last entry (surrounded by asterisks): the same 8 full words of main storage in EBCDIC. Only A through Z, 0 through 9, and blanks are printed; a period is printed for anything else.

The following lines may also appear:

LINES hhhhhh-hhhhhh SAME AS ABOVE
: are the starting addresses of the first and last lines for a group of lines that are identical to the line immediately preceding.

LINE hhhhhh SAME AS ABOVE
: is the starting address of a line that is identical to the line immediately preceding.

CPUx PSA (Model 65 Multiprocessing dumps only)
: identifies the next lines as the contents of the prefixed storage area (PSA) -- 0 through 4095 (FFF). If the system is operating in partitioned mode (1 CPU), x is the CPU identification. If the system is operating in a 2 CPU multisystem mode, both PSAs are printed, the first under the heading CPUA PSA and the second under CPUB PSA.

NUCLEUS
: identifies the next lines as the contents of the nucleus of the control program.

NUCLEUS CONT.
: identifies the next lines as the contents of the part of the nucleus that lies above the trace table.

REGS AT ENTRY TO ABEND or REGS AT ENTRY TO SNAP
: identifies the next 3 lines as the contents of the floating point and general registers when the abnormal termination routine received control in response to an ABEND macro instruction or when the SNAP routine received control in response to a SNAP

macro instruction. These are not the registers for the problem program when the error occurred.

FLTR 0-6
indicates the contents of floating point registers 0, 2, 4, and 6.

REGS 0-7
indicates the contents of general registers 0 through 7.

REGS 8-15
indicates the contents of general registers 8 through 15.

LOAD MODULE cccccccc
identifies the next lines as the contents of the main storage area occupied by the load module cccccccc. All the modules for the job step are dumped under this type of heading. Partial dumps do not contain this information.

CSECT hhhh OF cccccccc
identifies the next lines as the contents of the main storage area occupied by the control section (CSECT) indicated by hhhh. This control section belongs to the scatter-loaded load module cccccccc.

```
TRACE TABLE

DSP  NEW PSW     hhhhhhhh hhhhhhhh   R15/R0 hhhhhhhh hhhhhhhh   R1  hhhhhhhh   SW  hhhhhhhh   TCB hhhhhhhh   TME hhhhhhhh
I/O  OLD PSW     hhhhhhhh hhhhhhhh   R15/R0 hhhhhhhh hhhhhhhh   R1  hhhhhhhh   RES hhhhhhhh   TCB hhhhhhhh   TME hhhhhhhh
SIO  CC/DEV/CAW hhhhhhhh hhhhhhhh   CSW    hhhhhhhh hhhhhhhh   RES hhhhhhhh   RES hhhhhhhh   TCB hhhhhhhh   TME hhhhhhhh
SVC  OLD PSW     hhhhhhhh hhhhhhhh   R15/R0 hhhhhhhh hhhhhhhh   R1  hhhhhhhh   RES hhhhhhhh   TCB hhhhhhhh   TME hhhhhhhh
PGM  OLD PSW     hhhhhhhh hhhhhhhh   R15/R0 hhhhhhhh hhhhhhhh   R1  hhhhhhhh   RES hhhhhhhh   TCB hhhhhhhh   TME hhhhhhhh
EXT  OLD PSW     hhhhhhhh hhhhhhhh   R15/R0 hhhhhhhh hhhhhhhh   R1  hhhhhhhh   RES hhhhhhhh   TCB hhhhhhhh   TME hhhhhhhh
```

TRACE TABLE (SNAP dumps only)
identifies the next lines as the contents of the trace table. Each trace table entry is presented on one line; the name at the beginning of each line identifies the type of entry on the line:

- DSP Dispatcher entry
- I/O Input/output interruption entry
- SIO Start input-output (SIO) entry
- SVC Supervisor call (SVC) interruption entry
- PGM Program interruption entry
- EXT External interruption entry

OLD PSW hhhhhhhh hhhhhhhh
is the PSW stored when the interruption represented by the entry occurred.

NEW PSW hhhhhhhh hhhhhhhh
is the new PSW stored in the entry.

CC/DEV/CAW hhhhhhhh hhhhhhhh
contains, in the first 2 digits: completion code.

contains, in the next 6 digits: device type.

contains, in the last 8 digits: address of the channel address word (CAW) stored in the entry.

R15/R0 hhhhhhhh hhhhhhhh
contains, in the first 8 digits: contents of register 15 stored in the entry.

contains, in the last 8 digits: contents of register 0 stored in the entry.

CSW hhhhhhhh hhhhhhhh
is the channel status word (CSW) stored in the entry.

R1 hhhhhhhh
is the contents of register 1 stored in the entry.

RES hhhhhhhh
is reserved for future use; all digits are zeros.

SW hhhhhhhh
is reserved for future use; all digits are zeros.

TCB hhhhhhhh
is the starting address of the TCB associated with the entry.

TME hhhhhhhh
is a representation of the timer element associated with the entry.

```
TRT

X DSP  NEW PSW    hhhhhhhh hhhhhhhh   R15/R0 hhhhhhhh hhhhhhhh   R1  hhhhhhhh   NUA hhhhhhhh   NUB hhhhhhhh   TME hhhhhh
X I/O  OLD PSW    hhhhhhhh hhhhhhhh   CSW    hhhhhhhh hhhhhhhh   R1  hhhhhhhh   OLA hhhhhhhh   OLB hhhhhhhh   TME hhhhhh
X SIO  CC/DEV/CAW hhhhhhhh hhhhhhhh   CSW    hhhhhhhh hhhhhhhh   TCB hhhhhhhh   OLA hhhhhhhh   OLB hhhhhhhh   TME hhhhhh
X SVC  OLD PSW    hhhhhhhh hhhhhhhh   R15/R0 hhhhhhhh hhhhhhhh   R1  hhhhhhhh   OLA hhhhhhhh   OLB hhhhhhhh   TME hhhhhh
X PGM  OLD PSW    hhhhhhhh hhhhhhhh   R15/R0 hhhhhhhh hhhhhhhh   R1  hhhhhhhh   OLA hhhhhhhh   OLB hhhhhhhh   TME hhhhhh
X EXT  OLD PSW    hhhhhhhh hhhhhhhh   R15/R0 hhhhhhhh hhhhhhhh   R1  hhhhhhhh   MSK hhhhhhhh   TQE hhhhhhhh   TME hhhhhh
X SSM  OLD PSW    hhhhhhhh hhhhhhhh   R15/R0 hhhhhhhh hhhhhhhh   R1  hhhhhhhh   AFF yyhhhhhh   OLB hhhhhhhh   TME hhhhhh
```

TRT (MVT with Model 65 multiprocessing dumps only)
identifies the next lines as the contents of the trace table. Each trace table entry is presented on one line; the letter and name at the beginning of each line identify the CPU and the type of entry, respectively:

- DSP Dispatcher entry.
- I/O Input/output interruption entry.
- SIO Start input/output entry.
- SVC Supervisor call interruption entry.
- PGM Program interruption entry.
- EXT External interruption entry.
- SSM Set system mask entry.

OLD PSW hhhhhhhh hhhhhhhh
is the PSW stored when the interruption represented by the entry occurred.

NEW PSW hhhhhhhh hhhhhhhh
is the new PSW stored in the entry.

CC/DEV/CAW hhhhhhhh hhhhhhhh
contains, in the first 2 digits: completion code; in the next 6 digits: device type; in the last 8 digits: address of the channel address word stored in the entry.

R15/R0 hhhhhhhh hhhhhhhh
contains, in the first 8 digits: contents of register 15; in the last 8 digits: contents of register 0, both as stored in the entry.

CSW hhhhhhhh hhhhhhhh
is the channel status word stored in the entry.

R1 hhhhhhhh
is the contents of register 1 as stored in the entry.

TCB hhhhhhhh
is the starting address of the TCB associated with the entry.

NUA hhhhhhhh
is the starting address of the new TCB for CPU A, as stored in the entry.

OLA hhhhhhhh
is the starting address of the old TCB for CPU A, as stored in the entry.

MSK hhhhhhhh
is the STMASK of the other CPU as stored in the entry.

NUB hhhhhhhh
is the starting address of the new TCB for CPU B, as stored in the entry.

OLB hhhhhhhh
is the starting address of the old TCB for CPU B, as stored in the entry.

TQE hhhhhhhh
is the first word of the timer queue element stored in the entry, provided a timer interrupt occurred.

TME hhhhhhhh
is a representation of the timer element associated with the entry.

AFF yyhhhhhh
contains, in the first 2 digits: the ID of the locking CPU at the time of the interrupt; in the last 6 digits: starting address of the old TCB for CPU A, as stored in the entry.

```
SP ddd

hhhhhh   hhhhhhhh hhhhhhhh hhhhhhhh hhhhhhhh    hhhhhhhh hhhhhhhh hhhhhhhh hhhhhhhh   *ccccccccccccccccccccccccccccccc*
hhhhhh   hhhhhhhh hhhhhhhh hhhhhhhh hhhhhhhh    hhhhhhhh hhhhhhhh hhhhhhhh hhhhhhhh   *ccccccccccccccccccccccccccccccc*

END OF DUMP
```

SP ddd
: identifies the next lines as the contents of a block of main storage obtained through a GETMAIN macro instruction, and indicates the subpool number (ddd). The part of subpool 252 that is the supervisor work area is presented first, followed by the entire contents of any problem program subpools (0 through 127) in existence during the dumping.

END OF DUMP
: indicates that the dump or snapshot is completed. If this line does not appear, the ABDUMP routine was abnormally terminated before the dump was completed, possibly because enough space was not allocated for the dump data set.

Guide to Using an ABEND/SNAP Dump (MVT)

Cause of Abnormal Termination: Evaluate the user (USER=decimal code) or system (SYSTEM=hex code) completion code using Appendix B or the publication Messages and Codes.

Dumped Task: Check the ID field for an indication of which task is being dumped in relation to the task that was abnormally terminated:

- 001 indicates a partial dump of a subtask
- 002 indicates a partial dump of the invoking task

If the ID field is absent, the dump contains a full dump of the task that was abnormally terminated.

Active RB Queue: The first RB shown on the dump represents the oldest RB on the queue. The RB representing the load module that had control when the dump was taken is third from the bottom. The last RB represents the ABDUMP routine and the second from last, the ABEND routine. The load module name and entry point (for a PRB) are given in a contents directory entry, the address of which is shown in the last 3 bytes of the FL/CDE field.

Program Check PSW: The program check old PSW is the fifth entry in the first line of each RB printout. It is identified by the subheading APSW. For debugging purposes, the APSW of the third RB from the bottom of the dump is most useful. It provides the length of the last instruction executed in the program (bits 32,33), and the address of the next instruction to be executed (bytes 5-8).

Load List: Does the resume PSW indicate an instruction address outside the limits of the load module that had control at the time of abnormal termination? If so, look at the LLEs on the load list. Each LLE contains the CDE address in the dump field labeled RSP-CDE.

CDEs: The entries in the contents directory for the region are listed under the dump heading CDE. The printouts for each CDE include the load module and its entry point. If you have a complete dump, each load module represented in a CDE is printed in its entirety following the NUCLEUS section of the dump.

Trace Table (SNAP dumps only): Entries on an MVT SNAP dump, if valid, represent occurrences of SIO, external, SVC, program, I/O, and dispatcher interruptions. SIO entries can be used to locate the CCW (through the CAW), which reflects the operation initiated by an SIO instruction. If the SIO operation was not successful, the CSW STATUS portion of the entry will show you why it failed. EXT and PGM entries are useful for locating the instruction where the interruption occurred (bytes 5-8 of the PSW).

SVC trace table entries provide the SVC old PSW and the contents of registers 0, 1, and 15. The PSW offers you the hexadecimal SVC number (bits 20-31), the CPU mode (bit 15), and the address of the SVC instruction (bytes 5-8). The contents of registers 0 and 1 are especially useful in that many system macro instructions pass key information in these registers. (See Appendix A.)

I/O entries reflect the I/O old PSW and the CSW that was stored when the interruption occurred. From the PSW, you can learn the

address of the device that caused the interruption (bytes 2 and 3), the CPU state at the time of interruption (bit 15), and the instruction address where the interruption occurred (bytes 5-8). The CSW provides you with the unit status (byte 4), the channel status (byte 5), and the address of the previous CCW plus 8 (bytes 0-3).

You can use the DSP entry to delimit the entries in the trace table. To find all entries for the terminated task, scan word 7 of each trace table entry for the TCB address in a DSP entry. The lines between this and the next DSP entry represent interruptions that occurred in the task.

Region Contents: Free areas for the region occupied by the dumped task are identified under headings PQE and FBQE. The field labeled SZ gives the number of bytes in the free area represented by the FBQE.

Subpool Contents: Free and requested areas of the subpools used by the dumped task are described under the dump heading MSS. Subpool numbers are given under the SPID column in the list of SPQEs. If a GETMAIN macro instruction was issued without a subpool specification, space is assigned from subpool 0. Thus, two SPQEs may exist for subpool 0. The sizes of the requested areas and free areas are given under the LN column in the lists of DQEs and FQEs, respectively.

Load Module Contents: The contents of each load module used by the job step are given under the heading XL. Each entry includes the sizes (LN) and starting addresses (ADR) of the control sections in the load module.

Indicative Dump

An indicative dump is issued when a task is abnormally terminated by an ABEND macro instruction, and a dump is requested, but a dump data set is not defined, due either to omission or incorrect specification of a SYSABEND or SYSUDUMP DD statement. In systems with PCP or MFT, an indicative dump is issued automatically on the system output (SYSOUT) device. Indicative dumps issued by these two systems are identical in format. Systems with MVT do not issue indicative dumps.

Contents of an Indicative Dump

This explanation of indicative dumps utilizes capital letters for the headings found in all dumps, and lowercase letters for information that varies with each dump. The lowercase letter used indicates the mode of the information, and the number of letters indicates its length:

- h represents 1/2 byte of hexadecimal information
- d represents 1 byte of decimal information
- c represents a 1-byte character

Figure 25 shows the contents of an indicative dump. You may prefer to follow the explanation on your own indicative dump.

CONTROL BYTE=hh
describes the contents of the indicative dump.

First digit:

Bit	Setting	Meaning
0	0	Instruction image not present
	1	Instruction image present
1	0	Floating-point registers not present
	1	Floating-point registers present
2	0	One general register set present
	1	Two general register sets present
3	0	All active RBs present
	1	All active RBs not present

Last digit:

Digit in Hexadecimal	Meaning
0	All loaded RBs present
8	All loaded RBs not present

TCB FLAGS=hh
is the first byte of TCBFLGS field (byte 29 in the TCB for the program being dumped): task end flag byte:

Bit	Setting	Meaning
0	1	Abnormal termination in process
1	1	Normal termination in process
2	1	Abnormal termination was initiated by the resident ABTERM routine

```
CONTROL BYTE=hh  TCB FLAGS=hh  NO. ACTIVE RB=dd  NC. LOAD RB=dd
COMPLETION CODE - SYSTEM=hhh USER=dddd
cccccc...
REGISTER SET 1
hhhhhhhh  hhhhhhhh  hhhhhhhh  hhhhhhhh  hhhhhhhh  hhhhhhhh  hhhhhhhh  hhhhhhhh
hhhhhhhh  hhhhhhhh  hhhhhhhh  hhhhhhhh  hhhhhhhh  hhhhhhhh  hhhhhhhh  hhhhhhhh
REGISTER SET 2
hhhhhhhh  hhhhhhhh  hhhhhhhh  hhhhhhhh  hhhhhhhh  hhhhhhhh  hhhhhhhh  hhhhhhhh
hhhhhhhh  hhhhhhhh  hhhhhhhh  hhhhhhhh  hhhhhhhh  hhhhhhhh  hhhhhhhh  hhhhhhhh
INSTRUCTION IMAGE=hhhhhhhhhhhhhhhhhhhhhhhh
hhhhhhhhhhhhhhhh    hhhhhhhhhhhhhhhh    hhhhhhhhhhhhhhhh    hhhhhhhhhhhhhhhh
PROGRAM ID=cccccccc  RB TYPE=hh  ENTRY POINT=hhhhhh
RESUME PSW  SM=hh  K=h  AMWP=h  IC=hhhh  IL.CC=h  PM=h  IA=hhhhhh
PROGRAM ID=cccccccc  RB TYPE=hh  ENTRY POINT=hhhhhh
```

Figure 25. Contents of an Indicative Dump

3	1	ABTERM routine entered because of program interruption
4	1	Reserved for future use
5	1	Data set closing initiated by the ABTERM routine
6	1	The ABTERM routine overlaid some or all of the problem program
7	1	The system prohibited queuing of asynchronous exit routines for this task

NO. ACTIVE RB=dd
is the number of active RBs presented in the dump.

NO. LOAD RB=dd
is the number of RBs in the load list presented in the dump.

COMPLETION CODE SYSTEM=hhh USER=dddd
is the completion code supplied by the control program (SYSTEM=hhh) or the problem program (USER=dddd). Both SYSTEM=hhh and USER=dddd are printed; however, one of them is always zero.

ccccc...
explains the completion code or, if a program interruption occurred:

PROGRAM INTERRUPTION ccccc... AT LOCATION hhhhhh
where ccccc is the program interruption cause: OPERATION, PRIVILEGED OPERATION, EXECUTE, PROTECTION, ADDRESSING, SPECIFICATION, DATE, FIXED-POINT OVERFLOW, FIXED-POINT DIVIDE, DECIMAL OVERFLOW, DECIMAL DIVIDE, EXPONENT OVERFLOW, DECIMAL DIVIDE, EXPONENT OVERFLOW, EXPONENT UNDERFLOW, SIGNIFICANCE, or FLOATING-POINT DIVIDE; and hhhhhh is the address of the instruction being executed when the interruption occurred.

REGISTER SET 1
indicates that the next 2 lines give the contents of general registers 0 through 7 and 8 through 15 for a program being executed under control of an RB when it:

- Passed control to a type I SVC routine through an SVC instruction and the routine terminated abnormally.
- Lost control to the input/output interruption handler, which subsequently terminated abnormally.
- Was abnormally terminated by the control program because of a program interruption.
- Issued an ABEND macro instruction to request an abnormal termination.

If REGISTER SET 2 also appears in the dump, the lines under REGISTER SET 1 give the general register contents for a type II, III, or IV SVC routine operating under an SVRB.

REGISTER SET 2
indicates that the next 2 lines give the contents of general registers 0 through 7 and 8 through 15 for a program being executed under control of an RB other than an SVRB when the program last passed control to a type II, III, or IV SVC routine.

INSTRUCTION IMAGE=hhhhhhhhhhhhhhhhhhhhhhhh
is 12 bytes of main storage, with the instruction that caused a program interruption in the right part of the printout. This field appears only if a program interruption occurred and is also valid when the instruction length in the resume PSW is 0.

hhhhhhhhhhhhhhhh hhhhhhhhhhhhhhhh
hhhhhhhhhhhhhhhh hhhhhhhhhhhhhhhh
are the contents of floating-point registers 0, 2, 4, and 6 when the abnormal termination occurred. This field appears only if the floating point option is present. The first 2 digits of each register are the characteristic of the floating point number. The last 14 digits are the mantissa.

PROGRAM ID=cccccccc
is the XRBNM field (bytes 0 through 7): in PRB, LRBs, and LPRBs, the program name; in IRBs, the first character contains flags for the timer or, if the timer is not being used, contains no meaningful information; in SVRBs for a type II SVC routine, contains no meaningful information; in SVRBs for a type III or IV SVC routine, the first 4 bytes contain the relative track address (TTR) of the load module in the SVC library and the last 4 bytes contain the SVC number in signed, unpacked decimal; in SIRBs, the name of the error routine currently occupying the 400-byte input/output supervisor transient area.

RB TYPE=hh
indicates the type of active RB

hh	Type of RB
00	PRB that does not contain entry points identified by IDENTIFY macro instructions
10	PRB that contains one or more entry points identified by IDENTIFY macro instructions
20	LPRB that does not contain entry points identified by IDENTIFY macro instructions
30	LPRB that contains one or more entry points identified by IDENTIFY macro instructions
40	IRB
80	SIRB
C0	SVRB for a type II SVC routine
D0	SVRB for a type III or IV SVC routine
E0	LPRB for an entry point identified by an IDENTIFY macro instruction
F0	LRB

ENTRY POINT=hhhhhh
is the XRBEP field (bytes 13 through 15): address of entry point in the program.

RESUME PSW
XRBPSW field (bytes 16 through 23): is the contents of the resume PSW.

SM=hh
is bits 0 through 7 of PSW: system mask.

K=h
is bits 8 through 11 of PSW: protection key.

AMWP=h
is bits 12 through 15 of PSW: indicators.

IC=hhhh
is bits 16 through 31 of PSW: interruption code.

IL.CC=h
is bits 32 through 35 of PSW: instruction length code (bits 32 and 33) and condition code (bits 34 and 35).

PM=h
is bits 36 through 39 of PSW: program mask.

IA=hhhhhh
is bits 40 through 63 of PSW: instruction address.

PROGRAM ID=cccccccc
is the XRBNM field (bytes 0 through 7): program name.

RB TYPE=hh
indicates the type of RB:

hh	Type of RB
20	LPRB that does not contain entry points identified by IDENTIFY macro instructions.
30	LPRB that contains one or more entry points identified by IDENTIFY macro instructions.
E0	LPRB for an entry point identified by an IDENTIFY macro instruction.
F0	LRB.

ENTRY POINT=hhhhhh
is the XRBEP field (bytes 13 through 15): address of entry point in the program.

Guide to Using an Indicative Dump

Completion Code: Evaluate the user (USER=decimal code) or system (SYSTEM=hex code) completion code using either Appendix B of this publication or the publication Messages and Codes. The line under the completion code gives a capsule explanation of the code or the type of program interruption that occurred.

Instruction Address: If a program interruption occurred, get the address of the erroneous instruction in the last 3 bytes of the field labeled INSTRUCTION IMAGE.

Active RB Queue: RBs are shown in the first group of two-line printouts labeled PROGRAM ID and RESUME PSW, with the most recent RB shown first. There are two lines for as many RBs indicated by NC. ACTIVE RB=dd.

Register Contents: General register contents at the time a program last had control are given under the heading REGISTER SET 2 or, if this heading is not present, under REGISTER SET 1. Register contents, particularly those of register 14, may aid you in locating the last instruction executed in your program.

Core Image Dump

A core image dump displays all of main storage from location 00 through the end of printable storage. These dumps are identical for all control program options, except for the first line of the dump, which identifies the control program option; i.e., PCP, MFT, MVT, or M65MP.

The Damage Assessment routine (DAR) will produce a core image dump when a system task fails if the SYS1.DUMP data set is properly defined and available to accept the dump. Once the core image dump has been written to the SYS1.DUMP data set, the print dump program (IEAPRINT) can print it.

Note: IEAPRINT is placed in SYS1.LINKLIB at SYSGEN time; it may be invoked with the JCL statements shown in Figure 23.

DAMAGE ASSESSMENT ROUTINE (DAR)

The Damage Assessment routine (DAR) is designed to provide increased system availability in the event of a system failure, and to provide more meaningful diagnostic information by means of a core image dump taken at the time of the system failure. This core image dump is written to the SYS1.DUMP data set, which you may print by means of the IEAPRINT print dump program.

If a system routine fails, DAR attempts to reinitialize the failing task, thereby permitting the system to continue operation without interruption. DAR permits the system to continue processing in a degraded condition if it encounters a system failure that does not permit total reinstatement of the affected task or region. The operator will be informed, via a WTO, that the system is in an unpredictable state; he then must decide whether or not already-scheduled jobs should be allowed to attempt completion.

SYSTEM FAILURE

If a system failure occurs, the Damage Assessment routine immediately attempts to write a core image dump to the SYS1.DUMP data set. A system failure may be caused by a failure in any of the following system tasks:

PCP and MFT:

Communications Task
Master Scheduler Task
Log Task (MFT only)

MVT:

System Error Task
Rollout/Rollin Task
Communications Task
Master Scheduler Task
Transient Area Fetch Task

A system failure is also caused by an ABEND recursion in other than OPEN, CLOSE, ABDUMP, or STAE; by a failure of a task in 'must complete' status; or, in MFT only, by a failure in the scheduler if no SYSABEND or SYSUDUMP DD card is provided.

THE SYS1.DUMP DATA SET

One of the primary functions of the Damage Assessment routine is to provide a core image dump at the time of a system failure. Secondary storage space must be available to receive this dump. The SYS1.DUMP data set provides this space.

The SYS1.DUMP data set may reside on tape or on a direct access device.

Tape

If you wish to have the SYS1.DUMP data set reside on tape, you may specify the tape drive during IPL. If the drive has not been made ready prior to IPL, a MOUNT message is issued to the console, specifying the selected device. The device should be mounted with an unlabeled tape.

Keep in mind that the Damage Assessment routine rewinds and unloads a tape after writing a core image dump. If the operator has not readied the specified device before a second core image dump is to be written, DAR will bypass the writing of the dump but will continue processing.

Direct Access

If you wish to have the SYS1.DUMP data set placed on a direct access device, you may preallocate the data set at SYSGEN or prior to any IPL of the system. The following restrictions apply:

- The data set name must be SYS1.DUMP.
- The data set must be cataloged on the IPL volume.
- The data set may be preallocated on any volume that will be online during system operation.
- The data set must be sequential.
- Sufficient space must be allocated to receive a core image dump for all of main storage.

When a direct access device is used for the SYS1.DUMP data set, the data set can hold only one core image dump. If additional failures occur, and if the SYS1.DUMP data set is occupied, DAR does not attempt to write another core image dump.

You may execute the print dump program (IEAPRINT) to produce hard copy of the dump. Once the print dump program is executed, the SYS1.DUMP data set can accept another core image dump.

THE PRINT DUMP PROGRAM (IEAPRINT)

You must use the print dump program to print out the core image dump contained on the SYS1.DUMP data set. The print dump program is placed in SYS1.LINKLIB at SYSGEN time; it may be invoked in the same manner as any other problem program.

You must supply the job control statements for the print dump program; the following statements are required:

JOB	This is a standard statement.
EXEC	This statement specifies the program name (PGM=IEAPRINT) or, if the job control statements reside on the procedure library, the procedure name.
SYSPRINT DD	This statement defines an output data set. The data set may be written onto a system output device, a magnetic tape volume, or a direct access device.
SYSUT1 DD	This statement defines the input data set. The DSNAME SYS1.DUMP must be used.

(See Figure 26 for the JCL statements required to execute the IEAPRINT print dump program.)

```
//URJOB  JOB   ,URNAME,MSGLEVEL=(1,1)
//       EXEC  PGM=IEAPRINT
//SYSPRINT DD  SYSOUT=A,SPACE=(CYL,(20,5))
//SYSUT1   DD  DSNAME=SYS1.DUMP,UNIT=2400,LABEL=(,NL),DISP=(OLD,KEEP), X
//            VOLUME=SER=1234
```

• Figure 26. Sample JCL Statements Required for IEAPRINT

Input to the Print Dump Program

Input to the IEAPRINT program is the sequential data set SYS1.DUMP, which may reside on either a direct access device or on magnetic tape. The first byte of the first record on the SYS1.DUMP data set will be the contents of storage location 00, and the data set will contain the full core image up to the last writable byte. The input devices supported are:

IBM 2301 Drum Storage Unit

IBM 2302 Disk Storage Drive

IBM 2303 Drum Storage Unit

IBM 2311 Disk Storage Drive

IBM 2314 Storage Facility

IBM 2400 Magnetic Tape Drive

Output From the Print Dump Program

The output from the print dump program is a formatted core image dump of the printable contents of main storage, beginning at location 00. The dump may be written onto a system output device, a magnetic tape volume, or a direct access device. You must define the device, upon which the dump is to be written, on the SYSPRINT DD card of the JCL statements that invoke the print dump program. (See Figure 26.)

CONTENTS OF A CORE IMAGE DUMP

The core image dump is formatted into two distinct sections: low storage and register contents are displayed on the first page, and a printout of the contents of main storage begins on the second page. The main storage contents are unedited and are displayed beginning from location 00 through the end of printable storage. (See Figure 27.)

Low Storage and Registers

The initial section of a core image dump (the first page) consists of information of immediate use to the programmer who must determine the cause of the failure.

The first printed line displays the control program option of the operating system, i.e. PCP, MFT, MVT, or M65MP; the timer contents at the time of the failure; and the date of the failure.

The remainder of the first page consists of a printout of register contents and hardware control words as they appeared at the time of the failure. The contents of floating point registers 0, 2, 4, and 6 are displayed; if the floating point feature is not present in the system, these register printouts contain zeros. The two lines beginning with REG 0-7 and REG 8-15 show the contents of general registers 0 through 7 and 8 through 15, respectively.

Storage below location 128(80 hex) is permanently assigned and can be used to determine the status of a program. The line beginning 40-CSW (following the register printout) gives, in unedited form, the CSW and CAW. The next five lines contain the new and old PSWs for the five types of interruptions.

The last line in this portion of the dump, beginning 4C-UNUSED-, gives the contents of locations 76(4C hex) through 87 (57 hex), which include unused bytes and the timer. This line contains pointers useful in locating key debugging information, such as the CVT and the trace table. The use of these locations will be explained under the sections headed "Guide to Using...".

Main Storage

The main section of the dump is printed starting with location zero and continuing to the end of printable storage. Each line contains, from left to right:

- The hexadecimal storage address of the first byte on the line.
- Eight words of storage in hexadecimal.
- The same eight words in EBCDIC, enclosed in asterisks (*).

If one or more consecutive lines contain the same word throughout the line, the first line will be printed, followed by the message,

hhhhhh TO THE NEXT LINE ADDRESS - SAME AS ABOVE

where:

hhhhhh
is the address of the first omitted line.

```
 CORE IMAGE DUMP OF  MVT  SYSTEM                                  TIMER= 084082                          DATE =  00099366

FLOATING POINT REGISTERS      0                       2                       4                       6
                              C9D5C9E3C9C1E3D6        D9407DC1D3D37D40        E6C1C9E3C9D5C740        0000000000000000

REG 0-7           00020CD0  8CC00C08  00021B98  000000F0        00000010  400586EC  00020CD0  00021748
REG 8-15          00021B8C  00FFFFF8  00000068  400586EE        6007EAB2  000587AD  00008904  00000008

40-CSW  000CD5C00C000000                                        48-CAW  00004408

EXTERNAL INTERRUPT PSWS       NEW=0004000000007628      OLD=0104008080038BF6
SUPERVISOR CALL PSWS          NEW=0004000C000C8080      OLD=FF0400015000D8C4
PROGRAM CHECK PSWS            NEW=0004000000000785C     OLD=000C0CCCCCC00000
MACHINE CHECK PSWS            NEW=0000000000000184C0    OLD=0000FF0000000000
INPUT/OUTPUT PSWS             NEW=0CC4C0CC000077E0      OLD=FF06C2918C0C0000

4C-UNUSED-0000DE48        50-TIMER-08408262        54-UNUSED-0000EE70

000000   0CCC0CCC 0CC00000 00000000 0C000000   0000DE48 C0000000 C1040C8C 80038BF6   *.............................6*
000020   FF040001 5000D8C4 00000000 00000000   0000FF00 00000000 FF060291 80000000   *....&.QD.....................*
000040   0CCCD5CC CCCCCCCC 000044C8 0CC0DE48   0840B262 0000EE70 00040000 00007628   *..N.............. ..........*
000060   0C040CCC 0000B0BC 0CC40C00 0000785C   C0000000 000184CC CCC40000 000077E0   *.............*.............*
000080   A7ABCCFF F2F39FFF 0F003FFF F23F9FFF   00000000 C000000C FFFFFFFF 000880CC   *....23.....2.................*
0000A0   00004000 4C0C00C0 300080C8 005F8F81   001AC200 FFC40000 02010000 00000000   *.. ..............B..D.........*
0000CC   00000429 0CC008CC C0000429 03831600   D2078300 C3DAE8C1 0070CF8A D2070030   *.................K.....Y.....K...*
0000E0   FF6FFFFF CC000000 D02CF9FF 0003830A   00000000 00000000 00000000 00021000   *..........9..................*
000100   0CCC0CC0 001001CA C0CC0CCC CC80E800   0C0C0000 46C0828S CCCCC000 5010CF03   *.............Y.............&...*
000120   0CCC0CCC 0C000000 00000000 02010000   00000000 00000C00 00C00000 00000000   *..............................*
000140   CCCCCCCC C0000CCC CCCCCCCC 0C000000   00000000 C0000000 00000000 00000000   *..............................*
000160   00000C00 0CC000CC 00C00000 82000170   00CCC000 00038280 CCC00000 00000000   *..............................*
000180   0CCC0CCC 0C0000C0 C0000000 00000000   00000000 00000000 00000000 00000000   *..............................*
0001A0 TO THE NEXT LINE ADDRESS  -  SAME AS ABOVE
000200   FF060291 80000CCC 0CC00001 0001D344   CCCCDE48 0000DE48 00C1D380 4000D5CA   *.............L...........L. .N.*
000220   000220C0 8C00D68C 90CC0832 0C021508   0001D310 F30024F8 00020CD0 000006CA   *......0...Q....Q..L.3..8.....*
000240   8C00D644 000C24F4 CCCCC000 0C000000   C0C0C000 00000000 00000000 00000000   *..O....4.....................*
000260   00C0000C C0000000 00000C0C 0C000000   00C00000 0C0CCCCC C0000CCC 00000000   *..............................*
000280   0CCC0CCC C0000000 CC000000 00000000   0000A820 0C000000 0000DE38 00019CC8   *.............................H*
0002A0   00CC010C 8200C300 34CC350C 3EC00001   0C07F8CC CCCCCCCC C2000C00 00000000   *.................8.....B.....*
0002C0   000C8340 00008340 00000000 0000C01F   112C1BE4 24F802DA 02DA02DA 02DA7FFF   *... ... ............U.8.....".*
0002E0   0000000C C00184C0 CCC20C00 0C000A21   CCC4C0CC 00007628 00040000 00000472   *.............................*
000300   00000000 00000000 00000000 00000000   0000C000 00000000 00000000 00000000   *.............................*
000320 TO THE NEXT LINE ADDRESS  -  SAME AS ABOVE
000340   FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF   FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF   *.............................*
000360 TO THE NEXT LINE ADDRESS  -  SAME AS ABOVE
0003CC   CCCC0CCC CCC00CCC C0C00C00 0C0C0000   00000000 00000000 0000C0CC 00000C0   *.............................*
000420 TO THE NEXT LINE ADDRESS  -  SAME AS ABOVE
000460   CCCC0C00 0CC0C0CC 00000000 00000000   0C0090EF C4DC5EEC C2B09120 001B4710   *.............................*
000480   05109110 E2BC471C 050C9121 E2BC4770   06209120 04714710 04BA41F0 02F09107   *....S.......S.............0..0..*
0004A0   04714770 04FE58EC E2BC54E0 C508477C   04BE91CF C01B477C C4BE41F0 0018D207   *.........S.................0..K.*
0004C0   04D8F00C 98EF04D0 82000408 00000000   0C000000 00000000 0C000006 00000000   *.QO........Q.................*
0004EC   000C0000 0CC000CC CCCC0000 0C000000   0C020CC0 4000D5CA 00020CD0 7000D622   *.....................N........O.*
000500   00020F10 0000D5F2 DEFFFFFF 94FFE2BC   968002CC 918CE2CC 477CC53A 91200018   *.......N2......S.......S.....*
000520   478C056C 58F0029C 9300F001 47800542   C500F000 02B84770 C54241F0 02E847FC   *...-.0....0.....N.0.........0.Y.0*
000540   04BED20C F000E2B8 D207EC00 02E058E0   06140700 07000700 46EC0558 848005F0   *..K.0.S.K.....................0*
000560   94F702CC 58F00618 58E0061C 07000700   46E0057C 910802CC 47700594 58EC02B0   *.7...0.....................*
000580   9121E28C 477CC62C 46FC0568 41F005F0   47F004BE 58FD0608 9102F001 478005A8   *..S.....0...0.0.0...0....0.....*
0005A0   91FFF00C 478004BE D20704D8 0018D207   CC58C5EC 82000058 82C005E8 947F02CC   *..0.....K..Q..K.............Y."..*
0005C0   D60004D8 0018D207 0018040B 94DF001B   D207005E C2F841F0 02F847F0 04BE0000   *O.....K....Q....K....8.0.8.0....*
0005EC   C1C4CCCC CCCC05B8 CCC40CC0 0C0005BC   0C02CCC0 00000A22 0104C0C0 000006A0   *.....................*
000600   00040C0C 300006A4 00019948 00000300   0C8C0000 0003512F CCC01F40 000006CB   *.....................  ....*
000620   9CEFC4E0 58E002B0 9120E2BC 4710C888   91010471 4780063E D207C4C0 C04091C1   *.........S.............K.... ..*
000640   E2BC4710 D7409101 04714780 06540207   00400400 98EF04E0 918002CC 47800492   *S.... ........K.. ..............*
000660   47F00588 91C302AF 077E91A1 02BC078E   9CEF04E8 58FC061C 5CFCC60C 841005FC   *.C........=.........Y.0..&0.....0*
000680   9121028C 478CC6C4 58F0060C 58E002B0   91FFE032 47100686 96200471 820005F8   *.......D.0.....................8*
0006AC   82C00600 54DFC471 D6CCC470 001B4780   06B65602 C4714EF0 0678D207 04C004E8   *.........C.............0..K....Y*
0006C0   47FC058C 98EF04E8 07FE9048 04F050E0   05045860 02B04170 06F25840 62C44580   *.0.....Y.....0&....-.....2. .D..*
0006EC   C7189680 02BC45EC C66491C2 64714780   06E84180 07305840 02C44570 07185840   *.....................  .D..... *
000700   62C04570 07185840 02C04570 07189848   04FC58E0 050407FF 12440788 48504020   *.......  .........0.........& .*
000720   1255077E 58504C00 91FF501C 077807F7   D70302C0 02C0D703 62C062C0 47F007CE   *.....& ...&....7P.....P......0..*
0006740  900F0810 910302AF 478C075C 58E002B0   94EE2BC 980F0810 47F00646 58700864   *.............*......S.....0......*
000760   488C7000 417070C2 5480087C 47800760   558C0870 4780074C 5810086C 1A184320   *.............-...........%....*
0006780  1CCCE82C CCC4542C C8744420 087C4780   07604320 10005420 08785920 02B44770   *.............@...-.............*
0007A0   07AA58C0 C86845F0 D0064320 02B8542C   08748920 00045720 08704420 088447F0   *.......0.....................0*
```

Figure 27. Sample of a Core Image Dump

Stand-Alone Dump

Stand-alone hexadecimal dumps display all of main storage with the exception of certain low storage locations. These dumps are the only means by which you can see the untouched contents of main storage at a given time. They are identical in format for all levels of the operating system.

In this discussion, dumps are referred to as PCP, MFT, and MVT dumps, depending on which level operating system occupied the CPU at the time the dump was taken.

Invoking a Stand-Alone Dump

A stand-alone dump is most useful when a program check or unexpected wait has occurred and abnormal termination and ABEND/SNAP routines overlaid a critical area of main storage. To recover this critical area, re-execute the job step and take a stand-alone dump at the point where abnormal termination or the wait occurred.

To reach this point, either (1) turn on the wait bit in the program check PSW or (2) set an address stop at the entry point to the ABTERM routine. To find the entry point of ABTERM, stop the system after IPL but before setting the date, and display the address of the CVT given at location 16(10). Then, display the contents of the word beginning at CVT+52(34). This word contains the address of the entry point to ABTERM. Next, run the job with an address stop set at this address. When the system enters the wait or manual state, IPL and execute the dump program you have produced from the IMDSADMP macro instruction, or execute card program number UT-056 to produce a stand-alone dump. The stand-alone dump described here is the one produced by the card program UT-056. For a discussion of the dump produced by the service aids IMDSADMP and IMDPRDMP, and for discussions of the other IBM provided service aids, see the manual, IBM System/360 Operating System: Service Aids, GC28-6719.

Contents of a Stand-Alone Dump

A stand-alone dump comprises three different types of storage printouts, each with its own format:

- The initial areas
- Lower main storage and registers
- Remaining main storage

To return the largest practical number of main storage locations, editing of the initial area of the dump is limited. However, locations 0 to 23(17) and 128(80) to 319(13F) are destroyed. If you wisn to see the contents of these areas, you must display them before taking the dump. Figure 28 illustrates the three printout formats in a stand-alone dump.

Initial areas: The initial areas (the first page) printed in a stand-alone dump consist of locations 320(140) through 1023 (3FF). The first 16 lines are locations 320(140) through 383(17F), printed at a rate of one word per line. The second 8 lines are locations 384(180) through 511 (1FF), printed 4 words per line. The last 16 lines represent locations 512(200) through 1023(3FF), 8 words per line. The printout of the initial areas is followed by a legend of the hexadecimal address limits of each area.

Low Storage and Registers: The next section of the dump (top of page 2) is a printout of register contents and hardware control words. If the floating point feature is present, the first line gives the contents of floating point registers 0, 2, 4, and 6. The two lines, beginning with REG0 and REG8, show the contents of general registers 0 through 7 and 8 through 15, respectively.

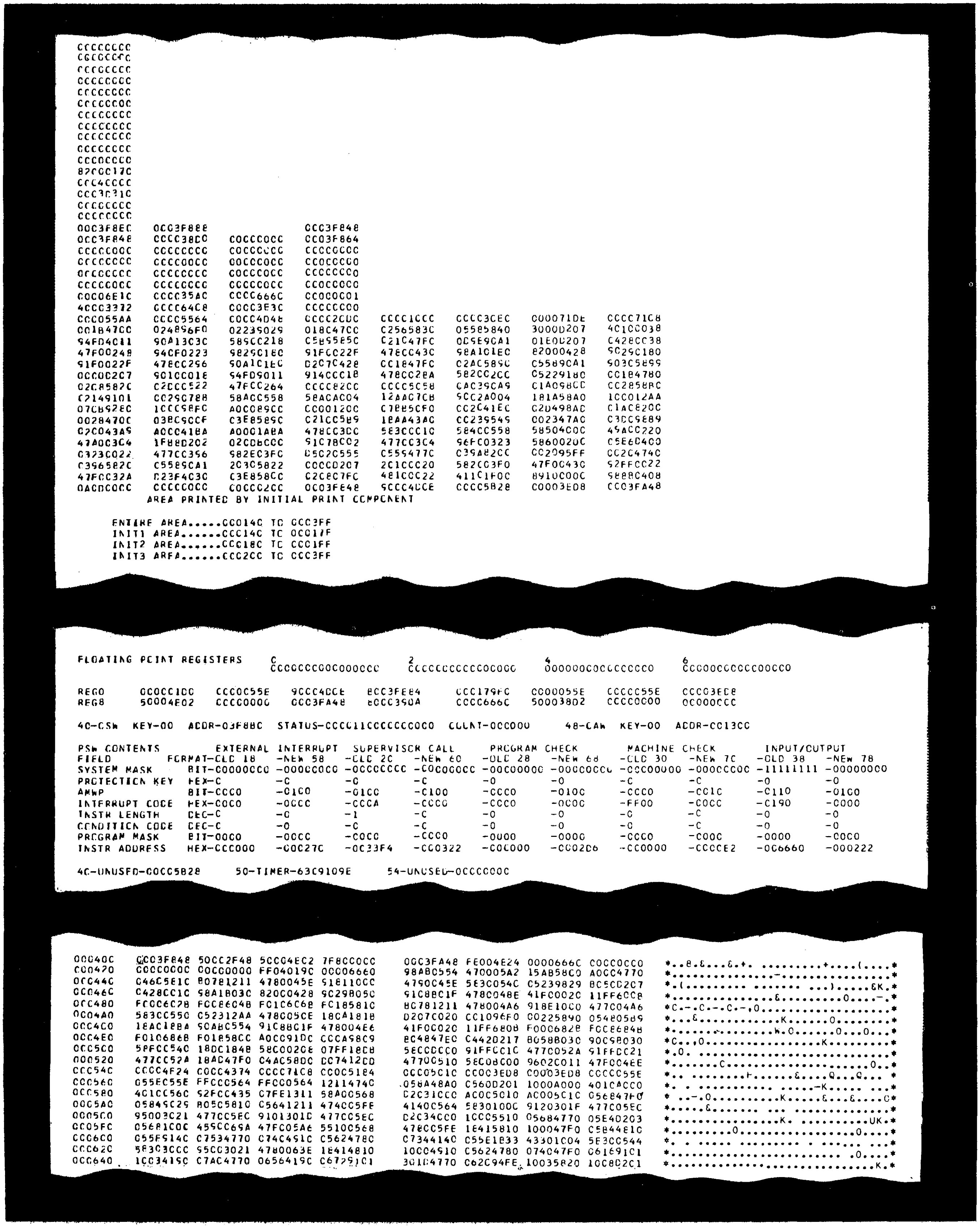
Storage below location 128(80) is permanently assigned and can be used to determine the status of a program. The line beginning 40-CSW (following the register printout) gives, in edited form, the CSW and CAW. The next ten lines are a table containing the old and new PSWs for the five types of interruptions. The identification and address of each PSW is given on tne first two lines across the top of the table. Entries in the table (i.e., edited fields in each PSW) make up the remaining 8 lines.

The last line in this portion of the dump, beginning 4C-UNUSED-, gives the contents of locations 76(4C) through 87(57), which include unused bytes and the timer. On some dumps, this line contains pointers useful in locating key debugging information, such as the CVT and the trace table.

Remaining Main Storage: The contents of remaining main storage, beginning at location 1024(400), are printed in the third and largest portion of the dump. Each line contains, from left to right:

- The hexadecimal storage address of the first byte on the line.
- Eight words of storage in hexadecimal.
- The same eight words in EBCDIC, enclosed in asterisks(*). (This field is found only in dumps issued with release 9 and after.)

If one or more lines contain the same word throughout the line, the lines are omitted from the dump and the message hhhhhh TO THE NEXT LINE ADDRESS CONTAINS hhhhhhhh is substituted, where hhhhhh is the address of the first omitted line and hhhhhhhh is the common word.



```
CCCCCCCC
CCCCCCFC
CCCCCCCC
CCCCCCCC
CCCCCCCC
CCCCCC0C
CCCCCCCC
CCCCCCCC
CCCCCCCC
CCCCCCCC
CCC0CCCC
82CCC17C
CCC4CCCC
CCC3C31C
CCCCCCCC
CCCCCCCC
00C3F8EC   0CC3F8E8               CCC3F848
0CC3F848   CCCC38C0   C0CCC0CC    CC03F864
CCCCC00C   CCCCCCCC   C0CCCCCC    CCCCCCCC
CCCCCCCC   CCCC00CC   00CCC0CC    CC0CCCC0
0CCCCCCC   CCCCCCCC   C0CCC0CC    CCCCCCC0
CCCCC0CC   CCCCCCCC   CCCCC0CC    CC0CC0C0
C0C06E1C   CCCC35AC   CCCC666C    CC000C01
40CC3372   CCCC64C8   C0CC3E3C    CCCCCCC0
CCC055AA   CCCC5564   C0CC4D48    CCCC2CUC    CCCC1CCC   CCCC3CEC   000071DE   CCCC71C8
001847CC   024896F0   02239029    018C47CC    C256583C   05585840   3000D207   4C1CC038
94FD4C11   90A13C3C   589CC218    C5B9585C    C21C47FC   0C9E9CA1   01E0D207   C428CC38
47F00248   94CF0223   9829C18C    91FCC22F    478CC43C   98A1C1EC   82000428   9C29C180
91F0022F   478CC296   90A1C1EC    D2C7C428    CC1847FC   C2AC589C   C5589CA1   903C5899
0CC0D2C7   901CC018   94FD9011    914CCC18    478CC28A   582CC2CC   C522918C   CC184780
02C8582C   C2CCC522   47FCC264    CCCC82CC    CCCC5C58   CAC39CA9   C1A098CC   CC2858BC
C2149101   CC29C788   58ACC558    58ACAC04    12AAC7CB   9CC2A004   181A58A0   1CC012AA
07CB92EC   1CCC98FC   A0C089CC    CC0012CC    C7E85CF0   CC2C41EC   C2D498AC   C1AC820C
0028470C   03BC9CCF   C3E8589C    C21CC589    18AA43AC   CC239549   002347AC   C3CC9889
C2C043A9   ACCC418A   A000 1A8A   478CC3CC    583CCC1C   584CC558   58504C0C   49ACC220
47A0C3C4   1F88D202   02CD6CCC    91C78C02    477CC3C4   96FC0323   586002CC   C5E6D400
C323C022   477CC396   982EC3FC    C5C2C555    C559477C   C39A82CC   CC2095FF   CC2C474C
C396582C   C5589CA1   20305822    CCCCD207    2C1CCC20   582CC3F0   47F0043C   92FFCC22
47FCC32A   C23F4C3C   C3E858CC    C2C8C7FC    481CCC22   411C1F0C   8910C00C   9888C408
0ACDC0CC   CCCCC0CC   C0CCC2CC    0C03FE48    9CCC4CCE   CCCC5828   C0003E08   CC03FA48
        AREA PRINTED BY INITIAL PRINT CCMPCNENT

     ENTIRE AREA.....CC014C TC CCC3FF
     INIT1 AREA......CCC14C TC 0CC17F
     INIT2 AREA......CCC18C TC CCC1FF
     INIT3 AREA......CCC2CC TC CCC3FF
```

```
FLOATING PCINT REGISTERS    C                     2                     4                     6
                            CCCCCCC00C0000CC      CCCCCCCCCCCC0C0CC     000000C0CCCCCCC0      CCC00CCCCCCC00CC0

REG0      0C0CC1CC   CCC0C55E   9CCC4DCE   8CC3FE84    CCC179FC   C000055E   CCCCC55E   CCC03EC8
REG8      50004E02   CCCC000C   CCC3FA48   8CCC390A    CCCC666C   50003802   CCCCC000   0C000CCC

4C-CSW  KEY-00  ACDR-03F8BC  STATUS-CCCC11CCCCCCC0C0  CCUNT-0CC000     48-CAW  KEY-00  ACDR-CC13CC

PSW CONTENTS          EXTERNAL INTERRUPT  SUPERVISCR CALL     PRCGRAM CHECK      MACHINE CHECK      INPUT/CUTPUT
FIELD        FCRMAT-CLD 18   -NEW 58    -CLD 2C    -NEW 60    -OLD 28    -NEW 68    -CLD 30    -NEW 7C    -OLD 38    -NEW 78
SYSTEM MASK     BIT-00000CC0 -00CCC0C0 -0CCCCCCC -C0C0C0CC -00C00000 -0000C0CC -CCC00000 -000CCC0C -11111111 -00000000
PROTECTICN KEY  HEX-C        -C        -C        -C        -0        -0        -C        -C        -0        -0
AMWP            BIT-CCC0     -01C0     -01CC     -C100     -CCC0     -010C     -CCC0     -CC1C     -C110     -01C0
INTERRUPT CODE  HEX-C0C0     -0CCC     -CCCA     -CCCC     -CCC0     -0C0C     -FF00     -C0CC     -C190     -0000
INSTR LENGTH    DEC-C        -C        -1        -C        -0        -0        -C        -C        -0        -0
CONDITICN CODE  DEC-C        -0        -C        -C        -0        -0        -C        -C        -0        -0
PROGRAM MASK    BIT-00C0     -0CCC     -C0CC     -CCC0     -0000     -0000     -CCC0     -C00C     -0000     -C0C0
INSTR ADDRESS   HEX-CCC000   -C0C27C   -0C33F4   -CC0322   -C0C000   -CC02C6   -CC0000   -CCCCE2   -0C6660   -000222

4C-UNUSED-C0CC5B28       50-TIMER-63C9109E       54-UNUSED-0CCCC00C
```

```
00040C   CCC3F848 50CC2F48 5CC04EC2 7F8CC0CC    00C3FA48 FE004E24 0000666C C0CC0CC0   *..8.&...&.+. .........+....(....*
C00420   C0CC000C 00CC0000 FF04019C 00006660    98AB0554 470005A2 15AB58C0 A0CC4770   *..............-.................*
0CC44C   C46C5E1C 80781211 4780045E 91811CCC    4790C45E 5E3C054C C5239829 BC5CD2C7   *.(......... ....... ...).....&K.*
0CC46C   C428CC1C 98A1B03C 820C0428 9C29805C    91C8BC1F 4780048E 41FC002C 11FF6CC8   *.................&.........0....-.*
0CC480   FCC06C28 FCC8604B FC1C6C68 FC18581C    8C781211 478004A6 918E10C0 477004A6   *C.-.C.-.C.-,0...................*
0C04A0   583CC55C C52312AA 478C05CE 18CA1818    D207C020 CC1096F0 C0225890 054805B9   *...&.............K......0.......*
0CC4C0   18AC18BA 9CA8C554 91C88C1F 478004E6    41F0C02C 11FF6808 F000682B FCC8684B   *.................W.0......0...0...*
0CC4E0   F010686B F01858CC A0CC91DC CCCA98C9    8C4847EC C4420217 80588030 90C98030   *C...0.................K.........*
0CC5C0   58FCC540 180C1848 58C002C8 07FF18C8    5ECCDCC0 91FFCC1C 477C052A 91FFCC21   *.0. ............................*
000520   477CC52A 18AC47F0 C4AC58DC CC7412CD    47700510 5EC08C00 9602C011 47FC04EE   *.......C...................0..*
CCC54C   CCCC4F24 C0CC4374 CCCC71C8 CC0C5184    CCCC5C1C CC0C3ED8 C0003ED8 CCCCC55E   *.. .........H......&....Q...Q... *
CCC56C   055EC55E FFCC0564 FFC00564 1211474C    .056A48A0 C560D201 1000A000 401CACC0   *. . ........... .....-K..... ...*
0CC580   4C1CC56C 92FCC435 C7FE1311 58A0C568    D2C31CCC AC0C5C10 AC005C1C 056847F0   * ..-.0..........K.....&...&....0*
00C5A0   05849C29 805C5810 C5641211 474CC5FE    41400564 5830100C 9120301F 477C05EC   *.....&....... ... ..............*
0005C0   95003C21 477CC5EC 9101301C 477CC5EC    D2C34CC0 1CCC5510 05684770 05E4D203   *................K. ..........UK.*
CC05FC   05681C0C 459CC69A 47FC05A6 55100568    478CC5FE 18415810 100047F0 C5844E1C   *.........0.................0....*
CCC6C0   055F914C C7534770 C74C491C C562478C    C7344140 C55E1833 43301C04 5E3CC544   *. . ..... ........ . ...... ...*
CCC62C   58303CCC 95CC3021 4780063E 18414810    10004910 C5624780 074047F0 C61691C1   *........................ .0....*
0CC640   1CC3419C C7AC4770 0656419C C6729101    30104770 C62C94FE 10035820 10C8D2C1   *............................K.*
```

Figure 28. Sample of a Stand-Alone Dump

Guide to Using a Core Image or a Stand-Alone Dump

The core image dump and the stand-alone dump are both hexadecimal dumps of the contents of main storage. The stand-alone dump destroys the contents of locations 0 to 23 (18) and 128 (80) to 319 (13F), but aside from this, the hexadecimal printouts of the stand-alone and the core image dump are identical. The debugging procedures to be used for either of these dumps are the same, and are presented, in the following pages, under the sub-headings: Guide to Using a PCP Dump, Guide to Using an MFT Dump, and Guide to Using an MVT Dump.

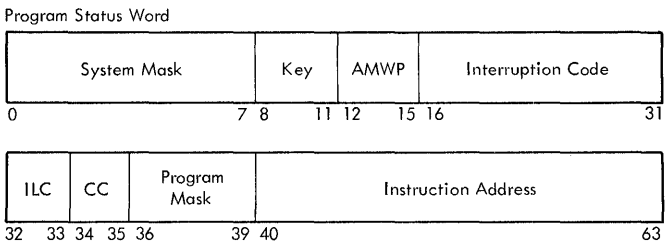
If you are not sure under which system configuration the stand-alone dump was taken, pick up the address of the CVT from the formatted section of the dump, following the heading 4C UNUSED. Add 74 hex to this address and look at that location in the dump. The first two hexadecimal digits found at this location are the contents of the CVTDCB field, and indicate the system configuration according to the following convention:

10	MVT	Uniprocessing
14	MVT	Multiprocessing
20	MFT	
40	PCP	

Guide to Using a PCP Dump

Cause of the Dump: Evaluate the PSWs that appear in the formatted section of the dump (first or second page), to find the cause of the dump.

The PSW has the following format:



- Does the instruction address field of the old machine check PSW show either the value E2 or E02? If so, a hardware error has occurred.
- Does the instruction address field of the old program check PSW have a value other than zero. If so, a program check at the instruction preceding that address caused the interruption.

Active RB Queue: To find the active RB queue, look at location 384(180 hex), the TCB. The first word of the TCB contains a one-word pointer to the first word of the most recent RB added to the queue. In its eighth word, RB+28(1C), each RB contains a pointer to the next most recent RB. The last RB points back to the TCB. The TCB occupies locations 384(180) to 504(1F8). You can determine the identity of the load module by looking either in the first and/or second words of the RB for its EBCDIC name or in the last 3 digits of the resume PSW in the previous RB for its SVC number. The entry point to the module is in the last 3 bytes of the fourth word in the RB, RB+13(D).

Load List: In systems with PCP, the load list is a chain of request blocks associated with load modules invoked by a LOAD macro instruction. By looking at the load list, you can determine which system and problem program routines were loaded before the dump was taken.

To construct the load list, look at the tenth word in the TCB, location 420(1A4), for a pointer to the most recent RB entry on the load list (RB-8). This word, in turn, points to the next most recent entry (minus 8), and so on. The word preceding the most recent RB on the list (RB-4) points back to the TCB's load list pointer.

TRACE TABLE: Look at the 3-word trace table control block.

Location 20(14) contains the address of the first word of this control block. If you are using a stand-alone dump and do not have access to the contents of location 20(14), scan the contents of main storage between locations 16,384(4000) and 32,768(8000) for trace table entries. Each entry is four words long. To find the table boundaries and the current entry, scan the table in reverse until you reach the three-word trace table control block.

To distinguish trace table entries, look at the fourth and fifth digits of the first words for the following bit configurations:

	Fourth Digit 8 4 2 1 bits	Fifth Digit 8 4 2 1 bits
SIO	0	0
SVC	1	1
I/O	1	0

Trace table entries for systems with PCP are 4 words long and represent occurrences of SIO, I/O, and SVC interruptions. Figure 29 gives some sample entries and their contents.

SIO entries can be used to locate the CCW (through the CAW), which reflects the operation initiated by an SIO instruction. If the SIO operation was not successful, the CSW STATUS portion of the entry will show you why it failed.

I/O entries reflect the I/O old PSW and the CSW that was stored when the interruption occurred. From the PSW, you can learn the address of the device on which the interruption occurred (bytes 2 and 3), the CPU state at the time of interruption (bit 15), and the instruction address where the interruption occurred (bytes 5-8). The CSW provides you with the unit status (byte 4), the channel status (byte 5), and the address of the previous CCW plus 8 (bytes 0-3).

SVC entries provide the SVC old PSW and the contents of registers 0 and 1. The PSW offers you the hexadecimal SVC number (bits 20-31), the CPU mode (bit 15), and the address of the SVC instruction (bytes 5-8). The contents of registers 0 and 1 are useful in that many system macro

instructions use these registers for parameter information. Contents of registers 0 and 1 for each SVC interruption are given in Appendix A.

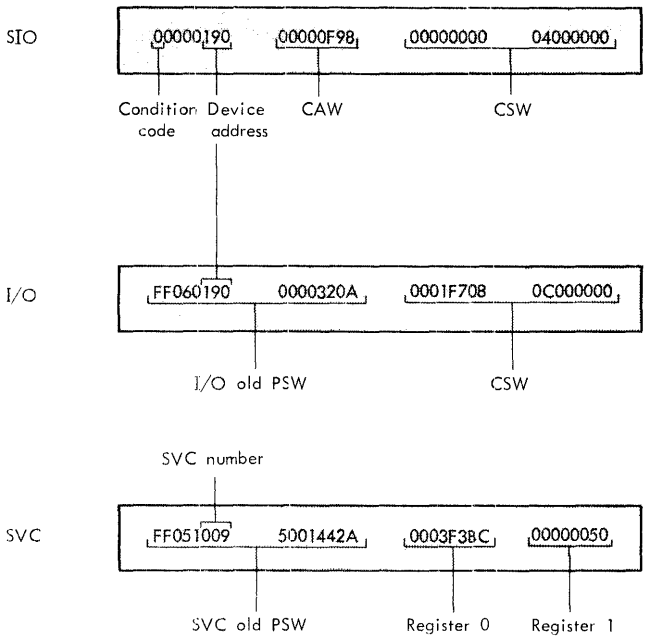


Figure 29. Sample Trace Table Entries (PCP)

CVT: To find the CVT, a source of other pointers, look at location 76(4C) in the formatted section of the dump (first or second page). The address given following the heading 4C-UNUSED- points to the first word of the CVT.

Queue of DEBs: To find the queue of DEBs, look at location 392(188). The address given there points to the first word of the most recent entry on the DEB queue. The last three bytes of the second word in each DEB (DEB+5) point to the next most recent DEB on the queue. The queue contains one DEB for each open data set.

UCBs: Unit information for each device can be found in the UCB. The address of the UCB is contained in the last 3 bytes of the ninth word of the DEB, DEB+33(21). If the DEB queue is empty, scan the dump around location 4096(1000) for words whose fifth and sixth digits are FF. These are the first words of the UCBs for the system; UCBs are arranged in numerical order by device address. (You may find it easier to locate UCBs by looking for the device address in the EBCDIC printout to the right of each page.) The first two bytes of the second word of each UCB give the device address. The device type and class are given in the third and fourth bytes of the fifth word, UCB+18(12). The sense bytes begin in the last two bytes of the sixth UCB word, UCB+22(16), and extend for from 1 to 6 bytes depending on the device type. Sense bytes are explained in Appendix F.

DCB: The address of the DCB, a control block that describes the attributes of an open data set, is in the last 3 bytes of the seventh DEB word, DEB+25(19).

IOB: The IOB for an open data set contains a pointer to the CCW list in the last three bytes of the fifth word, IOB+17(11). The IOB address is in the seventeenth word of the DCB, DCB+68(44). You can also locate the IOB associated with an I/O request by looking at the fourth word of the trace table entry for an SVC 0.

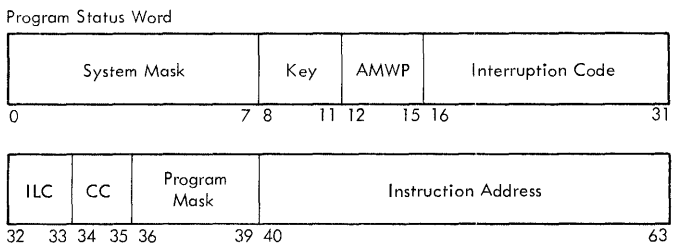
ECB: The address of the ECB is in the last 3 bytes of the second word of the IOB (IOB+5). The completion code for the I/O event is posted in the first byte of the ECB. ECB completion codes are explained in Appendix E. If the I/O event is not complete and an SVC 1 has been issued, the high-order bit of the ECB is on, and bytes 1 through 3 contain the address of the associated RB.

Free Areas: Areas of main storage available for allocation at the time the dump was taken are described by the MSS boundary box and a series of FQEs. The seventh word of the TCB, TCB+24(18), points to the MSS boundary box. The first word of the MSS boundary box points to the FQE with the highest processor storage address, and the fourth word, to the FQE with the highest 2361 Core Storage address. The first word of each FQE points to the next lower FQE; the second word gives the length of the free area it describes. FQEs occupy the first 8 bytes of the area they describe.

Guide to Using an MFT Dump

Cause of the Dump: Evaluate the PSWs that appear in the formatted section of the dump (first second page), to find the cause of the dump.

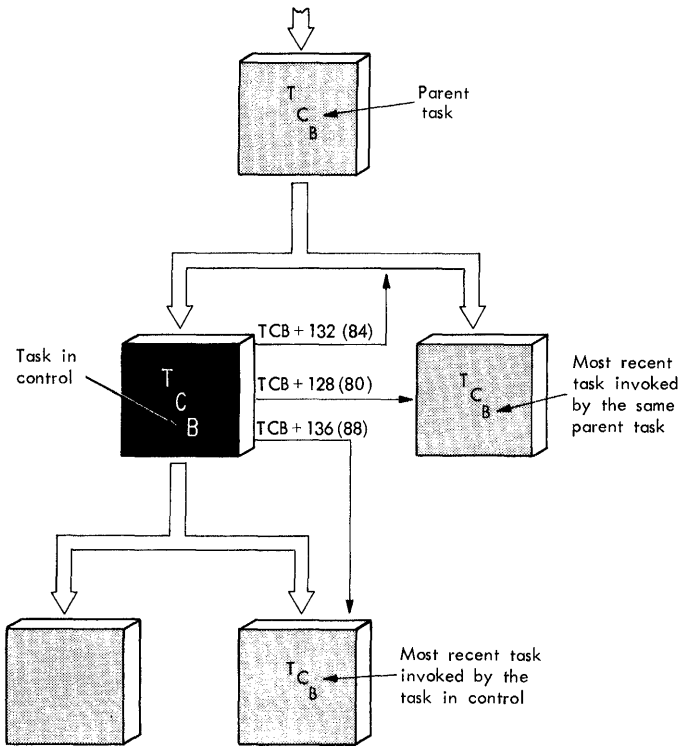
The PSW has the following format:



- Does the instruction address field of the old machine check PSW show either the value E2 or E02? If so, a hardware error has occurred.
- Does the instruction address field of the old program check PSW have a value other than zero? If so, a program check at the instruction preceding that address caused the interruption.

Finding the TCB: To find the TCB for the task that had control at the time the dump was taken:

1. Look at location 76(4C), following the heading 4C-UNUSED-, for a pointer to the CVT.
2. The first word of the CVT contains a pointer to a doubleword of TCB addresses, which contain pointers to the next TCB to be dispatched (first word) and the current TCB (second word).
3. The TCB found at the address shown in the second word represents the task that last had control.



- Figure 30. Re-Creating the Task Structure

Re-Creating the Task Structure (MFT with Subtasking only): To re-create the task structure for the job step, use the thirty-third through thirty-fifth words of the TCB. The thirty-fourth word, TCB+132(84), contains the address of the TCB for the parent task. The thirty-third word, TCB+128(80), is a pointer to the TCB of the task invoked most recently by the same parent task. The thirty-fifth word, TCB+136(88), contains the address of the TCB for the subtask invoked most recently by the task in control, or zeros if none were invoked. Each TCB in the job step contains the same pointers. Using these TCB pointers, you can re-create a task structure to aid in locating the point of error, as shown in Figure 30.

Finding the Partiiton TCBS

The partition TCBs (job step TCBs in MFT with subtasking) can be found by beginning at the CVTIXAVL field of the CVT, offset 124(7C). The address contained at CVTIXAVL is a pointer to the IOS freelist. At offset 4 in the IOS freelist is a pointer to the first address in a lsit of TCB addresses. You can look through this list of TCB addresses, and, keeping your system options in mind, find the TCBs for each partition (the job step TCBs in an MFT with subtasking system). The TCB addresses are listed in the following order:

- Transient area loading task.
- System error task (MFT witn subtasking).
- Multiple console support write-to-log task (optional).
- I/O recovery management support task (optional).
- Communications task.
- Master scheduler task.
- System management facilities task (optional).
- Partition 0 task.
- Partition 1 task.
- •
- •
- Partition n task.

In an MFT system with subtasking, the partition TCBs (job step TCBs) may be found by a more direct method. CVT offset 245(F5) contains a pointer to the partition 0 job step TCB address in this address table.

To recreate the task structure within any partition, simply locate the job step TCB, and follow the TCB pointers - as explained in the previous section, "Re-Creating the Task Structure."

Active RB Queue: The first word of a TCB points to the most recent RB added to the active RB queue. Each RB on the active RB queue, contains a pointer to the previous RB in its eighth word, RB+28(1C). The last RB points back to the TCB. You can determine the identity of the load module by looking either in the first and/or

second words of the RB for the EBCDIC name, or in the last 3 digits of the resume PSW in the previous RB for the SVC number. The entry point to the module is given in the last 3 bytes of the fourth word in the RB, RB+13(D).

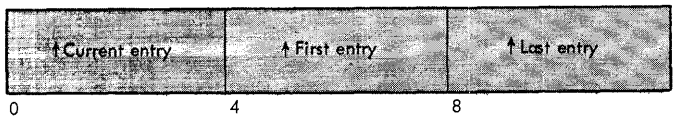
Load List: In systems with MFT, the load list is a chain of request blocks associated with load modules invoked by a LOAD macro instruction. By looking at the load list, and at the job pack area queue described below, you can determine which system and problem program routines were loaded before the dump was taken. To construct the load list associated with the task in control, look at the tenth word in the TCB, TCB+36(24), for a pointer to the most recent RB entry on the load list, minus 8 bytes (RB-8). This word, in turn, points to the next most recent entry (minus 8), and so on. The word preceding the most recent RB on the list (RB-4) points back to the TCB's load list pointer.

Job Pack Area Queue (MFT with subtasking only): To reconstruct the job pack area queue, look at TCB+125(7D) for a three byte pointer to the Partition Information Block (PIB). The twelfth word of the PIB, PIB+44(2C), points to the most recent RB on the job pack area queue minus 8 bytes (RB-8). This word in turn points to the next most recent RB minus 8, and so on. The word preceding the most recent RB on the queue (RB-4) points back to the job pack area queue pointer in the PIB. You can determine the identify of the load module by looking either in the first and/or second words of the RB for its EBCDIC name, or in the last three digits of the resume PSW in the previous RB for the SVC number. The entry point of the module is given in the last three bytes of the fourth word in the RB, RB+29(1D), unless it is an FRB.

The first five words of an FRB (beginning at offset minus 8) are identical in content to those of other RBs. The XRWTL field, offset 12(C), contains the address of a wait list element. The first word of the WLE points to the next WLE, or contains zeros if the WLE is the last one. The second word points to the waiting SVRB. You can determine the number of deferred requests for the module by tracing the chain of WLEs.

The XRREQ field of an FRB, offset 16(10), contains a pointer to the TCB of the requesting task. The next word, XRTLPRB, offset 20(14), points to an LPRB built by the Finch routine for the requested program. The FRB for the requested program is removed from the job pack area queue by the Finch routine when the program is fully loaded.

Trace Table: Look at the 3-word trace table control block, which precedes the table by several words (usually four words):



Location 20(14) contains the address of the first word of this control block. If you are using a stand-alone dump and do not have access to the contents of location 20(14), scan the contents of main storage between locations 16,384(4000) and 32,768(8000) for trace table entries. Entries are four words long and begin at addresses ending with zero. To find the table boundaries and current entry, scan the table in reverse until you reach the trace table control block. Figure 31 gives some sample trace table entries and their contents.

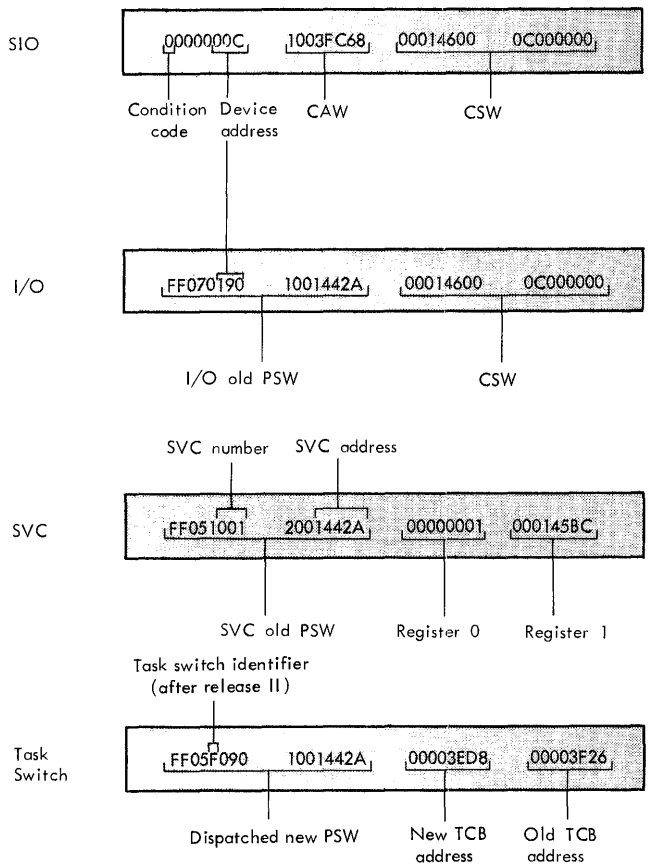


Figure 31. Sample Trace Table Entries (MFT)

SIO entries can be used to locate the CCW (through the CAW), which reflects the operation initiated by an SIO instruction. If the SIO operation was not successful, the CSW STATUS portion of the entry will show you why it failed.

I/O entries reflect the I/O old PSW and the CSW that was stored when the interruption occurred. From the PSW, you can learn the address of the device on which the interruption occurred (bytes 2 and 3), the CPU state at the time of interruption (bit 15), and the instruction address where the interruption occurred (bytes 5-8). The CSW provides you with the unit status (byte 4), the channel status (byte 5), and the address of the previous CCW plus 8 (bytes 0-3).

SVC entries provide the SVC old PSW and the contents of registers 0 and 1. The PSW offers you the hexadecimal SVC number (bits 20-31), the CPU mode (bit 15), and the address of the SVC instruction (bytes 5-8). The contents of registers 0 and 1 are useful in that many system macro instructions use these registers for parameter information. Contents of registers 0 and 1 for each SVC interruption are given in Appendix A.

TASK SWITCH entries look similar to an SVC entry, except that words 3 and 4 of the entry contain the address of the TCBs for the "new" and "old" tasks being performed, respectively. The trace table entries for one particular task are contained between sets of two task switch entries. Word 3 of the beginning task switch entry and word 4 of the ending task switch entry point to the TCB for that task. Task switch entries are identified by a fifth digit of 'F'.

Queue of DEBs: To find the queue of DEBs for the task, look at the third word in the TCB (TCB+8). It points to the first word of the most recent entry on the DEB queue. The last three bytes of the second word in each DEB (DEB+5) point to the next most recent DEB on the queue. The queue contains one DEE for each open data set.

UCBs: Unit information for each device can be found in a UCB. The address of the UCB is contained in the last 3 bytes of the ninth word of the DEB, DEB+33(21). If the DEB queue is empty, scan the dump around location 4096(1000) for words whose fifth and sixth digits are FF. These are the first words of the UCBs for the system; UCBs are arranged in numerical order by device address. (You may find it easier to locate UCBs by looking for the device address in the EBCDIC printout to the right of each page.) The first two bytes of the second word of each UCB gives the device address. The sense bytes begin in the second byte of the sixth UCB word, UCB+22 (16), and extend from 1 to 6 bytes, depending on the device type. Sense bytes are explained in Appendix F. The device type and class are given in the third and fourth bytes of the fifth word, respectively.

DCB: The address of the DCB, a control block that describes the attributes of an open data set, is located in the last 3 bytes of the seventh DEB word, DEB+25(19).

IOB: The IOB for an open data set contains a pointer to the CCW list in the last three bytes of the fifth word, IOB+17(11). The IOB address is located in the seventeenth word of the DCB, DCB+68(44). You can also locate an IOB by looking at the fourth word of a trace table entry for an SVC 0.

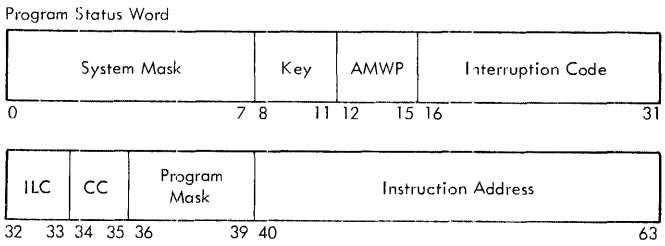
ECB: The address of the ECB for BSAM and BDAM data sets can be found in the last 3 bytes of the second word of the IOB (IOB+5). The completion code for the I/O event is posted in the first byte of the ECB. ECB completion codes are explained in Appendix E. If the I/O event is not complete and an SVC 1 has been issued, the high-order bit of the ECB is on, and bytes 1 through 3 contain the address of the associated RB.

Free Areas: Areas of a partition that are available for allocation at the time the dump was taken are described by the MSS boundary box and a series of FQEs. The seventh word of the TCB for the task, TCB+24(18), points to a six-word MSS boundary box. The first word of the MSS boundary box points to the FQE with the highest processor storage address in the partition, and the fourth word, to the highest 2361 Core Storage address in the partition. The second word of the FQE gives the length of the area it describes. FQEs occupy the first 8 bytes of the area they describe.

Gotten Subtask Areas: Areas of a partition allocated by the system to a subtask within the partition are described by gotten subtask area queue elements (GQE). The seventh word of the subtask TCB, TCB+24(18), points to a one word pointer to the most recently created GQE on the GQE queue. Bytes 0 through 3 of the GQE contain a pointer to the previous GQE or, if zero, indicate that the GQE is the last one on the queue. Bytes 4 through 7 of the GQE contain the length of the gotten subtask area. Each GQE occupies the first eight bytes of the gotten subtask area it describes.

Cause of the Dump: Evaluate the PSWs that appear in the formatted section of the dump (first or second page), to find the cause of the dump.

The PSW has the following format:



- Does the instruction address field of the old machine check PSW show either the value E2 or E02? If so, a hardware error has occurred.
- Does the instruction address field of the old program check PSW have a value other than zero? If so, a program check at the instruction preceding that address caused the interruption.

Trace Table: Location 84(54), labeled 54-UNUSED-hhhhhhhh on the dump, contains the address of the first word of a 3-word trace table control block that immediately precedes the table:

Entries in an MVT trace table are 8 words long and represent occurrences of SIO, external, SVC, program, I/O, and dispatcher interruptions. You can identify what type of interruption caused an entry by looking at the fifth digit:

0 = SIO
1 = External
2 = SVC
3 = Program
5 = I/O
D = Dispatcher

Figure 32 gives some sample entries and their contents.

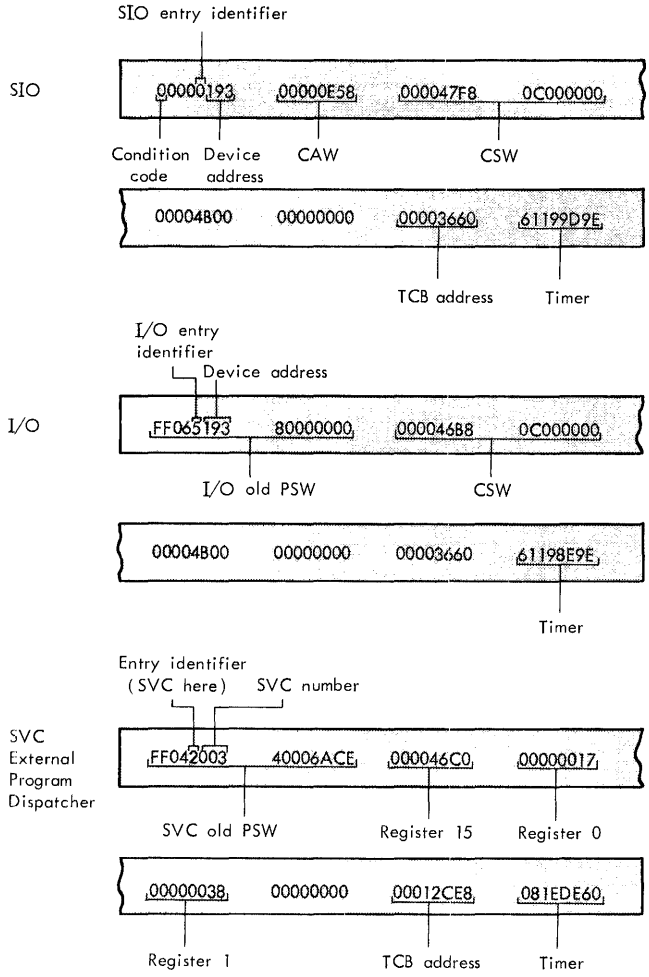


Figure 32. Sample Trace Table Entries (MVT)

In dumps of Model 65 Multiprocessing systems, trace table entries differ as follows:

SIO	5th word:	address of TCB.
	6th word:	address of old TCB for CPU A.
	7th word:	address of old TCB for CPU B.
	8th word:	CPU identification (last byte).
I/O	3rd word:	contents of register 15.
	4th word:	contents of register 0.
	8th word:	CPU identification (last byte).
SVC and Program	6th word:	address of old TCB for CPU A.
	7th word:	address of old TCB for CPU B.
	8th word:	CPU identification (last byte).

Dispatcher	6th word:	address of new TCB for CPU A.
	7th word:	address of new TCB for CPU B.
	8th word:	CPU identification (last byte).
External	6th word:	STMASK of other CPU.
	7th word:	TQE if timer interrupt occurred.
	8th word:	CPU identification (last byte).

Finding the TCB: To find the TCB for the task that had control at the time the dump was taken, perform one of the following steps:

1. Examine the current entry in the trace table. Look at the seventh word of this entry for the address of the TCB. If an I/O interruption caused the current entry, scan the table in reverse order for the corresponding SIO entry (the most recent SIO entry having the same device address). The seventh word of this entry contains the TCB address.

2. If you do not have a trace table, look at location 76(4C) for a pointer to the CVT, following the heading 4C-UNUSED-. The first word of the CVT contains a pointer to a doubleword of TCB addresses, which contains pointers to the next TCB to be dispatched (first word) and the current TCB (second word). Beginning with the current TCB, you can recreate the task structure for the job step.

Note: If the first word of the TCB located by the above steps points to itself, there are no ready tasks to be dispatched, and the system has been placed in an enabled wait state. This TCB, now in control, is called the System Wait TCB.

Recreating The Task Structure: To recreate the task structure for the job step, use the thirty-third through thirty-fifth words of the TCB. The thirty-fourth word, TCB+132(84), contains the address of the TCB for the parent task. The thirty-third word, TCB+128(80), is a pointer to the TCB of the task invoked most recently by the same parent task. The thirty-fifth word, TCB+136(88), contains the address of the TCB for the subtask invoked most recently by the task in control, or zeros if none were invoked. Each TCB in the job step contains the same pointers. Using these TCB pointers, you can recreate a task structure to aid in locating the point of error, as shown in Figure 33.

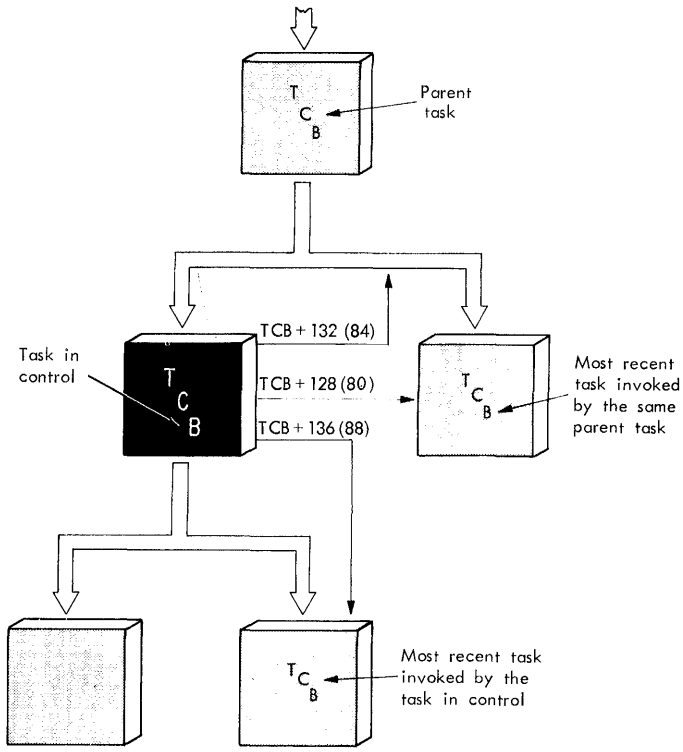


Figure 33. Recreating the Task Structure

Active RB Queue: The first word of the TCB points to the most recent RB added to the queue. Each RB contains a pointer to the next most recent RB in its eighth word, RB+28(1C). The last RB points back to the TCB. Unlike the RBs for other systems, the name and entry point of the associated load module are not always contained in the RB associated with the module. Instead, they are found in a contents directory entry.

CDE: The address of the contents directory entry for a particular load module is given in the fourth word of the RB, RB+12(C). The CDE gives the address of the next entry in the directory (bytes 1-3), the name of the load module, bytes 8-15(F); the entry point of the module, bytes 17-19(11-13); and a pointer to the extent list, bytes 21-23(15-17).

Load List: To construct the load list associated with the task in control, look at the tenth word in the TCB, TCB+36(24), for a pointer to the most recent load list entry (LLE). Each LLE contains the address of the next most recent entry (bytes 0-3), the count (byte 4), and the address of the CDE for the associated load module (bytes 5-7).

Queue of DEBs: To find the queue of DEBs for the task, look at the third word in the TCB (TCB+8). The address given here points to the first word of the most recent entry on the DEB queue. The last three bytes of the second word in each DEB (DEB+5) points to the next most recent DEB on the queue. The queue contains one DEB for each open data set.

UCBs: Unit information for each device can be found in a UCB. The address of the UCB is contained in the last 3 bytes of the ninth word of the DEB, DEB+33(31). If the DEB queue is empty, scan the dump around location 4096(1000) for words whose fifth and sixth digits are FF. These are the first words of the UCBs for the system; UCBs are arranged in numerical order by device address. (You may find it easier to locate UCBs by looking for the device address in the EBCDIC printout to the right of each page.) The first two bytes of the second word of each UCB give the device address. The device type and class are given in the third and fourth bytes of the fifth word, UCB+18(12), respectively. The sense bytes are given in the last two bytes of the sixth UCB word, UCB+22(16), and extend for from 1 to 6 bytes, depending on the device type. Sense bytes are explained in Appendix F.

DCB: The address of the DCB, a control block that describes the attributes of an open data set, is located in the last 3 bytes of the seventh DEB word, DEB+25(19).

IOB: The IOB for an open data set contains a pointer to the CCW list in the last three bytes of the fifth word, IOB+17(11). The IOB address is located in the seventeenth word of the DCB, DCB+68(44). You can also locate the IOB for an I/O request by looking at the fifth word of the trace table entry for the SVC 0.

ECB: The address of the ECB for BSAM and BDAM data sets can be found in the last 3 bytes of the second word of the IOB (IOB+5) or in the last 3 bytes of the thirty-seventh word of the TCB, TCB+145(91). The completion code for the I/O event is posted in the first byte of the ECB. ECB completion codes are explained in Appendix E. If the I/O event is not complete and an SVC 1 has been issued, the high-order bit of the ECB is on, and bytes 1 through 3 contain the address of the associated RB.

Region Contents: The TCB for the dumped task contains a pointer to the dummy partition queue element minus 8 in its thirty-ninth word, TCB+152(98). The first word of the dummy PQE points to the first PQE and the second word, to the last PQE. Each PQE, in turn, points to the first and last FBQEs within a given storage hierarchy.

Subpool Contents: The seventh word of the TCB, TCB+24(18), points to the SPQE representing the first subpool used by the task. Each SPQE contains the address of the next SPQE (bytes 1-3), the subpool number (byte 4), and the address of the first DQE for the subpool (bytes 5-7) or, if the subpool is owned by another task (bit 0 is 1), the address of the SPQE that describes it (bytes 5-7). Each DQE contains a pointer to the FQE representing the free area with the highest main storage address in the subpool (bytes 1-3), a pointer to the next DQE (bytes 5-7), and the length of the area described by the DQE, bytes 13-15(D-F).

Appendix A: SVCs

Register contents at entry to an SVC routine are often helpful in finding pointers and control information. The table below lists SVC numbers in decimal and hexadecimal, and gives the type, associated macro instruction, and significant contents of registers 0 and 1 at entry to each SVC routine.

Macro instructions followed by an asterisk (*) are documented in the System Programmers Guide. Expanded descriptions of remaining macro instructions listed here may be found in the publication Supervisor and Data Management Macro Instructions. Graphics and telecommunications macro instructions are discussed in the Program Logic Manuals associated with these access methods.

Decimal No.	Hex. No.	Type	Macro	Register 0	Register 1
0	0	I	EXCP *		IOB address
0	0	I	XDAP *		
1	1	I	WAIT	Event count	ECB address
1	1	I	WAITR	Event count	2's complement of ECB address
1	1	I	PRTOV		
2	2	I	POST	Completion code	ECB address
3	3	II			
4	4	I	GETMAIN		Parameter list address
5	5	I	FREEMAIN		Parameter list address
6	6	II	LINK		Parameter list address
7	7	II	XCTL		Parameter list address
8	8	II	LOAD	Address of entry point address	DCB address
9	9	I, II	DELETE	Address of program name	
10	A	I	GETMAIN or FREEMAIN (R Operand)	Subpool number (byte 0) Length (bytes 1-3)	Address of area to be freed
10	A	I	FREEPOOL		
11	B	I, III	TIME		Time units code
12	C	II	SYNCH *		
13	D	IV	ABEND		Completion code
14	E	II, III	SPIE		PICA address
15	F	I			Address of request queue element

(Part 1 of 4)

Decimal No.	Hex. No.	Type	Macro	Register 0	Register 1
16	10	III	PURGE *		
17	11	III	RESTORE *		IOB chain address
18	12	II	BLDL	Address of build list	DCB address
18	12	II	FIND		
19	13	IV	OPEN		Address of parameter list of DCB addresses
20	14	IV	CLOSE		Address of parameter list of DCB addresses
21	15	III	STOW	Parameter list address	DCB address
22	16	IV	OPEN TYPE=J*		Address of parameter list of DCB addresses
23	17	IV	CLOSE TYPE=T		Address of parameter list of DCB addresses
24	18	III	DEVTYPE *		ddname address
25	19	III			DCB address
26	1A	IV	CATALOG *		Parameter list address
26	1A	IV	INDEX *		Parameter list address
26	1A	III	LOCATE *		Parameter list address
27	1B	III	OBTAIN *		Parameter list address
28	1C	IV			
29	1D	IV	SCRATCH *	UCB address	Parameter list address
30	1E	IV	RENAME *	UCB address	Parameter list address
31	1F	IV	FEOV		DCB address
32	20	IV			Address of UCB list
33	21	III	IOHALT		UCB address
34	22	IV	MGCR (MAST CMD EXCP)		
35	23	IV	WTO		Message address
35	23	IV	WTOR		Message address
36	24	IV	WTL		Address of message
37	25	II	SEGLD		Segment name address
37	25	II	SEGWT		Segment name address
38	26	II			
39	27	III,IV	LABEL		Parameter list address

(Part 2 of 4)

Decimal No.	Hex. No.	Type	Macro	Register 0	Register 1
40	28	I, II, III	EXTRACT		Parameter list address
41	29	II, III	IDENTIFY	Entry point name address	Entry point address
42	2A	II, III	ATTACH		
43	2B	II, III	CIRB *	Entry point address	Size of work area in doublewords
44	2C	I	CHAP	+ Increase priority - Decrease priority	TCB address
45	2D	II			
46	2E	I	TTIMER		1: Cancel
47	2F	II	STIMER	Exit address	Timer interval address
48	30	I, II	DEQ		QCB address
49	31	III	TEST		
50	32	IV			
51	33	IV	SNAP		Parameter list address
52	34	IV			DCB address
53	35	III	RELEX	Key address	DCB address
54	36	II			
55	37	IV	EOV *	EOB address	DCB address
56	38	I, II	ENQ	QEL address	QCB address
56	38	I, II	RESERVE *		
57	39	III	FREEDBUF	DECB address	DCB address
58	3A	I	RELBUF		DCB address
58	3A	I	REQBUF		DCB address
59	3B	III			
60	3C	III	STAE	0 Create SCB 4 Cancel SCB 8 0	Parameter list address
61	3D	III			Parameter list address
62	3E	II	DETACH		TCB address
63	3F	IV	CHKPT		DCB address
64	40	III	RDJFCB *		Address of parameter list of DCB addresses
65	41	II			Parameter list address
66	42	IV			

(Part 3 of 4)

Decimal No.	Hex. No.	Type	Macro	Register 0	Register 1
67	43	II	ENDREADY		QPOST
68	44	IV	SYNADAF	Same as register 0 on entry to SYNAD	Same as register 1 on entry to SYNAD
68	44	IV	SYNADRLS		
69	45	III	BSP		DCB address
70	46	II	GSERV		Parameter list address
71	47	III	RLSEBFR		Parameter list address
71	47	III	ASGNBFR		Parameter list address
71	47	III	BUFINQ		Parameter list address
72	48	IV			Parameter list address
73	49	III	SPAR		Parameter list address
74	4A	III	DAR		Parameter list address
75	4B	III			Parameter list address
76	4C	III			
77	4D	IV			
78	4E	III			
79	4F	I	STATUS		
80	50	III			
81	51	IV	SETPRT		
82	52	IV			
83	53	III	SMFWTM *		Message address
84	54	I		UCB address and buffer restart address	
85	55	IV			
86	56	IV	ATLAS		Parameter list address
87	57	III	DOM	If zero If negative	A DOM message I.D. A pointer to a list of DOM message I.Ds
88	58	III	MOD88	Routine code	DCB address
89	59	III	EMSRV		Parameter list address
90	5A	IV	XQMNGR	Address of list of ECB/IOB pointers (optional)	QMPA address
91	5B	III	VOLSTAT	DCB address	zero: issued by CLOSE Non-zero: issued by EOV

(Part 4 of 4)

Appendix B: Completion Codes

Completion codes issued by operating system routines are often caused by problem program errors. This appendix includes the most common system completion codes, their probable causes, and how to correct the error or locate related information using a dump. For a more comprehensive coverage of completion codes, see the publication Messages and Codes.

0Cx A program check occurred without a recovery routine. If bit 15 of the old program PSW (PSW at entry to ABEND) is on, the problem program had control when the interruption occurred; "x" reflects the type of error that causes the interruption:

x	Cause
1	Operation
2	Privileged operation
3	Execute
4	Protection
5	Addressing
6	Specification
7	Data
8	Fixed-point overflow
9	Fixed-point divide
A	Decimal overflow
B	Decimal divide
C	Exponent overflow
D	Exponent underflow
E	Significance
F	Floating-point

The correct register contents are reflected under the heading "REGS AT ENTRY TO ABEND" in an ABEND/SNAP dump. In a stand-alone dump, register contents can be found in the register save area for ABEND'S SVRB.

0F1 A program check occurred in the interruption handling part of the input/output supervisor. The applicable program check PSW can be found at location 40(28). (In systems with MFT, this PSW is valid only if the first four digits are 0004).

The problem program can be responsible for this code if:

1. An access method routine in the problem program storage area has been overlaid.

2. An IOB, DCB, or DEB has been modified after an EXCP has been issued, but prior to the completion of an event.

If a trace table exists (trace option was specified at system generation), the instruction address in the new program check PSW, location 104(68), contains the address of a field of register contents. This field includes registers 10 through 1 (PCP) or 10 through 9 (MFT) on an ABEND/SNAP dump, or 10 through 1 (both systems) on a stand-alone dump.

If no trace table exists, the above field contains registers 10 through 1 on both ABEND/SNAP (MFT only) and stand-alone dumps.

0F2 Most frequently caused by incorrect parameters passed to a type I SVC routine.

100 A device has been taken off-line without informing the system, or a device is not operational.

If a trace table exists, the most current entry is an SIO entry beginning with 30. The last 3 digits of the first word give the device address.

If a trace table does not exist, register 1 (in the SVRB for the ABEND routine) contains a pointer to the IOB associated with the device.

101 The wait count, contained in register 0 when a WAIT macro instruction was issued, is greater than the number of ECBs being waited upon.

102 An invalid ECB address has been given in a POST macro instruction.

If a POST macro instruction has been issued by the problem program, the ECB address is given in register 1 of either the trace table entry or the SVRB for the ABEND routine.

If the POST was issued by an I/O interruption handler, the ECB address can be found in the IOB associated with the event.

106 During a transient area load or a dynamic load resulting from a LINK, LOAD, XCTL, or ATTACH macro instruction, the fetch routine found an error. A description of the error is contained in register 15 of ABEND's SVRB register save area:

0D The control program found an invalid record type.

0E The control program found an invalid address. The problem program may contain a relocatable expression that specifies a location outside the partition boundaries.

0F A permanent I/O error has occurred. This error can probably be found in the trace table prior to the ABEND entry.

Register 6 of ABEND's SVRB register save area points to the work area used by the fetch routine. This area contains the IOB, channel program, RLD buffer, and the BLDL directory entry associated with the program being loaded.

122 The operator canceled the job and requested a dump.

155 An unauthorized user (a user other than Dynamic Device Reconfiguration) has issued SVC 85. The user's task has been abnormally terminated by Dynamic Device Reconfiguration.

201 This completion code is identical to 102, but applies to the WAIT macro instruction instead of POST.

202 An invalid RB address was found in an ECB. The RB address is placed in the ECB when a WAIT macro instruction is issued.

213 The error occurred during execution of an OPEN macro instruction for a data set on a direct-access device. Either:

1. The data set control block (DSCB) could not be found on the direct access device.
2. An uncorrectable input/output error occurred in reading or writing the data set control block.

Register 4 contains the address of a combined work and control block area. This address plus x'64' is the address of the data set name in the JFCBDSNM field of the job file control block (JFCB).

222 The operator canceled the job without requesting a dump. The cancellation was probably the result of a wait state or loop.

301 A WAIT macro instruction was issued, specifying an ECB which has not been posted complete from a previous event. Either:

1. The ECB has been reinitialized by the problem program prior to a second WAIT on the same ECB, or
2. The high order bit of the ECB has been inadvertently turned on.

308 The problem program requested the loading of a module using an entry point given to the control program by an IDENTIFY macro instruction.

Register 0 of LOAD's SVRB register save area contains the address (or its complement) of the name of the module being loaded.

400 The control program found an invalid IOB, DCB, or DEB. Check the following blocks for the indicated information:

- IOB - a valid DCB address.
- DCB - a valid DEB address.
- DEB - ID of 0F and a valid UCB address.
- UCB - a valid identification of FF.

Note: In systems with MVT, this code may appear instead of a 200 code, for the reasons given under 200.

406 A program has the "only loadable" attribute or has an entry point given to the control program by an IDENTIFY macro instruction. In either case, the program was invoked by a LINK, XCTL, or ATTACH macro instruction.

Register 15 of the LINK, XCTL, or ATTACH SVRB register save area contains the address of the name of the program being loaded.

506 The error occurred during execution of a LINK, XCTL, ATTACH, or LOAD macro instruction in an overlay program or in a program that was being tested using the TESTRAN interpreter.

The program name can be found as follows:

1. If a LOAD macro instruction was issued, register 0 in the trace table SVC entry or in the SVRB register save area contains the address (or its complement) of the program name.

2. If a LINK, XCTL, or ATTACH was issued, register 15 of the associated SVRB register save area contains the address of a pointer to the program name.

Note: Programs written in an overlay structure or using TESTRAN should not reside in the SVC library.

604 During execution of a GETMAIN macro instruction, the control program found one of the following:

1. A free area exceeds the boundaries of the main storage assigned to the task. This can result from a modified FQE.

2. The A-operand of the macro instruction specified an address outside the main storage boundaries assigned to the task.

605 During execution of a FREEMAIN macro instruction, the control program found that part of the area to be freed is outside the main storage boundaries assigned to the task, possibly resulting from a modified FQE.

Item 1 under the 604 completion code is also applicable to 605.

606 During execution of a LINK, XCTL, ATTACH, or LOAD macro instruction, a conditional GETMAIN request was not satisfied because of a lack of available main storage for a fetch routine work area. Consequently, the request was not satisfied.

The name of the load module can be found as described under completion code 506.

60A Results from the same situations described under 604 and 605 for R-form GETMAIN and FREEMAIN macro instructions.

613 The error occurred during execution of an OPEN macro instruction for a data set on magnetic tape. An uncorrectable input/output error occurred in tape positioning or in label processing.

700 A unit check resulted from an SIO issued to initiate a sense command.

The defective device can be determined from the SIO trace table entry that reflects a unit check in the CSW status.

704 A GETMAIN macro instruction requested a list of areas to be allocated. This type of request is valid only for systems with MVT.

The applicable SVC can be found in a trace table entry or in the PSW at entry to ABEND.

705 Results from the same situations described under 704 for FREEMAIN macro instructions.

706 During execution of a LINK, LOAD, XCTL, or ATTACH macro instruction, the requested load module was found to be not executable.

The name of the module can be found as described under the completion code 506.

804 The error occurred during execution of a GETMAIN macro instruction with a mode operand of EU or VU. More main storage was requested than was available.

806 The error occurred during execution of a LINK, XCTL, ATTACH, or LOAD macro instruction.

An error was detected by the control program routing for the BLDL macro instruction. This routine is executed as a result of these macro instructions if the problem program names the requested program in an EP or EPLOC operand. The contents of register 15 indicate the nature of the error:

X'04' The requested program was not found in the indicated source.

X'08' An uncorrectable input/output error occurred when the control program attempted to search the directory of the library indicated as containing the requested program.

Register 12 contains the address of the BLDL list used by the routine. This address plus 4 is the location of the 8-byte name of the requested program that could not be loaded.

80A The error occurred during execution of an R-form GETMAIN macro instruction. More main storage was requested than was available.

905 The address of the area to be freed (given in a FREEMAIN macro instruction) is not a multiple of eight. The contents of register one in either the trace table entry or ABEND's SVRB register save area reflect the invalid address.

90A Results from the same situations described under 905 for R-forms of GETMAIN and FREEMAIN macro instructions.

A05 The error occurred during execution of a FREEMAIN macro instruction. The area to be freed overlaps an already existing free area. This error can occur if the address or the size of the area to be freed were incorrect or modified.

The contents of registers 0 and 1 in either the SVC trace table entry or ABEND's SVRB register save area reflect the size and address.

A0A Results from the same situations described under A05 for R-form of GETMAIN and FREEMAIN macro instructions.

B04 This error occurred during execution of a GETMAIN macro instruction. A subpool number greater than 127 was specified. The problem program is restricted to using subpools 0-127. This error can occur if the subpool number was either incorrectly specified or modified.

A displacement of nine bytes from the list address passed to GETMAIN in register 1 contains the subpool number. Register 1 can be found in either the SVC trace table entry or ABEND's SVRB register save area.

B05 Results from the same situation described under B04 for a FREEMAIN macro instruction.

B0A Results from the same situations described under B04 and B05 for R-form of GETMAIN and FREEMAIN macro instructions.

The subpool number can be found in the high order bytes of register 0 in either the SVC trace table entry or ABEND's SVRB register save area.

B37 The error occurred at an end of volume. The control program found that all space on the currently mounted volumes was allocated, that more space was required, and that no volume was available for demounting.

Eitner allocate more devices or change the program so that a device will be free when a volume must be mounted.

Fnn An SVC instruction contained an invalid operand; nn is the hexadecimal value of the SVC.

This error can occur if either an invalid instruction was issued by the problem program or an operand referring to an optional function was not included during system generation.

Appendix C: System Module Name Prefixes

All load modules associated with a specific operating system component have a common prefix on their module names. This appendix lists the module name prefixes and the associated system component(s).

Prefix	Component
IBC	Independent utility programs
IEA	Supervisor, I/O supervisor, and NIP
IEB	Data set utility programs
IEC	Input/output supervisor
IEE	Master scheduler
IEF	Job scheduler
IEG	TESTRAN
IEH	System utility programs
IEI	Assembler program during system generation
IEJ	FORTRAN IV E compiler
IEK	FORTRAN IV H compiler
IEM	PL/I F compiler
IEP	COBOL E compiler
IEQ	COBOL F compiler
IER	Sort/Merge program
IES	Report program generator
IET	Assembler E
IEU	Assembler F
IEW	Linkage editor/overlay supervisor/program fetch
IEX	ALGOL compiler
IEY	FORTRAN IV G compiler
IFB	Environment recording routines
IFC	Environment recording and print routines
IFD	On line test executive program
IFF	Graphic programming support
IGC	Transient SVC routines
IGE	I/O error routines
IGF	Machine check handler program
IGG	Close, open, and related routines
IHA	System control blocks
IHB	Assembler during expansion of supervisor and data management macro instructions
IHC	FORTRAN library subroutines
IHD	COBOL library subroutines
IHE	PL/I library subroutines
IHF	PL/I library subroutines
IHG	Update analysis program
IHI	Object program originally coded in ALGOL language
IHJ	Checkpoint/restart
IHK	Remote job entry
IIN	7094 emulator program for the Model 85
IKA	Graphic Job Processor
IKD	Satellite graphic job processor messages
IKF	USAS COBOL compiler
ILB	USAS COBOL subroutines

Appendix D: List of Abbreviations

ABEND	abnormal end-of-task
APR	alternate path retry
CCW	channel command word
CDE	contents directory entry
CPU	central processing unit
CSW	channel status word
CVT	communications vector table
DAR	damage assessment routine
DCB	data control block
DDR	dynamic device reconfiguration
DEB	data extent block
DPQE	dummy partition queue element
DQE	descriptor queue element
ECB	event control block
FBQE	free block queue element
FQE	free queue element
FRB	finch request block
GQE	gotten subtask area queue element
IOB	input/output block
IPL	initial program loading
IRB	interrupt request block
LLE	load list element
LPRB	loaded program request block
LRB	loaded request block
MFT	multiprogramming with a fixed number of tasks
MVT	multiprogramming with a variable number of tasks
NIP	nucleus initialization program
PCP	primary control program
PIB	partition information block
PQE	partition queue element
PRB	program request block
PSA	prefixed storage area
PSW	program status word
QCB	queue control block
QEL	queue element
RB	request block
SCB	STAE control block
SIO	start input/output
SIRB	supervisor interrupt request block
SPQE	subpool queue element
SVC	supervisor call
SVRB	supervisor request block
SYSOUT	system output
TCB	task control block
TIOT	task input/output table
UCB	unit control block
XCTL	transfer control
XL	extent list

Appendix E: ECB Completion Codes

Hexadecimal Code	Meaning
7F000000	Channel program has terminated without error. (CSW contents can be useful.)
41000000	Channel program has terminated with permanent error. (CSW contents can be useful.)
42000000	Channel program has terminated because a direct access extent address has been violated. (CSW contents do not apply.)
44000000	Channel program has been intercepted because of permanent error associated with device end of previous request. You may reissue the intercepted request. (CSW contents do not apply.)
48000000	Request element for channel program has been made available after it has been purged. (CSW contents do not apply.)
4F000000	Error recovery routines have been entered because of direct access error but are unable to read home address of record 0. (CSW contents do not apply.)

Appendix F: UCB Sense Bytes

BYTE 0

BIT / DEVICE	0	1	2	3	4	5	6	7
2400	CMD REJ	INT REQ	BUS OUT	EQ CHK	DATA CHK	OVER-RUN	WRT CNT ZERO	DATA CNVTT CHK
2311, 2841	CMD REJ	INT REQ	BUS OUT	EQ CHK	DATA CHK	OVER-RUN	TRK CCND CHK	SEEK CHK
2301, 2302, 2303, 2314, 2820	CMD REJ	INT REQ	BUS OUT	EQ CHK	DATA CHK	OVER-RUN		INVAL ADDR
2250	CMD REJ	SHOULD NOT OCCUR	BUS OUT	SHOULD NOT OCCUR	DATA CHK	SHOULD NOT OCCUR	BUFFER RUN-NING	SHOULD NOT OCCUR
2280	CMD REJ	INT REQ	BUS OUT	EQ CHK	DATA CHK	SHOULD NOT OCCUR	SHOULD NOT OCCUR	ILLGL SEG
2282	CMD REJ	INT REQ	BUS OUT	EQ CHK	DATA CHK	SHOULD NOT OCCUR	SHOULD NOT OCCUR	ILLGL SEGN
1052, 2150	CMD REJ	INT REQ	BUS OUT	EQ CHK				
1285	CMD REJ	INT REQ	BUS OUT	EQ CHK	DATA CHK	OVER-RUN	NON RCVY	KYBD CORR
1287	CMD REJ	INT REQ	BUS OUT	EQ CHK	DATA CHK	OVER-RUN	NON RCVY	KYBD CORR
1288	CMD REJ	INT REQ	BUS OUT	EQ CHK	DATA CHK	OVER-RUN	NON RCVY	SHOULD NOT OCCUR
2495	CMD REJ	INT REQ	BUS OUT	EQ CHK	DATA CHK	SHOULD NOT OCCUR	POSN CHK	SHOULD NOT OCCUR
2540, 2021	CMD REJ	INT REQ	BUS OUT	EQ CHK	DATA CHK		UN-USUAL CMD	
1403, 1443	CMD REJ	INT REQ	BUS OUT	EQ CHK	TYPE BAR	TYPE BAR		CH 9
1442, 2501, 2520	CMD REJ	INT REQ	BUS OUT	EQ CHK	DATA CHK	OVER-RUN		
2671, 2822	CMD REJ	INT REQ	BUS OUT	EQ CHK	DATA CHK			
2260	CMD REJ	INT REQ	BUS OUT	EQ CHK	SHOULD NOT OCCUR	SHOULD NOT OCCUR	SHOULD NOT OCCUR	SHOULD NOT OCCUR
2701, 2702	CMD RES	INT REQ	BUS OUT	EQ CHK	DATA CHK	OVER-RUN	LOST DATA	TIME OUT
1419/ 1275 PCU	CMD REJ	INT REQ	BUS OUT	NOT USED	DATA CHK	OVER-RUN	AUTO SELECT	NOT USED
1419/ 1275 SCU	CMD REJ	INT REQ	BUS OUT CHK	NOT USED	NOT USED	LATE STKR SELECT	AUTO SELECT	OP ATT

BYTE 1

0	1	2	3	4	5	6	7
NOISE	00-NON-XST TU 01-NOT READY 10-RDY & NO RWD 11-RDY & RWDNG		7 TRK	AT LOAD POINT	WRT STATUS	FILE PROTECT	TAPE IND
DATA CHK FLD	TRK OVER-RUN	END OF CYL	IN-VALID SEQ	NO REC FOUND	FILE PROT	MISSING ADR MRKR	OVER-FLOW INL
DATA CHK IN COUNT	TRK OVER-RUN	END OF CYL	INVAL SEQ	NO REC FOUND	FILE PROT	SERVICE OVER-RUN	OVER-FLOW INL
LIGHT PEN DETECT	END ORDER SEQ	CHAR MODE					
READ COUNT CHK	FILM LOW	RECRDR FORCED GAP	SHOULD NOT OCCUR	SHOULD NOT OCCUR	2840 OUTPUT CHK	2840 INPUT CHK	GRAPH-IC CHK
READ COUNT CHK	FILM LOW	RECRDR FORCED GAP	FILM MOTION LIMIT	SHOULD NOT OCCUR	2840 OUTPUT CHK	2840 INPUT CHK	GRAPH-IC CHK
TAPE MODE	LATE STKR SELECT	NO DOC FOUND	SHOULD NOT OCCUR	INVAL OP	SHOULD NOT OCCUR	SHOULD NOT OCCUR	SHOULD NOT OCCUR
SHOULD NOT OCCUR	END OF PAGE	NO DOC FOUND	SHOULD NOT OCCUR	INVAL OP	SHOULD NOT OCCUR	SHOULD NOT OCCUR	SHOULD NOT OCCUR
NOT USED	NOT USED	DOC UNDER READ HEAD	AMT FIELD VALID	PROCESS CNTRL FIELD VALID	ACCT # FIELD VALID	TRANSIT FIELD VALID	SERIAL # FIELD VALID

BYTE 2

0	1	2	3	4	5	6	7
BITS 0-7 INDICATE A TRACK IS IN ERROR						6 & 7 INDICATE NO ERROR OR MULTI-ERROR	
UN-SAFE		SERIAL-IZER CHK	TAG LINE CHK	ALU CHK	UNSEL STATUS		
UN-SAFE	SHIFT REG CHK	SKEW FAIL	CTR CHK	COMP CHK			
BUFFER ADDRESS REGISTER							
BIT 15	BIT 14	BIT 13	BIT 12	BIT 11	BIT 10	BIT 9	
BUFFER ADDRESS REGISTER							
BIT 15	BIT 14	BIT 13	BIT 12	BIT 11	BIT 10	BIT 9	
BUFFER ADDRESS REGISTER							
BIT 15	BIT 14	BIT 13	BIT 12	BIT 11	BIT 10	BIT 9	

BYTE 3

BIT / DEVICE	0	1	2	3	4	5	6	7
2400	R/W VRC	LRCR	SKEW	CRC	SKEW REQ VRC	0-1600 1-800	BKWD STATUS	COM-PARE
2311, 2841	READY	ON LINE	READ SAFETY	WRITE SAFETY		END OF CYL		SEEK INCMPL
2301, 2302, 2303, 2314, 2820	LRC BIT 0	LRC BIT 1	LRC BIT 2	LRC BIT 3				
2250	BUFFER ADDRESS REGISTER							
	BIT 8	BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1
2280	BUFFER ADDRESS REGISTER							
	BIT 8	BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1
2282	BUFFER ADDRESS REGISTER							
	BIT 8	BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1

BYTE 4

0	1	2	3	4	5	6	7
ECHO ERR	RES TAPE UNIT	READ CLOCK ERR	WRITE CLOCK ERR	DELAY CNTR ERR	SEQ IND C	SEQ IND B	SEQ IND A
SEQ IND 0	SEQ IND 1	SEQ IND 2	SEQ IND 3	SEQ IND 4	SEQ IND 5	SEQ IND 6	SEQ IND 7

BYTE 5

0	1	2	3	4	5	6	7
COMMAND IN PROGRESS WHEN OVERFLOW INCOMPLETE OCCURS OR ZERO							
COMMAND IN PROGRESS WHEN OVERFLOW INCOMPLETE OCCURS OR ZERO WRITE = X'05' READ = X'06'							

Appendix G: Service Aids

In addition to the debugging facilities discussed in this manual, IBM provides the following service aid programs to aid you in debugging. A complete description of each of these service aids and instructions for their use are found in the publication IBM System/360 Operating System Service Aids, GC28-6719.

Program Name	Functional Description
IMDSADMP	A stand-alone program, assembled with user-selected options, that dumps the contents of main storage onto a tape or a printer. The program has two versions: • A high speed version that dumps the contents of main storage to a tape. • A low speed version that formats and dumps the contents of main storage either to a tape or directly to a printer.
IMDPRDMP	A problem program that reads, formats according to user supplied parameters, and prints the tape produced by execution of the stand-alone dump program assembled from the service aid IMDSADMP. The format of the printed output is similar to that produced by ABEND.
IMCJQDMP	A stand-alone program that reads, formats, and prints either the entire operating system data set SYS1.SYSJOBQE, or selects and prints information related to a specific job in that data set. Because it operates independently of the operating system, IMCJQDMP can print the contents of the job queue as it appeared at the time of abnormal termination.
IMBMDMAP	A problem that produces a map of the system nucleus, any load module, the resident reenterable load module area of an MFT system, or the link pack area of an MVT system. The listing produced by this program shows the locations of CSECTS, external references, and entry points within a load module.
IMASPZAP	A problem program that can inspect and modify either data records or load modules located on a direct access storage device.
IMAPTFLS	A problem program that identifies program temporary fixes (PTFs) and local fixes that have been applied to libraries.
IMAPTFLE	A problem program that produces the job control language (JCL) statements necessary to apply PTFs to a system; these JCL statements are tailored to the user's individual system.

Appendix H: Control Block Pointers

This appendix summarizes the contents of the control blocks that are most useful in debugging. Control blocks are presented in alphabetical order, with displacements in decimal, followed by the hexadecimal counterpart in parentheses. Figure 34 illustrates control block relationships in the System/360 Operating System. Figure 35 shows relationships between storage control elements in a system with MVT.

CVT - Communications Vector Table

+0	Address of TCB control words
+53(35)	Address of entry point of ABTERM
+193(C1)	Address of secondary CVT (used only with Model 65 Multiprocessing systems)

DCB - Data Control Block

+40(28)	ddname (before open); offset to ddname in TIOT (after open)
+45(2D)	DEB address
+69(45)	IOB address

DEB - Data Extent Block

+1	TCB address
+5	Address of next DEB
+25(19)	DCB address
+33(21)	UCB address
+38(26)	Address of start of extent
+42(2A)	Address of end of extent

ECB - Event Control Block

+1	RB address or completion code

IOB - Input/Output Block

-7	Address of next IOB (BSAM, QSAM, and BPAM)
+2	Sense bytes
+5	ECB address
+9	CSW
+17(11)	CCW list address
+21(15)	DCB address

RB - Request Block (PCP and MFT)

-8	Address of previous RB on load list
-4	Address of next RB on load list
+0	Module name
+13(D)	Entry point address
+16(10)	Resume PSW
+29(1D)	Address of previous RB

RB - Request Block (MVT)

+4	Last half of user's PSW
+13(D)	CDE address
+16(10)	Resume PSW
+29(1D)	Address of previous RB

TIOT - Task Input/Output Table

+0	Job name
+8	Step name
+24(18)	DD entries begin (one variable-length entry for each DD statement)
+0	Length of DD entry
+4	ddname
+16(10)	Device entries begin (one 4-byte entry for each device)
+20(14)	Next device entry (if there is one)
	(Next DD entry begins at 24(18) plus length of first DD entry)

TCB - Task Control Block (PCP and MFT)

+1	Address of most recent RB
+9	Address of most recent DEB
+13(D)	TIOT address
+16(10)	Completion code
+25(19)	MSS boundary box address
+37(25)	Address of most recent RB on load list
+113(71)	Address of first save area
+161(A1)	Address of STAE control block
+181(B5)	Address of the job step control

TCB - Task Control Block (MFT) with Subtasking

+45(2D)	Address of TCB for job step task
+129(81)	Address of TCB for next subtask attached by same parent task
+133(85)	Address of TCB for parent task
+137(89)	Address of TCB for most recent subtask
+145(91)	Address of ECB to be posted at task completion
+181(B5)	Address of the job step control

TCB - Task Control Block (MVT)

+1	Address of most recent RB
+9	Address of most recent DEB
+13(D)	TIOT address
+16(10)	Completion code
+25(19)	Address of most recent SPQE
+33(21)	Bit 7 -- Non-dispatchability bit
+37(25)	Address of most recent LLE
+113(71)	Address of first save area
+125(7D)	Address of TCB for job step task
+129(81)	Address of TCB for next subtask attached by same parent task
+133(85)	Address of TCB for parent task
+137(89)	Address of TCB for most recent subtask
+145(91)	Address of ECB to be posted at task completion
+153(99)	Address of dummy PQE minus 8 bytes
+161(A1)	Address of STAE control block
+181(B5)	Address of the job step control

UCB - Unit Control Block

-4	CPU ID (used only with Model 65 Multiprocessing systems)
+2	FF (UCB identification)
+4	Device address
+13(D)	Unit name
+18(12)	Device class
+19(13)	Device type
+22(16)	Sense bytes
+40(28)	Number of outstanding RESERVE requests (shared DASD only)

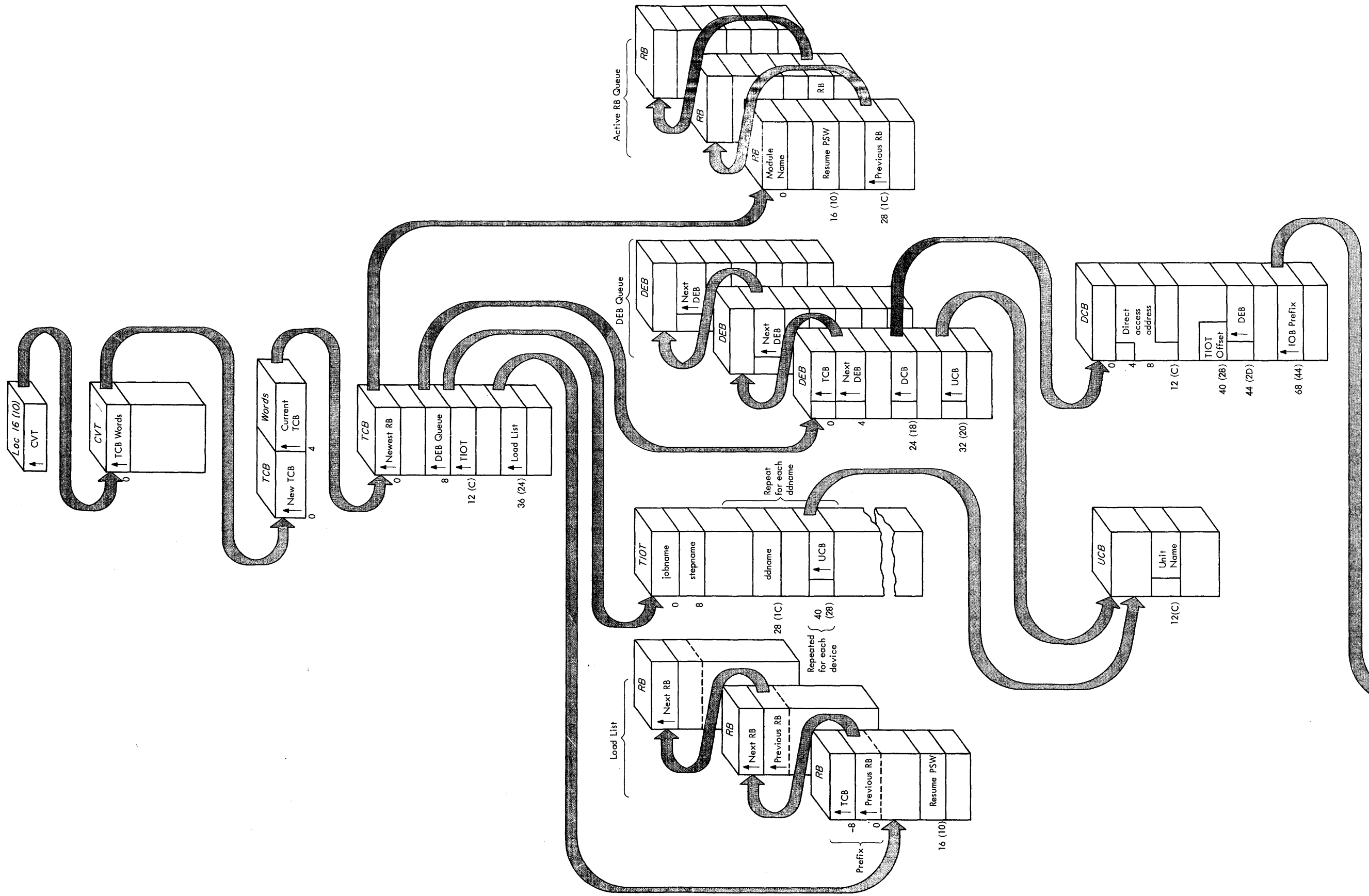
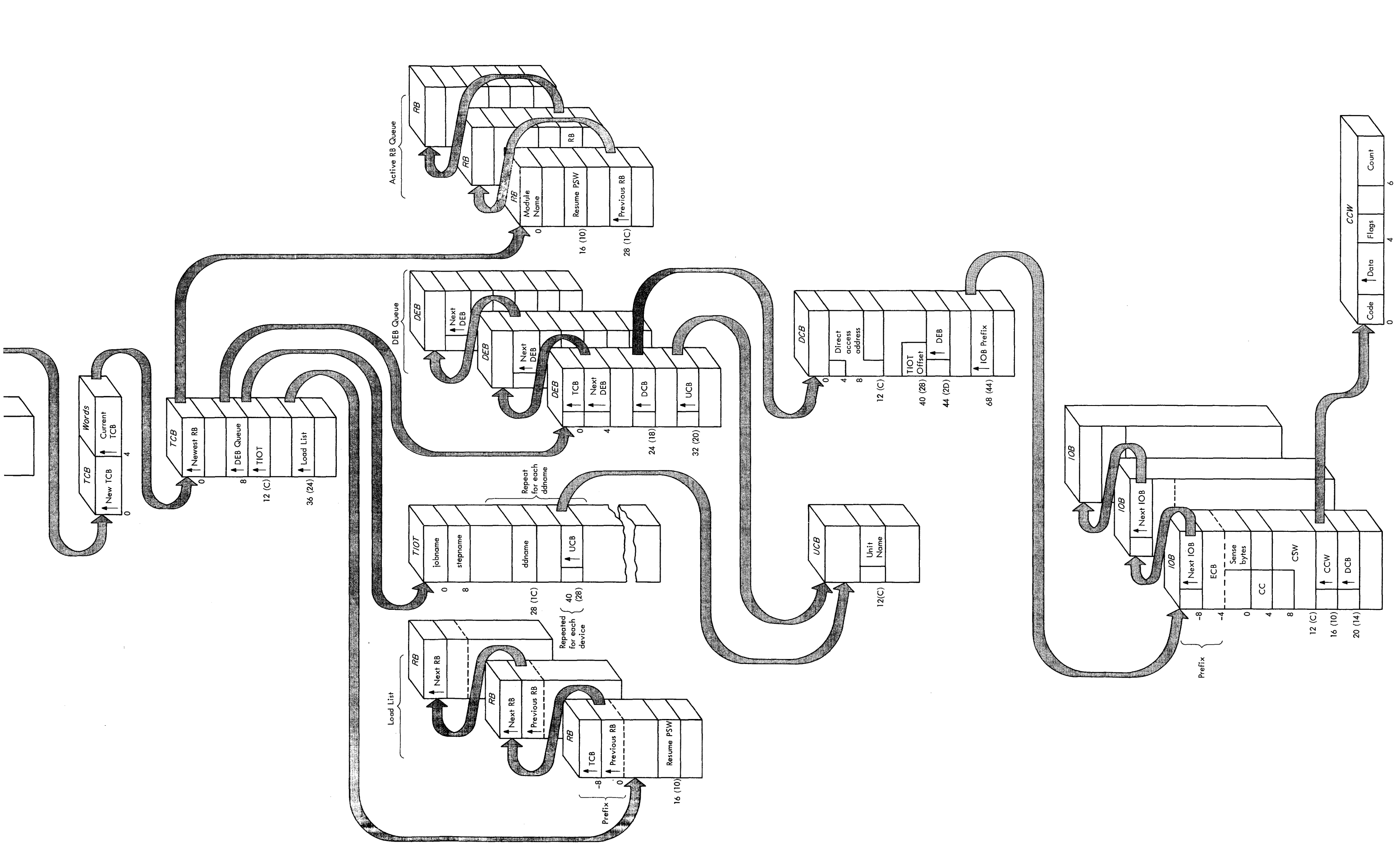


Figure 34. Control Block Flow


TCB
New TCB
Current TCB
Words
0
4
TCB
Newest RB
DEB Queue
TIOT
Load List
0
8
12 (C)
36 (24)
Active RB Queue
RB
Module Name
Resume PSW
Previous RB
RB
0
16 (10)
28 (1C)
DEB Queue
DEB
Next DEB
TCB
Next DEB
DCB
UCB
0
4
24 (18)
32 (20)
DCB
Direct access address
TIOT Offset
DEB
IOB Prefix
0
4
8
12 (C)
40 (28)
44 (2D)
68 (44)
Repeat for each ddname
TIOT
jobname
stepname
ddname
UCB
0
8
28 (1C)
40 (28)
Repeated for each device
UCB
Unit Name
12(C)
Load List
RB
Next RB
RB
Next RB
Previous RB
RB
TCB
Previous RB
Resume PSW
-8
0
Prefix
16 (10)
IOB
IOB
Next IOB
IOB
Next IOB
ECB
Sense bytes
CC
CSW
CCW
DCB
-8
-4
0
4
8
12 (C)
16 (10)
20 (14)
Prefix
CCW
Code
Data
Flags
Count
0
4
6

Block Flow

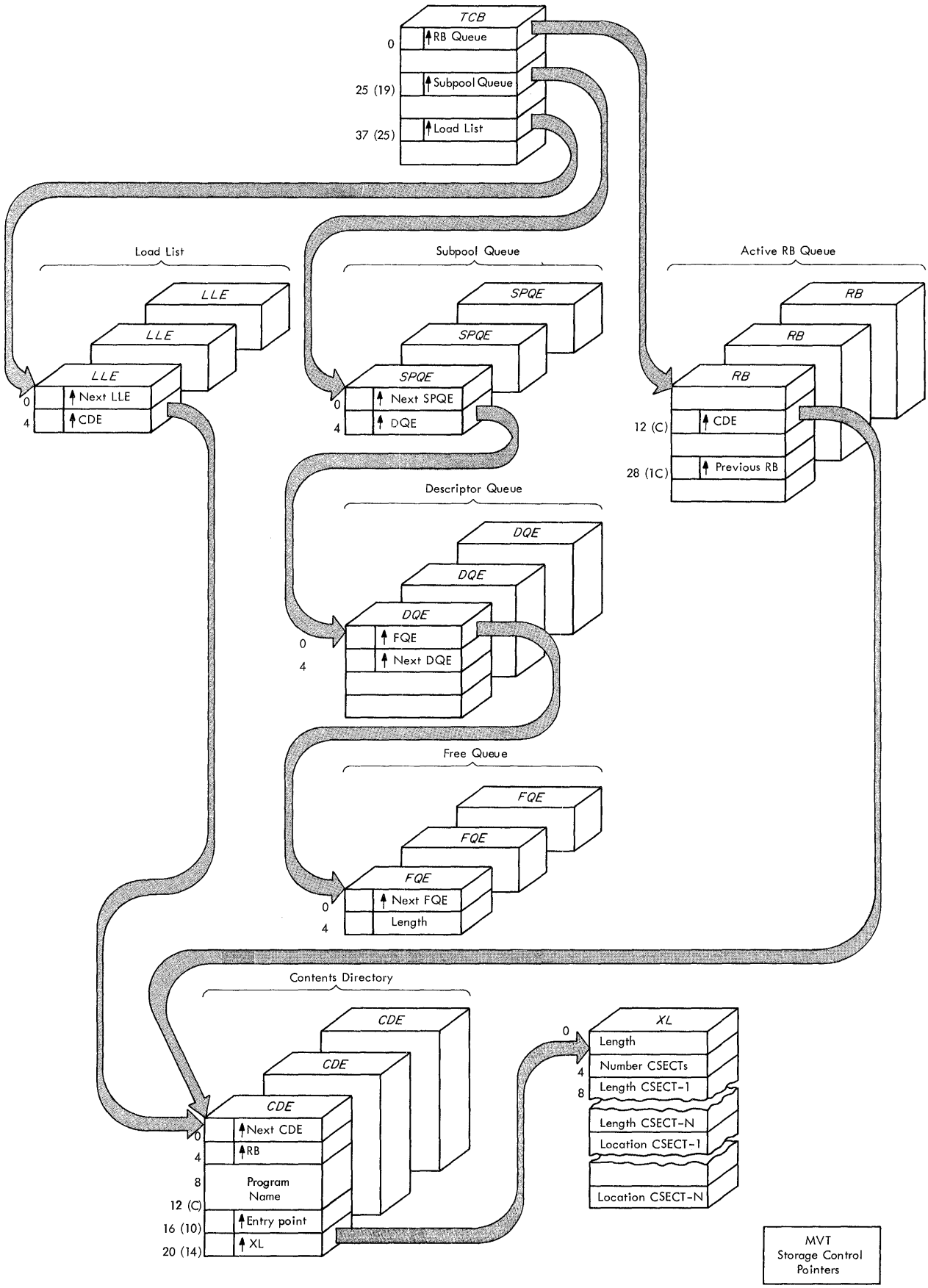


Figure 35. MVT Storage Control Flow

Indexes to systems reference library manuals are consolidated in the publication IBM System/360 Operating System: Systems Reference Library Master Index, GC28-6644. For additional information about any subject listed below, refer to other publications listed for the same subject in the Master Index.

When more than one page reference is given, the major reference is first.

Abbreviations, list of 96
ABEND dumps
  contents of (MVT) 49-67
  contents of (PCP,MFT) 36-47
  guide to using (MVT) 66-67
  guide to using (PCP,MFT) 47,48
  how to invoke (MVT) 49
  how to invoke (PCP,MFT) 33
  introduction to 9
  samples of (MVT) 50,51
  samples of (PCP) 34,35
ABEND macro instruction 33
Abnormal termination, cause of
  in an ABEND/SNAP dump (MVT) 66
  in an ABEND/SNAP dump (PCP,MFT) 47
Abnormal termination dumps (see ABEND dumps)
Active RB queue
  description of 13
  instructions for using 30
  in a core image dump (MFT) 81,82
  in a core image dump (MVT) 85
  in a core image dump (PCP) 79
  in a stand-alone dump (MFT) 81,82
  in a stand-alone dump (MVT) 85
  in a stand-alone dump (PCP) 79
  in an ABEND/SNAP dump (MVT) 55-56,67
  in an ABEND/SNAP dump (PCP,MFT) 40-41,47
  in an indicative dump 70
AMWP bits
  in an indicative dump 70
  meaning of 31
APSW field, in an ABEND/SNAP dump (MVT) 55,66
ATTACH macro instruction, effects of 15,16
Attaching subtasks 17,18

Boundary
  problem program 31,43

Catalog dump 33,34
CDE
  as used with the load list 14
  format of 23,24
  in an ABEND/SNAP dump 57
  in a core image dump 85
  in a stand-alone dump 85
CHAP macro instruction 18
Communications vector table (see CVT)
Complete dump (MVT)
  description of 49
  sample of 50,51
Completion codes
  description of common 91-94
  explanation of 30
  in an ABEND/SNAP dump (MVT) 52
  in an ABEND/SNAP dump (PCP,MFT) 38
  in an indicative dump 69
COND parameter,
  to regulate job step execution 34
  to regulate space deletion 36
Contents directory
  description of 14,23-24
  entries (see CDE)
Control blocks
  descriptions of 25-26
  pointers in 100-101
  relationships between 25
  use in debugging 31
Control information 10
Control program nucleus
  ABEND/SNAP (MVT) 63
  ABEND/SNAP (PCP,MFT) 46-47
Core image dumps
  contents of 73
  guide to using (MFT) 80-84
  guide to using (MVT) 84-86
  guide to using (PCP) 79,80
  introduction to 71
CVT
  description of 25
  in a core image dump (PCP) 80
  in a stand-alone dump (PCP) 80
  pointers in 100

Data control block (see DCB)
Data event control block 25
Data extent block (see DEB)
Damage assessment routine (DAR) 71
DCB
  description of 25
  in a core image dump (MFT) 83
  in a core image dump (MVT) 86
  in a core image dump (PCP) 80
  in a stand-alone dump (MFT) 83
  in a stand-alone dump (MVT) 86
  in a stand-alone dump (PCP) 80
  pointers in 100
DD statements
  required with ABEND/SNAP dumps 33-34
  sample of SYSABEND 36
DEB
  description of 25
  in a core image dump (MFT) 83
  in a core image dump (MVT) 86
  in a core image dump (PCP) 80
  in a stand-alone dump (MFT) 83

DEB (continued)
in a stand-alone dump (MVT) 86
in a stand-alone dump (PCP) 80
in an ABEND/SNAP dump (MVT) 58
in an ABEND/SNAP dump (PCP,MFT) 44
pointers in 100
DEB queue
in a core image dump (MFT) 83
in a core image dump (MVT) 86
in a core image dump (PCP) 80
in a stand-alone dump (MFT) 83
in a stand-alone dump (MVT) 86
in a stand-alone dump (PCP) 80
in an ABEND/SNAP dump (MVT) 53
in an ABEND/SNAP dump (PCP,MFT) 38
Debugging procedure
description of 30-32
summary 32
DECB 25
DELETE macro instruction 14
Dequeued elements 37
Descriptor queue element (see DQE)
Destroyed queues 37
Device considerations,
for ABEND/SNAP dumps 33-34
Dispatcher trace table entry (MVT)
format of 28
in a SNAP dump 64,66
in a core image dump 84-85
in a stand-alone dump 84-85
Dispatching priority 17-18
Displacements, how shown 9
DQE
format of 22-23
in a core image dump 86
in a stand-alone dump 86
in an ABEND/SNAP dump 59,67
Dump (see individual type of dump, e.g., ABEND, indicative)
Dump data set
MVT 49
PCP,MFT 33
Dynamic area
in systems with MVT 18
in systems with MFT 17
in systems with PCP 16-17

ECB
completion codes, list of 97
description of 25
in a core image dump (MFT) 83-84
in a core image dump (MVT) 86
in a core image dump (PCP) 80
in a stand-alone dump (MFT) 83-84
in a stand-alone dump (MVT) 86
in a stand-alone dump (PCP) 80
pointers in 100
posting of, using ATTACH 16
Event control block (see ECB)
Extent list (see XL)
External interruption 31,32
External trace table entry
format of 28
in a SNAP dump 64,66-67
in a core image dump 84-85
in a stand-alone dump 84-85

FBQE
format of 21-22
in a core image dump 86
in a stand-alone dump 86
in an ABEND/SNAP dump 60,67
FINCH request block 11-12
Finding the partition TCB 81
FRB 11-12
Fixed area
in systems with MFT 17-18
in systems with MVT 18
in systems with PCP 16
FQE
format of (MFT,PCP) 19
format of (MVT) 23
in a core image dump (MFT) 84
in a core image dump (PCP) 80
in a stand-alone dump (MFT) 84
in a stand-alone dump (PCP) 80
in an ABEND/SNAP dump (MVT) 59,67
Free areas
in a core image dump (MFT) 84
in a core image dump (PCP) 80
in a stand-alone dump (MFT) 84
in a stand-alone dump (PCP) 80
in an ABEND/SNAP dump (PCP,MFT) 47
Free block queue element (see FBQE)
Free queue element (see FQE)

General debugging procedure
description of 30-32
summary 32
GETMAIN macro instruction 20
Gotten subtask area 18-20
Gotten subtask area queue element 20-21
GQE 20-21
Guide to using core image or a stand-alone dump 78

Hardware error 31
Hierarchy, main storage 19-21

IEAPRINT 71,72
IMAPTFLE 99
IMAPTFLS 99
IMASPZAP 99
IMBMDMAP 99
IMCJQDMP 99
IMDPRDMP 99
IMDSADMP 99
Indicative dumps
contents of 68-70
description of 68
guide to using 70
introduction 9
Input/output block (see IOB)
Interrupt request block 11
Interruptions 31-32
Introduction 9
IOB
description of 25
in a core image dump (MFT) 83
in a core image dump (MVT) 86

IOB (continued)
in a core image dump (PCP) 80
in a stand-alone dump (MFT) 83
in a stand-alone dump (MVT) 86
in a stand-alone dump (PCP) 80
pointers in 100
I/O interruption 31-32
I/O trace table entry
format of 28
in a core image dump (MFT) 83
in a core image dump (MVT) 84-85
in a core image dump (PCP) 79
in a stand-alone dump (MFT) 83
in a stand-alone dump (MVT) 84-85
in a stand-alone dump (PCP) 79
in a SNAP dump (MVT) 64,66-67
in an ABEND/SNAP dump (PCP,MFT) 45,47
IRB 11,12

Job pack area 14-15
Job pack area queue 14-15
Job step 16-18
Job step task (MVT) 18,49
JPAQ 14,15

Keep dump 33-34

LINK macro instruction, effects of 15
Link pack area (MVT) 18
LLE
count field 14
description of 14
in an ABEND/SNAP dump (MVT) 53
Load list
description of 14
instruction for using 30,32
in a core image dump (MFT) 82
in a core image dump (MVT) 85
in a core image dump (PCP) 79
in a stand-alone dump (MFT) 82
in a stand-alone dump (MVT) 85
in a stand-alone dump (PCP) 79
in an ABEND/SNAP dump (MVT) 56,66
in an ABEND/SNAP dump (PCP,MFT) 41-42,47
in an indicative dump 69
in systems with MVT 14
in systems with PCP or MFT 13-14
Load list element (see LLE)
LOAD macro instruction, effects of 16
Load module, storage control for
in an ABEND/SNAP dump (MVT) 56-57,67
in systems with MVT 23-24
Loaded program request block 11,12
Loaded request block 11,12
LPRB 11,12
LRB 11,12

Main storage hierarchy support
inclusion of 19-21
effects on MSS boundary box 19-20
effects on partition queue 19

Main storage layout
in systems with MFT with subtasking 17-18
in systems with MFT without subtasking 17
in the systems with MVT 18
in system with PCP 11-17
Main storage management 10
Main storage supervisor's boundary box (see MSS)
Machine check interruption 31-32
MFT, systems with
considerations in using an ABEND/SNAP dump of 47-48
contents of an ABEND/SNAP dump of 36-47
guide to using a core image dump of 80-84
guide to using a stand-alone dump of 80-84
how to invoke an ABEND/SNAP dump of 33-34
main storage layout in 17,18
storage control in 20-21
task control characteristics of 17-18
trace table entries in 25,82-83
Model 65 Multiprocessing system
trace table formats 28
prefixed storage area, as shown in an ABEND/SNAP dump (MVT) 63
trace table entries in a SNAP dump 65
Module name prefixes, list of 95
description of (MFT) 20
description of (PCP) 19
in a core image dump (MFT) 84
in a core image dump (PCP) 80
in a stand-alone dump (MFT) 84
in a stand-alone dump (PCP) 80
in an ABEND/SNAP dump (MVT) 58-59
starting address (PCP,MFT) 38
Multiprogramming with a fixed number of tasks (see MFT, systems with)
Multiprogramming with a variable number of tasks (see MVT, system with)
MVT, systems with
complete ABEND/SNAP dump of 50-51
contents of an ABEND/SNAP dump 49-66
guide to using a core image dump of 84-86
guide to using a stand-alone dump of 84-86
guide to using an ABEND/SNAP dump of 66-67
how to invoke an ABEND/SNAP dump of 49
load list in 14
main storage layout in 18
storage control in 22-24
task control characteristics in 18
trace table entries in 28,84-85

Nucleus
contents of 16-18
in an ABEND/SNAP dump (MVT) 63
in an ABEND/SNAP dump (PCP,MFT) 47

Only loadable (OL) 11
Option 2 (see MFT, systems with)

Option 4 (see MVT, systems with)
Overlaid problem program 37

Partition (MFT) 17-18
Partition queue element (see PQE)
Partition TCBs 81
PCP, system with
  contents of an ABEND/SNAP dump of 37-47
  guide to using a core image dump of 79-80
  guide to using a stand-alone dump of 79-80
  guide to using an ABEND/SNAP dump of 47-48
  how to invoke an ABEND/SNAP dump of 33-34
  load list in 13-14
  main storage layout in 16
  storage control in 19
  task control characteristics of 16-17
  trace table entries in 28,79-80
PIE 38,52
Pointers, control block 100-101
PQE
  format of 21
  in a core image dump 86
  in a stand-alone dump 86
  in an ABEND/SNAP dump 59-67
PRB 11
Prerequisite publications 3
Primary control program (see PCP, systems with)
Priority 17,18
Problem program, how to locate in a dump 30-32
Problem program storage boundaries, in an ABEND/SNAP dump (PCP, MFT) 43
Program check interruption 31
Program check old PSW
  in an ABEND/SNAP dump (MVT) 55,66
  information in 31
Program check trace table entry
  format of 28
  in a SNAP dump 64-65
  in a core image dump 80-85
  in a stand-alone dump 80-85
Program interruption element (see PIE)
Program request block 11
Protection key 38
PSW at entry to ABEND
  in an ABEND/SNAP dump (MVT) 52
  in an ABEND/SNAP dump (PCP,MFT) 38
PSW, program check old (see program check old PSW)
PSW, resume (see resume PSW)

QCB 60
Queue elements (MVT) 19,21-24
Queues destroyed 37

RB
  as affected by LINK, ATTACH, XCTL and LOAD 15-17
  formats of 10-12
RB (continued)
  in an ABEND/SNAP dump (MVT) 55-56
  in an ABEND/SNAP dump (PCP,MFT) 40-41,47
  in an indicative dump 69-70
  most recent 38,52
  name field, in a dump 30,32
  purpose of 12-13
  pointers in 100
  pointers to, in a core image dump (MFT) 81-82
  pointers to, in a core image dump (MVT) 86
  pointers to, in a core image dump (PCP) 79
  pointers to, in a stand-alone dump (PCP) 79
  queue (see active RB queue)
  sizes of 11-12
  types of 10-12
  usefulness in debugging 10-11,26,28
  when created 11-15
  which ones appear in a dump 30-31
Re-creating the task structure
  MFT with subtasking 81
  MVT 85
Reenterable load module area (MFT) 17
Reference publications 3
Region (MVT)
  contents of, in a core image dump 86
  contents of, in a stand-alone dump 86
  contents of, in an ABEND/SNAP dump 67
  description of 18
  storage control for 21-22
Register contents
  in a save area 27
  in an ABEND/SNAP dump (MVT) 63-64
  in an ABEND/SNAP dump (PCP,MFT) 46
  in an indicative dump 69
Request block (see RB)
Resume PSW
  description of 11
  in an ABEND/SNAP dump (MVT) 56,65
  in an ABEND/SNAP dump (PCP,MFT) 41,47
  in an indicative dump 68,70
Retain dump 33-34
Rollout/rollin
  effects on partition queue 20

Save areas
  format of 27
  in an ABEND/SNAP dump (MVT) 61-62
  in an ABEND/SNAP dump (PCP,MFT) 43
Sense bytes, UCB
  in a core image dump (MFT) 83
  in a core image dump (MVT) 86
  in a core image dump (PCP) 80
  in a stand-alone dump (MFT) 83
  in a stand-alone dump (MVT) 86
  in a stand-alone dump (PCP) 80
  table of 98
Sequential partitioned system (see MFT, systems with)
Sequential scheduling system (see PCP, systems with)
Service aids 99

Set system mask trace table entry
format of 29
in a core image dump (MVT) 84-85
in a stand-alone dump (MVT) 84-85
in an ABEND/SNAP dump 64-65
SIO trace table entry
format of (MFT) 28
format of (MVT) 28-29
format of (PCP) 28
in a SNAP dump (MVT) 64-65
in a core image dump (MFT) 82-83
in a core image dump (MVT) 84-85
in a core image dump (PCP) 79-80
in a stand-alone dump (MFT) 82-83
in a stand-alone dump (MVT) 84-85
in a stand-alone dump (PCP) 79-80
in an ABEND-SNAP dump (PCP,MFT) 45,47-48
SIRB 11-12
SNAP dumps
contents of (MVT) 49-66
contents of (PCP,MFT) 36-47
guide to using (MVT) 66-67
guide to using (PCP,MFT) 47-48
how to invoke (MVT) 49
how to invoke (PCP,MFT) 33-34
introduction to 9
SNAP macro instruction 33
Snapshot dumps (see SNAP dumps)
Space considerations, for ABEND/SNAP dumps 33-34
SPQE
format of 22-23
in a core image dump 86
in a stand-alone dump 86
in an ABEND/SNAP dump 58,67
SQS (see system queue space)
SSM (see set system mask trace table entry)
Stand-alone dumps
areas shown on 75-76
description of 75-76
contents of 75-76
guide to using (MFT) 80-84
guide to using (MVT) 84-86
guide to using (PCP) 79-80
how to invoke 75
introduction to 9
Storage control
in systems with MFT with subtasking 20
in systems with MFT without subtasking 20-21
in systems with MVT 21-24
in systems with PCP 19
Subpool
definition of 22
in a core image dump 86
in a stand-alone dump 86
in an ABEND/SNAP dump 58-59,67
queue elements (see SPQE)
Subtask, as created by ATTACH 15-16
Supervisor calls, list of 87-90
Supervisor interrupt request block 11-12
Supervisor request block 11-12
SVC interruption 31-32
SVC trace table entries
format of (MFT) 28
format of (MVT) 28
format of (PCP) 28
SVC trace table entries (continued)
in a SNAP dump (MVT) 64-65
in a core image dump (MFT) 83
in a core image dump (MVT) 84-85
in a core image dump (PCP) 79-80
in a stand-alone dump (MFT) 83
in a stand-alone dump (MVT) 84-85
in a stand-alone dump (PCP) 79-80
in an ABEND/SNAP dump (PCP,MFT) 45,47
SVCs, list of 87-90
SVRB 11-12
SYSABEND DD statement
description of 33-34
samples of 33
SYSOUT, as a dump data set 33-34
System control blocks (see control blocks)
System differences in task control 16-18
System failure 71
System queue space (MVT) 18
System tasks 16-18
System wait TCB 85
SYS1.DUMP data set 71
SYS1.SVCLIB
SYSUDUMP DD statement 33-34

Task completion code (see completion codes)
Task control block (see TCB)
Task control differences, by system 16-18
Task dispatching priority 17-18
Task input/output table (see TIOT)
Task management 10-12
Task supervision 10-12
Task structure, recreating the, using a core image dump (MVT) 85
Task structure, recreating the, using a stand-alone dump (MVT) 85
Task switch trace table entry (MFT)
format of 28
in core image dump 82-83
in a stand-alone dump 82-83
in an ABEND/SNAP dump 47
Task switching (MFT) 17-18
TCB
description of 10
in an ABEND/SNAP dump (MVT) 52-54
in an ABEND/SNAP dump (PCP,MFT) 38-40
information available through 10
locating, in a core image dump 85
locating, in a stand-alone dump 85
pointers in 100-101
pointers to, in a core image dump (MFT) 76
pointers to, in a stand-alone dump (MFT) 81
queue (MFT) 17
queue (MVT) 18
relationships 17-19
TCBLTC 17,100-101
TCBNTC 17,100-101
TCBOTC 17,100-101
TCBTCB 17,100-101
Termination, abnormal (see abnormal termination)
TIOT
description of 25
pointers in 100

Traces 27-29
Trace table
control block 79,82,84
delimiting entries, in an ABEND/SNAP dump (MFT) 47
description of 27-29
format of entries (MFT) 28
format of entries (MVT) 28
format of entries (PCP) 28
format of entries (Mod 65 multiprocessing systems) 29
in a SNAP dump (MVT) 64-65
in a core image dump (MFT) 82-83
in a core image dump (MVT) 84-85
in a core image dump (PCP) 79-80
in a stand-alone dump (MFT) 82-83
in a stand-alone dump (MVT) 84-85
in a stand-alone dump (PCP) 79-80
in an ABEND/SNAP dump (PCP,MFT) 45
samples of entries (MFT) 82-83
samples of entries (MVT) 84-85
samples of entries (PCP) 79-80
usefulness in debugging 31-32

UCB
description of 25
in a core image dump (MFT) 83
in a core image dump (MVT) 86
in a core image dump (PCP) 80
in a stand-alone dump (MFT) 83
in a stand-alone dump (MVT) 86
in a stand-alone dump (PCP) 80
in an ABEND/SNAP dump (PCP,MFT) 44
pointers in 101
Unit control block (see UCB)
Use count 15-17

Wait list 15,20
Wait list element 15,20
WLE 15,20

XCTL macro instruction, effects of 16
XL
description of 24
in a core image dump 86
in a stand-alone dump 86
in a ABEND/SNAP dumps 57,67

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