IBM

Series/1

SC34-0941-0

Event Driven Executive Problem Determination Guide

Version 6.0

Library Guide and Common Index SC34-0938	Installation and System Generation Guide SC34-0936	Operator Commands and Utilities Reference SC34-0940
Language Reference SC34-0937	Communications Guide SC34-0935	Messages and Codes SC34-0939
Operation Guide SC34-0944	Event Driven Language Programming Guide SC34-0943	APPC Programming Guide and Reference SC34-0960
Problem Determination Guide SC34-0941	Customization Guide SC34-0942	Internal Design LY34-0364

Series/1

SC34-0941-0

Event Driven Executive Problem Determination Guide

Version 6.0

Library Guide and Common Index SC34-0938	Installation and System Generation Guide SC34-0936	Operator Commands and Utilities Reference SC34-0940
Language Reference SC34-0937	Communications Guide SC34-0935	Messages and Codes SC34-0939
Operation Guide SC34-0944	Event Driven Language Programming Guide SC34-0943	APPC Programming Guide and Reference SC34-0960
Problem Determination Guide **SC34-0941**	Customization Guide SC34-0942	Internal Design LY34-0364

First Edition (September 1987)

Use this publication only for the purposes stated in the section entitled "About This Book."

Changes are made periodically to the information herein; any such changes will be reported in subsequent revisions or Technical Newsletters.

This material may contain reference to, or information about, IBM products (machines and programs), programming, or services that are not announced in your country. Such references or information must not be construed to mean that IBM intends to announce such IBM products, programming, or services in your country.

Publications are not stocked at the address given below. Requests for copies of IBM publications should be made to your IBM representative or the IBM branch office serving your locality.

This publication could contain technical inaccuracies or typographical errors. A form for readers' comments is provided at the back of this publication. If the form has been removed, address your comments to IBM Corporation, Information Development, Department 28B (5414), P. O. Box 1328, Boca Raton, Florida 33429-1328. IBM may use or distribute any of the information you supply in any way it believes appropriate without incurring any obligation whatever. You may, of course, continue to use the information you supply.

© Copyright International Business Machines Corporation 1987

Summary of Changes For Version 6.0

This document contains the following changes:

4956 J and K processors

- Chapter 3, "Interpreting the Task Control Block Information" on page 3-8 contains information about the AKR for 3-, 4-, and 5-bit processors
- Chapter 4, "How to Determine the Cause of a Run Loop" on page 4-1 contains information about the AKR for 3-, 4-, and 5-bit processors
- Chapter 6, "Interpreting the Standard Program Check Message" on page 6-2 contains information about the AKR for 3-, 4-, and 5-bit processors
- Chapter 8, "Exception Entry Format" on page 8-4 contains information about the AKR for 3-, 4-, and 5-bit processors

Usability Changes

- Chapter 9, "Displaying APPC Error Log Information" on page 9-12 contains APPC error log examples, explanations, and information.

Contents

Chapter 1. Some Things You Should Know About Problem Determination 1-1

Chapter 2. Determining the Problem Type 2-1
Some Hints to Determine the Possible Problem Type 2-1
Can You Operate the System After Pressing the Load Button? 2-1
Is the Run Light On and Solidly Lit? 2-1
Is the System or a Program Idle While You Expect Activity? 2-1
Did the System Issue a Program Check Message? 2-1

Chapter 3. Analyzing and Isolating an IPL Problem 3-1
What You Should Check First 3-1
How to Recognize a Problem with the IPL Device 3-1
How to Correct the IPL Text 3-2
How to Reload the Supervisor 3-2
Determining the Failure in a Tailored Supervisor 3-3
Detecting an IPL Stop Code Error 3-3
Finding the Initialization Module in Storage When the Failure Occurred 3-4
Isolating a Failing Terminal Using the Terminal Control Block 3-5
Analyzing the INITTASK Task Control Block 3-6

Chapter 4. Analyzing and Isolating Run Loops 4-1
How to Determine the Cause of a Run Loop 4-1
How to Identify a Program in a Run Loop 4-2
Using the $D Operator Command to Identify a Looping Program 4-3
Using the Programmer Console to Identify a Looping Program 4-6
Using $DEBUG to Isolate a Run Loop 4-8
Determining the Starting and Ending Points of the Loop 4-9
Some Common Causes of Run Loops 4-11
Using the Compiler Listing to Locate the Loop 4-12
Examining an Unmapped Storage Area for the Cause of a Loop 4-14
Run Loops Caused by Device Interrupts 4-20
Run Loops Caused by Stack Overflows 4-20

Chapter 5. Analyzing and Isolating a Wait State 5-1
How to Find the Address of the Waiting Instruction Using $DEBUG 5-1
Analyzing the Instruction that Caused the Wait State 5-2
Analyzing an ENQ Instruction 5-2
Common Causes of a Program Wait Using QCBs 5-5
Analyzing an ENQT Instruction 5-6
Analyzing a WAIT Instruction 5-7
Common Causes of a Program Wait Using ECBs 5-8
Other Possible Causes of a Wait State 5-8

Chapter 6. Analyzing and Isolating a Program Check 6-1
How to Interpret the Program Check Message 6-1
Interpreting the Standard Program Check Message 6-2
How to Interpret the Processor Status Word 6-4
Interpreting the Processor Status Word Bits 6-4
Interpreting the Program Check Message from $$EDXIT 6-7
How to Analyze an Application Program Check 6-11
Examining an Unmapped Storage Area for the Cause of a Program Check 6-15
Some Common Causes of Application Program Checks 6-21

How to Analyze a System Program Check 6-21
Analyzing the Program Causing the System Program Check 6-22

Chapter 7. Analyzing a Failure Using a Storage Dump 7-1
Interpreting the Dump 7-1
Hardware Level and Register Contents 7-2
Floating-Point Registers and Exception Information 7-5
Segmentation Registers 7-6
Storage Map 7-10
Level Table and TCB Ready Chain 7-12
Terminal Device Information 7-13
Disk, Diskette, and Tape Device Information 7-13
EXIO, BSC, and Timer Information 7-16
Storage Partition Information 7-17
Unmapped Storage Information 7-18
Analyzing a Wait State 7-24
Analyzing a Program Check 7-30
Analyzing a Run Loop 7-34

Chapter 8. Tracing Exception Information 8-1
Displaying the Software Trace Table 8-1
Software Trace Table Format 8-2
Control Information Format 8-3
Exception Entry Format 8-4
Finding the Program Load Point Address 8-6

Chapter 9. Recording Device I/O Errors and Program Check Information 9-1
Controlling Error Logging 9-2
Changing the Size of the Default Log Data Set 9-3
Printing or Displaying the Log Information 9-5
Printing the Default Log Data Set Using the ERAP Operator Command 9-5
Printing or Displaying a Log Data Set Using the $DISKUT2 Utility 9-6
Interpreting the Log Information 9-8
Displaying APPC Error Log Information 9-12

Appendix A. How to Use the Programmer Console A-1
Reading the Console Indicator Lights A-2
Displaying Main Storage Locations A-4
Storing Data into Main Storage A-5
Displaying Register Contents A-6
Storing Data into Registers A-6
Stopping at a Storage Address A-7
Stopping When an Error Occurs A-7
Executing One Instruction at a Time A-8

Appendix B. Allowing IBM Access to Your System B-1
Hardware Requirements B-2
Authorizing the Link B-2
Disconnecting the Line B-4

Appendix C. Interpreting a Dump (Example) C-1
Overview C-1
Interpreting The Formatted Control Blocks in a Dump C-2
Interpreting the State of Tasks (TCBs) in the Dump C-10

Appendix D. Conversion Table D-1

Index X-1

About This Book

This book is a guide to assist you in determining the causes of problems you may encounter while using the Event Driven Executive (EDX) operating system. It explains how to use many of the diagnostic tools available to help you identify problems. Use this book when the *Messages and Codes* manual cannot point you to the source of a problem or the corrective action to take.

Audience

This book is intended for anyone who encounters a hardware or software problem while using the EDX operating system on the Series/1. The *Operation Guide* describes how to record information that may be of help to you when analyzing the problems discussed in this book.

How This Book Is Organized

This book contains 9 chapters and 3 appendixes:

- Chapter 1, "Some Things You Should Know About Problem Determination" introduces the process of problem determination.
- Chapter 2, "Determining the Problem Type" presents some problem symptoms to help you determine the type of problem you have.
- Chapter 3, "Analyzing and Isolating an IPL Problem" describes some procedures that can help identify the cause of an IPL failure.
- Chapter 4, "Analyzing and Isolating Run Loops" explains how to pinpoint the cause of a run loop in an application program.
- Chapter 5, "Analyzing and Isolating a Wait State" describes how to determine the cause of a wait state during normal system operation.
- Chapter 6, "Analyzing and Isolating a Program Check" discusses how to isolate the cause of a system or application program check.
- Chapter 7, "Analyzing a Failure Using a Storage Dump" describes how to read a stand-alone or $TRAP storage dump to isolate failures.
- Chapter 8, "Tracing Exception Information" explains how you can isolate the cause of exceptions by analyzing the software trace table, CIRCBUFF.
- Chapter 9, "Recording Device I/O Errors and Program Check Information" discusses the use of the $LOG utility to record device I/O errors and program check messages.
- Appendix A, "How to Use the Programmer Console" describes the functions of the optional Series/1 programmer console and how you can use it during problem analysis.

- Appendix B, "Allowing IBM Access to Your System" describes the hardware requirements and procedures for using the Remote Support Link feature of the Event Driven Executive. This feature enables an IBM support center representative to get direct access to your Series/1 system through a remote terminal.
- Appendix D, "Conversion Table" contains a table that shows the hexadecimal, binary, EBCDIC, and ASCII equivalents of decimal values.
- Appendix C, "Interpreting a Dump (Example)" provides an example of an interpretation of a dump and analyses of the causes for typical problems.

A Guide to the Library

Refer to the *Library Guide and Common Index* for information on the design and structure of the Event Driven Executive library, for a bibliography of related publications, for a glossary of terms and abbreviations, and for an index to the entire library.

Contacting IBM about Problems

You can inform IBM of any inaccuracies or problems you find with this book by completing and mailing the **Reader's Comment Form** provided in the back of the book.

If you have a problem with the IBM Series/1 Event Driven Executive, refer to the *IBM Series/1 Software Service Guide*, GC34-0099.

Chapter 1. Some Things You Should Know About Problem Determination

Problem determination involves analyzing a software or hardware error. The system can indicate in various ways that a problem exists. The two most common ways are by displaying messages on a terminal or by returning a return code to your application program. By using the *Messages and Codes* manual *before* you use this book, you may be able to determine the type of problem you have and the corrective action to take. If, however, you cannot determine the type of problem you have or how to correct it, use this book.

This book can help you isolate the cause of an error and indicate what actions you need to take to correct the error.

The cause of an error may not always be immediately apparent. An error may occur in an IBM-supplied software component, a hardware unit, or in an application program. A software component refers to programs or program modules such as $EDXASM, $S1ASM, $EDXLINK, and the rest of the software you install on your Series/1. A hardware unit refers to a particular device attached to your Series/1. Application programs are programs you write.

Some problems you encounter may require you to place a service call. However, by using this book before you place a call for service:

- You might be able to correct the problem and continue operations.
- You might be able to circumvent the problem while you arrange for servicing.
- You may find that the problem is caused by equipment or programming other than that supplied by IBM.
- The information you gather can reduce the time it takes to correct the problem if you do call for service.

EDX provides various aids, such as utilities and operator commands, that help you to pinpoint the source of a problem. The programmer console, an optional Series/1 hardware feature, enables you to perform more extensive analysis.

Some of the topics presented in this book show the use of the programmer console in analyzing problems. For more information on using this feature, see Appendix A, "How to Use the Programmer Console" on page A-1.

To begin investigating your problem, turn to Chapter 2, "Determining the Problem Type" on page 2-1.

Chapter 2. Determining the Problem Type

Before you begin analyzing a problem, you must determine the type of problem you have. Some problem types you encounter may be very apparent while others may not be so apparent. The following section presents some problem indicators and symptoms to help you determine the problem type.

Some Hints to Determine the Possible Problem Type

To help you determine your problem type, review the following problem indicators and symptoms. After reviewing these items and finding the indicator or symptom that best describes your problem, turn to the chapter indicated. The chapter you are referred to will help you to analyze and isolate the problem.

Can You Operate the System After Pressing the Load Button?

When you press the Load button on your Series/1, the system performs an initial program load (IPL). When the IPL process ends, the system is ready for use. If you cannot use the system after attempting an IPL, see Chapter 3, "Analyzing and Isolating an IPL Problem" on page 3-1.

Is the Run Light On and Solidly Lit?

When the Series/1 performs an operation, the Run light is on. Typically, the Run light flickers on and off during the operation. However, if you observe that the Run light remains on with a steady glow, the system or your program may be in a loop. If this is your problem symptom, Chapter 4, "Analyzing and Isolating Run Loops" on page 4-1 will help you isolate this problem type.

Is the System or a Program Idle While You Expect Activity?

When the Series/1 is not performing any operation or servicing an interrupt, the Wait light is on. The Wait light indicates the system is inactive. If, however, you notice the Wait light on solidly while programs should be active, the system or a program is probably in a wait state. Another symptom indicating a wait state is that you do not receive the "greater than" symbol (>) after you press the attention key on your terminal. If your system or program has these symptoms, see Chapter 5, "Analyzing and Isolating a Wait State" on page 5-1.

Did the System Issue a Program Check Message?

When the system encounters an abnormal condition, it issues a program check message. Two kinds of program checks can occur: a system program check or an application program check. The system displays the program check message on the $SYSLOG device. The system also records the program check message in a log data set if $LOG is active.

If you observe a program check message, Chapter 6, "Analyzing and Isolating a Program Check" on page 6-1, can help you isolate the problem.

Note: If you defined the SYSMSG statement in your $EDXDEF data set, the messages go to your $SYSLOG terminal, a disk data set, the Communications Facility log, or any combination of these depending on what you specified in the $EDXDEF data set. For more information on the SYSMSG statement, refer to the *Installation and System Generation Guide*.

Chapter 3. Analyzing and Isolating an IPL Problem

If your system fails to IPL correctly, there are a number of possible causes. This chapter presents some problem symptoms and procedures that can help you to identify the failing area and correct the problem.

What You Should Check First

Before you begin troubleshooting the problem, review the items in the following list. By checking these items first, you may be able to pinpoint the problem immediately:

- Is the power switch in the ON position for all devices?
- Is the IPL Source switch in the correct position for the device from which you are trying to IPL?
- For diskette IPL, is the IPLable diskette inserted correctly?
- For diskette IPL, is the door on the diskette device closed?
- If this is a new installation (EDX is not installed) and you are trying to IPL the starter system, verify with your service representative that all devices are at the addresses supported in the starter system. Refer to the program directory or the *Installation and System Generation Guide* for the device addresses.
- If EDX is already installed and the supervisor *previously* IPLed, does a backup supervisor (or starter system) IPL from the alternate IPL device? If the alternate device IPLs, go to the next section "How to Recognize a Problem with the IPL Device."
- If the starter system IPLs but your tailored supervisor does not IPL, go to the section "Determining the Failure in a Tailored Supervisor" on page 3-3.

If the previous items do not point out the problem, the problem may lie in the IPL device, IPL text, the supervisor, or other attached devices. The following sections describe how to isolate problems in these areas.

How to Recognize a Problem with the IPL Device

If the Load light remains on and you cannot IPL from the primary or alternate IPL device and you have checked all the items listed under the heading "What You Should Check First," call your service representative for corrective action. These symptoms indicates that the hardware could not read the IPL text (bootstrap program) from the IPL device. If you have a programmer console, you may also notice that the console lights display the value X'E0' or X'E5'. The value X'E0' indicates that there is a hardware problem with the IPL device. The value X'E5' may indicate either a hardware or software problem.

If you can IPL from one IPL device, the following procedures can help you determine if the failure is due to:

- No IPL text written when you initialized the disk or diskette
- Defective IPL text
- IPL text points to an invalid supervisor
- Hardware problem on that IPL device.

How to Correct the IPL Text

Use the following procedure to correct the IPL text:

1. Set the IPL Source switch to point to the device from which you can IPL.
2. Press the Load button to IPL the system.
3. Load $INITDSK and rewrite the IPL text (II command) to the failing IPL device.
4. Set the IPL Source switch to IPL from the failing IPL device.
5. Press the Load button to IPL the system.

If this procedure does not correct the IPL problem, the problem may be with the supervisor on the failing IPL device or it may be a hardware problem. By reloading the supervisor, you may correct the problem. The next section describes how to do this.

How to Reload the Supervisor

Use the following procedure to reload the supervisor:

1. Set the IPL Source switch to point to the device from which you can IPL.
2. Press the Load button to IPL the system.
3. Load $COPYUT1 and copy (CM command) the IPL supervisor from the current IPL device to the failing IPL device. Copy also $LOADER and any initialization modules you require.
4. Load $INITDSK and rewrite the IPL text (II command) to point to the supervisor you copied to the failing IPL device.
5. Set the IPL Source switch to IPL from the failing IPL device.
6. Press the Load button to IPL the system.

If this procedure does not correct the IPL problem, you have a hardware problem with that IPL device. Call your service representative for corrective action.

Determining the Failure in a Tailored Supervisor

Review the following items before you begin analyzing the failure:

- Did you receive a −1 completion code (successful) from the system generation assembly and link-edit?
- Did you include all the modules you need (on the INCLUDE statements) to support the attached devices?
- Are $EDXNUC the first seven characters of the $XPSLINK output?
- Does this tailored supervisor fail to IPL, although it did IPL previously? If it did IPL previously, go to the section "How to Recognize a Problem with the IPL Device" on page 3-1.
- If this tailored supervisor never did IPL, the following sections may assist you in isolating the failure. In order to use this information, however, you must have a programmer console or be able to use the $D operator command (in partition 1) after the IPL failure.

If you do not have a programmer console but can use the $D operator command (in partition 1) after the IPL failure, go to the section "Analyzing the INITTASK Task Control Block" on page 3-6.

If you have a programmer console, begin with the section "Detecting an IPL Stop Code Error."

If you do not have a programmer console and cannot use $D after the failure, use the following procedure:

1. Set the IPL Source switch to IPL from diskette.
2. IPL the starter system.
3. Load $IOTEST and verify all hardware configured and their addresses (LD command).
4. Review the system generation listing and ensure that you defined all devices correctly and that you included all modules required to support those devices.

Detecting an IPL Stop Code Error

If the system encounters an error during terminal initialization or it encounters an error within the cross-partition supervisor you are trying to IPL, the error could cause the system to enter a run loop or a wait state. For example, the error could be caused by a defective attachment card or perhaps a missing random access memory load module. When such errors exist, the system issues a stop code. The stop code can help you identify which area is failing.

This section explains how to determine if the failure is due to a stop code error. You will need a programmer console to perform this step.

To determine if the IPL failed because of a stop code, follow these procedures:

1 Set the IPL Source switch to point to the device from which you will IPL.

2 Set the Mode switch to Diagnostic mode position.

3 If the IPL is from diskette, insert the IPL diskette and close the door on the diskette device.

4 Press the Load button.

If the system encounters a stop code condition, the processor will stop. The Stop light also comes on.

5 Press the Op Reg button on the programmer console.

When you press the Op Reg button, the system displays the stop code in the indicator lights. The stop code is in the form X'64xx'. The **xx** portion of the code indicates the error condition. Refer to the *Messages and Codes* manual for an explanation of the stop code and the corrective action.

If the system has not issued a stop code, go to "Finding the Initialization Module in Storage When the Failure Occurred."

Finding the Initialization Module in Storage When the Failure Occurred

If your system does not issue a stop code when an IPL failure occurs, you may find it helpful to determine which initialization module was in storage at the time of the failure. The initialization modules prepare ("initialize") the hardware devices on your system and set up storage areas required by the system after the IPL.

During an IPL, as the system calls each initialization module into storage, it displays the entry point address of the module in the indicator lights of the programmer console. When a failure occurs, the indicator lights contain the entry point address of the module that was being processed at the time of the failure.

"Reading the Console Indicator Lights" on page A-2 describes how to read the address displayed in the lights. After determining the entry point address:

1 Look in the INITMODS section of your supervisor link map (SECTION = INITMODS).

2 Scan the addresses listed in this section for the entry point address displayed in the indicator lights.

3 When you find the correct address, note the entry point it refers to. The entry point name indicates which initialization module was in storage at the time of the failure. For example, $DISKINT is the entry point for the DISKINIT initialization module. $TRMINIT is the entry point for the TERMINIT module. DISKINIT handles disk initialization. TERMINIT is the hardware initialization module for all terminals. (The *Internal Design* lists each of the initialization modules and the entry points for those modules.)

In most cases, the entry point name itself will give you a good clue as to the purpose of the initialization module. $TAPEINT, for example, is the entry point for the module that initializes tape devices (TAPEINIT).

4 Knowing the type of initialization module in use at the time of the error can point you to the source of the IPL problem. For example, if the system stopped while processing the DISKINIT module, the IPL problem is probably related to the disk devices you defined on your system. If the problem seems related to a specific type of device, such as disks or terminal devices, review the system generation listing to ensure that:

- You correctly defined the definition statements for these devices.
- You defined only one device at any one address.
- The last definition statement for the device type (for example, the last TERMINAL statement) specifies END=YES.
- You included all the modules the system needs to support these devices.

If you suspect that one of the terminals on your system is causing the IPL failure, you may also want to follow the procedure described under "Isolating a Failing Terminal Using the Terminal Control Block."

If you cannot locate the source of the IPL problem after reviewing the system generation listing, turn to "Analyzing the INITTASK Task Control Block" on page 3-6.

Isolating a Failing Terminal Using the Terminal Control Block

This procedure enables you to determine if the system fails to initialize a terminal. The terminal control block (CCB) may point to the failing terminal. To help you detect if a terminal is causing the problem, you need the system generation link map listing for your supervisor. Look in the link map and find the address of the entry NEXTERM in module TERMINIT.

Using the programmer console, do the following:

1 Press the Reset key.

2 Press the Stop On Address key.

3 Enter the address of NEXTERM.

4 Press the Store key.

5 IPL the system. Each time the processor stops, the system has successfully initialized the terminal whose terminal control block (CCB) address is in register 3 (R3).

If the processor does not stop, the failure occurred prior to terminal initialization. If this is the case, go to the section "Analyzing the INITTASK Task Control Block" on page 3-6.

6 When the processor stops, press R3 on the programmer console to determine which terminal the system initialized. The address shown in R3 will match a CCB address in the section $EDXDEF of the link map. The name of the terminal also appears beside the address.

If R3 does not contain a CCB address and you have overlay support, press Start. When the processor stops, press R3 again. Repeat this step until R3 contains a CCB address.

7 Press Start after checking off the CCB address in your link map. The system initializes each terminal in the order the terminals are specified in the $EDXDEF data set during system generation.

8 If the system then enters a run loop or a wait state, the terminal whose address follows the last CCB that you checked off is probably the cause of the problem.

Ensure that you included all required initialization modules (if any) for that terminal during system generation. Also check to see if you defined that terminal correctly on the TERMINAL statement. If both the terminal and the support modules are defined correctly, call your service representative for corrective action on that terminal or attachment.

9 If the system does not enter a run loop, return to step 6 on page 3-5.

If you still cannot identify the cause of the IPL failure using the previous procedure, go to the section "Analyzing the INITTASK Task Control Block."

Analyzing the INITTASK Task Control Block

The technique discussed in this section requires you to examine the INITTASK task control block. By examining this control block, you may be able to identify the cause of the IPL failure. INITTASK is the label of the task control block (TCB) used by the system initialization routines. The address of INITTASK (in module EDXSTART) is in the supervisor link map from system generation.

If you have a programmer console, begin with the section "Storing the Address of INITTASK" on page 3-7.

If, after the IPL failure has occurred, you can press the attention key, enter $D from a terminal in partition 1, and receive a prompt for input, continue with the next section "Displaying the INITTASK Task Control Block with $D."

Displaying the INITTASK Task Control Block with $D

Do the following when you receive the prompt ENTER ORIGIN from $D:

1 Enter **0000**.

The next prompt, ADDRESS,COUNT, asks you for an address and the number of words you want to display.

2 For ADDRESS, enter the address for INITTASK shown in the supervisor link map.

3 For COUNT, enter the value **14**. This value represents the first 14 words in the INITTASK TCB.

The system then displays the 14 words of information.

4 Record all the values displayed on the terminal.

5 Reply **N** to the prompt ANOTHER DISPLAY?

6 Go to the section "Interpreting the Task Control Block Information" on page 3-8.

Storing the Address of INITTASK

After you locate the address of INITTASK in the supervisor link map, do the following at the programmer console:

1 Press the Stop key.

2 Press the SAR key.

3 Press the AKR key.

4 Enter X'0'.

5 Press the Store key.

6 Press the SAR key.

7 Enter the address of INITTASK.

8 Press the Store key.

The next step is to display the contents of the INITTASK task control block.

Displaying the INITTASK Task Control Block Using the Programmer Console

By displaying the values contained in the INITTASK task control block, you may get a clue as to what is causing the IPL failure.

The procedure discussed here requires you to display and record the first 14 words of information in the INITTASK TCB. To read the first word of the TCB do the following:

1 Press the Main Storage key. The contents are displayed in the indicator lights.

2 Record the value displayed in the indicator lights.

Each time you press the Main Storage key, a new value is displayed.

3 Repeat the two previous steps 13 more times to obtain the remaining values in the TCB.

Interpreting the Task Control Block Information

The first three words (words 0 – 2) of the INITTASK TCB make up the event control block (ECB). The next 11 words (words 3 – 13) contain the level status block (LSB) information. This 14-word area appears as follows:

Word 0 – 2 ECB
Word 3 IAR
Word 4 AKR
Word 5 LSR
Word 6 R0
Word 7 R1
Word 8 R2
Word 9 R3
Word 10 R4
Word 11 R5
Word 12 R6
Word 13 R7

The information in the LSB (words 3 – 13 of the TCB) is what you use to identify the failure. Since many of the system initialization modules are written in EDL, the register contents usually indicate the following:

IAR The instruction address register (IAR) contains the address of the last machine instruction the system executed when the failure occurred.

AKR For 3-bit processors, bits 5 – 7 form the operand 1 key, bits 9 – 11 form the operand 2 key, and bits 13 – 15 form the instruction space key. For 4-bit processors, bits 4 – 7 form the operand 1 key, bits 8 – 11 form the operand 2 key and bits 12 – 15 form the instruction space key. For 5-bit processors, bit 1 and bits 4 – 7 form the operand 1 key, bit 2 and bits 8 – 11 form the operand 2 key, and bit 3 and bits 12 – 15 form the instruction space key. For all processors, bit 0 of the AKR is the equate operand spaces (EOS) bit. If bit 0 is set to 1, the operand 2 key is used for both operand 1 and operand 2.

LSR When set, the bit values of the level status register (LSR) indicate the following:

- Bits 0 – 4 — The status of arithmetic operations. Refer to the processor description manual for the meanings of these bits.
- Bit 8 — Program is in supervisor state.
- Bit 9 — Priority level is in process.
- Bit 10 — Class interrupt tracing is active.
- Bit 11 — Interrupt processing is allowed.

Bits 5 – 7 and bits 12 – 15 are not used and are always zero.

R0 Because the supervisor uses this register as a work register, the contents are usually not significant.

R1 Contains the address in storage of the last EDL instruction executed in the initialization module when the failure occurred.

R2 Contains the address in storage of the active task control block (TCB).

R3 Contains the address in storage of EDL operand 1 of the failing instruction.

R4 Contains the address in storage of EDL operand 2 (if applicable) of the failing instruction.

R5 Contains the EDL operation code of the failing instruction. The first byte contains flag bits that indicate how operands are coded. For example, the flag bits indicate whether the operand is in #1, #2, or is specified as a constant. The second byte is the operation code of the EDL instruction.

R6 Because the supervisor uses this register as a work register, the contents are usually not significant. However, you can determine if the system was emulating EDL code when the failure occurred if R6 is twice the value shown in the second byte of R5. For example, if the second byte of R5 contained X'32' *and* the system was emulating EDL, R6 would contain X'0064'.

R7 The supervisor uses this register as a work register. However, in many cases, R7 may contain the address of a branch and link instruction. The address may give you a clue as to which module passed control to the address in the IAR.

After you record all the TCB values, compare the value you recorded for R2 against the address of INITTASK. If these addresses do not match, you either have the wrong storage area or the wrong link map.

If R2 does contain the address of INITTASK, start looking at the addresses in the remaining registers for a possible clue. Not all the registers may point to the failing area, but you should check the addresses that the registers point to nevertheless. Comparing the addresses you recorded and the addresses in the supervisor link map can help you identify the failure.

You can generally get an idea of which device is failing by the name or names of the supervisor modules. For example, if several of the addresses you recorded point to disk routines, you could assume that the IPL failure was related to a disk device.

The following discussion illustrates how the register contents can identify the problem area.

In this example, the IPL failure occurred because a disk device was defined incorrectly during system generation. Figure 3-1 shows the registers in the INITTASK TCB and what they pointed to in the link map. The registers that did not help identify the problem in this example are shown as "not applicable."

Register	Address	Module pointed to by register
IAR	X'27FA'	TAPE060 in DISKIO module
AKR	X'0000'	(not applicable)
LSR	X'80D0'	(not applicable)
R0	X'0000'	(not applicable)
R1	X'77BE'.	DSKINIT1 in module DSKINIT2
R2	X'20DE'	INITTASK in module EDXSTART
R3	X'709A'	DINITDS1 in module DISKINIT

Figure 3-1 (Part 1 of 2). Sample INITTASK Register Contents

Register	Address	Module pointed to by register
R4	X'06BA'	DMDDB in module $EDXDEF
R5	X'0000'	(not applicable)
R6	X'0000'	(not applicable)
R7	X'27F6'	TAPE060 in DISKIO module

Figure 3-1 (Part 2 of 2). Sample INITTASK Register Contents

Notice that the names of the supervisor modules are all disk-related. Since the address in R4 (X'06BA') in this example is within the module $EDXDEF, you can identify exactly which device is causing the failure as follows:

1. Subtract the address of $EDXDEF from the address in R4. The link map showed that $EDXDEF is at address X'052E'. The resulting address is X'018C'.

2. Look in the system generation listing and find the definition statement at the address you calculated in step 1. The device defined on this definition statement is the cause of the IPL failure.

As was mentioned previously, the disk device was defined incorrectly. The disk was defined as a 4963-23. It *should* have been defined as a 4963-64.

No IPL Completion Messages on $SYSLOG

If R5 contains the value X'0016', the supervisor has issued a DETACH for INITTASK and has completed the IPL process. (X'0016' is the EDL operation code for a DETACH.) However, if the system did not display IPL completion messages on $SYSLOG, $SYSLOG may be the cause of the problem.

Ensure that $SYSLOG is at the address you specified for $SYSLOG during system generation.

If R5 is not X'0016' and R6 does not contain X'002C', look at the remaining TCB values and see what supervisor modules they point to. The names of the modules may give you a clue as to which device is failing.

Chapter 4. Analyzing and Isolating Run Loops

A loop is a sequence of instructions that the system executes a repeated number of times. Often in application programs, you may need to code a loop to manipulate data. Your program exits the loop, based on some exit condition that you establish. Occasionally, a system or programming error can cause the system to execute a sequence of instructions endlessly. This type of error is called a "run loop" and when it occurs, you must isolate the cause.

If you know that a specific application program is in a run loop, see "Using $DEBUG to Isolate a Run Loop" on page 4-8. If you do not know the source of the run loop, you should check first to see whether or not the system has issued a stop code. A stop code may point directly to the cause of the error. "How to Determine the Cause of a Run Loop" describes how to obtain a stop code if your system has issued one.

If your system has not issued a stop code, this chapter explains how you can identify which program is in a run loop when more than one program is running. You can then use tools, such as $DEBUG, to isolate the run loop in the failing program.

How to Determine the Cause of a Run Loop

Your system may enter a run loop if any one of a number of conditions occurs. These conditions may cause the system to issue a stop code. The following procedure describes how to determine whether or not your system has issued a stop code. Before you begin, consider what effect stopping the system will have on any active programs, in particular, any time-dependent programs.

1 Set the Mode switch on the Series/1 console to Diagnostic Mode.

2 If your system issues a stop code, the system will stop and the wait light will come on and remain lit. If this is the case, continue with step 3.

If the wait light does *not* come on, return the Mode switch to its previous setting. If you have more than one program running on your system, go to "How to Identify a Program in a Run Loop" on page 4-2. Otherwise, proceed to "Using $DEBUG to Isolate a Run Loop" on page 4-8.

3 If you have a programmer console, press the Op Reg button on the console. (If you do not have a programmer console, go to the next step.) When you press the Op Reg button, the system displays the stop code in the console indicator lights. See "Reading the Console Indicator Lights" on page A-2 if you do not know how to read the contents of the lights.

The stop code is in the form X'64xx'. The **xx** portion of the code identifies the error condition. Refer to the *Messages and Codes* manual for an explanation of the stop code and the corrective action. If the stop code is X'64FB', see "Run Loops Caused by Device Interrupts" on page 4-20.

4 If you do not have a programmer console, take a stand-alone or $TRAP dump. Refer to the *Operation Guide* for details on taking a stand-alone dump. The *Operator Commands and Utilities Reference* explains how to use $TRAP.

After you perform the dump:

a Look at the first page of the dump, which lists the register contents on each hardware level. (Figure 7-1 on page 7-2 shows an example of this information.)

b Examine the contents of registers R0 – R4 on levels 1, 2, and 3. Find the level that shows values (other than X'0000') for one or more of these registers. This level was the active level.

c Record the contents of the IAR and AKR for the active level. For 3-bit processors, bits 5 – 7 form the operand 1 key, bits 9 – 11 form the operand 2 key, and bits 13 – 15 form the instruction space key. For 4-bit processors, bits 4 – 7 form the operand 1 key, bits 8-11 form the operand 2 key and bits 12 – 15 form the instruction space key. For 5-bit processors, bit 1 and bits 4 – 7 form the operand 1 key, bit 2 and bits 8 – 11 form the operand 2 key, bit 3 and bits 12 – 15 form the instruction space key. For all processors, bit 0 of the AKR is the equate operand spaces (EOS) bit. If bit 0 is set to 1, the operand 2 key is used for both operand 1 and operand 2.

Add one to the instruction space key to find the partition that contains the IAR. For example, if the AKR contains the value X'0103', the IAR resides in partition 4.

d Your dump displays the storage contents of each partition. Using the information recorded in step 4c, find the partition the AKR points to. Within this partition, look for the word at the address shown in the IAR. This word contains the stop code.

e The stop code is in the form X'64xx'. The **xx** portion of the code identifies the error condition. Refer to the *Messages and Codes* manual for an explanation of the stop code and the corrective action. If the stop code is X'64FB', see "Run Loops Caused by Device Interrupts" on page 4-20.

How to Identify a Program in a Run Loop

This section explains how to identify which program is in a run loop when more than one program is running on your system.

Before beginning the procedures in this section, press the attention key on your display terminal. If the system displays the "greater than" symbol (>), proceed to "Using the $D Operator Command to Identify a Looping Program" on page 4-3. If the system does *not* display the "greater than" symbol (>) but you have a programmer console, proceed to "Using the Programmer Console to Identify a Looping Program" on page 4-6.

If you do not have a programmer console and your terminal does not respond to the attention key, take a stand-alone or $TRAP dump. Chapter 7, "Analyzing a Failure Using a Storage Dump" on page 7-1 explains how to read and analyze the contents of the dump. Refer to the *Operation Guide* for details on taking a stand-alone dump. The *Operator Commands and Utilities Reference* explains how to use the $TRAP utility.

Using the $D Operator Command to Identify a Looping Program

To identify the program in a run loop, use the following procedure:

1 If your terminal is not assigned to partition 1, press the attention key and enter **$CP 1**.

2 Look in the supervisor link map for your system and find the addresses of the following entry points: SVCL1, SVCL2, and SVCL3. The addresses are located in the EDXSYS section of the link map (SECTION = EDXSYS).

Each entry point refers to a 4-word area in storage that contains information about the tasks running on a particular hardware level. SVCL1 points to information about hardware level 1. SVCL2 and SVCL3 describe hardware levels 2 and 3, respectively.

The first (leftmost) word of each area contains the address of the task control block (TCB) for the active task on the hardware level. The second word shows the address space of the TCB. The third word contains the address of the task with the next highest priority on the hardware level. This task is called the "ready task." The fourth (right-most) word shows the address space of the ready task.

3 Press the attention key and enter **$D**.

4 After you enter the command, use the following procedure:

a For "ORIGIN," enter **0000**.

b For "ENTER ADDRESS,COUNT," enter the address of SVCL1 and a count of **12**. Use a comma to separate the address from the count.

c Record the values the system displays.

5 Figure 4-1 shows an example of the information that the system displays. In this example, the address of SVCL1 is X'02B6'.

```
> $D
ENTER ORIGIN: 0000
ENTER ADDRESS,COUNT: 2B6,12
       1                   2    3     4     5
 02B6: 1308 0000 0000 0000 67B4  0001  6976  0001
       6
 02C6: 8BF0 0003 43B6 0005
ANOTHER DISPLAY? _
```

Figure 4-1. Displaying Hardware Level Information

Item **1** in Figure 4-1 shows the start of the 4-word area for the entry point SVCL1. The word below item **1** contains the address of the TCB for the active task on hardware level 1. The task on this level is typically the keyboard task for the terminal you used to issue the $D command.

Item **2** points to a word at address X'02BE'. This is the address of the entry point SVCL2. The word below item **2** contains the address of the TCB for the active task on hardware level 2. The word below item **3** shows

the address space for this task. The task is running in address space 1 (partition 2).

The word below item **4** contains the address of the ready task on level 2. Item **5** shows that this task is also in address space 1 (partition 2).

Item **6** marks the start of the 4-word area for entry point SVCL3. In this example, the area begins at address X'02C6'. The TCB of the active task on this level is at address X'8BF0'. The active task is in address space 3 (partition 4). The ready task on level 3 is at address X'43B6' in address space 5 (partition 6).

6 Respond **N** to the prompt message "ANOTHER DISPLAY?" If you have a programmer console, continue with step 7. Otherwise, skip to step 8.

```
ANOTHER DISPLAY? N
```

7 Look at the programmer console indicator lights for hardware levels 1 − 3 (Level 1, Level 2, Level 3). Note which of the lights stays lit continuously. Programs generally run on level 2 (the default) and level 3. Programs with an attention list task active (ATTNLIST instruction) run on level 1. When the indicator light for a level is constantly lit, you can generally assume that the looping program is running on that hardware level.

Once you know the hardware level that contains the looping program, review the information you recorded for that level in step 4 on page 4-3. Determine the address and address space of the TCB for the active task on this level.

For example, if the looping program appears to be on hardware level 2, you would look at the 4-word area for the entry point SVCL2. In Figure 4-1 on page 4-3, the address of the TCB for the active task on level 2 is X'67B4' (item **2**). This TCB is in address space 1 (item **3**).

Continue with step 9.

8 Review the information you recorded in step 4 on page 4-3. Programs generally run on level 2 (the default) and level 3. Programs with an attention list task active (ATTNLIST instruction) run on level 1.

If you are running programs with attention list tasks, find the address and address space of the TCB for the active task on level 1. If you are *not* running programs with attention list tasks, find the address and address space of the TCB for the active task on level 2.

9 Add one to the TCB address space you recorded. The result is the partition that contains the TCB for the active task.

Press the attention key on your terminal and enter **$CP** followed by the partition number.

The $CP operator command displays the programs active within the partition you selected and the load points for those programs.

10 Using the TCB address you recorded, find which program in the partition contains this address. The program that contains the TCB is probably the looping program.

In Figure 4-1 on page 4-3, X'67B4' is the address of the TCB for the active task on level 2. Suppose that the partition you looked at contained a program, PROGA, with a load point of X'6700' and a program, PROGB, with a load point of X'6900'. By looking at the program load points, you can see that the TCB address of the active task (X'67B4') is within PROGA. If the loop is occurring on this hardware level, PROGA is the most likely source.

11 Press the attention key and enter **$D**.

a For "ORIGIN," enter **0000**.

b For "ENTER ADDRESS,COUNT," enter the address of the TCB for the active task (from step 10) and a count of **8**. Use a comma to separate the address from the count.

c Reply **N** to the prompt message "ANOTHER DISPLAY?"

In the following example, the address of the TCB is X'67B4'.

```
> $D
ENTER ORIGIN: 0000
ENTER ADDRESS,COUNT: 67B4,8
 67B4: FFFF 0000 0000 34CE 0110 80D0 0000 67A8
ANOTHER DISPLAY? N
```

12 The last word displayed shows the contents of general purpose register 1, R1. Subtract the load point of the program that contains the active TCB from the address in R1. The result is the address of one of the instructions within the run loop.

In step 11, R1 contains the address X'67A8'. If the load point of the failing program is X'6700', one of the instructions within the loop is located at X'00A8'.

13 Look at the compiler listing for the program and find the instruction at the address you calculated in step 12. Examine this area of your program for the cause of the loop. If you cannot determine the exact cause of the loop, proceed to "Using $DEBUG to Isolate a Run Loop" on page 4-8.

If you do *not* have a programmer console and you cannot find the cause of the error, you may also want to examine the active task on another hardware level. To do so, return to step 8 on page 4-4 and use the information you recorded for the other hardware levels.

Using the Programmer Console to Identify a Looping Program

Look in the supervisor link map for your system and find the addresses of the following entry points: SVCL1, SVCL2, and SVCL3. The addresses are located in the EDXSYS section of the link map (SECTION = EDXSYS).

Each entry point refers to a 4-word area in storage that contains information about the tasks running on a particular hardware level. SVCL1 points to information about hardware level 1. SVCL2 and SVCL3 describe hardware levels 2 and 3, respectively.

The first (leftmost) word of each area contains the address of the task control block (TCB) for the active task on the hardware level. The second word shows the address space of the TCB. The third word contains the address of the task with the next highest priority on the hardware level. This task is called the "ready task." The fourth (right-most) word shows the address space of the ready task.

After you locate the entry point addresses in the link map, perform the following steps on the programmer console:

1. Press the Stop key.
2. Press the SAR key.
3. Press the AKR key.
4. Enter X'0000'.
5. Press the Store key.
6. Press the SAR key.
7. Enter the address of SVCL1.
8. Press the Store key.
9. Press the Main Storage key.

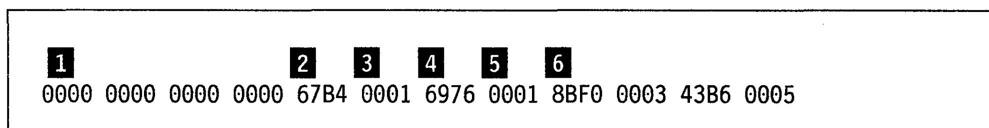
   The system displays a value in the console indicator lights. See "Reading the Console Indicator Lights" on page A-2 if you do not know how to read the contents of the lights.

10. Record the value displayed in the indicator lights.

    Each time you press the Main Storage key, the system displays a new value.

11. Repeat steps 9 and 10 eleven more times to obtain the values for SVCL1, SVCL2, and SVCL3 (12 words).

    Figure 4-2 shows a sample of the values you might record.



```
1                   2    3    4    5    6
0000 0000 0000 0000 67B4 0001 6976 0001 8BF0 0003 43B6 0005
```

Figure 4-2. Obtaining Hardware Level Information with the Programmer Console

Item 1 in Figure 4-2 shows the start of the 4-word area for the entry point SVCL1.

Item 2 shows the start of the 4-word area for the entry point SVCL2. The word below item 2 contains the address of the TCB for the active task on hardware level 2. The word below item 3 shows the address space for this task. The task is running in address space 1 (partition 2).

The word below item 4 contains the address of the ready task on level 2. Item 5 shows that this task is also in address space 1 (partition 2).

Item **6** marks the start of the 4-word area for the entry point SVCL3. The TCB of the active task on this level is at address X'8BF0'. The active task is in address space 3 (partition 4). The ready task on level 3 is at address X'43B6' in address space 5 (partition 6).

12 Look at the programmer console indicator lights for hardware levels 1 – 3 (Level 1, Level 2, Level 3). Note which of the lights stays lit continuously. Programs generally run on level 2 (the default) and level 3. Programs with an attention list task active (ATTNLIST instruction) run on level 1. When the indicator light for a level is constantly lit, you can generally assume that the looping program is running on that hardware level.

Once you know the hardware level that contains the looping program, review the information you recorded for that level in step 11. Record the address and address space of the TCB for the active task on this level.

For example, if the looping program appears to be on hardware level 2, you would look at the 4-word area for the entry point SVCL2. In Figure 4-2 on page 4-6, the address of the TCB for the active task on level 2 is X'67B4' (item **2**). This TCB is in address space 1 (item **3**).

13 Use the following procedure on the programmer console:

a Press the SAR key.

b Press the AKR key.

c Key in the TCB address space you recorded in step 12.

d Press the Store key.

e Press the SAR key.

14 Add X'52' to the TCB address you recorded in step 12. Key in this address.

15 Press the Store key.

16 Press the Main Storage key.

The address displayed is the program load point of the looping program. Record this address.

17 Press the SAR key and key in the address displayed in step 16. Now press the Store key.

18 Press the Main Storage key. The system displays the value X'0808' in the lights. Repeat this step four more times and record the values the system displays.

The resulting four words show the name of the looping program in hexadecimal notation. See Appendix D, "Conversion Table" on page D-1 to convert these hexadecimal values into EBCDIC characters.

19 When you have determined the name of the looping program, do the following:

a Press the SAR key.

b Key in the TCB address you recorded in step 12 on page 4-7.

c Press the Store key.

d Press the Main Storage key eight times. Record the value displayed in the lights. This value reflects the contents of general purpose register 1, R1. (If you make a mistake, repeat steps 19a through 19d.)

e Subtract the program load point of the looping program from the value shown for R1. The result is the address of one of the instructions within the run loop.

20 Look at the compiler listing for the program and find the instruction at the address you calculated in step 19. Examine this area of your program for the cause of the loop. If you cannot determine the exact cause of the loop, proceed to "Using $DEBUG to Isolate a Run Loop."

Using $DEBUG to Isolate a Run Loop

This section explains how to isolate a run loop with $DEBUG. The $DEBUG utility is described in detail in the *Operator Commands and Utilities Reference*. To show some techniques of isolating a run loop with $DEBUG, this section uses a sample program called MYPROG. The sample program contains a coding error which causes it to loop. The sample program should display a prompt message requesting up to 40 characters of input data. After receiving input, the program should insert a blank between each character and then display the data. You end the program by entering a /*. Figure 4-3 on page 4-9 shows the compiler listing for the sample program MYPROG. You will need the compiler listing for your program when using $DEBUG.

The first step in isolating a run loop is to determine the starting point and ending point of the instructions causing the loop. "Determining the Starting and Ending Points of the Loop" on page 4-9 shows you how to perform this step using $DEBUG.

Note: If you use the EDL Accelerator Custom Feature, RPQ D02723, or have a 4956 Model E, 60E, G10, H10, J, or K processor, do not leave $DEBUG loaded on your system after you finish using the utility. $DEBUG disables the accelerator feature. When you end the last copy of $DEBUG, the system enables the accelerator feature again.

```
LOC     +0   +2   +4   +6   +8
                                        PRINT     NODATA
0000    0008 D7D9 D6C7 D9C1 D440  MYPROG   PROGRAM   LABEL1
0034                              LABEL1   EQU       *
0034    8026 1A1A C5D5 E3C5 D940           PRINTEXT  'ENTER UP TO 40 CHARACTERS@'
0052    8026 1C1C C5D5 E3C5 D940           PRINTEXT  'ENTER A ''/*'' TO END PROGRAM@'
0072                              LABEL2   EQU       *
0072    402F 00D6 0000                     READTEXT  INPUT,PROMPT=COND
0078    A0A2 00D6 615C 00D0                IF        (INPUT,EQ,C'/*'),GOTO,LABEL4
0080    005A 0151 00D5                     MOVE      COUNT+1,INPUT-1,(1,BYTE)
0086    835C 0000 00D6                     MOVEA     #1,INPUT
008C    835C 0002 0100                     MOVEA     #2,OUTPUT
0092                              LABEL3   EQU       *
0092    065A 0000 0000                     MOVE      (0,#2),(0,#1),(1,BYTE)
0098    8332 0002 0001                     ADD       #2,1
009E    025A 0000 0152                     MOVE      (0,#2),BLANK,(1,BYTE)
00A4    8332 0000 0001                     ADD       #1,1
00AA    8332 0002 0001                     ADD       #2,1
00B0    A0A2 0150 0000 00C2                IF        (COUNT,NE,0),THEN
00B8    8035 0150 0001                       SUB     COUNT,1
00BE    00A0 0092                            GOTO    LABEL3
                                           ENDIF
00C2    0026 0100                          PRINTEXT  OUTPUT
00C6    902A 0001 0000                     PRINTEXT  SKIP=1
00CC    00A0 0072                          GOTO      LABEL2
00D0                              LABEL4   EQU       *
00D0    0022 FFFF                          PROGSTOP
00D4    2828 4040 4040 4040 4040  INPUT    TEXT      LENGTH=40
00FE    5050 4040 4040 4040 4040  OUTPUT   TEXT      LENGTH=80
0150    0000                      COUNT    DATA      F'0'
0152    40                        BLANK    DATA      C' '
0154    0000 0000 0000 0234 0000           ENDPROG
                                           END
```

Figure 4-3. Sample Program Compiler Listing

Determining the Starting and Ending Points of the Loop

While the program is running and in a loop, use the following procedure:

1 Load $DEBUG in any available partition.

Try to load $DEBUG from a terminal other than the terminal from which the looping program was loaded. If you cannot use a different terminal, then load $DEBUG from the terminal used by the looping program.

2 Enter the name of the looping program when $DEBUG asks you for a program name and volume. Because the program is already loaded, you do *not* need to enter the volume name.

3 When $DEBUG asks for a partition, enter the number of the partition that contains the looping program. If $DEBUG and the looping program are in the same partition, press the enter key.

4 Reply N when asked if you want a new copy of the program loaded.

The following example shows what you would enter if you loaded $DEBUG in partition 2, with the sample program MYPROG running in partition 1:

```
> $L $DEBUG
LOADING $DEBUG     nnP,hh:mm:ss, LP= xxxx, PART= yy
PROGRAM (NAME,VOLUME): MYPROG
PARTITION (DEFAULT IS CURRENT PARTITION): 1
ALREADY ACTIVE AT B400
DO YOU WANT A NEW COPY TO BE LOADED? N
```

5 Press the attention key and enter **AT** to set the first breakpoint at the address of the program's entry point. The entry point is the address of the first operand of the PROGRAM statement. Enter **TASK** when you are prompted for an option.

The entry point for the sample program MYPROG is at address X'0034', as shown in the example below:

```
> AT
OPTION (*/ADDR/TASK/ALL): TASK
LOW ADDRESS: 34
```

6 Set the next breakpoint at the address of the last executable instruction. This will ensure that all instructions within the loop are traced by $DEBUG.

The last executable instruction for MYPROG is the PROGSTOP at address X'00D0'.

Because only the starting and ending points of the loop are needed at this point, the NOLIST and NOSTOP options are selected:

```
HIGH ADDRESS: D0
LIST/NOLIST:NOLIST
STOP/NOSTOP: NOSTOP
     1 BREAKPOINT(S) SET
```

7 Press the attention key and enter **GO**. $DEBUG displays the addresses of the instructions that the program executes.

An example showing the output that $DEBUG displays while tracing the sample program MYPROG follows. Notice that the low address (starting point of the loop) is X'0072'. The high address (ending point of the loop) is X'00CC'.

```
           •
           •
           •
TASK0154 CHECKED AT  0072        (low address)
TASK0154 CHECKED AT  0078
TASK0154 CHECKED AT  0080
TASK0154 CHECKED AT  0086
TASK0154 CHECKED AT  008C
TASK0154 CHECKED AT  0092
TASK0154 CHECKED AT  0098
TASK0154 CHECKED AT  009E
TASK0154 CHECKED AT  00A4
TASK0154 CHECKED AT  00AA
TASK0154 CHECKED AT  00B0
TASK0154 CHECKED AT  00C2
TASK0154 CHECKED AT  00C6
TASK0154 CHECKED AT  00CC        (high address)
TASK0154 CHECKED AT  0072
TASK0154 CHECKED AT  0078
           •
           •
           •
```

Figure 4-4. Sample Trace Addresses from $DEBUG

8 Ensure that *all* addresses displayed by $DEBUG are repeated at least once before you end $DEBUG. You end $DEBUG by pressing the attention key and entering **END**. When all the addresses have been repeated, you now have all the instructions within the loop.

9 Using the trace addresses from $DEBUG, try to determine the cause of the loop from the compiler listing. "Using the Compiler Listing to Locate the Loop" on page 4-12 explains how you use the trace addresses to follow the logic of the loop.

The section "Some Common Causes of Run Loops" gives some hints as to what might be the cause of the loop.

Some Common Causes of Run Loops

Run loops are often caused by some exit condition not being met within a program. The reason the exit condition is not met could be any of the following:

- Counters or variables that are never initialized when the program begins
- Counters or variables that are not tested for an exit condition
- Counters that never reach the limit you expected
- Control passed to the wrong label in the program.

Check your program listing to be sure that none of the previous logic errors exist. If you cannot pinpoint any of these conditions immediately, continue reading this chapter.

Using the Compiler Listing to Locate the Loop

The compiler listing and the trace addresses displayed by $DEBUG enable you to follow the flow of the loop. Use the following procedure to determine the problem:

1 Locate in the compiler listing the lowest trace address displayed by $DEBUG. The lowest address for the sample program, MYPROG, is X'0072' (see Figure 4-4 on page 4-11).

At address X'0072', the instruction executed is a READTEXT.

```
LOC    +0   +2   +4   +6   +8
                                           .
                                           .
                                           .
0034   8026 1A1A C5D5 E3C5 D940            PRINTEXT  'ENTER UP TO 40 CHARACTERS@'
0052   8026 1C1C C5D5 E3C5 D940            PRINTEXT  'ENTER A ''/*'' TO END PROGRAM@'
0072                               LABEL2  EQU       *
0072   402F 00D6 0000                      READTEXT  INPUT,PROMPT=COND
0078   A0A2 00D6 615C 00D0                 IF        (INPUT,EQ,C'/*'),GOTO,LABEL4
                                           .
                                           .
                                           .
```

The symptoms of the loop appear to be that the READTEXT did not allow you to enter input data when the program issued a message to do so.

2 Reload $DEBUG in any available partition to determine the problem.

In this example, $DEBUG is loaded in partition 1, the same partition as MYPROG:

```
> $L $DEBUG
LOADING $DEBUG     nnP,hh:mm:ss, LP= xxxx, PART= yy
PROGRAM (NAME,VOLUME): MYPROG
PARTITION (DEFAULT IS CURRENT PARTITION):
ALREADY ACTIVE AT B400
DO YOU WANT A NEW COPY TO BE LOADED? N
```

3 Press the attention key to set a breakpoint at the address following the READTEXT (address X'0078'):

```
> AT
OPTION (*/ADDR/TASK/ALL): ADDR
BREAKPOINT ADDR: 78
LIST/NOLIST: NOLIST
STOP/NOSTOP: STOP
     1 BREAKPOINT(S) SET
```

When the following message is displayed, $DEBUG has suspended the program's execution:

```
TASK0154 STOPPED AT  0078
```

At this point, you can look at any area of storage the program uses. If you set counters or variables in a program, examine those fields first. For MYPROG, you want to look at the number of characters the program read in as a result of executing the READTEXT instruction.

The area labeled INPUT receives the input data when the program executes the READTEXT:

```
LOC    +0   +2   +4   +6   +8
                                           •
                                           •
                                           •
0072   402F 00D6 0000                      READTEXT  INPUT,PROMPT=COND
                                           •
                                           •
                                           •
00D4   2828 4040 4040 4040 4040  INPUT     TEXT      LENGTH=40
```

4 Press the attention key and enter the following to see the number of characters stored in INPUT:

```
> LIST
OPTION (*/ADDR/R0...R7/#1/#2/IAR/TCODE/UNMAP): ADDR
ADDRESS: D4
LENGTH: 1
MODE(X/F/D/A/C): X
```

$DEBUG displays the following information:

```
00D4 X' 2800'
```

This information shows the length and count bytes for INPUT. The X'28' indicates the buffer size is 40 characters in length. However, the X'00' indicates that no characters were read in as a result of the READTEXT. If INPUT contained any data, the count byte would indicate the number of bytes.

Because INPUT contains no data, the problem might be either the TEXT statement coded for INPUT or the READTEXT instruction. Because you use READTEXT instructions to receive input data, the problem is probably with the READTEXT.

5 Review the description of READTEXT in the *Language Reference* to determine if the READTEXT is coded correctly. The READTEXT is coded as follows in the sample program:

```
READTEXT  INPUT,PROMPT=COND
```

The description for PROMPT=COND explains that when you use this operand, you must also code message text. No message text is coded on

READTEXT in the sample program. The description further explains that when no message text is specified, READTEXT sets the count byte to zero and does not wait for input.

The sample program entered a run loop because the READTEXT is coded incorrectly. Isolating the run loop for this sample program is now complete.

6 Press the attention key and enter **END** to end $DEBUG.

7 Cancel the looping program using the $C operator command.

8 Correct the coding error on the READTEXT as follows:

```
READTEXT  INPUT,'ENTER NEW DATA: ',PROMPT=COND
```

9 Recompile the program.

The techniques discussed up to this point in the chapter were useful in isolating the run loop in the sample program, MYPROG. The error, in this case, was somewhat obvious. However, you can apply these same techniques when the cause of a run loop in your program is not so apparent. The next section introduces additional techniques that may be helpful if you are trying to locate the cause of a run loop in a program that uses unmapped storage.

Examining an Unmapped Storage Area for the Cause of a Loop

A program may occasionally receive invalid or incorrect data. If the program is not prepared to handle such a situation, it could go into a run loop.

By using the LIST command of $DEBUG, you can examine the data areas in your program to see if any of the data in these areas is invalid or incorrect. (For more information on using the LIST command of $DEBUG, refer to the *Operator Commands and Utilities Reference*.) If the failing program uses unmapped storage, you may also want to look at the data in the unmapped storage areas. This section explains how to examine an unmapped storage area to find the cause of a run loop.

The sample program used in this section is called ADDNAMES. ADDNAMES processes a list of names and addresses which it reads from a data set into unmapped storage. The program should end when it encounters a −1 (X'FFFF') or when it processes more than 1,000 bytes of data. When ADDNAMES was loaded last, however, it went into a run loop. Figure 4-5 on page 4-15 shows the compiler listing for the sample program.

```
LOC   +0   +2   +4   +6   +8

0000  0008 D7D9 D6C7 D9C1 D440  ADDNAMES PROGRAM   START, DS=((DATA,DONORS))
000A  0000 0104 0184 0000 0000
0014  0188 0000 0001 0000 0100
001E  0186 0000 0000 0000 0000
0028  0000 0000 0000 0000 0000
0032  FFFF 0000 0000 0808 C4C1
003C  E3C1 4040 4040 0606 C4D6
0046  D5D6 D9E2 4040 0000 0000
0050  0000 0001 0000 0001 0000
005A  0000 0000 0000 0000 0000
006E  0000 0000 0000 0000
0076  0000 C1C1 0000 0000 0008  STORBLK1 STORBLK   TWOKBLK1=1,MAX=2
0080  0001 FFFF 0000 0000 0090
008A  0000 0000 0000 FFFF FFFF
0094  0000                      TOTAL    DC        F'0'
0096  0000                      LENGTH   DC        F'0'
                                START    EQU       *
0098  00B9 0076 0000 0000 0101           GETSTG    STORBLK1,TYPE=ALL
00A2  035C 0000 0082                     MOVE      #1,STORBLK1+$STORMAP
00A8  80B9 0076 0001 0000 0300           SWAP      STORBLK1,1
00B2  8120 0000 0008 0000 020C           READ      DS1,(0,#1),8
00BC  0032
00BE  00A0 00CA 90A2 0094 03E8           DO        UNTIL,(TOTAL,GT,1000)
00C8  00F6
00CA  045C 0096 0000                       MOVE    LENGTH,(0,#1)
00D0  A0A2 0096 FFFF 00F6                  IF      (LENGTH,EQ,-1),GOTO,QUIT
00D8  E0A2 0096 0000 00F2                  IF      (LENGTH,GT,0),
                                          •
                                          •
                                          •
0100  8332 0000 0002                         ADD       #1,2
0106  0332 0000 0096                         ADD       #1,LENGTH
010C  0032 0094 0096                         ADD       TOTAL,LENGTH
0112                                       ENDIF
0112  00A0 00C2                          ENDDO
                                QUIT     EQU       *
0116  00B9 0076 0000 0000 0201           FREESTG   STORBLK1,TYPE=ALL
0120  0022 FFFF                          PROGSTOP
                                         COPY      STOREQU
                                          •
                                          •
                                          •
```

Figure 4-5. Sample Program Compiler Listing

When $DEBUG is used to trace the execution of the program, the starting point of the loop (low address) is at X'00BE'. The ending point of the loop (high address) is at X'0112'. (The procedure for locating a run loop in a program is shown under "Determining the Starting and Ending Points of the Loop" on page 4-9.)

The compiler listing for the sample program shows a DO instruction at address X'00BE'. The DO instruction marks the beginning of the loop. The loop ends with the ENDDO instruction at address X'0112'.

Looking at the contents of the DO loop, you can see that the program should be able to exit the loop when one of two conditions is met:

(1) The total length of the data read into storage exceeds 1000 bytes. At this point, the DO instruction at X'00BE' would satisfy the condition that it execute **until** the value in TOTAL is greater than 1000.

(2) The program finds a −1 in the data area. In this case, the IF instruction at X'00D0' would detect the condition and send the program to the label QUIT.

Since neither of these conditions occurred, it appears that the program had less than 1000 bytes of data to process but did not encounter a −1 when the data ended. Looking at the data in the unmapped storage area should reveal the source of the problem. To look at the contents of an unmapped storage area, do the following:

1 While the program is running and in the loop, load $DEBUG in any available partition.

Try to load $DEBUG from a terminal other than the terminal from which the looping program was loaded. If you cannot use a different terminal, then load $DEBUG from the terminal used by the looping program.

2 Enter the name of the looping program when $DEBUG asks you for a program name and volume. Because the program is already loaded, you do *not* need to enter the volume name.

3 When $DEBUG asks for a partition, enter the number of the partition which contains the looping program. If $DEBUG and the looping program are in the same partition, press the enter key.

4 Reply **N** when asked if you want a new copy of the program loaded.

The sample program ADDNAMES is running in partition 1. In the following example, $DEBUG also is loaded in partition 1:

```
> $L $DEBUG
LOADING $DEBUG     nnP,hh:mm:ss, LP= xxxx, PART= yy
PROGRAM (NAME,VOLUME): ADDNAMES
PARTITION (DEFAULT IS CURRENT PARTITION):
ALREADY ACTIVE AT 5C00
DO YOU WANT A NEW COPY TO BE LOADED? N
```

5 Press the attention key and enter **AT** to set a breakpoint at the address following the instruction that reads the data into unmapped storage.

Note: Your program may be using several unmapped storage areas. If the SWAP instruction refers to a variable to find out the number of the unmapped storage area it should gain access to, check the contents of this variable to see which area was in use when the loop began.

In the sample program, the address of the instruction following the READ instruction is X'00BE':

```
> AT
OPTION (*/ADDR/TASK/ALL): ADDR
BREAKPOINT ADDR: BE
LIST/NOLIST: NOLIST
STOP/NOSTOP: STOP
     1 BREAKPOINT(S) SET
```

6 Press the attention key and enter **GO**.

$DEBUG displays a message when it suspends the program's execution at the breakpoint:

```
TASK0124 STOPPED AT  00BE
```

7 Press the attention key and enter the **LIST** command. After you enter this command, use the following procedure:

a For "OPTION," enter **UNMAP**.

b For "STORBLK ADDRESS," enter the address of the STORBLK statement that defines the unmapped storage area you want to see.

c For "SWAP#," enter the number of the unmapped storage area you want to see.

d For "DISPLACEMENT," indicate how far from the beginning of the unmapped storage area the utility should go before listing the contents of the area. Enter a number of bytes (in hexadecimal). For example, if you enter **1A**, $DEBUG will begin the listing after the 26th byte in the unmapped storage area.

e For "LENGTH," enter the number of words, doublewords, or characters you want to list, depending on the MODE you select. Enter a decimal number.

f For "MODE," enter the format you want the data to appear in.

The sample program reads eight 256-byte records into unmapped storage. The following example lists the first 256-byte record in the unmapped storage area:

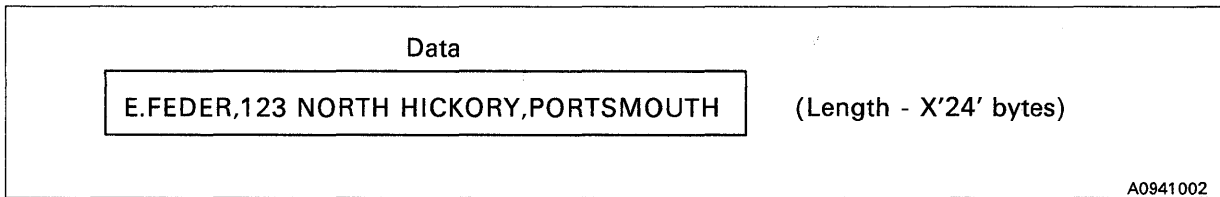
```
> LIST
OPTION (*/ADDR/R0...R7/#1/#2/IAR/TCODE/UNMAP): UNMAP
STORBLK ADDRESS (0 TO CANCEL LIST): 76
SWAP#: 1
DISPLACEMENT: 0
LENGTH: 128
MODE(X/F/D/A/C): X
```

Figure 4-6 shows how $DEBUG displays the first record of the unmapped storage area for the ADDNAMES program.

```
0000 X' 0024 C54B C6C5 C4C5 D96B F1F2 F340 D5D6'
0010 X' D9E3 C840 C8C9 C3D2 D6D9 E86B D7D6 D9E3'
0020 X' E2D4 D6E4 E3C8 0026 D14B D7C9 E9E9 D6D3'
0030 X' C1E3 D66B F2F2 40E2 E8C3 C1D4 D6D9 C540'
0040 X' C4D9 4B6B C2C5 C1E5 C5D9 D2C9 D3D3 0020'
0050 X' D34B D3C9 D5C7 6B40 F5F5 F540 D4C1 C9D5'
0060 X' 40E2 E34B 6BC1 D3D3 C5D5 E3D6 E6D5 C540'
0070 X' 001E C44B C2C1 D2C5 D96B F1F2 40D5 D6D9'
0080 X' E3C8 40E4 D5C9 D6D5 6BD9 C5C4 D5C5 C3D2'
0090 X' 0028 D14B C1D5 E9C1 D3D6 D5C5 6BF5 F2F3'
00A0 X' 40E6 C5E2 E3E5 C9C5 E640 C2D3 E5C4 4B6B'
00B0 X' D9D6 C3D2 C3D9 C5C5 D26B 0000 0000 0000'
00C0 X' 0000 0000 0000 0000 0000 0000 0000 0000'
00D0 X' 0000 0000 0000 0000 0000 0000 0000 0000'
00E0 X' 0000 0000 0000 0000 0000 0000 0000 0000'
00F0 X' 0000 0000 0000 0000 0000 0000 0000 0000'
```

Figure 4-6. Sample Listing from $DEBUG

Each "logical record" that ADDNAMES processes consists of a name and address preceded by a "length" word. The length word indicates the length of the name and address in bytes. The program checks the length word, processes the amount of data that follows it, and moves to the next length word. The following is what the contents of the first logical record in Figure 4-6 would look like if they were translated into EBCDIC.



If you were to list the rest of the contents of the unmapped storage area, you would see that no more data exists. A brief examination of the storage contents in Figure 4-6 reveals that fewer than 1000 bytes of data were processed by the program. However, when you look for the second exit condition, a −1 (X'FFFF') at the end of the data, no −1 exists.

In the compiler listing for the ADDNAMES program, the first IF instruction in the DO loop looks for a −1 and the second IF instruction checks to see if the length of the data being processed is greater than 0. (See Figure 4-5 on page 4-15.) If no −1 is found, and if the length word contains only zeros, the program begins the loop again. Without a −1 to indicate the end of the data, the program performs the DO loop endlessly.

In this case, the sample program obviously needs to be modified. However, to ensure that you have diagnosed the cause of the error correctly, you could place a −1 at the end of the data with the PATCH command of $DEBUG.

To use the PATCH command:

1 Press the attention key and enter **PATCH**.

2 After you enter the command, use the following procedure:

a For "OPTION," enter **UNMAP**.

b For "STORBLK ADDRESS," enter the address of the STORBLK statement that defines the unmapped storage area you want to modify.

c For "SWAP#," enter the number of the unmapped storage area you want to modify.

d For "DISPLACEMENT," indicate how far from the beginning of the unmapped storage area the utility should go before listing the contents of the area. Enter a number of bytes (in hexadecimal). For example, if you enter **1A**, $DEBUG will begin the listing after the 26th byte in the unmapped storage area.

e For "LENGTH," enter the number of bytes, up to 16, that you want to modify. You cannot modify more than 16 bytes of data at a time. Enter a decimal number.

f For "MODE," enter the format you want the data to appear in.

3 The PATCH command displays the data to be modified. Enter your new data following the "DATA:" prompt message. Separate each word of data with a space.

If you enter less data than the amount displayed, the command pads the remaining area with blanks (for character data) or zeros (for all other types of data).

4 The command displays the data you entered and issues the prompt message "YES/NO/CONTINUE." Respond **Y** to confirm the change, **N** to cancel the change, or **CONTINUE** to confirm the change and to continue modifying data.

The following example uses the PATCH command to place a −1 at the end of the data in the unmapped storage area. After the change is made, resume program execution by pressing the attention key and entering **GO**.

```
> PATCH
OPTION (*/ADDR/R0...R7/#1/#2/IAR/TCODE/UNMAP): UNMAP
STORBLK ADDRESS (0 TO CANCEL PATCH): 76
SWAP#: 1
DISPLACEMENT: BA
LENGTH: 1
MODE(X/F/D/A/C): X
NOW IS
 00BA X' 0000'
DATA: FFFF
NEW DATA
 00BA X' FFFF'
YES/NO/CONTINUE: Y

> GO
```

Run Loops Caused by Device Interrupts

The system can go into a run loop when device interrupts fill up the buffer area that the system uses to contain interrupts. When the buffer fills up, the system issues a stop code of X'64FB'. The loop begins at entry point SVCIBFOF in the supervisor module EDXSVCX.

This problem can be caused by the following:

1 The value you specified on the IABUF= operand of the SYSPARMS statement (in $EDXDEFS) is not large enough to contain the number of interrupts. The default for IABUF= is 20. You may have to increase the value specified. Refer to the *Installation and System Generation Guide* for details on this operand.

2 A hardware problem on a device causes the device to send excessive interrupts which in turn causes IABUF to become full. Loading the $LOG utility, which records I/O errors, may identify the device experiencing errors. The $LOG utility is discussed in Chapter 9, "Recording Device I/O Errors and Program Check Information" on page 9-1.

Run Loops Caused by Stack Overflows

The system can enter a run loop when the buffer fills up with more pointers than there are XPSSTK entries for pointers. When this is the case, the system issues a stop code of X'64FC'. The loop begins at entry point XPSSTKOF in the supervisor module EDXSVCX.

This problem can be caused by the following:

1 The value you specified on the XPSSTK= operand of the SYSPARMS statement (in $EDXDEF) is not large enough to contain the number of return addresses and partition numbers saved during cross-partition branches. The default for XPSSTK= is 20. You may have to increase the value specified. Refer to the *Installation and System Generation Guide* for details on this operand.

2 A hardware problem on a device causes the device to send excessive interrupts which in turn causes XPSSTK to become full. Loading the $LOG utility, which records I/O errors, may identify the device experiencing errors. The $LOG utility is discussed in Chapter 9, "Recording Device I/O Errors and Program Check Information" on page 9-1.

3 More terminals than stack entries may be defined on your system. Make sure you defined more stack entries than you have terminals.

Chapter 5. Analyzing and Isolating a Wait State

A wait state is a condition where the system or a program is waiting for the completion of an event or operation, but because of an error, the completion of the event or operation never occurs. When this condition exists, you must determine what prevented the event or operation from completing.

This chapter describes how to determine the cause of a wait state in an application program.

If, during a wait state, you press the attention key and the system does **not** display a "greater than" symbol (>), you should take a stand-alone or $TRAP dump. Chapter 7, "Analyzing a Failure Using a Storage Dump" on page 7-1 explains how you can determine the cause of the problem from the dump. Refer to the *Operation Guide* for details on taking a stand-alone dump. The *Operator Commands and Utilities Reference* explains how to use the $TRAP utility.

In order to determine what caused the wait state in the application program, you must first find the address of the waiting instruction. How to do this is described in the next section.

Note: Several procedures in this chapter use the $DEBUG utility. If you have the EDL Accelerator Custom Feature, RPQ D02723, or have a 4956 Model E, 60E, G10, H10, J or K processor, do not leave $DEBUG loaded on your system after you finish using the utility. $DEBUG disables the accelerator feature. When you end the last copy of $DEBUG, the system enables the accelerator feature again.

How to Find the Address of the Waiting Instruction Using $DEBUG

To find the address of the waiting instruction, do the following while the program is in the wait state:

1. Load $DEBUG in any available partition.

   Try to load $DEBUG from a terminal other than the terminal from which the waiting program was loaded. If you cannot use a different terminal, then load $DEBUG from the terminal used by the waiting program.

2. Enter the name of the waiting program when $DEBUG asks you for a program name and volume. Because the program is already loaded, you do *not* need to enter the volume name.

3. When $DEBUG asks for a partition, enter the number of the partition which contains the waiting program. If $DEBUG and the waiting program are in the same partition, press the enter key.

4. Reply N when asked if you want a new copy of the program loaded.

The following example shows what you would enter for the program WAITPGM located in partition 1. $DEBUG, in this example, is loaded in partition 2.

```
> $L $DEBUG
LOADING $DEBUG      nnP,hh:mm:ss, LP= xxxx, PART= yy
PROGRAM (NAME,VOLUME): WAITPGM
PARTITION (DEFAULT IS CURRENT PARTITION): 1
ALREADY ACTIVE AT B400
DO YOU WANT A NEW COPY TO BE LOADED? N
```

5 Press the attention key and enter the **WHERE** command. $DEBUG then displays the instruction address where the program is waiting. The following is an example of this sequence:

```
> WHERE
TASK1234 AT  00B8
```

6 Using the address displayed by $DEBUG, look at the compiler listing of that program to see what instruction is at that address.

7 Press the attention key and enter **END** to end $DEBUG.

After you identify the instruction that caused the wait, you must determine the reason why it was waiting. The next section can help you analyze the instruction that caused the wait state.

Analyzing the Instruction that Caused the Wait State

This section discusses how you can analyze the wait state if the program is stopped at any of the following instructions:

- ENQ
- ENQT
- WAIT.

If the program is not waiting on any of these instructions, go to the section "Other Possible Causes of a Wait State" on page 5-8.

Analyzing an ENQ Instruction

When the program is pointing to an ENQ instruction, you must examine the queue control block (QCB) the program tried to enqueue. By examining the queue control block, you can determine which task has control of that queue control block.

This section explains how to examine the queue control block when the following conditions apply:

- The queue control block is defined within the program with a QCB statement.
- The queue control block is defined in the system common area, $SYSCOM.

Examining a Queue Control Block Defined in the Program

Use the following procedure to examine the queue control block defined in the program:

1 Find the address of the QCB statement in the program compiler listing.

2 While the program is in the wait state, load $DEBUG in any available partition.

Try to load $DEBUG from a terminal other than the terminal from which the waiting program was loaded. If you cannot use a different terminal, then load $DEBUG from the terminal used by the waiting program.

3 Enter the name of the waiting program when $DEBUG asks you for a program name and volume. Because the program is already loaded, you do *not* need to enter the volume name.

4 When $DEBUG asks for a partition, enter the number of the partition which contains the waiting program. If $DEBUG and the waiting program are in the same partition, press the enter key.

5 Reply **N** when asked if you want a new copy of the program loaded.

The following example shows what you would enter for the program WAITPGM located in partition 1. $DEBUG, in this example, is loaded in partition 2:

```
> $L $DEBUG
LOADING $DEBUG     nnP,hh:mm:ss, LP= xxxx, PART= yy
PROGRAM (NAME,VOLUME): WAITPGM
PARTITION (DEFAULT IS CURRENT PARTITION): 1
ALREADY ACTIVE AT B400
DO YOU WANT A NEW COPY TO BE LOADED? N
```

6 Press the attention key and enter the **LIST** command.

7 Respond to the prompts to display the 5-word queue control block. For example, if the address of the QCB statement were at X'05E8', you would respond to the prompts as follows:

```
> LIST
OPTION (*/ADDR/R0...R7/#1/#2/IAR/TCODE/UNMAP): ADDR
ADDRESS: 5E8
LENGTH: 5
MODE(X/F/D/A/C): X
```

An example of the output follows:

```
05E8 X'0000 0000 0000 CD38 0001'
```

8 Look at word 3 of the queue control block. (The first word of the QCB is word 0.) Word 3 contains the task control block (TCB) address of the task that owns the QCB. In the sample output, the TCB address is X'CD38'. Word 4 contains the address space in which that task resides. Word 4 in the example shows address space 1 (partition 2).

9 Examine the task at the address (identified in step 8) and determine why that task did not issue a DEQ instruction.

The section "Common Causes of a Program Wait Using QCBs" on page 5-5 presents some hints as to what might be the cause of the problem.

10 Press the attention key and enter **END** to end $DEBUG.

Examining a Queue Control Block Defined in $SYSCOM

Do the following steps to examine the queue control block defined in $SYSCOM:

1 Using the link map listing of the current supervisor, find the address of the queue control block in $SYSCOM that you attempted to enqueue.

2 Press the attention key and enter **$CP 1**.

3 Press the attention key and enter **$D**.

```
>$D
ENTER ORIGIN:
```

4 Enter **0000** as the origin. Enter the queue control block address from step 1. Enter the number 5 for the count.

```
>$D
ENTER ORIGIN: 0000
ENTER ADDRESS, COUNT: 19D0,5
```

The following is an example of the output displayed for a queue control block at address X'19D0':

```
19D0: 0000 CD38 0000 1F00 0001
```

The first word of the QCB (word 0) indicates the status of the QCB. A value of X'FFFF' means that the QCB is available. A value of X'0000' means that the QCB is enqueued.

5 Look at words 3 and 4 of the QCB. Word 3 is the task control block (TCB) address of the task that owns the QCB. In the sample output, this TCB address is X'1F00' Word 4 contains the address space in which that task

resides. In the sample output, the address space in which that task resides is address space 1 (partition 2).

Word 1 contains the TCB address of the waiting task. Word 2 contains the address space in which that task resides. The waiting task is at address X'CD38' in address space 0 (partition 1).

6 Press the attention key and enter **$CP**, specifying the partition number you identified in step 5 on page 5-4.

7 Press the attention key and enter **$A**.

8 Find the program whose load point is within the range of the TCB address you identified in step 5 on page 5-4.

Note: If the $A shows that no programs are active, the task whose TCB address you identified in step 5 on page 5-4 is no longer in storage and failed to issue a DEQ. When this is the case, you must IPL the system to clear the wait state and to release the enqueued QCB.

To prevent this condition in the future, determine what other programs use that QCB. If possible, also determine which of those programs was previously active. Examine those programs and determine which one failed to dequeue the QCB. The section "Common Causes of a Program Wait Using QCBs" presents some hints as to what might have caused the problem.

9 Subtract the program load point address from the TCB address of the task that owns the QCB. In this example, the TCB address is X'1F00'.

10 Using the resulting address from step 9, locate that address in the compiler listing for that program.

11 If that address points to an ENDPROG, ENDTASK, or DETACH statement, examine that program and determine why it did not issue a DEQ.

12 If that address does not point to an ENDPROG, ENDTASK, or DETACH statement, then the program in storage is not the program that enqueued the QCB. When this is the case, you must IPL the system to clear the wait state and to release the enqueued QCB.

To prevent this condition in the future, determine what other programs use that QCB. If possible, also determine which of those programs was previously active. Examine those programs and determine which one failed to dequeue the QCB. The section "Common Causes of a Program Wait Using QCBs" presents some hints as to what might have caused the problem.

Common Causes of a Program Wait Using QCBs

Wait states are often caused when:

- A program fails to issue a DEQ to an enqueued QCB.
- A program issues an ENQ to a queue control block defined in $SYSCOM when $SYSCOM is not mapped in that program's partition. You map $SYSCOM across partitions during system generation (COMMON= operand on the SYSCOMM statement).

  If $SYSCOM is not mapped in the partition in which you issued the ENQ or DEQ, ensure you use cross-partition services to enqueue or dequeue the QCB.

Also check that the field $TCBADS of the program's TCB points to the address space in which the QCB resides. This consideration applies to any QCB not residing in a program's partition. Refer to the *Language Reference* for examples of cross-partition operations.

- A program overlays the QCB area in storage (QCB destroyed).

Review the compiler listing of your program to ensure that none of the previous conditions exist.

Analyzing an ENQT Instruction

When the program is pointing to an ENQT instruction, you must examine the terminal control block (CCB) of the device the program tried to enqueue. By examining the terminal control block, you can determine which task has control of that device.

Do the following steps to examine the terminal control block:

1 In the compiler listing, find the name of the terminal to which the program issued the ENQT.

2 Look in the link map listing of your current supervisor and locate the section labeled $EDXDEF. In that section, find the label that matches the name of the device the program tried to enqueue.

3 Add X'60' to the address of that device. The resulting address points to word 3 of the field $CCBQCB in the terminal control block.

4 At the terminal, press the attention key and enter **$CP 1**.

5 Press the attention key and enter **$D**. The following example illustrates this step.

```
>$D
ENTER ORIGIN:
```

6 Enter **0000** as the origin. Enter the address you calculated in step 3. In the example, this address is represented by xxxx. Enter the number **2** for the count. The following example illustrates this step.

```
>$D
ENTER ORIGIN: 0000
ENTER ADDRESS, COUNT: xxxx,2
```

7 The first word displayed is the task control block (TCB) address of the program that has control of the device. The partition in which that program is running is the value of the second word plus 1.

8 Press the attention key and enter **$CP**, specifying the partition number from step 7.

9 Press the attention key and enter **$A**.

10 The TCB address from step 7 on page 5-6 will be within the range of the load point address for the program that has control of the device.

11 Examine the compiler listing of that program and determine why it has not issued a DEQT.

Analyzing a WAIT Instruction

If the event control block the program is waiting on is defined with an ECB statement, go to the section "Common Causes of a Program Wait Using ECBs" on page 5-8 for some hints as to what might be the problem.

If the event control block the program is waiting on is defined as a result of coding the EVENT= operand on a PROGRAM or TASK statement, do the following:

1 While the program is in the wait state, load $DEBUG in any partition.

Try to load $DEBUG from a terminal other than the terminal from which the waiting program was loaded. If you cannot use a different terminal, then load $DEBUG from the terminal used by the waiting program.

2 Enter the name of the program which contains the EVENT= operand when $DEBUG asks you for a program name and volume. Because the program is already loaded, you do *not* need to enter the volume name.

3 When $DEBUG asks for a partition, enter the number of the partition which contains the waiting program. If $DEBUG and the waiting program are in the same partition, press the enter key.

4 Reply **N** when asked if you want a new copy of the program loaded.

The following example shows what you would enter for the program WAITPGM located in partition 1. $DEBUG, in this example, is loaded in partition 2:

```
> $L $DEBUG
LOADING $DEBUG     nnP,hh:mm:ss, LP= xxxx, PART= yy
PROGRAM (NAME,VOLUME): WAITPGM
PARTITION (DEFAULT IS CURRENT PARTITION): 1
ALREADY ACTIVE AT B400
DO YOU WANT A NEW COPY TO BE LOADED? N
```

5 Press the attention key and enter the **WHERE** command.

6 Using the compiler listing of that program, locate the instruction address displayed in step 5 and determine why that program has not ended.

7 Press the attention key and enter **END** to end $DEBUG.

The next section, "Common Causes of a Program Wait Using ECBs" on page 5-8, gives some hints as to what might be the problem.

Common Causes of a Program Wait Using ECBs

Wait states are often caused when a program:

- Fails to post an event control block (ECB) which another program is waiting on. Ensure that all attached tasks post the ECB before issuing a DETACH.
- Issues a WAIT with the RESET operand specified when the event has already been posted. Coding a WAIT followed by a RESET instruction may resolve the problem.
- Waits on an ECB defined in $SYSCOM when $SYSCOM is not mapped in the program's partition. You map $SYSCOM across partitions during system generation (COMMON= operand on the SYSCOMM statement).

  If $SYSCOM is not mapped in the partition in which you issued the WAIT or POST, ensure that you use cross-partition services to wait on or post the ECB. Also check that the field $TCBADS of the program's TCB points to the address space in which the ECB resides. This consideration applies to any ECB not residing in a program's partition. Refer to the *Language Reference* for examples of cross-partition operations.
- Has a logic error that unintentionally branches to a WAIT instruction.

Review the compiler listing of your program and ensure none of the previous conditions exist.

Other Possible Causes of a Wait State

When the program stops at an instruction other than ENQ, ENQT, or WAIT, consider the following:

- Is the program waiting for operator input to instructions such as READTEXT, GETVALUE, or QUESTION? The problem may be that the operator never responded to a prompt message or a prompt message requesting input was not coded.
- Is the instruction a READ or WRITE? It is possible that a hardware problem on disk prevented a device interrupt being sent to the supervisor. The system would wait until it received the device interrupt signaling completion of the I/O request.

  Any of the following may verify that a disk problem exists:

  - Verifying the disk using $INITDSK (VD command). If $INITDSK indicates errors, load $DASDI and try assigning alternate sectors on the device.

    Note: If you are not familiar with the procedures for assigning alternate sectors, contact your customer service representative for assistance.
  - Allocating a data set using $DISKUT1.
  - Verifying the hardware configuration using $IOTEST (LS or LD command).

  If any or all of these attempts fail, the disk probably has a hardware problem. Contact your service representative for corrective action.
- Is a program, while using full screen support, enqueued to $SYSLOG? If the supervisor is unable to display a program check message to $SYSLOG, the system enters a wait state.

Chapter 6. Analyzing and Isolating a Program Check

The system issues a program check message to provide you with status information on an error that occurred during processing. The system writes this message to the terminal defined as $SYSLOG.

Note: If you defined the SYSMSG statement in your $EDXDEF data set, the messages go to your $SYSLOG terminal, a disk data set, the Communications Facility log, or any combination of these depending on what you specified in the $EDXDEF data set. However, if $SYSLOG is busy, the system does **not** redirect the program check message to another terminal. For more information on the SYSMSG statement, refer to the *Installation and System Generation Guide*.

The system provides two types of program check messages: one for a system program check and another for an application program check. Application program checks are caused by errors within an application program. System program checks typically occur when the supervisor detects an error in its own code or when an application program somehow overlays part of the supervisor.

This chapter explains how to analyze the status information in a program check message so that you can determine the cause of a problem. A sample program that causes a program check when executed is included to show the steps required to isolate an error.

The first step in determining the cause of the problem is understanding the information displayed in the message. The following section explains the program check message.

How to Interpret the Program Check Message

The program check message can be in one of the following three formats:

- The standard format issued by the supervisor for application and all system program checks. The system issues the standard program check message for application programs when you do not code the ERRXIT= operand on the PROGRAM or TASK statement. Go to the section "Interpreting the Standard Program Check Message" on page 6-2 when you receive the standard program check message.
- The format displayed when you code the ERRXIT= operand on the PROGRAM or TASK statement and specify the task error exit routine $$EDXIT. Refer to the *Event Driven Executive Language Programming Guide* for details on how to use $$EDXIT. Go to the section "Interpreting the Program Check Message from $$EDXIT" on page 6-7 when you receive this application program check message.
- Any format you create when you code the ERRXIT= operand on the PROGRAM or TASK statement and supply your own error exit routine. Refer to the *Customization Guide* for details on how to provide your own task error exit routine.

Interpreting the Standard Program Check Message

This section explains the information displayed in the standard program check messages. A description of the information follows the sample messages.

The following example shows the standard application program check message:

```
PROGRAM CHECK:
 PLP  TCB  PSW  IAR  AKR  LSR  R0   R1   R2   R3   R4   R5   R6   R7
 3A00 0120 8002 2AD6 0110 80D0 0064 3B0A 3B20 3A37 3A34 015C 00B8 0000
```

The next example shows the system program check message:

```
SYSTEM PGM CHECK:
PSW  IAR  AKR  LSR  R0   R1   R2   R3   R4   R5   R6   R7
8002 2AD6 0110 80D0 0064 3B0A 3B20 3A37 3A34 015C 00B8 0000
```

The 11 words of information beginning with IAR and ending with R7 are called the level status block (LSB).

The headings displayed in the messages and what the information means follows. (Normally when you analyze an EDL application program check, you need only be concerned with PLP, TCB, PSW, R1, R3, and R4.)

PLP The address in storage of the program load point. This is the address at which the program was loaded for execution and represents the first word of your program listing.

For a system program check message, this field is omitted because the failing instruction is within the supervisor.

TCB The address of the active task control block (TCB) as per the compiler listing (nonrelocated).

For a system program check message, this field is omitted because the failing instruction is within the supervisor.

PSW The value of the processor status word (PSW) when the program check occurred. See the section "How to Interpret the Processor Status Word" on page 6-4 to determine the meaning of this value.

IAR The contents of the instruction address register (IAR) at the time of the error. The value shown is the address of the machine instruction currently executing.

AKR The value of the address key register (AKR) at the time of the error. For 3-bit processors, bits 5–7 form the operand 1 key, bits 9–11 form the operand 2 key, and bits 13–15 form the instruction space key. For 4-bit processors, bits 4–7 form the operand 1 key, bits 8–11 form the operand 2 key and bits 12–15 form the instruction space key. For 5-bit processors, bit 1 and bits 4–7 form the operand 1 key, bit 2 and bits 8–11 form the operand 2 key, bit 3 and 12–15 form the instruction space key. For all processors, bit 0 of the AKR is the equate operand spaces (EOS) bit. If bit 0 is set to 1, the operand 2 key is used for both operand 1 and operand 2.

LSR The value of the level status register (LSR) when the error occurred. The bits, when set, indicate the following:

- Bits 0–4 — The status of arithmetic operations. Refer to the processor description manual for the meanings of these bits.
- Bit 8 — Program is in supervisor state.
- Bit 9 — Priority level is in process.
- Bit 10 — Class interrupt tracing is active.
- Bit 11 — Interrupt processing is allowed.

Bits 5–7 and bits 12–15 are not used and are always zero.

The next portion of the program check message displays the contents of the general purpose registers R0–R7. If the failing program is written in a language other than EDL, refer to the user's guide for that language to determine the register usage.

Because the EDL interpreter, EDXALU, uses the general purpose registers, the contents of the registers can vary during instruction processing. The description below reflects the contents of the registers prior to entry into the system code that executes an EDL instruction.

R0 Because the supervisor uses this register as a work register, the contents are usually not significant to the failing program.

R1 Contains the address of the failing EDL instruction.

R2 Contains the address in storage of the active task control block (TCB). The address in R2 is the sum of the TCB address and the load point address.

R3 Contains the address in storage of EDL operand 1 of the failing instruction.

R4 Contains the address in storage of EDL operand 2 (if applicable) of the failing instruction.

R5 Contains the EDL operation code of the failing instruction. The first byte contains flag bits that indicate how operands are coded. For example, the flag bits indicate whether the operand is in #1, #2, or is specified as a constant. The second byte is the operation code of the EDL instruction.

R6 Because the supervisor uses this register as a work register, the contents are usually not significant to the failing program. However, you can determine if the system was emulating EDL code when the failure occurred if R6 is twice the value shown in the second byte of R5. For example, if the second byte of R5 contained X'32' *and* the system was emulating EDL, R6 would contain X'0064'.

R7 Because the supervisor uses this register as a work register, the contents are usually not significant to the failing program. Sometimes the supervisor uses this register for a branch and link instruction. The address may give a clue as to which function passed control to the address in the IAR.

After reviewing the information shown in the program check message, you must analyze the contents displayed for the *processor status word* (PSW).

The processor status word is a 16-bit register the system uses to save error status. By looking at the processor status word, you can determine whether the error is hardware or software related. The next section explains how to interpret the processor status word.

How to Interpret the Processor Status Word

The value of the processor status word is shown as four hexadecimal digits. Each hexadecimal digit represents the sum of four binary bits. Starting from left to right, the value of each bit (when set) is 8, 4, 2, and 1. To interpret what bits are on, you must convert each hexadecimal digit to binary. For example, if the PSW indicated the value X'8002', the binary representation and the bit positions would be as shown in Figure 6-1:

Hex Value	Binary Value	PSW Bits
8	1000	0-3
0	0000	4-7
0	0000	8-11
2	0010	12-15

Figure 6-1. Sample Processor Status Word Bit Settings

In the previous example, note that bits 0 and 14 are set. These bit settings are the same as X'8002'.

After you convert the value to binary and identify which bit positions are set, refer to "Interpreting the Processor Status Word Bits" for an explanation of what each bit indicates. Remember that bit 0 is the leftmost bit in the 16-bit string.

Interpreting the Processor Status Word Bits

The information indicated by the processor status word bits can be categorized into three types:

- Software problems — bits 0 – 6
- Hardware problems — bits 8, 10, or 11
- Processor status — bit 7 and bits 12 – 15.

Figure 6-2 on page 6-5 shows the PSW bits and their general assignment for the different processors. An explanation of the bit settings follows Figure 6-2.

Refer to the specific processor description manual for details on class interrupts, I/O interrupts, and the basic instruction set (including indicator settings and possible exceptions conditions).

If the PSW indicates a hardware error (machine check), call your service representative for corrective action.

If the PSW indicates a software problem *and* the program check occurred in an application program, read the section "How to Analyze an Application Program Check" on page 6-11.

Review the section "How to Analyze a System Program Check" on page 6-21 if the error is a system program check.

Bit	Processor type 495x: 2	3	4	5	6	Condition	Class interrupt
0	X	X	X	X	X	Specification check	Program check
1	X	X	X	X	X	Invalid storage address	Program check
2	X	X	X	X	X	Privilege violate	Program check
3	X		X	X	X	Protect check	Program check
4	X	X	X	X	X	Invalid function	Soft exception
5			X	X	X	Floating-point exception	Soft exception
6	X	X	X	X	X	Stack exception	Soft exception
7					X	Extended Address Mode	None
8			X	X	X	Storage parity check	Machine check
9						Not used	
10	X	X	X	X	X	Processor control check	Machine check
11	X	X	X	X	X	I/O check	Machine check
12	X	X	X	X	X	Sequence Indicator	None
13	X		X	X	X	Translator enabled	None
14	X	X	X	X	X	Auto IPL	None
15	X	X	X	X	X	Power/thermal warning	Power/thermal

Figure 6-2. Processor Status Word Bit Assignments

Processor Status Word Bit Descriptions

An explanation of the bit settings follows.

Bit 0 - Specification Check: Set to 1 if (1) the storage address violates the boundary requirements of the specified data type, or (2) the effective (computed) address is odd.

This error would occur, for example, if a program attempted to move word to an area on an odd-byte boundary. You can identify which operand (R3 or R4 addresses) violates the boundary if the last hex digit of the operand address is either 1, 3, 7, 9, B, D, or F.

This is a software error.

Bit 1 - Invalid Storage Address: Set to 1 when an attempt is made to access a storage address outside the storage size of the partition or when an attempt is made to refer to a storage address in a nonexistent partition.

This error would occur, for example, if a program attempted to do a cross-partition move to a nonexistent partition.

This is a software error.

Bit 2 - Privilege Violate: Set to 1 if a program in problem state attempts to issue a privileged instruction. The processor can run in either supervisor or problem state. Some assembler instructions can be used only while in supervisor state. If an assembler program in problem state attempts to issue a privileged instruction, the privilege violate condition occurs.

Normally, this error would never occur in an EDL program.

This is a software error.

Bit 3 - Protect Check: Set to 1 if a program attempts to access protected storage. The processor can control access to areas in storage by using a storage protect feature. If a program attempts to address any part of the protected storage, the protect check indicator is set.

Normally, this error would never occur in an EDL program.

This is a software error.

Bit 4 - Invalid Function: Set to 1 by if any of the following conditions occur:

- Attempted execution of an illegal operation code or function combination.
- The processor attempts to execute an instruction associated with a feature that is not contained in the supervisor.

An EDL program can cause this error if it attempts to use floating-point instructions (FADD, FSUB, FMULT, or FDIVD) when floating-point support is not in the supervisor.

This is a software error.

Bit 5 - Floating-Point Exception: Set to 1 when an exception condition is detected by the optional floating-point processor. Floating-point hardware sets this bit to indicate underflow, overflow, and divide check exceptions. An EDL program can detect these exceptions by the return code from a floating-point instruction. No program check message is issued when this exception occurs.

This is a software error.

Bit 6 - Stack Exception: Set to 1 when an attempt has been made to pop an operand from an empty processor storage stack or push an operand into a full processor storage stack. A stack exception also occurs when the stack cannot contain the number of words to be stored by an assembler Store Multiple (STM) instruction.

Normally, this error would never occur in an EDL program.

This is a software error.

Bit 7 - Extended Address Mode: Set to 1 when the processor is operating in extended address mode.

This is a status indicator.

Bit 8 - Storage Parity:: Set to 1 when the hardware detects a parity error on data being read out of storage by the processor.

This is a hardware error.

Bit 10 - Processor Control Check: Set to 1 if no levels are active but execution continues.

This is a hardware error.

Bit 11 - I/O Check: Set to 1 when a hardware error has occurred on the I/O interface that may prevent further communication with any I/O device.

This is a hardware error.

Bit 12 - Sequence Indicator: Set to 1 to reflect the last I/O interface sequence to occur. This indicator is used in conjunction with I/O check (bit 11).

This is a status indicator.

Bit 13 - Auto IPL: Set to 1 by the hardware when an automatic IPL occurs.

This is a status indicator.

Bit 14 - Translator Enabled: Set to 1 when the Storage Address Relocation Translator Feature is installed and enabled.

This is a status indicator.

Bit 15 - Power Warning and Thermal Warning: Set to 1 when these conditions occur (refer to the appropriate processor manual for a description of a power/thermal warning class interrupt).

This is a status indicator.

Interpreting the Program Check Message from $$EDXIT

When you specify $$EDXIT as the task error exit for an EDL program, the output you receive is formatted with descriptive headings. In addition, $$EDXIT provides more information than the standard program check message. $$EDXIT also interprets the processor status word and tells you what it means.

When a program check occurs, the program check message is directed to $SYSLOG and $SYSPRTR.

The following is an example of a program check message issued by $$EDXIT. An explanation of each numbered item in the sample output follows the example.

```
        ******************************************
        * WARNING!!  AN EXCEPTION HAS OCCURRED!! *
        ******************************************

 1   PROGRAM NAME            = PCHECK  2   PSW = 8002
 3   PROGRAM VOLUME          = MYVOL   4   IAR = 2AD6
 5   PROGRAM LOAD POINT      =   0000  6   AKR = 0110
 7   ADDRESS OF ACTIVE TCB   =   0120  8   LSR = 80D0
 9   ADDRESS OF CCB          =   0F5E  10  R0 (WORK REGISTER) =  0064
 11  NUMBER OF DATA SETS     =      0  12  R1 (EDL INSTR ADDR) =  010A
 13  NUMBER OF OVERLAYS      =      0  14  R2 (EDL TCB ADDR)   =  0120
 15  $TCBADS                 =   0001  16  R3 (EDL OP1 ADDR)   =  0037
 17  ADDRESS OF FAILURE                18  R4 (EDL OP2 ADDR)   =  0034
     ((REL. TO PGM LOAD PT) =   010A   19  R5 (EDL COMMAND)   =  015C
 20  DUMP OF FAIL ADDRESS              21  R6 (WORK REGISTER)  =  00B8
     010A:  015C 0000 0034 8332        22  R7 (WORK REGISTER)  =  0000
 23  $TCBCO  =      -1 DEC;  FFFF HEX  24  #1 =  0037
 25  $TCBCO2 =       0 DEC;  0000 HEX  26  #2 =  0000
 27  PSW ANALYSIS:

      SPECIFICATION CHECK
      TRANSLATOR ENABLED
```

After this message is issued, $$EDXIT displays the following message on the loading terminal:

```
   A MALFUNCTION HAS OCCURRED -- CALL SYSTEM PROGRAMMER
```

The previous message is not displayed if you code an extension error routine to $$EDXIT with the entry point name PCHKRTN. Refer to the *Customization Guide* for details on how to code an extension to $$EDXIT.

A description of the sample program check message follows.

1 The **PROGRAM NAME** field identifies the name of the failing application program. In this example, the program PCHECK failed.

2 The **PSW** field indicates the value of the *processor status word* when the error occurred. $$EDXIT interprets this value and displays its meaning as shown in field **27** of this sample message.

A detailed description of the processor status word and the associated bits are presented in the section "Interpreting the Processor Status Word Bits" on page 6-4.

3 The **PROGRAM VOLUME** field identifies the name of the volume from which the failing application program was loaded. In this example, the name of the volume is MYVOL.

4 The **IAR** field (instruction address register) contains the address of the currently executing machine instruction.

5 The **PROGRAM LOAD POINT** field contains the address at which the program was loaded for execution. The address represents the first word of your program listing.

6 The **AKR** field contains the value of the address key register (AKR). For 3-bit processors, bits 5–7 form the operand 1 key, bits 9–11 form the operand 2 key, and bits 13–15 form the instruction space key. For 4-bit processors, bits 4–7 form the operand 1 key, bits 8–11 form the operand 2 key and bits 12–15 form the instruction space key. For 5-bit processors, bit 1 and bits 4–7 form the operand 1 key, bit 2 and bits 8–11 form the operand 2 key, bit 3 and bits 12–15 form the instruction space key. For all processors, bit 0 of the AKR is the equate operand spaces (EOS) bit. If bit 0 is set to 1, the operand 2 key is used for both operand 1 and operand 2.

7 The **ADDRESS OF ACTIVE TCB** field contains the address (nonrelocated) of the active task control block (TCB) as per the compiler listing.

8 The **LSR** field level status register (LSR) information. The bits, when set, indicate the following:

- Bits 0–4 — The status of arithmetic operations. Refer to the processor description manual for the meanings of these bits.
- Bit 8 — Program is in supervisor state.
- Bit 9 — Priority level is in process.
- Bit 10 — Class interrupt tracing is active.
- Bit 11 — Interrupt processing is allowed.

Bits 5–7 and bits 12–15 are not used and are always zero.

9 The **ADDRESS OF CCB** field contains the address of the terminal control block (CCB) assigned to the failing program.

10 The **R0** field contains the contents of hardware register 0 when the error occurred. Because the supervisor uses this register as a work register, the contents are usually not significant when you analyze the failing program.

11 The **NUMBER OF DATA SETS** field shows the number of data sets specified on the DS= operand of the PROGRAM statement.

12 The **R1** field contains the address of the failing EDL instruction.

13 The **NUMBER OF OVERLAYS** field indicates the number of overlay programs specified on the PGMS= operand of the PROGRAM statement.

14 The **R2** field contains the address in storage of the active task control block. This address is the sum of the TCB address and the program load point.

15 The **$TCBADS** field contains the target task address space. The value of this field plus 1 indicates the partition number in which the program was running.

16 The **R3** field contains the address of EDL operand 1 for the failing EDL instruction.

17 The **ADDRESS OF FAILURE** field contains the address of the failing EDL instruction. This is the address shown in the compiler listing. This is also the address shown in field **12** in this sample output. In this example, the failing EDL instruction is at address X'010A'.

18 The **R4** field contains the address of EDL operand 2 (if applicable) for the failing EDL instruction.

19 The **R5** field contains the EDL operation code of the instruction that was executing when the failure occurred. The first byte contains flag bits which indicate how operands are coded. For example, the flag bits indicate whether the operand is in #1, #2, or specified as a constant. The second byte is the operation code of the EDL instruction.

20 The **DUMP OF FAIL ADDRESS** field shows the location and content of the instruction that was executing when the failure occurred. The information at this address also appears in the compiler listing.

21 The **R6** field contains the contents of hardware register 6 when the error occurred. Because the supervisor uses this register as a work register, the contents are usually not significant when you analyze the failing program. However, you can determine if the system was emulating EDL code when the failure occurred if R6 is twice the value shown in the second byte of R5. For example, if the second byte of R5 contained X'32' *and* the system was emulating EDL, R6 would contain X'0064'.

22 The **R7** field contains the contents of hardware register 7 when the error occurred. Because the supervisor uses this register as a work register, the contents are usually not significant when you analyze the failing program.

Sometimes the supervisor uses this register for a branch and link instruction. The address may give you a clue as to which function passed control to the address in the IAR.

23 The **$TCBCO** field shows the value in the first word of the failing program's task control block (TCB). The value is displayed in decimal and followed by the hexadecimal equivalent.

24 The **#1** field shows the contents of index register 1 when the failure occurred. In this example, #1 contains the value X'0037'.

25 The **$TCBCO2** field shows the value in the second word of the failing program's task control block (TCB). The value is displayed in decimal and followed by the hexadecimal equivalent.

26 The **#2** field shows the contents of index register 2 when the failure occurred.

27 The **PSW ANALYSIS** field explains the meanings of the bit settings in the processor status word (PSW). The hexadecimal format of the processor status word is shown in field **2**. This information indicates the type of error that occurred.

See the section "Processor Status Word Bit Descriptions" on page 6-5 to determine the type of error the "PSW ANALYSIS" field indicates. If the error points to hardware, call your service representative for corrective action. If the error points to software, read the following section.

How to Analyze an Application Program Check

When the processor status word (PSW) indicates a software error, you need to find out where in the program the error occurred. The information in the program check message can help you find the error.

This section contains a sample program check message and the program that caused the error. Using both the program check message and the compiler listing for the sample program, this section will explain the steps required to find the problem. The techniques used here can help you to analyze program checks that occur with your own application programs.

The section "Examining an Unmapped Storage Area for the Cause of a Program Check" on page 6-15 presents techniques that may be helpful if your program uses unmapped storage. "Some Common Causes of Application Program Checks" on page 6-21 provides some additional hints about what may cause this type of error.

Note: Several procedures in this chapter use the $DEBUG utility. If you have the EDL Accelerator Custom Feature, RPQ D02723, or have a 4956 Model E, 4956-60E processor, a 4956 Model G10 or H10 processor, or a 4956 Model J or K processor do not leave $DEBUG loaded on your system after you finish using the utility. $DEBUG disables the accelerator feature. When you end the last copy of $DEBUG, the system enables the accelerator feature again.

To find the cause of the program check, use the following procedure:

1 Look at the program check message and determine what type of software error the processor status word indicates.

The program check message from the sample program follows:

```
PROGRAM CHECK:
 PLP  TCB  PSW  IAR  AKR  LSR  R0   R1   R2   R3   R4   R5   R6   R7
 3A00 0120 8002 2AD6 0110 80D0 0064 3B0A 3B20 3A37 3A34 015C 00B8 0000
```

The PSW indicates that a specification check occurred and that the translator was enabled. A specification check indicates a boundary violation. Therefore the specification check is the cause of the error.

2 Look at the addresses for operands 1 and 2 and determine which operand is on an odd-byte boundary. R3 contains the address of operand 1. R4 contains the address of operand 2.

Determining which operand is on an odd-byte boundary can help you analyze the failing instruction.

In the sample program check message, notice that the address of operand 1 (X'3A37') is on an odd-byte boundary.

3 Find the address of the failing instruction. Subtract the program load point (PLP) from the address of R1. The result is the address of failing instruction.

The program load point of the sample program is X'3A00'. The value of R1 is X'3B0A'. The result of subtracting these addresses is X'010A'.

At this point you know the address of the failing instruction and which operand is on an odd-byte boundary.

4 Look in the compiler listing and determine if the instruction at the address you calculated in step 3 on page 6-11 is coded correctly.

In the compiler listing of the sample program, a MOVE instruction is at address X'010A':

```
LOC    +0   +2   +4   +6   +8
0000   0008 D7D9 D6C7 D9C1 D440  PCHK     PROGRAM   START
000A   0000 0120 01A0 0000 0000
0014   01A4 0000 0000 0000 0100
001E   01A2 0000 0000 0000 0000
0028   0000 0000 0000 0000 0000
0032   0000
0034   4040                      A        DATA      X'4040'
0036   0000 0000 0000 0000 0000  B        DATA      100F'0'
00FE                             START    EQU       *
00FE   835C 0000 0036                     MOVEA     #1,B
0104   809C 0116 0064                     DO        100
010A   015C 0000 0034                       MOVE    (0,#1),A
0110   8332 0000 0001                       ADD     #1,1
0116   009D 0000 0001                     ENDDO
011C   0022 FFFF                          PROGSTOP
0120   0000 0000 0000 0234 0000           ENDPROG
012A   00D0 0000 00FE 0120 0000
0134   0000 0000 0000 0000 0000
013E   0002 0096 0000 0000 FFFF
0148   0000 0000 014C 0000 0000
0152   014E D7C3 C8D2 4040 4040
015C   0000 0000 0000 0000 0000
0166   0000 0000 FFFF 0000 0000
0170   0000 0000 0000 0120 0000
017A   0000 0000 0000 0000 0000
0198   0000 0000 0120 0080 0000
01A2   0000 0000 0000 0000 0000
01B6   0000
01B8                                      END
```

In this example, the MOVE instruction and its operands are coded correctly. Because the cause of the error is not apparent by looking at the failing instruction, you can use $DEBUG to trace the program's execution.

5 At the terminal, press the attention key and load $DEBUG. Enter the name of the program (and volume if not on EDX002) when $DEBUG asks you for the program name and volume.

When $DEBUG asks you for a partition, enter the number of the partition where you want the failing program to be loaded. If you want the program loaded in the same partition as $DEBUG, press the enter key. For the "TERMINAL" prompt, enter the terminal on which you want $DEBUG to load the program. If you press the enter key, $DEBUG loads the program on the terminal it is currently using.

In this example, $DEBUG is loaded in partition 2. The utility loads the failing program, PCHK, in the same partition and the program and the utility share the same terminal.

```
> $L $DEBUG
LOADING $DEBUG      nnP,hh:mm:ss, LP= xxxx, PART= yy
PROGRAM (NAME,VOLUME): PCHK
PARTITION (DEFAULT IS CURRENT PARTITION):
TERMINAL (DEFAULT IS CURRENT TERMINAL):
LOADING PCHK        2P,00:00:00, LP=1F00, PART=2

REQUEST "HELP" TO GET LIST OF DEBUG COMMANDS
PCHK     STOPPED AT  00FE
```

6 Press the attention key and enter **AT** to set the first breakpoint at the address of the program's entry point (low address). Enter **TASK** when you are prompted for an option. The entry point in the sample program is at address X'00FE'. This sequence follows:

```
> AT
OPTION(*/ADDR/TASK/ALL): TASK
LOW ADDRESS: FE
```

7 Set the next breakpoint at the address of the last executable instruction (high address). The last executable instruction of the sample program is the PROGSTOP at address X'011C'.

Because you only need the trace addresses at this point, select the NOLIST and NOSTOP options:

```
HIGH ADDRESS: 11C
LIST/NOLIST: NOLIST
STOP/NOSTOP: NOSTOP
      1 BREAKPOINT(S) SET
```

8 Press the attention key and enter **GO**.

The program will run until it program checks again. During its execution, however, $DEBUG will display all the instruction addresses up to the point of the program check.

The following is an example of the trace addresses from the sample program:

```
PCHK     CHECKED AT  0104
PCHK     CHECKED AT  010A
PCHK     CHECKED AT  0110
PCHK     CHECKED AT  0116
PCHK     CHECKED AT  010A
```

9 Look at the trace addresses. Notice that in the sample trace output, the instruction at address X'010A' (MOVE) executed successfully the first time. However, the second time the program executed the instruction at X'010A', the program failed with a program check. The supervisor cancels the program.

Because the last instruction the program executed was at address X'010A', you need to reload the program under $DEBUG, set a breakpoint at address X'010A', and examine index register 1 (#1). The sample program uses the index of #1 to point to the target address of the MOVE instruction.

By examining #1 before the program executes the instruction at X'010A', you can determine if #1 points to an odd-byte boundary.

10 Press the attention key and enter **END** to end the current $DEBUG.

11 Reload $DEBUG and specify the name of the program.

12 Press the attention key and enter **AT**.

13 For the sample program, reply to the prompts as follows to set a breakpoint at address X'010A' and to examine #1:

```
OPTION(*/ADDR/TASK/ALL): ADDR
BREAKPOINT ADDR: 10A
LIST/NOLIST: LIST
OPTION( */ADDR/R0...R7/#1/#2/IAR/TCODE/UNMAP): #1
LENGTH: 1
MODE(X/F/D/A/C): X
STOP/NOSTOP: STOP
      1 BREAKPOINT(S) SET
```

14 Press the attention key and enter **GO**.

$DEBUG stops the program's execution at address X'010A' and displays the contents of #1. The following is an example of the output:

```
PCHK     STOPPED AT  010A
  #1 PCHK     X' 1F36'
```

The value X'1F36' in #1 is the address *in storage* of the variable labeled "B". This address gets stored in #1 on the previous MOVEA instruction. Notice that at this point, the address for operand 1 (#1) points to an even address (word aligned).

The trace output showed that no problem occurred the first time through the DO loop. Thus, you can assume that some instruction after that point caused the address in #1 to point to an odd-byte boundary.

The next sequence shows how you can identify the cause of the problem.

15 Press the attention key and enter **GO**.

Again $DEBUG stops the program's execution at address X'010A' and displays the contents of #1. The following sample output shows what #1 points to now:

```
PCHK     STOPPED AT  010A
  #1 PCHK      X' 1F37'
```

Notice that the address #1 points to is on an odd-byte boundary (X'1F37'). Further examination of the compiler listing shows that immediately after the MOVE instruction, the program incremented the value in #1 by 1:

```
                                             •
                                             •
                                             •
00FE   835C 0000 0036                        MOVEA     #1,B
0104   809C 0116 0064                        DO        100
010A   015C 0000 0034                          MOVE    (0,#1),A
0110   8332 0000 0001                          ADD     #1,1
0116   009D 0000 0001                        ENDDO
```

Because the program attempts to move a word of data and #1 points to an odd-byte boundary (X'1F37'), the program fails with a specification check.

Although the program check message indicates that the MOVE instruction failed, the cause of the problem is the ADD instruction at address X'0110'.

Because the MOVE instruction attempts to move a word of data, the program should have incremented #1 by 2. Adding 2 to #1 enables the program to receive the next word of data on a word boundary.

Examining an Unmapped Storage Area for the Cause of a Program Check

An application program check can occur if a program receives invalid data. By using the LIST command of $DEBUG, you can examine the data areas in your program to see if any of the data in these areas is invalid. (For more information on using the LIST command of $DEBUG, refer to the *Operator Commands and Utilities Reference*.) If the failing program uses unmapped storage, you may also want to look at the data in the unmapped storage areas. This section explains how to examine an unmapped storage area to determine the cause of an application program check.

The sample program used in this section is named CODE. The CODE program reads a set of addresses into unmapped storage, acquires the data at those addresses, and processes the data. The last time CODE was loaded, however, the operator received a program check message. The program check message from the sample program follows:

```
PROGRAM CHECK:
 PLP  TCB  PSW  IAR  AKR  LSR  R0   R1   R2   R3   R4   R5   R6   R7
 0000 095A 4002 3CBA 0330 88D0 0080 08DE 0904 00A0 8210 025C 00B8 0000
```

The PSW in the message indicates that the sample program attempted to use an invalid storage address. This error can occur if a program attempts to use an

address that is outside of the partition in which the program was loaded. It also can occur if a program refers to a storage address in a nonexistent partition. In addition to the software error, the PSW also shows that the translator was enabled. (See "Interpreting the Processor Status Word Bits" on page 6-4 for an explanation of the bit settings.)

To find the address of the failing EDL instruction, subtract the program load point (PLP) from the contents of R1 in the program check message. The value of R1 in the program check message is X'08DE'. Since the program load point for the sample program is X'0000', the address of the failing EDL instruction is X'08DE'.

In the compiler listing for the sample program, a MOVE instruction is at address X'08DE':

```
LOC   +0   +2   +4   +6   +8
0000  0008 D7D9 D6C7 D9C1 D440  CODE   PROGRAM  START,DS=((DATA,VOL))
000A  0000 0104 0184 0000 0000
0014  0188 0000 0001 0000 0100
001E  0186 0000 0000 0000 0000
0028  0000 0000 0000 0000 0000
0032  FFFF 0000 0000 0808 C4C1
003C  E3C1 4040 4040 0606 E5D6
0046  D340 4040 0000 0000 0000
0050  0000 0001 0000 0001 0000
005A  0000 0000 0000 0000 0000
006E  0000 0000 0000 0000
0076  0000 C1C1 0000 0000 0008  BLOCK  STORBLK  TWOKBLK=1,MAX=2
0080  0002 FFFF 0000 0000 0090
008A  0000 0000 0000 FFFF FFFF
0094  FFFF FFFF
0098  0000                      INDEX  DC       F'0'
009A  0000 0000 0000 0000 0000  ENTRY  DC       1024F'0'
0892  0000 0000 0000 0000
089A                            START  EQU      *
089A  00B9 0076 0000 0000 0101         GETSTG   BLOCK,TYPE=ALL
08A4  80B9 0076 0001 0000 0300         SWAP     BLOCK,1
08AE  035C 0000 0082                   MOVE     #1,BLOCK+$STORMAP
08B4  8120 0000 0008 0000 020C         READ     DS1,(0,#1),8
08BE  0032
08C0  835C 0002 009A                   MOVEA    #2,ENTRY
08C6  805C 0098 0000 809C 08F0         DO       128,TIMES,INDEX=INDEX
08D0  0080 8032 0098 0001
08D8  045C 08E2 0000                     MOVE    ADDRESS,(0,#1)
08DE  025C 0000 08E2                     MOVE    (0,#2),*,P2=ADDRESS
08E4  8332 0000 0002                     ADD     #1,2
08EA  8332 0002 0002                     ADD     #2,2
08F0  009D 0000 0001                   ENDDO
                                       •
                                       •
                                       •
0946  00B9 0076 0000 0000 0201         FREESTG  BLOCK,TYPE=ALL
0A00  0022 FFFF                        PROGSTOP
                                       COPY     STOREQU
                                       •
                                       •
                                       •
```

The MOVE instruction at X'08DE' should take a word of data from an address in storage and place it in the data area labeled ENTRY at X'009A'. The address of ENTRY is contained in #2. The MOVE instruction moves data from addresses supplied by the previous MOVE instruction at X'08D8'. The addresses reside in the unmapped storage area obtained by the program.

From the program check message, it appears that the MOVE instruction at X'08DE' received a storage address that was not in the partition in which the program was loaded. To determine if this was the case, you first need to know the partition CODE was loaded in and the largest storage address in that partition.

In this example, the operator loaded CODE in partition 2. You can find the largest storage address in a partition by looking at the storage map for your system. The storage map appears on the last page of the listing created when you generated your system. It also is displayed when you IPL your system.

Look under the heading "TOTAL SIZE (HEX)" in the storage map and find the value listed for the partition. Subtract 1 from this value to get the largest usable storage address in the partition. For the sample system on which CODE is running, the storage map shows a total size for partition 2 of X'8000'. Therefore, the largest usable address in partition 2 is X'7FFF'.

To see if the sample program attempted to gain access to a storage address greater than X'7FFF', you need to look at the data in the unmapped storage area used by the program. To examine the contents of an unmapped storage area, do the following:

1 Load $DEBUG in any available partition.

2 Enter the name of the failing program (and volume if not on EDX002).

3 When $DEBUG asks for a partition, enter the number of the partition where the utility should load the failing program. If you want the program loaded in the same partition as $DEBUG, press the enter key.

4 For the "TERMINAL" prompt, enter the terminal on which you want $DEBUG to load the program. If you press the enter key, $DEBUG loads the program on the terminal it is currently using.

In the following example, $DEBUG is loaded in partition 1. The utility loads the sample program in partition 2, but $DEBUG and the program share the same terminal.

```
> $L $DEBUG
LOADING $DEBUG     nnP,hh:mm:ss, LP= xxxx, PART= yy
PROGRAM (NAME,VOLUME): CODE
PARTITION (DEFAULT IS CURRENT PARTITION): 2
TERMINAL (DEFAULT IS CURRENT TERMINAL):
LOADING CODE        3P,00:01:32, LP=0000, PART=2

REQUEST "HELP" TO GET LIST OF DEBUG COMMANDS
CODE     STOPPED AT  089A
```

5 Press the attention key and enter **AT** to set a breakpoint at the address following the instruction that reads the data into unmapped storage.

Note: If your program obtains several unmapped storage areas, you may need to trace the execution of the program to determine what area was in use when the program check occurred. Review the trace procedure beginning with step 6 on page 6-13.

In the sample program, the address following the READ instruction is X'08BE':

```
> AT
OPTION (*/ADDR/TASK/ALL): ADDR
BREAKPOINT ADDR: 8BE
LIST/NOLIST: NOLIST
STOP/NOSTOP: STOP
      1 BREAKPOINT(S) SET
```

6 Press the attention key and enter **GO**.

$DEBUG displays a message when it suspends the program's execution at the breakpoint:

```
CODE     STOPPED AT  08BE
```

7 Press the attention key and enter the **LIST** command. After you enter this command, do the following:

a For "OPTION," enter **UNMAP**.

b For "STORBLK ADDRESS," enter the address of the STORBLK statement that defines the unmapped storage area you want to see.

c For "SWAP#," enter the number of the unmapped storage area you want to see.

d For "DISPLACEMENT," indicate how far from the beginning of the unmapped storage area the utility should go before listing the contents

of the area. Enter a number of bytes (in hexadecimal). For example, if you enter **1A**, $DEBUG will begin the listing after the 26th byte in the unmapped storage area.

e For "LENGTH", enter the number of words, doublewords, or characters you want to list, depending on the MODE you select. Enter a decimal number.

f For "MODE," enter the format you want the data to appear in.

The following example shows how you would list the first 256-byte record the sample program read into unmapped storage.

```
> LIST
OPTION (*/ADDR/R0...R7/#1/#2/IAR/TCODE/UNMAP): UNMAP
STORBLK ADDRESS (0 TO CANCEL LIST): 76
SWAP#: 1
DISPLACEMENT: 0
LENGTH: 128
MODE(X/F/D/A/C): X
```

Figure 6-3 shows how $DEBUG displays the first record of the unmapped storage area for the CODE program.

```
0000 X' 0B36 0B38 0B3A 0B3C 0B3E 0B40 0B42 0B44'
0010 X' 0B46 0B48 0B4A 0B4C 0B4E 0B50 0B52 0B54'
0020 X' 0B56 0B58 0B5A 0B5C 0B5E 0B60 0B62 0B64'
0030 X' 0B76 0B78 0B7A 0B7C 0B7E 0C00 0C02 0C04'
0040 X' 0C06 0C08 0C0A 0C0C 0C0E 0C10 0C12 0C14'
0050 X' 0C16 0C18 0C1A 0C1C 0C1E 0C20 0C22 0C24'
0060 X' 0C26 0C28 0C2A 0C2C 0C2E 0C30 0C32 0C34'
0070 X' 0D00 0D02 0D04 0D06 0D08 0D0A 0D0C 0D0E'
0080 X' 0D10 0D12 0D14 0D16 0D18 0D1A 0D1C 0D1E'
0080 X' 7200 7202 7204 7206 7208 720A 720C 720E'
0090 X' 8210 7212 7214 7216 7218 721A 721C 721E'
00A0 X' 7220 7222 7224 7226 7228 722A 722C 722E'
00B0 X' 2100 2102 2104 2106 2108 210A 210C 210E'
00C0 X' 2110 2112 2114 2116 2118 211A 211C 211E'
00D0 X' 2120 2122 2124 2126 2128 212A 212C 212E'
00E0 X' 2130 2132 2134 2136 2138 213A 213C 213E'
00F0 X' 2140 2142 2144 2146 2148 214A 214C 214E'
```

Figure 6-3. Sample Listing from $DEBUG

Notice the word of data at address X'0090' in Figure 6-3. The word contains the value X'8210'. When the MOVE instruction in the sample program attempted to use this value as an address, it went beyond the bounds of the partition and caused the program check.

To verify that the address caused the program check, you could replace it with a valid address (one smaller than X'7FFF') and see if the program runs successfully. You can replace data in an unmapped storage area with the PATCH command of $DEBUG.

To use the PATCH command do as follows:

1 Press the attention key and enter **PATCH**.

2 After you enter the command, do the following:

a For "OPTION," enter **UNMAP**.

b For "STORBLK ADDRESS," enter the address of the STORBLK statement that defines the unmapped storage area you want to modify.

c For "SWAP#," enter the number of the unmapped storage area you want to modify.

d For "DISPLACEMENT," indicate how far from the beginning of the unmapped storage area the utility should go before listing the contents of the area. Enter a number of bytes (in hexadecimal). For example, if you enter **1A**, $DEBUG will begin the listing after the 26th byte in the unmapped storage area.

e For "LENGTH," enter the number of bytes, up to 16, that you want to modify. You cannot modify more than 16 bytes of data at a time. Enter a decimal number.

f For "MODE," enter the format you want the data to appear in.

3 The PATCH command displays the data to be modified. Enter your new data following the "DATA:" prompt message. Separate each word of data with a space.

If you enter less data than the amount displayed, the command pads the remaining area with blanks (for character data) or zeros (for all other types of data).

4 The command displays the data you entered and issues the prompt message "YES/NO/CONTINUE." Respond **Y** to confirm the change, **N** to cancel the change, or **CONTINUE** to confirm the change and to continue modifying data.

The following example uses the PATCH command to replace the invalid address in the unmapped storage area with the address X'7210'. After the change is made, the program resumes executing when you press the attention key and enter **GO**.

```
> PATCH
OPTION (*/ADDR/R0...R7/#1/#2/IAR/TCODE/UNMAP): UNMAP
STORBLK ADDRESS (0 TO CANCEL PATCH): 76
SWAP#: 1
DISPLACEMENT: 90
LENGTH: 1
MODE(X/F/D/A/C): X
NOW IS
 0090 X' 8210'
DATA: 7210
NEW DATA
 0090 X' 7210'
YES/NO/CONTINUE: Y

> GO
```

Some Common Causes of Application Program Checks

Program checks in an application program are commonly caused by the following:

- PROGSTOP statement omitted in the program
- Failure to link-edit programs with external references (EXTRNs)
- Nonexecutable statements coded within inline executable code
- Attempting to move a word of data to an odd-byte boundary
- Reading or moving data into a storage area too small to contain the data.

How to Analyze a System Program Check

Generally a system program check is caused by either of the following:

- An error in the assembly or link-edit of the current supervisor during system generation.
- An application program that somehow overlays a part of the supervisor in storage.

This section describes some methods you may be able to use to isolate the cause of a system program check.

To begin analyzing the system program check, do the following:

1. Review the compiler and link-edit listings of the current supervisor for −1 completion codes. If either of the listings do not indicate successful completion, correct the errors and perform another system generation.

2. Try to reproduce the failure by rerunning all the programs that were active. Ensure those programs run in the same partition they were running in when

the failure occurred. While you rerun the programs, identify which program caused the failure.

A program that was running in a partition containing supervisor code or a program doing a cross-partition move is most likely the cause of the problem.

After determining which program caused the failure, go to the section "Analyzing the Program Causing the System Program Check."

3 If you determine that the cause of the failure was not due to an application program, submit an authorized program analysis report (APAR) along with a stand-alone dump the next time the failure occurs.

Analyzing the Program Causing the System Program Check

The program you identified as the cause of the system program check probably overlaid an area of the supervisor. To correct the problem, you need to find the instruction in the program that overlays the supervisor area.

This section explains two techniques you can use to isolate the cause of the failure. The technique you use depends on the contents of the instruction address register (IAR) shown in the system program message.

If the address shown in the IAR does not contain all zeros, review the following section. Go to the section "Technique 2 — IAR is All Zeros" on page 6-24 when the IAR address is all zeros.

Technique 1 — IAR is Not All Zeros

To isolate the problem, do the following:

1 Record the address shown for the instruction address register (IAR) in the system program check message.

2 Press the Load button to IPL the system.

3 Press the attention key and enter **$CP 1**.

4 Press the attention key and enter **$D**.

5 Enter **0000** as the origin. Enter the IAR address from step 1. Enter the number 1 for the count.

6 Record the value displayed for that address.

7 Press the attention key and load $DEBUG.

8 Enter the name of the program you identified as the cause of the problem.

The next sequence of steps enables you to determine if the contents displayed in step 6 change during the program's execution. By setting breakpoints at various addresses in the program and determining when the value from step 6 changes, you can locate the portion of the program that causes the error.

9 Using the compiler listing of the program, select several addresses throughout the program at which you want $DEBUG to stop the program's execution.

10 Press the attention key and enter **AT**.

11 At the prompts, enter **ADDR**, a breakpoint address, and the **NOLIST** and **STOP** options.

12 Repeat steps 10 and 11 for each breakpoint address you selected.

13 Press the attention key and enter **GO**.

14 When $DEBUG stops the program's execution at the breakpoint, press the attention key and enter **$D** in partition 1.

15 Enter **0000** as the origin. Enter the IAR address from step 1 on page 6-22. Enter the number 1 for the count.

16 Determine whether the value now displayed is the same value you recorded in step 6 on page 6-22.

17 Repeat steps 13 through 16 until you notice a value other than the value shown in step 6 on page 6-22. When you notice a different value, go to step 18.

18 In the compiler listing, look at the instructions between the last two breakpoint addresses. One or more of the instructions within those breakpoint addresses are the instructions that overlaid a supervisor area and caused a system program check.

19 Determine what instructions caused the failure and correct the error.

Technique 2 — IAR is All Zeros

This technique uses $DEBUG to trace the program's execution. To isolate the problem, do the following:

1. Press the attention key and enter **$CP 1**.
2. Press the attention key and load $DEBUG.
3. Enter the name of the program you identified as the cause of the problem.
4. Press the attention key and enter **AT** to set the first breakpoint at the address of the program's entry point. Enter **TASK** when $DEBUG prompts for an option. For the low address, enter the address of the program's entry point.
5. Enter the address of the program's last executable instruction as the high address.
6. Press the attention key and enter **GO**.
7. When the system program check occurs, the instruction that caused the failure is most likely at one of the last few addresses shown in the trace output.
8. Examine the compiler listing and determine which instruction caused the failure.
9. Correct the error and recompile the program.

Chapter 7. Analyzing a Failure Using a Storage Dump

This chapter explains how you can use a storage dump created by either $TRAP or the stand-alone dump method to analyze a failure. The discussions include how to analyze a wait state, run loop, and a program check.

Very often when you use a dump to analyze a failure, you may have to look at control blocks to find information about the failure. You can obtain a control block equate listing (copy code) by including a COPY statement in your program and specifying the name of the control block you need. The *Language Reference* contains a list of commonly used control block equate names. The control block equates reside on volume ASMLIB and end with the characters "EQU." The *Internal Design* shows the control blocks in detail.

Before you begin to analyze a failure using a dump, you need to know how to interpret the various fields shown in a dump and what they mean. The following section explains the various fields of a dump.

Interpreting the Dump

This section explains the various fields of a sample dump. $TRAP was used to produce the sample dump presented in this section.

Some of the fields shown in a dump differ depending on whether you created the dump using $TRAP or the stand-alone dump method. These differences are noted in the explanation of the sample dump where appropriate. In addition, some of the fields that can appear in a dump depend on the devices and features installed on your system.

The examples presented show how $DUMP prints the information when you select the "format control block" option. The order in which the examples are presented is the same order the information would appear in a dump.

The various pieces of the dump shown in this section have numbered items. An explanation of the numbered items follows each example.

Hardware Level and Register Contents

Figure 7-1 shows the first part of the dump.

```
1 EVENT DRIVEN EXECUTIVE $TRAP FORMAT STORAGE DUMP

2 AT TIME OF TRAP PSW WAS 8006 ON HARDWARE LEVEL 1

3          LEVEL 0   LEVEL 1   LEVEL 2   LEVEL 3      SVC-LSB   SVCI-LSB
4  IAR       1FFA      2AD6      1F32      1F32         1F32       1F0A
5  AKR       0100      0110      0000      0000         0000       0000
6  LSR       8090      00D0      0090      0090         00C0       00C0
7  R0        0000      0001      0000      0000         0000       0000
   R1        0000      0044      0000      0000         0000       0000
   R2        02C2      02C2      0000      0000         0000       0000
   R3        02B6      004D      0000      0000         0000       0000
   R4        0000      0048      0000      0000         0000       0000
   R5        0001      805C      0002      0003         0001       0000
   R6        0000      00B8      8000      8000         8000       0000
   R7        0000      0000      0000      0000         0000       0000
```

Figure 7-1. Hardware Level and Register Contents

Item 1 as shown in Figure 7-1 indicates what type of dump was taken. This example indicates a $TRAP dump. If a stand-alone dump were taken, the text **STAND ALONE STORAGE DUMP** would appear.

Item 2 indicates the value of the processor status word (PSW) and the active hardware interrupt level. In the sample dump, the PSW value indicates X'8006' on hardware level 1. A $TRAP dump always shows the value of the PSW and the active level; a stand-alone dump never contains this line of information.

See the section "How to Interpret the Processor Status Word" on page 6-4 for the meaning of the processor status word.

The column headings at item 3 identify six level status blocks (LSB). There is an 11-word level status block shown for each of the system's hardware interrupt levels (0 – 3). In addition, the contents of the SVC (supervisor call) LSB and the SVCI (supervisor call immediate action) LSB are shown.

The contents of a level status block for a particular hardware interrupt level is shown vertically beginning with IAR and ending with R7. The fields shown for a level status block in the dump are also displayed in a program check message.

Level 0 is inaccurate in the stand-alone dump. This is the level on which the dump program runs; therefore, none of the information for level 0 in a stand-alone dump is relevant to the problem being analyzed. However, the information shown for level 0 in a $TRAP dump *is reliable*; $TRAP saves the information for level 0 as well as levels 1, 2, and 3.

EDX uses the four hardware levels as follows. Level 0 is the highest priority level:

Level 0 — Timer interrupts and task dispatcher

Level 1 — Attention list tasks, supervisor tasks, and I/O interrupts

Level 2 — EDL tasks with a priority of 1 – 255

Level 3 — EDL tasks with a priority of 256 – 510.

Item **4** shows the contents of the instruction address register (IAR). The value shown is the address of the machine instruction currently executing.

Item **5** shows the value of the address key register (AKR). For 3-bit processors, bits 5-7 form the operand 1 key, bits 9-11 form the operand 2 key, and bits 13-15 form the instruction space key. For 4-bit processors, bits 4-7 form the operand 1 key, bits 8-11 form the operand 2 key and bits 12-15 form the instruction space key. For 5-bit processors, bit 1 and bits 4-7 form the operand 1 key, bit 2 and bits 8-11 form the operand 2 key, bit 3 and bits 12-15 form the instruction space key. For all processors, bit 0 of the AKR is the equate operand spaces (EOS) bit. If bit 0 is set to 1, the operand 2 key is used for both operand 1 and operand 2.

The value of the AKR for level 1 in the sample dump (X'0110') indicates operands 1 and 2 reside in address space 1 (partition 2). The IAR resides in address space 0 (partition 1).

Item **6** shows the value of the level status register (LSR). The bits, when set, indicate the following:

- Bits 0 – 4 — The status of arithmetic operations. Refer to the processor description manual for the meanings of these bits.
- Bit 8 — Program is in supervisor state.
- Bit 9 — Priority level is in process.
- Bit 10 — Class interrupt tracing is active.
- Bit 11 — Interrupt processing is allowed.

Bits 4 – 7 and bits 12 – 15 are not used and are always zero.

The LSR value (X'00D0') for level 1 in the sample dump indicates that bits 8, 9, and 11 are set.

Item **7** shows the contents of general-purpose registers R0 through R7 for each hardware interrupt level.

For programs written in EDL, the contents of these registers are described as follows. If the program were written in a language other than EDL, refer to the user's guide for that language to determine the register usage.

R0 Because the supervisor uses this register as a work register, the contents are usually not significant to the failing program.

R1 Contains the address in storage of the failing EDL instruction.

R2 Contains the address in storage of the active task control block (TCB).

R3 Contains the address in storage of EDL operand 1 of the failing instruction.

R4 Contains the address in storage of EDL operand 2 (if applicable) of the failing instruction.

R5 Contains the EDL operation code of the failing instruction. The first byte contains flag bits that indicate how operands are coded. For example, the flag bits indicate whether the operand is in #1, #2, or is specified as a constant. The second byte is the operation code of the EDL instruction.

R6 Because the supervisor uses this register as a work register, the contents are usually not significant to the failing program. However, you can determine if the system was emulating EDL code when the failure occurred if R6 is twice the value shown in the second byte of R5. For example, if the second byte of R5 contained X'32' *and* the system was emulating EDL, R6 would contain X'0064'.

R7 Because the supervisor uses this register as a work register, the contents are usually not significant to the failing program.

If the hardware registers in your dump do not follow the EDL register conventions previously discussed, you should examine the IAR and the AKR.

The IAR contains the address of the last machine instruction the system executed when the failure occurred. The AKR tells you in which address space the IAR resides.

To determine where the program failed, you must check the AKR for the correct address space (partition) and check the IAR to find out what was executing at that address.

Look in the supervisor link map from system generation and see if the IAR address is within one of the supervisor modules. If that IAR address appears in the link map, the name of the module that contains the IAR address may give you a clue as to what function was executing when the failure occurred.

Since register usage can vary from one supervisor module to another, the contents of each register may or may not be meaningful to you. You should, however, check the contents of each register.

Sometimes a register may point to a control block. For example, if R3 points to a terminal control block (CCB), you can assume that the program was doing terminal I/O when the failure occurred.

Sometimes the supervisor uses a register (R7 in many cases) for a branch and link instruction. The address in R7 may give you a clue as to which function passed control to the current IAR address.

If the address shown in the IAR is within your program, subtract the program load point from the IAR. Using the resulting address, look in the compiler listing and/or link-edit listing of that program and determine which instruction is at that address and why it failed.

Floating-Point Registers and Exception Information

Figure 7-2 shows the next part of the sample dump.

```
8 FR0   FFDF FFFF  FFFF FFFF  FFFF FFFF  FFFF FFFF
        FFFF FFFF  0000 0000  0000 0000  FFFF FFFF

  FR1   FFFF FFFF  FFFF FFDF  0000 0010  0000 0000
        0000 0080  0000 0000  0000 0008  0000 0000

  FR2   00DD FFFF  FFFF FFFF  FFFF FFFF  FFFF FFFE
        FFFF FFFF  0000 0000  0000 0000  FFFF FFFF

  FR3   FFFF FFFF  FFFF FFFF  0000 0000  0000 0000
        0020 0000  0000 0000  0000 0008  0080 0000

9 MACHINE/PROGRAM CHECK LOG BUFFER  - LATEST ENTRY PRINTS LAST

   S/EAK TCBA  PSW  SAR  IAR  AKR  LSR  R0   R1   R2   R3   R4   R5   R6   R7
    0100 0120 8006 B437 2AD6 0000 80D0 0064 850A B520 B437 B434 015C 00B8 0000
```

Figure 7-2. Floating-point Registers and Exception Information

Item **8** shows the contents of the floating-point registers (FR0 – FR3) for each hardware level. This information is printed if the system has the floating-point feature installed.

Item **9** shows entries from the system's software trace table, CIRCBUFF (if included during system generation). The system uses the software trace table to record any program and machine-check entries that occurred since the last IPL. The software trace table is described in greater detail in Chapter 8, "Tracing Exception Information" on page 8-1.

The 2-byte S/EAK field indicates a state variable and an error address key.

The state variable (first byte) can be one of the following values:

0 — No interrupt in process

1 — Standard processing (the default value)

2 — Now processing task error exit

3 — Undefined.

The error address key (second byte) is the address key (1 plus this value is the partition number) that was in use when the error occurred.

The SAR (storage address register) field indicates the address in storage last accessed when the failure occurred.

The remaining fields shown in item **9** also appear in a program check message.

Segmentation Registers

The next portion of the dump lists the contents of the system's segmentation registers. Figure 7-3 and Figure 7-4 on page 7-7 illustrate how the dump displays the segmentation registers for systems with eight or less partitions. Figure 7-5 on page 7-8 and Figure 7-6 on page 7-9 show how the dump displays the segmentation registers for a processor in extended address mode. Your system could have up to 32 partitions, numbered ADS00 through ADS31.

In Figure 7-3, the segmentation registers indicate a system with four partitions and no supervisor mapping across partitions. The partitions are 64K each. The heading ADS00 represents partition 1, ADS01 represents partition 2, and so on, up through ADS07, which represents partition 8.

The leftmost column (BLOCK) shows the addresses mapped for each segmentation register. Each segmentation register maps 2K of storage. The segmentation registers are listed below each address space (ADS) heading.

```
STORAGE SEGMENTATION REGISTERS:

BLOCK    ADS00 ADS01 ADS02 ADS03 ADS04 ADS05 ADS06 ADS07

 0000    0004  0104  0204  0304
 0800    000C  010C  020C  030C
 1000    0014  0114  0214  0314
 1800    001C  011C  021C  031C
 2000    0024  0124  0224  0324
 2800    002C  012C  022C  032C
 3000    0034  0134  0234  0334
 3800    003C  013C  023C  033C
 4000    0044  0144  0244  0344
 4800    004C  014C  024C  034C
 5000    0054  0154  0254  0354
 5800    005C  015C  025C  035C
 6000    0064  0164  0264  0364
 6800    006C  016C  026C  036C
 7000    0074  0174  0274  0374
 7800    007C  017C  027C  037C
 8000    0084  0184  0284  0384
 8800    008C  018C  028C  038C
 9000    0094  0194  0294  0394
 9800    009C  019C  029C  039C
 A000    00A4  01A4  02A4  03A4
 A800    00AC  01AC  02AC  03AC
 B000    00B4  01B4  02B4  03B4
 B800    00BC  01BC  02BC  03BC
 C000    00C4  01C4  02C4  03C4
 C800    00CC  01CC  02CC  03CC
 D000    00D4  01D4  02D4  03D4
 D800    00DC  01DC  02DC  03DC
 E000    00E4  01E4  02E4  03E4
 E800    00EC  01EC  02EC  03EC
 F000    00F4  01F4  02F4  03F4
 F800    00FC  01FC  02FC  03FC
```

Figure 7-3. Segmentation Registers of a Four-Partition System

Figure 7-4 on page 7-7 shows an example of the segmentation registers for a system where part of the supervisor is mapped across three partitions.

EDX maps partitions starting at address X'0000'. As shown in Figure 7-4 on page 7-7, address spaces 0 and 1 both have 32 segmentation registers mapped. Address space 2 contains only 10 segmentation registers.

Because the first five segmentation registers in each partition are identical (up to item **10** in Figure 7-4), you can see that the first 10K of the supervisor in partition 1 is mapped across each partition. Mapping the partitions in this manner leaves partitions 1 and 2 with 54K of storage and partition 3 with 10K of storage which can be used for either supervisor code or application programs.

```
     STORAGE SEGMENTATION REGISTERS:

     BLOCK   ADS00 ADS01 ADS02 ADS03 ADS04 ADS05 ADS06 ADS07

      0000   0004  0004  0004
      0800   000C  000C  000C
      1000   0014  0014  0014
      1800   001C  001C  001C
      2000   0024  0024  0024
 10   2800   002C  0104  01DC
      3000   0034  010C  01E4
      3800   003C  0114  01EC
      4000   0044  011C  01F4
      4800   004C  0124  01FC
      5000   0054  012C
      5800   005C  0134
      6000   0064  013C
      6800   006C  0144
      7000   0074  014C
      7800   007C  0154
      8000   0084  015C
      8800   008C  0164
      9000   0094  016C
      9800   009C  0174
      A000   00A4  017C
      A800   00AC  0184
      B000   00B4  018C
      B800   00BC  0194
      C000   00C4  019C
      C800   00CC  01A4
      D000   00D4  01AC
      D800   00DC  01B4
      E000   00E4  01BC
      E800   00EC  01C4
      F000   00F4  01CC
      F800   00FC  01D4
```

Figure 7-4. Segmentation Registers with Supervisor Mapped Across Partitions

Figure 7-5 on page 7-8 shows the segmentation registers for a processor in extended address mode. The segmentation registers show a system with seven partitions and no supervisor mapping across partitions. In extended address mode, the system could have up to 32 partitions.

The heading ADS00 represents partition 1, ADS01 represents partition 2, and so on, up through ADS31, which represents partition 32. The leftmost column (BLOCK) shows the addresses mapped for each segmentation register. Each segmentation register maps 2K of storage. The segmentation registers are listed below each address space (ADS) heading.

STORAGE SEGMENTATION REGISTERS:

BLOCK	ADS00	ADS01	ADS02	ADS03	ADS04	ADS05	ADS06	ADS07
0000	0004	0104	0204	0304	0404			0504
0800	000C	010C	020C	030C	040C			050C
1000	0014	0114	0214	0314	0414			0514
1800	001C	011C	021C	031C	041C			051C
2000	0024	0124	0224	0324	0424			0524
2800	002C	012C	022C	032C	042C			052C
3000	0034	0134	0234	0334	0434			0534
3800	003C	013C	023C	033C	043C			053C
4000	0044	0144	0244	0344	0444			0544
4800	004C	014C	024C	034C	044C			054C
5000	0054	0154	0254	0354	0454			0554
5800	005C	015C	025C	035C	045C			055C
6000	0064	0164	0264	0364	0464			0564
6800	006C	016C	026C	036C	046C			056C
7000	0074	0174	0274	0374	0474			
7800	007C	017C	027C	037C	047C			
			•					
			•					
			•					
F800	00FC	01FC	02FC	03FC	04FC			

BLOCK	ADS08	ADS09	ADS10	ADS11	ADS12	ADS13	ADS14	ADS15
0000								0574
0800								057C
1000								0584
1800								058C
2000								0594
2800								059C
3000								05A4
3800								05AC
4000								05B4
4800								05BC
5000								05C4
5800								05CC
6000								05D4
6800								05DC
			•					
			•					
			•					
F800								066C

Figure 7-5. Segmentation Registers for a Processor in Extended Address Mode

For processors in extended address mode, the dump also lists the contents of the I/O segmentation registers. Figure 7-6 shows how this information is presented.

The heading BNK00 refers to the first "bank" of I/O segmentation registers. BNK01 refers to the second bank of I/O segmentation registers, and so on. For more information on the I/O segmentation registers, refer to the processor description manuals for your processor.

I/O SEGMENTATION REGISTERS:

BLOCK	BNK00	BNK01	BNK02	BNK03	BNK04	BNK05	BNK06	BNK07
0000	0004	0104	0204	0304	0404			0504
0800	000C	010C	020C	030C	040C			050C
1000	0014	0114	0214	0314	0414			0514
1800	001C	011C	021C	031C	041C			051C
2000	0024	0124	0224	0324	0424			0524
2800	002C	012C	022C	032C	042C			052C
3000	0034	0134	0234	0334	0434			0534
3800	003C	013C	023C	033C	043C			053C
4000	0044	0144	0244	0344	0444			0544
4800	004C	014C	024C	034C	044C			054C
5000	0054	0154	0254	0354	0454			0554
5800	005C	015C	025C	035C	045C			055C
6000	0064	0164	0264	0364	0464			0564
6800	006C	016C	026C	036C	046C			056C
7000	0074	0174	0274	0374	0474			
7800	007C	017C	027C	037C	047C			
8000	0084	0184	0284	0384	0484			
8800	008C	018C	028C	038C	048C			
9000	0094	0194	0294	0394	0494			
9800	009C	019C	029C	039C	049C			
A000	00A4	01A4	02A4	03A4	04A4			
A800	00AC	01AC	02AC	03AC	04AC			
B000	00B4	01B4	02B4	03B4	04B4			
B800	00BC	01BC	02BC	03BC	04BC			
C000	00C4	01C4	02C4	03C4	04C4			
C800	00CC	01CC	02CC	03CC	04CC			
D000	00D4	01D4	02D4	03D4	04D4			
D800	00DC	01DC	02DC	03DC	04DC			
E000	00E4	01E4	02E4	03E4	04E4			
E800	00EC	01EC	02EC	03EC	04EC			
F000	00F4	01F4	02F4	03F4	04F4			
F800	00FC	01FC	02FC	03FC	04FC			

Figure 7-6. I/O Segmentation Registers

Storage Map

The next section of the sample dump shows the activity in each partition when the dump was taken. This part is called the storage map.

```
     STORAGE MAP:          11 $SYSCOM AT ADDRESS 19C6

12    EDXFLAGS  6000       13 SVCFLAGS  1000

14    PART#  NAME          ADDR PAGES  ATASK  TCB(S)

15     P1     ADS= 0       0000  256
          $FSEDIT          CB00   31          E8AC
17        **FREE**         EA00   22

       P2     ADS= 1       0000  256          19
18        SAMPLA           0000     4 02C2(A) 0242 01A6 010E 0072
          **FREE**         0400  252

       P3     ADS= 2       0000  256
          $SMURON          0000     5         038A
          $DISKUT1         0500    59 2FF6(A) 2F76
          **FREE**         4000  192

20     P4     ADS= 3       0000  256
16        $TRAP            0000    65 3E92(A) 3E12  1936  1762
          **FREE**         4100  191
```

Figure 7-7. Storage Map

Item **11** in Figure 7-7 shows the address (X'19C6') of the system common area, $SYSCOM (if specified during system generation).

Item **12** is the EDXFLAGS field. The first two digits (60) shown for this field represent the version and modification level of the supervisor. The dump programs do not use the third digit. The last digit (0) indicates the program temporary fix (PTF) level.

Item **13**, SVCFLAGS, contains status information. The bits, when set, indicate the following:

- Bit 0 — Supervisor busy. The current active task will not be switched. The bit is set on by a BAL (Branch and Link) to SETBUSY, R7, and turned off by the SVC request.
- Bit 1 — A bit that tells the supervisor whether or not an immediate routine requested an SVC (BAL SVCI) type of operation. For more information on the EDXSVCX module, refer to the *Internal Design.*
- Bit 2 — Dequeue request.
- Bit 3 — Tells whether you have or do not have floating-point hardware. If this bit is on, your hardware is floating-point hardware. If the bit is off, your hardware is not floating-point hardware.
- Bit 4 — A task is active. The EDXSVCX module needs this for chaining information.
- Bit 5 — Remote IPL through Communications Facility. If the bit is on, remote IPL has already been done.

- Bit 6 — WAITM posting in progress. If this bit is on, the EDXSVCX module can tell that there is a wait for multiple events.
- Bit 7 — If this bit is off, your supervisor is a single partition supervisor. If the bit is on, your supervisor is a cross partition supervisor.
- Bit 8 — Supervisor initialization complete. This bit is turned on when initialization is complete.
- Bit 9 — Copy of $MEMDISK active. If this bit is on, a copy is already loaded into the system. Only one copy may be loaded at a time.
- Bits 10 and 11 — extended address mode support. These bits indicate the following possible support:
  - If Bit 10 is off (whether Bit 11 is on or off), your processor has a three-bit architecture.
  - If Bit 10 is on *and* Bit 11 is off, your processor has a 4-bit architecture.
  - If Bit 10 is on *and* Bit 11 is on, your processor has a 5-bit architecture.

Bits 12–15 are reserved for future use. The value shown in the example, X'1000', indicates that floating-point hardware is installed.

The column headings at item **14** mean the following:

PART# Partition number.

NAME Program name.

ADDR Program load point address.

PAGES The size of the address space (partition) or program in pages. A page is 256 bytes in length. Programs loaded for execution always begin on a page boundary.

ATASK The task control block (TCB) address of the attention list task, if one exists. Task control block addresses of attention list tasks also have **(A)** beside the address.

TCB(S) The task control block addresses in a task chain. The first address in the task chain is always the main task.

Item **15** indicates that partition 1 (address space 0) begins at address X'0000' and is 256 pages in length (64K). Because the whole supervisor resides in partition 1 in this example, the load point of the first program in this partition, $FSEDIT, begins at address X'CB00'. $TRAP is shown at item **16**. The dump also shows that $TRAP is 65 pages in length.

The TCB address X'3E92' is the address of $TRAP's attention list task. The main TCB for $TRAP is at address X'3E12'.

Item **17** indicates the free space in partition 1 beginning at address X'EA00'. The 22 pages of free storage are contiguous.

Item **18** indicates the program SAMPLA is loaded at address X'0000' in partition 2 (address space 1). SAMPLA has an attention list task at address X'02C2'. Also notice that the TCB chain shows the addresses of four task control blocks (item **19**). The task control block at address X'0242' is the main TCB for SAMPLA. The program SAMPLA consists of five task control blocks.

Task control block addresses shown on the TCB chain are the addresses of the tasks defined within the main program. If the main program attaches a task that was link-edited to the main program, and the ATTACH instruction has CHAIN=NO, the address of that task does not appear on the TCB chain.

Because the load point of SAMPLA is at address X'0000', all addresses shown for these tasks would be identical to the compiler listing of SAMPLA.

Item **20** shows that no programs are running in partition 4 (address space 3) and that there are 256 pages of free contiguous storage.

Level Table and TCB Ready Chain

Figure 7-8 shows the next part of the sample dump.

```
21  EDX LEVEL TABLE - TCB READY CHAIN

    LEVEL ACTIVE      READY (TCB-ADS)


22    1   02C2-1      NONE
23    2   NONE        010E-1 0242-1
      3   NONE        NONE


24  LOADER QCB  CUR-TCB   CHAIN (TCB-ADS)

     94F4  FFFF NONE      NONE
```

Figure 7-8. Level Table and Task Ready Chain

Item **21** shows the level table and TCB ready chain. The level table keeps pointers to the currently active tasks, all ready tasks for levels 1, 2, and 3, and the address space key in which the tasks reside.

Item **22** shows an active TCB on level 1 at address X'02C2'. The -1 that appears beside this address indicates the address space. Notice also that for level 1, there are no TCBs on the ready chain.

The active TCB at address X'02C2' belongs to the attention list task in partition 2 for program SAMPLA (item **18** in Figure 7-7 on page 7-10).

Item **23** shows no tasks active on level 2 and two tasks on the ready chain. Notice that these two ready tasks are in address space 1 (partition 2).

The TCB at address X'010E' will be the first task on level 2 to become active if no other task on level 1 or level 2 (with a higher priority) becomes active. Also notice that these two ready tasks reside in program SAMPLA (item **19** in Figure 7-7 on page 7-10).

Item **24** shows the address (X'94F4') of the loader queue control block (QCB). This address is the entry point of LOADQCB in the resident loader. This entry point appears in the supervisor link map from system generation.

The value X'FFFF' indicates that no tasks are enqueued. If programs were being loaded, this value would be X'0000' and the address of a TCB would be shown.

Terminal Device Information

Figure 7-9 shows the terminals defined in the supervisor (item 25).

```
25 TERMINAL LIST:

26 NAME     CCB  ID   IODA FEAT QCB CUR-TCB       CHAIN

27 CDRVTA   09FA FFFF 0040 0800 FFFF NONE         NONE
   CDRVTB   0BAA FFFF 0000 0000 FFFF NONE         NONE
28 $SYSLOG  0D84 0406 0004 0400 0000 E8AC-0       NONE
   TERM2    0F5E 040E 0024 0400 0000 02C2-1       NONE
   TERM3    1138 040E 0025 0400 0000 2F76-2       NONE
   $SYSPRTR 131C 0306 0021 0020 FFFF NONE         NONE
   MPRTR    1534 0206 0001 0020 FFFF NONE         NONE
   T3101    177A 2816 0058 0440 FFFF NONE
```

Figure 7-9. Terminal Device Information

The column headings at item 26 mean the following:

NAME The label on the TERMINAL statement for this device.

CCB The address of the terminal control block (CCB).

ID This value identifies the type of terminal. The values shown also appear when you issue the LD or LS commands of $IOTEST. The value X'FFFF' as shown in item 27 indicates that both CDRVTA and CDRVTB are virtual terminals.

IODA The device address specified on the TERMINAL statement. For virtual terminals, ignore any addresses that appear under this heading.

FEAT This value indicates the device characteristics defined at system generation, such as output pause or spoolable device.

QCB The queue control block (QCB) for the terminal. The value X'FFFF' indicates that no task has enqueued the terminal. If the value were X'0000' as shown in item 28 , a task has enqueued the terminal. For example, the task control block at address X'E8AC' in address space 0 (partition 1) belongs to $FSEDIT as shown in the storage map (Figure 7-7 on page 7-10).

CUR-TCB The address of the task control block and address space of the task currently enqueued on the terminal.

CHAIN The task control block chain. If a task issued an ENQT to any of these terminals while the terminal is currently enqueued by a different task, the TCB address and address space of the task attempting to enqueue that terminal would appear on the chain.

Disk, Diskette, and Tape Device Information

Information on disk, diskette, and tape devices is presented in Figure 7-10 on page 7-14, which is the next portion of the dump.

These three device types have volume directory entry (VDE) and device data block (DDB) information listed. The VDE and DDB information is listed under separate headings in the dump. Because of the interrelationship between the VDE and the DDB, the meanings of the headings are explained first.

```
          DISK(ETTE)/TAPE VDE :

29   VDE  NAME   DDB  FLAGS  QCB CUR-TCB    CHAIN (TCB-ADS)

31   06DC *DDE*  0738  0800  FFFF NONE       NONE
     070A EDX002 0738  8000  FFFF NONE       NONE
     07F0 *DDE*  081E  2900  FFFF NONE       NONE

30   DDB  IODA DEVID DSCB-> TASK DSCB-CHAIN

32   0738 0003  00CA 94A6-0 08DE NONE
     081E 0002  0106 CA5A-0 08DE NONE
```

Figure 7-10. Disk, Diskette, and Tape Device Information

The column headings for the volume directory entry are shown at item **29** and mean the following:

VDE — The volume descriptor entry (VDE) control block describes a volume on disk, diskette, or tape. One VDE is created for each DISK or TAPE statement specified during system generation. If the VOLNAME= operand is coded, one additional VDE is generated for each performance volume.

NAME — The name of the volume. The first VDE for each device is identified as *DDE*. If you coded the VOLNAME= operand on the DISK statement, the performance volumes you specified for the device also appear here.

DDB — The device data block (DDB) describes the physical disk, diskette, or tape device. One DDB is created for each device.

FLAGS — This value indicates information about the volume such as performance volume, diskette, or disk directory.

QCB — The queue control block (QCB) for the disk, diskette, or tape device. The value X'FFFF' indicates that no task has enqueued the device. If the value is X'0000', a task has enqueued the device.

CUR-TCB — The task control block address and address space of the task currently enqueued on the device.

CHAIN — The task control block chain. If a task attempts to enqueue any of these devices while that device is currently enqueued by a different task, the TCB address and address space of the task attempting to enqueue the device would appear on the chain.

The column headings for the device data block (DDB) are shown at item **30** and mean the following:

DDB — The device data block (DDB) describes the physical disk, diskette, or tape device. One DDB is created for each device.

IODA — The device address.

DEVID — The value identifies the type of device. The values shown also appear when you issue the LD or LS commands of $IOTEST.

DSCB-> — A pointer to the data set control block (DSCB) that is currently performing I/O.

TASK	The address of the disk task TCB. If TASK=YES were coded on each DISK or TAPE statement during system generation, one task control block is created for each statement.
DSCB-CHAIN	Identifies the data set control block (DSCB), and its address space, in the chain waiting for service.

If the system encounters erroneous data within a DDB, the dump would show ***ERROR-x** following the line of DDB information. The "x" could be any of the following characters:

A Control block pointer is an odd address.

D Address does not exist.

L Dump facility can dump up to 150 DSCBs. This limit was exceeded.

T TCB points to itself.

Item **31** in Figure 7-10 on page 7-14 shows the address of the VDE for a device descriptor entry (DDE). A device descriptor entry describes the entire device and points to the volume directory. The device data block (DDB) for this device is at address X'0738'. Volume EDX002, which was defined as a performance volume, also has X'0738' as the DDB address.

By looking at the DDB address at item **32**, you can obtain further information about this device. This information shows that the device is at address X'0003'. The device ID, X'00CA', means that this device is a 4962 disk model 3.

Because TASK=YES was not specified for either device during system generation, the disk task TCB address (X'08DE') is identical for the DDBs at addresses X'0738' and X'081E'.

EXIO, BSC, and Timer Information

Figure 7-11 shows the last part of the formatted control block section of the dump.

```
33 EXIO DEVICE LIST

      NO EXIO DEVICE SYSGENED


34 BSCA DEVICE LIST

      NO BSCA DEVICE SYSGENED

35 7840 TIMER ATTACHMENT

      TIMER DDB   CHAIN (TCB-ADS)                 36 10:01:28  mm/dd/yy

37       095E   0072-1 01A6-1
```

Figure 7-11. EXIO, BSC, and Timer Device Information

Item 33 indicates that no EXIO devices are defined in this system. If any EXIO devices were defined, the DDB address, device type, and device address would appear.

Item 34 also indicates that no binary synchronous communications (BSC) devices are defined. An example of the information you would see if BSC devices were defined follows:

```
BSCA DEVICE LIST

 DDB   ID  IODA

 2864 1006 0009
```

This example shows the DDB at address X'2864'. The value X'1006' indicates a single-line ACCA connection. The device address is X'0009'.

Item 35 indicates the type of timer attached to the system.

Item 36 indicates the time and date of the dump.

Item 37 shows the timer DDB and the TCB address and address space in the TCB chain. If any tasks were executing an STIMER instruction, the entries on the chain are indicated. In this example, the TCBs at addresses X'0072' and X'01A6' (both in address space 1) are on the timer chain. By looking at the storage map section of this sample dump (Figure 7-7 on page 7-10), you can see that at item 19, these two TCB addresses are on the TCB chain for the program SAMPLA.

Storage Partition Information

The next portion of the dump shows some of the information dumped from a partition. The information in this example is in half-page (one column) format.

```
38 P2   BEGINNING AT ADDRESS 0000 FOR 256 PAGES

39 PARTIAL DUMP REQUESTED FOR 0000 THRU 045E
                 41                                         42
40 0000   0808 E2C1 D4D7 D3C1 4040 0000 0242 0034   |..SAMPLA  ......|
   0010   0000 0F5E 0344 0000 0000 0000 0100 0342   |...;............|
   0020   0000 0000 0000 02C2 0000 0000 C5C4 E7F0   |.......B....EDX0|
   0030   F0F2 0000 0001 0404 C6C9 D5C9 003E 0019   |02......FINI....|
   0040   004E FFFF 805C 004D 0001 001D 0000 FFFF   |.+...*.(........|
   0050   0000 0001 90A9 1388 0015 0072 FFFF 0015   |................|
    •
    •
    •
   03F0   0000 0000 0000 0000 0000 0000 0000 0000   |................|
43     SAME AS ABOVE
44 0450   0000 0000 0000 0000 0000 0000 0000 0000   |................|
```

Figure 7-12. Sample Contents of a Partition

Item **38** indicates which partition number was dumped and the size of that partition in pages. In this example, partition 2 was dumped and is 256 pages in length (64K).

Item **39** shows the range of storage addresses dumped. The partition addresses X'0000' through X'0400' appear because the "partial dump" option of $DUMP was selected.

Item **40** shows the beginning address (X'0000') of partition 2. Each line of information shown for an address is 8 words in length. The information shown is the contents of this location in storage when the dump was taken.

Below item **41.**, the value X'E2C1' is shown. The dump shows that this value is at address X'0002' and begins on a word boundary.

Below item **42** is the EBCDIC representation of the values that were in storage. Thus, the value X'E2C1' shown for item **41** translates to EBCDIC as the characters **SA**. These are the first two characters as shown in the name **SAMPLA**. All characters that are not printable are shown as periods.

The text at item **43** appears in the dump whenever the address that would have been printed for this line contains all null characters (X'00'). In this example, you can see this because the address after X'03F0' is X'0450'.

Item **44** shows the ending address that was specified for the partial dump display.

Unmapped Storage Information

If you choose to dump and format the unmapped storage areas of your system, the storage dump also will contain a list of unmapped storage pointers. Each unmapped storage pointer refers to a 2K-byte block of unmapped storage that has been obtained by an application program. Figure 7-13 shows a portion of a dump that contains unmapped storage pointers.

```
1  UNMAPPED STORAGE POINTER -  0780
           2
 0000   AAAA 0000 0000 0000 0000 0000 0000 0000    |................|
 0010   0000 0000 0000 0000 0000 0000 0000 0000    |................|
        SAME AS ABOVE
 0100   AAAA 0000 0000 0000 0000 0000 0000 0000    |................|
 0110   0000 0000 0000 0000 0000 0000 0000 0000    |................|
        SAME AS ABOVE
  •
  •
  •
 0700   AAAA 0000 0000 0000 0000 0000 0000 0000    |................|
 0710   0000 0000 0000 0000 0000 0000 0000 0000    |................|

3  UNMAPPED STORAGE POINTER -  0788

 UNMAPPED STORAGE POINTER -  0790

 UNMAPPED STORAGE POINTER -  0798
```

Figure 7-13. Unmapped Storage Pointers

Item 1 in the figure shows how the unmapped storage pointers are displayed in the dump.

Beneath item 2 is a listing of the contents of the unmapped storage area. The contents of the unmapped storage area appear in the dump if the area was moved into mapped storage with a SWAP instruction. If, at the time the dump was taken, a program had acquired an area of unmapped storage but had not yet used it, only the pointer to that area appears in the dump. The contents of the area are not listed. See item 3.

When the dump occurs, you may have several programs running that are using unmapped storage. Determining which unmapped storage areas belong to a particular program and which of those areas were in use when the dump occurred is described next.

Locating the Unmapped Storage Areas That Belong to a Program

You can locate the unmapped storage areas that belong to your program by following the steps in this section. You will need the compiler listing for your program and a storage dump. The dump should include the formatted control blocks, a list of the unmapped storage pointers, and the contents of the partition in which the program was running.

The examples in this section refer to a sample program, MAILSORT, and portions of a sample dump.

To identify which unmapped storage areas belong to your program, do the following:

1. Look in the compiler listing for your program and find the address of the STORBLK statement. The STORBLK statement creates a storage control block that defines the size and number of unmapped storage areas your program can use. If your program contains more than one STORBLK statement, repeat the steps described in this section for each statement.

```
•
•
•
0034   0000 C1C1 0000 0000 0040  BLK     STORBLK   TWOKBLK=8,MAX=3
003E   0003 FFFF 0000 0000 006A
0048   0000 0000 0000 0000 0000
0066   0000 0000 FFFF FFFF FFFF
0070   FFFF FFFF FFFF FFFF FFFF
```

In the sample program, the STORBLK statement is at address X'0034':

2. Look at the storage map section of the dump to find the partition in which the program was running and the load point of the program.

```
STORAGE MAP:           $SYSCOM AT ADDRESS 19C6

EDXFLAGS  6000       SVCFLAGS  1000

PART#   NAME        ADDR PAGES  ATASK  TCB(S)

 P1      ADS= 0     0000  256
     **FREE**       3D00    3
     **DATA**       4000   64
     **FREE**       8000  128

 P2      ADS= 1     0000  256
     $TRAP          0000   65 3E92(A)  3E12 1936 1762
     **FREE**       4100  191

 P3      ADS= 2     0000  256
     CATALOG        0000    4          0242 01A6 010E
     **FREE**       0400  252

 P4      ADS= 3     0000  256
     **FREE**       0000  256

 P5      ADS= 4     0000   96
     REORDER        0000    4          0240
     **FREE**       0400   92

 P6      ADS= 5     0000  160
     **DATA**       0000   80
                    [2]
[1]  MAILSORT       5000    4          52D0
     **FREE**       5400   76
```

In the sample storage map, MAILSORT is in partition 6 (item **1**). The load point of the program is X'5000' (item **2**).

3. Add the address of the STORBLK statement to the program's load point. The result is the address in storage of the storage control block.

Adding the address of the STORBLK statement in MAILSORT to the program's load point yields a result of X'5034'.

4. Look at the portion of the dump which lists the contents of the partition in which the program was running. Search this portion of the dump for the address you calculated in step 3.

Figure 7-14 on page 7-21 shows the portion of the sample dump that contains the storage control block for MAILSORT. The beginning of the control block is shown at item **1**.

```
P6   BEGINNING AT ADDRESS 0000 FOR 160 PAGES
 •
 •
 •                  1
 5030   E2E3 0000 0000 C1C1 0000 0000 0040 0003    |ST....AA..... ..|
                         2
 5040   4000 0001 0000 506A 0000 0144 0000 014C    | .....&........<|
 5050   0000 0154 0000 015C 0000 0164 0000 016C    |.......*.......%|
                                   3
 5060   0000 0174 0000 017C 0000 078C 0000 0794    |................|
 5070   0000 079C 0000 07A4 0000 07AC 0000 07B4    |................
 5080   0000 07BC 0000 07C4 0000 07CC 0000 07D4    |.......D.......M|
 5090   0000 07DC 0000 07E4 0000 07EC 0000 07F4    |.......U.......4|
 50A0   0000 07FC 0000 0804 0000 080C 0000 0814    |................|
 50B0   0000 081C 0000 0824 0000 082C 0000 0834    |................|
                         4
 50C0   0000 083C 0000 0844 0000 0007 0003 0001    |................|
 50D0   D02A 0001 0000 802C 50CE 50E0 0001 3231    |........&.&/....|
```

Figure 7-14. Sample Storage Control Block Listing

5. Within the storage control block, find the address of the first pointer to the unmapped storage areas your program obtained. To find this address, do the following:

   a. Refer to the list of unmapped storage equates in your program. These equates are generated when you code

      ```
               COPY     STOREQU
      ```

      in your program. The list of equates in the MAILSORT program is as follows:

      ```
      $STRPCHN EQU    0
      $STRPID  EQU    $STRPCHN+2
      $STRPLEN EQU    $STRPID+2
      $STRPRES EQU    $STRPLEN+2
      $STORBLK EQU    $STRPRES+2
      $STORMAX EQU    $STORBLK+2
      $STORMAP EQU    $STORMAX+2
      $STORMPK EQU    $STORMAP+2
      $STORRSV EQU    $STORMPK+2
      $STORUSR EQU    $STORRSV+2
      $STORFLG EQU    $STORUSR+2
      $STOROVY EQU    X'8000'
      $STORMSR EQU    $STORFLG+2
      ```

      Note: The equates shown above are **only** for use in this example. For a current listing of the STOREQU equates, refer to the list generated in your program or refer to the control block equates shown in the *Internal Design*.

   b. Find the $STORUSR equate in the list. This equate points to the word in storage that contains the address of the first unmapped storage pointer. The location of $STORUSR in the list reflects the displacement of this word from the beginning of the storage control block.

      In the equates in the MAILSORT program, $STORUSR is the tenth equate in the list. Therefore, in this example, the word that contains the address of

the first unmapped storage pointer is the tenth word from the beginning of the storage control block. See item **2** in Figure 7-14.

c. Using the displacement into the storage control block, find the word that contains the address of the first unmapped storage pointer. When you have found the address of the pointer, locate this address in the dump.

   The tenth word from the beginning of the MAILSORT control block contains the address X'506A'. Item **3** in Figure 7-14 on page 7-21 shows the location of this address in storage. In this example, the first pointer to an unmapped storage area is the doubleword **078C 0000**.

6. Now that you have found the first unmapped storage pointer, refer back to the STORBLK statement in your program. The statement tells you how many 2K-byte blocks of unmapped storage the program obtained. The dump will contain one pointer for each 2K-byte block of unmapped storage. Use the STORBLK statement to calculate the number of unmapped storage pointers your program required.

The STORBLK statement for the MAILSORT program is:

```
BLK    STORBLK    TWOKBLK=8,MAX=3
```

The STORBLK statement defines three unmapped storage areas of 16K-bytes each. The number of unmapped storage pointers required then is 24.

7. Note that each unmapped storage pointer is a doubleword. The second word of the doubleword consists of zeros (0000) and can be ignored. Return to the storage dump and, beginning with the first unmapped storage pointer, list the first word of each pointer that belongs to the program.

In the MAILSORT storage control block, the first word of the second unmapped storage pointer is 0794. The first word of the third pointer is 079C. The first word of the fourth pointer is 07A4, and so on. The first word of the last pointer (number 24) is 0844. (See item **4** in Figure 7-14 on page 7-21.)

8. The list of pointer values you collected in step 7 tells you which unmapped storage areas belong to your program. To determine which unmapped storage areas were in use when the dump occurred, look at the portion of the dump that lists the segmentation registers for your system. Scan this list for any of the pointer values that belong to your program. If your program was using a block of unmapped storage when the dump occurred, the pointers to that block of unmapped storage will appear in the segmentation register list.

The following is the list of pointer values which belong to MAILSORT. Each of these values is the first word of an unmapped storage pointer contained in Figure 7-14.

078C	07CC	080C
0794	07D4	0814
079C	07DC	081C
07A4	07E4	0824
07AC	07EC	082C
07B4	07F4	0834
07BC	07FC	083C
07C4	0804	0844

Figure 7-15 on page 7-23 shows the segmentation register information in the sample dump. Looking at the segmentation register values for partition 2 (address space 1), you can see eight of the pointer values that belong to MAILSORT. The pointers are highlighted.

The pointers indicate that MAILSORT was using one of the three 16K-byte blocks of unmapped storage it obtained with a GETSTG instruction. The segmentation register values also show that MAILSORT obtained its mapped storage area in partition 2.

STORAGE SEGMENTATION REGISTERS:

BLOCK	ADS00	ADS01	ADS02	ADS03	ADS04	ADS05	ADS06	ADS07
0000	0004	0104	0204	0304	0404	073C		
0800	000C	010C	020C	030C	040C	0744		
1000	0014	0114	0214	0314	0414	074C		
1800	001C	011C	021C	031C	041C	0754		
2000	0024	0124	0224	0324	0424	075C		
2800	002C	012C	022C	032C	042C	0764		
3000	0034	0134	0234	0334	0434	076C		
3800	003C	013C	023C	033C	043C	0774		
4000	0044	080C	0244	0344	0444	077C		
4800	004C	0814	024C	034C	044C	0784		
5000	0054	081C	0254	0354	0454	0464		
5800	005C	0824	025C	035C	045C	046C		
6000	0064	082C	0264	0364		0474		
6800	006C	0834	026C	036C		047C		
7000	0074	083C	0274	0374		0484		
7800	007C	0844	027C	037C		048C		
8000	0084	0184	0284	0384		0494		
8800	008C	018C	028C	038C		049C		
9000	0094	0194	0294	0394		04A4		
9800	009C	019C	029C	039C		04AC		
A000	00A4	01A4	02A4	03A4				
A800	00AC	01AC	02AC	03AC				
B000	00B4	01B4	02B4	03B4				
B800	00BC	01BC	02BC	03BC				
C000	00C4	01C4	02C4	03C4				
C800	00CC	01CC	02CC	03CC				
D000	00D4	01D4	02D4	03D4				
D800	00DC	01DC	02DC	03DC				
E000	00E4	01E4	02E4	03E4				
E800	00EC	01EC	02EC	03EC				
F000	00F4	01F4	02F4	03F4				
F800	00FC	01FC	02FC	03FC				

Figure 7-15. Sample Segmentation Register Values

Once you find which unmapped storage areas were in use by your program, return to the portion of the dump which lists the contents of the unmapped storage areas (see Figure 7-13 on page 7-18). You can then examine the contents of the unmapped storage areas that belong to your program.

Analyzing a Wait State

This section explains how you analyze a wait state using a stand-alone or $TRAP dump. A sample program and portions of a $TRAP dump are presented to show how you analyze the failure.

When you begin analyzing the dump for a wait state, first check to see if a value is shown for the processor status word (PSW). If a value is shown, examine that value to determine if a program check occurred also. The section "How to Interpret the Processor Status Word" on page 6-4 explains what the PSW indicates. If the PSW value does indicate a program check, refer to the section "Analyzing a Program Check" on page 7-30 to help you analyze the failure.

The sample program, WTPGM, prints a test pattern on $SYSPRTR. An ATTNLIST defined in the program *should* enable you to print the test pattern again when you press the attention key and enter **YES**. However, when you attempt to repeat the test pattern, the program enters a wait state.

The following discussion explains how to use the dump and the compiler listing to identify the problem:

1. Look in the storage map section of the dump and find all the task control block (TCB) addresses of the waiting tasks.

As shown for item **1** in the following sample dump, the TCB addresses of the waiting tasks are X'CC28' and X'CBA8'. The task control block at address X'CC28' is the TCB address of the program's attention list task. The task control block at address X'CBA8' is the TCB address of the main task WTPGM.

Notice also for item **2** that the level table shows no active or ready tasks on any hardware level. This further indicates that WTPGM is in a wait state. The dump also shows that $TRAP is not active on any hardware level because the dump was taken using the "programmer console interrupt" option of $TRAP.

```
STORAGE MAP:        $SYSCOM AT ADDRESS  19C6

EDXFLAGS  6000      SVCFLAGS  1000

PART#  NAME        ADDR PAGES  ATASK  TCB(S)

 P1      ADS= 0    0000  256
     **FREE**      B400   23
1    WTPGM         CB00    2 CC28(A)  CBA8
     **FREE**      CD00   51

 P2      ADS= 1    0000   256
     **FREE**      0000   256

 P3      ADS= 2    0000   256
     **FREE**      0000   256

 P4      ADS= 3    0000   256
     $TRAP         0000    65 3E92(A) 3E12 1936 1762
     **FREE**      4100   191


EDX LEVEL TABLE - TCB READY CHAIN

LEVEL ACTIVE       READY (TCB-ADS)


2 1    NONE        NONE
  2    NONE        NONE
  3    NONE        NONE


LOADER QCB  CUR-TCB   CHAIN (TCB-ADS)

 94F4  FFFF NONE      NONE
```

Figure 7-16. Sample Storage Map for a Wait State

Because no tasks were active on any hardware level (except the supervisor on level zero), the section of the dump showing the hardware registers *does not* point to the last instruction executed (R1).

```
EVENT DRIVEN EXECUTIVE $TRAP FORMAT STORAGE DUMP

AT TIME OF TRAP PSW WAS 0002 ON HARDWARE LEVEL 0

        LEVEL 0    LEVEL 1    LEVEL 2    LEVEL 3    SVC-LSB   SVCI-LSB
IAR        1F32       1F32       1F32       1F32       1F32       1F0A
AKR        0000       0000       0000       0000       0000       0000
LSR        00C0       0090       0090       0090       00C0       00C0
R0         0000       0000       0000       0000       0000       0000
R1         0000       0000       0000       0000       0000       0000
R2         0000       0000       0000       0000       0000       0000
R3         0000       0000       0000       0000       0000       0000
R4         0000       0000       0000       0000       0000       0000
R5         0000       0001       0002       0003       0000       0002
R6         8000       8000       8000       8000       8000       0000
R7         0000       0000       0000       0000       0000       114C
```

Because you need the address to which R1 is pointing to determine the last instruction executed by each task, you must examine a dump of the partition containing the TCB address for each task. By reviewing the dump of that partition, you can find the address that R1 points to within the TCB of each task.

Figure 7-17 on page 7-27 shows a sample dump of partition 1. The dump begins at the program's load point (X'CB00') and continues up to the beginning of the free storage area (X'CD00').

2. Do the following to find R1 in the TCB:

   a. Look in the dump and find the TCB address (as shown in Figure 7-16 on page 7-25) of the first task. The first TCB address of the sample program is at address X'CC28'. This address appears under item **1** in Figure 7-17.

   b. Using the TCB equates, find the R1 save area ($TCBS1) in the dump. You locate this field by adding the offset X'0E' to the address of the TCB. In this case, the address X'CC36' points to the address of R1 for the program's attention list task. This address is X'CB60' and appears under item **2**.

   c. Subtract the program load point from the address shown for R1. The program load point of the sample program is at X'CB00'. The resulting address for the program's attention list task is X'0060'. You use this address and the compiler listing to identify which instruction the program was executing when the dump was taken. The compiler listing for the sample program is shown in Figure 7-18 on page 7-28.

Because the sample program consists of two tasks (an attention list task and the main program), you must also determine what address R1 points to for the second task (main program). The steps you follow are the same as steps 1 through 2c but using the TCB address X'CBA8' of the main task.

The TCB address for the main task is shown under item **3**. The address R1 points to for the main task is X'CB96' and is shown under item **4**.

Again, after subtracting the program load point from the address R1 points to for the main task, the resulting address is X'0096'.

```
P1   BEGINNING AT ADDRESS 0000 FOR 256 PAGES

PARTIAL DUMP REQUESTED FOR CB00 THRU CD00

 CB00    0808 E6E3 D7C7 D440 4040 0000 CBA8 CB3C     |..WTPGM  ......|
 CB10    0000 0D84 CCAA 0000 0000 0000 0100 CCA8     |................|
 CB20    0000 0000 0000 CC28 CB00 0000 C5C4 E7F0     |............EDX0|
 CB30    F0F2 0000 0000 CBA8 0000 0001 0002 0202     |02..............|
 CB40    D5D6 CB4C 0403 E8C5 E240 CB5A 805C CB3A     |NO.<..YES .!.*..|
 CB50    0002 0019 CB34 FFFF 001D 805C CB3A 0001     |...........*....|
 CB60    001D A025 8026 1212 C1C2 C3C4 C5C6 C7C8     |........ABCDEFGH|
 CB70    C9D1 D2D3 D4D5 D6D7 D8D9 8026 1413 E2E3     |IJKLMNOPQR....ST|
 CB80    E4E5 E6E7 E8E9 F1F2 F3F4 F5F6 F7F8 F9F0     |UVWXYZ1234567890|
 CB90    7C40 001A CB34 0017 CB34 A0A2 CB3A 0001     |. ..............|
                              3
 CBA0    CB62 00B2 0022 FFFF FFFF 0000 0000 2098     |................|
                         4
 CBB0    0000 88D0 0000 CB96 CBA8 CB34 A0A2 0017     |................|
 CBC0    002E 2094 0000 02BE 0096 0000 0000 0000     |................|
 CBD0    0000 0000 CBD4 0000 0000 CBD6 C4C5 C2E4     |.....M.....ODEBU|
 CBE0    C740 4040 0000 0000 0000 0000 0000 0000     |G  ............|
 CBF0    0000 FFFF 0000 0000 131C CB00 0000 CBA8     |................|
 CC00    0000 0000 0000 0000 0000 0000 0000 0000     |................|
    SAME AS ABOVE             1
 CC20    0000 0000 CBA8 0080 FFFF 0000 0000 49D6     |...............O|
                         2
 CC30    0000 88D0 0000 CB60 CC28 0D84 FB00 001D     |.......-........|
 CC40    003A 49D2 0000 0001 000A 0000 0000 FFFF     |...K............|
 CC50    0000 0000 CC54 CC28 0D84 CC56 5BC1 E3E3     |............$ATT|
 CC60    C1E2 D240 0000 8000 49CE 0000 0000 0000     |ASK ............|
 CC70    0000 FFFF 0000 0000 0D84 CB00 0000 CBA8     |................|
 CC80    0000 0000 0000 0000 0000 0000 0000 0000     |................|
    SAME AS ABOVE
 CCA0    0000 0000 CC28 0080 0000 0000 0000 0000     |................|
 CCB0    0000 0000 0000 0000 0000 0000 0000 0000     |................|
 CCC0    0000 0000 0000 0000 0000 0000 01CC 0000     |................|
 CCD0    0000 01CE E3C1 E2D2 F340 4040 0000 0000     |....TASK3   ....|
 CCE0    0000 0000 0000 0000 0000 FFFF 0000 0000     |................|
 CCF0    0000 0000 0000 0108 0000 0000 0000 0000     |................|
 CD00    D11E 0000 D11C B0A2 D11E 0000 CD1A 805C     |J...J...J......*|
```

Figure 7-17. Sample Storage Dump for a Wait State

3. Using the resulting address from step 2c on page 7-26, look at the instruction at that address in the compiler listing and try to determine what caused the wait.

Figure 7-18 on page 7-28 shows the compiler listing of the sample program. The attention list task points to an ENDATTN instruction at address X'0060'. This address is shown as item **1** in Figure 7-18.

The main task points to a WAIT instruction at address X'0096'. This address is shown as item **2**.

```
     LOC    +0   +2   +4   +6   +8

     0000   0008 D7D9 D6C7 D9C1 D440  DEBUG  PROGRAM    START
     000A   0000 00A8 003C 0000 0000
     0014   01AA 0000 0000 0000 0100
     001E   01A8 0000 0000 0000 0128
     0028   0000 0000 0000 0000 0000
     0032   0000
     0034   FFFF 0000 0000            EVENT  ECB
     003A   0000                      PRINT  DATA       F'0'
     003C   0002 0202 D5D6 004C 0403  ALIST  ATTNLIST   (NO,POST1,YES,POST2)
     0046   E8C5 E240 005A
     004C                             POST1  EQU        *
     004C   805C 003A 0002                   MOVE       PRINT,2
     0052   0019 0034 FFFF                   POST       EVENT
     0058   001D                             ENDATTN
     005A                             POST2  EQU        *
     005A   805C 003A 0001                   MOVE       PRINT,1
[1]  0060   001D                              ENDATTN
     0062                             START  EQU        *
     0062   A025                             ENQT       $SYSPRTR
     0064   8026 1212 C1C2 C3C4 C5C6         PRINTEXT   'ABCDEFGHIJKLMNOPQR'
     006E   C7C8 C9D1 D2D3 D4D5 D6D7
     0078   D8D9
     007A   8026 1413 E2E3 E4E5 E6E7         PRINTEXT   'STUVWXYZ1234567890@'
     0084   E8E9 F1F2 F3F4 F5F6 F7F8
     008E   F9F0 7C40
     0092   001A 0034                        RESET      EVENT
[2]  0096   0017 0034                         WAIT       EVENT
     009A   A0A2 003A 0001 0062              IF         PRINT,EQ,1,START
     00A2   00B2                             DEQT
     00A4   0022 FFFF                        PROGSTOP
     00A8   0000 0000 0000 0234 0000         ENDPROG
     00B2   00D0 0000 0062 00A8 0000
     00BC   0000 0000 0000 0000 0000
      •
      •
      •
     01BE                                    END
```

Figure 7-18. Compiler Listing of Wait State Program

Because the dump indicates that the attention list task is at the ENDATTN, you can assume the program did pass control to the code at label POST2. The code at POST2 handles the **YES** response. At this label, a value of 1 is moved to the field PRINT. The main task is supposed to repeat the test pattern (branch to START) when PRINT is equal to 1.

By examining the contents of PRINT in the storage dump, you can see that PRINT does contain a 1. The field PRINT is at address X'CB3A' and is under item [5].

```
P1   BEGINNING AT ADDRESS 0000 FOR 256 PAGES

PARTIAL DUMP REQUESTED FOR CB00 THRU CD00

 CB00   0808 E6E3 D7C7 D440 4040 0000 CBA8 CB3C    |..WTPGM   ......|
 CB10   0000 0D84 CCAA 0000 0000 0000 0100 CCA8    |................|
 CB20   0000 0000 0000 CC28 CB00 0000 C5C4 E7F0    |............EDX0|
                                  5
 CB30   F0F2 0000 0000 CBA8 0000 0001 0002 0202    |02..............|
  •
  •
  •
```

However, even though the value of PRINT signals the program to repeat the test pattern, the main task is still in a wait state.

By further examining the code at label POST2, notice that an ENDATTN is coded immediately after the MOVE:

```
                                             •
                                             •
                                             •
 005A                               POST2   EQU       *
 005A   805C 003A 0001                      MOVE      PRINT,1
 0060   001D                                ENDATTN
 0062                               START   EQU       *
                                             •
                                             •
                                             •
 0096   0017 0034                           WAIT      EVENT
 009A   A0A2 003A 0001 0062                 IF        PRINT,EQ,1,START
```

Because the main task is waiting on the event control block EVENT to be posted, you must determine what in the program prevents that event control block from being posted.

Closer examination of the code at label POST2 shows that a POST instruction, required to post the event control block, was omitted. Because the attention list routine that processes the **YES** response never posts EVENT, control never passes to the IF instruction which causes a branch to label START.

In order to correct the problem of the wait state in the sample program, the code at label POST2 should look as follows:

```
POST2   EQU       *
        MOVE      PRINT,1
        POST      EVENT
        ENDATTN
```

Analyzing a Program Check

This section explains how you analyze a program check using a stand-alone or $TRAP dump. A sample program, SAMPLA, and portions of a $TRAP dump are presented to show how you analyze the failure.

The failure discussed in this section occurred while SAMPLA, which has an attention list, was executing in partition 2. $FSEDIT was loaded in partition 1 and was enqueued to $SYSLOG. When an operator entered the attention list command **FINI**, the system stopped processing and the terminal from which SAMPLA was loaded would not respond to the attention key. The operator, in this case, IPLed the system, loaded $TRAP to trap all exception types, and reproduced the situation in which the failure occurred. The failure occurred again and the operator printed the dump using $DUMP. The "format control blocks" option was selected.

To analyze the failure, do the following:

1. Look at the portion of the dump that shows the contents of the hardware registers and see if the processor status word (PSW) indicates a program check. The section "How to Interpret the Processor Status Word" on page 6-4 explains the meaning of the PSW.

   Note: If a stand-alone dump was taken, begin with step 2.

Figure 7-19 shows a portion of the $TRAP dump which contains the hardware registers when the failure occurred:

```
 EVENT DRIVEN EXECUTIVE $TRAP FORMAT STORAGE DUMP

1 AT TIME OF TRAP PSW WAS 8006 ON HARDWARE LEVEL 1

          LEVEL 0    LEVEL 1    LEVEL 2    LEVEL 3        SVC-LSB   SVCI-LSB
  IAR       1FFA       2AD6       1F32       1F32           1F32       1F0A
  AKR       0100       0110       0000       0000           0000       0000
  LSR       8090       00D0       0090       0090           00C0       00C0
  R0        0000       0001       0000       0000           0000       0000
  R1        0000       0044       0000       0000           0000       0000
  R2        02C2       02C2       0000       0000           0000       0000
  R3        02B6       004D       0000       0000           0000       0000
  R4        0000       0048       0000       0000           0000       0000
  R5        0001       805C       0002       0003           0001       0000
  R6        0000       00B8       8000       8000           8000       0000
  R7        0000       0000       0000       0000           0000       0000
```

Figure 7-19. Register Contents from Program Check

Because the PSW value shown at item 1 (X'8006') indicates that a program check did occur on level 1, you must determine which task was active on level 1.

2. Look at the level table portion of the dump and find the active task on the highest level.

Figure 7-20 on page 7-31 shows the portion of the sample dump containing the storage map and level table. Item 2 shows that level 1 has an active TCB at address X'02C2' in address space 1 (partition 2). The storage map shows that this TCB is the attention list task (item 3) for program SAMPLA. The load point for SAMPLA is X'0000'.

```
STORAGE MAP:          $SYSCOM AT ADDRESS 19C6

EDXFLAGS  6000      SVCFLAGS  1000

PART#  NAME       ADDR PAGES  ATASK  TCB(S)

 P1     ADS= 0    0000  256
     **FREE**     B400   23
     $FSEDIT      CB00   31          E8AC
     **FREE**     EA00   22

 P2     ADS= 1    0000  256  3
     SAMPLA       0000    4 02C2(A)  0242 01A6 010E 0072
     **FREE**     0400  252

 P3     ADS= 2    0000  256
     $TRAP        0000   65 3E92(A)  3E12 1936 1762
     **FREE**     4100  191

 P4     ADS= 3    0000  256
     **FREE**     0000  256


EDX LEVEL TABLE - TCB READY CHAIN

LEVEL ACTIVE      READY (TCB-ADS)


2  1    02C2-1    NONE
   2    NONE      010E-1 0242-1
   3    NONE      NONE


LOADER QCB  CUR-TCB   CHAIN (TCB-ADS)

 94F4  FFFF NONE      NONE
```

Figure 7-20. Storage Map and Level Table for Program Check

3. Look at the portion of the dump containing the hardware registers and see if the address of the active TCB is in R2 of the level 1 registers.

At item **4** in the following example, notice that the address for R2 on level 1 does show the address X'02C2'.

```
EVENT DRIVEN EXECUTIVE $TRAP FORMAT STORAGE DUMP

AT TIME OF TRAP PSW WAS 8006 ON HARDWARE LEVEL 1

        LEVEL 0   LEVEL 1   LEVEL 2   LEVEL 3     SVC-LSB  SVCI-LSB
IAR        1FFA      2AD6      1F32      1F32        1F32      1F0A
AKR        0100      0110      0000      0000        0000      0000
LSR        8090      00D0      0090      0090        00C0      00C0
R0         0000      0001      0000      0000        0000      0000
R1         0000    5 0044      0000      0000        0000      0000
R2         02C2    4 02C2      0000      0000        0000      0000
R3         02B6      004D      0000      0000        0000      0000
R4         0000      0048      0000      0000        0000      0000
R5         0001      805C      0002      0003        0001      0000
R6         0000      00B8      8000      8000        8000      0000
R7         0000      0000      0000      0000        0000      0000
```

Notice also that the address for R1 (item 5), which points to the failing EDL instruction, points to address X'0044'. Because the program load point for SAMPLA is at address X'0000', the address X'0044' corresponds to address X'0044' in the compiler listing of SAMPLA.

When a program load point is other than X'0000', subtract the load point address from the address of R1. Use the resulting address to find the failing EDL instruction in the compiler listing.

4. Using the address of the failing EDL instruction (the address in R1 in this case), look at that address in the compiler listing and determine the cause of the failure.

Figure 7-21 on page 7-33 shows the compiler listing for the program SAMPLA. As shown for item 6, notice that at address X'0044' the program attempts to move a word of data to an odd-byte boundary (WORD + 1).

```
     LOC     +0   +2   +4   +6   +8

                                              PRINT       NODATA
     0000    0008 D7D9 D6C7 D9C1 D440  SAMPLA PROGRAM     START
     0034    0001 0404 C6C9 D5C9 003E         ATTNLIST    (FINI,DONE)
     003E    0019 004E FFFF            DONE   POST        ECB
6    0044    805C 004D 0001                   MOVE        WORD+1 ,1
     004A    001D                             ENDATTN
     004C    0000                      WORD   DC          F'0'
     004E    0000 0000 0000            ECB    ECB         0
     0054    90A9 1388                 START  STIMER      5000,WAIT
     0058    0015 0072 FFFF                   ATTACH      TASK1
     005E    0015 010E FFFF                   ATTACH      TASK2
     0064    0015 01A6 FFFF                   ATTACH      TASK3
     006A    0017 004E                        WAIT        ECB
     006E    00A0 023E                        GOTO        END
     0072    0000 0000 0000 0234 0000  TASK1  TASK        START1
     00F2    835C 0000 0014            START1 MOVE        #1,20
                                              •
                                              •
                                              •
     0106    0016 FFFF 00A0 00F2              ENDTASK
     010E    0000 0000 0000 0234 0000  TASK2  TASK        START2
     018E    835C 0000 0028            START2 MOVE        #1,40
                                              •
                                              •
                                              •
     019E    0016 FFFF 00A0 018E              ENDTASK
     01A6    0000 0000 0000 0234 0000  TASK3  TASK        START3
     0226    835C 0000 0080            START3 MOVE        #1,128
                                              •
                                              •
                                              •
     0236    0016 FFFF 00A0 0226              ENDTASK
     023E    0022 FFFF                 END    PROGSTOP
     0242    0000 0000 0000 0234 0000         ENDPROG
                                            END
```

Figure 7-21. Compiler Listing of Program Check Program

In the following example of the hardware registers for level 1, item **7** shows that R3 (operand 1) is at address X'004D', which is on an odd-byte boundary. Item **8** shows that the address of R4 (operand 2) is at address X'0048', which is on a word boundary. Thus, any attempt to move a word of data to a byte boundary causes a specification check as indicated by item **1**.

```
EVENT DRIVEN EXECUTIVE $TRAP FORMAT STORAGE DUMP

1 AT TIME OF TRAP PSW WAS 8006 ON HARDWARE LEVEL 1

        LEVEL 0   LEVEL 1   LEVEL 2   LEVEL 3      SVC-LSB  SVCI-LSB
IAR        1FFA      2AD6      1F32      1F32         1F32      1F0A
AKR        0100      0110      0000      0000         0000      0000
LSR        8090      00D0      0090      0090         00C0      00C0
R0         0000      0001      0000      0000         0000      0000
R1         0000      0044      0000      0000         0000      0000
R2         02C2      02C2      0000      0000         0000      0000
R3         02B6    7 004D      0000      0000         0000      0000
R4         0000    8 0048      0000      0000         0000      0000
R5         0001      805C      0002      0003         0001      0000
R6         0000      00B8      8000      8000         8000      0000
R7         0000      0000      0000      0000         0000      0000
```

Because $FSEDIT had the $SYSLOG terminal enqueued, the system was unable to display the program check message, and as a result, caused the system to stop processing.

Analyzing a Run Loop

This section explains an approach you can use to analyze a run loop with the help of a stand-alone or $TRAP dump.

Because a run loop occurs within a range of instruction addresses in a program, the dump would only show the instruction address at which the program was executing when the dump was taken. You can, however, use a dump to identify which task was active and the hardware level on which the task was executing.

To analyze a run loop using a dump, do the following:

1. Look at the level table in the dump and find the TCB address of the active task on the highest level.
2. Look in the storage map of the dump and find the name of the program whose TCB address matches the TCB address from step 1.
3. Rerun that program.
4. Turn to the section "Determining the Starting and Ending Points of the Loop" on page 4-9. That section explains how to trace the addresses within the loop using $DEBUG.

Chapter 8. Tracing Exception Information

The system sets aside an area in storage that it uses to record program check, soft exception, and machine check information. This area in storage is called the software trace table.

The software trace table provides you with an alternate method of identifying the cause of an exception. For example, if for some reason you were not able to record the information displayed in a program check message, you could use the information in the trace table to help you analyze the exception.

The system makes an entry into the software trace table when an exception occurs. The system does not record exceptions that occur in a program or task that has the ERRXIT= operand coded on the PROGRAM or TASK statement.

The software trace table can contain a maximum of eight entries. When the maximum number of entires is reached, the system overlays the oldest entry in the table with the newest entry. The system records these entries in a "circular" fashion.

The entries in the trace table reflect the number of exceptions since the last IPL. The system resets (clears) this table during each IPL.

If any entries are in the trace table when you take a stand-alone or $TRAP dump, these entries are also shown in the dump. Figure 7-2 on page 7-5 shows an example of how an entry appears in a dump.

You can display the contents of the trace table on a terminal using the $D operator command. How you do this is described next.

Displaying the Software Trace Table

You can display the contents of the software trace table at your terminal. In order to display the trace table, first you need the supervisor link map listing from system generation.

To display the software trace table, do the following:

1 Change your terminal to partition 1 by pressing the attention key and entering **$CP 1**.

2 Press the attention key and enter **$D**.

3 At the prompt for "ORIGIN," enter **0000**.

The next prompt, "ADDRESS,COUNT," asks you for an address and the number of words you want to display.

4 For ADDRESS, enter the address of the software trace table. The address of the software trace table appears beside the entry point name CIRCBUFF in the supervisor link map listing.

5 For COUNT, enter the value **125**. This value is the number of words in storage the trace table occupies.

The system then displays the contents of the trace table at the terminal. An explanation of the information displayed is in the section "Software Trace Table Format."

6 Reply **N** to the prompt "ANOTHER DISPLAY?"

Figure 8-1 is an example showing steps 1 through 5. The address of the trace table (CIRCBUFF) in this example is X'8F64'. The trace table contains two entries.

```
> $CP 1

PROGRAMS AT 00:00:15
IN PARTITION #1  NONE
         PARTITION ADDRESS: B400 HEX;  SIZE:  19456 DECIMAL BYTES
> $D
ENTER ORIGIN: 0000
ENTER ADDRESS,COUNT: 8F64,125
 8F64: 8F6E 8FAA 905E 0002 001E 0100 0120 8002
 8F74: B437 2AD6 0000 80D0 0064 B50A B520 B437
 8F84: B434 015C 00B8 0000 0101 01A8 8002 01A9
 8F94: 2B86 0110 80D0 0192 013C 01A8 019A 01A9
 8FA4: 005E 00BC 0000 0000 0000 0000 0000 0000
 8FB4: 0000 0000 0000 0000 0000 0000 0000 0000
 8FC4: 0000 0000 0000 0000 0000 0000 0000 0000
 8FD4: 0000 0000 0000 0000 0000 0000 0000 0000
 8FE4: 0000 0000 0000 0000 0000 0000 0000 0000
 8FF4: 0000 0000 0000 0000 0000 0000 0000 0000
 9004: 0000 0000 0000 0000 0000 0000 0000 0000
 9014: 0000 0000 0000 0000 0000 0000 0000 0000
 9024: 0000 0000 0000 0000 0000 0000 0000 0000
 9034: 0000 0000 0000 0000 0000 0000 0000 0000
 9044: 0000 0000 0000 0000 0000 0000 0000 0000
 9054: 0000 0000 0000 0000 0000
```

Figure 8-1. Sample Software Trace Table Entries

The next section explains the format and contents of the software trace table.

Software Trace Table Format

The software trace table is a 125-word area in processor storage. The trace table consists of control information and exception entries. This area in storage is described in the following sections.

Control Information Format

The first 5 words of the trace table are control information. This 5-word area contains the following information:

Word	*Contents*
0	The address of the first entry in the table.
1	The address at which the next entry will be written.
2	The ending address of the table. This address points to the first byte beyond the end of the table.
3	The number of exceptions that occurred since the last IPL.
4	The size (in bytes) of each entry in the table. This field contains the value X'1E' which indicates each entry is 30 bytes (15 words) in length.

Figure 8-2 shows several lines of control information from the previous example. An explanation of each numbered item follows the figure.

```
         1    2    3    4    5    6
8F64: 8F6E 8FAA 905E 0002 001E 0100 0120 8002
8F74: B437 2AD6 0000 80D0 0064 B50A B520 B437
                               7
8F84: B434 015C 00B8 0000 0101 01A8 8002 01A9
8F94: 2B86 0110 80D0 0192 013C 01A8 019A 01A9
                          8
8FA4: 005E 00BC 0000 0000 0000 0000 0000 0000
  •
  •
  •                            9
9054: 0000 0000 0000 0000 0000
```

Figure 8-2. Control Information Example

The address (X'8F6E') shown below item **1** points to the first exception entry in the trace table. The first exception entry is shown below item **6**.

The address (X'8FAA') shown below item **2** points to the address at which the next exception entry will be written. This address is shown below item **8**.

Item **3** points to the first byte of storage following the trace table. This address (X'905E') is not shown in the example, but would begin immediately *after* item **9**.

Item **4** indicates that two exceptions have occurred since the last IPL. The second exception entry begins below item **7**.

The value (X'001E') below item **5** indicates the length (in bytes) of each entry.

The next section explains the format and contents of an exception entry.

Exception Entry Format

Each exception entry in the trace table is 15 words (30 bytes) in length. The *first* entry, which follows the five words of control information, begins at word 5 in the table. When the maximum number of entries (eight) is reached, the system writes the next entry at word 5 again, overlaying the previous entry. Each entry contains the following information:

Word	*Contents*
0	This word contains a state variable and an address key. The state variable, which is the first byte, can have any of the following values: 0 — No interrupt in process 1 — Standard (default) processing 2 — Now processing task error exit 3 — Undefined. The address key, which is the second byte, indicates the address space that was in use when the exception occurred. The partition in which the exception occurred is this value plus 1.
1	The task control block (TCB) address of the failing task.
2	The value of the processor status word (PSW). The section "How to Interpret the Processor Status Word" on page 6-4 explains the meaning of this value.
3	The contents of the storage address register (SAR). This field indicates the address in storage last accessed when the failure occurred.
4	The contents of the instruction address register (IAR). This field indicates the address of the machine instruction currently executing.
5	The contents of the address key register (AKR). For 3-bit processors, bits 5−7 form the operand 1 key, bits 9−11 form the operand 2 key, and bits 13−15 form the instruction space key. For 4-bit processors, bits 4−7 form the operand 1 key, bits 8−11 form the operand 2 key and bits 12−15 form the instruction space key. For 5-bit processors, bit 1 and bits 4−7 form the operand 1 key, bit 2 and bits 8−11 form the operand 2 key, bit 3 and bits 12−15 form the instruction space key. For all processors, bit 0 of the AKR is the equate operand spaces (EOS) bit. If bit 0 is set to 1, the operand 2 key is used for both operand 1 and operand 2.
6	The contents of the level status register (LSR). The bits, when set, indicate the following: Bits 0−4 — The status of arithmetic operations. Refer to the processor description manual for the meanings of these bits. Bit 8 — Program is in supervisor state. Bit 9 — Priority level is in process. Bit 10 — Class interrupt tracing is active. Bit 11 — Interrupt processing is allowed. Bits 5−7 and bits 12−15 are not used and are always zero.

7 The contents of hardware register 0 (R0). Because the supervisor uses this register as a work register, the contents are usually not significant to the failing program.

8 The contents of hardware register 1 (R1). This field contains the address in storage of the failing EDL instruction.

9 The contents of hardware register 2 (R2). This field contains the address in storage of the active task control block (TCB).

10 The contents of hardware register 3 (R3). This field contains the address in storage of EDL operand 1 of the failing instruction.

11 The contents of hardware register 4 (R4). This field contains the address in storage of EDL operand 2 (if applicable) of the failing instruction.

12 The contents of hardware register 5 (R5). This field contains the EDL operation code of the failing instruction. The first byte contains flag bits which indicate how operands are coded. For example, the flag bits indicate whether the operand is in #1, #2, or specified as a constant. The second byte is the operation code of the EDL instruction.

13 The contents of hardware register 6 (R6). Because the supervisor uses this register as a work register, the contents are usually not significant to the failing program. However, you can determine if the system was emulating EDL code when the failure occurred if R6 is twice the value shown in the second byte of R5. For example, if the second byte of R5 contained X'32' *and* the system was emulating EDL, R6 would contain X'0064'.

14 The contents of hardware register 7 (R7). Because the supervisor uses this register as a work register, the contents are usually not significant to the failing program. However, in many cases, R7 may contain the address of a branch and link instruction. The address may give you a clue as to which module passed control to the address in the IAR.

Excluding the address of the program load point, all entries in the trace table contain the same information that the system displays in a program check message, *plus* two additional fields: the state variable and address key word, and the storage address register (SAR). The section "Finding the Program Load Point Address" on page 8-6 explains how you can find the address of the program load point.

The following application program check message caused the system to create the exception entry in the trace table shown below the message.

```
PROGRAM CHECK:
 PLP  TCB  PSW  IAR  AKR  LSR  R0   R1   R2   R3   R4   R5   R6   R7
 B400 0120 8002 2AD6 0000 80D0 0064 B50A B520 B437 B434 015C 00B8 0000
```

The exception entry for the previous program check message begins below item **1** and ends below item **15**.

```
                                      1    2    3
8F64: 8F6E 8FAA 905E 0002 001E 0100 0120 8002
        4    5    6    7    8    9   10   11
8F74: B437 2AD6 0000 80D0 0064 B50A B520 B437
       12   13   14   15
8F84: B434 015C 00B8 0000 0101 01A8 8002 01A9
```

Item **1** shows the value of the state variable and address key. The value of the state variable (X'01') indicates standard processing. The address key indicates address space 0 (partition 1).

Item **2** shows the task control block (TCB) address X'0120'.

Item **3** shows the value of the processor status word (PSW). The value X'8002' indicates a specification check occurred and that the translator was enabled. The specification check was caused by a word move to a odd-byte boundary.

Item **4** shows the value (X'B437') of the storage address register (SAR).

Item **5** shows the value (X'2AD6') of the instruction address register (IAR).

Item **6** shows the value (X'0000') of the address key register (AKR).

Item **7** shows the value (X'80D0') of the level status register (LSR).

Items **8** through **15** show the contents of hardware registers R0 through R7.

Finding the Program Load Point Address

In order to determine where the failure occurred in the application program, you need the address of the program load point. An exception entry in the trace table does not contain this address, but you can find the load point address by using the value of the address key and the TCB address.

If the area in storage that contained the failing program's task control block (TCB) has been overlaid by other active tasks, you *cannot* find the load point address in the failing program's TCB. The note under step 1 on page 8-7 may apply, however.

This discussion assumes that you are using the most recent exception entry in the trace table and that you were unable to record the program check message displayed for this exception. The following steps explain how to find the program load point address:

1. Look at the value in the address key (word 0, second byte) and determine the partition in which the failing program was active.

   Note: If the failing program was the *only* program active in that partition, the load point address is the address at which the partition begins. The $A ALL operator command displays the beginning address of each partition. Using the beginning address of that partition as the program load point address and the rest of the information in the exception entry, turn to the section "How to Analyze an Application Program Check" on page 6-11.

   If multiple programs were active in that partition, go to step 2.

2. Add the value X'52' to the address shown for the TCB (word 1 in the exception entry). Adding this value to the TCB address points to the field $TCBPLP in the task control block. $TCBPLP contains the program load point address.

3. Press the attention key and enter **$CP**, specifying the partition number from step 1.

4. Press the attention key and enter **$D**.

5. At the prompt for "ORIGIN," enter **0000**.

6. At the prompt for "ADDRESS,COUNT," enter the address you calculated in step 2. Enter the value 1 for the count.

The value the system displays is the program load point address of the failing program.

7. Reply **N** to the prompt "ANOTHER DISPLAY?"

The following items are ways in which you can determine if the program load point is valid:

- Check to see if the address is within the size of the partition in which the program was running.
- Subtract the load point address from the address shown for R1 (word 8 in the exception entry). Using the resulting address and the compiler listing of the failing program, determine if that address is within the program.
- Make sure that if the address is within the program, it is the address of an executable instruction.

If all of the above items seem correct, the address of the program load point is probably valid and belongs to the failing program. Using this program load point address and the rest of the information in the exception entry, turn to the section "How to Analyze an Application Program Check" on page 6-11.

Chapter 9. Recording Device I/O Errors and Program Check Information

When the system detects an I/O error for a device or encounters an error that interrupts processing, it can supply you with information to help you pinpoint the cause of the problem. The $LOG utility enables you to capture and record such error information whenever the system issues it.

Typically, when the system detects an I/O error for one of the devices attached to your Series/1, it issues status information about the device. However, $LOG does not log busy conditions. If the system encounters an error during processing, it may also report information about the error in the form of a program check message. The system provides two types of program check messages: a system program check and an application program check. (See to Chapter 6, "Analyzing and Isolating a Program Check" on page 6-1 for more details on program check messages.)

Advanced program-to-program communication (APPC) generates error logs also. You can display or print general error information about APPC, or you can display or print APPC error log GDS variable information. You use $DISKUT2 to display this information. For more information about these types of error log information, see "Displaying APPC Error Log Information" on page 9-12.

$LOG stores the error information it receives in a default log data set named EDXLOGDS. The system creates EDXLOGDS when you perform an IPL from disk after system generation. (The system does not re-create EDXLOGDS on subsequent IPLs unless you delete the data set.)

EDXLOGDS resides on the IPL volume. The system allocates 200 records for the data set but you can change the size of EDXLOGDS if you need to.

$LOG writes a single 256-byte record in the log data set for each device I/O error or program check error that it records. A log data set must contain at least three records because $LOG uses the first two records of the data set for control information.

If the log data set is empty, $LOG begins writing to the third record in the data set. If the log data set already contains entries, $LOG adds new entries following the old ones.

You can have other log data sets on your system but $LOG will not write information to these data sets unless you end the utility and reload it, specifying the particular data set you want to use. You can allocate a separate log data set with the AL command of the $DISKUT1 utility. The data set can reside on any disk or diskette volume.

Note: For the Remote Manager (5719-RM1) to receive error log information, you must load either the host program (CJUALTHL) or the send program (CJUALTSL) after each IPL.

See the following headings for more information on error logging:

- "Changing the Size of the Default Log Data Set" on page 9-3
- "Controlling Error Logging" on page 9-2

- "Printing or Displaying the Log Information" on page 9-5
- "Interpreting the Log Information" on page 9-8.

Controlling Error Logging

This section describes how to load or reload $LOG and lists the utility commands that enable you to control error logging. The utility commands are listed under "$LOG Utility Commands" on page 9-3.

Loading $LOG

On most systems, $LOG is loaded automatically after each IPL. If you need to load $LOG on your system or if you need to restart error logging, you can do so with the $L operator command.

To load $LOG in any partition, press the attention key on your terminal and enter **$L $LOG**. As shown in Figure 9-1, $LOG requests the name and volume of the log data set. The name of the data set in this example is EDXLOGDS on volume EDX002.

Note: For the remote manager (RM1) to receive error log information, you must also load either the host program (CJUALTHL) or the send program (CJUALTSL).

After you identify the log data set, $LOG displays the attention commands you can use to control the utility. You can issue these commands at any time. Error logging starts when you receive the message "LOGGING ACTIVATED."

```
> $L $LOG
 LOGDS   (NAME,VOLUME): LOGDS,EDX002
LOADING $LOG         nnP,hh:mm:ss, LP= xxxx, PART= yy

 *******************************************************
 *       $LOG UTILITY
 *
 *  THE FOLLOWING ATTENTION COMMANDS ARE AVAILABLE:
 *     ATTN/$LOGOFF   - TEMPORARILY DEACTIVATE LOGGING
 *     ATTN/$LOGON    - REACTIVATE LOGGING
 *     ATTN/$LOGINIT  - INITIALIZE LOG DATA SET
 *                        REACTIVATE LOGGING
 *     ATTN/$LOGTERM  - TERMINATE LOGGING
 *     ATTN/$LOG      - REISSUE COMMAND LIST
 *     ATTN/$LOGDISP  - DISPLAY ERROR MSG ON OCCURRENCE
 *     ATTN/$LOGTDW   - TERMINATE ON DATA SET WRAP
 *
 *   WARNING: DO NOT CANCEL ($C) THIS PROGRAM
 *******************************************************


LOGGING ACTIVATED
```

Figure 9-1. Example of Starting Error Logging

$LOG Utility Commands

$LOG has attention commands that enable you to control its activity. To use these commands, your terminal must be in the same partition as the utility. (The command **$A ALL** lists the programs and utilities active in each partition on your system.)

When you locate $LOG, you can display the utility commands by pressing the attention key on your terminal and entering **$LOG**. To issue one of the utility commands, press the attention key and enter the command name. The commands are as follows:

Command	*Use*
$LOGOFF	Suspend error logging ($LOG is still loaded).
$LOGON	Restart error logging.
$LOGINIT	Clear the log data set and restart error logging. When you use the $LOGINIT command, the system writes a new log control record to indicate that no entries are in the log data set.
$LOGTERM	End error logging ($LOG is no longer loaded).

Command	*Use*
$LOG	Display the list of attention commands. This command also displays any error messages issued **by** the $LOG utility. These error messages are from the utility itself and have nothing to do with the errors that $LOG is tracking.
$LOGDISP	Display any error messages issued **by** $LOG when they occur. For example, if the log data set becomes full during error logging, an error message will be displayed immediately. If you don't enter $LOGDISP, you must use the $LOG command to display errors.
$LOGTDW	End the $LOG utility if the log data set becomes full during error logging. If you do not enter this command, $LOG returns to the third record in the data set and begins writing over the existing entries.

Changing the Size of the Default Log Data Set

To change the size of the default log data set, EDXLOGDS:

1 Find the partition that contains the $LOG utility. If you coded the LOGPART= operand on the SYSPARMS statement during system generation, this operand instructs the system where to load $LOG. If you did not code LOGPART=, the system loads $LOG in any available partition, starting with the highest and searching down.

By pressing the attention key on your terminal and entering **$A ALL**, you can display the programs or utilities active in each partition.

2 If $LOG is in the same partition as your terminal, proceed to the next step. If the utility is in a different partition, press the attention key and enter **$CP** followed by the number of the partition that contains $LOG. For example, if $LOG is in partition 2, you would enter **$CP 2**.

3 Press the attention key and enter **$LOGTERM** to cancel the $LOG utility.

```
> $LOGTERM

LOG UTILITY TERMINATED

$LOG     ENDED AT 15:30:07
```

4 Press the attention key and enter **$L $DISKUT1**.

```
> $L $DISKUT1
LOADING $DISKUT1     nnP,hh:mm:ss, LP= xxxx, PART= yy

$DISKUT1 - DATA SET MANAGEMENT UTILITY I

USING VOLUME EDX002

COMMAND (?):
```

5 Delete EDXLOGDS on the IPL volume. (The IPL volume is typically EDX002.)

```
COMMAND (?): DE EDXLOGDS
EDXLOGDS DELETE (Y/N)? Y
EDXLOGDS DELETED

COMMAND (?):
```

6 $LOG writes a single 256-byte entry in the log data set for each device I/O error or program check error that it records. The default log data set created by the system can hold up to 198 entries, one for each record. You may require more or fewer log entries. You must allocate at least three records because $LOG uses the first two records of the data set for control information.

The following example shows how to allocate a default log data set that can contain up to 50 "log records."

```
COMMAND (?): AL EDXLOGDS 52 D
EDXLOGDS CREATED

COMMAND (?): EN

$DISKUT1 ENDED AT 15:35:30
```

7 To restart error logging, see the heading "Loading $LOG" on page 9-2.

Printing or Displaying the Log Information

By reviewing the log information, you can determine if any device I/O errors or program check errors occurred while $LOG was active.

The ERAP operator command enables you to print the contents of the default log data set, EDXLOGDS, on the system printer. The system printer is $SYSPRTR. "Printing the Default Log Data Set Using the ERAP Operator Command" describes how to use ERAP. The $DISKUT2 utility enables you to display the contents of a log data set on your terminal or to print it on any printer. See "Printing or Displaying a Log Data Set Using the $DISKUT2 Utility" on page 9-6 for more details.

Printing the Default Log Data Set Using the ERAP Operator Command

To print the default log data set, EDXLOGDS, using the ERAP command, press the attention key on any display terminal and enter **ERAP**. When the system has printed the entire log data set on $SYSPRTR, the message "ERAP ENDED" appears on your display screen.

```
> ERAP

ERAP ENDED
```

When you use the ERAP command, the system directs all output to the system printer, $SYSPRTR. If $SYSPRTR is busy when you enter the ERAP command, the system issues the message "$SYSPRTR NOT AVAILABLE." The system, in this case, redirects the output to the terminal you used to issue the ERAP command.

Cancelling the ERAP Command

The ERAP command loads the program $ERAPUT1, which controls the printing of the default log data set. The system loads this program in any available partition.

Note: You cannot load the $ERAPUT1 program independently.

To cancel or stop the printing of the default log data set, you must cancel $ERAPUT1 as follows:

1. Press the attention key on your terminal and enter **$A ALL**. This command lists all of the storage partitions for your system and tells you the names of the programs running in each partition.

2. Look at the contents of each partition until you locate the $ERAPUT1 program. If the program is in the same partition as your terminal, proceed to the next step. If the program is in a different partition, press the attention key and enter **$CP** followed by the number of the partition that contains $ERAPUT1. For example, if $ERAPUT1 is in partition 4, you would enter **$CP 4**.

3. Press the attention key and enter **$C $ERAPUT1**. This command cancels the program.

Printing or Displaying a Log Data Set Using the $DISKUT2 Utility

You can display log information on your terminal by using the LL command of $DISKUT2. The PL command prints the contents of the log data set on a printer.

Note: If you use the remote manager (RM1), use the LR command of $DISKUT2 to display the log information on a terminal or the PR command to print the information on a printer. Refer to the *Operator Commands and Utilities Reference* for more information on using these commands.

$DISKUT2 also enables you to display or print the following:

- The log entries for an I/O device at a particular address. If you do not know the I/O device addresses on your system, load the $IOTEST utility and issue the LS or LD command.
- The log entries for all program checks issued by the system while $LOG was active (application program checks and system program checks).
- The log entries for all errors issued by the APPC support or APPC transaction programs.
- All log entries in the log data set. This includes log entries for the I/O devices on your system and for program check errors.

Figure 9-2 shows an example of how to print all of the log entries in the log data set. An explanation of the numbered items follows the example.

```
1   > $L $DISKUT2
    LOADING $DISKUT2        nnP,hh:mm:ss, LP= xxxx, PART= yy

    $DISKUT2 - DATA SET MGMT. UTILITY II

2   USING VOLUME EDX002

3   COMMAND(?): PL MPRTR
4   LOG DS NAME: EDXLOGDS

5   CHOOSE ONE OF THE FOLLOWING:
            1 - DISPLAY ALL LOG RECORDS (DEFAULT)
            2 - DISPLAY LOG RECORDS BY DEVICE ADDRESS
            3 - DISPLAY PROGRAM/SYSTEM CHECKS
            4 - DISPLAY APPC GENERAL INFORMATION
            5 - DISPLAY APPC GDS VARIABLE INFORMATION

    OPTION NUMBER: 1

6   DUMP ALL OF LOG(Y/N)? Y

    COMMAND(?): EN

    $DISKUT2 ENDED AT hh:mm:ss
```

Figure 9-2. Example of Printing the Log Data Set

Item **1** shows how you load $DISKUT2 after pressing the attention key.

As shown at item **2**, $DISKUT2 assumes that you are using the IPL volume. If the log data set does not reside on the IPL volume, enter the CV command (change

volume) for the "COMMAND(?)" prompt. Then specify the volume on which the log data set resides.

The PL command entered at item **3** instructs the utility to print the log information on a printer. The printer in this example is MPRTR. If you do not enter the name of the printer, the system sends the output to $SYSPRTR. If you enter the LL command, $DISKUT2 displays the log information on your terminal.

The prompt message at item **4** asks for the name of the log data set. If your system loads $LOG automatically, the name of the log data set is EDXLOGDS.

The prompt message shown at item **5** asks you to specify the type of log information you want displayed or printed. To display or print the log entries for a specific I/O device, enter the option number for displaying log records by device address, which is 2, and the address (hexadecimal) of the device. To display or print only the log information for program or system check errors, enter option number 3. Enter option number 1 if you want to display or print all of the log entries in the log data set. To display APPC log entries, you enter either option number 4 or option number 5.

In this example, the option number 1 is entered. If you press the enter key, you receive the prompt shown at item **6**. Reply **Y** to confirm your choice to print the entire log data set. If you reply **N**, $DISKUT2 asks you again for the type of log information you want printed.

Interpreting the Log Information

The figures in this section show examples of the log entries formatted by $DISKUT2 or the ERAP operator command. An explanation of the numbered items follows each example. Figure 9-3 shows the general format of error log entries for I/O devices.

```
1  ERROR LOG LIST, DATASET: EDXLOGDS ON EDX002
2  I/O LOG ERROR COUNTERS (BY DEVICE ADDR):
                      3
    0000      0000 0100 0000 0000 0000 0000 0000 0000
    0010      0000 0000 0000 0000 0000 0000 0000 0000
              4
    0020      0001 0000 0000 0000 0000 0000 0000 0000
    0030      0000 0000 0000 0000 0000 0000 0000 0000
    0040      0000 0000 0000 0000 0000 0000 0000 0000
    0050      0000 0000 0000 0000 0000 0000 0000 0000
    0060      0000 0000 0000 0000 0000 0000 0000 0000
    0070      0000 0000 0000 0000 0000 0000 0000 0000
    0080      0000 0000 0000 0000 0000 0000 0000 0000
    0090      0000 0000 0000 0000 0000 0000 0000 0000
    00A0      0000 0000 0000 0000 0000 0000 0000 0000
    00B0      0000 0000 0000 0000 0000 0000 0000 0000
    00C0      0000 0000 0000 0000 0000 0000 0000 0000
    00D0      0000 0000 0000 0000 0000 0000 0000 0000
    00E0      0000 0000 0000 0000 0000 0000 0000 0000
    00F0      0000 0000 0000 0000 0000 0000 0000 0000
5  PERM ERR
   6                   7
   DEV ADDR:  0002     DEV ID:  0106
   8                   9            10
   DATE:  9/15/84      LVL:  0001   AKR:   0000
   11                  12           13
   TIME:  0:20:22      RETRY: 10    IDCB:  7002 0852
   14                  15
   INTCC:  0002        ISB:  0080
16 DCB 1:  8007 0000 0000 0000 0000 0862 0000 0000

   DCB 2:  8005 0001 0000 0001 0000 0872 0000 0000

   DCB 3:  2109 0000 0000 1001 0001 0000 0100 1D4C

17 CSSW:   0881 4000 1001 0001

   PERM ERR   18               19
   DEV ADDR:  0021     DEV ID:  0306
   DATE:  9/16/84      LVL:  0003   AKR:   0100
   TIME:  0: 2:53      RETRY: 2     IDCB:  0000 0000
   INTCC:  0002        ISB:  0080
   CSSW:   12D1 2041 0015 4200 0000 FFFF 00F8 6080
   LOG LISTING ENDED
```

Figure 9-3. Example of Log Entries for I/O devices

Item **1** identifies the name and volume of the log data set $DISKUT2 is printing or displaying. In this example, the log data set is EDXLOGDS on volume EDX002.

The information shown below item **2** lists device addresses and the number of I/O errors that have occurred at those addresses. The device addresses range from X'00'-X'FF' (0-255).

Each byte indicates a device address and the number of I/O errors (in hexadecimal) logged at that address since the log data set was last initialized. For example, the value X'01' shown below item **3** indicates that one I/O error occurred at device address X'02'. The information beneath item **4** indicates that one I/O error occurred at device address X'21'.

Item **5** indicates the type of I/O error. $DISKUT2 indicates either a permanent error (PERM ERR) or a soft-recoverable error (SOFT RECOV ERR). A permanent error is an I/O error from which the device cannot recover after attempting to retry the I/O operation.

A soft-recoverable error is one from which the device is able to recover after retrying the I/O operation.

Item **6** identifies the address of the device encountering the I/O error. The device address is contained in the rightmost byte of the word. In this example, the device is at address X'02'.

Item **7** identifies the device type. The value shown in this example, X'0106', represents a 4964 diskette unit. The device type is also shown when you issue the LS or LD command of $IOTEST.

Item **8** shows the date, according to the system clock, when the I/O error occurred.

Item **9** indicates the hardware interrupt level that was active when the I/O error occurred. This example shows that hardware interrupt level 1 was active.

Item **10** shows the value of the address key register (AKR). This value indicates the address space that contained the active task when the error occurred. In this example, address space 0 (partition 1) contained the active task.

Item **11** shows the time, according to the system clock, when the I/O error occurred.

Item **12** shows the number of times that the supervisor issued the I/O instruction to the device before logging the error.

Item **13** shows two words of immediate device control block (IDCB) information. The first word contains the I/O operation and the device address. The second word can contain either an immediate data word, a DCB address, or zeros. The contents of this word are device dependent. Refer to the device description manual for the meaning of the two words of IDCB information.

Item **14** shows the value of the interrupt condition code. The code indicates the successful or unsuccessful completion of the I/O operation. The meaning of the interrupt condition code is device dependent. Refer to the device description manual for the meaning of this code. If the device is a Local Communications Controller (LCC), this item shows the return code issued by an LCC instruction.

Item **15** shows the value of the interrupt status byte (ISB). The ISB contains additional information about the I/O error. The meaning of the ISB is device dependent. Refer to the device description manual for the meaning of this value.

Item **16** shows the device control block (DCB) information for this device when the I/O error occurred. If the device did not require a DCB to perform the I/O operation, this item would not appear in the listing. This example shows the contents of three chained DCBs the device needed to perform the I/O.

Item **17** shows the contents of the cycle steal status words (CSSW) when the I/O error occurred. Each word provides some information about the error. The number of words varies by device type and in some cases by error type. Refer to the device description manual for the meaning of the cycle steal status words.

Item **18** shows information about the I/O error that occurred on the device at address X'21'. (Item **4** shows that only one I/O error occurred at this address.)

The value X'0306' shown below item **19** means that this device is a 4973 printer.

Notice that for this device, no DCBs were required to perform the I/O and that eight words of cycle steal status were logged.

Figure 9-4 shows the format of a log entry for an application program check and a system program check. See "How to Interpret the Program Check Message" on page 6-1 for more information on the various fields shown in this example.

```
1                       ***  PROGRAM CHECK  ***
2  DATE:  12/23/85              TIME:  11:17:  31
    3               4              5
   SAR = 5F4B     PSW = 8002    PSW ANALYSIS:  SPECIFICATION CHECK
                                               TRANSLATOR ENABLED
6  ADDRESS OF TCB = 0070     7   PROGRAM NAME: TRAP1
                                8 LOAD POINT =  5F00
    9              10           11
   IAR = 5380     AKR = 0111    LSR = 40D0
    12
   R0 (WORK REG)       = 0002   R4 (EDL OP2 ADDR) = 0100
   R1 (INSTR ADDR)     = 5F49   R5 (EDL COMMAND)  = 0000
   R2 (EDL TCB ADDR)   = 5F70   R6 (WORK REG)     = 0000
   R3 (EDL OP1 ADDR)   = 0000   R7 (WORK REG)     = 0001


13                       ***  SYSTEM CHECK  ***
   DATE:  11/15/85              TIME:  08:25:31
   SAR = 90C2     PSW = 8002    PSW ANALYSIS:  SPECIFICATION CHECK
                                               TRANSLATOR ENABLED
   ADDRESS OF TCB = 004C
   IAR = 7B20     AKR = 0300    LSR = 10D0
   R0 = 02BE                    R4 = 2222
   R1 = FFFF                    R5 = 7AFE
   R2 = 0904                    R6 = 8888
   R3 = A7A7                    R7 = 2222
```

Figure 9-4. Example of Program Check Log Entries

Item **1** indicates the type of program check information in the log record. $DISKUT2 indicates either an application program check (PROGRAM CHECK) or a system program check (SYSTEM CHECK).

Item **2** shows the date and time when the program check occurred, according to the system clock.

Item **3** shows the contents of the Storage Address Register (SAR). The SAR tells you which storage address the system was referring to when the program check occurred.

Item **4** shows the value of the processor status word (PSW) when the program check occurred. The PSW indicates the type of error encountered. The meaning of the PSW is shown under item **5**. In this example, a specification check occurred in the program. The **PSW ANALYSIS** field also shows that the Storage Address Relocation Translator Feature was installed and enabled.

Item **6** shows the address of the active task control block (TCB). The address is not relocated and reflects the address of the TCB in the program's compiler listing.

Item **7** shows the name of the failing program.

Item **8** is the address in storage of the program load point. This is the address at which the program was loaded for execution.

Item **9** shows the contents of the instruction address register (IAR). The address in the register is the address of the machine instruction that was executing when the program check occurred.

Item **10** shows the contents of the address key register (AKR). Item **11** shows the contents of the level status register.

Item **12** shows a list of the general purpose registers (R0 – R7) and their contents. For programs written in EDL, the contents of these registers are as follows:

Register	*Contents*
R0	Work register. The contents of this register are usually not significant.
R1	The address of the failing EDL instruction.
R2	The address in storage of the active task control block (TCB). The address in R2 is the sum of the TCB address and the load point address of the program.
R3	The address in storage of operand 1 of the failing EDL instruction.
R4	The address in storage of operand 2 (if applicable) of the failing EDL instruction.
R5	The operation code of the failing EDL instruction.
R6	Work register. The contents of this register are usually not significant.
R7	Work register. The contents of this register are usually not significant.

Item **13** is a sample of a log record for a system program check. The format of the system program check is similar to that used for application program checks. Notice, however, that the general purpose registers are not labeled in the log entry

for the system program check. The registers are not labeled because system program checks normally involve Series/1 assembler code where the contents of the registers can vary.

Displaying APPC Error Log Information

You can display two types of error log information relating to APPC:

- APPC general information error logs
- APPC Error Log GDS variable information.

To display either type of error log information, use $DISKUT2.

Figure 9-5 shows an example of APPC general information. Some of the information is required information and is displayed whenever you request this type of error log. Other information is included with some APPC error logs and omitted with others. An explanation of the numbered items follows the example. Most values for these items are in hexadecimal notation (hh). Some values are in decimal notation (dd) or EBCDIC (ee).

```
                    1 ***APPC GENERAL INFORMATION***

2  DATE:  mm/dd/yy          TIME:  hh:mm:ss

3  TCB:  hhh              4 PART:  hhhh

5  REPORTED BY LAYER:  dd

6  SENSE CODES:  hhhh hhhh

7  PU DEVICE ADDRESS:  hh 8 PU STATION ID:  hh

9  TH:  hhhh hhhh hhhh

10 RH:  hhhh hhhh hhhh

11 RU:  hhhh hhhh hhhh hhhh hhhh . . .

12 CONVID:  hhhh
```

Figure 9-5. Required and Optional APPC General Information Displayed

Note: Items 1 through 6 will always appear in the log. Items 7 through 11 are included for certain errors and omitted for others.

Item 1 (Required) Indicates the type of error log information in the log record. $DISKUT2 allows you to display an application program check, a system program check, APPC general information, of APPC GDS information.

Item 2 (Required) Shows the date and time when the error logging occurred (according to the system clock).

Item 3 (Required) Shows the address of the active TCB.

Item 4 (Required) Shows the partition number where the program was executing.

Item 5 (Required) Corresponds to an SNA grouping of related functions that are logically separate from the functions in other layers. Valid layer identifications are as follows:

Value	Layer
0	LU Basic Conversation Presentation Services
1	LU Services Resource Manager
2	LU Data Flow Control
3	LU Transmission Control
4	PU Path Control
5	EDX service routines
6	PU Network Addressable Unit Manager
7	PU Network Services
8	Operator supervisor services
9	PU activation services
10	LU Mapped Conversation Presentation Services
11	LU Operator Verb Presentation Services
12	SDLC Link Manager
13	LU Network Services
14	PU network deactivation services.

For more information on layer numbers for APPC, refer to *Advanced Program-to-Program Communication Programming Guide and Reference.*

Item 6 (Required) Shows the value of SNA-defined sense data. For explanations of sense data, refer to the *Systems Network Architecture Reference Summary*. For a discussion of sense codes, refer to *Advanced Program-to-Program Communication Programming Guide and Reference.*

Item 7 (Required) Shows the device address for the PU. (A local physical unit has a device address of 00.)

Item 8 (Optional) Shows the identification value of the PU's station. (For SDLC PUs, this is the secondary station address.)

Item 9 (Optional) Shows the bytes in the transmission header (TH). For formats and meanings of the bytes in the TH, refer to the *Systems Network Architecture Reference Summary.*

Item 10 (Optional) Shows the bytes in the request/response header (RH). For formats and meanings of the bytes in the RH, refer to the *Systems Network Architecture Reference Summary.*

Item 11 (Optional) Shows the bytes in the request/response unit (RU). For formats and meanings of the bytes in the RU, refer to the *Systems Network Architecture Reference Summary.*

Note: Only as much of the RU as will fit in the log record is included.

Item 12 (Optional) Shows the conversation identifier.

Figure 9-6 on page 9-14 shows an example of the information that is displayed when you choose to have APPC Error Log GDS variable information displayed. An explanation of the fields follows each example. The values for some fields are displayed in hexadecimal notation (hh); the values of other fields are displayed in EBCDIC.

You can log APPC error log information by specifying the LOGDATA parameters on two APPC EDL instructions: ACDEALLC and ACSNDERR. In addition, your partner transaction programs can provide log data along with error notification.

For more information on logging data for APPC, refer to the *Advanced Program-to-Program Communication Programming Guide and Reference.*

```
                    1 ***APPC GDS VARIABLE***

2 DATE:  mm/dd/yy          TIME:  hh:mm:ss

3 GDS VARIABLE ID:  12E1

4 PRODUCT ID       :  eeee eeee eeee . . .
5 PRODUCT ID (HEX):  hhhh hhhh hhhh . . .

6 MESSAGE      :  eeee eeee eeee . . .
7 MESSAGE (HEX):  hhhh hhhh hhhh . . .
```

Figure 9-6. APPC GDS Information

Item 1 Indicates the type of error log information in the log record. $DISKUT2 allows you to display an application program check, a system program check, APPC general information, or APPC Error Log GDS variable information.

Item 2 Shows the date and time when the error logging occurred (according to the system clock).

Item 3 Contains the error log GDS variable identifier, X'12E1'.

Item 4 Shows the value of the product identifier. This is specified by the transaction program that logged the error. (EBCDIC)

Item 5 Shows the value of the product identifier. This is specified by the transaction program that logged the error. (hexadecimal)

Item 6 Contains the message text error information for use in debugging and error recovery. This is specified by the transaction program that logged the error. (EBCDIC)

Item 7 Contains the message text error information for use in debugging and error recovery. This is specified by the transaction program that logged the error. (hexadecimal)

Appendix A. How to Use the Programmer Console

The programmer console, which is an optional Series/1 processor feature, is a useful tool when you analyze problems.

Several of the chapters in this book mention the use of the programmer console to display storage locations. However, you can perform many more functions with the programmer console. This appendix explains some additional functions you can do. You can use the programmer console to:

- Display or alter main storage locations
- Store data into main storage
- Display or alter register contents
- Store data into registers
- Stop on a selected address
- Stop on an error condition
- Execute one instruction at a time.

The topics discussed in this appendix use the term "console" when referring to the programmer console.

Before the various functions of the console are discussed, a section on how to read the indicator lights is presented. This section follows.

Reading the Console Indicator Lights

Across the top of the console is a row of 16 indicator lights. These lights represent the 16 binary bits of a Series/1 word or two bytes. You refer to each indicator light as a bit position. The bit positions are numbered left to right as bit position 0 through bit 15. When an indicator light is on, this means that that bit is on or set to 1.

The value displayed in the lights may represent data in storage or registers, or it may represent a storage address. What the value represents depends on the function you are performing. How the console represents a value and how you read that value is described as follows.

Each group of four binary indicators represents four bits of a word area. Byte 0 (group 1 and group 2) is the leftmost byte. Each light in a group of four has a binary-coded decimal value, as follows:

```
XXXX    XXXX    XXXX    XXXX
8421    8421    8421    8421

Group 1    Group 2    Group 3    Group 4
```

Figure A-1. Indicator Lights — Example 1

If you add the values of any one group of four lights when each of the lights are on in that group, the total is 15 or F in hexadecimal.

Because data and addresses in the Series/1 are represented in hexadecimal, it is good practice to convert the binary-coded decimal values displayed by the lights to hexadecimal. Appendix D, "Conversion Table" on page D-1 contains a table to help you convert from binary to hexadecimal.

In the following example, assume that the top row represents the indicator lights. The 0 represents lights that are off (set to 0) and an X represents the lights that are on (set to 1).

```
000X    00X0    0X0X    X000
   1      2    4 1   8

Group 1  Group 2  Group 3  Group 4
```

Figure A-2. Indicator Lights — Example 2

In the second row is the decimal equivalent that corresponds to the X above the value. Add the values within each group of four to get the total value of each group. Therefore, the value of the indicator lights in Figure A-2 is 1 2 5 8.

Figure A-3 shows a value which requires conversion to hexadecimal. The value of the indicator lights in this example is 1 3 9 A.

```
000X    00XX    X00X    X0X0
   1     21   8   1   8  2

Group 1  Group 2  Group 3  Group 4
```

Figure A-3. Indicator Lights — Example 3

The remaining sections explain the various functions of the console.

Displaying Main Storage Locations

To display an area in main storage, do the following:

1. Press the Stop key.
2. Press the SAR (storage address register) key.
3. Press the AKR (address key register) key. The contents of the AKR are displayed in the indicator lights.
4. Key in one hexadecimal value (new address key). This is the value of the address space (partition number minus 1) in which you want to display main storage. For example, to display main storage in partition 2, you would key in the value 1 on the console. The value you enter is displayed in bits 11 – 15 of the indicator lights.
5. Press the Store key to store the new address key into the AKR.
6. Press the SAR key. The contents of the SAR are displayed in the indicator lights.
7. Key in the address (four hexadecimal characters) you want to display. This address is displayed in the indicator lights.
8. Press the Store key. The address displayed in the lights is stored into the SAR.
9. Press the Main Storage key. The contents of storage at the address you entered is displayed in the indicator lights. To display sequential main storage locations, continue pressing the Main Storage key.

Each time you press the Main Storage key, the system increments the storage address by 2 and displays the contents at that address.

Storing Data into Main Storage

To store data area into main storage, do the following:

1. Press the Stop key.
2. Press the SAR (storage address register) key.
3. Press the AKR (address key register) key. The contents of the AKR are displayed in the indicator lights.
4. Key in one hexadecimal value (new address key). This is the value of the address space (partition number minus 1) in which you want to store data. For example, to store data in partition 1, you would key in the value 0 on the console. The value you enter is displayed in bits 11 – 15 of the indicator lights.
5. Press the Store key to store the new address key into the AKR.
6. Press the SAR key. The contents of the SAR are displayed in the indicator lights.
7. Key in the address (four hexadecimal characters) at which you want to store data. The address you enter is displayed in the indicator lights.
8. Press the Store key. The address displayed in the indicator lights is stored into the SAR.
9. Press the Main Storage key. The contents of the address you entered is displayed in the indicator.
10. Key in the data (four hexadecimal digits) that you want stored at that address in main storage. The value you entered is displayed in the indicator lights.
11. Press the Store key. The value shown in the indicator lights is stored at the address you entered in step 7.

Each time you press the Store key, the system increments the SAR by 2, and the data stored at that location is displayed.

Displaying Register Contents

To display the contents of a register, do the following:

1. Press the Stop key.

2. Press the Level key for the hardware level that contains the register(s) you want to display. Timers run on level 0. The supervisor and attention list tasks run on level 1. User programs and tasks run on levels 2 and 3.

   You can display the contents of any of the following registers on that level by pressing the key for that register:

   LSR Level status register

   AKR Address key register

   IAR Instruction address register

   R0 – R7 Hardware registers 0 through 7.

After you press the register key, the contents of that register are displayed in the indicator lights.

Storing Data into Registers

You can store data into the IAR or registers R0 – R7. Only the address key register (AKR) and level status register (LSR) can be displayed.

To store data into a register, do the following:

1. Press the Stop key.

2. Press the Level key for the hardware level that contains the register(s) in which you want to store data.

3. Press the key for the register in which the data is to be stored. The contents of that register are displayed in the indicator lights.

4. Key in the data that you want to store. The value you enter is displayed in the indicator lights.

5. Press the Store key. The value displayed in the indicator lights is stored in the register you selected.

Stopping at a Storage Address

To stop on an address, do the following:

1. Press the Stop key.
2. Press the Stop On Address key twice.
3. Press the AKR (address key register) key. The contents of the AKR are displayed in the indicator lights.
4. Key in one hexadecimal value (new address key). This is the value of the address space (partition number minus 1) which contains the address on which you want the system to stop. For example, to set a stop address in partition 1, you would key in the value 0 on the console. The value you enter is displayed in bits 13 – 15 of the indicator lights.
5. Press the Store key to store the new address key into the AKR.
6. Press the Stop On Address key.
7. Key in the address at which you want execution to stop.
8. Press the Store key. The address and address key are placed in the stop-on-address buffer.
9. Press the Start key. Execution begins at the current IAR address on the current hardware level.

When the system loads the address you specified into the IAR, the processor enters the stop state. At this point, you can examine the contents of storage. To exit the stop state, press the Start key; execution begins at the next sequential address.

Stopping When an Error Occurs

Pressing the Stop On Error key causes the system to stop immediately if it detects a program check, machine check, or power/thermal warning. To determine the error type, press the PSW (processor status word) key. The value of the PSW is displayed in the indicator lights. The section "Interpreting the Processor Status Word Bits" on page 6-4 explains what the bits indicate.

To restart the processor, press the Start key. The processor will proceed with error handling as if it had not been stopped.

Executing One Instruction at a Time

Pressing the Instruct Step key causes the system to execute one instruction and then stop.

To enable the system to execute one instruction at a time, do the following:

1. Press the Stop key.
2. Press the Stop On Address key twice.
3. Press the AKR (address key register) key. The contents of the AKR are displayed in the indicator lights.
4. Key in one hexadecimal value (new address key). This is the value of the address space (partition number minus 1) which contains the IAR address on which you want the system to stop. For example, if the IAR address was in partition 1, you would key in the value 0 on the console. The value you enter is displayed in bits 11 – 15 of the indicator lights.
5. Press the Store key to store the new address key into the AKR.
6. Press the Stop On Address key.
7. Key in the IAR address at which you want the system to stop.
8. Press the Store key. The IAR address and address key are placed in the stop-on-address buffer.
9. Press the Start key. When the system attempts to execute the IAR address, the processor stops.
10. Press the Instruct Step key. The system resets the Stop On Address to off.
11. Press the Start key. The system executes the instruction at the IAR address you entered and then stops. The system updates the IAR to point to the next instruction address.

Each time you press the Start key, one instruction is executed and the IAR is updated to the next instruction address.

If your supervisor contains timer support, interrupts will occur while you are single-instruction stepping through your program. When this happens, you enter the system interrupt handler at the time you press the Start key. You can set stop-on-address mode on your program's next instruction and press the Start key; then, single-step until the next interrupt.

If the processor is in run state, pressing the Instruct Step key causes the processor to enter the stop state. Pressing the Instruct Step key a second time resets instruction-step mode; the processor remains in the stop state.

Appendix B. Allowing IBM Access to Your System

On occasion, you may need to call an IBM support center to assist you in analyzing a problem with your system. If the problem is complex, the IBM support center representative may ask to establish a Remote Support Link. The Remote Support Link enables the support center representative to get direct access to your Series/1 system through a remote terminal. The link is established over a switched telephone line.

Using the Remote Support Link, an IBM support center representative can issue operator commands to your system and run EDX utilities. You can use the link to transfer disk data sets to the support center to assist representatives in diagnosing your problem.

This appendix describes the hardware you need to set up a Remote Support Link and the procedures for authorizing and disconnecting the link. To use these procedures, you must have defined a remote support terminal and included the necessary supervisor modules during system generation. Refer to the *Installation and System Generation Guide* for more details.

You are responsible for ensuring the security and integrity of your data and software *before* giving IBM access to your system. You must, for example, give IBM permission to establish a Remote Support Link and you should remove all confidential data from your system. IBM takes every precaution to ensure the integrity of your data and software, but IBM assumes no responsibility in this regard.

Hardware Requirements

To set up a Remote Support Link, you need the following hardware:

- One of the following communications adapters:
  - An Asynchronous Communications Single-Line Controller (#1610)
  - An Asynchronous Communications 8-Line Controller (#2091) with a 4-Line Adapter (#2092)
  - A Multifunction Attachment - Port 0 (#1310)
  - A Feature Programmable 8-Line Controller (#2095) with a 4-Line Adapter (#2096).
- A Communications Power Feature (#2010)
- An EIA[1] Communication Cable (#2057)
- A modem (compatible with the American Telephone & Telegraph Co. 212A modem)
- A voice-grade switched telephone line, preferably one that is not routed through a manually-operated switchboard.

  Note: It is easier for the IBM support center to assist you if you have a second telephone line available near your Series/1. The second line enables you to speak with a support center representative while your system is linked to the IBM support center.

In addition to the hardware just described, your system also must have a disk and diskette unit.

Authorizing the Link

If the IBM support center representative determines that a Remote Support Link would help in isolating or resolving your problem, you can use the following procedure to authorize the link. Remember, you are responsible for ensuring the security and integrity of your data and software *before* authorizing the link. You should, for example, remove all confidential data from your system.

1 Check to see that your modem is switched on and that the line is ready for use.

[1] Electronic Industries Association

2 Load the IBM-supplied program called ANSWER. The ANSWER program resides on the IPL volume. You can load this program from any terminal and in any partition, but all messages issued by the program appear on the operator console, $SYSLOG. To load the ANSWER program, press the attention key on your terminal and enter **$L ANSWER**.

```
> $L ANSWER
LOADING ANSWER       nnP,hh:mm:ss, LP=xxxx, PART=yy

IF YOU AGREE THAT IBM SHOULD INITIATE THE REMOTE SUPPORT LINK, AND
YOU HAVE TAKEN APPROPRIATE STEPS TO SAFEGUARD YOUR DATA, ENTER "Y"
    OR
ENTER  "N"  TO EXIT AND NOT ALLOW REMOTE SUPPORT ACCESS ==> _
```

3 If you have taken the appropriate steps to safeguard the data in your system, enter **Y** to authorize the Remote Support Link.

Entering **N** ends the program and prevents access to your system.

```
IF YOU AGREE THAT IBM SHOULD INITIATE THE REMOTE SUPPORT LINK, AND
YOU HAVE TAKEN APPROPRIATE STEPS TO SAFEGUARD YOUR DATA, ENTER "Y"
    OR
ENTER  "N"  TO EXIT AND NOT ALLOW REMOTE SUPPORT ACCESS ==> Y
NAME OF REMOTE TERMINAL ==> _
```

4 Enter the name of the remote support terminal. This name is the same as the label on the TERMINAL definition statement for the remote support terminal. In this example, the name of the terminal is REMSUPT.

```
IF YOU AGREE THAT IBM SHOULD INITIATE THE REMOTE SUPPORT LINK, AND
YOU HAVE TAKEN APPROPRIATE STEPS TO SAFEGUARD YOUR DATA, ENTER "Y"
    OR
ENTER  "N"  TO EXIT AND NOT ALLOW REMOTE SUPPORT ACCESS ==> Y
NAME OF REMOTE TERMINAL ==> REMSUPT
```

When you complete this step, the program enables the communications adapter and answers the phone when it receives a ring interrupt.

5 The IBM support center representative now has access to your Series/1 to diagnose a problem or to transfer a correction over the line. The support center representative can communicate with you by sending messages over the Remote Support Link or by talking with you on a separate telephone line.

Disconnecting the Line

To disconnect the line and end the ANSWER program, press the attention key and enter **HANGUP**.

```
> HANGUP

REMOTE SUPPORT LINE IS DISCONNECTED

ANSWER   ENDED AT 02:40:06
```

It is your responsibility to ensure that the Remote Support Link has been disconnected and disabled at the end of the problem-solving session.

Note: To communicate with your system, the IBM support center representative loads a program called RSLEDX1 from the remote terminal. If you disconnect the line before the support center representative ends RSLEDX1, the program will still be running on your system. You can cancel RSLEDX1 in this case by pressing the attention key and entering the $C command.

Appendix C. Interpreting a Dump (Example)

This appendix gives an interpretation of a storage dump as an example for reading your own storage dumps. You will also find examples of determining specific problems. Before reading this appendix you should read Chapter 7, "Analyzing a Failure Using a Storage Dump" and be familiar with the procedures discussed there. The information in this appendix supplements the instructions for using storage dumps to analyze failures that appear in Chapter 7, "Analyzing a Failure Using a Storage Dump."

Overview

The Event Driven Executive (EDX) is a task-driven system, and its language, the Event Driven Language (EDL), is an emulated language. The EDL instructions are examined and executed by a group of Series/1 assembler instructions in the appropriate supervisor supporting module.

The Series/1 (EDX) Task Control Block (TCB) is useful for determining the state of the task when interpreting a dump. A task's TCB is the place where the EDX operating system saves the Level Status Block (LSB) when the task is not executing. This LSB consists of the following hardware registers:

- The Instruction Address Register (IAR). This register always points to a Series/1 assembler language instruction. If you are coding in EDL, this register always points into the supervisor.
- The Address Key Register (AKR). This register tells you which address space contains operand 1, operand 2, and the IAR.
- The Level Status Register (LSR).
- Hardware registers 0 (R0) through 7 (R7).

R1 must be preserved because it points to the EDL instruction being executed.

R2 contains the address of the TCB and is preserved.

R3 through R7 may vary extensively depending upon the EDL instruction being emulated.

For example, in terminal I/O, Register 3 contains the address of the Terminal Control Block (CCB). A CCB is generated for each TERMINAL definition that is defined in the supervisor. Commonly in TCBs, the contents of an IAR is R7 plus X'0004'. It can be assumed that at that point in the code, the task executed an assembler branch and link instruction (BAL xxx,R7) in the supervisor.

If a task is executing on a level, the contents of the LSB in the TCB reflect the hardware registers the last time they were saved. When a task is executing and a dump is taken, the hardware register listed on the second page of the dump shows exactly where the executing task was when the dump was was taken. Figure C-1 on page C-2 shows the LSB in the TCB. The LSB is located in the first three rows in the TCB.

Offset	0	2	4	6	8	A	C	E
0	Task code word 1	Task code word 2		IAR	AKR	LSR	R0	R1
10	R2	R3	R4	R5	R6	R7	Temp work area R0	Level
20	Priority	Chain TCB address	Chain address space	Task	end	ECB	Pointer to #1	#1

A0941001

Figure C-1. Level Status Block Layout

Interpreting The Formatted Control Blocks in a Dump

The following section shows the formatted control blocks that have been printed from a $TRAP dump by the utility $DUMP. The interpretation of the formatted control blocks is divided into several examples. Each example considers a portion of the dump. An explanation of the numbered items follows the examples. All numbers shown are in hex notation except where specified.

Example 1: Each level in EDX is used for specific functions. Level 0 is used for timer support and the EDX dispatcher. Level 1 is used for attention lists and for all input/ output (I/O). Levels 2 and 3 are used by user programs as well as EDX utilities. The priority as specified on the program and task statement will determine on which of these two levels (2 or 3) the program or task will execute. For more information on coding priority, refer to the *Language Reference*. If no priority is specified, the program or task will take the default of level 2, priority 150, X'96'.

The first portion of the dump contains information on the following:

- The IAR
- The AKR
- The LSR
- R0 through R7.

```
EVENT DRIVEN EXECUTIVE $TRAP FORMAT STORAGE DUMP
                            1              2
AT TIME OF TRAP PSW WAS 8002 ON HARDWARE LEVEL 2
           LEVEL0   LEVEL1   LEVEL2   LEVEL3    SVC-LSB   SVCI-LSB
IAR          2910     2832     3CDA     2832      2832       280A
AKR          0200     0000   5 0021     0000      0000       0000
LSR          8090     0090     88D0     0090      00C0       00C0
R0           0000     0000     0000     0000      0000       0000
R1           0000     0000     061A     0000      0000       0000
R2         3 058E     0000   6 058E     0000      0000       0000
R3         4 02BE     0000     1590     0000      0000       0000
R4           0000     0000     0000     0000      0000       0000
R5           0002     0001   7 028D     0003      0002       0000
R6           0000     C000     0000     8000      8000       0000
R7           0000     0000     0000     0000      0000       0000
```

From this example, you can determine that the following applied when you took the trap:

Item	Explanation
1	The PSW was 8002.
2	The PSW was on hardware level 2.
3	Level 0 R2 contains a X'058E'.
6	Level 2 R2 also contains a X'058E'.

From this information, you can assume that a TCB located at address X'058E' was executing at the time the trap dump was taken. Further analysis shows the following:

Item	Explanation
4	Level 0 R3 contains a X'02BE' which points to entry point SVCL2 in the EDX supervisor fixed storage area in partition 1 (module EDXSYS). This entry point is the system table for the active and ready tasks for level 2.
5	The AKR on level 2 shows which partition or address space this task was executing in. The AKR contains a X'0021' meaning that operand 1, represented by the second hex digit, (x0xx), was in address space 0 (partition 1). Operand 2 represented by the third hex digit (xx2x) was in address space 2 (partition 3). The IAR represented by the fourth hex digit of the AKR (xxx1) was executing a Series/1 assembler language instruction in address space 1 (partition 2).

Since the program that is executing is written in EDL, the IAR will always be executing in the supervisor. From this you can assume that the supervisor resides in this system in at least partitions 1 and 2. The task in partition 3 at address X'058E' was the cause of the problem.

Since at the time of the trap, the PSW was 8002, this task caused a program check with a specification error. A specification error means that the system tried to execute an instruction and expected operand 1 and operand 2 to be on an even-byte boundary. Instead, one or both were on an odd-byte boundary.

Item	Explanation
7	R5, which contains a X'028D', is the only register on level 2 that is on an odd-byte boundary.

R1 points to the failing EDL instruction. The LSR values confirm that at the time of the trap, level 2 was active.

With 3-bit mode, the Series/1 supports up to 8 partitions (address spaces 0 to 7). With 4-bit mode, address spaces can be 0 to 15. With 5-bit mode, the address spaces can be 0 to 31. In 3-bit and 4-bit mode, the AKR has three (3) reserved bits. In 5-bit mode, the bits are used to address partitions 17 to 32 (address spaces 16 to 31). The AKR as it is used in 5-bit mode is as follows:

Bit	Explanation
0	The EOS bit
1 and 4 – 7	Address space of operand 1
2 and 8 – 11	Address space of operand 2
3 and 12 – 15	Address space of the IAR

Sample AKR Values: The following are interpretations of some AKR values:

Value	Interpretation
0271	Operand 1 is in address space 2 (partition 3). Operand 2 is in address space 7 (partition 8). The IAR is executing in address space 1 (partition 2).
0AD0	Operand 1 is in address space 10 (partition 11). Operand 2 is in address space 13 (partition 14). The IAR is executing in address space 0 (partition 1).
8254	Since the EOS bit is on, ignore bits 4-7 and use the value for the address space of operand 1 that is used for the address space of operand 2. So, operand 1 is in address space 5 (partition 6). Operand 2 is in address space 5 (partition 6). The IAR is executing in address space 4 (partition 5).
4AD0	Since operand 1 bit 1 is on, add a binary 10000 to binary 01010 resulting in binary 11010, or add a hexadecimal 10 (decimal 16) to the hexadecimal number in bits 4 to 7 a hexadecimal A (decimal 10). The result is hexadecimal 1A (or decimal 26) for the address space (partition 27). Since bit 2 is off, operand 2 is in address space 13 (hexadecimal D or decimal 13) (partition 14). Since bit 3 is off and bits 12 to 15 are also off, the IAR is executing in address space 0 (partition 1).

Example 2: The SVCI Interrupt Table follows the floating-point register information (not shown for this interpretation).

```
SVCI INTERRUPT TABLE

          REQ  ADDR AKR
NO SVCI INTERRUPTS PENDING
```

The SVCI Interrupt buffer is used by the system to stack the SVCI requests when the supervisor is marked busy. If entries appear in this buffer, it means that the system has not processed these SVCIs yet. When this buffer is full, the system goes into a loop or stops, depending on the setting of the Mode switch—normal, auto IPL, or in diagnostic mode.

The IABUF parameter on the SYSPARMS statement in the system definitions data set ($EDXDEF) allocates the SVCI buffer. The default value is 20 entries, each made up of 4 words. The words are as follows:

Word 0 Address of the SVCI function to be performed (ATTACH, POST, or DEQ)

Word 1 Address of the TCB, ECB or QCB

Word 2 ATTACH, POST or DEQ code value

Word 3 Address space key of the TCB, ECB, or QCB.

For this dump, no SVCI interrupts were pending.

Example 3: The next portion of the dump is the machine/program check log buffer.

```
MACHINE/PROGRAM CHECK LOG BUFFER  - LATEST ENTRY PRINTS LAST

NO CHECK LOG ENTRIES SINCE IPL
```

If any program checks had occurred since the last IPL, this portion of the dump would contain information about those checks, but only if the system can get control to log the error. The most recent information about program checks is printed last in this portion of the dump.

In this case, since $TRAP was enabled, the program check that caused the trap dump to be taken would not appear because the system did not get control to log it.

Example 4: The storage map portion of the dump follows the segmentation register portion, which is not considered in this discussion. (For more information on segmentation registers, see "Segmentation Registers" on page 7-6.

The storage map portion of the dump contains information about the flags (both EDXFLAGS and SVCFLAGS). The partitions, numbered P1 through P8, P16, or P32 (depending on the number of partitions supported for your system), indicate which programs they contain and the tasks that are in that program. In the following example, the program $TRAP is loaded in partition number P1.

```
STORAGE MAP: $SYSCOM AT ADDRESS 212A

EDXFLAGS  5103      SVCFLAGS  1080

PART#  NAME       ADDR PAGES  ATASK   TCB(S)

P1       ADS= 0   0000  256
    $TRAP         7300   34  8E5A(A)  8DDA
     **FREE**     9500  107

P2       ADS= 1   0000  256
     **FREE**     8C00  116

P3       ADS= 2   0000  256
    $COMMON       0000    9  081C(A)  079C 06EC 063E 058E 04F4
                                      044E 03A2 0310
     **FREE**     0900  247

P4       ADS= 3   0000  256
     **FREE**     0000  256

P5       ADS= 4   0000  256
     **FREE**     0000  256

P6       ADS= 5   0000  256
     **FREE**     0000  256

P7       ADS= 6   0000  256
     **FREE**     0000  256

P8       ADS= 7   0000  256
     **FREE**     0000  256
```

The EDXFLAGS portion of this storage map shows the version, modification, and PTF level of the supervisor, in this case, V5.1 PTF 3. The SVCFLAGS shows that floating point hardware is present and the IPL was successful. The most important bit in the SVCFLAGS is bit 0. If it is on, it shows that SVC processing was occurring. Since this bit is off, you can conclude that SVC processing was not occurring, This section also shows that a $SYSCOM exists in the supervisor at address X'212A'. It does not, however, show how its user area was defined.

From examining this storage map, you can conclude that the program $COMMON (in partition 3) contains the task at address X'058E'. This program contains nine tasks: An attention list task at address X'081C', a main task (which is generated by the ENDPROG statement) at address X'079C', and seven secondary tasks. Since task at address X'058E' is not the first task under the TCB(S) heading, it is a secondary task. A secondary task is one defined in a program by the TASK statement.

Example 5: The next portion of the dump to examine is the EDX level table and TCB ready chain. This portion of the dump shows which task is active on which level and any ready tasks for levels 1, 2 and 3. The table also show the address space keys in which tasks reside.

```
EDX LEVEL TABLE - TCB READY CHAIN

LEVEL ACTIVE     READY (TCB-ADS)

  1    NONE       NONE
  2    058E-2     NONE
  3    NONE       NONE
```

In this example, the information provided confirms the information you gathered from the hardware registers. You can conclude that the task in address space 0 (partition 3), at address X'058E', was active on level 2. No ready tasks show for any level.

Example 6: The next portion of the dump contains loader QCB information.

```
LOADER QCB  CUR-TCB   CHAIN (TCB-ADS)
 57C4   FFFF NONE       NONE
```

In this example, the loader QCB is located at address X'57C4'. Also, the first word is X'FFFF' (or −1). This shows that the resource is not busy. Were programs being loaded this word would be X'0000'.

Example 7: The next portion of the dump, the terminal device DDB information, shows those terminals defined in the supervisor.

```
  IO DEVICE DDB INFORMATION

TERMINAL LIST:

  NAME     CCS  ID   IODA FEAT QCB  CUR-TCB    CHAIN
CDRVTA    11AE FFFF 002E 0800 FFFF NONE        NONE
CDRVTB    138A FFFF 0000 0000 FFFF NONE        NONE
$SYSLOGA  1590 040E 0004 0000 0000 058E- 2     04F4- 2
$PRINTER  17AC 020A 005A 0020 FFFF NONE        NONE
$SYSLOG   1A1E 2816 005B 0040 FFFF NONE        NONE
PRINTER1  1D00 0206 0001 0020 FFFF NONE        NONE
$SYSPRTR  1F50 2001 00C0 0020 0000 03A2- 2
```

The terminal table shows that the failing task (at address X'058E') was in control (ENQT) on $SYSLOGA. A second task at address X'04F4' in address space 0 (partition 3) has also done an ENQT on $SYSLOGA. The task at X'04F4' will only gain support of the terminal when the task (owner), at address X'058E', releases the terminal with a DEQT. This also shows that a task at address X'03A2' in address space 2 (partition 3) is enqueued on $SYSPRTR. All other terminals are free, meaning no task has enqueued them.

Example 8: The next portion of the dump contains information on disk, diskette, and tape.

The volume descriptor entry (VDE) is a control block that describes a volume. One VDE is created automatically for each DISK statement in the system definitions, and in this case they are referred to as a Device Descriptor Entry (DDE). A DDE is a special entry that describes the entire disk and points to the volume directory on the disk—the Volume Table of Contents (VTOC). A DDE is also automatically generated for each diskette. For instance, because the 4966 diskette unit can support 23 diskettes, 23 DDEs are generated for it.

A DDE and all VDEs that have the same Device Data Block (DDB) reside on the same physical disk. One VDE is generated for each performance volume coded on a DISK statement. A DDE or VDE contains information about the volume:

What the volume type is

What the volume name is

Where the volume starts and ends.

```
DISK(ETTE) OR TAPE VDE:

 VDE  NAME   DDB  FLAGS  QCB CUR-TCB    CHAIN (TCB-ADS)

 0A96 *DDE*  0B4E  0800  819E NONE       NONE
 0AC4 EDX002 0B4E  8000  819E NONE       NONE
 0AF2 ASMLIB 0B4E  8000  819E NONE       NONE
 0B20 EDX    0B4E  8000  819E NONE       NONE
 0C1A *DDE*  0C48  0800  819E NONE       NONE
 0D14 *DDE*  0D70  8000  819E NONE       NONE
 0D42 EDX003 0D70  8000  819E NONE       NONE
 03EC *DDE*  0E6A  2901  819E NONE       NONE
```

The disk DDE and VDEs show that the disk DDB at address X'0B4E' has three performance volumes (EDX002, ASMLIB, and EDX) defined, and these volumes are located at addresses X'0AC4', X'0AF2', and X'0B20'. Another VDE is allocated for that disk automatically at address X'0A96'. No performance volumes were defined on the disk whose DDB is at address X'0C48'. The disk at DDB X'0D70' has EDX003 defined as a performance volume an its VDE, which is located at address X'0D42'. The last DDB is for a diskette unit and has no performance volumes.

Example 9: The next portion of the dump contains device data block (DDB) information. The DDB describes the physical disk, diskette, or tape device.

```
DDB  IODA DEVID DSCB->  TASK DSCB-CHAIN

0B4E 0048  3116 169E- 2 0F3E NONE
0C48 0049  3116 0032- 2 0FBE NONE
0D70 0044  5152 899E- 0 103E NONE
0E64 0045  5152 5776- 0 10BE NONE
```

From this section, it can now be determined what DDB is associated with each type of disk as well as what address the disk is on. For example, the disk whose DDB is at X'0B4E' is on address (IODA) 48, and it is a model 4967. The last DSCB that accessed that disk was at address X'169E' in address space 2 (partition 3). The disk whose DDB is at address X'0C48' is on address (IODA) 49 and is also a 4967. The last DSCB to access this disk is at address X'0032' in address space 2 (partition 3). The last two DDBs are for an integrated disk and diskette type DDSK. This section shows that each DDB has a different TASK, which means that on each disk a statement TASK=YES was coded.

Example 10: The next portions of the dump contain information on various devices. For instance, a system might have one or more of the following:

- EXIO devices
- Binary synchronous communications (BSC) devices
- Local communications controller (LCC) devices.

```
EXIO DEVICE LIST

NO EXIO DEVICE SYSGENED


BSCA DEVICE LIST

NO BSCA DEVICE SYSGENED


LCC DEVICE LIST

NO LCC DEVICE SYSGENED
```

In this example, the information shows that no EXIO, binary synchronous communications, or local communications controller devices have been defined in this system. If any of these devices had been defined, the DDB address, device type, and device address would appear for each type of device.

Example 11: The next portion of the dump, native timer, contains information on timers. The information includes the type of timer attached to the system and the time and date of the dump. It also shows the address of the timer DDB and the TCB. In addition, it shows the address space in the TCB chain.

```
 NATIVE TIMER

TIMER DDB   CHAIN (TCB-ADS)          hh:mm:ss  mm/dd/yy

     4E0A   0310- 2 03A2- 2
```

This portion of the dump shows that two of the secondary tasks, one at address X'0310' and the other at address X'03A2', in the TCB chain address space have done timer instructions, and those instructions have not yet been satisfied. These are the final two tasks of the program $COMMON in partition 3. The storage map in "Example 4" on page C-5 shows that this is the same program that contains the failing secondary task at address X'058E'.

Interpreting the State of Tasks (TCBs) in the Dump

By analyzing each task in a program, what each task was doing at the time of the failure can be determined. The tasks to be analyzed are those in the program $COMMON (see the storage map in "Example 4" on page C-5).

A Task that Received a Specification Error (Program Check)

The following section shows how to determine why the failing task (at address X'058E') received a program check. The example shows the contents of the TCB in the dump. This TCB is located in partition 3 at address space X'058E'. The task at address X'058E' is in address space 02 (partition 3) executing on hardware level 2.

```
      +0   +2   +4   +6   +8   +A   +C   +E
058E  FFFF 0000 0000 4F9E 0020 88D0 0000 061A
059E  058E 05D8 0616 0001 80AC 4F9A 0000 02BE
05AE  00C8 0000 0000 0000 0000 0000 05BA 058E
05BE  0000 05BC E3C1 E2D2 F440 4040 0000 0000
05CE  3C9E 0000 0000 0000 0000 FFFF 0000 0000
05DE  1590 0000 0000 04F4 0000 0000 0000 0000
05EE  061A 0000 0000 0000 0000 0000 0000 0000
05FE  0000 0002 0000 0000 0000 0000 058E 0080
```

The level status block (LSB) in the hardware registers shows the LSB at the time of the dump, as follows:

```
IAR  AKR  LSR  R0   R1   R2   R3   R4   R5   R6   R7
3CDA 0021 88D0 0000 061A 058E 1590 0000 028D 0000 0000
```

The contents of the registers in the TCB the last time they were saved (prior to the dump) shows the following:

```
                    IAR  AKR  LSR  R0   R1
058E  FFFF 0000 0000 4F9E 0020 88D0 0000 061A

      R2   R3   R4   R5   R6   R7
059E  058E 05D8 0616 0001 80AC 4F9A 0000 02BE
```

Register	Address	Explanation
AKR	in TCB is 0020	in hardware register 0021
IAR	4F9E in P1 3CDA IN P2	EDXTIMR2 ENTRY WAITIMER 4F84 EDXTIO ENTRY RDTEXT 3C8A
R1	IN BOTH 061A	002F 028D 0000 READTEXT BUF3-1 in $EDXASM listing
R2	Self-pointer in both cases	
R3		in TCB 5D8 Timer Event Control Block (ECB), the TCB in the hardware register is the address of $SYSLOGA CCB
R5		in the hardware register, it is the address of the text statement

This information shows why the failing task received a program check. The TCB LSB shows the remnants of the STIMER instruction that preceded the READTEXT. The hardware registers on level 2 show that the task received a program check because the operand on the READTEXT was on an odd-byte boundary, causing a specification error and yielding the PSW of 8002.

A Task That is Waiting

The following section illustrates how to determine why the task at address X'079C' in address space 2 (partition 3) is waiting. The task at address X'079C' is the main task in the program $COMMON located in address space 2 (partition 3) in the storage map (see "Example 4" on page C-5).

```
      +0   +2   +4   +6   +8   +A   +C   +E
079C  FFFF 0000 0000 29E0 0020 88D0 0000 02F4
07AC  079C 0336 0002 0017 002E 29DC 0000 02BE
07BC  0096 0000 0002 0000 0000 0000 07C8 0000
07CC  0000 07CA 7EB2 E8E2 4040 4040 0000 0000
07DC  0000 0000 0000 0000 0000 FFFF 0000 0000
07EC  1590 0000 0000 06EC 0000 0000 0000 0000
07FC  0000 0000 0000 0000 0000 0000 0000 0000
080C  0000 0002 0000 0000 0000 0000 079C 0080
```

Analysis of the level status block (LSB) shows the following:

Register	Address	Explanation
AKR	0020	Shows the IAR in address space 0 (partition 1)
$TCBADS	0002	TCB offset of X'0072'
IAR	29E0	Module EDXSVCX Entry SWAIT 29B6 Entry SPOST 29E2
R1	02F4 0017 0336	WAIT EOT1 $EDXASM listing is waiting for TASK1 to end
R2	079C	Points to the TCB
R3	0336	Points to the ECB at X'0336' in address space 2, 0000 079C 0002 ECB
R5	0017	WAIT opcode
R6	002E	double the opcode
R7	29DC	Is 4 less than the IAR. Therefore, it was on a BRANCH and LINK R7 to SVC wait.
$TCBLEV	02BE	Points to Level Active and Ready Table for level 2 in module EDXSYS at entry point SVCL2.

From the information available, you can conclude that this task is waiting in TASK1's TCB at address X'0310'. The task at address X'0336' is the task end event control block ($TCBEEC) at offset X'0026' in TASK1's TCB. Therefore, when TASK1 issues an ENDTASK, this task will be posted. This task attached TASK1. TASK1's task statement is coded as follows:

```
TASK1     TASK     START1,EVENT=EOT1
```

A Task That Has Never Been Started

The following section illustrates how to identify a task that has never been started. This task is at address X'06EC' in the example. The task at address X'06EC' is one of the secondary tasks in the program $COMMON (see "Example 4" on page C-5).

```
      +0   +2   +4   +6   +8   +A   +C   +E
06EC  0000 0000 0000 0234 0000 00D0 0000 076C
06FC  06EC 0000 0000 0000 0000 0000 0000 0002
```

A TCB that has never been attached will look like the example. The TCB was located in storage at address X'06EC'. Register 1 contains the address of the first instruction to be executed, which in the task is located at address X'076C'. The IAR contains a X'0234' pointing to a BRANCH to $EXEC, which will be executed when the task is attached.

The task, when attached, will execute on level 2 at a priority of 150. The TCB LEVEL at offset X'1E' contains a binary 2 which is proof that the task is not attached. When the task is attached, the TCB LEVEL will be changed from a X'0002' to a X'02BE'. On examination, a system generation link map of partition 1 in the module EDXSYS shows an entry point SVCL2 located at address X'02BE'. This label is the level active and ready task for level 2. The TCB level will not change again until the task is detached. Then the X'02BE' will be replaced with a X'0002'.

The AKR contains X'0000'. IAR contains X'0234' which points to partition 1 in the EDX communication vector table, which is in the module EDXSYS. The module starts at fixed location X'0230'. At address X'0234' is a branch to $EXEC, which when attached will go to command setup. $TCBLEV is located at address X'001E'in the TCB containing a X'0002' which also proves the task is not attached. When this task is attached, this field will contain a X'02BE' (active and ready chain for level2), which is the entry point of SVCL2 in the supervisor. R1 contains the address of the first EDL instruction to be executed when the task is attached.

From the information, you can conclude that if the IAR save area in the TCB contains a X'0234', then the task has never been started.

A Task That Has Been Detached

The following section illustrates how to tell if a task has been detached. The task is at address X'063E' in the example. This task is a secondary task in the program $COMMON.

```
      +0   +2   +4   +6   +8   +A   +C   +E
063E  FFFF 0000 0000 297C 0020 88D0 0000 06E4
064E  063E FFFF 00A0 0016 002C 2978 0000 0002
065E  0097 044E 0002 FFFF 0000 0000 066A 063E
066E  0000 066C E2C1 E2D2 F640 4040 0002 0000
067E  4F12 0000 0000 0310 0002 FFFF 0000 0002
068E  1590 0000 0000 058E 0000 0000 0000 0000
069E  0000 0000 0000 0000 0002 0000 0000 0000
06AE  0000 0002 0000 0000 0000 0000 063E 0080
```

Register 1 contains the address of the next EDL instruction to be executed, which in the task is located at address X'06E4'. The address of the IAR points into the module EDXSVCX in the entry SDETACH; R1 is still pointing to the ENDTASK instruction. When the task is re-attached, R1 will be incremented by 4, and the system will execute a GOTO, to the entry point of the task. The task when attached will execute on level 2 at a priority of 150. The TCB level at offset X'1E' contains a binary 2, indicating that the task is not attached. R5 contains a X'0016', which is the opcode for a detach. This task must be a secondary task since a primary task issues a PROGSTOP instead of a detach.

The ENDTASK instruction generates two instructions. The first is a detach with a default code of −1, and the second is a GOTO, to the beginning of the task. Therefore, when the task is re-attached, R1 will execute the GOTO to the beginning of the task and the TCB level will again contain a X'02BE' if it is to execute on level 2.

Analysis of the register contents shows the following:

Register	Address	Explanation
AKR	0020	IAR is in address space 0 (partition 1)
IAR	297C	Points to module EDXSVCX ENTRY SDETACH 2964 next ENTRY 2986
R1	06E4	0016 FFFF 00A0 06BE ENDTASK DETACH GOTO beginning of task
$TCBLEV	0002	No longer points to the Level Active and Ready Table X'02BE'
R7	2978	Probably a BRANCH AND LINK R7

From the information, you can conclude that the detach has occurred. When the task is attached again, R1 will be incremented by 4 and will execute the GOTO, the first instruction (entry point) of the task.

The task at address X'044E' in the example is also a secondary task in the program $COMMON.

```
      +0   +2   +4   +6   +8   +A   +C   +E
044E  FFFF 0001 0000 0D50 0021 80D0 0001 04D4
045E  044E 0032 0C48 0D28 0002 0D4C 0000 02BE
046E  00C0 0000 0002 0000 0000 0000 047A 0032
047E  0000 047C 8020 E2D2 F340 4040 0000 0000
048E  0000 0000 0000 0000 0000 FFFF 0000 0000
049E  1590 0000 0000 03A2 0000 0000 0000 0000
04AE  0000 0000 0000 0000 0000 0000 0000 0000
04BE  0000 0002 0000 0000 0000 0000 044E 0080
```

Analysis of the register contents shows the following:

Register	Address	Explanation
AKR	0021	IAR in partition 2
IAR	0D50	in DISKIO in partition 2 entry DSKXRET1 0D28 next entry DSKXRET3 0D74
R1	04D4	8020 018C 0001 0001 020C 0032 $EDXASM listing READ READ DS1,BUF2,1,1
R3	0032	Points to the DSCB used by the READ. The first 3 words of the DSCB are 0000 044E 0002; There is a wait for IO to complete.
R4	0C48	Disk Device Block (DDB)

Register	Address	Explanation
R6	0002	User address space key
R7	0D4C	BRANCH AND LINK R7

From this information, you can conclude that this task has issued a disk read and the IO has not completed.

The task at address X'04F4' in the example is another secondary task in he program $COMMON.

```
      +0   +2   +4   +6   +8   +A   +C   +E
04F4  FFFF 0000 0000 4FF8 0021 80D0 057A 057A
0504  04F4 1590 0000 0000 0002 4FF4 1666 02BE
0514  00C5 0000 0002 0000 0000 0000 0520 04F4
0524  0000 0522 E3C1 E2D2 F440 4040 0002 8002
0534  4DE2 0000 0000 0000 0000 FFFF 0000 0000
0544  1590 0000 0000 044E 0000 0000 0000 0000
0554  0000 0000 0000 0000 0000 0000 5050 0000
0564  0000 0000 0000 0000 0000 0000 04F4 0080
```

Analysis of the register contents shows the following:

Register	Address	Explanation
AKR	0021	IAR is in address space 1 (partition 2)
IAR	4FF8	Points to EDXTERMQ ENTRY QUTERM 4F6C ENTRY DQTERM 501E
R1	057A	Points to 8025 $EDXASM listing ENQT
R3	1590	Points to the $SYSLOGA CCB in address space 0 in the formatted control dump in the terminal list (see "Example 7" on page C-7): $SYSLOGA 1590 040E 0004 0000 0000 058E- 2 04F4- 2 $CCBQCB is at location 15EA OFFSET X'005A' in the CCB 0000 04F4 0002 058E 0002

From this information, you can conclude that this task is on the waiting queue for $SYSLOGA. When the task at address X'058E' −2 dequeues the $SYSLOGA terminal, this task will execute.

The task at address X'081C' in the example is the ATTENTION LIST task for the program $COMMON (see "Example 4" on page C-5).

```
      +0   +2   +4   +6   +8   +A   +C   +E
081C  FFFF 0000 0000 425C 0021 80D0 0002 0086
082C  081C 1590 FB00 001D 003A 4258 0000 0001
083C  000A 0000 0000 FFFF 0000 0000 0848 081C
084C  1590 084A 5BC1 E3E3 C1E2 D240 0002 8002
085C  4256 0000 0000 0000 0000 FFFF 0000 0000
086C  1590 0000 0000 079C 0000 0000 0000 0000
087C  0000 0000 0000 0000 0000 0000 5050 0000
088C  0000 0002 0000 0000 0000 0000 081C 0080
```

Analysis of the register contents shows the following:

Register	Address	Explanation
AKR	0021	IAR is in address space 1 (partition 2)
IAR	425C	is in EDXTIO Entry ENDATTN 423E Entry #TERMOUT 4258
R1	0086	Points to 001D $EDXASM listing ENDATTN
R3	1590	$SYSLOGA CCB
R5	001D	ENDATTN opcode
R6	003A	Double the opcode
$TCBLEV	0001	X'001E' is in the TCB ATTENTION LIST task run on level 1
$TCBPRI	000A	Offset X'0020' task priority of 10

From this information, you can conclude that this task executed the ENDATTN instruction. Since $TCBLEV is X'0001', the task has been detached.

Appendix D. Conversion Table

This appendix contains a conversion table for the hexadecimal, binary, EBCDIC, and ASCII equivalents of decimal values. The table also contains transmission codes for communications devices.

Conversion Table

Decimal	Hex	Binary	EBCDIC	ASCII (see Notes 1 and 3)	EBASC* (see Notes 2 and 3)	EBCD	CRSP
0	00	0000 0000	NUL	NUL	NUL		
1	01	0001	SOH	SOH	NUL	space	space
2	02	0010	STX	STX	@	1	1,]
3	03	0011	ETX	ETX	@		
4	04	0100	PF	EOT	space	2	2
5	05	0101	HT	ENQ	space		
6	06	0110	LC	ACK	'		
7	07	0111	DEL	BEL	'	3	
8	08	1000		BS	DLE	4	5
9	09	1001	RLF	HT	DLE		
10	0A	1010	SMM	LF	P		
11	0B	1011	VT	VT	P	5	7
12	0C	1100	FF	FF	0		
13	0D	1101	CR	CR	0	6	6
14	0E	1110	SO	SO	p	7	8
15	0F	1111	SI	SI	p		
16	10	0001 0000	DLE	DLE	BS	8	4
17	11	0001	DC1	DC1	BS		
18	12	0010	DC2	DC2	H		
19	13	0011	TM	DC3	H	9	0
20	14	0100	RES	DC4	(		
21	15	0101	NL	NAK	(	0	Z
22	16	0110	BS	SYN	h	Ⓓ (EOA)	Ⓓ (EOA),9
23	17	0111	IL	ETB	h		
24	18	1000	CAN	CAN	CAN		
25	19	1001	EM	EM	CAN		
26	1A	1010	CC	SUB	X	RS	RS
27	1B	1011	CU1	ESC	X		
28	1C	1100	IFS	FS	8	upper case	upper case
29	ID	1101	IGS	GS	8		⩞
30	1E	1110	IRS	RS	x		
31	1F	1111	IUS	US	x	Ⓒ (EOT)	Ⓒ (EOT)
32	20	0010 0000	DS	space	EOT	@	t
33	21	0001	SOS	!	EOT		
34	22	0010	FS	"	D		
35	23	0011		#	D	/	x
36	24	0100	BYP	$	$		
37	25	0101	LF	%	$	s	n
38	26	0110	ETB	&	d	t	u
39	27	0111	ESC	'	d		
40	28	1000		(	DC4		
41	29	1001		)	DC4	u	e
42	2A	1010	SM	*	T	v	d
43	2B	1011	CU2	+	T		
44	2C	1100		,	4	w	k
45	2D	1101	ENQ	-	4		
46	2E	1110	ACK	.	t		
47	2F	1111	BEL	/	t	x	c
48	30	0011 0000		0	form feed		
49	31	0001		1	form feed	y	l
50	32	0010	SYN	2	L	z	h

*The no-parity TWX code for any given character is the code that has the rightmost bit position off.

Decimal	Hex	Binary	EBCDIC	ASCII (see Notes 1 and 3)	EBASC* (see Notes 2 and 3)	EBCD	CRSP
51	33	0011		3	L		
52	34	0100	PN	4	,		
53	35	0101	RS	5	,		
54	36	0110	UC	6	1	SOA	
55	37	0011 0111	EOT	7	1	Ⓢ (SOA),comma	b
56	38	1000		8	FS		
57	39	1001		9	FS		
58	3A	1010		:	\		
59	3B	1011	CU3	;	\	index	index
60	3C	1100	DC4	<	<		
61	3D	1101	NAK	=	<	Ⓑ (EOB)	
62	3E	1110		>	|		
63	3F	1111	SUB	?	|		
64	40	0100 0000	space	@	STX	Ⓝ (NAK),-	!
65	41	0001		A	STX		
66	42	0010		B	B		
67	43	0011		C	B	i	m
68	44	0100		D	″		
69	45	0101		E	″	k	
70	46	0110		F	b	l	v
71	47	0111		G	b		
72	48	1000		H	DC2		
73	49	1001		I	DC2	m	'
74	4A	1010	¢	J	R	n	r
75	4B	1011	.	K	R		
76	4C	1100	<	L	2	o	i
77	4D	1101	(	M	2		
78	4E	1110	+	N	r		
79	4F	1111	]	O	r	p	a
80	50	0101 0000	&	P	line feed		
81	51	0001		Q	line feed	q	o
82	52	0010		R	J	r	s
83	53	0011		S	J		
84	54	0100		T	*		
85	55	0101		U	*		
86	56	0110		V	j		
87	57	0111		W	j	$	w
88	58	1000		X	SUB		
89	59	1001		Y	SUB		
90	5A	1010	!	Z	Z		
91	5B	1011	$	[	Z	CRLF	CRLF
92	5C	1100	*	\	:		
93	5D	1101	)	]	:	backspace	backspace
94	5E	1110	;	∧	z	idle	idle
95	5F	1111	¬	—	z		
96	60	0110 0000	-	`	ACK		
97	61	0001	/	a	ACK	&	j
98	62	0010		b	F	a	g
99	63	0011		c	F		
100	64	0100		d	&	b	
101	65	0101		e	&		
102	66	0110		f	f		
103	67	0111		g	f	c	f

Conversion Table

Decimal	Hex	Binary	EBCDIC	ASCII (see Notes 1 and 3)	EBASC* (see Notes 2 and 3)	EBCD	CRSP
104	68	1000		h	SYN	d	p
105	69	1001		i	SYN		
106	6A	1010	¦	j	V		
107	6B	1011	,	k	V	e	
108	6C	1100	%	1	6		
109	6D	1101		m	6	f	q
110	6E	1110	>	n	v	g	comma
111	6F	1111	?	o	v		
112	70	0111 0000		p	shift out	h	/
113	71	0001		q	shift out		
114	72	0010		r	N		
115	73	0011		s	N	i	y
116	74	0100		t	.		
117	75	0101		u	.		
118	76	0110		v	n	Ⓨ (YAK),period	
119	77	0111		w	n		
120	78	1000		x	RS		
121	79	1001		y	RS		
122	7A	1010	:	z	∧	horiz tab	tab
123	7B	1011	#	{	∧		
124	7C	1100	@	¦	>	lower case	lower case
125	7D	1101	'	}	>		
126	7E	1110	=	~	∿		
127	7F	1111	"	DEL	∿	delete	
128	80	1000 0000		NUL	SOH		
129	81	0001	a	SOH	SOH	space	space
130	82	0010	b	STX	A	=	±,[
131	83	0011	c	ETX	A		
132	84	0100	d	EOT	!	<	@
133	85	0101	e	ENQ	!		
134	86	0110	f	ACK	a		
135	87	0111	g	BEL	a	;	#
136	88	1000	h	BS	DC1	:	%
137	89	1001	i	HT	DC1		
138	8A	1010		LF	Q		
139	8B	1011		VT	Q	%	&
140	8C	1100		FF	1		
141	8D	1101		CR	1	'	¢
142	8E	1110		SO	q	>	*
143	8F	1111		SI	q		
144	90	1001 0000		DLE	horiz tab	*	$
145	91	0001	j	DC1	horiz tab		
146	92	0010	k	DC2	l		
147	93	0011	l	DC3	l	(	)
148	94	0100	m	DC4	)		
149	95	0101	n	NAK	)	)	Z
150	96	0110	o	SYN	i	D (EOA),"	(
151	97	0111	p	ETB	i		
152	98	1000	q	CAN	EM		
153	99	1001	r	EM	EM		
154	9A	1010		SUB	Y		
155	9B	1011		ESC	Y		
156	9C	1100		FS	9	upper case	upper case

Decimal	Hex	Binary	EBCDIC	ASCII (see Notes 1 and 3)	EBASC* (see Notes 2 and 3)	EBCD	CRSP
157	9D	1101		GS	9		
158	9E	1110		RS	y		
159	9F	1111		US	y	C (EOT)	C (EOT)
160	A0	1010 0000		Space	ENQ	¢	T
161	A1	0001		!	ENQ		
162	A2	0010	s	"	E		
163	A3	0011	t	#	E	?	X
164	A4	0100	u	$	%		
165	A5	0101	v	%	%	S	N
166	A6	1010 0110	w	&	e	T	U
167	A7	0111	x	'	e		
168	A8	1000	y	(	NAK		
169	A9	1001	z	)	NAK	U	E
170	AA	1010		*	U	V	D
171	AB	1011		+	U		
172	AC	1100		,	5	W	K
173	AD	1101		-	5		
174	AE	1110		.	u		
175	AF	1111		/	u	X	C
176	B0	1011 0000		0	return		
177	B1	0001		1	return	Y	L
178	B2	0010		2	M	Z	H
179	B3	0011		3	M		
180	B4	0100		4	-		
181	B5	0101		5	-		
182	B6	0110		6	m		
183	B7	0111		7	m	Ⓢ (SOA),|	B
184	B8	1000		8	GS		
185	B9	1001		9	GS		
186	BA	1010		:	]		
187	BB	1011		;	]	index	index
188	BC	1100		<	=		
189	BD	1101		=	=	Ⓑ(EOB),ETB	
190	BE	1110		>	}		
191	BF	1111		?	}		
192	C0	1100 0000	}	@	ETX	Ⓝ (NAK),–	
193	C1	0001	A	A	ETX		
194	C2	0010	B	B	C		
195	C3	0011	C	C	C	J	M
196	C4	0100	D	D	#		
197	C5	0101	E	E	#	K	
198	C6	0 0110	F	F	c	L	V
199	C7	0111	G	G	c		
200	C8	1000	H	H	DC3		
201	C9	1001	I	I	DC3	M	"
202	CA	1010		J	S	N	R
203	CB	1011		K	S		
204	CC	1100	⑀	L	3	O	I
205	CD	1101		M	3		
206	CE	1110	⑂	N	s		
207	CF	1111		O	s	P	A
208	D0	1101 0000	}	P	vertical tab		
209	D1	0001	J	Q	vertical tab	Q	O

Conversion Table

Decimal	Hex	Binary	EBCDIC	ASCII (see Notes 1 and 3)	EBASC* (see Notes 2 and 3)	EBCD	CRSP
210	D2	0010	K	R	K	R	S
211	D3	0011	L	S	K		
212	D4	0100	M	T	+		
213	D5	0101	N	U	+		
214	D6	0110	O	V	k		
215	D7	0111	P	W	k	!	W
216	D8	1000	Q	X	ESC		
217	D9	1001	R	Y	ESC		
218	DA	1010		Z	[		
219	DB	1011		[	[	CRLF	CRLF
220	DC	1100		\	;		
221	DD	1101		]	;	backspace	backspace
222	DE	1110		∧	{	idle	idle
223	DF	1111		—	{		
224	E0	1110 0000	\	`	bell		
225	E1	0001		a	bell	+	J
226	E2	0010	S	b	G	A	G
227	E3	0011	T	c	G		
228	E4	0100	U	d	'	B	+
229	E5	0101	V	e	'		
230	E6	0110	W	f	g		
231	E7	0111	X	g	g	C	F
232	E8	1000	Y	h	ETB	D	P
233	E9	1001	Z	i	ETB		
234	EA	1010		j	W		
235	EB	1011		k	W	E	
236	EC	1100	⑂	l	7		
237	ED	1101		m	7	F	Q
238	EE	1110		n	w	G	comma
239	EF	1111		o	w		
240	F0	1111 0000	0	p	shift in	H	?
241	F1	0001	1	q	shift in		
242	F2	0010	2	r	O		
243	F3	0011	3	s	O	I	Y
244	F4	0100	4	t	/		
245	F5	0101	5	u	/		
246	F6	0110	6	v	o	Ⓨ (YAK), ¬	
247	F7	0111	7	w	o		
248	F8	1000	8	x	US		
249	F9	1001	9	y	US		
250	FA	1010	LVM	z	—	horiz tab	tab
251	FB	1011		{	—		
252	FC	1100		|	?	lower case	lower case
253	FD	1101		}	?		
254	FE	1110		~	DEL		
255	FF	1111		DEL	DEL	delete	

Notes:

1. ASCII terminals attached via #1310, #7850, #2095 with #2096, or #2095 with RPQ D02350.
2. ASCII terminals attached via #1610 or #2091 with #2092.
3. There are two entries for each character, depending on whether the parity is odd or even.

Index

Special Characters

$SEDXIT task error exit routine
  interpreting the output 6-8
  message description 6-8
  output example 6-7
$D - dump storage
  use to identify looping program 4-3
$DEBUG utility
  analyzing program checks 6-12, 6-15
  analyzing wait state 5-1
  examine unmapped storage 4-14, 6-15
  isolating run loops 4-8
  list
    storage area 4-13
    unmapped storage 6-17
  modify data in unmapped storage 4-18, 6-19
  set
    breakpoints 4-10, 6-18
    trace ranges 4-10
$DISKUT2 utility
  list
    log data set 9-6
$EDXNUC supervisor data set
  analyzing problems with 3-3
  reloading 3-2
  rewriting IPL text 3-2
$LOG utility
  commands 9-3
  controlling 9-2
  description 9-1
  display errors 9-5
  end 9-3
  end if data set is full 9-3
  load from a terminal 9-2
  loaded during IPL 9-1
  log data set
    change default data set size 9-3
    clear 9-3
    when the system loads $LOG 9-1
  print errors 9-5
  record I/O errors 9-1
  record program check messages 9-1
  restart 9-3
  sample output, explanation 9-8
  suspend 9-3
  use with remote manager (RM1) 9-2
$TRAP utility
  interpreting the dump 7-1, C-10
$VIRLOG
  storing program check messages
    in a disk data set 2-1
    in a log data set 2-1
    on a $SYSLOG terminal 2-1
    with Communications Facility log 2-1

A

activate
  error logging from a terminal 9-2
address key register (AKR) 3-8, 7-3
address, failing instruction 6-3, 7-3
AKR C-3
  See also address key register (AKR)
analyze failures, how to
  IPL problems 3-1
  program checks 6-1, 7-30
  run loops 4-1, 7-34
  wait states 5-1, 7-24
ANSWER program, use for remote support B-2
application program check
  analyzing 6-11
  logging occurrences 9-1
auto IPL, description 6-7

B

bit settings
  level status register 3-8, 6-3, 7-3
  processor status word 6-4
  programmer console A-2
  SVCFLAGS 7-10
bootstrap, rewriting 3-2
boundary
  violations 6-5, 6-11
breakpoint and trace range
  settings 4-10, 6-12

C

cancel
  ERAP command 9-5
CCB
  See terminal control block (CCB)
CIRCBUFF, software trace table 8-1
class interrupt descriptions 6-5
codes
  obtaining stop code for IPL error 3-3
  obtaining stop code for run loop 4-1
communications features
  used with remote support link B-2
console, programmer
  displaying main storage A-4
  displaying registers A-6
  instruction step A-8
  reading indicator lights A-2
  stop on address A-7
  stop on error A-7
  storing data into main storage A-5
  storing data into registers A-6

control blocks
analyzing queue control block 5-2
INITTASK task control block 3-6
cross-partition supervisor
obtaining IPL stop codes 3-3
segmentation registers 7-6

D

Device Data Block (DDB) C-8
Device Descriptor Entry (DDE) C-8
diagnostic mode, putting processor into 4-1
display
an error log 9-5
program check messages
in a disk data set 2-1
in a log data set 2-1
on a $SYSLOG terminal 2-1
with Communications Facility log 2-1
registers A-6
software trace table 8-1
storage
on the programmer console A-4
dump, interpreting a storage
BSC information 7-16
disk/diskette information 7-13
exception information 7-5
EXIO information 7-16
floating-point registers 7-5
hardware level and registers 7-2
level table 7-12
loader QCB 7-12
partition contents 7-17
segmentation registers 7-6
storage map 7-10
tape information 7-13
TCB ready chain 7-12
terminal information 7-13
timer information 7-16
unmapped storage contents 7-18

E

EDX level table, example C-7
EDXALU C-1
EDXFLAGS, example C-6
EDXLOGDS, default log data set
change size of 9-3
clear 9-3
description of 9-1
ENQT instruction
examining the terminal control block 5-6
identifying the task in control 5-6
entry point C-1
ERAP - print log data set
cancelling 9-5
interpreting sample output 9-8
procedure 9-5
error handling
error logging 9-1
program checks 6-1
remote manager (RM1) considerations 9-2, 9-6
error log data set
change default data set size 9-3
clear 9-3
contents 9-8
when the system loads $LOG 9-1
error logging facility
See $LOG utility
errors
determining the type 2-1
IBM assistance in diagnosing B-1
recording I/O 9-1
recording program check 9-1
event control block
causes of a wait state 5-8
waiting task, identifying 5-7
exception interrupt
how to trace 8-1
types of 6-4
Extended Address Mode support
segmentation registers 7-7

F

floating-point
exception, description 6-6
registers 7-5
formatted control blocks in a dump, interpreting C-2

H

hardware
registers
contents during program check 6-2
INITTASK task control block 3-8
software trace table 8-4
storage dump 7-2

I

I/O check, description 6-7
I/O error logging
controlling 9-2
display errors 9-5
for remote manager (RM1) 9-2
interpreting sample output 9-8
log data set
change default data set size 9-3
clear 9-3
when the system loads $LOG 9-1
print errors 9-5
utility, $LOG 9-1
I/O segmentation registers
in storage dump 7-8
IBM support center, communication with B-1

initialization modules
  in storage during IPL failure, find 3-4
INITTASK, analyzing at IPL
  interpreting register contents 3-8
  using $D operator command 3-6
  using programmer console 3-7
instruction address register (IAR)
  description 7-4
  displaying 6-22, A-6
instruction address, failing 6-3, 7-3
instruction step (console) A-8
interpreting a dump (example) C-1
interrupt
  class 6-5
invalid function, description 6-6
invalid storage address, description 6-5
IPL problems
  detecting stop codes 3-3
  disk/diskette device 3-1
  find initialization module in use during 3-4
  initialization failures
    displaying INITTASK 3-6, 3-7
    no messages on $SYSLOG 3-10
    register contents 3-8
  isolating terminal control blocks 3-5
  reloading supervisor 3-2
  rewriting IPL text 3-2
  tailored supervisor 3-3
  terminal errors 3-3
  what to check first 3-1

L

level status block (LSB)
  analyzing an IPL problem 3-8
  interpreting a program check message 6-2
  interpreting a storage dump 7-2
  layout in TCB C-1
  software trace table 8-4
level status register (LSR) 7-3
levels in EDX, specific functions of C-2
link, remote support B-1
load light, symptom at IPL 3-1
loader QCB, example C-7
log data set
  change default data set size 9-3
  clear 9-3
  contents 9-8
  default, EDXLOGDS 9-1
  list on printer 9-5
  list on terminal 9-5
logging errors ($LOG) 9-1
loops, analyzing run
  caused by device interrupts 4-20
  caused by stack overflow 4-20
  how to identify the program
    using $D operator command 4-3
    using the programmer console 4-5

loops, analyzing run *(continued)*
  locating the loop in the compiler listing 4-12
  obtain stop code 4-1
  some common causes 4-11
  using $DEBUG
    examining storage locations 4-13
    examining unmapped storage 4-14
    sample trace output 4-10
    setting breakpoints 4-16
    tracing the loop addresses 4-9
LSB (level status block)
  analyzing an IPL problem 3-8
  interpreting a program check message 6-2
  interpreting a storage dump 7-2
  software trace table 8-4

M

machine/program check log buffer C-5
main storage
  displaying A-4
  storing data into A-5
mapped storage
  segmentation register use 7-6
messages, interpreting exception
  $$EDXIT program check 6-7
  application program check 6-2
  system program check 6-2
Mode switch setting C-5
module descriptions
  NOLOGLD 9-1

N

NEXTERM, stop on address 3-5
NOLOGLD module, affect on error logging 9-1
nucleus, reloading 3-2

O

odd-byte boundary, analyzing 6-11
operator commands
  ERAP - print log data set 9-5

P

partition
  size, finding 7-6
partitions 17 to 32 C-4
patch
  data in unmapped storage 4-18, 6-19
performance volumes C-8
power/thermal warning, description 6-7
print
  an error log 9-5
privilege violate, description 6-6
problem determination
  definition 1-1
  how to start 1-1

problem determination *(continued)*
  IBM support center assistance B-1
  identifying problem type 2-1
  reading a dump 7-1, C-1
  using $VIRLOG 2-1
  using a remote support link B-1
processor control check, description 6-7
processor status word (PSW)
  bit descriptions 6-5
    auto IPL indicator 6-7
    Extended Address Mode 6-6
    floating-point exception 6-6
    I/O check 6-7
    invalid function 6-6
    invalid storage address 6-5
    power/thermal warning 6-7
    privilege violate 6-6
    processor control check 6-7
    protect check 6-6
    sequence indicator check 6-7
    specification check 6-5
    stack exception 6-6
    storage parity 6-7
    translator enabled indicator 6-7
  converting to bits 6-4
  how to interpret 6-4
program check
  analyzing 6-1
  analyzing system 6-21
  bit settings, interpreting PSW 6-4
  displaying log records of 9-5
  examine unmapped storage for cause of 6-15
  exception types 6-4
  failing instruction 6-3
  how to analyze application 6-11
  locating failing instruction 7-3
  logging occurrences 9-1
  message description 6-2
  message types
    $$EDXIT error exit 6-7
    application check 6-2
    system check 6-2
  printing log records of 9-5
  processor status word, analysis 6-4
  program check, determining a C-10
  register contents at failure 6-3, 7-3
  storing
    in disk data set 2-1
    on a $SYSLOG terminal 2-1
    with $VIRLOG 2-1
    with Communications Facility log 2-1
  using $DEBUG to analyze 6-13
programmer console
  displaying main storage A-4
  displaying registers A-6
  instruction step A-8
  reading indicator lights A-2
  stop on address A-7
programmer console *(continued)*
  stop on error A-7
  storing data into main storage A-5
  storing data into registers A-6
  use to identify a looping program 4-5
  use to identify IPL failure 3-7
protect check, description 6-6
PSW (processor status word)
  bit descriptions 6-5
    auto IPL indicator 6-7
    Extended Address Mode 6-6
    floating-point exception 6-6
    I/O check 6-7
    invalid function 6-6
    invalid storage address 6-5
    power/thermal warning 6-7
    privilege violate 6-6
    processor control check 6-7
    protect check 6-6
    sequence indicator check 6-7
    specification check 6-5
    stack exception 6-6
    storage parity 6-7
    translator enabled indicator 6-7
  converting to bits 6-4
  interpreting 6-4

Q

queue control block
  analyzing
    causes of wait state 5-5
    defined in $SYSCOM 5-4
    defined in program 5-3
    task ownership 5-4

R

recording
  I/O errors 9-1
  program checks 9-1
registers
  contents
    in a storage dump 7-3
    program check 6-3
  displaying A-6
  floating-point 7-5
  INITTASK during IPL failure 3-8
  level status block 7-2
  segmentation 7-6
  shown in software trace table 8-4
  storing data into A-6
Remote Support Link
  authorizing the link B-2
  customer responsibilities B-1
  description B-1
  disconnecting the line B-4
  hardware requirements B-2

run loops, analyzing
caused by device interrupts 4-20
caused by stack overflow 4-20
how to identify the program
using $D operator command 4-3
using the programmer console 4-5
locating the loop in the compiler listing 4-12
obtain stop code 4-1
some common causes 4-11
using $DEBUG
examining storage locations 4-13
examining unmapped storage 4-14
sample trace output 4-10
setting breakpoints 4-16
tracing the loop addresses 4-9
run loops, stack overflow 4-20

S

segmentation registers
mapping of 7-6
sequence indicator error, description 6-7
set
breakpoints and trace ranges 4-10, 6-12
software trace table
control table format 8-3
displaying 8-1
exception entry format 8-4
specification check, description 6-5
stack exception, description 6-6
stand-alone dump
BSC information 7-16
disk/diskette information 7-13
EXIO information 7-16
floating-point registers 7-5
hardware level and registers 7-2
interpreting 7-1, C-10
level table 7-12
loader QCB 7-12
partition contents 7-17
segmentation registers 7-6
storage map 7-10
tape information 7-13
TCB ready chain 7-12
terminal information 7-13
timer information 7-16
unmapped storage contents 7-18
standard program check message, formats 6-2
stop
on error A-7
stop codes
obtaining for IPL failure 3-3
obtaining for run loop error 4-1
storage
displaying
on programmer console A-4
locate unmapped 7-18
mapping 7-6
storage *(continued)*
parity error 6-7
storage dump
how to interpret 7-1, C-1
use to
analyze a program check 7-30
analyze a run loop 7-34
analyze a wait state 7-24
storage map, example C-6
storage map, IPL
find last usable address in partition 6-17
supervisor
IPL problems with 3-3
reloading 3-2
SVCFLAGS, example C-6
SVCI buffer C-5
SVCI interrupt table C-5
SYSPARMS C-5
system
program check, analyzing 6-21
program check, logging 9-1
system definitions ($EDXDEF)
Word 0 C-5
Word 1 C-5
Word 2 C-5
Word 3 C-5
system unit

T

task control block (TCB) C-1
INITTASK during IPL 3-6
ready chain in dump 7-12
task error exit routine
interpreting output of $$EDXIT 6-7
TCB C-1
TCB ready chain C-7
terminal
errors at IPL 3-3
information in dump 7-13
used for remote support B-3
terminal control block (CCB)
CCB generation C-1
displaying during IPL 3-5
enqueuing task, determining 5-6
task partition, determining 5-6
trace
exceptions 8-1
loop addresses 4-9
program check addresses 6-12
trace table, CIRCBUFF software
control table format 8-3
displaying 8-1
exception entry format 8-4
translator enabled, description 6-7
types of problems, determining 2-1

U

unmapped storage
  data in storage dump 7-18
  examine using $DEBUG 4-14, 6-15
  find areas in use 7-19
  modify data in 4-18, 6-19

V

volume descriptor entry (VDE) C-8
Volume Table of Contents (VTOC). C-8

W

WAIT instruction
wait state
  analyzing
    ENQ instruction 5-2
    ENQT instruction 5-6
    finding the waiting instruction 5-1
    some common causes 5-5, 5-8
    using $DEBUG 5-1
    WAIT instruction 5-7
  cause of 5-7
  sample program 7-28
  using a dump to analyze
    finding the TCB address 7-24
    locating R1 in the TCB 7-26
    locating the error in the compiler listing 7-27
    multiple tasks active 7-26

IBM Series/1 Event Driven Executive

Publications Order Form

Instructions:

1. Complete the order form, supplying all of the requested information. (Please print or type.)
2. If you are placing the order by phone, dial **1-800-IBM-2468.**
3. If you are mailing your order, fold the postage-paid order form as indicated, seal with tape, and mail.

Ship to:

Name: ____________________

____

Address: ____________________

____

City: ____________________

State: __________ Zip: __________

Bill to:

Customer number: ____________________

Name: ____________________

____

Address: ____________________

____

City: ____________________

State: __________ Zip: __________

Your Purchase Order No.: ____________________

Phone: (   ) ____________________

Signature: ____________________

Date: ____________________

Order:

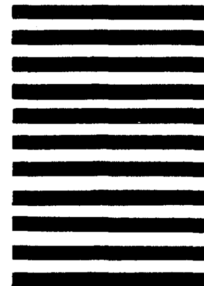
Description:	Order number	Qty.
Basic Books:		
Set of the following eight books. (For individual copies, order by book number.)	SBOF-0255	____
Advanced Program-to-Program Communication Programming Guide and Reference	SC34-0960	____
Communications Guide	SC34-0935	____
Installation and System Generation Guide	SC34-0936	____
Language Reference	SC34-0937	____
Library Guide and Common Index	SC34-0938	____
Messages and Codes	SC34-0939	____
Operator Commands and Utilities Reference	SC34-0940	____
Problem Determination Guide	SC34-0941	____
Additional books and reference aids:		
Set of the following three books and reference aids. (For individual copies, order by number.)	SBOF-0254	____
Customization Guide	SC34-0942	____
Event Driven Executive Language Programming Guide	SC34-0943	____
Operation Guide	SC34-0944	____
Language Reference Summary	SX34-0199	____
Operator Commands and Utilities Reference Summary	SX34-0198	____
Conversion Charts Card	SX34-0163	____
Reference Aids Storage Envelope	SX34-0141	____
Set of three reference aids with storage envelope. (One set is included with order number **SBOF-0254**.)	SBOF-0253	____
Binders:		
Easel binder with 1 inch rings	SR30-0324	____
Easel binder with 2 inch rings	SR30-0327	____
Standard binder with 1 inch rings	SR30-0329	____
Standard binder with 1 1/2 inch rings	SR30-0330	____
Standard binder with 2 inch rings	SR30-0331	____
Diskette binder (Holds eight 8-inch diskettes.)	SB30-0479	____

Publications Order Form

Cut or Fold Along Line

Fold and tape | Please Do Not Staple | Fold and tape

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES



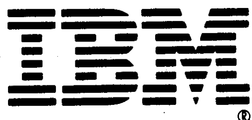
BUSINESS REPLY MAIL

FIRST CLASS PERMIT NO. 40 ARMONK, N.Y.

POSTAGE WILL BE PAID BY ADDRESSEE:

IBM Corporation
1 Culver Road
Dayton, New Jersey 08810

Fold and tape | Please Do Not Staple | Fold and tape



IBM Series/1 Event Driven Executive
Problem Determination Guide

Order No. SC34-0941-0

READER'S COMMENT FORM

This manual is part of a library that serves as a reference source for systems analysts, programmers, and operators of IBM systems. You may use this form to communicate your comments about this publication, its organization, or subject matter, with the understanding that IBM may use or distribute whatever information you supply in any way it believes appropriate without incurring any obligation to you. Your comments will be sent to the author's department for whatever review and action, if any, are deemed appropriate.

Note: *Copies of IBM publications are not stocked at the location to which this form is addressed. Please direct any requests for copies of publications, or for assistance in using your IBM system, to your IBM representative or to the IBM branch office serving your locality.*

Note: Staples can cause problems with automated mail sorting equipment.
Please use pressure sensitive or other gummed tape to seal this form.

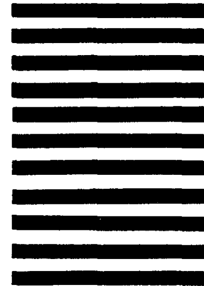
Thank you for your cooperation. No postage stamp necessary if mailed in the U.S.A. (Elsewhere, an IBM office or representative will be happy to forward your comments or you may mail directly to the address in the Edition Notice on the back of the title page.)

SC34-0941-0
Printed in U.S.A.

Reader's Comment Form

Fold and tape   Please Do Not Staple   Fold and tape

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES



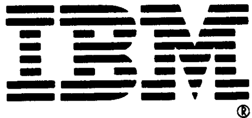
BUSINESS REPLY MAIL

FIRST CLASS   PERMIT NO. 40   ARMONK, N.Y.

POSTAGE WILL BE PAID BY ADDRESSEE:

International Business Machines Corporation
Information Development, Department 28B
5414 (Internal Zip)
P.O. Box 1328
Boca Raton, Florida 33429-9960

Fold and tape   Please Do Not Staple   Fold and tape



—Cut or Fold Along Line—

Program Number
5719-XS6

File Number
S1-37

SC34-0941-0

Printed in U.S.A.