CA IDMS™ Online

Online Debugger Guide

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CA Technologies Product References

This document seeences the following CA product:

- CA IDMS®/DC Transaction Server Option
- CA IDMS® Database Universal Communications Facility Option
- CA ADS® for CA IDMS®

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Chapter 1: Introduction

This manual provides detailed instructions for users debugging programs that operate in a CA IDMS /DC Transaction Server or CA IDMS Database Universal Communications Facility (UCF) Option (DC/UCF) environment.

This section contains the following topics:

About the Debugger (see page 9)
Debugger Features (see page 10)
Debugging Process (see page 12)
Session Considerations (see page 19)

About the Debugger

What You Can Debug

The CA IDMS online debugger is an interactive facility used to detect, trace, and resolve programming errors in programs that run under the control of DC/UCF. The debugger can be used with these load modules:

- Assembler, COBOL, and PL/I programs
- CA ADS
- Subschemas
- Maps
- Tables

For more information on using the debugger with Assembler, COBOL, and PL/I programs, see Aids for Debugging Assembler, COBOL, and PL/I Programs.

How You Use the Debugger

You use the online debugger to:

- Receive control when an abend occurs

  The online debugger receives control when your program abends (for example, with a data exception). You can then determine the abending instruction and examine program variable storage to determine the error.

- Receive control at predetermined breakpoints

  To trap logic errors, set breakpoints that halt program execution at a specified line number. The online debugger receives control when your program reaches that line number, so that you can examine program variable storage.

Chapter Contents

This introductory chapter discusses:

- Debugger features
- Debugging in prompt or menu mode
- Setup and runtime phases of a debugger session
- Factors to consider when establishing a debugger session

Debugger Features

High Level of Control

The online debugger allows you to maintain a high level of control over the debugging process. With the debugger, you can:

- Set breakpoints
- Display the contents of registers and storage
- Modify storage values
- Snap tasks and storage areas to the log
- Trap abends in the module being debugged

Each of these functions is discussed below.

Setting Breakpoints

Breakpoints are temporary program interruptions that you can set at any address within a program or dialog that complies with debugger validation rules, as described in "Valid Breakpoints" later in this chapter.

At runtime, the debugger takes control at these breakpoints, and program execution is temporarily suspended. While execution is suspended, you can perform a variety of activities before returning control to the DC/UCF system or resuming execution of the program.

Displaying and Modifying Storage Values

You can examine storage values in any area, assuming that you have the security necessary to access the area. (Traditional error-handling routines and dumps supply information only after an error occurs or a program finishes executing.)

You can modify storage values and then execute the program to test the modifications.

The ability to examine and modify storage values in any area makes the debugger a very powerful tool.

Therefore, it's important to use debugger security to control access to storage.

Note: For information on the security methods used by the debugger, see *CA IDMS Security Administration Guide*.

Snapping Tasks and Storage Areas

You can create dumps for a task or for a specific area; the dumps are written to the DC/UCF log. From the log you can make a hard copy of storage contents and then examine them at your leisure.

Trapping Abends

The debugger automatically takes control when an instruction causes an abend in the module being debugged, allowing you to examine storage and to take appropriate action.

Managing Program Execution

The debugger also provides you with a flexible tool for managing an executing program. Under the control of the debugger during runtime:

- After a breakpoint, you can:
  - Allow the program to resume execution from the current breakpoint address
  - Specify resumption at an address before or after the breakpoint
- After an abend, you can:
  - Allow standard abend processing to continue
  - Resume program execution at an address before or after the abend
- In both cases, you can modify previous debugger commands or issue new commands, for example to:
  - Ignore all remaining breakpoints
  - Bypass specific breakpoints
  - Set additional breakpoints for the duration of a session

Debugging Process

What to Define

You cannot debug an Assembler, COBOL, or PL/I program until you define it to the DC/UCF system. For example, you cannot debug a program until it is defined in the PROGRAM statement at system generation time or defined dynamically with the DCMT VARY DYNAMIC PROGRAM statement.

Similarly, you must define the program task code either in the TASK statement at system generation or dynamically with the DCMT VARY DYNAMIC TASK statement.

Important! You don't have to define the task code for the initial stage of the debugging process, but you must define it before executing the program.

You don't have to define CA ADS dialogs, subschemas, maps, and tables.

Debugger Structure

You can conduct a debugger session in one of two modes or a combination of both:

- **Prompt mode** enables you to issue debugger commands line by line
- **Menu mode** enables you to issue commands from a series of activity and tutorial screens

Debugging a module takes place in two phases:

- The **setup phase**, invoked before a program is executed
- The **runtime phase**, occurring during program execution and dependent on actions taken during setup

DEBUG and QUIT

A debugger session begins when you issue the first DEBUG task code. A session ends when you either issue the debugger QUIT command or terminate the DC/UCF session by signing off.

Debugger session modes and phases are discussed in detail below.

Prompt Mode

Line-oriented Method

Prompt mode is the line-oriented method of communicating with the debugger. In prompt mode you can:

- Initiate a debugging session
- Issue a debugger command
- Return to the DC/UCF system

Initiating a Debugging Session

To initiate a debugging session in prompt mode, enter the DEBUG task code in response to the Enter Next Task Code prompt:

```
ENTER NEXT TASK CODE:
debug
```

The debugger indicates that it is in control by responding with its special prompt:

```
DEBUG >
```

Issuing a Debugger Command

You can issue debugger commands whenever the debugger responds with the DEBUG> prompt. **To issue a debugger command at the same time you initiate a debugging session**, enter the task code in conjunction with the DEBUG command that names the entity to be debugged. In this example, the task code DEBUG is followed by a DEBUG command that identifies TESTPROG to the debugger:

```
ENTER NEXT TASK CODE:
debug debug testprog
```

When you enter the above command, you invoke the debugging facility. The command is echoed, and the debugger responds by validating the command and displaying the next DEBUG> prompt:

```
DEBUG TESTPROG
DEBUG > DEBUGGING INITIATED FOR TESTPROG VERSION 1
DEBUG >
```

If you try to debug a program which has not been defined to a DC/UCF system, the debugger issues an error message after echoing the command, then repeats the command that cannot be completed, and redisplays the DEBUG> prompt, as in this example:

```
DEBUG TESTPROG
DC574902 DEBUG > LOAD OF TESTPROG FAILED - NOT FOUND
DEBUG > DEBUG TESTPROG
DEBUG >
```

Difference between EXIT and QUIT

To return control to the DC/UCF system, issue either the EXIT command or the QUIT command.

The **EXIT** command saves the debugger control blocks and allows you to continue the same debugger session.

The **QUIT** command clears the control blocks and terminates the debugger session completely.

How to Check Session Activity

To determine whether a debugger session exists, issue the command DCMT DISPLAY LTE *. This command lists information about your logical terminal. If you see DEBUG ACT, a debugger session is active; if you see DEBUG INACT, no debugger session is active.

To inquire for a list of modules known to the debugger, use the DEBUG INQUIRE command (see Debugger Commands).

Valid Commands

In prompt mode, you can use all commands except RESUME, IOUSER, and WHERE during setup, and all commands except DEBUG during runtime. The PROMPT command performs no function while you are in prompt mode.

For a detailed discussion of the debugger commands, see Debugger Commands.

Menu Mode

Choosing Activities from Screens

Menu mode is designed to make your options easy to see. You can enter commands or display information by filling in the fields on a series of fixed-format screens:

- Activity screens provide fields for commands that require additional input
- Individual help screens provide detailed descriptions of each command

- The Usage global help screen summarizes debugging activities
- Two other global help screens let you display program and debugger symbols and program function key (PF-key) assignments

For a complete description of each of the screens, see Debugging in Menu Mode.

Initiating a Debugger Session

To initiate a debugging session in menu mode, issue the DEBUG task code followed by the MENU command in response to the Enter Next Task Code prompt:

```
ENTER NEXT TASK CODE:
debug menu
```

When you enter this command, you see the Usage screen, which is the top-level menu screen:

```
  IDMS-DC REL nn.n ONLINE DEBUGGER *** USAGE ***        SETUP    PAGE  1 OF  4
 PROGRAM:           V:          CSECT:
 ->
                    PROCEDURAL COMMANDS.

 EXIT.....RETURNS CONTROL TO IDMS-DC/UCF WITHOUT TERMINATING THE CURRENT DEBUGG
ER SESSION
 QUIT.....TERMINATES THE DEBUGGER SESSION AND RETURNS CONTROL TO IDMS-DC/UCF.
 PROMPT...INVOKES THE PROMPT MODE OF THE DEBUGGER.


                    RETRIEVAL COMMANDS.

 AT.......ESTABLISHES OR MODIFIES BREAKPOINTS WITHIN A USER PROGRAM.
 DEBUG....DESIGNATES, DURING THE SETUP PHASE, THE ENTITY TO BE DEBUGGED OR
          INQUIRES ABOUT ENTITIES KNOWN TO THE DEBUGGER.
 IOUSER...DISPLAYS THE USER SCREEN THAT IS CURRENT WHEN A BREAKPOINT, PROGRAM
          INTERRUPT OR TRAPPED ABEND IS ENCOUNTERED.

 NEXT _ ACTIVITY OR _ HELP:
      _ AT        _ LIST      _ SET      _ SNAP    _ RESUME     _ DEBUG  _ WHERE

      _ EXIT      _ PROMPT    _ QUIT     _ IOUSER
 HELP SCREENS:    _ USAGE     _ SYMBOLS  _ KEYS
```

Switching Mode

To switch from prompt mode to menu mode, issue the MENU command in response to the DEBUG> prompt:

```
DEBUG >
menu
```

Now you also see the Usage screen.

Going to a Specific Screen

To go to a specific activity screen or global help screen, issue the MENU command followed by a valid screen name. This example illustrates the use of the DEBUG task code with a MENU command that names the screen to be displayed:

```
ENTER NEXT TASK CODE:
debug menu at
```

When you enter the above command, you invoke the debugging facility in menu mode and see the At command activity screen:

```
 IDMS-DC REL nn.n ONLINE DEBUGGER *** AT ***          SETUP    PAGE  1 OF  1
PROGRAM:           V:          CSECT:
->









ADD BREAKPOINT AT:

BEFORE: MAX                  AFTER: 0                    EVERY: 1


OTHER ACTION.......:   (I-INQUIRE/D-DELETE/G-IGNORE)
BREAKPOINT OR <ALL>:

NEXT _ ACTIVITY OR _ HELP:
     _ AT        _ LIST      _ SET       _ SNAP    _ RESUME      _ DEBUG  _ WHERE

     _ EXIT      _ PROMPT    _ QUIT      _ IOUSER
HELP SCREENS:    _ USAGE     _ SYMBOLS   _ KEYS
```

Valid Commands

Menu mode allows the same set of debugger commands as prompt mode, with the exception that the PROMPT command is allowed and the MENU command is disabled.

Leaving Menu Mode

To leave menu mode you can:

- Select the PROMPT activity
- Return to prompt mode with the associated control key
- Enter the PROMPT command on the menu DEBUG> prompt line

Note: If you leave menu mode with an EXIT command or with the CLEAR control key, the debugger remains in menu mode. Subsequently, when control returns to the debugger, the debugger is still in menu mode. The debugger remains in menu mode until you issue the PROMPT command.

Note: For a more detailed discussion of menu mode, see Debugging in Menu Mode.

Setup Phase

Breakpoints and Abends

The setup phase is the preliminary phase of the debugging process. During this stage, you can define modules to the debugger for two reasons:

- **To enable the setting of breakpoints**

  Breakpoints can be established as soon as the DEBUG command is used to define the load module to the debugger.

- **To gain control under the debugger when a program check or abend occurs**

  The setting of breakpoints is not mandatory; you can trap possible abends in a program during runtime and receive control under the debugger if:

  - You have defined the program to the debugger (that is, issued a DEBUG command for the program during the setup phase)
  - You have defined the current DC/UCF program to the debugger

    The last program to receive control through a #LINK or #XCTL is called the **current DC/UCF program**. When a program check occurs in a module unknown to the debugger, you will gain control under the debugger if the current DC/UCF program is defined to the debugger.

Note: For a detailed discussion of DC/UCF and debugger methods of assigning currency, see Program Currency (see page 20).

Runtime Phase

DEBUG and EXIT Required

The runtime phase of the debugging process takes place during the execution of a program. Debugging cannot occur during runtime unless:

- You have used the **DEBUG command** during the setup phase to define the program to the debugger
- You have used the **EXIT command**, which retains the debugger control blocks, when leaving the setup phase

What Happens at the Breakpoint

When you have defined a program to the debugger, the program task code invokes both the runtime phase of the debugger and the execution of the program. At a breakpoint, the DC/UCF runtime system suspends program execution, and you gain control under the debugger. A message is displayed that signals the breakpoint interrupt and describes its location.

Three Breakpoint Display Formats

For example, assume that a program called TESTPROG is defined to the debugger and a breakpoint is established like this during the setup phase:

```
DEBUG >
at @00bf080
```

The debugger verifies the establishment of the breakpoint:

```
AT @00BF080
AT > @00BF080 ADDED
DEBUG >
```

When this breakpoint is encountered during runtime, the debugger identifies the address, the program, and the debug expression that established the breakpoint:

```
AT OFFSET @80 IN TESTPROG EXPRESSION @00BF080
DEBUG >
```

In response to the DEBUG> prompt, you can make additional queries or perform other debugging activities.

Session Considerations

Three Factors

You'll need to consider the following factors when you establish and conduct debugger sessions:

- Performance standards
- Valid breakpoints
- Program currency

Each of these topics is discussed below.

Performance Standards

All Activities Permissible

During a debugger session, you can perform any activity related to DC/UCF, not just debugging. For a given session, there are no restrictions on the number or kinds of entities debugged or on the length of the session.

For example, within a single debugger session, you can successively:

- Initiate a debugger setup phase
- Leave the debugger setup phase to conduct an online PLOG session
- Return to the setup phase to debug another program
- Leave the debugger setup phase again to conduct an IDD session
- Execute one of the programs you are debugging

Minimize Unrelated Work

When the DEBUG task code initiates a debugger session, the DC/UCF system saves your current screen, whether or not the screen is directly related to any modules being debugged. Consequently, the debugger incurs some processing overhead each time the current screen changes. For best performance, therefore, keep work unrelated to the debugging process to a minimum.

Also, although the setup phase is pseudo conversational, the runtime phase is completely conversational, which ties up system resources. Even database resources are tied up while the debugger has control.

In order to use resources most efficiently, therefore, always return control to DC/UCF before you leave your terminal or attend to concerns other than debugging.

Valid Breakpoints

Verified by Debugger

Program breakpoints, established with the AT command, must be set at addresses that contain valid instructions or valid command elements (CMEs for CA ADS dialogs). If the address cannot be validated, the debugger displays a message to indicate that the breakpoint could not be set. A verifying message is displayed when the address is valid.

Note: The debugger checks for a valid operation code at each breakpoint that is set; you are responsible for placing the breakpoint at an actual instruction. If a breakpoint address resolves to an address offset that contains a valid operation code but does not contain a valid instruction, the program could be altered with unpredictable results.

Program Currency

Determines Abend Trapping

When a task abends or when a program checks occurs, the setting of program currency determines whether or not the debugger traps the abend and transfers control to you.

DC/UCF and Debugger Currency

The DC/UCF system assigns currency on the basis of the most recent program to have been given control with #LINK or #XCTL program control services.

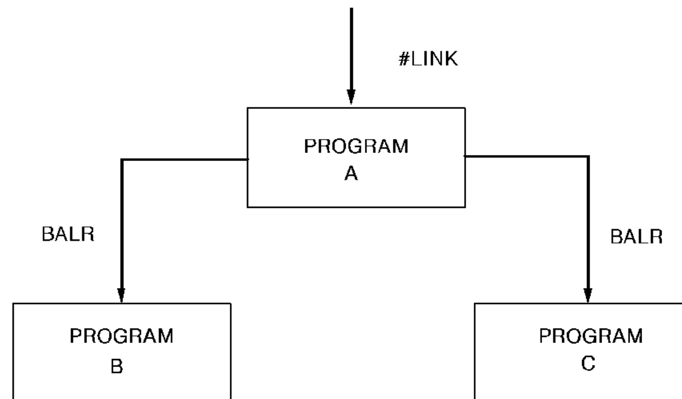
The **debugger** assigns currency according to these rules:

- If the address of the interrupt is contained in one of the programs defined to the debugger, this program is assigned debugger currency, and you are given control under the debugger
- If the address is not found in a debugged program, the debugger checks the current DC/UCF program to see whether it has been defined to the debugger:
  - If the current DC/UCF program has been defined to the debugger, this program is assigned debugger currency, and you gain control under the debugger
  - If the program has not been defined, no debugger currency is assigned, you do not gain control under the debugger, and the standard DC/UCF abend processing takes place

Sample Program Structure

The following examples illustrate how program currency can affect whether the DC/UCF system passes control to the debugger. Each of the examples is based on the sample program structure:

Sample Program Structure for Examples



Example 1

During the setup phase, you define Programs A, B, and C to the debugger. When the program is executing, a program check occurs in Program B.

These currencies are now in effect:

- The current DC/UCF program is Program A, the last program to have been given control by #LINK or #XCTL
- Debugger currency is assigned to Program B

You receive control under the debugger because Program B, one of the programs defined to the debugger, contains the address of the interrupt.

Example 2

During the setup phase, you define Program A to the debugger. When the program is executing, a program check occurs in Program B.

These currencies are now in effect:

- The current DC/UCF program is Program A, the last program to have been given control by #LINK or #XCTL
- Debugger currency is assigned to Program A

You receive control under the debugger because the current DC/UCF program has also been defined to the debugger.

Example 3

During the setup phase, you define Program C to the debugger. When the program is executing, a program check occurs in Program B.

These currencies are now in effect:

- The current DC/UCF program is Program A, the last program to have been given control by #LINK or #XCTL
- Debugger currency is not assigned, because the debugger cannot find the interrupt address in a known program and the current DC/UCF program is not defined to the debugger

You do not receive control under the debugger because no debugger currency can be set. The program abends without an interruption from the debugger, and the system issues a standard abend message.

Example 4

During the setup phase, you define Program A to the debugger. During execution, Program B branches into unknown storage and a program check occurs.

These currencies are now in effect:

- The current DC/UCF program is Program A, the last program to have been given control by #LINK or #XCTL
- Debugger currency is assigned to Program A

You receive control under the debugger because the current DC/UCF program has also been defined to the debugger.

Chapter 2: Command Considerations

This section contains the following topics:

About this Chapter (see page 23)
Expression Components (see page 24)
Length Attributes (see page 31)
Parsing Rules (see page 35)
Command Modification (see page 36)
Delimiters (see page 36)
Data Values (see page 37)
Command Format (see page 38)

About this Chapter

When issuing debugger commands, you consider:

Expression components	Variables that can be specified in a debug expression
Length attributes	Display lengths for expressions with and without data characteristics
Parsing rules	Debugger rules for processing command input
Command modification	Rules for modifying commands
Delimiters	Delimiters recognized by the debugger
Data values	Numeric and string values recognized by the debugger
Command format	Guidelines used to format a debugger command

This chapter discusses each of these topics.

Expression Components

Four Basic Components

The basic components of a debug expression are:

- Debugger symbols
- User symbols
- Program symbols
- Operators

Three Ways to Appear

When a debug expression is used in a command, the expression can appear as:

- A single debugger symbol, user symbol, program symbol, or integer
- Multiple debugger symbols, user symbols, program symbols, and integers joined by operators
- Multiple expressions joined by operators

Debugger Symbols

Three Categories

Debugger symbols can:

- Designate general registers
- Designate certain DC/UCF system entities
- Point to specific addresses

Address Symbols and Markers

Three special characters can be used in debugger expressions to address particular locations in a program or dialog:

Symbol	Symbol Name	Designated Location
@	At sign	Absolute address
$	Dollar sign	Load address
¢	Cent sign	Address of current dialog process

Each type of location is described separately below.

Absolute Address

The **at sign (@)** functions as the debugger marker that prefaces an absolute address notation. An absolute address cannot exceed eight digits.

Syntax for the marker is shown below:

```
►►── @ hex-value ──────────────────────────────────────────────────►◄
```

In a debug expression, @*hex-value* can be used interchangeably with the address notation X*hex-value*. For example, an absolute address could be represented as @2B90 or X'002B90'; an offset value could be represented as +@C0 or +X'C0'.

For more information about the hexadecimal values recognized by the debugger, see Data Values (see page 37).

Load Address

The **dollar sign ($)** functions as the debugger label that expresses the load address of the current program. In a command that uses debug expressions, the dollar sign ($) can be used by itself or in combination with other expression components.

This example illustrates the use of the dollar sign ($) in an expression requesting a display of the current CSECT address:

```
list $
```

This example sets a breakpoint at an offset address 16 bytes from the load address:

```
at $ + @10
```

Address of Current Dialog Process

The **cent sign (¢)** functions as the debugger label that expresses the address of the current dialog process. In a command that uses debug expressions, the cent sign **(¢)** can be used by itself or in combination with other expression components.

This example illustrates the use of the cent sign **(¢)** to request the load address of the current dialog process:

```
list &cent.
```

General Registers Symbols

General registers include the registers used by the program at the time of execution and the registers used by the DC/UCF system. The program status word (PSW) and register definitions are always preceded by a colon (:) and are specified by these symbols:

- **:PSW** for the current program status word
- **:Rn** for the user program register at the time of interrupt, where *n* represents the number of the register and can have a value of 0 through 15
- **:REGS** for all user program registers at the time of interrupt
- **:SRn** for a DC/UCF system register at the time of interrupt, where *n* represents the number of the register and can have a value of 0 through 15
- **:SREGS** for all DC/UCF system registers at the time of interrupt

Important! A single debug expression can reference only one general register.

DC/UCF System Symbols

Certain DC/UCF system symbols also function as debugger entities, and you can refer to them during a debugging session. A colon (:) must precede each symbol. These are the valid symbols:

:BAT

Specifies the base address table for session.

:CSA

Specifies the DC/UCF common storage area.

:DLB

Specifies the debug local block, control block required for debugging session.

:LTE

Specifies the current logical terminal element.

:PTE

Specifies the current physical terminal element.

:TCE

Specifies the current task control element.

:VECT

Specifies the vector table for debugger.

Important! A single debug expression can reference only one system entity.

User Symbols

Additional Work Areas

User symbols identify storage areas set aside by the debugger as additional work areas. Each user symbol must be prefaced by a colon (:). The user symbols and their meanings are:

- **:DRn** for a debugger general register, where *n* represents the number of the register and can have a value of 0 through 15
- **:DREGS** for all debugger registers
- **:H1** and **:H2** for halfword 1 and halfword 2
- **:F1** and **:F2** for fullword 1 and fullword 2
- **:UCHR** for a 48-byte character area

  You can also refer to specified sections of this area:

  - **:UC0**, the first 16 bytes
  - **:UC16**, the next 16 bytes
  - **:UC32**, the last 16 bytes

Examples

The example below illustrates one way in which you can use the work areas as a debugging aid. In this example, when the program being debugged has reached a breakpoint and the debugger facility is in control, you can copy the current values in program registers to registers in the debugger work area. For instance, to save the contents of all 16 of the general registers of the program, issue this command:

```
set :dregs = :regs
```

To save the contents of a single register, copy the values currently in the user register to a debugger register, with a command in this format:

```
set :dr1 = :r1
```

Later in the debugger session, the user register previously saved can be restored with this command:

```
set :r1 = :dr1
```

Contents Remain for Session

You can modify or refer to the values in these registers at any time during a debugger session; debugger register contents remain only for the duration of the current session.

For more detailed information on the use of the SET command, see Debugger Commands.

Program Symbols

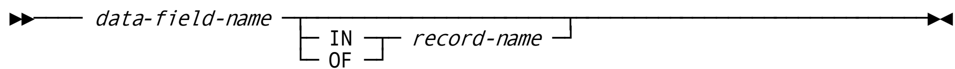
Data field names and line numbers are two types of program symbols used as components of debug expressions. Each of these components is discussed separately below, followed by a discussion of how program symbols can be qualified.

Data Field Names

When debugging a dialog during runtime, you can reference a specific data field.

Syntax

This is a summary of syntax for the use of data field names:



Parameters

data-field-name

Specifies the data field to be displayed. The name must be enclosed in quotation marks if it contains embedded delimiters. The data field name must be qualified if it is not unique to the process.

IN/OF *record-name*

Specifies the name of the record associated with the data field being requested. The record name must be enclosed in quotation marks if it contains embedded delimiters.

For a complete list of the delimiters used in debugger commands, see Delimiters (see page 36).

You cannot list or set data fields during the setup phase of a debugger session. If you try to, the debugger issues an error message, as in this example:

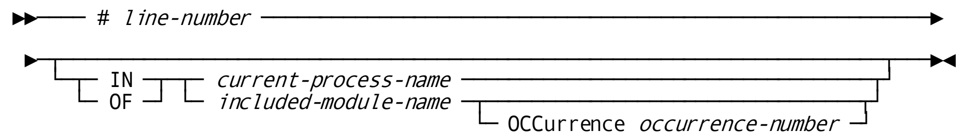
```
DEBUG >
list date

DC704900 LIST > DATE CANNOT BE RESOLVED
LIST DATE
DEBUG >
```

Line Numbers

When debugging a dialog, you can use symbolic line numbers in a debug expression.

Syntax

This is a summary of syntax for the use of line numbers:



Parameters

#line-number

Specifies the process line number referenced in the expression. The line number can stand alone if it is unique to the current process.

current-process-name

Specifies what process currently being debugged contains the line number. The process name must be enclosed in quotation marks if it contains delimiters. The current process name is the default value.

included-module-name

Specifies the name of the included module called from the current process containing the line number. The name of the included module must be enclosed in quotation marks if it contains delimiters.

OCCurrence *occurrence-number*

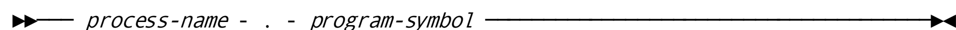
Specifies the occurrence of the included module for modules included more than once in the process.

Qualifying Program Symbols

You can also use program symbols to refer to a line in another process without resetting the process currency.

Syntax

The syntax for temporary qualification is:



Parameters

process-name

Specifies the current process.

program-symbol

Specifies the program symbol used in this expression. The program symbol is a line number or a data field name. You can further qualify the symbol with the OF *included-module-name-qa* clause of a debug expression.

Example 1

Assume that the dialog being debugged has three processes: MIS-MAIN1 (the current process), MIS-MAIN2, and MIS-MAIN3. To set a breakpoint at line 200 in MIS-MAIN2, you can use the QUALIFY command to reset the currency to MIS-MAIN2 (QUALIFY PROCESS 'MIS-MAIN2' AT #200). However, to establish a breakpoint at line 200 *without* resetting currency, you can issue this command:

```
at 'mis-main2'.#200
```

Example 2

To set a breakpoint at line 150 in MIS-INC3, a module included by MIS-MAIN3, you can qualify the line number without changing currency from the MIS-MAIN1 process:

```
at 'mis-main3'.#150 of 'mis-inc3'
```

Expression Operators

Standard Operators

The standard operators are:

Operator	Meaning
+	Addition
-	Subtraction
*	Multiplication
/	Division

You can use these operators in any command containing a debug expression.

Special Operators

The **percent sign (%)** is a special operator that you can use for **indirect addressing**. With indirect addressing, the address in the expression is not the address of the operand itself, but a pointer to a storage area that contains the address of the operand. When the percent sign precedes a valid debug expression, the content of the expression is used as the address of the target value.

Examples

Assume that register 3 contains the value BF040. You ask for display of the contents of register 3, like this:

```
list :r3
```

```
000BF040                                        *..0.            *
```

In this example, the command points to the contents of register 3 as the target value for the display:

```
list %:r3
```

In response to the command above, the debugger locates the operand address (BF040) in register 3 and lists the contents stored at BF040:

```
000BF040  000047F0 C0280000 00000000 00000000  *...0...........*
```

Now you ask for display of the contents found at 10C010, the address supplied in the debug expression:

```
list reca +10
```

```
0010C010  000BF000 00000000 00000000 00000000  *..0............*
```

In the next example, the relative storage location points to the address of the effective operand. The debugger responds by listing the contents of BF000, the operand address found at RECA+10:

```
list %(reca+10)
```

```
000BF000  D1D6C8D5 40E2D4C9 E3C80000 00000000  *JOHN SMITH......*
```

Length Attributes

The types of components used in an expression can determine the amount of information displayed or modified by the debugger in response to your request. When determining the length of a display, the debugger distinguishes between expressions with and expressions without associated data characteristics.

Expressions with Data Characteristics

When an expression component has associated data characteristics, the length of the display depends on:

- The length attribute of the symbol
- The length attribute of the end symbol
- The explicit length

Length Attribute of the Symbol

The length attribute of the symbol is used as the default value.

For example, this command requests the display of register 1:

```
list :r1
```

The length attribute of a general register is four bytes. The debugger uses the register attribute as the default value and issues the following display in response to the above command:

```
00000000
```

Length Attribute of the End Symbol

The length attribute of the end symbol in an expression range delineates the end of the display. For example, this command requests a display of register 1 through register 3:

```
list :r1 to :r3
```

The debugger responds with a display that includes the full four-byte length of register 3:

```
00000000 00000001 00000002
```

Explicit Length

An explicit length overrides the display length implied by the data characteristics of a symbol.

This table lists the length attributes of debugger symbols:

Entity	Symbol	Length Attribute
Single registers	:R*n* :SR*n* :DR*n*	4 bytes
Register blocks	:REGS :SREGS :DREGS	64 bytes
Program status word	:PSW	8 bytes
Halfwords	:H1 :H2	2 bytes
Fullwords	:F1 :F2	4 bytes
Line number	#*Line-n*	12 bytes
Control blocks	:BAT, :CSA, :DLB, :LTE, :PTE, :TCE, :VECT	Variable (depending on length of block)

Expressions without Data Characteristics

As soon as a component appears in an expression with any other component, it no longer has associated data characteristics. For example: PTE is an expression with an implicit length attribute equal to the length of the control block, but: PTE +@10 is an expression without associated data characteristics.

Ways to Determine Length

When an expression component does not have associated data characteristics, the length of the display is based on:

- The default length of the command
- An explicit length
- The first byte of the end expression

Default Command Length

Default lengths vary for commands that use length parameters. For example, the default length is 16 bytes for the LIST command and 256 bytes for the SNAP command.

In this example, the display begins 32 bytes from the start of the current physical terminal element (PTE) for a length of 16 bytes:

```
list :pte +@20
```

Explicit Length

You can supply an explicit length, which overrides the default length of the command. This example requests a 100-byte display that begins at the load address:

```
list $ 100
```

The next example requests that the display begin at an offset address for a length of 20 bytes:

```
list :pte +@10 len 20
```

First Byte of the End Expression

The first byte of the end expression in an expression range specifies the end of the display. For example, the debugger displays 17 bytes of memory in response to this command:

```
list @bf000 to @bf010
```

Parsing Rules

Parameter Order

The parameters of a command must appear **in the order specified in the syntax**.

In the display below, the first example is incorrect, because the BEFORE parameter cannot follow the AFTER parameter in an AT command:

```
at $ +@10 after 2 before 10 on
```
◄**incorrect order**

```
at $ +@10 before 10 after 2 on
```
◄**correct order**

Errors that Stop Execution

If one command in a string of debugger commands contains a **syntax error**, all following commands are parsed for syntax but **not executed**.

The command containing the syntax error may be partly executed. In the first example above, the part of the command preceding the error (*at $ +@10 after 2*) will be executed:

```
DEBUG >
at $ +@10 after 2 before 10 on

AT $ +@10 ADDED
BEFORE 10 IGNORED
$
UNRECOGNIZABLE DEBUG COMMAND
DEBUG > AT $ +@10 AFTER 2 BEFORE 10 ON
DEBUG >
```

Commands that Stop Execution

If a RESUME, EXIT, IOUSER, MENU, PROMPT, or QUIT command is embedded in a string of concatenated debugger commands, **all successive commands in the string are ignored**.

Command Modification

Rules of Modification

Commands can be modified to specify different options or to turn off options completely. You can modify commands with expressions corresponding to the original command.

When you modify a command:

- A respecified option overrides its counterpart in the previous command
- All options specified in the previous command remain in effect unless overridden

Example

In this example these two commands

at $ + 8 before 10 ignore

at $ + 8 after 2 on

establish the breakpoint parameters specified in this display:

```
AT $ + 8 BEFORE 10 AFTER 2 ON
```

Delimiters

Valid Delimiters

Delimiter	Meaning
*	Asterisk
	Blank
,	Comma
=	Equal sign
!	Exclamation point
-	Hyphen
%	Percent sign
.	Period
+	Plus sign
/	Slash

Data Values

Valid Data Values

The debugger recognizes values supplied by the following types of numbers and strings:

Value	Description
Halfword values	Two-byte fixed-point values ranging from +32,767 to -32,768
Fullword values	Four-byte fixed-point values ranging from +2,147,483,647 to -2,147,483,648
Hexadecimal numbers	Values of one to eight hexadecimal digits preceded by an at (@) sign; can include characters A through F and numerals 0 through 9; when not used in a debug expression, contents must be paired hexadecimal digits
Decimal numbers	Values that can include decimal positions
Character strings	One- to 16-character alphanumeric values enclosed in single or double quotation marks and preceded by letter C (for example, C"F34"); can contain any printable character or blank

Value	Description
Hexadecimal strings	Even-numbered strings of up to 16 hexadecimal digits enclosed in single or double quotation marks and preceded by letter X (for example, X"C6F4"); paired characters A through F and paired numerals 0 through 9 for hexadecimal values
Numeric strings	Variable length numeric values enclosed in single or double quotation marks; preceded by letter H, F, or P to designate halfword values (H'0'), fullword values (F'555'), or packed decimal values (P"2315")

Command Format

Rules

- One or more blanks must precede and follow all keywords
- Spaces are optional within an expression

  An offset value can be expressed with separating blanks or without blanks. For example, the same command can be accurately formatted in any of these ways:

  ```
  at @00bf280 + 10
  at @00bf280+10
  at @00bf280 +10
  ```

- The entire command string must not exceed twice the line length of the terminal
- Multiple commands can be entered on one prompt line

  The commands can be separated with an exclamation point (!) delimiter, but the delimiter is not required. For example, the same command string can be accurately formatted in any of these ways:

  ```
  DEBUG >
  at $ + 8 every 5 on!resume

  DEBUG >
  at $ + 8 every 5 on resume

  DEBUG >
  at $ + 8 every 5 on
  AT > $ + 8 ADDED
  DEBUG >
  resume
  ```

Chapter 3: Debugger Commands

This section contains the following topics:

Summary of Commands (see page 39)
AT (see page 40)
DEBUG (see page 44)
EXIT (see page 46)
IOUSER (see page 47)
LIST (see page 47)
MENU (see page 51)
PROMPT (see page 52)
QUALIFY (see page 52)
QUIT (see page 54)
RESUME (see page 55)
SET (see page 56)
SNAP (see page 60)
WHERE (see page 62)

Summary of Commands

This chapter presents a functional description, syntax, syntax rules and examples for each debugger command you can use during the setup or runtime phases. The commands are presented in alphabetical order.

This table summarizes the commands and their functions.

Command	**Description**
AT	Establishes or modifies breakpoints at specified locations in a user program
DEBUG	Designates an entity to be debugged or inquires about entities known to the debugger
EXIT	Returns control to the DC/UCF system, retaining the debugger control blocks created in the current session
IOUSER	Displays the screen current when a breakpoint, program check, or trapped abend is encountered
LIST	Displays session attributes, debugger variables, and areas of memory at your terminal
MENU	Invokes menu mode for a debugger session
PROMPT	Invokes prompt mode for a debugger session

Command	Description
QUALIFY	Assigns currency to a new process within the current dialog or inquires about program, dialog and process currencies in effect
QUIT	Terminates the debugger session and returns control to the DC/UCF system, clearing all control blocks created in the current debugger session
RESUME	Continues program or abend execution
SET	Allows you to modify storage and debugger session attributes
SNAP	Allows you to create and write a dump to the DC/UCF log
WHERE	Provides information about the last interrupt encountered in the entity being debugged

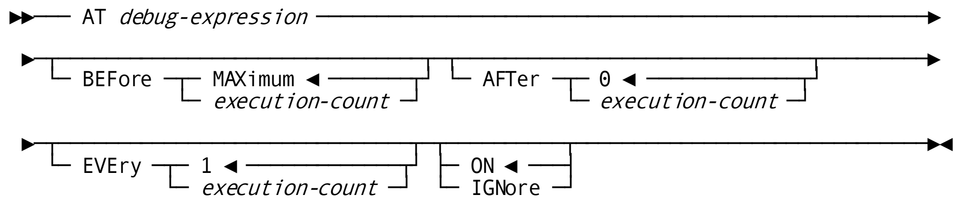
AT

Purpose

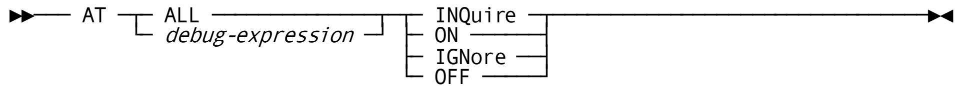
Sets, modifies, removes, or reviews breakpoints in a program.

Syntax

ADD Format



INQUIRE Format



Parameters

debug-expression

Specifies a breakpoint location in a user program. *Debug-expression* can include multiple debug expressions, and it resolves to an address containing a valid instruction or a valid CME (CA ADS dialogs only). It is not valid to set a breakpoint at the target of an Assembler execute (EX) instruction.

Note: Debugger will not successfully resume if you set breakpoint at a "BALR RX,0" type instruction or a "BAL RX,..." instruction later used as a base register. An alternative is to set breakpoint at next instruction.

Note: For more information on the values used in a debug expression, see Expression Components (see page 24) in the "Command Considerations" chapter.

ALL

Specifies that the action should apply to all previously established breakpoints. Can be used only in INQUIRE format.

BEFore MAXimum

Causes the debugger to pause each time the breakpoint instruction is reached. MAXIMUM is the default.

BEFore *execution-count*

Specifies an execution pause every time the specified breakpoint instruction is encountered, up to but not including *execution-count*.

AFTer 0

Causes the debugger to pause each time the breakpoint instruction is reached. Zero is the default.

AFTer *execution-count*

Specifies an execution pause each time the same breakpoint instruction is encountered beyond *execution-count*.

EVEry 1

Causes the debugger to pause every time the breakpoint instruction is encountered. One is the default.

EVEry *execution-count*

Specifies an execution pause each time the counter for the specified breakpoint instruction reaches a multiple of *execution-count*.

ON

Sets a new breakpoint or resets the status of a breakpoint previously ignored. ON is the default in ADD format.

IGNore

Bypasses the specified breakpoint but increments the breakpoint counter.

OFF

Removes the breakpoint. Can be used only in INQUIRE format.

INQuire

Requests a listing of the breakpoint locations and characteristics. Can be used only in INQUIRE format.

Usage

Two formats

The AT command has two formats. The ADD format is used to set and modify breakpoints; the INQUIRE format is used to review breakpoint locations, if any have been set, as well as to modify the breakpoints.

Temporary processing halt

A breakpoint temporarily halts processing, allowing you to examine the results of execution up to the point of interruption. Processing is halted *before* the instruction at the breakpoint is executed. You can use the AT command in both the setup and the runtime phases of a debugger session.

Breakpoint count

In response to the INQUIRE format, the debugger displays all parameters in effect for the named breakpoints and indicates the breakpoint count. The breakpoint count (BKPT COUNT) shows how often the breakpoint has been encountered from the time the program received control via #LINK or #XCTL.

If you issue an AT INQUIRE command is issued during the setup phase, the breakpoint count documents the count from the most recently executed program. The breakpoint counter is reset to zero each time a #LINK or #XCTL is processed for the program.

Example 1

This command schedules program breaks on the second through ninth time the instruction at the address $ + 8 is encountered.

```
DEBUG >
at $ + 8 before 10 after 1
```

The debugger verifies the breakpoint with this message:

```
AT>  $ + 8 ADDED
```

Once the breakpoint in the example above has been set, the debugger displays the following message in response to an AT $ + 8 INQUIRE command:

```
AT>  AT $ + 8 BEFORE 10 AFTER 1 EVERY 1 BKPT COUNT 0 ON
```

In this example, the default value is indicated for the EVERY parameter. BKPT COUNT 0 indicates that this breakpoint has not yet been encountered in the current execution of the program.

Example 2

When a breakpoint is reached during the runtime phase, the debugger displays a message that names the address, identifies the program, and displays the debug expression that established the breakpoint. For example, the following message would appear for a breakpoint established with an AT $ + 8 command for program TESTPROG:

```
AT OFFSET @8 IN TESTPROG EXPRESSION $ + 8
```

Example 3

In CA ADS dialogs you can set breakpoints by specifying a line number:

```
DEBUG >
at #200
```

If line 200 is a valid address, the debugger responds to the above command as follows:

```
AT #200
AT> #200 ADDED
```

Example 4

When debugging a dialog, you can set a breakpoint in a process other than the current process without changing the currency. In the following example where MIS-MAIN1 is the current process, a breakpoint is set at line 100 in a second process (MIS-MAIN2); MIS-MAIN1 retains its currency. As usual, the debugger sends a verifying message when the breakpoint address is valid.

```
DEBUG >
at 'mis-main2'.#100

AT 'MIS-MAIN2'.#100
AT> 'MIS-MAIN2'.#100 ADDED
DEBUG >
```

In the above example, the programmer encloses the process name in single quotation marks (') because the name contains an embedded hyphen (-). Quotation marks are required for any name that contains embedded delimiters.

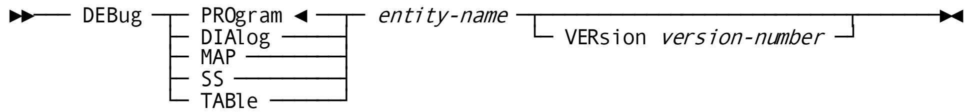
DEBUG

Purpose

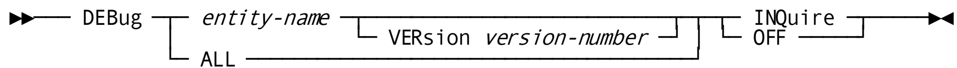
Specifies the programs to be debugged or inquires about the debugged programs.

Syntax

ADD format



INQUIRE format



Parameters

PROgram/DIAlog/MAP/SS/TABle

Identifies the type of load module to be debugged. Used only in ADD format. PROGRAM is the default.

entity-name

Specifies the name of the entity to be used by the debugger as the current load module. *Entity-name* contains a maximum of eight characters.

ALL

Specifies all modules defined to the debugger during the current session. Can be used only in INQUIRE format.

VERSION *version-number*

Identifies the version of the program being debugged.

If the version is *not* specified:

- In ADD format, the debugger uses the version set with DCUF TEST, or version 1 if DCUF TEST hasn't been issued
- In INQUIRE format, the debugger displays all versions if none is specified

INQuire

Requests a listing of the modules being debugged in this session.

OFF

Terminates all debugging for the specified programs for the remainder of the session.

Usage

Functions of DEBUG

The word DEBUG has several functions:

- **Task code** used to initiate a debugging session
- **Prompt** displayed during a debugging session in prompt mode
- **Command** used during the setup phase to designate the programs to be debugged or to inquire about the debugged programs

You can use the DEBUG command only during the setup phase.

Special copy loaded

When you issue the DEBUG command for a module, a special copy is loaded, so that setting breakpoints and making data changes will not affect other users.

Two formats

The DEBUG command has two formats. The ADD format initially identifies the entities to be debugged; the INQUIRE format lists entities defined to the debugger in a given session.

Example 1

This example illustrates the use of the DEBUG task code in conjunction with the DEBUG command to transfer control from DC/UCF to the debugger and to define a module to the debugger; the debugger verifies the commands and displays the DEBUG> prompt in response:

```
ENTER NEXT TASK CODE:
debug debug testprog

DEBUG TESTPROG
DEBUG > DEBUGGING INITIATED FOR TESTPROG VERSION 1
DEBUG >
```

Example 2

In this example, the DEBUG command names the load module to be debugged:

```
DEBUG >
debug dialog msgtext version 3

DEBUG DIALOG MSGTEXT VERSION 3
DEBUG > DEBUGGING INITIATED FOR MSGTEXT VERSION 3
DEBUG >
```

Example 3

This command requests a list of all programs defined to the debugger during the current session:

```
DEBUG >
debug all inquire

DEBUG ALL INQUIRE
PROGRAM TESTPROG VERSION 1
DIALOG MSGTEXT VERSION 3 PROCESS MSG-MAIN1 CURRENT
DEBUG >
```

EXIT

Purpose

Returns control to DC/UCF and retains the debugger control blocks.

Syntax

```
►►─── EXIt ──────────────────────────────────────────────────────────────►◄
```

Usage

Use EXIT to complete the setup phase and return to DC/UCF.

In a concatenated list of commands, the debugger ignores any command that follows the EXIT command.

Important! In debugging a dialog, the EXIT command causes rollbacks to be issued for both the database, if a run unit is open, and the task.

Examples

This example illustrates the use of the EXIT command and the resulting system response:

```
DEBUG >
exit

EXIT
EXIT DEBUGGER
ENTER NEXT TASK CODE:
```

IOUSER

Purpose

Redisplays the screen that appeared at your terminal immediately before the debugger processed the breakpoint or trapped abend.

Syntax

```
►►── IOUser ─────────────────────────────────────────────────────►◄
```

Usage

After the screen is redisplayed, you can return to the menu mode screen or to the DEBUG> prompt by pressing any control key.

You can issue the IOUSER command only at runtime. In a concatenated list of commands, the debugger ignores any command that follows the IOUSER command.

LIST

Purpose

Displays selected areas of storage and session attributes at your terminal.

Syntax

MEMORY Format

```
►►─┬ List ────┬┬───────────┬ begin-debug-expression ──────────────►
   └ Display ─┘└ Memory ───┘

►─┬──────────────────────────────────┬┬──────┬──────────────────►◄
  ├ TO end-debug-expression ─────────┤├ C ───┤
  ├────────────┬ byte-count-number ──┤├ X ───┤
  │└ LENgth ───┘                     │└ XC ──┘
```

ATTRIBUTES Format

```
►►─┬ List ────┬ SESsion ATTributes ──────────────────────────────►◄
   └ Display ─┘
```

Parameters

begin-debug-expression

Specifies the beginning location of the display. *Begin-debug-expression* can include multiple debug expressions and it resolves to an address for which you have retrieval security.

For information on the security methods used by the debugger, see *CA IDMS Security Administration Guide*.

For more information on the values used in a debug expression, see Expression Components (see page 24) in Chapter 2, "Command Considerations."

end-debug-expression

Specifies the ending location of the display. *End-debug-expression* can include the same debugger entities as those specified in *begin-debug-expression*. The expression must resolve to a valid address for which you have retrieval security.

byte-count-number

Indicates the number of bytes to be displayed.

Important! If a resource is listed and the length or ending address exceeds the resource boundary, the list is truncated at the boundary, and the debugger issues a warning message.

C

Requests a display in character format.

X

Requests a display in hexadecimal format.

XC

Requests a display in both hexadecimal and character format.

Usage

Two formats

There are two formats for the LIST command. The MEMORY format requests a display of the contents of memory; the ATTRIBUTES format requests a display of session attributes.

Rules for default length

When neither *end-debug-expression* nor *byte-count-number* is specified, the default length is based on these rules:

- If the expression is composed of a single symbol, the data characteristics of the symbol determine the default length. The number of bytes displayed is equal to the default length of the symbol.
- If the expression does not have data characteristics, the default length is 16 bytes.

Format specified for this command

XC/X/C specifies the format for the requested information. This specification can override the type of display previously established as a session attribute; the override is only valid for the duration of this command. See the ATTRIBUTES format of the SET command to reestablish the session attributes more permanently.

Example 1

This command requests a list of the storage contents beginning at @BF002, for a length of 48 bytes:

```
list @bf002 48
```

The debugger responds with a display of the beginning address and the requested storage contents:

```
000BF002      47F0 C028....    *...0...........*
000BF010  58509002 ........    *...............*
000BF020  4780C12A ........    *..A............*
000BF030  4770                 *..             *
```

The first line of the storage display is indented for a space of two bytes, reflecting the exact beginning address.

Example 2

This command instructs the debugger to display the physical terminal element (PTE) control block from the beginning to the end of the entity. The length of the data field is determined by the data characteristics of the PTE.

```
list :pte
```

Example 3

The next command instructs the debugger to display storage contents beginning at @BF020. Since this expression has no data characteristics, the display defaults to 16 bytes.

```
list @bf020
```

Example 4

In debugging CA ADS dialogs you can use a data field name:

```
list date
```

The debugger responds by displaying the requested information:

```
001C2C50  F8F4F0F3  F0F1              *840301        *
```

Important! You cannot refer to data fields of Assembler, COBOL, or PL/I programs by name.

Example 5

You can also use a line number:

```
list #100
```

Example 6

When field names or line numbers are not unique, you must qualify them. This example lists line 100 from a process other than the current dialog process:

```
list 'process-b'.#100
```

Example 7

This example qualifies a request by specifying the display of a field name *USERID-1301* from a record *EMPLOYEE-1301*:

```
list 'userid-1301' in 'employee-1301'
```

Example 8

This is an example of the ATTRIBUTES format:

```
DEBUG >
list session attributes

LIST SESSION ATTRIBUTES
LIST > SESSION ATTRIBUTES
        LIST:         CHAR
        TEST VERSION: 2
DEBUG >
```

This display indicates that DCUF TEST 2 and SET CHAR were issued.

MENU

Purpose

Switches the debugger session from prompt mode to menu mode.

Syntax

```
►►── MENu ─┬─────────────────┬──────────────────────────────────────────►◄
           └─ screen-name ───┘
```

Parameter

screen-name

Indicates the name of a global help screen or an activity screen to be displayed. If *screen-name* is not specified, the debugger displays the Usage screen, the top-level global help screen that presents a list of debugger commands and functions.

Usage

The MENU command is executed in prompt mode and switches the debugger session from prompt mode to menu mode. MENU is disabled in menu mode.

In a concatenated list of commands, the debugger ignores any command that follows the MENU command.

Example

This command instructs the debugger to switch from prompt mode to menu mode with the display of the activity screen for the LIST command:

```
DEBUG >
menu list
```

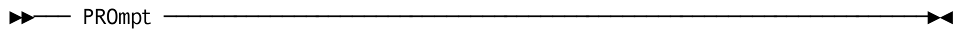
For a complete discussion of the screens available in menu mode, see Debugging in Menu Mode.

PROMPT

Purpose

Switches the debugger session from menu mode to prompt mode.

Syntax



Usage

The PROMPT command is executed in menu mode and switches the debugger session from menu mode to prompt mode. PROMPT is disabled in prompt mode.

In a concatenated list of commands, the debugger ignores any command that follows the PROMPT command.

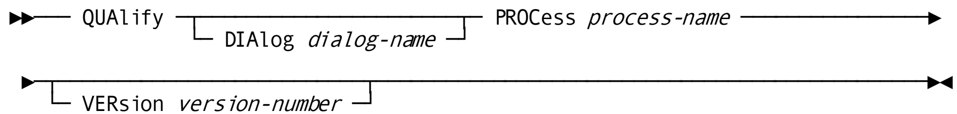
QUALIFY

Purpose

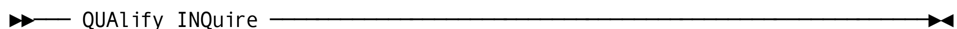
Establishes a new current process or inquires about the current program, or dialog and process.

Syntax

RESET Format



INQUIRE Format



Parameters

DIAlog *dialog-name*

Specifies the dialog currently defined to the debugger. Only current dialog can be qualified.

PROCess *process-name*

Specifies the new dialog process to become current. Enclose the process name in single quotation marks if the name contains embedded delimiters.

VERsion *version-number*

Specifies the version number of the current dialog.

Usage

Resetting currency

When a dialog is defined to the debugger, the premap process becomes the current process by default. You can use the QUALIFY command to assign currency to a different process within the current dialog.

Two formats

The QUALIFY command has two formats. The RESET format resets currency; the INQUIRE format requests a display of the current program, or the current dialog and process.

The QUALIFY command can be used in both the setup and the runtime phases of a debugger session.

Example 1

You can inquire about the current dialog process:

```
DEBUG >
qualify inquire
```

The debugger responds in this format:

```
QUALIFY INQUIRE
DIALOG MISINDC VERSION 1 PROCESS MIS-MAIN1 CURRENT
DEBUG >
```

Example 2

These commands reassign currency to MIS-MAIN2 and set a breakpoint at line 200 within MIS-MAIN2:

```
qualify proc 'mis-main2' at #200
```

The debugger responds like this:

```
QUALIFY PROCESS 'MIS-MAIN2'
QUALIFY > CURRENCY SET
AT #200
AT > #200 ADDED
DEBUG >
```

QUIT

Purpose

Terminates a debugger session and returns control to DC/UCF, clearing the debugger control blocks.

Syntax

```
►►── QUIt ──────────────────────────────────────────────────────────►◄
```

Usage

The QUIT command discontinues debugging and lets you enter a new task code in response to the Enter Next Task Code prompt.

In a concatenated list of commands, the debugger ignores any commands that follow the QUIT command.

Important! In debugging a dialog, the QUIT command causes rollbacks to be issued for both the database, if a run unit is open, and the task.

Example

This is how the system responds to the QUIT command:

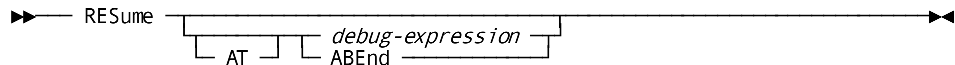
```
DEBUG >
quit
QUIT
QUIT DEBUGGER
ENTER NEXT TASK CODE:
```

RESUME

Purpose

Instructs the runtime system to continue program execution at the next instruction or a specified location or to continue standard processing of an abend.

Syntax



Parameters

debug-expression

Specifies the location at which execution is to continue, if other than the instruction immediately following the breakpoint. *Debug-expression* can include multiple debug expressions, and it resolves to an address containing a valid instruction or a valid CME (CA ADS dialogs only).

For more information about the values used in a debug expression, see Expression Components (see page 24) in Chapter 2, "Command Considerations."

ABEnd

Specifies that standard DC/UCF abend processing, including the execution of any STAE set, should continue.

Usage

You can issue the RESUME command only at runtime.

When program execution resumes at an address other than the address of the instruction immediately following the breakpoint, you must be sure that the program environment (for example, the contents of registers and storage) is appropriate for running the program.

Examples

This command requests that execution of the program resume with the instruction at the breakpoint:

```
resume
```

This command requests that program execution resume at the load address:

```
resume $
```

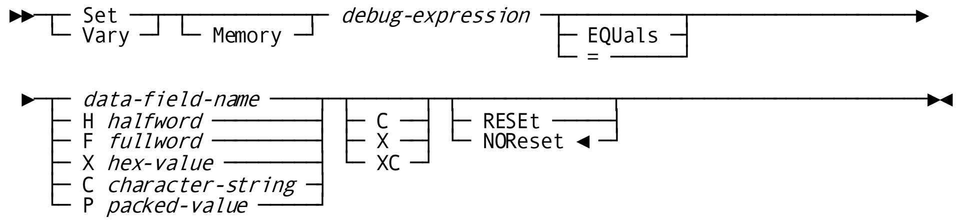
SET

Purpose

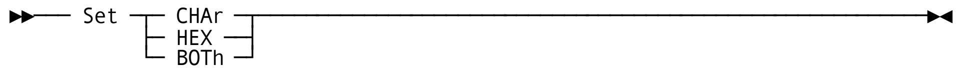
Modifies selected areas of storage and debugger symbols.

Syntax

MEMORY Format



ATTRIBUTES Format



Parameters

debug-expression

Specifies the beginning location of the entity to be modified. *Debug-expression* can include multiple debug expressions, and it resolves to an address for which you have update security.

For information on the security methods used by the debugger, see *CA IDMS Security Administration Guide*.

For more information on the values used in a debug expression, see Expression Components (see page 24) in Chapter 2, "Command Considerations."

data-field-name

Identifies a specific data field value. Can be used in CA ADS dialogs only.

For a complete discussion of the use of field names, see Program Symbols (see page 28) in Chapter 2, "Command Considerations."

H*halfword*

Is a halfword number. H specifies the halfword format; *halfword* represents the actual data content and must be enclosed in single quotation marks.

F*fullword*

Is a fullword number. F specifies the fullword format; *fullword* represents the actual data content and must be enclosed in single quotation marks.

***X**hex-value*

Is a hexadecimal string. X specifies the hexadecimal format; *hex-value* represents the actual data content and must be enclosed in single quotation marks.

***C**character-string*

Is a character literal used to assign alphanumeric or symbolic character values. C specifies the character format; *character-string* represents the actual data content and must be enclosed in single quotation marks.

***P**packed-value*

Is an assigned packed decimal value. P specifies the packed decimal format; *packed-value* represents the actual data content and must be enclosed in single quotation marks.

C

Requests a display in character format.

X

Requests a display in hexadecimal format.

XC

Requests a display in both hexadecimal and character format.

RESEt

Specifies that the named storage be reset to its original value at the end of the debugging session. This option is not supported for release 10.2 of the debugger.

NOReset

Specifies that the storage is not to be reset to its original value at the end of the debugging session. This option does not affect storage in the debugged program itself since a special copy of the program is loaded for the debugging session. NORESET is the default.

CHAr

Requests a display in character format for ATTRIBUTES format.

HEX

Requests a display in hexadecimal format for ATTRIBUTES format.

BOTh

Requests a display in both hexadecimal and character format for ATTRIBUTES format.

Usage

Two formats

The SET command has two formats. The MEMORY format specifies the values assigned to a given debug expression; the ATTRIBUTES format specifies the debugger session attributes to be established.

When *debug expression* is a symbol with data characteristics (for example, :REGS), the length of the symbol is used in the set. When the expression does not have data characteristics (for example, $ + 10), the data characteristics of the source field are used in the set.

Important! The debugger does not allow a set across resource boundaries.

Character and hexadecimal format

C/X/XC in the MEMORY format specifies how the information is to be listed. This specification can override the session attributes previously established for the session; the override is valid only for the duration of this command. To reestablish the session attributes more permanently use the ATTRIBUTES format.

Example 1

This command modifies the contents of a program register:

```
DEBUG >
set :r7 x'00000001' x
```

The debugger responds to the X parameter with the hexadecimal display of the original value and the reset value:

```
SET :R7 X'00000001' X
OLD
00000000
NEW
00000001
DEBUG >
```

Example 2

This command modifies storage at an offset address:

```
DEBUG >
set $ + 8 = x'58' x
```

The debugger responds:

```
SET $ + 8 = X'58' X
OLD
000BF008  41
NEW
000BF008  58
DEBUG >
```

Example 3

This command modifies storage at the same address with a fullword value:

```
DEBUG >
set $ + 8 equ f'58' x
```

The debugger responds:

```
SET $ + 8 EQU F'58' X
OLD
000BF008  4130C050
NEW
000BF008  0000003A
DEBUG >
```

Example 4

This is an example of the ATTRIBUTES format:

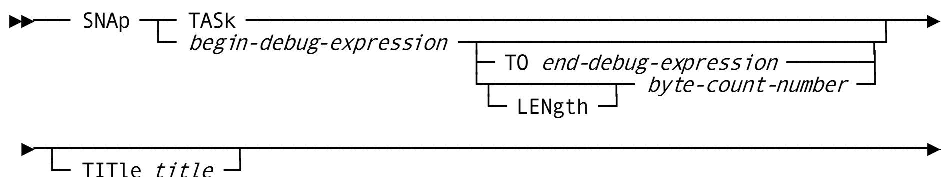
```
DEBUG >
set char

SET CHAR
SET ATTRIBUTE CHAR
DEBUG >
```

SNAP

Purpose

Allows you to create a dump and write it to the DC/UCF log.

Syntax



Parameters

TASk

Requests a dump of all resources associated with the executing task, as well as the Task Control Element (TCE) and the Dispatch Control Element (DCE).

begin-debug-expression

Specifies the location at which to begin the snap. *Begin-debug-expression* can include multiple debug expressions, and it resolves to an address for which you have retrieval security.

For information on the security methods used by the debugger, see *CA IDMS Security Administration Guide*.

For more information on the values used in a debug expression, see Expression Components (see page 24) in Chapter 2, "Command Considerations."

end-debug-expression

Specifies the ending location of the display. *End-debug-expression* can include the same debugger entities as those specified in *begin-debug-expression*. The expression must resolve to a valid address for which you have retrieval security.

byte-count-number

Specifies the number of bytes to be displayed.

TITle ***title***

Specifies an optional title for the snap. The title must be enclosed in single quotation marks ('), may not exceed 32 characters, and must be prefaced by a valid ASA carriage control character. These are the valid carriage control characters:

(Space bar)	Space one line
0	Space two lines
-	Space three lines

1	Skip to the top of the next page

The length of 32 characters includes the carriage control character. Code apostrophes in the title as two single quotation marks (''). They are counted as one character position.

When a title is not specified, a default title is written to the log.

Usage

Types and timing

You can use a SNAP command for a Task snap or a snap of specific area; the command is valid at any point in a debugger session.

You can examine the Snap dumps online with OLP (OnLine Plog), or make a hard copy by running the print log functions of the Batch Command Facility utility.

For more information see *CA IDMS Utilities Guide*.

Default length

When neither *end-debug-expression* nor *byte-count-n* is specified, the default length is based on these rules:

- If the expression is composed of a single symbol, the data characteristics of the symbol determine the default length. The number of bytes dumped is equal to the default length of the symbol.
- If the expression does not have data characteristics, the default length is 256 bytes.

Example 1

This command causes a snap to begin at the load address and terminate at @000BF050; the default title is to be used:

```
DEBUG >
snap $ to @bf050
```

The default title takes the form:

SNAP *command-entered* USER *user-id*

For example, if the user ID is MMC, the default title is:

```
SNAP $ TO @000BF050 USER MMC
```

Example 2

This command requests a snap starting at the load address for 256 bytes; the default title is to be used:

```
DEBUG >
snap $
```

Example 3

This command requests a task snap; the title IDMSTEST, positioned at the top of a display page, will be used for the dump:

```
DEBUG >
snap task title '1idmstest'
```

WHERE

Purpose

Provides information about the last interrupt of the entity being debugged.

Syntax

```
▶▶── WHEre ──────────────────────────────────────────────────────────▶◀
```

Usage

You can issue the WHERE command only at runtime.

Example

This is how the debugger responds to the WHERE command:

```
DEBUG >
where

WHERE > @000BF010 LAST INTERRUPT MESSAGE FOLLOWS
AT OFFSET @10 IN TSTPROG EXPRESSION $ + @10
```

Chapter 4: Debugging in Menu Mode

This section contains the following topics:

Features of Menu Mode (see page 63)
Screen Design (see page 64)
Accessing Screens (see page 69)
Activity Screens (see page 73)
Global Help Screens (see page 81)

Features of Menu Mode

Menu Mode Facilities

Menu mode provides screens that allow you to choose any of the debugging activities that can be performed in prompt mode. Fixed-format activity screens are available for each command to simplify the process of debugging. Menu mode also offers several help facilities.

Chapter Contents

This chapter discusses the following features of menu mode:

- Screen design—Standard format of the activity and help screens
- Accessing screens—Moving between screens
- Activity screens—Descriptions of the variable fields on the command-specific activity screens
- Global help screens—Descriptions of the global help screens

Screen Design

Screen Areas

The menu mode screens are designed for ease of use. Each screen has a:

- Heading area
- Display area
- Specification area
- Selection area

This diagram shows the areas of the screen:

```
┌  IDMS-DC REL nn.n ONLINE DEBUGGER *** LIST ***         SETUP    PAGE  1 OF   1
│ PROGRAM:          V:          CSECT:
└  ->
┌
│
│
│
│
│
└
┌ LIST: M (M-MEMORY/A-ATTRIBUTES)
│ MEMORY ONLY:
│     BEGIN LIST AT:
│
│     LENGTH.......:         - OR -    END LIST AT:
│
│     LIST FORMAT..: B (C-CHARACTER/X-HEX/B-BOTH)
└
┌ NEXT _ ACTIVITY OR _ HELP:
│      _ AT        _ LIST      _ SET      _ SNAP     _ RESUME   _ DEBUG  _ WHERE
│
│      _ EXIT      _ PROMPT    _ QUIT     _ IOUSER
└ HELP SCREENS:    _ USAGE     _ SYMBOLS  _ KEYS
```

Each of the screen areas is described below.

Heading Area

Contents

The heading area includes three lines:

- Header line
- Currency line
- Prompt line

Header Line

The header line contains several fields:

- The **PF-key** field provides a two-position entry area for simulation of a program-function key. For example, typing a 5 in this field and pressing [Enter] has the same effect as pressing [PF5].

  The simulated PF-key field is useful when your terminal does not have program-function keys. You can specify the numerals 1 through 24, as well as EN for [Enter], CL for [Clear], P1 for [PA1], and P2 for [PA2].

- **Product name** and **release number** fields supply information formatted like this:

  `IDMS-DC REL` *`n.n`* `ONLINE DEBUGGER`

- The **screen label** field indicates the name of the current screen. The screen name changes as you move from one activity or help screen to another in the debugging process. (The sample screen is the List screen.)

- The **session mode** field indicates whether you are in the setup or runtime phase of the debugging process. (The sample screen indicates a setup phase.)

- **Page notations** supply the current page and the total number of pages available for the given display. The sample screen indicates that you are viewing the first page of a one-page display. Typically the help screens have more than one page. You can display a different page by:

  - **Overwriting** the current page number on the header line and pressing [Enter]
  - **Using the designated control key** to scroll backward or forward.

Default Control Key Assignments This table presents a list of the default control key assignments for the debugger:

Key	Action	Description	Function
[PF1]	Usage	Displays the Usage screen	2
[PF2]	Unassigned		5
[PF3]	Activity	Displays the activity screen for the current command	3
[PF4]	Help	Displays the help screen for the current command	4
[PF5]	Symbols	Displays the Symbols screen	9
[PF6]	Keys	Displays the default control key assignments	6
[PF7]	Scroll up	Displays the previous page	7
[PF8]	Scroll down	Displays the next page	8

Key	Action	Description	Function
[PF9]	Prompt	Returns the debugger to prompt mode	1
[PF10]	Unassigned		15
[PF11]	Unassigned		11
[PF12]	Reserved		12
[PA1]	Refresh	Refreshes the current screen	14
[PA2]	Exit	Exits the debugger	10
[Clear]	Return	Goes back one level	16
[Enter]	Process	Processes the current screen	13

The default control key assignments can be changed at DC/UCF system generation time with the KEYS statement.

For more information on the KEYS statement used in system generation, see *CA IDMS System Generation Guide*.

The Keys screen displays the key assignments for your particular installation.

Currency Line

The currency line displays the **current values for five variable fields**:

- The **entity type** indicates whether a program, dialog, map, table or subschema load module is currently being debugged
- The **entity name** field displays the name of the current entity
- **V:version-n** displays the version number associated with the current entity
- The **section type** field indicates whether a dialog process or a program CSECT is currently being debugged.
- The **section name** field displays the current CSECT or process name

When the current entity is a **program**, the currency line reads like this:

```
PROGRAM: PROG01 V:3 CSECT:
```

When the current entity is a **dialog**, the currency line reads like this:

```
DIALOG: MISINDC V: 1 PROCESS: MIS-MAIN2
```

The currency line remains constant until there is a change in the entity of the CSECT or process being debugged. You can change the current CSECT or process by:

- Overwriting the name on the screen and pressing [Enter] to automatically initiate the QUALIFY command
- Issuing the QUALIFY command on the prompt line

Prompt Line

The prompt line is prefaced by an arrow (►) and functions in the same manner as the DEBUG> prompt in prompt mode. You can use the prompt line on any screen during menu mode; you can submit a single debugger command or a string of commands at any time.

For a complete discussion of the debug expressions and commands that you can enter on the prompt line, see Expression Components (see page 24) in Chapter 2, "Command Considerations" and Debugger Commands (see page 39).

Display Area

Contents

The display area is reserved to display:

- The information being presented for each of the help screens
- Output you have requested from the debugger
- Informational and error messages supplied by the debugger

Specification Area

Contents

The specification area contains fields in which you can specify the desired options for the command being used. The contents of the specification area vary from screen to screen, and not all screens have a specification area.

Screen content in the specification area of the activity screens is saved for as long as the command is current. This feature allows you to suspend action on a partially filled screen while seeking further information.

For example, you can:

- Begin to fill the activity screen for the List command
- Switch to the Symbols help screen to review program or debugger symbols
- Return to the List screen, where all previous input remains intact

For more information about command currency, see 4 (see page 71).

Selection Area

List of Procedures

The selection area presents a list of the debugger commands and global help screens that you can initiate from the screen. You can select the next action by entering any character other than a blank or an underscore in the response field to the left of an activity or help function.

Two Sections

You can select actions from one of two sections:

- Section A displays the choice of command-specific activity and help screens:

```
NEXT  _ ACTIVITY OR  _ HELP
      _ AT     _LIST    _SET    _SNAP  _RESUME  _ DEBUG  _WHERE

      _EXIT    _PROMPT  _QUIT   _IOUSER
```

- Section B displays the choice of global help screens:

```
HELP SCREENS:  _ USAGE    _ SYMBOLS    _ KEYS
```

Command-specific Activities

When choosing from Section A, you first select Activity (the default) or Help and then choose one of the commands. If you select Activity, the system can:

- Execute immediately an EXIT, PROMPT, QUIT, or IOUSER command
- Display the activity screen for an AT, LIST, SET, SNAP, RESUME, or DEBUG command
- Display the information requested by the WHERE command

Control keys can also be used to request activities.

Selecting Help If you select Help from Section A, the system displays a command-specific help screen.

If you mark the select byte for Activity or Help but do not choose a specific command, the system displays the activity or help screen for the current command. The debugger system displays an error message if there is no current command.

You can choose a global help screen from Section B.

Each of the activity screens and global help screens is described in detail later in this chapter.

Accessing Screens

Considerations

When moving between screens, you need to consider:

- Screen hierarchy
- Screen sequence
- Selection processing
- Command currency

Screen Hierarchy

Three Screen Levels

The debugger supports three levels of screens:

Screens	Level
Usage screen	Top
Activity screens	Second
Help screens	Third

Usage Screen

The Usage screen is an informational global help screen that contains a list of the debugger commands and a brief description of their functions. The Usage screen is the default screen for the MENU command.

Activity Screens

Activity screens are screens that provide you with an area for specifying command options. The debugger provides activity screens for the AT, DEBUG, LIST, RESUME, SET, and SNAP commands. You can initiate these commands from the activity screens once you've entered the necessary information in the specification area.

Help Screens

Help screens provide two types of assistance:

- Command-specific help screens supply tutorial information on all the debugger commands. When the command is one that uses an activity screen, the help screen for that command also describes the field options.
- Global help screens provide information not associated with a particular command. For example, the Symbols screen enables you to choose a display of program and debugger symbols for the current session, and the Keys screen displays site-specific PF-key assignments.

Screen Sequence

Next Activity or [Clear]

You can change to the next screen by:

- Explicitly specifying the next activity to be performed
- Using the [Clear] key (or the key associated with function 16)

Specifying the Next Activity

You can select an activity by:

- **Using the control key** associated with the activity to be performed

  Default control key assignments are discussed in "Heading area" earlier in this chapter. The Keys screen displays a list of the current function assignments for your installation.

- **Entering a nonblank character in the response field** to the left of the activity to be performed

  You can use any character other than a blank or an underscore. The choice of actions is listed in the selection area of each screen. For a description of the selection area, see Screen Design (see page 64) earlier in this chapter.

Using [Clear]

The performance of [Clear] depends on the screen level from which you initiate the action:

- From an activity screen, [Clear] displays the Usage screen
- From the Symbols screen, the Keys screen, or one of the command-specific Help screens:
  - When there is a **current command**, [Clear] displays the activity screen for the current command
  - When there is **no current command**, [Clear] displays the Usage screen
- From the Usage screen, [Clear] returns control to DC/UCF

Selection Processing

Order of Precedence

The debugger determines its next action based on these factors, in order of precedence:

1. **Control key** used to initiate a particular action
2. **Select byte(s)** marked in the selection area
3. **Page number** designated in the heading area
4. Commands initiated from the **menu-mode prompt line**
5. Commands initiated from the **specification area**

Once an action is identified for processing, the system ignores all other requested actions.

Example

For example, if the USAGE screen is your current screen and you choose the AT activity from the selection area and then press the CLEAR key, the CLEAR key takes precedence and you are returned to DC/UCF.

Command Currency

Repeating a Command

Command currency is a feature of menu mode that simplifies the debugging process when you use the same command in successive actions. With command currency, you select the command the first time only.

Defining the Current Command

The current command is defined as the most recent debugger command referenced on a command-specific help screen or an activity screen. No current command exists until you take either of two actions:

- Use the *screen-name* option with the MENU command to name an activity screen.

  For example, the command MENU LIST establishes the LIST command as the current command.

- Designate a command from the activity or help selection list at the bottom of any screen.

  The newly-selected command functions as the current command.

The current command is the default command. This means that the debugger system automatically displays the appropriate screen for the current command.

You can choose Activity or Help in the selection area, or press the control key associated with either of these actions, without specifying a command. If no current command has been established when you make any of the above choices, the debugger system displays an error message.

Changing Command Currency

You can change command currency in the same way you establish it.

For example, if the current command is LIST, mark the select byte for the SET command and press the control key associated with the current command-specific help screen (for example, [PF4]). The Help screen for SET appears, because SET is the newly-designated current command.

Command currency does *not* change when you:

- Enter a command on the screen prompt line.

  For example, while setting breakpoints with the At screen, you can use the prompt line to request a memory display with the LIST command. In this case, the AT command remains as the current command.

- Select a global help screen, that is, a screen that is not associated with a specific debugger command.

  For example, you can move from the LIST command activity screen to the Usage, Symbols, or Keys screen without changing command currency.

Activity Screens

Format

An activity screen is provided for any debugger command that has fields for user-supplied values. Some fields are required and others have default values or are optional. The command-specific area of the activity screens is the **specification area**; all other areas have the standard format presented in "Screen design" above.

At Screen

Purpose

You can use the At screen to:

- Add breakpoints
- Modify breakpoints
- Delete breakpoints
- Inquire about the breakpoints that have already been set

As explained in "Debugger features", Chapter 1, breakpoint temporarily halts processing, allowing you to examine the results of execution up to the point of interruption.

'Remember': Processing is halted before the instruction at the breakpoint is executed.

The AT command can be used in both the setup and runtime phases of the debugger.

Two Sections

The specification area of the At screen has two separate sections:

- The first section sets new breakpoints:

  ```
  ADD BREAKPOINT AT:

  BEFORE: MAX        AFTER: 0          EVERY: 1
  ```

- The second section inquires about existing breakpoints, or deletes them:

  ```
  OTHER ACTION.......:   (I-INQUIRE/D-DELETE/G-IGNORE)
  BREAKPOINT OR <ALL>:
  ```

- Both sections modify breakpoints

You can specify both sections of the screen at the same time.

Field Options

These are the field options for this area:

ADD BREAKPOINT AT:

Designates the location in your program that will contain a breakpoint. The specified value can include one or more debug expressions resolving to an address that contains a valid instruction or, for CA ADS dialogs, a valid CME.

Remember: It is not valid to set a breakpoint at the target of an Assembler execute (EX) instruction.

BEFORE: MAX

Specifies the execution pause on encountering the instruction up to, but not including, the specified number of times. The default (MAX) is to pause as many times as the instruction is encountered.

AFTER: 0

Specifies that the debugger will pause at the breakpoint after the instruction has been executed the specified number of times. The default (0) is to start pausing when the instruction is first encountered.

EVERY: 1

Specifies an execution pause every time the counter for the breakpoint instruction reaches a multiple of the value specified. The default (1) is to pause every time the instruction is encountered.

Tip: If you don't change the defaults, the debugger will pause each time the breakpoint instruction is encountered.

OTHER ACTION...: (I-INQUIRE/D-DELETE/G-IGNORE)

- I requests a listing of the breakpoint location and characteristics
- D removes the breakpoint
- G bypasses the breakpoint but increments the breakpoint counter

BREAKPOINT OR <ALL>:

Indicates the breakpoints affected by the Other Action field. You can indicate a specific breakpoint (that is, a *debug-expression*), or specify that the action applies to ALL breakpoints within the current program or dialog.

Debug Screen

Two Sections

The specification area of the Debug screen also has two sections:

- The first section designates the load module to be debugged:

```
DEBUG LOAD MODULE...:     TYPE: P (P-PGM/D-DIALOG/M-MAP/T-TABLE/S-SS)
VERSION.............:
```

- The second section inquires about certain debugged modules or removes modules from the debugging process:

```
OTHER ACTION........:   (I-INQUIRE/D-DELETE)
LOAD MODULE OR <ALL>:
VERSION.............:
```

You can submit both types of requests at the same time.

Field Options

These are the field options for this area:

DEBUG LOAD MODULE...:

Identifies the name of the entity to be debugged. The entity name can be up to eight characters long.

TYPE: P (P-PGM/D-DIALOG/M-MAP/T-TABLE/S-SS)

Identifies the type of module to be debugged:

- P (the default) identifies a program
- D identifies a CA ADS dialog
- M identifies a map
- T identifies an edit or code table
- S identifies a subschema

VERSION......:

Identifies the version of the load module to be debugged. If the version is not specified, the debugger uses the version you have set with DCUF TEST, or if none, version 1.

OTHER ACTION....: (I-INQUIRE/D-DELETE)

- I requests a display of the load module(s) being debugged in this session
- D requests that the specified module(s) be removed from the list of load modules known to the debugger

LOAD MODULE OR <ALL>:

Indicates the load module(s) affected by the specified Other Action value. An *entity-name* identifies the single load module for which **I** or **D** is requested. Using All requests **I** or **D** for all load modules being debugged.

VERSION......:

Identifies the version of the load module for which **I** or **D** is requested. If no version is specified and there is more than one version of the load module being debugged, the debugger displays or deletes all versions. If a version is specified, the debugger displays or deletes only the specified version.

List Screen

Purpose

You can use the List screen to display storage areas, session attributes, and debugger symbols at your terminal. The List screen can be used during setup and at runtime.

The specification area of the List screen looks like:

```
LIST: M (M-MEMORY/A-ATTRIBUTES)
MEMORY ONLY:
       BEGIN LIST AT:

       LENGTH.......:         - OR -    END LIST AT:

       LIST FORMAT..: B (C-CHARACTER/X-HEX/B-BOTH)
```

Field Options

These are the field options for this area:

LIST: M (M-MEMORY/A-ATTRIBUTES)

- M(the default) requests a list of an area of memory specified in the Memory Only section of the screen
- A requests a list of current session attributes; no other options need to be specified on the screen in this case

BEGIN LIST AT:

Specifies the beginning location for the display. The beginning location can include one or more debug expressions resolving to an address for which you have retrieval security.

For information on the security methods used by the debugger, see *CA IDMS Security Administration Guide*. This field is required if a memory display is selected.

LENGTH........:

Specifies the number of bytes to be displayed.

END LIST AT:

Specifies the ending location for the display. The ending location can include the same debugger entities as those specified for the beginning location.

Important! If a resource is listed and the length or ending location exceeds the resource boundary, the list is truncated at the boundary and the debugger issues a warning message.

When neither Length nor End List At is specified, the length of the display is based on two rules:

- If the debug expression is composed of a single symbol, the data characteristics of the symbol determine the default length. The number of bytes displayed is equal to the length attribute of the symbol.
- If the expression does not have data characteristics, the default length is 16 bytes.

LIST FORMAT..: B (C-CHARACTER/X-HEX/B-BOTH)

- C requests a display in character format
- X requests a display in hexadecimal format
- B (the default) requests a display in both character and hexadecimal format

Resume Screen

Purpose

You can use the Resume screen to instruct the runtime system to continue program execution at the next instruction or at another location or to continue standard processing of an abend.

The specification area of the Resume screen looks like:

```
RESUME: E (E-EXECUTION/A-ABEND)

EXECUTION ONLY:
  LOCATION IF OTHER THAN BREAKPOINT:
```

Field Options

These are the field options for this area:

RESUME: E (E-EXECUTION/A-ABEND)

Indicates the next action of the runtime system:

- E (the default) requests that execution continue at the next instruction or at another location as indicated by the address specified in the Execution Only section of the screen
- A requests that standard DC/UCF abend processing, including the execution of any STAE exit, should continue

LOCATION IF OTHER THAN BREAKPOINT:

Specifies the location at which execution is to continue. The specified value can be a debug expression that resolves to an address containing a valid instruction or a valid CME (CA ADS dialogs only).

Set Screen

Purpose

You can use the Set screen to modify selected areas of storage and session attributes. The Set screen can be used during setup and at runtime.

The specification area of the Set screen looks like:

```
SET: M (M-MEMORY/C-CHARACTER/X-HEX/B-BOTH)
MEMORY ONLY:
       BEGIN SET MEMORY AT:

       EQUALS......:

       RESET.......: N (Y-YES/N-NO)
```

Field Options

These are the field options for this area:

SET: M (M-MEMORY/C-CHARACTER/X-HEX/B-BOTH)

- **M** (the default) requests modification of the area of memory specified in the Memory Only section of the screen
- The other three options pertain to the setting of session attributes:
  - C requests a display in character format
  - X requests a display in hexadecimal format
  - B requests a display in both character and hexadecimal format

BEGIN SET MEMORY AT:

Specifies the beginning location of the entity to be modified. The beginning location can be a debug expression that resolves to an address for which you have update security. A beginning location value is required when you are updating memory.

If the debug expression is a symbol with data characteristics, the length of the symbol is used in the set. Otherwise, the data characteristics of the source field are used in the set.

Remember: The debugger does not allow a set across resource boundaries.

EQUALS......:

Indicates the new value that will be assigned to the entity. You can supply an explicit value or a data field name, as in these examples:

```
h'03'
f'9956'
x'f0c4'
c'edit'
p'1234'
'customer-name-0145'
```

The EQUALS field is required when you are updating memory.

RESET.......: N (Y-YES/N-NO)

Indicates the disposition of the original storage value:

- Y requests that the named storage be reset to its original value at the end of the debugging session; this option is not supported for release 10.2 of the debugger
- N (the default) requests that the named storage not be reset to its original value at the end of the debugging session

This option does not affect storage in the debugged program itself since a special copy of the program is loaded for the debugging session.

Snap Screen

Purpose

The Snap screen lets you create and write a dump to the DC/UCF log at any point in the debugging session, in order to make a hard copy of storage contents.

Remember: To obtain a hard copy of the Snap dump, use the Batch Command Facility utility.

The specification area of the Snap screen looks like:

```
SNAP:   (A-AREA/T-TASK)     TITLE:
SKIP:   (1-ONE LINE/2-TWO LINES/3-THREE LINES/T-TOP OF NEXT PAGE)

AREA ONLY:
     BEGIN SNAP AT:

     LENGTH:         -OR-    END SNAP AT:
```

Field Options

These are the field options for this area:

SNAP: (A-AREA/T-TASK)

- Arequests a dump of the memory area specified in the fields in the Area Only section of the screen
- T requests a dump of all resources associated with the executing task

This is a required field on the Snap screen.

TITLE:

Specifies an optional title for the snap. The title can contain up to 42 characters. Do *not* enclose the title in quotation marks. An apostrophe in the title must be coded as two single quotes. When a title is not specified, a default title is written to the log:

USER *user-id*

SKIP: (1-ONE LINE/2-TWO LINES/3-THREE LINES/T-TOP OF NEXT PAGE)

Indicates the carriage control that will be used for placement of the title:

- 1 skips one line
- 2 skips two lines
- 3 skips three lines
- T skips to the top of the next page

If you specify nothing, two lines are skipped.

BEGIN SNAP AT:

Specifies the location at which to begin the snap. The beginning location can be a debug expression that resolves to an address for which you have retrieval security. This field is required when snapping an area.

LENGTH:

Indicates the number of bytes to be snapped.

END SNAP AT:

Indicates the ending location of the snap. The ending location can specify the same types of debug expressions as those used in the Begin Snap At field.

When you do not specify an ending location or a specific length, the default length is based on two rules:

- If the debug expression is composed of a single symbol, the data characteristics of the symbol determine the default length. The number of bytes dumped is equal to the default length of the symbol.
- If the expression does not have data characteristics, the default length is 256 bytes.

Global Help Screens

Three Available

The debugger provides three global help screens, one each of commands, symbols and control keys.

Usage Screen

Top-level Screen

The Usage screen is the top-level screen for menu mode. It presents a list of all debugger commands and summarizes the command functions. The Usage screen looks like this:

```
  IDMS-DC REL nn.n ONLINE DEBUGGER *** USAGE ***       SETUP    PAGE  1 OF  4
 PROGRAM:           V:          CSECT:
 ->
                    PROCEDURAL COMMANDS.

 EXIT.....RETURNS CONTROL TO IDMS-DC/UCF WITHOUT TERMINATING THE CURRENT DEBUGG
ER SESSION
 QUIT.....TERMINATES THE DEBUGGER SESSION AND RETURNS CONTROL TO IDMS-DC/UCF.
 PROMPT...INVOKES THE PROMPT MODE OF THE DEBUGGER.


                    RETRIEVAL COMMANDS.

 AT.......ESTABLISHES OR MODIFIES BREAKPOINTS WITHIN A USER PROGRAM.
 DEBUG....DESIGNATES, DURING THE SETUP PHASE, THE ENTITY TO BE DEBUGGED OR
          INQUIRES ABOUT ENTITIES KNOWN TO THE DEBUGGER.
 IOUSER...DISPLAYS THE USER SCREEN THAT IS CURRENT WHEN A BREAKPOINT, PROGRAM
          INTERRUPT OR TRAPPED ABEND IS ENCOUNTERED.

 NEXT _ ACTIVITY OR _ HELP:
      _ AT        _ LIST      _ SET      _ SNAP    _ RESUME     _ DEBUG  _ WHERE

      _ EXIT      _ PROMPT    _ QUIT     _ IOUSER
 HELP SCREENS:    _ USAGE     _ SYMBOLS  _ KEYS
```

Symbols Screen

Has a Specification Area

The Symbols screen lets you list program or debugger symbols owned by the entity being debugged. The Symbols screen is the only global help screen with a specification area:

```
 IDMS-DC REL nn.n ONLINE DEBUGGER *** SYMBOLS ***      SETUP    PAGE  1 OF  1
PROGRAM:           V:          CSECT:
->










SYMBOLS TO DISPLAY: P (P-PROGRAM/D-DEBUGGER)
SYMBOL OR SEARCH STRING:

NEXT _ ACTIVITY OR _ HELP:
     _ AT        _ LIST      _ SET      _ SNAP    _ RESUME     _ DEBUG  _ WHERE

     _ EXIT      _ PROMPT    _ QUIT     _ IOUSER
HELP SCREENS:    _ USAGE     _ SYMBOLS  _ KEYS
```

Field Options

These are the field options for the specification area:

SYMBOLS TO DISPLAY: P (P-PROGRAM/D-DEBUGGER)

Indicates whether program symbols (**P**) or debugger symbols (**D**) for the current entity are to be displayed. The default is **P**. The symbols are listed alphabetically.

SYMBOL OR SEARCH STRING:

Identifies a specific symbol or string that begins the display. When this field does not contain an entry, all specified program or debugger symbols are displayed from the beginning of the list

Example

For example, to begin the display with program symbols prefaced by MIS, you would supply this information on the screen:

SYMBOLS TO DISPLAY: *p* (P-PROGRAM/D-DEBUGGER)
SYMBOL OR SEARCH STRING: *mis*

Keys Screen

Installation-specific

The Keys screen provides a list of the current control key assignments for your particular installation. The information displayed on this screen reflects the installation-specific key assignments made with the KEYS statement when the system was generated. The Keys screen contains the most up-to-date information on control key assignments. If an assignment is modified after the system is generated, the Keys screen is also modified automatically.

A sample Keys screen is shown below.

```
 IDMS-DC REL nn.n ONLINE DEBUGGER *** KEYS ***         SETUP    PAGE  1 OF  1
PROGRAM:           V:          CSECT:
->
|   PFKEY ........ ACTIVITY          ||   PFKEY ........ ACTIVITY          |
|   -----          --------          ||   -----          --------          |
|   ENTER   PROCESS CURRENT SCREEN   ||   PF5     SYMBOLS SCREEN           |
|   CLEAR   PREVIOUS LEVEL           ||   PF6     PFKEYS SCREEN            |
|   PA1     REFRESH                  ||   PF7     DISPLAY PREVIOUS PAGE    |
|   PA2     EXIT                     ||   PF8     DISPLAY NEXT PAGE        |
|   PF1     USAGE SCREEN             ||   PF9     CHANGE TO PROMPT MODE    |
|   PF2     UNASSIGNED               ||   PF10    UNASSIGNED               |
|   PF3     ACTIVITY SCREEN          ||   PF11    UNASSIGNED               |
|   PF4     ACTIVITY HELP SCREEN     ||   PF12    RESERVED                 |





NEXT _ ACTIVITY OR _ HELP:
     _ AT        _ LIST      _ SET      _ SNAP     _ RESUME      _ DEBUG  _ WHERE

     _ EXIT      _ PROMPT    _ QUIT     _ IOUSER
HELP SCREENS:    _ USAGE     _ SYMBOLS  _ KEYS
```

Chapter 5: Aids for Debugging Assembler, COBOL, and PL/I Programs

This section contains the following topics:

Overview (see page 85)
Compiler Options (see page 85)
COBOL Programs (see page 86)
PL/I Programs (see page 95)

Overview

This chapter discusses online debugger usage with Assembler, COBOL, and PL/I programs. To effectively use the debugger with these languages, specific compiler options must be utilized to produce listings to obtain required information. The compiler options for each programming language are shown in the next topic.

To use the debugger with COBOL or PL/I programs, some preliminary computations must be done to calculate the exact location of variable storage fields or object code to set breakpoints. This chapter contains a discussion of these calculations and sample debugger sessions for both languages.

Compiler Options

The following table shows the compiler options which provide the information required to use the online debugger to analyze your program.

Language	Object Code	Variable Storage
VS-COBOL	PMAP or CLIST	DMAP
VS-COBOL II IBM COBOL* Enterprise COBOL*	LIST or OFFSET	MAP
PL/I	LIST, XREF, and OFFSET	STORAGE and MAP
Assembler	LIST	LIST

*IBM COBOL includes: COBOL/370, COBOL for VM, COBOL for Z/OS and VM, COBOL for z/OS.

*Enterprise COBOL includes Enterprise COBOL for z/OS.

COBOL Programs

This section discusses the preparation that is necessary before beginning to debug a COBOL program and provides a sample COBOL debugging session.

Note: The discussion and sample debugger session that follow are for a program compiled under the VS-COBOL compiler. The basic principals are the same for other compiler levels. Some specific differences are noted. For more information on register conventions and program structure, refer to the appropriate IBM documentation.

Preliminary Computations

Before beginning the debugging process, it is recommended that you determine the breakpoints that you want to set and the storage locations that you want to examine.

The first step is to compile the program with appropriate listing options. The following options are recommended:

For VS-COBOL

SOURCE, CLIST or PMAP, DMAP

SOURCE gives a listing of the program source with compiler-assigned line numbers.

CLIST gives a cross reference of the assembler offset of each COBOL statement within the program.

PMAP gives a complete listing of the equivalent assembler code for the entire COBOL program.

CLIST is sufficient for most debugging sessions, but programmers who are familiar with assembler may wish to use the PMAP option.

By examining the register usage in the assembler code, it is sometimes possible to access data fields at a particular breakpoint more efficiently than by using the methods described below using CLIST and DMAP.

Either CLIST or PMAP will also cause the listing of global tables, particularly the TGT which is needed to determine the location of data variables.

DMAP gives a listing of the BL or BLL number and displacement for each field in the WORKING STORAGE and LINKAGE sections.

For COBOL II or LE COBOL

SOURCE, OFFSET or LIST, MAP

SOURCE has the same meaning as for VS-COBOL described above. **OFFSET** and **LIST** have the same meanings as CLIST and PMAP, respectively. **MAP** has the same meaning as the VS-COBOL DMAP option.

Breakpoints

To determine the hexadecimal offset of an executable program instruction at which you want to set a breakpoint, perform the following steps:

1. Examine the COBOL compiler portion of your listing and record the line number of the statement at which you want to set the breakpoint:

```
00787         *
00788         *     OBTAIN EMPLOYEE DB-KEY IS EMP-DBKEY
00789         *              ON ANY-STATUS
00790                    MOVE 0 TO DCNUM1 DCNUM2 DCFLG1 DCFLG2
00791                    MOVE 0028 TO DML-SEQUENCE
00792                    CALL 'IDMSCOBI' USING SUBSCHEMA-CTRL
00793                           IDBMSCOM (06)
00794                           SR415
00795                           EMP-DBKEY
00796                           IDBMSCOM (43)
00797                    IF NOT ANY-STATUS PERFORM IDMS-STATUS;
00798                    ELSE
00799                                      NEXT SENTENCE.
00800               IF DB-REC-NOT-FOUND
00801          *       MAP OUT USING DCTEST01
00802          *           MESSAGE IS EMP-NOT-FOUND-MESS
00803          *                  TO EMP-NOT-FOUND-MESS-END
00804          *                DETAIL CURRENT
```

1. Examine the condensed listing (CLIST) portion of the COBOL compiler listing, locate the previously recorded COBOL line number, and record its corresponding hexadecimal displacement value:

```
                          CONDENSED LISTING

                        .                                      .
                        .                                      .
785     MOVE       001CCC             786     GO       001CD0
790     MOVE       001CD6             791     MOVE     001CEE
792     CALL       001CF4             797     IF       001D3E
797     PERFORM    001D4C             800     IF       001D74
805     MOVE       001D80             806     MOVE     001D98
807     MOVE       001D9E             808     MOVE     001DA4
                        .                                      .
                        .                                      .
```

WORKING-STORAGE SECTION variables

To determine the register assignment and offset of WORKING- STORAGE SECTION variables, perform the following steps:

1. Locate the register assignment portion of the COBOL compiler listing and record the base locator (BL) number that corresponds to each register listed:

   ```
   REGISTER ASSIGNMENT
    REG 6 BL =1
   ```

   Note: For some WORKING-STORAGE or LINKAGE SECTIONfields, there may not be a fixed register which always points to the base locator for linkage (BLL) cell. However, the BL cell is at a given offset from the beginning of the TGT.

   For non-LE-compliant compilers, register 13 usually points to the TGT at runtime. For LE-compliant compilers, register 9 usually points to the TGT at runtime.

   A copy of the TGT and WORKING STORAGE is allocated in the CA IDMS storage pools for each task at runtime. Therefore, you must not use the TGT or WORKING STORAGE in the program pool.

2. Locate the data map (DMAP) portion of the COBOL compiler listing and record the displacement value and register assignment for each variable that you want to examine during the debugging process:

```
DNM=1-364     01  LONGTERM-TEST           BL=1     038    DNM=1-364    DS
DNM=1-387     01  EMP-DBKEY               BL=1     040    DNM=1-387    DS
DNM=1-406     01  FIRST-PAGE-SW           BL=1     048    DNM=1-406    DS
DNM=1-432     88  LESS-THAN-A-PAGE                        DNM=1-432
                      .
                      .
                      .
DNM=4-276     01  SUBSCHEMA-CTRL          BL=1     260    DNM=4-276    DS
DNM=4-303     02  PROGRAM-NAME            BL=1     260    DNM=4-303    DS
DNM=4-325     02  ERROR-STATUS            BL=1     268    DNM=4-325    DS
DNM=4-350     88  DB-STATUS-OK                            DNM=4-350
DNM=4-376     88  ANY-STATUS                              DNM=4-376
DNM=4-399     88  ANY-ERROR-STATUS                        DNM=4-399
DNM=4-425     88  DB-END-OF-SET                           DNM=4-425
DNM=4-452     88  DB-REC-NOT-FOUND                        DNM=4-452
DNM=6-028     02  DBKEY                   BL=1     26C    DNM=6-028    DS
DNM=6-043     02  RECORD-NAME             BL=1     270    DNM=6-043    DS
                      .
                      .
```

LINKAGE SECTION variables

To determine the location of LINKAGE SECTION variables, perform the following steps:

1. Examine the memory map portion of the COBOL compiler listing and locate the hexadecimal displacement values for the TGT and for the base locator for linkage (BLL) cells:

```
                MEMORY MAP
         TGT                    00868

      SAVE AREA                 00868
      SWITCH                    008B0
      TALLY                     008B4
      SORT SAVE                 008B8
      ENTRY-SAVE                008BC
          .
          .
          .
      TEMP STORAGE-3            00A78
      TEMP STORAGE-4            00A78
      BLL CELLS                 00A78
      VLC CELLS                 00A8C
          .
          .
```

1. Perform the following calculation to determine the displacement value for the BLL cells:

   BLL CELLS - TGT = displacement for BLL cells within TGT

   X'A78' - X'868' = X'208'

   Note: This value will be used later in the runtime phase to locate the actual BLL cells.

2. Locate the BLL number for the desired LINKAGE SECTION variable from the DMAP portion of the compiler listing:

```
DNM=14-361    01  PASS-DEPT-INFO        BLL=3   000   DNM=14-361    D
DNM=14-391    02  PASS-DEPT-ID          BLL=3   000   DNM=14-391    D
DNM=14-416    02  PASS-DEPT-INFO-END    BLL=3   004   DNM=14-416    D
DNM=14-444    01  ERROR-DATA            BLL=4   000   DNM=14-444    D
DNM=14-467    02  ERROR-DEPT-ID         BLL=4   000   DNM=14-467    D
DNM=15-000    02  ERROR-MESSAGE-CODE    BLL=4   004   DNM=15-000    D
DNM=15-031    02  ERROR-DATA-END        BLL=4   008   DNM=15-031    D
```

1. Save the displacement values of the BLL cells and the BLL numbers of LINKAGE SECTION variables for use during the runtime phase to obtain the absolute address for LINKAGE SECTION values.

You can use the following table to record displacement information before starting a debugger session.

Program Name________________________ Comment_____________________

Line Number	Displacement

Variable-Storage Field	Displacement	Base Register

Linkage Section Field	BLL Displacement	Absolute Address

Sample COBOL Online Debugger Session

To use the online debugger with a DC/UCF VS-COBOL program, perform the steps shown below. The steps may vary depending on the release level of the compiler; however, the basic methodology is the same. The following examples correspond to the sample listings shown in Preliminary Computations (see page 86).

1. Compile the program with the DMAP and CLIST compiler options before defining it to the DC/UCF system.

   Note: To obtain the complete Assembler source code, substituteCLIST with PMAP as described in Preliminary Computations (see page 86).

2. Record breakpoint and storage displacements, as explained earlier under COBOL Programs.

3. Initiate the debugger session by entering the DEBUG task code from the DC/UCF system. The DEBUG> prompt displays indicating that the debugger is in control:

   ```
   ENTER NEXT TASK CODE:
   debug

   DEBUG>
   ```

4. Specify the program to be debugged by entering DEBUG followed by the program name. The debugger verifies the program name:

   ```
   DEBUG>
   debug testprog

   DEBUG TESTPROG
   DEBUG> DEBUGGING INITIATED FOR TESTPROG VERSION 1
   DEBUG>
   ```

5. Establish breakpoints by issuing the AT command followed by a dollar sign, which signifies the address of the beginning of the program; follow the dollar sign with the command's hexadecimal offset. The debugger verifies the establishment of the breakpoint. The following example sets a breakpoint at line 797 in TESTPROG based on the SOURCE and CLIST shown in Preliminary Computations (see page 86).

   ```
   DEBUG>
   at $ + @1d4c

   AT $ + @1D4C
   AT> $ + @1D4C ADDED
   DEBUG>
   ```

After all breakpoints have been set, leave the setup phase of the debugger session by issuing the EXIT command:

```
DEBUG>
exit
```

Note: You will also be able to set new breakpoints whenever you are stopped at a breakpoint during the runtime phase.

6. Initiate the runtime phase by issuing the task code that invokes the task in which the program participates:

```
ENTER NEXT TASK CODE:
deptmod
```

When a breakpoint is encountered at runtime, the debugger assumes control and identifies the address, program, and the debugger expression that was used to establish the breakpoint:

```
AT OFFSET @1D4C IN TESTPROG EXPRESSION $+@1D4C
DEBUG>
```

7. Examine program variable storage by issuing LIST commands. Use indirect addressing and the previously noted register and offset. The following example lists the value of the first 32 bytes of SUBSCHEMA-CTRL. The DMAP listing for SUBSCHEMA-CTRL shows that it is addressed through BL=1 at offset hexadecimal 260. The REGISTER ASSIGNMENT portion of the listing shows that base register 6 contains the value from BL=1.

   Note: Registers are sometimes used for multiple purposes within a COBOL program. When a breakpoint is set using the CLIST value, the equivalent assembler code to load the BL value into R6 may not have occurred. If you are not certain a register contains the appropriate value, use the method for listing LINKAGE SECTION variables described below. That method is also always valid for WORKING STORAGE variables.

   ```
   list %:r6 + @260 32

   LIST %:R6 + @260 32
   00140270  E3C5E2E3 D7D9D6C7 F0F0F0F0 3D3D4F06 *TESTPROG0000..|.*
   00140280  C4C5D7C1 D9E3D4C5 D5E34040 40404040 *DEPARTMENT      *
   ```

   To examine LINKAGE SECTION variables, perform the following steps:

   a. Register 13 normally contains the address of the TGT for VS-COBOL programs. Use register 9 for later COBOL compilers. Use the previously determined offset to find the desired BLL cell. The offset of the BLL cells for TESTPROG was found to be X'208', as shown in Preliminary Computations (see page 86). The following command lists the BLL cells using indirect addressing.

      ```
      DEBUG>
      list %:rR13 + @208

      LIST %:R13 + @208
                (BLL1)   (BLL2)   (BLL3)   (BLL4)
      001499E0  00000000 00000000 00000000 00149AC8 *...............H*
      ```

      Each BLL is 4-bytes long. Note the absolute address located in the BLL for the field that you want to display.

   b. Suppose we wish to display the field named ERROR-DATA. The DMAP shows that its base locator is in BLL=4. List the absolute address to display the first field.

      ```
      DEBUG>
      LIST @149ac8 9
      00149AC8  F1F1F1F1 C4C5D7E3 00                *1111DEPT        *
      ```

   c. Alternatively use an offset from the first field to display another field addressed through the same BLL. For example, use the following command to display ERROR-MESSAGE-CODE.

      ```
      DEBUG>
      LIST @149ac8+@4 4
      00149AC8  C4C5D7E3                             *DEPT            *
      ```

8. Enter the RESUME command from the DEBUG> prompt to continue program execution:

```
DEBUG>
resume
```

9. Enter the QUIT command from the DEBUG> prompt to end a debugger session:

```
DEBUG>
quit

QUIT
QUIT DEBUGGER
ENTER NEXT TASK CODE:
```

PL/I Programs

This section discusses the preparation that is necessary before beginning to debug a PL/I program and provides a sample PL/I debugging session.

Note: The discussion and sample debugger session that follow are for a program compiled under the PL/I Version 2.3 compiler. The basic principals are the same for other compiler levels. For more information on register conventions and program structure, refer to the appropriate IBM documentation.

Preliminary Computations

Before beginning the debugging process, it is recommended to determine the breakpoints that you want to set and the storage locations that you want to examine.

Breakpoints

To determine the hexadecimal offset of an executable program instruction at which you want to set a breakpoint, perform the following steps:

1. Examine the cross-reference table portion of your link-edit listing for an entry in the form program-name1. Record the hexadecimal offset listed under ORIGIN:

```
                       CROSS REFERENCE TABLE

CONTROL SECTION                          ENTRY
  NAME    ORIGIN   LENGTH                  NAME    LOCATION
PLISTART      00       50
                                         PLICALLA        6
PLIMAIN       50        8
*PLIPROG2     58      394
*PLIPROG1    3F0      EB4
                                         PLI3PROG      3F8
IDMSPLI     12A8      284
```

1. Examine the PL/I compiler portion of your listing and record the line number of the statement at which you want to set the breakpoint:

```
133                   WORK_LAST = EMP_LAST_NAME_0415;
134                   WORK_FIRST = EMP_FIRST_NAME_0415;
                                                          /*
                      MAP OUT (DCTEST01) OUTPUT DATA YES
                          MESSAGE (INITIAL_INSTRUCTIONS_MSG_1)
                          LENGTH (25)
                          DETAIL NEW KEY (DBKEY).
                                                          */
135                         /* IDMS PLI/I DML EXPANSION */   DO;
136                         DML_SEQUENCE=0013;
137                         DCCFLG1=0;
138                         DCCFLG1=13;
139                         DCCFLG2=16;
140                         DCCFLG3=0;
141                         DCCFLG4=4;
142                         DCCFLG5=72;
143                         DCCFLG6=0;
```

1. Examine the Assembler listing generated by the LIST option, locate the previously recorded PL/I line number, and record its corresponding hexadecimal displacement value:

```
* STATEMENT NUMBER 136
0006AA  41 80 7 21C          LA     8,SUBSCHEMA_CTRL.D
                                    CCALIGN_AREA.FILLE
                                    R0001
0006AE  58 40 3 124          L      4,292(0,3)
0006B2   50 40 8 008          ST     4,SSC_ERRSAVE_AREA
                                    .DML_SEQUENCE
```

1. Add the origin offset and the breakpoint instruction's hexadecimal displacement to obtain the breakpoint address:

   X'3F0' + X'6AA' = X'A9A'

AUTOMATIC Variables

To determine the offset of AUTOMATIC variables, locate the variable storage map and record the displacement value for each variable that you want to examine during the debugging process:

```
MAP_WORK_REC          1        796     31C     AUTO
WORK_DEPT_ID          1        796     31C     AUTO
WORK_EMP_ID           1        800     320     AUTO
WORK_FIRST            1        804     324     AUTO
WORK_LAST             1        814     32E     AUTO
WORK_ADDRESS          1        829     33D     AUTO
WORK_STREET           1        829     33D     AUTO
WORK_CITY             1        849     351     AUTO
WORK_STATE            1        864     360     AUTO
WORK_ZIP              1        866     362     AUTO
WORK_DEPT_NAME        1        871     367     AUTO
```

You can locate AUTOMATIC variables at runtime through register 13.

STATIC INTERNAL Variables

To determine the location of STATIC INTERNAL variables, examine the static internal storage map to find the hexadecimal offset for each variable that you want to examine during the debugging process.

You can locate STATIC INTERNAL variables at runtime through register 3.

You can use the following table to record displacement information before starting a debugger session.

Program Name________________________ ORIGIN________________________
Comment____________________________

Line Number	Beginning Offset +	ORIGIN =	"At" Value

Variable Name	Offset	Register	DSA Nesting

Sample PL/I Online Debugger Session

To use the online debugger with a DC/UCF PL/I program, perform the following steps:

1. Compile the program with the LIST, OFFSET, XREF STORAGE, and MAP compiler options before defining it to the DC/UCF system.
2. Record breakpoint and storage displacements, as explained above.
3. Initiate the debugger session by entering the DEBUG task code from the DC/UCF system. The DEBUG> prompt displays indicating that the debugger is in control:

```
ENTER NEXT TASK CODE:
debug

DEBUG>
```

4. Specify the program to be debugged by entering DEBUG followed by the program name. The debugger verifies the program name:

```
DEBUG>
debug pliprog

DEBUG PLIPROG
DEBUG> DEBUGGING INITIATED FOR PLIPROG VERSION 1
DEBUG>
```

5. Establish breakpoints by issuing the AT command followed by a dollar sign, which signifies the address of the beginning of the program; follow the dollar sign with the command's hexadecimal offset. The debugger verifies the establishment of the breakpoint:

```
DEBUG>
at $ + @a9a

AT @A9A
AT> @A9A ADDED
DEBUG>
```

   After all breakpoints have been set, leave the setup phase of the debugger session by issuing the EXIT command:

```
DEBUG>
exit
```

6. Initiate the runtime phase by issuing the task code that invokes the task in which the program participates:

```
ENTER NEXT TASK CODE:
deptmod
```

   When a breakpoint is encountered at runtime, the debugger assumes control and identifies the address, program, and the debugger expression that was used to establish the breakpoint:

```
AT OFFSET @A9A IN PLIPROG EXPRESSION @BDE
DEBUG>
```

7. Examine program variable storage by issuing LIST commands. Use indirect addressing and the previously noted register and offset:

```
list %:r13 + @31c 32

LIST %:R13 + @31C 32
001DB7F4  F3F2F0F0 F0F0F0F4 C8C5D9C2 C5D9E340 *32000004HERBERT*
001DB804  4040C3D9 C1D5C540 40404040 40404040 *  CRANE         *
```

   If your program contains any nested procedures or begin blocks, you will need to navigate the chain of dynamic storage areas (DSAs) to obtain the correct variable-storage base address. To navigate the DSA chain for nested procedures or begin blocks, list the contents of register 13 to determine the DSA for the current level of nesting:

```
list %:r13

LIST %:R13
001C7A30  84200000 001C7948 00000000 5E422A20 *D..........
...*
```

   For subsequent levels of nesting, perform the following steps:

   a. List the absolute address which is located 4 bytes off of the previously displayed line:

```
list @1c7948

LIST @1C7948
001C7948  84200000 001C74D8 00000000 4E4227EC *D......Q....+...*
```

   b. List AUTOMATIC variable-storage values after the final level of nesting has been reached. Use the absolute address as the base address, which is located 4 bytes off of the display:

```
DEBUG>
list 1c74d8 + @31c 32

LIST 1C74D8 + @31C 32
001C77F4  F3F2F0F0 F0F0F0F4 C8C5D9C2 C5D9E340 *32000004HERBERT *
001C7804  4040C3D9 C1D5C540 40404040 40404040 *  CRANE         *
```

To examine variables defined as BASED storage, perform the following steps:

c. List the contents of the associated pointer variable using indirect addressing:

```
DEBUG>
list %:r13 + @d4

LIST %:R13 + @D4
001499E0  00149AC8 00000000 00000000 00000000 *...H............*
```

d. List the absolute address to display the BASED variable's values:

```
DEBUG>
LIST @149ac8 16
00149AC8  F1F1F1F1 C4C5D7E3 00000000 00000000 *1111DEPT........*
```

8. Enter the RESUME command from the DEBUG> prompt to continue program execution:

```
DEBUG>
resume
```

9. Enter the QUIT command from the DEBUG> prompt to end a debugger session:

```
DEBUG>
quit

QUIT
QUIT DEBUGGER
ENTER NEXT TASK CODE:
```

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